

Contract Routing Form

ROUTING: Routine

printed on: 03/26/2019

Contract between: R.G. Huston Co., Inc.
 and Dept. or Division: Engineering Division
 Name/Phone Number:

Project: S. Bryan St., Daley Dr., James St. and Thorp St. Reconstruct
 ion Dist 2018

Contract No.: 8119
 Enactment No.: RES-19-00222
 Dollar Amount: 4,475,235.00

File No.: 54890
 Enactment Date: 03/25/2019

(Please DATE before routing)

Signatures Required	Date Received	Date Signed
City Clerk	3-27-19	3-27-19
Director of Civil Rights	3/27/19	3-29-19 FWD
Risk Manager	03-27-2019	3/29/19
Finance Director	3/29/19	3/29/19 MCR
City Attorney	337 4-01-19	4-02-19
Mayor	4.01.19	4.02.19

Please return signed Contracts to the City Clerk's Office
 Room 103, City-County Building for filing.

Original + 2 Copies

03/26/2019 15:27:47 enjls - Jim Wolfe 266-4099

Dis Rights: OK / N/A / Problem - Hold
 Prev Wage: AA / Agency / No
 Contract Value: 4,475,235
 AA Plan: Approved
 Amendment / Addendum #
 Type: POS / Dvlp / Sbdv / Gov't /
 Grant / PW / Goal / Loan / Agrmt



Legislation Details (With Text)

File #: 54890 **Version:** 1 **Name:** Awarding Public Works Contract No. 8119, S. Bryan Street, Daley Drive, James Street and Thorp Street Reconstruction District 2018.

Type: Resolution **Status:** Passed

File created: 2/26/2019 **In control:** Engineering Division

On agenda: 3/19/2019 **Final action:** 3/19/2019

Enactment date: 3/25/2019 **Enactment #:** RES-19-00222

Title: Awarding Public Works Contract No. 8119, S. Bryan Street, Daley Drive, James Street and Thorp Street Reconstruction District 2018. (6th AD)

Sponsors: BOARD OF PUBLIC WORKS

Indexes:

Code sections:

Attachments: 1. Contract 8119.pdf

Date	Ver.	Action By	Action	Result
3/19/2019	1	COMMON COUNCIL	Adopt Under Suspension of Rules 2.04, 2.05, 2.24, and 2.25	Pass
3/6/2019	1	BOARD OF PUBLIC WORKS		
2/26/2019	1	Engineering Division	Refer	

The proposed resolution awards the contract for the reconstruction of Bryan Street, Daley Drive, James Street, and Thorp Street on the City's east side at a total estimated cost of \$4,833,250. Funding is provided in the adopted 2019 capital budget for Engineering Major Streets via the Reconstruction Streets capital program. These street reconstruction projects are funded by GO Borrowing and associated utility components as follows:

- Major Streets - \$1,413,890
- Stormwater Utility - \$498,520
- Sewer Utility - \$2,086,700
- Water Utility - \$834,140

Awarding Public Works Contract No. 8119, S. Bryan Street, Daley Drive, James Street and Thorp Street Reconstruction District 2018. (6th AD)

BE IT RESOLVED, that the following low bids for miscellaneous improvements be accepted and that the Mayor and City Clerk be and are hereby authorized and directed to enter into a contract with the low bidder contained herein, subject to the Contractor's compliance with Section 39.02 of the Madison General Ordinances concerning compliance with the Affirmative Action provisions **and subject to the Contractor's compliance with Section 33.07 of the Madison General Ordinances regarding Best Value Contracting:**

BE IT FURTHER RESOLVED, that the funds be encumbered to cover the cost of the projects contained herein.

See attached document (Contract No. 8119) for itemization of bids.

CDO
3-26-19

CONTRACT NO. 8119
 S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET RECONSTRUCTION DISTRICT 2018

R. G. HUSTON CO., INC

\$4,475,235.00

Acct. No. 11185-402-170: 54410 (91350)	\$1,129,747.67
Contingency 8%±	<u>90,382.33</u>
Sub-Total	\$1,220,130.00

Acct. No. 11185-402-174:54445 (91345)	\$179,410.00
Contingency 8%±	<u>14,350.00</u>
Sub-Total	\$193,760.00

Acct. No. 11185-84-174:54445 (91345)	\$193,086.07
Contingency 8%±	<u>15,443.93</u>
Sub-Total	\$208,530.00

Acct. No. 11185-83-173:54445 (91345)	\$1,386,895.01
Contingency 8%±	<u>110,954.99</u>
Sub-Total	\$1,497,850.00

Acct. No. 11185-86-179:54445 (91360)	\$772,352.09
Contingency 8%±	<u>61,787.91</u>
Sub-Total	\$834,140.00

Acct. No. 11749-84-174-84300: 54250 (91223)	\$268,511.74
Contingency 8%±	<u>21,478.26</u>
Sub-Total	\$289,990.00

Acct. No. 11853-83-173:54445 (91345)	\$545,232.42
Contingency 8%±	<u>43,617.58</u>
Sub-Total	\$588,850.00

GRAND TOTAL	<u>\$4,833,250.00</u>
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Jurisdiction: Wisconsin

Demographics

Company Name: Travelers Casualty and Surety Company of America
 SBS Company Number: 54218780
 Domicile Type: Foreign
 NAIC Group Number: 3548 - Travelers Grp
 Merger Flag: Yes

NAIC CoCode: 31194
 State of Domicile: Connecticut
 Organization Type: Stock

Short Name:
 FEIN: 06-0907370
 Country of Domicile: United States
 Date of Incorporation: 07/18/1974

Address

Business Address	Mailing Address	Statutory Home Office Address	Main Administrative Office Address
1 TOWER SQ HARTFORD, CT 06183 United States	1 TOWER SQ HARTFORD, CT 06183 United States	1 TOWER SQ HARTFORD, CT 06183 United States	1 TOWER SQ HARTFORD, CT 06183 United States

Phone, Email, Website

Phone	Email	Website
Type: Business Primary Phone Number: (860) 277-0111	No results found.	No results found.

Company Type

Company Type: Property and Casualty
 Status: Active
 Effective Date: 07/01/1997
 Issue Date: 09/10/1975
 Articles of Incorporation Received: No

Status Reason:
 Legacy State ID: 110846
 Approval Date:
 Article No:

Status Date: 09/10/1975
 File Date:
 COA Number:

Appointments

Show 10 entries Showing 1 to 2 of 4391 entries

Licensee Name	License Number	NPN	License Type	Line of Authority	Appointment Date	Effective Date	Expiration Date
DENNIS BARTON	283633	283633	Intermediary (Agent) Individual	Casualty	06/15/1993	01/24/2019	03/15/2020
DENNIS BARTON	283633	283633	Intermediary (Agent) Individual	Property	06/15/1993	01/24/2019	03/15/2020

First Previous 1 Next Last

Line Of Business

Show 10 entries Showing 1 to 10 of 11 entries

Line of Business	Citation Type	Effective Date
Aircraft	Aircraft	09/10/1975
Automobile	Automobile	09/10/1975
Credit Insurance	Credit Insurance	09/10/1975
Disability Insurance	Disability Insurance	09/10/1975
Fidelity Insurance	Fidelity Insurance	09/10/1975
Workers Compensation Insurance	Workers Compensation Insurance	06/29/1990
Liability and Incidental Medical Expense Insurance (other than automobile)	Liability and Incidental Medical Expense Insurance (other than automobile)	09/10/1975
Miscellaneous	Miscellaneous	09/10/1975
Ocean Marine Insurance	Ocean Marine Insurance	09/10/1975
Surety Insurance	Surety Insurance	09/10/1975

First Previous 1 2 Next Last

Contact

Contact Type	Preferred Name	Name	E-mail	Phone	Address
Registered Agent for Service of Process					Other CORPORATION SERVICE COMPANY 8040 EXCELSIOR DR STE 400 MADISON, WI United States County 53717

Company Merger

SBS Company Number	NAIC CoCode	Non-Surviving Company	Non-Surviving Company Type	Terminated Appointments	Transferred Appointments	Merger Date	Comments
54221052	22535	Seaboard Surety Company	Property and Casualty	N	N	01/02/2009	

Companies Absorbed

Name Change History

Previous Name	New Name	Effective Date
Aetna Casualty & Surety Company of America	Travelers Casualty and Surety Company of America	07/01/1997
	Aetna Casualty & Surety Company of America	09/10/1975

\$4,475,235.00
FILE

BID OF R. G. HUSTON CO., INC.

2019

PROPOSAL, CONTRACT, BOND AND SPECIFICATIONS

FOR

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET
RECONSTRUCTION DISTRICT 2018

CONTRACT NO. 8119

PROJECT NO. 11185

IN

MADISON, DANE COUNTY, WISCONSIN

AWARDED BY THE COMMON COUNCIL
MADISON, WISCONSIN ON MARCH 19, 2019

CITY ENGINEERING DIVISION
1600 EMIL STREET
MADISON, WISCONSIN 53713

<https://bidexpress.com/login>

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET
RECONSTRUCTION DISTRICT 2018
CONTRACT NO. 8119

INDEX

SECTION A: ADVERTISEMENT FOR BIDS AND INSTRUCTIONS TO BIDDERSA-1
SECTION B: PROPOSAL SECTIONB-1
SECTION C: SMALL BUSINESS ENTERPRISE C-1
SECTION D: SPECIAL PROVISIONS D-1
SECTION E: BIDDER'S ACKNOWLEDGEMENT E-1
SECTION F: BEST VALUE CONTRACTINGF-1
SECTION G: BID BOND G-1
SECTION H: AGREEMENT..... H-1
SECTION I: PAYMENT AND PERFORMANCE BONDI-1

This Proposal, and Agreement have
been prepared by:

**CITY ENGINEERING DIVISION
CITY OF MADISON
MADISON, DANE COUNTY, WISCONSIN**



Robert F. Phillips, P.E., City Engineer

RFP: jw

SECTION A: ADVERTISEMENT FOR BIDS AND INSTRUCTIONS TO BIDDERS

REQUEST FOR BID FOR PUBLIC WORKS CONSTRUCTION CITY OF MADISON, WISCONSIN

A BEST VALUE CONTRACTING MUNICIPALITY

PROJECT NAME:	S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET RECONSTRUCTION DISTRICT 2018
CONTRACT NO.:	8119
SBE GOAL	12%
BID BOND	5%
SBE PRE BID MEETING (1:00 P.M.)	2/22/2019
PREQUALIFICATION APPLICATION DUE (2:00 P.M.)	2/21/2019
BID SUBMISSION (2:00 P.M.)	2/28/2019
BID OPEN (2:30 P.M.)	2/28/2019
PUBLISHED IN WSJ	2/7, 2/14 & 2/21/2019

SBE PRE BID MEETING: Representatives of the Affirmative Action Department will be present to discuss the Small Business Enterprise requirements at 1600 Emil Street, Madison Wisconsin.

PREQUALIFICATION APPLICATION: Forms are available on our website, www.cityofmadison.com/business/pw/forms.cfm. If not currently prequalified in the categories listed in Section A, an amendment to your Prequalification will need to be submitted prior to the same due date. Postmark is not applicable.

BIDS TO BE SUBMITTED by hand to 1600 EMIL ST., MADISON, WI 53713 or online at www.bidexpress.com.

THE BID OPENING is at 1600 EMIL ST., MADISON, WI 53713.

STANDARD SPECIFICATIONS

The City of Madison's Standard Specifications for Public Works Construction - 2019 Edition, as supplemented and amended from time to time, forms a part of these contract documents as if attached hereto.

These standard specifications are available on the City of Madison Public Works website, www.cityofmadison.com/Business/PW/specs.cfm.

The Contractor shall review these Specifications prior to preparation of proposals for the work to be done under this contract, with specific attention to Article 102, "BIDDING REQUIREMENTS AND CONDITIONS" and Article 103, "AWARD AND EXECUTION OF THE CONTRACT." For the convenience of the bidder, below are highlights of three subsections of the specifications.

SECTION 102.1: PRE-QUALIFICATION OF BIDDERS

In accordance with Wisconsin State Statutes 66.0901 (2) and (3), all bidders must submit to the Board of Public Works proof of responsibility on forms furnished by the City. The City requires that all bidders be qualified on a biennial basis.

Bidders must present satisfactory evidence that they have been regularly engaged in the type of work specified herein and they are fully prepared with necessary capital, materials, machinery and supervisory personnel to conduct the work to be contracted for to the satisfaction of the City. All bidders must be pre-qualified by the Board of Public Works for the type of construction on which they are bidding prior to the opening of the bid.

In accordance with Section 39.02(9)(a)l. of the General Ordinances, all bidders shall submit in writing to the Affirmative Action Division Manager of the City of Madison, a Certificate of Compliance or an Affirmative Action Plan at the same time or prior to the submission of the proof of responsibility forms.

The bidder shall be disqualified if the bidder fails to or refuses to, prior to opening of the bid, submit a Certificate of compliance, Affirmative Action Plan or Affirmative Action Data Update, as applicable, as defined by Section 39.02 of the General Ordinances (entitled Affirmative Action) and as required by Section 102.11 of the Standard Specifications.

SECTION 102.4 PROPOSAL

No bid will be accepted that does not contain an adequate or reasonable price for each and every item named in the Schedule of Unit Prices.

A lump sum bid for the work in accordance with the plans and specifications is required. The lump sum bid must be the same as the total amounts bid for the various items and it shall be inserted in the space provided.

All papers bound with or attached to the proposal form are considered a part thereof and must not be detached or altered when the proposal is submitted. The plans, specifications and other documents designated in the proposal form will be considered a part of the proposal whether attached or not.

A proposal submitted by an individual shall be signed by the bidder or by a duly authorized agent. A proposal submitted by a partnership shall be signed by a member/partner or by a duly authorized agent thereof. A proposal submitted by a corporation shall be signed by an authorized officer or duly authorized registered agent of such corporation, and the proposal shall show the name of the State under the laws of which such corporation was chartered. The required signatures shall in all cases appear in the space provided thereof on the proposal.

Each proposal shall be placed, together with the proposal guaranty, in a sealed envelope, so marked as to indicate name of project, the contract number or option to which it applies, and the name and address of the Contractor or submitted electronically through Bid Express (www.bidexpress.com). Proposals will be accepted at the location, the time and the date designated in the advertisement. Proposals received after the time and date designated will be returned to the bidder unopened.

SECTION 102.5: BID DEPOSIT (PROPOSAL GUARANTY)

All bids, sealed or electronic, must be accompanied with a Bid Bond (City of Madison form) equal to at least 5% of the bid or a Certificate of Annual/Biennial Bid Bond or certified check, payable to the City Treasurer. Bid deposit of the successful bidders shall be returned within forty-eight (48) hours following execution of the contract and bond as required.

MINOR DISCREPENCIES

Bidder is responsible for submitting all forms necessary for the City to determine compliance with State and City bidding requirements. Notwithstanding any language to the contrary contained herein, the City may exercise its discretion to allow bidders to correct or supplement submissions after bid opening, if the minor discrepancy, bid irregularity or omission is insignificant and not one related to price, quality, quantity, time of completion or performance of the contract.

Bidders for this Contract(s) must be Pre-Qualified for at least one of the following type(s) of construction denoted by an

Building Demolition

- 101 Asbestos Removal
120 House Mover

- 110 Building Demolition

Street, Utility and Site Construction

- 201 Asphalt Paving
205 Blasting
210 Boring/Pipe Jacking
215 Concrete Paving
220 Con. Sidewalk/Curb & Gutter/Misc. Flat Work
221 Concrete Bases and Other Concrete Work
222 Concrete Removal
225 Dredging
230 Fencing
235 Fiber Optic Cable/Conduit Installation
240 Grading and Earthwork
241 Horizontal Saw Cutting of Sidewalk
242 Infrared Seamless Patching
245 Landscaping, Maintenance
246 Ecological Restoration
250 Landscaping, Site and Street
251 Parking Ramp Maintenance
252 Pavement Marking
255 Pavement Sealcoating and Crack Sealing
260 Petroleum Above/Below Ground Storage Tank Removal/Installation
262 Playground Installer

- 265 Retaining Walls, Precast Modular Units
270 Retaining Walls, Reinforced Concrete
275 Sanitary, Storm Sewer and Water Main Construction
276 Sawcutting
280 Sewer Lateral Drain Cleaning/Internal TV Insp.
285 Sewer Lining
290 Sewer Pipe Bursting
295 Soil Borings
300 Soil Nailing
305 Storm & Sanitary Sewer Laterals & Water Svc.
310 Street Construction
315 Street Lighting
318 Tennis Court Resurfacing
320 Traffic Signals
325 Traffic Signing & Marking
332 Tree pruning/removal
333 Tree, pesticide treatment of
335 Trucking
340 Utility Transmission Lines including Natural Gas, Electrical & Communications
399 Other _____

Bridge Construction

- 501 Bridge Construction and/or Repair

Building Construction

- 401 Floor Covering (including carpet, ceramic tile installation, rubber, VCT)
402 Building Automation Systems
403 Concrete
404 Doors and Windows
405 Electrical - Power, Lighting & Communications
410 Elevator - Lifts
412 Fire Suppression
413 Furnishings - Furniture and Window Treatments
415 General Building Construction, Equal or Less than \$250,000
420 General Building Construction, \$250,000 to \$1,500,000
425 General Building Construction, Over \$1,500,000
428 Glass and/or Glazing
429 Hazardous Material Removal
430 Heating, Ventilating and Air Conditioning (HVAC)
433 Insulation - Thermal
435 Masonry/Tuck pointing

- 437 Metals
440 Painting and Wallcovering
445 Plumbing
450 Pump Repair
455 Pump Systems
460 Roofing and Moisture Protection
464 Tower Crane Operator
461 Solar Photovoltaic/Hot Water Systems
465 Soil/Groundwater Remediation
466 Warning Sirens
470 Water Supply Elevated Tanks
475 Water Supply Wells
480 Wood, Plastics & Composites - Structural & Architectural
499 Other _____

State of Wisconsin Certifications

- 1 Class 5 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for quarries, open pits and road cuts.
2 Class 6 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for trenches, site excavations, basements, underwater demolition, underground excavations, or structures 15 feet or less in height.
3 Class 7 Blaster - Blasting Operations and Activities for structures greater than 15' in height, bridges, towers, and any of the objects or purposes listed as "Class 5 Blaster or Class 6 Blaster".
4 Petroleum Above/Below Ground Storage Tank Removal and Installation (Attach copies of State Certifications.)
5 Hazardous Material Removal (Contractor to be certified for asbestos and lead abatement per the Wisconsin Department of Health Services, Asbestos and Lead Section (A&LS).) See the following link for application: www.dhs.wisconsin.gov/Asbestos/Cert. State of Wisconsin Performance of Asbestos Abatement Certificate must be attached.
6 Certification number as a Certified Arborist or Certified Tree Worker as administered by the International Society of Arboriculture
7 Pesticide application (Certification for Commercial Applicator For Hire with the certification in the category of turf and landscape (3.0) and possess a current license issued by the DATCP)
8 State of Wisconsin Master Plumbers License.

SECTION B: PROPOSAL

Please refer to the
Bid Express Website
at <https://bidexpress.com>
look up contract number
and go to
Section B: Proposal Page

You can access all City of Madison bid solicitations for FREE at www.bidexpress.com

Click on the "Register for Free" button and follow the instructions to register your company and yourself. You will be asked for a payment subscription preference, since you may wish to bid online someday. Simply choose the method to pay on a 'per bid' basis. This requires no payment until / unless you actually bid online. You can also choose the monthly subscription plan at this time. You will, however, be asked to provide payment information. Remember, you can change your preference at anytime. You will then be able to complete your free registration and have full access to the site. Your free access does not require completion of the 'Digital ID' process, so you will have instant access for viewing and downloading. To be prepared in case you ever do wish to bid online, you may wish to establish your digital ID also, since you cannot bid without a Digital ID.

If you have any problems with the free registration process, you can call the bidexpress help team, toll free at 1-888-352-2439 (option 1, option1).

SECTION C: SMALL BUSINESS ENTERPRISE

Instructions to Bidders City of Madison SBE Program Information

2 Small Business Enterprise (SBE) Program Information

2.1 Policy and Goal

The City of Madison reaffirms its policy of nondiscrimination in the conduct of City business by maintaining a procurement process which remains open to all who have the potential and ability to sell goods and services to the City. It is the policy of the City of Madison to allow Small Business Enterprises (SBE) maximum feasible opportunity to participate in City of Madison contracting. The bidder acknowledges that its bid has been submitted in accordance with the SBE program and is for the public's protection and welfare.

Please refer to the "ADVERTISEMENT FOR BIDS" for the goal for the utilization of SBEs on this project. SBEs may participate as subcontractors, vendors and/or suppliers, which provide a commercially useful function. The dollar value for SBE suppliers or 'materials only' vendors shall be discounted to 60% for purposes of meeting SBE goals.

A bidder which achieves or exceeds the SBE goal will be in compliance with the SBE requirements of this project. In the event that the bidder is unable to achieve the SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Failure to either achieve the goal or demonstrate a good faith effort to do so will be grounds for the bidder being deemed a non-responsible contractor ineligible for award of this contract.

A bidder may count towards its attainment of the SBE goal only those expenditures to SBEs that perform a commercially useful function. For purposes of evaluating a bidder's responsiveness to the attainment of the SBE goal, the contract participation by an SBE is based on the percentage of the total base bid proposed by the Contractor. The total base bid price is inclusive of all addenda.

Work performed by an SBE firm in a particular transaction can be counted toward the goal only if it involves a commercially useful function. That is, in light of industry practices and other relevant considerations, does the SBE firm have a necessary and useful role in the transaction, of a kind for which there is a market outside the context of the SBE Program, or is the firm's role a superfluous step added in an attempt to obtain credit towards goals? If, in the judgment of the Affirmative Action Division, the SBE firm will not perform a commercially useful function in the transaction, no credit towards goals will be awarded.

The question of whether a firm is performing a commercially useful function is completely separate from the question of whether the firm is an eligible SBE. A firm is eligible if it meets the definitional criteria and ownership and control requirements, as set forth in the City of Madison's SBE Program.

If the City of Madison determines that the SBE firm is performing a commercially useful function, then the City of Madison must then decide what that function is. If the commercially useful function is that of an SBE vendor / supplier that regularly transacts business with the respective product, then the City of Madison will count 60% of the value of the product supplied toward SBE goals.

To be counted, the SBE vendor / supplier must be engaged in selling the product in question to the public. This is important in distinguishing an SBE vendor / supplier, which has a regular trade with a variety of customers, from a firm which performs supplier-like functions on an ad hoc basis or for only one or two contractors with whom it has a special relationship.

A supplier of bulk goods may qualify as an eligible SBE vendor / supplier if it either maintains an inventory or owns or operates distribution equipment. With respect to the distribution equipment; e.g., a fleet of trucks, the term "operates" is intended to cover a situation in which the supplier leases the equipment on a regular basis for its entire business. It is not intended to cover a situation in which the firm simply provides drivers for trucks owned or leased by another party; e.g., a prime contractor, or leases such a party's trucks on an ad hoc basis for a specific job.

If the commercially useful function being performed is not that of a qualified SBE vendor / supplier, but rather that of delivery of products, obtaining bonding or insurance, procurement of personnel, acting as a broker or manufacturer's representative in the procurement of supplies, facilities, or materials, etc., only the fees or commissions will apply towards the goal.

For example, a business that simply transfers title of a product from manufacturer to ultimate purchaser; e. g., a sales representative who re-invoices a steel product from the steel company to the Contractor, or a firm that puts a product into a container for delivery would not be considered a qualified SBE vendor / supplier. The Contractor would not receive credit based on a percentage of the cost of the product for working with such firms.

Concerning the use of services that help the Contractor obtain needed supplies, personnel, materials or equipment to perform a contract: only the fee received by the service provider will be counted toward the goal. For example, use of a SBE sales representative or distributor for a steel company, if performing a commercially useful function at all, would entitle the Contractor receiving the steel to count only the fee paid to the representative or distributor toward the goal. This provision would also govern fees for professional and other services obtained expressly and solely to perform work relating to a specific contract.

Concerning transportation or delivery services: if an SBE trucking company picks up a product from a manufacturer or a qualified vendor / supplier and delivers the product to the Contractor, the commercially useful function it is performing is not that of a supplier, but simply that of a transporter of goods. Unless the trucking company is itself the manufacturer or a qualified vendor / supplier in the product, credit cannot be given based on a percentage of the cost of the product. Rather, credit would be allowed for the cost of the transportation service.

The City is aware that the rule's language does not explicitly mention every kind of business that may contribute work on this project. In administering these programs, the City would, on a case-by-case basis, determine the appropriate counting formula to apply in a particular situation.

2.2 Contract Compliance

Questions concerning the SBE Program shall be directed to the Contract Compliance Officer of the City of Madison Department of Civil Rights, Affirmative Action Division, 210 Martin Luther King, Jr. Blvd., Room 523, Madison, WI 53703; telephone (608) 266-4910.

2.3 Certification of SBE by City of Madison

The Affirmative Action Division maintains a directory of SBEs which are currently certified as such by the City of Madison. Contact the Contract Compliance Officer as indicated in Section 2.2 to receive a copy of the SBE Directory or you may access the SBE Directory online at www.cityofmadison.com/dcr/aaTBDDir.cfm.

All contractors, subcontractors, vendors and suppliers seeking SBE status must complete and submit the **Targeted Business Certification Application** to the City of Madison Affirmative Action Division by the time and date established for receipt of bids. A copy of the Targeted Business Certification Application is available by contacting the Contract Compliance Officer at the address and telephone indicated in Section 2.2 or you may access the Targeted Business Certification Application online at www.cityofmadison.com/dcr/aaTBDDir.cfm. Submittal of the Targeted Business Certification Application by the time specified does not guarantee that the applicant will be certified as a SBE eligible to be utilized towards meeting the SBE goal for this project.

2.4 Small Business Enterprise Compliance Report

2.4.1 Good Faith Efforts

Bidders shall take all necessary affirmative steps to assure that SBEs are utilized when possible and that the established SBE goal for this project is achieved. A contractor who self performs a portion of the work, and is pre-qualified to perform that category of work, may subcontract that portion of the work, but shall not be required to do so. When a bidder is unable to achieve the established SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Such a good faith effort should include the following:

- 2.4.1.1 Attendance at the pre-bid meeting.
- 2.4.1.2 Using the City of Madison's directory of certified SBEs to identify SBEs from which to solicit bids.
- 2.4.1.3 Assuring that SBEs are solicited whenever they are potential sources.
- 2.4.1.4 Referring prospective SBEs to the City of Madison Affirmative Action Division for certification.
- 2.4.1.5 Dividing total project requirements into smaller tasks and/or quantities, where economically feasible, to permit maximum feasible SBE participation.
- 2.4.1.6 Establishing delivery schedules, where requirements permit, which will encourage participation by SBEs.
- 2.4.1.7 Providing SBEs with specific information regarding the work to be performed.
- 2.4.1.8 Contacting SBEs in advance of the deadline to allow such businesses sufficient time to prepare a bid.
- 2.4.1.9 Utilizing the bid of a qualified and competent SBE when the bid of such a business is deemed reasonable (i.e. 5% above the lowest bidder), although not necessarily low.
- 2.4.1.10 Contacting SBEs which submit a bid, to inquire about the details of the bid and confirm that the scope of the work was interpreted as intended.
- 2.4.1.11 Completion of Cover Page (page C-6), Summary Sheet (page C-7) and SBE Contact Reports (pages C-8 and C9) if applicable.

2.4.2 Reporting SBE Utilization and Good Faith Efforts

The Small Business Enterprise Compliance Report is to be submitted by the bidder with the bid: This report is due by the specified bid closing time and date. Bids submitted without a completed SBE Compliance Report as outlined below may be deemed non-responsible and the bidder ineligible for award of this contract. Notwithstanding any language to the contrary contained herein, the City may exercise its discretion to allow bidders to correct or supplement submissions after bid opening, if the minor discrepancy, bid irregularity or omission is insignificant and not one related to price, quality, quantity, time of completion, performance of the contract, or percentage of SBE utilization.

2.4.2.1 If the Bidder meets or exceeds the goal established for SBE utilization, the Small Business Enterprise Compliance Report shall consist of the following:

2.4.2.1.1 **Cover Page**, Page C-6; and

2.4.2.1.2 **Summary Sheet**, C-7.

2.4.2.2 If the bidder does not meet the goal established for SBE utilization, the Small Business Enterprise Compliance Report shall consist of the following:

2.4.2.2.1 **Cover Page**, Page C-6;

2.4.2.2.2 **Summary Sheet**, C-7; and

2.4.2.2.3 **SBE Contact Report**, C-8 and C-9. (A separate Contact Report must be completed for each applicable SBE which is not utilized.)

2.5 Appeal Procedure

A bidder which does not achieve the established goal and is found non-responsible for failure to demonstrate a good faith effort to achieve such goal and subsequently denied eligibility for award of contract may appeal that decision to the Small Business Enterprises Appeals Committee. All appeals shall be made in writing, and shall be delivered to and received by the City Engineer no later than 4:30 PM on the third business day following the bidder's receipt of the written notification of ineligibility by the Affirmative Action Division Manager. Postmark not acceptable. The notice of appeal shall state the basis for the appeal of the decision of the Affirmative Action Division Manager. The Appeal shall take place in accordance with Madison General Ordinance 33.54.

2.6 SBE Requirements After Award of the Contract

The successful bidder shall identify SBE subcontractors, suppliers and vendors on the subcontractor list in accordance with the specifications. The Contractor shall submit a detailed explanation of any variances between the listing of SBE subcontractors, vendors and/or suppliers on the subcontractor list and the Contractor's SBE Compliance Report for SBE participation.

No change in SBE subcontractors, vendors and/or suppliers from those SBEs indicated in the SBE Compliance Report will be allowed without prior approval from the Engineer and the Affirmative Action Division. The contractor shall submit in writing to the City of Madison Affirmative Action Division a request to change any SBE citing specific reasons which necessitate such a change. The Affirmative Action Division will use a general test of reasonableness in approving or rejecting the contractor's request for change. If the request is approved, the Contractor will make every effort to utilize another SBE if available.

The City will monitor the project to ensure that the actual percentage commitment to SBE firms is carried out.

2.7 SBE Definition and Eligibility Guidelines

A Small Business Enterprise is a business concern awarded certification by the City of Madison. For the purposes of this program a Small Business Enterprise is defined as:

- A. An independent business operated under a single management. The business may not be a subsidiary of any other business and the stock or ownership may not be held by any individual or any business operating in the same or a similar field. In determining whether an entity qualifies as a SBE, the City shall consider all factors relevant to being an independent business including, but not limited to, the date the business was established, adequacy of its resources for the work in which it proposes to involve itself, the degree to which financial, equipment leasing and other relationships exist with other ineligible firms in the same or similar lines of work. SBE owner(s) shall enjoy the customary incidents of ownership and shall share in the risks and profits commensurate with their enjoyment interests, as demonstrated by an examination of the substance rather than form or arrangements that may be reflected in its ownership documents.
- B. A business that has averaged no more than \$4.0 million in annual gross receipts over the prior three year period and the principal owner(s) do not have a personal net worth in excess of \$1.32 million.

Firm and/or individuals that submit fraudulent documents/testimony may be barred from doing business with the City and/or forfeit existing contracts.

SBE certification is valid for one (1) year unless revoked.

SECTION D: SPECIAL PROVISIONS

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET RECONSTRUCTION DISTRICT 2018 CONTRACT NO. 8119

It is the intent of these Special Provisions to set forth the final contractual intent as to the matter involved and shall prevail over the Standard Specifications and plans whenever in conflict therewith. In order that comparisons between the Special Provisions can be readily made, the numbering system for the Special Provisions is equivalent to that of the Specifications.

Whenever in these Specifications the term "Standard Specifications" appears, it shall be taken to refer to the City of Madison Standard Specifications for Public Works Construction and Supplements thereto.

SECTION 102.11 **BEST VALUE CONTRACTING**

This Contract shall be considered a Best Value Contract if the Contractor's bid is equal to or greater than \$62,500 for a single trade contract; or equal to or greater than \$306,000 for a multi-trade contract pursuant to MGO 33.07(7).

ARTICLE 104 **SCOPE OF WORK**

The work under this contract shall include, but is not limited to, installation of sanitary sewer main and laterals, storm sewer structures and pipes, curb and gutter, base preparation, asphalt pavement, street lighting, traffic signals, sidewalk, driveway aprons and asphalt bike paths.

The project limits for the work are on S. Bryan St. from S. Fair Oaks Ave. to Milwaukee St., on Daley St. from the west end (Starkweather Creek) to S. Bryan St., on James St. from the west end to S. Fair Oaks Ave. and on Thorp St. from the west end to S. Fair Oaks Ave.

The Contractor shall view the site prior to bidding to become familiar with the existing conditions. It will be the responsibility of the Contractor to work with the utilities located in the right of way to resolve conflicts during the construction process.

SECTION 104.4 **INCREASED OR DECREASED QUANTITIES**

The Contractor shall note that some bid item quantities may increase or decrease based on what is encountered in the field. If the actual field conditions vary from the plan quantity, no additional compensation shall be given for increasing or decreasing quantities. Any overruns shall be paid for under the appropriate bid item(s) without any penalty or change to the bid price for the associated bid item. The Contractor shall not be reimbursed for any deletions to the contract. No change to the unit bid price will be allowed for changes to the quantities.

The Contractor shall note that the bid items for sidewalk removal and replacement may increase or decrease based on what is encountered in the field. The plans show assumed replacement locations but these may change depending on final locations of utility work or when directed by the Construction Engineer.

The electrical quantities include estimates for work that may or may not be required. If actual quantities are less than estimated, or if items are deleted from the contractor's work, the decreased quantities or deleted items shall not constitute the basis for a claim for damages for anticipated profits for the work dispensed with.

SECTION 104.10 CLEANING UP

Excess concrete from finishing operations and from spillage on adjacent sidewalk and curb & gutter shall be removed immediately. Excess concrete or mortar from the finishing operation and spillage into SASs and inlets shall be removed immediately. Any residue from concrete work that may splatter on to adjacent items to remain shall be removed immediately by the contractor.

SECTION 105.12 COOPERATION BY THE CONTRACTOR

It is anticipated that the Contractor will need to use multiple crews in order to complete the work under this contract within contract duration. It is also expected that certain items of work will require multiple mobilizations to meet the requirements of the traffic control and coordination specifications.

Existing Items to Remain

The Contractor shall use care around existing trees, plantings, walls, steps, signs, utilities and any other structures or amenities that are indicated on the plans to remain. No trees, other than those shown on the plan to be removed, shall be cut without the approval of the Engineer and the City Forester; the abutting property owners shall be notified in accordance with the City's Administrative Procedure Memorandum No. 6-2 prior to any removal. The Contractor shall not store materials or equipment within in 6 ft. of any existing tree that is to remain.

Access to Properties

This project includes work on multiple dead-end streets, and on these streets there are single family homes, an apartment building with a commercial parking lot, and a property where the owner operates a business (3146 Thorp St.). The Contractor shall maintain access to properties on these streets in accordance with the standard specifications, and shall provide access to the at-home business. Whenever access will be limited to any of these properties, the contractor shall clearly communicate with the residents the access limitations and timeframes. A minimum of 72 hours notice shall be provided to these properties.

The Contractor shall maintain access to a minimum of 50% of all driveways located within the project limits at all times. Any additional work, phasing mobilizations, plating or other means necessary to maintain access to the driveways shall be considered incidental to the contract.

The properties located within this project have walk-up mail carrier service. If construction activities result in access that is too difficult for mail service, the Contractor shall provide temporary mail boxes outside the construction limits and coordinate that location with USPS. It is expected that the Contractor maintain access for mail delivery; any temporary mailboxes that are installed as a result of construction activities will be considered incidental to the contract.

Coordination with Utilities

The Contractor will be responsible for coordination and providing work space for any conflict resolution work that will need to be performed by the private utility companies. Most existing utilities are located overhead. If there are any conflicts with existing poles, the Contractor shall coordinate with MG&E and the other utility companies for relocating poles.

MG&E will install new gas main within the limits of the project. This will also include replacement of gas services. Depending on when the contractor elects to begin work, construction activities may overlap with the gas main replacement. The contractor shall coordinate with MG&E to provide time and space as necessary to complete the gas main work. The contact for this project is Roger Ahles (rahles@mge.com or 608-252-5682).

SECTION 105.13 ORDER OF COMPLETION

The Contractor shall phase construction operations to minimize the amount of disturbed streambank. Along the streambank, the Contractor shall leave stumps that are called out to be grubbed in place until the Contractor is ready to complete riprap placement to stabilize the shoreline. If the streambank is

disturbed in advance of starting construction along the streambank, the Contractor shall be required to provide temporary stabilization measures, such as temporary erosion matting, at no additional cost to the City.

Final grading activities shall begin at the downstream end of the channel and progress upstream. The streambank shall be stabilized immediately following final grading. The Contractor shall not grade more bank than can be stabilized within the same working day.

Riprap installation shall take place immediately following removal of the bulkhead. The bank shall either be stabilized with the existing bulkhead or new riprap at all times.

SECTION 107.6 DUST PROOFING

The Contractor shall take all necessary steps to control dust arising from operations connected with this contract. When ordered by the Engineer, the Contractor shall dust proof the construction area by using power sweepers and water. Dust proofing shall be incidental with operations connected with this contract.

SECTION 107.7 MAINTENANCE OF TRAFFIC

The Contractor shall maintain access to properties as described under Section 105.12 Cooperation of the Contractor. This project will involve work on dead-end streets, which will require additional advanced notice to the residents from the Contractor along with planning construction methods as necessary to maintain access per the standard specifications and these special provisions.

All signing and barricading shall conform to Part VI of the Federal Highways Administrations "Manual on Uniform Traffic Control Devices" (MUTCD), the State of Wisconsin Standard Facilities Development Manual (including Chapter 16 – Standard Detail Drawings) and the City of Madison Standards for sidewalk and bikeway closures.

S Bryan Street, Thorp Street, James Street, and Daley Drive may be closed to through traffic at the project limits for the duration of the project.

Milwaukee Street shall remain fully open with no impacts to traffic due to construction for the duration of the project.

Two way traffic shall be maintained on S Fair Oaks Avenue at all times. This may be accomplished with the use of flaggers during off-peak hours for up to 10 days. Outside of these 10 days, S Fair Oaks Avenue shall be fully open to traffic.

Tubular markers used to separate traffic in opposite directions shall be per WISDOT S.D.D. 15C-11. Tubular markers used to shift traffic and placed between traffic operating in the same direction shall be white in color with yellow reflective tape. Double yellow reflective pavement marking tape shall be used whenever tubular markers are being used to separate travel lanes. Yellow four (4) inch reflective pavement marking tape shall be used whenever tubular markers are used to separate a travel lane from a work zone.

Traffic Control shall be measured as a lump sum. Payment for the Traffic Control is full compensation for constructing, assembling, hauling, erecting, re-erecting, maintaining, restoring, and removing non permanent traffic signs, drums, barricades, and similar control devices, including arrow boards, for providing, placing, and maintaining work zone. Maintaining shall include replacing damaged or stolen traffic control devices. Temporary pavement markings, tubular posts and bases and electronic message boards shall be paid for as separate bid items. Traffic control to install temporary or permanent pavement markings shall be included in the Traffic Control Lump Sum Bid Item.

Contractor shall supply all necessary mounting hardware and supports for signing. This shall also include covering and uncovering any conflicting overhead signs during the project. Contractor shall display all

signing so as to be easily viewed by all users. Contractor shall mount traffic control on posts or existing poles or drive posts whenever possible. Existing poles may be used with approval of Construction Engineer. Contractor shall inspect traffic control daily to ensure all traffic control remains in place during the project.

The traffic control plan may need to be altered as conditions change in the field or as unexpected conditions occur. This shall include relocating existing traffic control or providing additional traffic control. This should be considered incidental to providing traffic control for the project.

Type A warning lights shall be installed on all barricades used in the project per State of Wisconsin S.D.D. 15C2-4B. Contractor shall also place Type C warning lights on any barrels used to taper traffic or lane closures.

All temporary inlet or structure plating for traffic control phasing shall be considered incidental to the traffic control bid item.

Contractor shall place portable changeable message boards at least one week in advance of the start of work, notifying the public of the start of construction. Contractor shall locate the portable changeable message boards as directed by the Engineer.

Contractor shall notify the City of Madison Police Department, Fire Department, Madison Metro, and Traffic Engineering 48 hours in advance of all switchovers of traffic lanes and closures of streets. Notifications must be given by 4:00 P.M. on Thursday for any such work to be done on the following Monday. Notify Madison Metro one week prior to traffic switches, street closures, and reopening the road to through traffic for bus routing. Madison Metro contact is Tim Sobota (608) 261-4289.

Maintain sidewalk on one side of the street at all times and both sides whenever possible. When sidewalk must be closed for construction purposes, contractor shall ensure that sidewalk on opposite side of the street is open. Sidewalk closures shall be signed at the crosswalks prior to the closure. Sidewalk access to all businesses shall remain open from at least one end of a block at all times. Sidewalks shall be fully open during non-working hours except where necessary to enable sidewalk to cure. Maintaining Sidewalk is considered incidental to the contract.

Construction equipment and materials are not to be stored within the street right-of-way that is open to traffic during non-working hours.

Contractor is responsible for obtaining and installing temporary no parking signs to facilitate traffic control plan or as necessary to complete the work within the contract. The contractor shall contact John Villareal with the City of Madison Parking Utility (608-267-8756) at least 3 working days prior to needing the signs. Contractor shall post signs in accordance with the City of Madison Police Department Guidelines for temporary no parking restrictions for construction or special events. The guidelines can be found at the link listed below. This shall be considered incidental to the traffic control lump sum bid item.

http://www.cityofmadison.com/business/pw/documents/guidelines_temporarynoparkingrestrictions.pdf

The Contractor shall not remove traffic signs. For removal or replacement of traffic and parking signs, contact the City of Madison Traffic Engineering Field Operations, 1120 Sayle Street, 266-4767, 8:00 a.m. to 4:00 p.m., a minimum of 2 working days in advance of when any existing signs need to be removed. This service is provided free of charge. If the contractor removes the signs, the contractor will be billed for the reinstallation of, and any damage to, the signing equipment. The contractor shall notify The City of Madison Traffic Engineering Field Operations, 1120 Sayle Street, 266-4767 upon completion of final landscaping to have permanent signs reinstalled. The contractor shall expect a minimum of seven working days to have permanent signs reinstalled. The contractor shall leave in place all necessary traffic control until given notice by the construction engineer that permanent signing is in place and temporary traffic control may be removed.

Contact Jeremy Nash, City of Madison Traffic Engineering, at 266-6585 for questions on this spec.

SECTION 107.10 OPENING OF SECTION OF HIGHWAY TO TRAFFIC

Upon completion of all concrete work, final surface course of pavement, landscaping, topsoil, seed or sod, the City Construction Engineer shall certify that it is complete and shall contact the City of Madison Traffic Operations Section, 266-4767. The Contractor shall leave all barricades and traffic control in place until such time that the final signing has been installed by the City. The City shall notify the Contractor when the final signing is complete and the Contractor shall remove all temporary construction signs and barricades within 24 hours of the notification.

SECTION 107.13 TREE PROTECTION SPECIFICATIONS

The Contractor is advised to review Article 107.13 of the Standard Specifications for tree protection.

Trees shall be removed per the plans. Trees not identified to be removed on the plans are expected to remain and to be protected during construction. Some trees are identified for special protection measures as described under the Construction Fencing Bid Item.

It is recognized that grading operations and root cutting of trees within the project limits may need to occur within 5 feet of trees in order to complete the work, but care shall be taken in these areas. Roots shall be cut cleanly by using a saw, axe, lopping shears, chain saw, stump grinder, or other means which will produce a clean cut. Exposed roots shall be covered as soon as excavation is complete. The Contractor shall not rip or pull roots out towards the trunk of a tree while excavating with a backhoe. The use of a backhoe to cut roots is NOT acceptable. Grading within 5' of the trees within the construction area, if absolutely required, shall be minimized.

With regard to Article 107.13(f), pruning to accommodate construction equipment invading the tree crown shall be done by the Contractor with the exception of pruning along Starkweather Creek. Pruning shall only be completed with advance permission from the Construction Engineer, and under a certified arborist, hired by the Contractor. All pruning shall be done according to ANSI A300 tree pruning specifications. City Engineering will prune trees along the streambank in advance of the project, and City Forestry will prune trees along the streets prior to construction.

If additional pruning is needed along Starkweather Creek to accommodate equipment, the Contractor shall request permission from the Project Engineer prior to limbing. A representative will visit the site to assess the tree and permit or deny the pruning request.

With regard to Article 107.14(g), no equipment or materials will be allowed to be parked on, or piled on areas within 5 feet of a tree. Construction traffic within 5 feet of a tree will be allowed only where necessary to complete grading operations, as described above, at the discretion of the Construction Engineer. The Contractor shall notify the Project Engineer as to what trees they would like pruned at the pre-construction meeting. Pruning completed by the Contractor will be done at no additional cost to the City.

In order to minimize disturbance to protected trees along the streambank, the Contractor shall not track from STA: 2+00 to STA: 3+50, and from STA: 5+25 to STA: 5+75 except to remove the steel bulkhead and place the riprap within those limits.

SECTION 108.2 PERMITS

The following permits are required (and have been or will be applied for by the City) for this project:

- Army Corps of Engineers General Permit
- WI-DNR Chapter 30 Permit – See Attached Permit Conditions
- City of Madison Erosion Control and Stormwater Management Permit
- Wisconsin Department of Natural Resources Notice of Intent (Stormwater Permit)

It shall be the responsibility of the Contractor to obtain the permits listed below, if required, and to pay all applicable charges and fees associated with these permits.

- Wisconsin DNR Type II Dewatering

The Contractor shall be responsible for knowing, understanding, and meeting the conditions of all permits and shall keep a copy of each individual permit on site at all times throughout construction. Any questions pertaining to permit compliance shall be immediately brought to the attention of the Project or Construction Engineer.

With regard to Control of Invasive or Exotic Species, the Chapter 30 permit will stipulate that any equipment or materials that may be in contact with invasive or exotic species shall be decontaminated prior to and after work at the project site. It shall be the Contractor's responsibility to comply with decontamination requirements.

The Contractor shall meet the conditions of the permits involving properly installing and maintaining the erosion control measures shown on the plans, specified in these Special Provisions, as directed by the Construction Engineer or his designees, or as directed by any official representative of the DNR or USACOE. This work will be paid for under the appropriate bid items, or if appropriate items are not included in the contract, they shall be paid for as Extra Work.

The City's obtaining these permits is not intended to be exhaustive of all permits that may be required to be obtained by the Contractor for construction of this project. It shall be the responsibility of the Contractor to identify and obtain any other permits needed for construction.

SECTION 109.2 PROSECUTION OF WORK

The Contractor may start work as early as **APRIL 15, 2019**. All work under this contract shall be completed by **ONE HUNDRED SIXTY (160) CALENDAR DAYS**. The Contractor may elect to start work under this contract at any date but the contract duration will remain the same regardless of the start date or all work must be completed prior to October 31, 2019, whichever is sooner.

Work shall begin only after the start work letter is received. If it is desirable to begin work before the above-mentioned date, at another date or by a phased approach, the Contractor shall establish a mutually acceptable date with the Engineer, and the agreed upon date must be determined at least 21 days prior to the anticipated start date. If the Contractor wishes to start work after the start date noted above, the Contractor shall inform the Engineer of this decision no later than March 15, 2019.

The Contractor shall not install any of the asphalt pavement until after the streambank restoration work is complete. The Contractor shall protect and/or restore items of work completed prior to the streambank work as directed by the Engineer. Protection and/or restoration of items while streambank work is completed shall be considered incidental to the project.

The total contract includes additional time for work days necessary for MG&E to complete their work on the project. No time extensions will be given for coordinating with the utilities and for providing time and space for the private utilities to complete their work within the contract duration.

BID ITEM 20109 – FINISH GRADING

DESCRIPTION

Work under this bid item shall include all work, materials, labor, and incidentals required to properly grade the streambank, as shown on the streambank plans and details.

The Contractor shall grade the site such that standing water does not develop behind the canoe/kayak launch and that the bank slopes towards the riprap.

Minor amounts of cut or fill required to complete this grading shall be included in this bid item. If excess cut is generated during finish grading, the Contractor shall remove the material from the site and dispose of it in an acceptable location provided by the Contractor.

The Contractor shall work with caution when grading near trees along the streambank. The Contractor shall not grade in a manner that exposes, or excessively buries, tree roots. Damage to trees will be subject to Article 107.13 of the Standard Specifications. In accordance with the plans and as directed by the Engineer, the Contractor shall protect trees with Construction Fencing, which shall be paid separately.

Finish Grading shall be inspected and approved by the Engineer prior to seeding and mulching. It shall be the responsibility of the Contractor to schedule an inspection with the Engineer.

METHOD OF MEASUREMENT

Finish Grading shall be measured as a Lump Sum acceptably completed.

BASIS OF PAYMENT

Finish Grading shall be paid for at the contract unit price, which shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to grade the site in a manner that prevents standing water adjacent to shoreline features.

BID ITEM 20221 – TOPSOIL

DESCRIPTION

Work under this bid item shall include all work, materials, labor, and incidentals required to provide and place 6 inches of topsoil over all disturbed areas within the project, including street terraces and the Starkweather Creek shoreline. Topsoil provision and placement shall be in accordance with Article 202 of the Standard Specifications, and additional depth of topsoil shall be placed as necessary to fulfill the requirements of the Finish Grading bid item.

METHOD OF MEASUREMENT

Topsoil shall be measured per Square Yard of topsoil placed within the street terraces. Final measurement of topsoil along the streambank shall be based on the Plan Quantity. Topsoil quantity along the streambank was calculated by measuring all pervious area within the streambank Right-of-Way area to the proposed back edge of riprap. Additional depth of topsoil may also be needed from STA: 2+00 to STA: 3+50.

Summary of topsoil quantities:

Estimated street terraces to be measured in place: 6800 SY

Plan Quantity of topsoil along streambank to be paid: 1643 SY

BASIS OF PAYMENT

Topsoil, measured as provided above, shall be paid for at the contract unit price, which shall be full compensation all labor, tools, equipment, materials and incidentals necessary to place and grade 6 inches of topsoil over all disturbed areas.

BID ITEM 20228 – MEDIUM RIPRAP – GLACIAL FIELD STONE

DESCRIPTION

Work under this bid item shall include all work, materials, labor, and incidentals required to provide and place glacial field stone where riprap is called for in the plan set. Material shall be comprised of rounded,

durable, glacial till that has been sorted for size and is not susceptible to freeze-thaw degradation. Crushed, blasted, or "made" stone will not be permitted on site.

D50 (inches)	Min D (inches)	Max D (inches)
12	6	20

Prior to placement, the Contractor shall submit sourcing information to the Project Engineer or Construction Engineer. The Project Engineer, or their representative, may choose to evaluate the material at the source prior to acceptance.

The riprap shall be placed from the bottom of the creek, up to the 100-year lake level elevation (847.7') as shown on the streambank plans and details. The riprap shall be placed 18" thick and shall protrude 1' above the bank with 6" of riprap buried.

All riprap shall be underlain with geotextile filter fabric Type HR that conforms to Section 645 of the State of Wisconsin Standard Specifications for Highway and Bridge Construction, 2015 Edition. Provision and placement of filter fabric shall be incidental to this bid item. Filter fabric shall be placed in a manner that prevents material from showing at the top or edge of the stone.

- Geotextile Filter Fabric Type HR: 1189 S.Y. This quantity includes 15% overage for overlap and excess.

Prior to placement of geotextile fabric or stone, the Contractor shall prepare the creek bank by removing vegetation, roots, soil overhangs, etc. The Contractor shall minimize shoreline excavation or fill to that which is necessary to create an appropriate surface for riprap placement. Excavation and fill along the bank shall be limited to "shaping" the bank as necessary for riprap placement. Bank areas requiring fill may be filled with additional riprap; 3" clear stone; or clean, excavated material. Any excess cut shall be removed from the site and disposed of in an appropriate location provided by the Contractor. Excavation, hauling, and disposal of this material shall be incidental to this bid item. Estimated excavation and fill quantities are noted below; these quantities do not include any bulking or expansion factors.

- Estimated quantity of Excavation Cut: 240 C.Y.
- Estimated quantity of Fill: 125 C.Y.

METHOD OF MEASUREMENT

Medium Riprap – Glacial Field Stone shall be measured per Ton of stone acceptably installed.

BASIS OF PAYMENT

Medium Riprap – Glacial Field Stone shall be paid for at the contract unit price, which shall be full compensation for all labor, tools, materials, equipment, excavating, grading and incidentals necessary to shape the creek bank accordingly, provide and place geotextile filter fabric, and provide and place riprap as shown on the plan set and described herein.

BID ITEM 20312 – REMOVE CATCHBASIN

The BID ITEM 20312 REMOVE CATCHBASIN to remove an existing catchbasin will require the removal of the existing 60" round catchbasin with 4' sump. The installed SNOUT device shall be salvaged and returned to City Engineering located at 1600 Emil Street, Madison, WI.

BID ITEM 20336 – PIPE PLUG

With regard to the City of Madison Standard Specifications for Public Works Construction 2019 Edition Article 203.2(c), any pipe found in a trench that is less than 10" in diameter while installing a sewer facility

shall be considered incidental to the pipe being installed.

Any pipe plugs required to abandon or remove sewer access structure (pipes directly connected to the structure) shall be considered incidental to abandoning or removing the structure regardless of the size of the pipe being abandoned.

BID ITEM 20970 – TREES, SHRUBS, PERENNIALS AND GRASSES DROUGHT WATERING

DESCRIPTION

Work under this bid item shall include all work, materials, labor, and incidentals required to provide drought watering along the streambank in accordance with Article 209.5(j) of the City of Madison Specifications for Public Works Construction for all plants. Drought watering shall only be paid for per the conditions defined in Article 209.5(j) of the Specifications. Pumping from the creek is permissible.

METHOD OF MEASUREMENT

Drought Watering shall be measured by Each additional watering visit necessary to thoroughly soak the root zones of all plants at the site. The number of watering visits shall be defined such that one watering visit thoroughly waters all of the plants in this bid item, once.

BASIS OF PAYMENT

Drought Watering shall be paid for at the contract unit price each, which shall be full compensation for furnishing and transporting water to the site and watering the plants; and for furnishing all labor, tools, equipment and incidentals necessary to complete the work. In order to receive payment for drought watering, the Contractor shall submit proof of watering for each watering. This proof shall include photos of the watering with the date and time that each watering occurred.

SECTION 210.1(d) STREET SWEEPING

When required, either by the erosion control plan or the Construction Engineer, the Contractor shall perform mechanical street sweeping on all streets or paved surfaces affected by construction equipment, hauling or related construction activities that result in mud tracking or siltation. Mechanical street sweeping shall be completed as directed by the Construction Engineer and shall remove all loose material to the satisfaction of the Construction Engineer. Depending on site conditions, construction activities, and hauling methods utilized by the Contractor mechanical street sweeping may be required multiple times throughout the day with an absolute minimum that all streets are clean at the end of the work day.

BID ITEM 21061 – EROSION MATTING, CLASS I, URBAN TYPE A

DESCRIPTION

Work under this bid item shall include all work, materials, labor, and incidentals required to place, or provide and place ECRM Class I, Urban Type A on all disturbed areas, following the placement of topsoil and seed. Erosion control matting shall be provided and placed in accordance with Article 210 of the Standard Specifications.

METHOD OF MEASUREMENT

Erosion Matting, Class I, Urban Type A shall be measured per Square Yard of matting placed. Final measurement within the streambank restoration area shall be measured based on the Plan Quantity without an in-field measurement thereof. Matting plan quantity was calculated by measuring all pervious

areas within the Disturbance Limits shown in the plan set for the streambank work. The measured area extends from the edge of the Right-of-Way to the back edge of riprap.

Soil disturbed outside of the Disturbance Limits shall be restored with Topsoil, Terrace Seed Mix, and ERCM Class I, Urban, Type A at no additional cost to the City.

Summary of erosion matting quantities:

Estimated street terraces to be measured in place: 6800 SY

Plan Quantity along streambank to be paid: 1700 SY

BASIS OF PAYMENT

Erosion Matting, Class I, Urban Type A, measured as provided above shall be paid for at the contract unit price, which shall be full compensation all labor, tools, equipment and incidentals necessary to provide and place erosion matting at the site.

BID ITEM 40362 – ADJUST ACCESS STRUCTURE CASTING

Where plans for storm sewer call for the adjustment of castings the modifications shall include, removing existing castings, modifying the existing structure roof and installing two (2) R-1550-0054 castings. Work and materials to complete the adjustment shall be paid under BID ITEM 40362.

ARTICLE 500

SEWER AND SEWER STRUCTURES GENERAL

The shoreline designer is Jojo O'Brien and may be contacted at (608) 266-9721 or jobrien@cityofmadison.com. The sanitary sewer designer for the project is Matt Allie and may be contacted at (608) 266-4058 or mallie@cityofmadison.com. The storm sewer designer for this project is Daniel Olivares and may be contacted at (608) 261-9285 or daolivares@cityofmadison.com.

SANITARY SEWER GENERAL

This project shall include installing approximately 2,859 feet of new 8" PVC SDR-35 and SDR-26 sewer main and 2386 feet of new sanitary lateral SDR-35 and SDR-26.

ASTM D3034 SDR-35 and SDR-26 sewer main and lateral as called for on the plan set shall be payable under Sanitary Sewer Main (Bid Item 50301) and Sanitary Lateral (Bid Item 50353).

All new sanitary sewer access structures shall include Neenah R-1550 castings with the new City of Madison casting detail (see S.D.D. 5.7.16) of the City of Madison Standard Specifications for Public Works Construction 2019 ed. All new sewer main connections may be factory cored and shall be included in the structure. All existing main connections shall be field cored to accommodate existing conditions and shall be compensated under BID ITEM 50791 SANITARY SEWER TAP. All sewer main and/or laterals not slated for replacement that are damaged during the installation of a structure shall be replaced by the Contractor and shall be considered incidental to the project. All benches and flowlines shall have a smooth trowel finish.

Contractors shall have a locator device on-site if they intend to start laying lateral pipe at the property line to minimize the amount of extra sidewalk removal. Each sanitary lateral shall have a maximum of 4 sidewalk squares removed and replaced. No additional compensation shall be awarded beyond this amount for the replacement of a sewer lateral. If laterals called for reinstatement on the plans are to be plugged under the direction of the engineer on-site, Contractors are required to use a sonde device to confirm that the laterals are not active.

All sanitary sewer laterals on this project were located by television inspection of the main and from City records.

Connection of new pipes to existing structures, including the James Street sanitary sewer lift station, shall be accommodated with a Sanitary Sewer Tap – BID ITEM 50791.

It is advised that the Contractor visit the site prior to bidding to determine the type of trench protection that will be necessary for the sanitary sewer main installation.

On any streets where sanitary sewer is replaced before existing water main is abandoned, a temporary water supply system shall be installed and maintained until the new water main is installed and put in to service shall be paid under BID ITEM 70110 TEMPORARY WATER SUPPLY SYSTEM.

STORM SEWER GENERAL

Storm sewer pipe work shall include removing, salvaging, replacing, newly installing and/or protecting the existing storm sewer system to install the sanitary sewer.

Reconnection of existing pipes at new or existing structures, or new pipes at new or existing structures, shall be considered to be part of the work required to construct the new structure or to construct the new sewer pipe and shall not be rewarded with additional compensation. However, if the structure being removed is larger than the new structure, thus requiring additional pipe, the new pipe shall be paid under the appropriate bid item and the connection of the old pipe to the new pipe shall be accomplished with a concrete collar. All private storm connections to a new structure are incidental to the new structure. If a private connection is not shown on the plan, additional compensation shall be paid for as a private reconnection unless the structure is field poured.

Where a new structure is to be constructed at an existing pipe, it is expected that the contractor shall saw cut the existing pipe in the required location to accommodate the placement of the new structure. If the contractor for his or her convenience deems it more suitable to remove the existing pipe to a full joint, the additional pipe and concrete collar required to reconnect to the new structure shall be the contractor's responsibility and shall not be compensated.

Precast structures are only allowed where field poured structures are not specifically called for, and no precast structures are allowed until ULO's are completed and approval of the design engineer has been received.

BID ITEM 50353 - SANITARY SEWER LATERAL (SDR-35, SDR-26)

Sanitary sewer laterals shown on the construction plans were located by City television inspection and records only.

Where the existing sanitary sewer laterals are being extended to connect to the new sanitary sewer main (being installed in a different location as the existing main), pipe plugs shall be required to plug the existing sanitary sewer main on both sides of the old lateral location. The pipe plugs shall be considered incidental to the bid price for SANITARY SEWER LATERAL. All work associated with this bid item shall comply with Article 503 of the Standard Specifications.

Per the City of Madison Standard Specifications for sanitary sewer lateral construction on street reconstruction projects, Contractors are encouraged to begin installation of sanitary lateral pipe at the proposed sewer main. If Contractor starts excavation for the lateral at the property line, it shall be at the Contractor's risk. No Utility Line Openings (ULO's) will be granted for the inability to locate the sanitary lateral at the property line. Any extra sidewalk removal will not be compensated to the Contractor looking for an existing sanitary lateral at the property line. Contractors are encouraged to have a locator device on-site if they intend to start laying lateral pipe at the property line to minimize the amount of extra sidewalk removal.

Proposed sanitary lateral locations near trees are subject to change based upon data obtained in the field and property owner involvement. Excavation near trees shall comply with Article 107.13 of the Standard Specifications. If 5 ft of separation from the tree to the excavation cannot be maintained, lateral

replacement shall stop at the curb.

Each sanitary sewer lateral shall have a maximum of 4 sidewalk squares (106 sf) removed and replaced. No additional compensation shall be awarded beyond this amount for the replacement of a sewer lateral.

BID ITEM 50356 – RECONNECT SANITARY LATERAL

All work under this bid item shall be done in accordance with Article 503 of the City of Madison Standard Specifications for Public Works Construction, latest addition. Lateral risers shall be installed in conformance with the S.D.D. 5.3.1 and made payable as Reconnect (Bid Item 50356) and Sanitary Sewer Lateral (Bid Item 50353)

The first 5 feet of sewer lateral pipe/ fittings measured from the sewer main shall be considered the reconnect for all sewer lateral reconnections. Lateral connections to sewer access structures shall be paid for separately as a sanitary tap. 5' of lateral pipe is not considered incidental to the sanitary tap connection.

BID ITEM 50390 – SEWER ELECTRONIC MARKERS

With regard to the City of Madison Standard Specifications for Public Works Construction 2019 Edition Section 503.3(c), each sanitary lateral shall have a minimum of two (2) electronic markers with the City providing the Contractor with the required number of electronic markers. For sanitary laterals, which only include the installation of a wye, a marker ball shall be installed directly above the wye connection to the main.

A marker ball will be required for the pipe bend constructed on Bryan St near Milwaukee St and placed directly above the constructed bend.

BID ITEM 50499 – CONCRETE COLLAR

Where called out for on the plan or by the Engineer, the construction of a pipe bend shall be paid under BID ITEM 50499 and include the incidental materials and labor to construct a pipe bend (S-7B) connecting the existing 12" clay storm pipe to the 12" RCP storm pipe terminating at proposed storm inlet (S-7A).

BID ITEM 50797 - EXTERNAL SEWER ACCESS STRUCTURE JOINT SEAL

DESCRIPTION

Where called out for on the plan or by the Engineer, barrel joints shall be sealed on sanitary sewer structures around the outside circumference of the Sewer Access Structure. Manhole joint seal shall be minimum of nine (9) inches wide. The seal shall consist of flexible rubberize seal conforming to ASTM C923 held in place with stainless steel compression bands or butyl adhesive tape conforming to ASTM C877 or heat shrink sleeve over visco-elastic adhesive sealant.

Acceptable products and manufacturers are the following:

1. Mac Wrap, Mar Mac Manufacturing Company, Inc.
2. NPC External Joint Seal, NPC, Inc.
3. EZ-Wrap, Press-Seal Gasket Corporation
4. Riser-Wrap, Pipeline Seal and Insulator

Alternate manufacturers and products not listed above are subject to pre-approval by the Engineer

METHOD OF MEASUREMENT

External Sanitary Sewer Access Structure Joint Seal shall be measured separately as each for each sewer structure wrapped.

BASIS OF PAYMENT

External Sanitary Sewer Structure Joint Seal will be paid for at the contract price, and is considered full compensation for all work as listed above.

BID ITEM 50801 – UTILITY LINE OPENING (ULO)

The work under this item shall be completed in accordance with Article 508 of the Standard Specifications for Public Works Construction. It is the discretion of the Contractor to locate utilities by either a trench excavation or by a pothole technique. However, the Contractor shall not be compensated more than once for multiple utilities located within a maximum distance of five (5) feet long.

SECTION 701 PROVISIONS FOR WATER INSTALLATION AND ABANDONMENT

The water designer for this project is:

- Pete Holmgren
608.261.5530
pholmgren@madisonwater.org

This project consists of water main improvements on South Bryan Street, from the South Fair Oaks Avenue intersection to the Milwaukee Street intersection; James Street, from Starkweather Creek to the South Fair Oaks Avenue intersection; Thorp Street, from Starkweather Creek to the South Fair Oaks Avenue intersection; and Daley Drive, from Starkweather Creek to the South Fair Oaks Avenue intersection.

The water main infrastructure in this area currently consists of 6-inch cast-iron pipe from the 1920's, and known lead services in the area were replaced with copper in 2002. A general outline of the work is as follows:

- Furnish and install new 8-inch ductile iron water main and fittings as shown on the plans.
- Reconnect or replace existing services as shown on the plans.
- Abandon the existing 1920's cast-iron water main with a series of "cut-off" points as shown on the plans.
- Abandon valve boxes and valve structures on abandoned water main, and curb boxes on any abandoned services.
- Adjust new valve boxes, hydrants, and curb boxes to appropriate grades.

There is existing water main along Starkweather Creek between Daley Drive and James Street, however this water main will be abandoned when this project is complete.

Due to the layout of existing utilities, a water main bypass setup may be required. Review the requirements regarding water main bypass setups in the sanitary sewer special provisions, as well as the standard specifications.

View the site prior to bidding and become familiar with existing conditions and utilities.

SECTION 703 CONSTRUCTION METHODS

Perform all work in accordance with these provisions and the City of Madison *Standard Specifications For Public Works Construction, 2019 Edition*.

BID ITEM 70040 – FURNISH, INSTALL AND SALVAGE HYDRANT

The new hydrant at the Thorp Street and South Bryan Street intersection shall have its drain ports plugged during installation, due to the expected water table level at this location.

BID ITEM 90001 – TRAFFIC CONTROL FLEXIBLE TUBULAR MARKER POSTS

DESCRIPTION

This bid item includes all work, materials, equipment and labor necessary to install Traffic Control Flexible Tubular Marker Posts. All work under this bid item shall be in accordance with Section 633 of the current edition of the WISDOT standard specs.

METHOD OF MEASUREMENT

Traffic Control Flexible Tubular Marker Posts shall be measured as set forth in Section 633.4 of the Wisconsin DOT Standard Specifications, which shall be measured on a per unit basis acceptably installed.

BASIS OF PAYMENT

Traffic Control Flexible Tubular Marker posts will be paid at the contract unit price, which shall be full compensation for all work as provided in the description.

BID ITEM 90002 – TRAFFIC CONTROL FLEXIBLE TUBULAR MARKER BASES

DESCRIPTION

This bid item includes all work, materials, equipment and labor necessary to install Traffic Control Flexible Tubular Marker Bases. All work under this bid item shall be in accordance with Section 633 of the current edition of the WISDOT standard specs.

METHOD OF MEASUREMENT

Traffic Control Flexible Tubular Marker Bases shall be measured as set forth in Section 633.4 of the Wisconsin DOT Standard Specifications, which shall be measured on a per unit basis acceptably installed.

BASIS OF PAYMENT

Traffic Control Flexible Tubular Marker posts will be paid at the contract unit price, which shall be full compensation for all work as provided in the description.

BID ITEM 90030 – CANOE/KAYAK LAUNCH DEWATERING

DESCRIPTION

Work under this item shall include all labor, equipment, materials, and incidentals necessary to dewater or otherwise control Starkweather Creek levels in order to complete the installation of the Canoe/Kayak Launch and the Canoe/Kayak Launch Double Railing Slide.

Spring water levels of Lake Monona can vary significantly, depending on snowmelt and rain events. Starkweather Creeks functions as a backwater to Lake Monona, and maintains similar creek levels to the lake during dry weather. Dewatering is anticipated for the installation of the Canoe/Kayak Launch. The water level in Starkweather Creek, if not already drawn down by the Contractor, will be above the elevation of the bottom of the cut stone footings even at average water levels. This bid item is intended to compensate the Contractor if unfavorable lake levels are encountered while building the Canoe/Kayak Launch the Canoe/Kayak Launch Double Railing Slide. The water level may be above the 100-year lake level, as shown on the plans and details. The City highly recommends that the Contractor work on the shoreline when the water levels are below 846' if possible. No contract extension will be granted for high lake levels. The Contractor shall be aware that the majority of the proposed Canoe/Kayak Launch will be

below water should the lake reach the 100-year lake level (847.7', as shown on the streambank details), and that in 2018, the water level on Starkweather Creek reached 848.5'.

Fluctuation in water level shall not result in further compensation from the City.

Contractor may find it necessary to exclude water from the excavation by means of sandbags and pumping, or other methods. The Contractor shall be aware that any dewatering shall be treated prior to discharge. The pumped water shall be treated to remove suspended solids. At a minimum, this treatment shall include running the pump water through a geotextile sediment bag, prior to discharge to the storm sewer. This geotextile sediment bag shall have a 0.040 mm apparent opening size (AOS). If, at the determination of the Construction Engineer, this treatment process is not providing sufficient sediment removal the Contractor shall add a polymer to the sediment bag. These polymers shall comply with the WDOT standards for Polyacrylamide Soil Stabilizers and shall conform to the WDOT's Product Acceptability List (PAL) for Soil Stabilizers, Type B.

Polymer would be added to the sediment bag in amounts as recommended by the manufacturer based on the pump rates being experienced on the site.

If necessary the Contractor shall obtain, from the Wisconsin Department of Natural Resources (WDNR), in accordance with Paragraph 144.025(2)(e), Wisconsin Statutes, permits for all groundwater control wells which singly or in aggregate produce 70 or more gallons per minute. All wells shall be drilled and sealed in accordance with requirements of the WDNR for installing and abandoning wells. The address for obtaining well permits is:

Wisconsin Department of Natural Resources
Private Water Supply Section
BOX 7921
Madison, Wisconsin 53707

The Contractor shall be solely responsible for choosing a method of water control, which is compatible with the constraints defined. The Contractor shall be responsible for the adequacy of the groundwater control system and shall take all necessary measures to insure that the groundwater control operation will not endanger or damage any existing adjacent utilities or structures.

The method or methods shall be designed, installed and operated in such a manner to provide satisfactory working conditions and to maintain the progress of work. The methods and systems shall be designed so as to avoid settlement or damage to adjacent property in accordance with the applicable legislative statutes and judicial decisions of the State of Wisconsin. All required pumping, drainage and disposal of groundwater shall be done without damage to adjacent property or structures, or to the operations of other contractors and without interference with the access rights of public or private parties.

METHOD OF MEASUREMENT

Canoe/Kayak Launch Dewatering shall be measured as a Lump Sum for all field activities associated with the control of lake levels to complete the Canoe/Kayak Launch and Canoe/Kayak Launch slide.

BASIS OF PAYMENT

Canoe/Kayak Launch Dewatering shall be measured as defined above and shall be paid at the contract unit price, which shall be considered full compensation for all work, materials, equipment, and incidentals necessary to control water levels in order to construct the Canoe/Kayak Launch.

BID ITEM 90031 – CONSTRUCTION FENCING

DESCRIPTION

Work under this item shall include all work, materials, labor and incidentals necessary for the Contractor to provide, install, maintain and remove construction fencing from the project site as shown on the plans. This fence shall be highly visible, constructed of a plastic web, and able to withstand the expected amount of use it will receive on a construction site. Any required maintenance or re-installation of fencing is included with this item. The intent of this item is to delineate the area to which the Contractor shall confine his or her operations, to protect trees, and to prevent disturbance of areas by the public following seeding operations. The fencing shall be used freely at the direction of the Engineer.

Relocation of fencing may be required as the work progresses. No extra payment shall be made for temporarily opening and re-closing the fence, or relocation of the fencing as needed to perform the work.

This item includes construction fencing placed as tree protection fencing. Each tree within the disturbance limits that is identified as to remain shall be enclosed in a construction fencing perimeter, as shown on the plans. The 6 trees south of James Street shall be enclosed in a 15 foot diameter perimeter, and the 2 large silver maples north of James Street shall be enclosed in a 20 foot diameter perimeter, within the Right-of-Way.

Construction Fencing shall be Orange color, high-density polyethylene mesh conforming to the following:

- Mesh opening: 1 inch minimum to 3 inch maximum
- Height: 4 feet
- Ultimate tensile strength: Avg 3000lb per 4' width (ASTM D638)

METHOD OF MEASUREMENT

Construction Fencing (plastic) shall be measured by the Linear Foot of material placed, maintained, and removed.

BASIS OF PAYMENT

Construction fence (plastic) shall be measured as described above and shall be paid for at the contract unit price which shall be full compensation for all work, materials, tools, equipment, labor, hauling, placement, disposal and incidentals required to complete the work as set forth in the description.

BID ITEM 90032 – CANOE/KAYAK LAUNCH DOUBLE RAILING SLIDE

DESCRIPTION

Work completed as part of this bid item shall consist of purchasing, transporting, welding, and installing a double railing per the plans and details. The railing is intended to be used to slide kayaks and canoes from the top of the bank into Starkweather Creek, at varying water levels.

MATERIALS

Contractor shall use schedule 40 stainless steel pipe or Project Engineer approved equivalent. The railing shall consist of two level, parallel pipes, placed 18" apart. The railings shall be 2.5 inch nominal diameter, and the posts shall be 3 inch nominal diameter. All bolts used to connect 3 inch to 2.5 inch pipes shall also be stainless steel.

CONSTRUCTION METHODS

The three posts located on the top of bank shall be driven a minimum of 6 feet into the ground from the bottom of the clear stone. The creek-end of the railing shall be driven 8 feet into the ground from the bottom of the clear stone, or until resistance. At the top of bank, the railing shall be flat, or parallel to the

water level, for 4 feet. The railing shall then angle to the bottom corner of the final step following the edge of the limestone steps. The top end of the railing (furthest from the creek) shall be 2 feet above the top step, and the bottom end of the railing (nearest the creek) shall be 1.5 feet above the bottom step. The railing shall be offset 6" from the edge of the steps that runs perpendicular to the creek as shown in the streambank plans and details.

METHOD OF MEASUREMENT

The Canoe/Kayak Launch Double Railing Slide will be measured as a Lump Sum, acceptably completed.

BASIS OF PAYMENT

This work, measured as provided, will be paid for at the contract unit price for railings acceptably installed. Payment is full compensation for provision, and installation of the slides, including any necessary dewatering, backfilling and disposal of surplus material; for selecting, transporting and installing the pipe; and for furnishing all connectors, equipment, tools, labor and incidentals necessary to complete the work.

BID ITEM 90033 – CANOE/KAYAK LAUNCH AT JAMES STREET

DESCRIPTION

Work completed as part of this bid item shall consist of providing, transporting, and placing limestone steps on a clear stone bed, underlain with Geotextile Fabric, at the James St Street End. The limestone steps will be flanked by Light Riprap – Glacial Field Stone borders that will tie into the shoreline riprap. Preparation of the bed, provision and placement of geotextile filter fabric, provision and placement of the clear stone bedding material, and provision and placement of the Light Riprap – Glacial Field Stone shall all be incidental to this bid item. The Limestone step location is shown on the plans and details. The finished steps will be 6 feet in length.

MATERIALS

GEOTEXTILE FABRIC TYPE HR:

Geotextile Fabric Type HR shall conform to Section 645 of the State of Wisconsin Standard Specifications for Highway and Bridge Construction. Provision and placement of filter fabric shall be included in this bid item.

Estimated quantities are:

- Geotextile Filter Fabric, Type HR: 22 square yards for under steps and areas called out for Light Riprap

CLEAR STONE:

The Contractor shall import sufficient 1-inch clear stone to place a minimum of 1 foot of clear stone beneath and behind all stone steps. Up to 3-inch clear stone may be used below the Ordinary High Water Mark (OHWM). Imported clear stone shall comply with Standard Specifications Article 202 of the standard specifications. It is estimated that 5.8 cubic yards of clear stone will be needed.

Estimated quantities are:

- Clear Stone: 11.9 tons

CUT LIMESTONE:

All materials, equipment, labor, and incidentals necessary to purchase and move stone in an ordered and tidy manner, shall be included in the cost of this project. The Contractor shall purchase Beaver Creek limestone steps from Halquist stone, or an equal approved by the Project Engineer.

Stones shall meet the following specifications:

- Height: 6" to 8"

- Depth: 60"
- Length: 24"
- Snapped/natural on front, top and bottom
- Sawed or snapped on two 24" sides and back
- Water Absorption (ASTM C97): 0.66%
- Density (ASTM C97): 173 pcf
- Modulus of Rupture (ASTM C99): 1450 psi.
- Compressive Strength w/ Rift (ASTM C170): 26,260 psi
- Compressive Strength across Rift: 34,000 psi

Estimated quantities are:

- Cut Limestones: 36 stones
- Approximate weight of Beaver Creek 6"x60"x24" stone=865 lb

Halquist Contact Information:
 Ryan Bartsch
 Halquist Stone Company, Inc
ryanb@halquiststone.com
 (262) 346-9000 x175
 (262) 488-9004

LIGHT RIPRAP:

All materials, equipment, labor, and incidentals necessary to purchase, move and place stone in an ordered and tidy manner, shall be included in the cost of this project. It is estimated that 2.2 tons are needed.

Riprap shall be glacial field stone and conform to Section 212.2(a) Light Riprap. Material shall be comprised of rounded, durable, glacial till that has been sorted for size and is not susceptible to freeze-thaw degradation. Crushed, blasted, or "made" stone will not be permitted.

Estimated quantities are:

- 2.2 tons

CONSTRUCTION METHODS

LAYOUT:

The Contractor shall lay out the work and provide any survey control as needed for control of the work beyond the initial stakeout by City.

PREPARATION OF FOUNDATION:

Excavate as necessary to provide the minimum depth of clear stone bedding as shown on details. The bed for the cut limestone shall be properly trimmed and shaped. Note that the limestone shall consist of two courses laid horizontally in a running bond fashion. Therefore, stones of the proper height shall be selected and the exact depth of excavation or thickness of clear stone will vary to achieve the proper elevation for the top of stone.

DEWATERING:

Dewatering shall be paid in Bid Item 90030 Canoe/Kayak Launch Dewatering.

LIMESTONE INSTALLATION:

The Contractor shall select and place stones to fit snugly together and shall be firmly set with no rocking or tipping. Stones shall be placed tightly together such that at least 60% of all joined faces are in direct contact and any gap is less than 1 inch at any point along a joint. Cut stone blocks shall be field cut or chiseled as required to achieve this fit. Any costs associated with working the stone to accommodate placement shall be included in this bid item.

RIPRAP INSTALLATION:

Light Riprap shall be used to fill in any area between the edge of the limestone steps and the medium riprap along the creek bank as well to connect the steps to the existing bank. Riprap shall be placed 3 feet wide along each edge of the steps. The riprap shall be placed so that it is in line with the front edge of the limestone steps, as seen on the detail drawings.

METHOD OF MEASUREMENT

The City will measure the limestone steps, furnished, and installed, by the linear foot of exposed stone face measured at the front face of the wall parallel to the stream bank. The linear foot measurement shall include all courses of stone. Only accepted work will be measured for payment and quantity thereof will be based on the area within the stations shown on the plans, or directed by the engineer.

BASIS OF PAYMENT

This item, measured as provided, will be paid at the contract unit price, which payment is full compensation for excavation and preparation of the bed, including dewatering, backfilling and disposal of surplus material; furnishing and placing Geotextile Fabric Type HR; for furnishing and placing clear stone and light riprap; for purchasing, transporting, minor shaping and placing limestone; and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

BID ITEM 90034 – REMOVE STEEL BULKHEAD

DESCRIPTION

All work under this item shall be completed per Part II of the standard specifications, which shall include all labor, equipment, materials, and incidentals necessary to fully remove the existing steel bulkhead. Once removed, the Contractor shall properly haul and dispose of all materials. If it is necessary to cut the bulkhead below grade because it cannot be removed, the Contractor shall cut the bulkhead a minimum of 2' below grade.

METHOD OF MEASUREMENT

Remove Steel Bulkhead shall be measured per Linear Foot of steel bulkhead, measured along the center of the top of the bulkhead removed, parallel to the streambank.

BASIS OF PAYMENT

Remove Steel Bulkhead, measured as defined above, will be paid for at the contract unit price. Payment shall be considered full compensation for removal of the steel bulkhead, transportation of the materials off-site, and proper disposal of the material.

BID ITEM 90035 – SEEDING - WOODY UNDERSTORY AGGRESSIVE SPECIES MIX

DESCRIPTION

Work under this bid item shall include all labor, equipment, and incidentals necessary to provide, store, and install Woody Understory Aggressive Species Seed Mix in the locations shown on the plan set. All work, including the addition of soil stabilizers, and fertilizers shall be completed in accordance with Article 207 of the Standard Specifications. Following seeding, the site shall be stabilized with erosion matting, which shall be paid separately under the appropriate bid item.

The seed mix, as defined below, was provided by Agrecol in Madison, Wisconsin (608-223-3571). The Contractor may choose to use an alternate supplier, but shall submit the seed mix and supplier contact information to the Engineer for approval prior to installation. Individual species substitutions or omissions

may be permitted based on seed availability. Substitutions and omissions shall be approved by the Project Engineer prior to purchase.

SPECIES NAME	COMMON NAME	OZ/ACRE	% OF MIX
Grasses, Sedges & Rushes			
<i>Andropogon gerardii</i>	Big Bluestem	8.00	2.0
<i>Bromus ciliates</i>	Fringed Brome	16.00	2.7
<i>Calamagrostis Canadensis</i>	Blue Joint Grass	1.00	5.9
<i>Carex brevior</i>	Plains Oval Sedge	3.00	1.8
<i>Carex sprengeii</i>	Lon-Beaked Sedge	2.00	0.7
<i>Carex vulpinoidea</i>	Brown Fox Sedge	1.00	2.3
<i>Eleocharis acicularis</i>	Needle Spike Rush	0.50	0.7
<i>Elymus Canadensis</i>	Canada Wild Rye	16.00	2.0
<i>Elymus riparius</i>	River Bank Wild Rye	12.00	1.5
<i>Elymus villosus</i>	Silky Wild Rye	4.00	0.6
<i>Elymus virginicus</i>	Virginia Wild Rye	32.00	2.8
<i>Glyceria striata</i>	Fowl Manna Grass	2.00	4.7
<i>Hystrix patula</i>	Bottlebrush Grass	4.50	0.5
<i>Panicum virgatum</i>	Switchgrass	10.00	5.3
<i>Poa palustris</i>	Fowl Bluegrass	8.00	22.0
<i>Schizachyrium scoparium</i>	Little Bluestem	12.00	5.1
<i>Spartina pectinata</i>	Prairie Cordgrass	4.00	1.0
Grasses, Sedges, Rushes Subtotals		136.00	61.8%
Wildflowers			
<i>Anemone Canadensis</i>	Meadow Anemone	2.00	0.3
<i>Astragalus Canadensis</i>	Canada Milk Vetch	3.50	1.1
<i>Aster drummondii</i>	Drummond's Aster	1.25	1.7
<i>Coreopsis tripteris</i>	Tall Coreopsis	1.00	0.3
<i>Desmodium canadense</i>	Canada Tick Trefoil	1.00	0.1
<i>Echinacea purpurea</i>	Purple Coneflower	12.00	1.8
<i>Helenium autumnale</i>	Sneezeweed	1.00	3.2
<i>Helianthus grosseserratus</i>	Swatooth Sunflower	1.50	0.5
<i>Helianthus strumosus</i>	Pale-Leaved Sunflower	2.00	0.2
<i>Monarda fistulosa</i>	Wild Bergamot	1.50	3.2
<i>Physostegia virginiana</i>	Obedient Plant	1.00	0.4
<i>Pycnanthemum virginianum</i>	Mountain Mint	0.50	2.3
<i>Rudbeckia subtomentosa</i>	Sweet Black-Eyed Susan	2.50	3.4
<i>Solidago graminifolia</i>	Grass-Leaved Goldenrod	0.50	6.9
<i>Veronicastrum virginicum</i>	Culver's Root	0.75	12.7
Wildflower Subtotals		32.00	38.2%
TOTAL		168	100%

METHOD OF MEASUREMENT

Seeding - Woody Understory Aggressive Species Mix, within the limits shown on the plan set, shall be paid per Square Yard acceptably placed.

BASIS OF PAYMENT

Seeding - Woody Understory Aggressive Species Mix shall be measured as described above and shall be paid at the contract unit price, which shall constitute full compensation for provision and placement of seed as defined in this section and Article 207 of the Standard Specifications.

BID ITEM 90036 – STUMP MANAGEMENT

DESCRIPTION

This item includes all work, equipment and incidentals necessary to manage stumps within the streambank area of the project, created by tree clearing, and not specified for grubbing. The Contractor shall manage stumps to make the streambank area accessible without grubbing the stumps and disturbing the soil. The Contractor shall either grind the stumps down or cut the stumps to be flush with the proposed grading so that construction equipment and maintenance vehicles can access the streambank.

METHOD OF MEASUREMENT

The City shall measure Stump Management by the Inch Diameter acceptably completed. The City shall determine tree diameter by measuring the circumference approximately 4 1/2 feet above the existing ground level, but above the ground swell, and dividing by 3. Alternatively, the tree diameters listed on the plan set will also be acceptable. The City shall include only those in-place trees or stumps greater than 4-inches diameter. The City shall round circumference measurements and diameters to the nearest inch.

BASIS OF PAYMENT

The contract unit price for Stump Management, per inch diameter, shall be payment in full for furnishing all labor and equipment for all clearing and grubbing actually required and performed, and the handling and disposal of all debris resulting from Stump Management activities.

BID ITEM 90037 – BRUSHING

DESCRIPTION

This item shall include clearing of all brush, trees smaller than 4 inches in diameter, or removal of smaller, fallen logs, debris, yard waste, herbaceous vegetation, and other miscellaneous items to occur between the existing bulkhead and the property line along the streambank stationing limits.

The Contractor is strongly encouraged to visit the site prior to bidding in order to become familiar with site access and the quantity of brush removal.

Brush clearing shall consist of cutting or mowing all small trees, brush, shrubs, and herbaceous vegetation and completely removing the debris generated from the site. Smaller trees and brush shall be removed in line with the proposed finished grades. Remaining stumps shall not be grubbed. All clearing shall be done by sawing brush near the ground line.

This item shall include removal of windfalls, debris, and logs present within the brushing area.

The City anticipates the majority of the brushing to occur between STA: 2+00 and STA: 5+00 and from STA: 6+00 to STA 7+71.

The Contractor shall be responsible for the proper disposal of the material.

METHOD OF MEASUREMENT

Brushing completed within the streambank limits, as shown on the plan sheets shall be paid for as a Lump Sum.

BASIS OF PAYMENT

This work, measured as provided above, will be paid for at the contract price, which shall be considered full compensation for furnishing all labor and equipment for all brushing performed, and for the handling and disposal of all debris resulting from brush clearing.

BID ITEM 90038 – REMOVE EXISTING CANOE LAUNCH

DESCRIPTION

Work included in this bid item shall include all labor, materials, equipment, and incidentals necessary to remove the existing, wooden-bulkhead canoe launch, and restore the area.

The Contractor shall remove the existing timber canoe launch at STA: 5+50. No as-built information for the launch exists, so depth of wooden pilings and presence of footings is unknown. If necessary, the Contractor may cut the wooden pilings approximately 6 inches below the channel-side grade.

The Contractor shall backfill the launch area with clean fill that shall be compacted with excavation equipment. The fill shall be sufficient to tie into the adjacent creek banks. The Contractor shall fill the top 6" with topsoil, which shall be paid under the Topsoil bid item.

METHOD OF MEASUREMENT

Remove Existing Canoe Launch shall be measured as a Lump Sum for acceptable removal and restoration of the existing canoe launch.

BASIS OF PAYMENT

Remove Existing Canoe Launch shall be measured as described above, and shall be paid for at the contract unit price, which shall be considered full compensation for furnishing all labor, materials, equipment and incidentals for the removal of the existing canoe launch and for filling of the area to conform with the grading plan, and for the handling and disposal of all waste generated from the launch removal.

BID ITEM 90039 – STORM BOX TAP

DESCRIPTION

Work under this item shall include all labor, materials, and incidentals required to expand the existing dimensions of the storm box/bridge wall at S Fair Oaks Ave and Bryan St to accommodate the proposed 24" RCP storm pipe.

Dewatering of the existing storm box shall be considered incidental if high water elevations necessitate stormwater control. All dewatering or storm control methods shall be approved by the Engineer prior to the start of this work.

All work shall be completed in accordance with Article 507 of the Madison Standard Specifications for Public Works Construction.

MEASUREMENT AND PAYMENT

Storm Box Tap will be measured by the unit measurement of each, which price shall be full compensation for furnishing all materials including reinforcement steel, mortar and concrete; for installation and for all labor, tools, equipment and incidentals necessary to complete the work to connect the proposed 24" RCP storm pipe.

BID ITEM 90070 – SANITARY SEWER LIFT STATION

DESCRIPTION

This work shall include, but not necessarily be limited to, site clearing and grubbing, excavation for the lift station structures (wet well and valve vault) and lift station piping, removal of existing lift station, salvaging existing equipment, installation of the lift station, electrical service equipment and installation, lift station site grading, crushed stone, base course, concrete slabs, connection to force main and to sanitary sewer, restoration of the site, and furnishing all labor, tools, supplies, materials, equipment and any and all items necessary to provide a complete and properly operating lift station in accordance with the Plans, Special Provisions, Lift Station Provision, and City of Madison Standard Specifications for Public Works Construction 2019 Edition. Topsoil and Seed shall be paid for separately under BID ITEM 20221-TOPSOIL and BID ITEM 20701 – TERRACE SEEDING. Type 2 Dewatering for the lift station shall be paid for under BID ITEM 50202 - DEWATERING TYPE 2.

MEETHOD OF MEASUREMENT

SANITARY SEWER LIFT STATION shall be measured LUMP SUM for all work complete and accepted.

BASIS OF PAYMENT

SANITARY SEWER LIFT STATION, as provided above, shall be paid for at the contract price which shall be full compensation for all site clearing and grubbing, excavation for the lift station structures (valve vault and wet well) and lift station piping, removal of existing lift station, salvaging existing equipment, construction of the lift station including but not limited to pumps, piping, valves, controls, all fees and costs required to provide electrical service to the lift station site, electrical service equipment, lift station site grading, base course, concrete slabs, connection to force main and to sanitary sewer, restoration of the site, and furnishing all labor, tools, supplies, materials, equipment and any and all items necessary to provide a complete and properly operating lift station and to complete the work in accordance with the Specifications and Plans. The cost of furnishing and installing the Sanitary Sewer Lift Station shall be included in the "Sanitary Sewer Lift Station" lump sum bid item.

BID ITEM 90071 – SANITARY SEWER FORCE MAIN – 4 INCH

DESCRIPTION

This work shall consist of excavating required trenches, furnishing and laying therein PVC force main, including all necessary fittings, bedding, backfill, labor, tools supplies, materials and any and all items necessary to complete work in accordance with the Plans, Special Provisions, and City of Madison Standard Specifications for Public Works Construction 2019 Edition.

Materials

Force main pipe to be PVC, AWWA C900, Class 150 (DR-18) as specified in Article 503.2(c) of the City Specifications. Fittings shall be ductile iron mechanical joints as specified in Article 503.2(c) of the City Specifications. For the directional drill portion of the project, the fittings shall be C900/RJ Restrained Joint PVC Pipe with CertainTeed's Certa-Lok restrained joints or approved equal. Buttresses shall be high early strength concrete. Solid concrete blocks may be used when approved by the City Construction Representative.

Construction Methods

Construction methods shall conform to the Plans, Special Provisions, and City of Madison Standard Specifications for Public Works Construction 2019 Edition.

Sewer Electronic Marker Balls

Contractor shall install SEWER ELECTRONIC MARKERS above the force main, in accordance with section 503.2(f) and 503.2(g) of the Standard Specifications, at all horizontal and vertical grade breaks in the force main. SEWER ELECTRONIC MARKERS shall be paid separately under BID ITEM 50390.

Pressure Testing

The force main shall be installed and tested prior to making the final connection. Pressure testing shall be done in conformance with 501.3(c) of the City of Madison Standard Specifications for Public Works Construction 2019 Edition.

METHOD OF MEASUREMENT

SANITARY SEWER FORCE MAIN – 4 INCH shall be measured by linear foot.

BASIS OF PAYMENT

SANITARY SEWER FORCE MAIN – 4 INCH shall be measured and paid at the contract unit price per lineal foot. This price shall be full compensation for all excavation, bedding, native backfill, compacting, buttresses, restraint testing, connections to the existing sanitary sewer, furnishing all materials, permanent fittings, temporary fittings, tools, equipment, labor, and any and all items necessary to complete the work in accordance with the Plans, Special Provisions, and City of Madison Standard Specifications for Public Works Construction 2019 Edition.

ARTICLE 1000 SANITARY SEWER LIFT STATION SPECIAL PROVISIONS

Lift station shall be constructed in accordance with plans, special provisions, City standard spec and article 1000, see attached document.



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Janet Schmidt, P.E.

Facilities & Sustainability
Jeanne E. Hoffman, Manager
Bryan Cooper, Principal Architect

Mapping Section Manager
Eric T. Pederson, P.S.

Financial Manager
Steven B. Danner-Rivers

February 26, 2019

NOTICE OF ADDENDUM
ADDENDUM NO. 1
CONTRACT NO. 8119

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET
RECONSTRUCTION DISTRICT – 2018

Revise and amend the contract document(s) for the above project as stated in this addendum, otherwise, the original document shall remain in effect.

SPECIAL PROVISIONS:

DELETE THE METHOD OF MEASUREMENTS SECTION UNDER THE HEADING BID ITEM 90033 – CANOE/KAYAK LAUNCH AT JAMES STREET AND REPLACE WITH THE FOLLOWING:

The Canoe/Kayak Launch at James Street will be measured as a Lump Sum, acceptably completed.

DELETE THE ENTIRE ARTICLE 1000 SANITARY SEWER STATION SPECIAL PROVISIONS AND REPLACE WITH THE NEW ARTICLE WITHIN THIS ADDENDUM.

Changes to the original Special Provisions are indicated in RED text.

PROPOSAL:

See below for a summary of items that have been removed, added or revised. Refer to the proposal for updated quantities. See proposal on bidexpress.com.

ITEMS:

Action	Bid Item	Description
NEW	21110	TERRACE RAIN GARDEN
REVISE	70002	FURNISH AND INSTALL 6-INCH PIPE & FITTINGS
REVISE	70031	FURNISH AND INSTALL 6-INCH WATER VALVE
REVISE	70040	FURNISH, INSTALL AND SALVAGE HYDRANT

PLANS:

Title Sheet: Update index of sheets.

RG-1 & RG-2: Rain Garden Plans, new sheets.

LS-3: Revised lift station foundation and location of antenna tower.

LS-6: Revised key notes and lift station foundation.

LS-7: Revised lift station foundation section 1/LS-7. Revised removable post mounted detail 2/LS-7. Removed toe-plate and revised post to go over top of mounting plate vertical member. Revised guardrail elevation detail 3/LS-7. Changed diameter elevation of guardrail. Remove typical slab on grade detail 5/LS-7.

LS-9: Revised lift station foundation and location of antenna tower.

LS-14: Revised electrical plan notes.

LS-15: Revised note 8 for owner furnished antenna equipment and deleted station hand/auto and start/stop push button.

LS-16: Added note to generator to ground per NEC code.

LS-17: Deleted station hand/auto. Deleted start/stop push buttons. Added pilot lights.

LS-18: Revised conduit and box schedule.

LS-21: Revised generator pad detail. Revised free standing control panel detail.

LS-22: Revised antenna base.

W-7: An additional fire hydrant and associated fittings have been added to the 3000-block of Thorp Street.

W-10: Updating material estimates based on changes to sheet W-7.

Please acknowledge this addendum on page E1 of the contract documents and/or in Section E: Bidder's Acknowledgement on Bid Express.

Electronic version of these documents can be found on the Bid Express web site at:

<http://www.bidexpress.com>

If you are unable to download plan revisions associated with the addendum, please contact the Engineering office at 608-266-4751 receive the material by another route.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert Phillips". The signature is stylized with large, flowing loops.

Robert F. Phillips, P.E.
City Engineer

RFP-AJZ

ARTICLE 1000 SANITARY SEWER LIFT STATION SPECIAL PROVISIONS

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of the City's Standard Specifications shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS (NONE)

1.03 DESCRIPTION OF WORK

- A. Provide quality control for all work performed under this contract as described in this section.

1.04 RELATED WORK ELSEWHERE

- A. Structural Excavation for Structures – Division 31

1.05 SUBMITTALS (NONE)

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

1.07 QUALITY ASSURANCE

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

ARTICLE 1000 SANITARY SEWER LIFT STATION SPECIAL PROVISIONS

1.08 TOLERANCES

- A. Monitor tolerance control of installed products to produce acceptable work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.09 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. The contractual relationship, duties, and responsibilities of the parties in Contract nor those of the Engineer shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.10 INSPECTING AND TESTING LABORATORY SERVICES

- A. Contractor shall be responsible for concrete testing as outlined in Section 01 45 16.11 and Division 03 of these specifications. For other testing not related to defective work issues, Owner will appoint, contract, and pay for the services of an independent firm to perform inspecting and testing.
- B. Geotechnical services and soil testing shall be required to meet performance requirements specified in Divisions 31, and 33 and in other Sections related to this work. Geotechnical services and soil testing shall be procured and paid for by the Owner.
- C. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by the Engineer or the Owner.
- D. Inspecting, testing, and source quality control may occur on or off the project site. Perform off-site inspecting or testing as required by the Engineer or the Owner.

ARTICLE 1000 SANITARY SEWER LIFT STATION SPECIAL PROVISIONS

- 1 E. Reports will be submitted by the independent firm to the Engineer indicating
2 observations and results of tests and indicating compliance or non-compliance with
3 Contract Documents.

- 4 F. Cooperate with independent firm; furnish samples of materials, design mix,
5 equipment, tools, storage, safe access, and assistance by incidental labor as
6 requested.
 - 7 1. Notify Engineer and independent firm 24 hours prior to expected time for
8 operations requiring services.
 - 9 2. Make arrangements with independent firm and pay for additional samples
10 and tests required for Contractor's use.

- 11 G. Testing or inspecting does not relieve Contractor from the responsibility to perform
12 Work to contract requirements.

- 13 H. Retesting required because of non-conformance to specified requirements shall be
14 performed by the same independent firm on instructions by the Engineer. Payment
15 for retesting will be charged to the Contractor by deducting inspecting or testing
16 charges from the Contract Sum/Price.

17 1.11 MANUFACTURERS' FIELD SERVICES AND REPORTS

- 18 A. When specified in individual specification sections, require material or product
19 suppliers or manufacturers to provide qualified staff personnel to observe site
20 conditions, conditions of surfaces and installation, quality of workmanship, start-up
21 of equipment, and test, adjust and balance of equipment as applicable, and to initiate
22 instructions when necessary.

- 23 B. Report observations and site decisions or instructions given to applicators or
24 installers that are supplemental or contrary to manufacturers' written instructions.

- 25 C. Submit report within 30 days of observation to Engineer for information.

26 PART 2 PRODUCTS AND MATERIALS (N/A)

27 PART 3 CONSTRUCTION METHODS (N/A)

28 PART 4 MEASUREMENT AND PAYMENT (N/A)

29

30

END OF SECTION

1 SECTION 01 45 16.11

2
3 CONCRETE QUALITY CONTROL

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover sampling and testing of concrete to
7 determine the materials conformance and work conformance to the requirements
8 specified for cast-in-place concrete.

9 1.02 RELATED WORK ELSEWHERE

- 10 A. Concrete Accessories - Division 03
11 B. Cast-in-Place Concrete - Division 03

12 1.03 APPLICABLE PROVISIONS

- 13 A. Applicable provisions of Division 01 shall govern work of this section.

14 1.04 APPLICABLE PUBLICATIONS

- 15 A. The following publications of the issues listed below, but referred to thereafter by
16 basic designation only, form a part of this specification to the extent indicated by the
17 reference thereto.

- 18 1. American Society for Testing and Materials (ASTM), Annual Book of
19 ASTM Standards:
20 a. ASTM C31 - Standard Practice for Making and Curing Concrete Test
21 Specimens in the Field, Current Edition.
22 b. ASTM C39 - Standard Test Method for Compressive Strength of
23 Cylindrical Concrete Specimens, Current Edition.
24 c. ASTM C42 - Standard Test Method for Obtaining and Testing
25 Drilled Cores and Sawed Beams of Concrete, Current Edition.
26 d. ASTM C78 - Standard Test Method for Flexural Strength of Concrete
27 (Using Simple Beam with Third-Point Loading), Current Edition.
28 e. ASTM C114 - Standard Test Methods for Chemical Analysis of
29 Hydraulic Cement, Current Edition.
30 f. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement
31 Concrete, Current Edition.
32 g. ASTM C172 - Standard Practice for Sampling Freshly Mixed
33 Concrete, Current Edition.
34 h. ASTM C173 - Standard Test Method for Air Content of Freshly
35 Mixed Concrete by the Volumetric Method, Current Edition.

- 1 i. ASTM C183 - Standard Practice for Sampling and the Amount of
- 2 Testing of Hydraulic Cement, Current Edition.
- 3 j. ASTM C186 - Standard Test Method for Heat of Hydration of
- 4 Hydraulic Cement, Current Edition.
- 5 k. ASTM C187 - Standard Test Method for Normal Consistency of
- 6 Hydraulic Cement, Current Edition.
- 7 l. ASTM C188 - Standard Test Method for Density of Hydraulic
- 8 Cement, Current Edition.
- 9 m. ASTM C192 - Standard Practice for Making and Curing Concrete
- 10 Test Specimens in the Laboratory, Current Edition.
- 11 n. ASTM C219 - Standard Terminology Relating to Hydraulic Cement,
- 12 Current Edition.
- 13 o. ASTM C231 - Standard Test Method for Air Content of Freshly
- 14 Mixed Concrete by the Pressure Method, Current Edition.
- 15 p. ASTM C470 - Standard Specification for Molds for Forming
- 16 Concrete Test Cylinders Vertically, Current Edition.
- 17 q. ASTM C823 - Standard Practice for Examination and Sampling of
- 18 Hardened Concrete in Constructions, Current Edition.
- 19 r. ASTM E329 - Standard Specification for Agencies Engaged in
- 20 Construction Inspection and/or Testing, Current Edition.

21 PART 2 PRODUCTS AND MATERIALS (N/A)

22 PART 3 CONSTRUCTION METHODS

23 3.01 TESTING FOR ACCEPTANCE

- 24 A. Samples of concrete shall be delivered to a location on the site where material
- 25 conformance tests can be performed.
- 26 1. Samples of concrete shall be obtained in accordance with ASTM C172.
- 27 2. Test specimens shall be stored without being disturbed for the first 24 hours.
- 28 3. Sampling and Testing. An independent testing laboratory, engaged and paid
- 29 for by the Owner, shall conduct tests on the proposed concrete mixture to
- 30 determine the slump, entrained air content, compressive strength, or other
- 31 appropriate tests to determine conformance with these specifications.

- 32 B. Contractor shall cooperate with independent firm; furnish samples of materials,
- 33 design mix, equipment, tools, storage, safe access, and assistance by incidental labor
- 34 as requested.
- 35 1. Notify Engineer and independent firm 24 hours prior to expected time for
- 36 operations requiring services.
- 37 2. Make arrangements with independent firm and pay for additional samples
- 38 and tests required for Contractor's use.

- 39 C. Slump and Air Content Tests

1. Slump tests shall be made in accordance with ASTM C143. Air content tests shall be made in accordance with ASTM C173 or ASTM C231. Slump tests and air tests shall always be performed from the same batch from which strength tests are performed.
2. If the measured slump or air content falls outside the limits specified, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the requirements of the specifications and shall not be used in the work.

D. Strength Tests (Contractor's Sampling and Testing for Acceptance). Results from tests conducted by the Contractor shall be considered evidence of compliance of Contractor's materials used in the work, when strength is used as the basis for acceptance.

1. Cylinders for strength tests shall be made in accordance with ASTM C31. During the first 24 hours all test specimens shall be covered and kept at air temperatures between 60 Degrees Fahrenheit and 80 Degrees Fahrenheit in facilities provided on the job site by the Contractor. At the end of 24 hours, specimens will be carefully transported to the testing laboratory, where molds shall be removed, and cylinders shall be cured in a moist condition at 73.4 Degrees Fahrenheit \pm 3.0 Degrees Fahrenheit until time of test.
2. A strength test for any class of concrete shall consist of four standard cylinders made from a composite sample secured from a single load of concrete in accordance with ASTM C172, with one cylinder tested at 7 days, two at 28 days, and the fourth used as a spare. The test results at 28 days shall be the average of the strength of two specimens determined in accordance with ASTM C39, except that if one specimen in a test shows manifest evidence of improper sampling, molding or testing, it shall be disregarded and the spare cylinder shall be tested.

E. Strength Test (For Early Formwork or Shoring Removal). If the Contractor wishes to remove formwork or shoring prior to the minimum time as specified in Structural Cast-In-Place Concrete Forming - Division 03, they shall, at their expense, prepare test cylinders as evidence of concrete strength as follows:

1. Cylinders shall be made in accordance with ASTM C31. During the period of time from completion of the pour to removal of protective cover and stripping of forms, all test specimens shall be kept with the pour and be subjected to ambient conditions resulting from the curing and protection facilities provided on the job site by the Contractor. At the end of this period, specimens will be carefully transported to the testing laboratory, where molds shall be removed and cylinders shall be stored in outdoor ambient conditions to simulate on job site conditions until time of test.
2. A minimum of two cylinders made from a composite sample secured from a single load of concrete in accordance with ASTM C172. The test results shall be the average of the strength of two specimens determined in accordance with ASTM C39, except that if one specimen in a test shows

1 manifest evidence of improper sampling, molding or testing, it shall be
2 disregarded.

3 3.02 SELECTION OF TESTING LABORATORY

4 A. An independent testing laboratory to perform Concrete Quality Control shall meet
5 the requirements of ASTM E329. The laboratory shall be selected by the Owner.

6 3.03 TEST REPORTS

7 A. Test reports will be directly distributed by the laboratory to the Owner, Engineer, and
8 Contractor.

9 3.04 TESTING REQUIREMENTS

10 A. Tests shall be required to perform one test for each 50 cubic yards of concrete
11 poured, or fraction thereof, for each class of concrete used. Each test shall consist of
12 four (4) cylinders; one (1) to be tested at seven (7) days, two (2) to be tested at
13 twenty-eight (28) days, and one (1) to be a spare.

14 B. Compliance testing shall be performed on every single load, or portion thereof,
15 where water addition to the single load, or portion thereof, takes place on site.

16 C. A minimum of one (1) test shall be performed per day for each class of concrete
17 placed.

18 3.05 CONDITIONS OF COMPLIANCE AND NON-COMPLIANCE

19 A. Compliance of Contractor's Materials Used in the Work.

20 1. To conform to the requirements of this specification, every 28-day test
21 representing each mix must be equal to or greater than the specified
22 minimum strength without exception. If a specimen shows manifest
23 evidence of improper sampling, molding, or testing, it will be disregarded.
24 Note, however, that the anticipated strength for all mixes is appreciably
25 above the specified minimum strength due to quality required by the water-
26 cement ratio specified.

27 B. Non-Compliance of Contractor's Materials Used in the Work

28 1. When strength is used as the basis for acceptance, should individual tests of
29 the Contractor's specimens produce strengths less than 90% of the specified
30 strength ($f'c$), tests of cores drilled from the area in question may be required
31 in accordance with ASTM C42. Three cores shall be taken for each cylinder
32 test less than 90% of the specified strength ($f'c$). If the concrete in the
33 structure will be dry under service conditions, the cores shall be air dried
34 (temperature 60 to 80°F, relative humidity less than 60 percent) for seven (7)
35 days before test and shall be tested dry. If the concrete in the structure will

1 be more than superficially wet under service conditions, the cores shall be
2 immersed in water for at least 48 hours and tested wet.

- 3 2. Concrete represented by the core tests will be considered structurally
4 adequate and meet the requirements of this specification if the average of the
5 three cores is equal to at least 95 percent of the specified strength (f'c) and if
6 no single core is less than 90 percent of f'c. To check testing accuracy,
7 locations represented by erratic core strengths may be retested. If these
8 strength acceptance criteria are not met by the core tests, the Engineer shall
9 order appropriate action at no additional cost to the Owner.

10 PART 4 MEASUREMENT AND PAYMENT

11 4.01 GENERAL

- 12 A. All work specified herein shall be considered in the measurement and payment
13 method stipulated.

14 4.02 CONCRETE QUALITY CONTROL

- 15 A. Concrete Quality Control, Inclusive. All required sampling, preparing of specimen
16 and testing, except as modified by these specifications shall be performed by an
17 independent testing laboratory engaged and paid for by the Owner. Contractor shall
18 assist the independent laboratory by making the site and sampling locations
19 accessible for the specified testing. All costs shall be inclusive to the lump sum bid
20 item for the Lift Station.

21 B. Additional Testing.

- 22 1. The cost of any additional testing required because of failure of concrete to
23 meet specification requirements shall be borne by the Contractor for tests
24 which fail to comply with the specifications. All tests required under
25 Paragraph 3.05 "Conditions of Compliance and Non-Compliance", above
26 shall be borne by the Contractor.
27

28 END OF SECTION

SECTION 01 73 00

EXECUTION

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS (NONE)

1.03 DESCRIPTION OF WORK

A. The Work included under this section is related to the replacement of the James Street Lift Station as specified herein.

B. The Contractor shall be responsible for performing the work according to a sequence of construction that will not adversely affect the continued operation, performance, or reliability of the sewage conveyance systems and related systems during construction. The Contractor shall provide temporary facilities, including bypass pumping equipment and bypass piping as necessary to ensure that the existing sewage conveyance system continues to provide service required during the construction of the new facilities. If interruption of sewage conveyance systems or power outage is proposed/required, the Contractor shall provide temporary facilities to replace the disrupted operations.

1. The Contractor will be responsible to provide and operate all temporary pumps, automatic controls, equipment, and temporary piping to maintain operation of the existing wastewater conveyance facility during construction and implement phased construction in the recommended sequence.

C. The Work includes selective demolition and the replacement of the existing Lift Station, controls, electrical services, sanitary sewer, force main, various equipment and piping, along with the demolition of the existing structures, and the construction of new structures, equipment and piping that will impact the operation of the existing facilities.

D. Contractor shall provide manpower, labor, and equipment as needed to implement the start-up of newly constructed and modified facilities and implement the shutdown of existing facilities one-at-a-time prior to construction modifications.

1.04 RELATED WORK ELSEWHERE

A. All Sections of this Project Manual

1.05 SUBMITTALS

A. Where the work impacts the operation of the existing facilities and new construction, the Contractor shall submit a detailed sequence of construction and daily schedule

1 that demonstrates the ability to maintain the necessary reliability and performance of
2 the sewage conveyance system. Where temporary facilities are required, the
3 Contractor shall submit detail of the equipment and materials that will be provided to
4 ensure the reliability and performance of the facilities.

5 1.06 CRITICAL DELIVERY OF EQUIPMENT AND MATERIALS

- 6 A. No extra time or additional costs will be allowed by the Owner for any cause for
7 delay in the delivery of products, materials, and equipment required in this Project.

8 1.07 OPERATION/MAINTENANCE MANUALS AND INSTRUCTION (NONE)

9 PART 2 PRODUCTS AND MATERIALS (N/A)

10 PART 3 CONSTRUCTION METHODS

11 3.01 SEQUENCE OF CONSTRUCTION

- 12 A. The following sequence of construction is included as a guide for the Contractor for
13 construction of the lift station and forcemain. Contractor may need to consider other
14 factors in the overall sequence and schedule that are not discussed in the Section but
15 are specified in the Contract Documents.

- 16 B. The Contractor is responsible for their sequence of construction and the construction
17 schedule. The Contractor shall clearly define their intended sequence of construction
18 in the submitted construction schedule. The intent of the following sequence of
19 construction is to ensure the continued performance and reliability of the existing
20 facilities during construction and to ensure the successful start-up of all new
21 facilities. Deviations from the following sequence of construction shall be identified
22 by the Contractor at the Pre-Construction Meeting for discussion and approval by
23 Owner and Engineer.

24 C. Suggested Sequence of Construction

- 25 1. Removal and Replacement of Sanitary Sewer on East James Street (3100
26 block)
27 a. Remove/Replace Sanitary Sewer beginning at SAS#1 until
28 approximately 17+50. Connect all laterals to new Sanitary Sewer.
29 b. Relocate lateral for residence at 3137 James Street
30 c. Provide temporary sanitary sewer to connect SAS #1 into existing lift
31 station.
32 2. Relocate watermain on James Street
33 3. Construct the proposed Forcemain on James Street
34 a. Construct proposed forcemain beginning at approximately STA.
35 15+75 to STA. 22+60.96 including construction of SAS #100.
36 b. Install temporary piping and connection for use with bypass pumping
37 equipment at STA. 15+75.

- 1 4. Complete remaining utility work as specified in the Contract Documents
- 2 5. Install Temporary Bypass Pumping System
- 3 a. Install temporary bypass pumps in SAS #1. A minimum of two (2)
- 4 pumps shall be utilized including automated operation with a float
- 5 tree. Contractor shall submit information on pump model, capacity,
- 6 and proposed layout.
- 7 b. Pumps shall be connected through temporary piping to the new
- 8 forcemain. Contractor shall utilize quick-connects, isolation valves,
- 9 and check valves for reliability. Contractor shall submit the proposed
- 10 bypass piping layout for review by the Owner and Engineer.
- 11 c. Temporary pumping system shall remain in-place until the new lift
- 12 station is commissioned.
- 13 6. Demolish Existing Lift Station
- 14 a. Contractor shall provide a minimum of seven (7) days' notice to the
- 15 Owner prior to beginning demolition of the existing lift station.
- 16 Contractor shall disconnect all utilities from existing lift station prior
- 17 to beginning demolition.
- 18 7. Construct new Lift Station
- 19 8. Construct remaining proposed forcemain from new lift station to forcemain
- 20 previously installed to STA 15+75.
- 21 9. Start up, and test the new lift station including pumps, controls and standby
- 22 generator.
- 23 10. Discontinue and disconnect Temporary Bypass Pumping System after the
- 24 new lift station is commissioned.
- 25 a. Commissioning of new lift station shall include all controls, back-up
- 26 power, monitoring, alarms, and telemetry.
- 27 D. Utilities (new water, gas and electric service) associated with lift station and
- 28 generator structures shall be installed and operational for start-up of new pollution
- 29 control equipment and prior to abandonment and/or demolition of existing utilities in
- 30 accordance with the demolition plan.
- 31 E. The Contractor shall coordinate all work to be completed without disruption to the
- 32 collection and pumping of sewage. Contractor shall not cause a sewer system
- 33 overflow, or back-up of the sewage system. Contractor is responsible for all costs
- 34 that may be incurred due to a disruption in the collection and pumping of sewage.

35 PART 4 MEASUREMENT AND PAYMENT

36 4.01 EXECUTION

- 37 A. General. Execution of the project shall be paid for at the bid price in accordance
- 38 with one of the following methods, unless indicated otherwise in the Bid Schedule or
- 39 Special Provisions.
- 40 1. Execution, Inclusive. All costs associated with execution of the project in a
- 41 manner that ensures the continued performance and reliability of the sewage

1 conveyance systems shall be included in the Lump Sum bid price for the Lift
2 Station.

3 END OF SECTION
4

SECTION 02 41 16

STRUCTURE DEMOLITION

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.

1. American National Standards Institute (ANSI) Specifications and Standards:
 - a. ANSI A10.6 - Safety Requirements for Demolition, Current Edition.
2. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational Safety and Health Administration (OSHA), Department of Labor, Part 1926 Regulations, Current Edition.

1.03 DESCRIPTION OF WORK

A. The work under this section shall cover furnishing all materials, equipment, tools, labor and supervision necessary to remove equipment, adapt for new equipment, and dispose of unused materials as indicated upon contract drawings and as specified herein.

B. Comply with applicable rules, regulations, codes, and ordinances of local, state, and federal authorities including ANSI A10.6, Safety Requirements for Demolition.

C. Contractor shall sequence work to enable uninterrupted operation of the facility to the extent of practical limits, and as determined by Engineer.

1.04 RELATED WORK ELSEWHERE

A. Article 203 -- Removal of Miscellaneous Structures

B. Packaged Sewage Lift Station -- Division 33

1.05 SUBMITTALS

A. Submit detailed sequence of operation for structure demolition and removal work in accordance with City submittal to ensure minimum interruptions of Owner's operations. Submit timeline indicating removal and placement of proposed equipment.

B. Submit detailed information for weather protection, dust protection, openings required if any in protection walls, sealing system for perimeter of opening and wall.

- 1 C. Submit certificates and/or letters as evidence of discontinuation of services to
2 building or structure requiring removal from appropriate agencies and evidence of
3 discontinuation of water or electrical lines used for structure demolition purposes.

4 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

5 PART 2 PRODUCTS AND MATERIALS

6 2.01 EQUIPMENT

- 7 A. Use normal equipment for structure demolition purposes which meet all safety
8 requirements imposed on such equipment.

9 2.02 REMOVAL OF ITEMS

- 10 A. Items noted to be turned over to Owner shall be delivered to location on property
11 where designated by Owner.

- 12 B. Refer to contract drawings and Special Provisions for a list of items to be removed.

13 2.03 ITEMS FOR STORAGE

- 14 A. Items noted for storage shall be delivered to location on site at Contractor's
15 discretion until reincorporated into the Work.

16 PART 3 CONSTRUCTION METHODS

17 3.01 GENERAL

- 18 A. Conditions existing at time of inspection for bidding purposes will be maintained by
19 the Owner to the extent practicable. Owner shall have the right to salvage any
20 existing equipment and furnishings.

- 21 B. Owner assumes no responsibility for subsurface conditions on site. Become familiar
22 with subsurface conditions at the site. Owner assumes no responsibility for actual
23 conditions of structures and appurtenances to be demolished. Become familiar with
24 actual condition of structures and appurtenances.

- 25 C. Perform structure demolition work required in connection with this project with due
26 care, including shoring and bracing. Be responsible for any damage which may be
27 caused by such work to any part or parts of existing building which is to remain.
28 Where necessary to prevent collapse of any construction, install temporary shores,
29 struts, or bracing. Do not commence structure demolition work until all temporary
30 construction is complete.

1 3.02 POLLUTION CONTROLS

- 2 A. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust
3 and dirt rising and scattering in air to lowest level practical. Clean adjacent
4 structures and improvements of dust, dirt, and debris caused by structure demolition
5 operations. Return adjacent areas to condition existing prior to start of the work.
- 6 B. Comply with governing regulations pertaining to environmental protection.

7 3.03 BELOW-GRADE DEMOLITION

- 8 A. Demolish and remove below-grade wood, metal construction, and floor construction
9 as directed upon contract drawings. Demolish all abandoned structures to a depth of
10 not less than 24 inches below the existing ground surface, or 24 inches below
11 planned finish grade, whichever is lower.
- 12 B. All abandoned structures or tanks which could hold moisture shall have drain holes
13 cut through the bottom, or the structures or tanks shall be otherwise breached to
14 allow moisture to pass.
- 15 C. Cap, with appropriate thrust restraint, all abandoned piping and conduit for a
16 complete, permanent abandonment. Provide thrust restraint with a poured concrete
17 reaction block in accordance with the contract drawings.
- 18 D. Completely fill below-grade areas and voids resulting from demolition. Use
19 satisfactory soil materials consisting of stone, gravel, and sand, free from debris,
20 trash, frozen materials, roots and other organic matter. Prior to placement of fill
21 materials, ensure that areas to be filled are free of standing water, trash and debris.
22 Place fill materials in horizontal layers not exceeding 6 inches in loose depth.
23 Compact each layer at optimum moisture content of fill material to a density equal to
24 original adjacent ground, unless subsequent excavation for new work is required.
- 25 E. Coordinate activities to permit access by other trades required for the work, enabling
26 them to complete work which is assigned to them. Accomplish all work required by
27 contract drawings, including work specifically noted plus additional work related to
28 specific work noted.

29 3.04 SELECTIVE DEMOLITION

- 30 A. Demolish masonry and concrete in small sections. Use braces and shores as
31 necessary to support the structure of the building and protect it from damage. Where
32 limits of demolition are exposed in the finish work, cut with saws, providing a
33 straight line, plumb, true, and square.
- 34 B. Disconnect services to equipment at unions, flanges, valves, or fittings. Remove
35 and/or demolish plumbing, mechanical, and electrical components not requiring

1 salvage or reuse. Remove and/or demolish to penetration point at floor, ceiling, and
2 wall or surface, as applicable. Cut fire electrical systems in such a manner as to
3 insure continued operation of the systems in remaining buildings.

4 C. Leave exposed existing floor, ceiling, and wall or surface in suitable condition for
5 receiving new finish.

6 3.05 PROTECTION

7 A. Make such explorations and probes as necessary to ascertain any required protection
8 measures before proceeding with demolition and removal work. Provide protection
9 for workmen, public, adjacent construction, and occupants of existing building(s).
10 Provide protection for adjacent private property. Promptly repair damages caused to
11 adjacent facilities at no cost to Owner.

12 B. Provide and maintain adequate catch platforms, warning lights, barricades, guards,
13 weather protection, dust protection, fences, planking, bracing, shoring, piling, signs,
14 and other items required for proper protection.

15 C. Explosives shall not be used. Use no equipment or methods of operation which will
16 cause damage to adjoining buildings either by direct contact or by transmission.

17 3.06 UTILITY SERVICES

18 A. Maintain existing utilities indicated to remain, keep in service, and protect against
19 damage during demolition operations.

20 3.07 DISPOSAL

21 A. Remove all disposable material and equipment indicated and properly dispose of at
22 off-site location of Contractor's choice. Storage of disposable materials and
23 equipment on site shall not be permitted.

24 B. Burning of debris on site is not permitted.

25 3.08 RESTORATION

26 A. Restore the site after demolition operations are complete.

27 B. Restore interior and exterior building surfaces with similar materials and to a
28 condition equal to or better than previously existed. Refer to the finish schedules of
29 the contract drawings and specifications for materials and finishes specified.

30 C. Restore site with similar materials, and to a condition equal to or better than
31 previously existed. Perform grading in accordance with final grading requirements
32 as indicated on the contract drawings.

- 1 1. Grading tolerances shall be as indicated in contract drawings and City
2 specifications.
3 2. Restore turf areas disturbed.
4 3. Restore pavement or sidewalk areas disturbed.
- 5 D. Provide temporary erosion control measures until such time as permanent restoration
6 no longer requires these measures, and as directed by the Engineer.

7 PART 4 MEASUREMENT AND PAYMENT

8 4.01 GENERAL

- 9 A. Structure demolition shall be paid for at the bid price in accordance with one of the
10 following methods, unless indicated otherwise in the Bid Schedule or Special
11 Provisions.
- 12 B. All work specified herein shall be considered in each of the measurement and
13 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or
14 Special Provisions.

15 4.02 STRUCTURE DEMOLITION

- 16 A. Structure Demolition, Inclusive. Structure demolition related to the Lift Station as
17 shown on the contract drawings and as outlined in the Project Manual shall be
18 considered inclusive to payment for work associated with Sanitary Sewer Lift
19 Station, per Lump Sum.
20

21 END OF SECTION

1 SECTION 03 11.13

2
3 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

6 A. The work covered under this section shall consist of furnishing all materials,
7 equipment and labor required to furnish all formwork for cast-in-place concrete as
8 shown on the contract drawings and specified herein.

9 B. The work shall include formwork, shoring for cast-in-place concrete, and installation
10 into formwork of items by other such as anchor bolts, setting plates, bearing plates,
11 anchorages, inserts, frames, nosings and other items to be embedded in concrete.

12 1.02 RELATED WORK ELSEWHERE

13 A. Concrete Accessories - Division 03

14 B. Concrete Reinforcing - Division 03

15 C. Cast-in-Place Concrete - Division 03

16 1.03 APPLICABLE PROVISIONS (NONE)

17 1.04 APPLICABLE PUBLICATIONS

18 A. The following publications of the issues listed below, but referred to thereafter by
19 basic designation only, form a part of this specification to the extent indicated by the
20 reference thereto.

- 21 1. American Concrete Institute (ACI) Annual Book of ACI Standards:
22 a. ACI 117/177R - Specifications for Tolerances for Concrete
23 Construction and Materials and Commentary, Current Edition.
24 b. ACI 347 - Guide to Formwork for Concrete, Current Edition.
25 c. ACI SP-4 - Formwork for Concrete, Current Edition.
26 2. American Plywood Association (APA) Specifications and Standards:
27 a. APA PS1 - Plywood Design Specification, Current Edition.

28 PART 2 PRODUCTS AND MATERIALS

29 2.01 DESIGN

30 A. The design and engineering of the formwork and its accessories shall be the
31 responsibility of the Contractor. Formwork shall be designed, erected, supported,
32 braced and maintained so as to safely support all vertical and lateral loads until such
33 loads can be supported by the concrete structure.

1 B. Determination of loads and design shall be in accordance with ACI 301 and ACI
2 347.

3 2.02 FORMS

- 4 A. Forms may be wood, plywood, concrete-form-grade hardboard, metal or other
5 acceptable material which will produce smooth, true surfaces.
6 1. Provide lumber dressed on at least two edges and one side for tight fit.
7 2. Metal forms shall have smooth surfaces free from any pattern, irregularities,
8 dents, bends and sags.

9 2.03 SHORING

- 10 A. All shoring members shall be of such design and material to safely support all dead
11 and working loads throughout the placing and curing period. Shoring shall be placed
12 to prevent sagging and settlement.

13 2.04 FORM TIES AND ACCESSORIES

- 14 A. Form ties shall be factory-fabricated, adjustable-length, removable or snapoff metal,
15 designed to prevent form deflection, and to prevent spalling concrete surfaces upon
16 removal.
17 B. For exposed concrete surfaces, provide ties so that the portion remaining with the
18 concrete after removal is 1 inch to 1-1/2 inches inside the finished face of the
19 concrete.
20 C. Unless otherwise indicated, provide form ties which will not leave holes larger than 1
21 inch in diameter in concrete surfaces.

22 2.05 FORM COATING COMPOUND

- 23 A. Form coating compound shall be a commercial formulation that will not bond with,
24 stain, nor adversely affect concrete surfaces and not impede the wetting of surfaces
25 to be cured with water or curing compounds. Forms for concrete surfaces requiring
26 subsequent treatment shall receive a type of coating that will not impair bond or
27 adhesion.
28 B. Form coating compound for steel forms shall conform with all requirements stated
29 above and shall be of rust-preventative type.

30 PART 3 CONSTRUCTION METHODS

31 3.01 GENERAL

- 32 A. Responsibility. The design and construction of formwork shall be the sole
33 responsibility of the Contractor.

- 1 B. Earth forms are not acceptable or permitted.
- 2 C. Construct forms to the exact sizes, shapes, lines and dimensions shown, as required
3 to obtain accurate alignment, location, grades, level and plumb in finished
4 construction and to maintain tolerances in accordance with ACI 301. Provide for
5 openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets,
6 chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features
7 required. Chamfer all corners of concrete exposed to view using chamfer strips. Use
8 selected materials to obtain required finishes.
- 9 D. Forms shall be sufficiently tight to prevent leakage of concrete. Temporary openings
10 shall be provided in the inside form of all wall forms and in column forms to
11 facilitate cleaning and inspection immediately before placing concrete.
- 12 E. Assemble forms so their removal will not damage concrete and adjacent materials.

13 3.02 FORMWORK

- 14 A. Forms shall conform in general to shape, line, grade and dimensions of members as
15 shown on contract drawings, and shall have the strength and stability to insure
16 finished concrete within the tolerances specified in ACI 347.
- 17 1. Provide openings in concrete formwork to accommodate work of other
18 trades. Determine size and location of openings, recesses and chases from
19 those other trades.
- 20 2. Exterior edges of all exposed concrete, unless otherwise specified, shall have
21 a chamfer strip placed in form to provide bevel of sharp edges. Chamfer
22 strips shall be 3/4-inch by 3/4-inch by 45° wood, plastic, or rubber.
- 23 3. Accurately place and secure in position, prior to placing concrete, all
24 anchors, bolts, inserts and other items furnished under other sections of the
25 specifications and for other contractors on the project.
- 26 B. Formwork shall be mortar-tight and sufficiently rigid to prevent displacement or
27 sagging between supports.
- 28 C. Formwork shall be properly braced or tied together so as to maintain position and
29 shape and insure safety to workman and passersby.
- 30 D. Temporary openings may be provided on all wall and column forms to limit the free
31 fall of the concrete to less than 4 feet and should be so located as to facilitate the
32 placing and consolidation of the concrete. The ports shall be spaced no more than
33 6 feet apart to limit the horizontal flow of concrete.
- 34 E. All forms shall be cleaned and rubbed smooth prior to placing to insure true forming
35 surfaces for all concrete surfaces.

1 3.03 FORM TIES AND ACCESSORIES

- 2 A. Internal wall ties shall contain positive stops at the required wall thickness. The
3 exterior clamp portions of the pipe shall be adjustable to permit tightening of forms.
4 Ties shall provide a positive disconnection 1 inch to 1-1/2 inches inside the finished
5 face of the concrete. Cutting ties back from face of wall or use of wire ties will not
6 be permitted. All tie and plug holes shall be filled with non-shrink grout after forms
7 are removed.
- 8 B. All concrete tie locations shall be watertight. Wall ties shall be fitted with tapered
9 rubber plugs at all locations.
- 10 C. Accessories shall be used only for the purpose intended and shall in no way interfere
11 with the placing of concrete. Removal of accessories shall in no way impair or
12 disturb finish concrete surfaces. Accessories shall be compatible with formwork and
13 ties and shall maintain the watertight integrity of the formwork system.
- 14 D. Design of all form ties and accessories shall be adequate for all concrete placement,
15 horizontal and vertical, to prevent failures and blowouts.

16 3.04 FORM COATINGS

- 17 A. Coat form contact surfaces with form bond breaker compound before reinforcement
18 is placed. Do not allow excess form coating material to accumulate in the forms or
19 to come into contact with surfaces against which fresh concrete will be placed.
20 Apply in compliance with manufacturer's instructions.
- 21 B. Coat steel forms with form oil or otherwise protect against rusting. Rust-stained
22 steel formwork is not acceptable.
- 23 C. Clean reinforcing steel that has become contaminated with form coating to the
24 satisfaction of the Engineer prior to placing concrete.

25 3.05 EMBEDDED ITEMS

- 26 A. Items embedded in concrete shall be properly cleaned to be free from oil or foreign
27 matter that would weaken the bond of the concrete to these items.
- 28 B. Install in the formwork requisite inserts, anchors, sleeves and other items specified
29 under other sections of these specifications; close end conduits, piping and sleeves
30 embedded in concrete with caps or plugs.
- 31 C. Conduits or pipes embedded in slabs of larger outside diameter than 1-1/2 inches, or
32 when pipes and conduits come closer than 1 inch from either the upper or lower
33 surface of the slab, provide expanded metal or wire mesh laid and extended beyond
34 conduit or piping at least 8 inches on all sides; space conduits or pipes closer than 3

1 diameters on centers, place to avoid changing locations of reinforcement for
2 indicated locations.

3 3.06 CONSTRUCTION JOINTS

4 A. Make construction joints where indicated on the contract drawings; additional
5 construction joints are subject to prior approval of the Engineer; locate additional
6 construction joints to least impair the strength of the structure.

7 B. Form keyways and joints as indicated on the contract drawings.

8 C. Continue reinforcing steel and wire fabric across construction joints, unless noted
9 otherwise.

10 D. Install joint filler at locations indicated on the contract drawings; extend filler from
11 bottom of concrete; joints shall be carefully cleaned, free from dust, mortar or other
12 loose materials before installation; seal as indicated on the contract drawings.

13 3.07 EXPANSION JOINTS

14 A. Expansion joints shall be placed where indicated on the contract drawings;
15 reinforcement, corner protection angles or other fixed metal items embedded in or
16 banded to continuously shall not extend through expansion joints; finish concrete slab
17 edges along expansion joints neatly with slightly rounded edging tool; leave joints in
18 the completed work carefully tooled and free of mortar and concrete.

19 B. Joints between slabs on earth and vertical surfaces, including columns, piers, walls,
20 machinery foundation and other fixed structures shall have expansion joint material
21 placed on abutting vertical surfaces.

22 C. Joints to receive joint compound shall have premolded expansion filler strips at
23 proper level placed below finished floor with slightly tapered, dressed, oiled wood
24 strip secured temporarily to top thereof; install wood strip of depth to form groove at
25 least 1 inch deep; after concrete has set, remove strip; fill groove with light colored
26 joint compound for poured application; fill joint grooves flush, to be slightly
27 concave, after drying as specified in Joint Sealers - Division 07.

28 3.08 CONTROL JOINTS

29 A. Install vertical control joints as indicated on the contract drawings, and where not
30 indicated not more than 20 feet apart; locate specifically as follows:

31 1. Place not over 10 feet from corners or offsets; where concrete walls change
32 either thickness or height; where change in wall sections occurs.

33 2. At each control joint, extend only alternate horizontal reinforcement bars
34 through the joint; seal control joints with concrete colored joint compound.

- 1 B. Install control (contraction) joints in slabs as indicated on the contract drawings, and
2 where not indicated locate specifically as follows:
3 1. Space at a minimum of 25 feet on center; at each joint, cut reinforcing mesh
4 so only alternate wires extend through joint.
5 2. Resulting panels shall be approximately square; elongated and L-shaped
6 panels shall not be acceptable.
7 3. Provide 1/4 inch wide saw - cut control joints to a depth equivalent to 1/3 the
8 slab thickness; cut as soon as the slab will support the weight of the saw and
9 operator and not damage the surface and not more than 8 hours after
10 completion of concrete placement.
- 11 C. Apply joint compound to all control and construction joints after concrete has
12 sufficiently cured; clean joint slot; fill joint with light colored compound for poured
13 application; fill joint grooves flush, to be slightly concave after drying, as specified
14 in Joint Sealers - Division 07.

15 3.09 FORM/SHORING REMOVAL

- 16 A. Arrange forms to allow stripping without removal of principal shores, where required
17 to remain in place.
- 18 B. Removal of forms shall be accomplished in such a manner as will prevent injury to
19 concrete and insure complete safety of structure. Removal times listed below are
20 minimum and may be increased by the Engineer as job conditions warrant.
21 1. Where structure as a whole is supported on shores, vertical forms such as
22 beam and girder sides, columns, and similar vertical forms may be removed
23 24 hours after completion of pour, providing concrete has hardened
24 sufficiently to sustain its own weight and to prevent injury.
25 2. Wall forms shall not be removed in less than 24 hours after pouring, unless
26 otherwise required for curing.
27 3. Supporting forms and shoring must remain in place until concrete can carry
28 any loads to be imposed upon it and in no case shall be removed in less than
29 seven (7) days.
30 4. Forms ties, requiring any operation in removal of forms which would tend to
31 destroy bond between tie and concrete in order to remove form, shall not be
32 disturbed for seven (7) days after completion of pour.
33 5. The time periods stipulated above may be reduced if strength results of
34 concrete so indicate adequate conditions.
- 35 C. Notify the Engineer before the forms are removed in order that an examination of the
36 newly-stripped surfaces may be made prior to patching.

37 3.10 REPAIR TIE HOLES

- 38 A. After removal of form tie, the holes shall be filled as follows:
39 1. Thoroughly clean and dampen.

1 2. Fill solid with patching mortar.

2 B. Make repairs uniform in color and finish with surrounding concrete.

3 3.11 EXPOSED SURFACES

4 A. Exposed surfaces shall be Carborundum rubbed to take off fins; fill pores, stone
5 pickets, honeycombs, etc., with non shrink grout as follows:

6 1. Repair immediately after form removal and inspection by the Engineer.

7 2. Remove concrete surrounding defect to sound concrete, then wet affected
8 area.

9 3. Brush on bonding agent, mixed and applied in accordance with
10 manufacturer's recommendations.

11 4. Consolidate patch grout and strike off to leave the patch slightly higher than
12 the surrounding surface.

13 5. Finish the repaired area flush with the surrounding area after the patch has
14 been in place for one hour, or as prescribed by the manufacturer.

15 B. Perform patching before curing compound is applied; cure patched areas in the same
16 manner as adjacent concrete; make repairs uniform in color and finish with
17 surrounding concrete.

18 C. Exposed surfaces shall be protected from excessive sun, wind and rain, and kept wet
19 until curing compound is applied. When ambient temperature falls below 40°F heat
20 aggregate and mixing water; clear all forms, reinforcement and subgrade of snow and
21 ice; cover all freshly placed concrete with tarpaulins, and provide heat to maintain a
22 temperature of 70°F for at least three days or 50°F for five days; rate of cooling after
23 end of protection period shall be accomplished in a manner approved by the
24 Engineer.

25 3.12 REUSE OF FORMS

26 A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed,
27 delaminated or otherwise damaged form facing material will not be acceptable.
28 Apply new form coating compound material to concrete contact surfaces as specified
29 for the new formwork.

30 B. When forms are extended for successive concrete placement, thoroughly clean
31 surfaces, remove fins and laitance, and tighten forms to close all joints. Align and
32 secure joints to avoid offsets.

33 C. Do not use "patched" forms for concrete surfaces exposed to view.

1 PART 4 MEASUREMENT AND PAYMENT

2 4.01 GENERAL

3 A. Structural cast-in-place concrete forming shall be paid for at the bid price in
4 accordance with one of the following methods, unless indicated otherwise in the Bid
5 Schedule.

6 B. All work specified herein shall be considered in each of the measurement and
7 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule.

8 4.02 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

9 A. Structural Cast-in-Place Concrete Forming, Inclusive. When no quantity is provided,
10 structural cast-in-place concrete forming shall be considered inclusive to payment for
11 work associated with cast-in-place concrete.

12

13

END OF SECTION

1 SECTION 03 15 00

2
3 CONCRETE ACCESSORIES

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover furnishing and installing concrete accessories
7 as shown on the contract drawings and specified herein.

8 1.02 RELATED WORK ELSEWHERE

- 9 A. Structural Cast-In-Place Concrete Forming - Division 03
10 B. Cast-in-Place Concrete - Division 03

11 1.03 APPLICABLE PROVISIONS (NONE)

12 1.04 APPLICABLE PUBLICATIONS

- 13 A. The following publications of the issues listed below, but referred to thereafter by
14 basic designation only, form a part of this specification to the extent indicated by the
15 reference thereto.

16 1. American Society for Testing and Materials (ASTM), Annual Book of
17 ASTM Standards:

- 18 a. ASTM C171 - Standard Specification for Sheet Materials for Curing
19 Concrete, Current Edition.
20 b. ASTM C272 - Standard Test Method for Water Absorption of Core
21 Materials for Structural Sandwich Constructions, Current Edition.
22 c. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding
23 Systems for Concrete, Current Edition.
24 d. ASTM C882 - Standard Test Method for Bond Strength for Epoxy-
25 Resin Systems Used with Concrete by Slant Shear, Current Edition.
26 e. ASTM D6 - Standard Test Method for Loss on Heating of Oil and
27 Asphaltic Compounds, Current Edition.
28 f. ASTM D297 - Standard Test Methods for Rubber Products -
29 Chemical Analysis, Current Edition.
30 g. ASTM D994 - Standard Specification for Preformed Expansion Joint
31 Filler for Concrete (Bituminous Type), Current Edition.
32 h. ASTM D1751 - Standard Specification for Preformed Expansion
33 Joint Filler for Concrete Paving and Structural Construction
34 (Nonextruding and Resilient Bituminous Types), Current Edition.
35 i. ASTM D1752 - Standard Specification for Preformed Sponge
36 Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete
37 Paving and Structural Construction, Current Edition.

1 2. Federal Specification TTS 227 and TTS 230, Current Edition.

2 1.05 SUBMITTALS

3 A. Contractor shall submit such product literature and catalog cuts of materials to be
4 supplied to the rate these materials to the specifications. Information shall be in
5 conformance with requirements of City submittals.

6 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

7 PART 2 PRODUCTS AND MATERIALS

8 2.01 EXPANSION AND CONTRACTION JOINT FILLER

9 A. Preformed Bituminous. Bituminous expansion and contraction joint filler shall be
10 preformed bituminous strips which complies with ASTM D994.

11 B. Removable Plastic Expansion Joint Cap: Snap-Cap by W.R. Meadows.

12 2.02 BOND BREAKER

13 A. Cast-in-Place Concrete Flatwork. Asphalt impregnated felts, 15 pound.

14 B. Cast-in-Place Concrete Formwork. Non-staining liquid product which imparts a
15 waterproof film to prevent adhesion of concrete and will not leave a paint-impeding
16 coating on the face of the concrete.

17 2.03 WATERPROOF SHEET MATERIAL FOR CURING

18 A. Provide one of the following, complying with ASTM C171: waterproof paper,
19 polyethylene film or polyethylene-coated burlap.

20 B. Use only materials which are resistant to decay when tested in accordance with
21 ASTM E154, as follows:

- 22 1. Polyethylene sheet not less than 6 mils thick; or
23 2. Water resistant barrier paper consisting of heavy papers laminated together
24 with glass fiber reinforcement and overcoated with black polyethylene on
25 each side.

26 2.04 CONCRETE REPAIR COMPOUND

27 A. Concrete repair compound shall be Sonopatch, Sonneborn Building Products;
28 Embeco 411 Mortar, Master Builders, or equal.

29 2.05 PIPE SLEEVES AND ANCHOR BOLTS

30 A. Shall be furnished, installed, and anchored solid in their final location.

1 PART 3 CONSTRUCTION METHODS

2 3.01 INSTALLATION

- 3 A. Install accessories where shown on contract drawings and as specified herein.
- 4 B. Place bond breaker at junctures of slabs-on-grade with vertical walls.
- 5 C. Install expansion joint according to manufacturer's instructions; brace securely to
6 prevent displacement.
- 7 D. Seal all exposed surfaces of expansion and contraction joints with joint sealer
8 (3/4 inch deep and hold 1/8 inch below surface of concrete).

9 PART 4 MEASUREMENT AND PAYMENT

10 4.01 GENERAL

- 11 A. Concrete accessories shall be paid for at the bid price in accordance with one of the
12 following methods, unless indicated otherwise in the Bid Schedule.
- 13 B. All work specified herein shall be considered in each of the measurement and
14 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule.

15 4.02 CONCRETE ACCESSORIES

- 16 A. Concrete Accessories, Inclusive. When no quantity is provided, concrete accessories
17 shall be considered inclusive to payment for work associated with cast-in-place
18 concrete.

19
20

END OF SECTION

1 SECTION 03 20 00

2
3 CONCRETE REINFORCING

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover furnishing and installing concrete reinforcing
7 as shown on the contract drawings and as specified herein.

8 1.02 RELATED WORK ELSEWHERE

- 9 A. Concrete Accessories - Division 03

- 10 B. Cast-in-Place Concrete - Division 03

11 1.03 APPLICABLE PROVISIONS (NONE)

12 1.04 APPLICABLE PUBLICATIONS

- 13 A. The following publications of the issues listed below, but referred to thereafter by
14 basic designation only, form a part of this specification to the extent indicated by the
15 reference thereto.

16 1. American Concrete Institute (ACI) Specifications and Standards:

- 17 a. ACI 315 - Manual of Standard Practice for Detailing Reinforced
18 Concrete Structures, Current Edition.

- 19 b. ACI 318 - Building Code Requirements for Structural Concrete and
20 Commentary, Current Edition.

21 2. American Society for Testing and Materials (ASTM), Annual Book of
22 ASTM Standards:

- 23 a. ASTM A82 - Standard Specification for Steel Wire, Plain, for
24 Concrete Reinforcement, Current Edition.

- 25 b. ASTM A184 - Standard Specification for Welded Deformed Steel
26 Bar Mats for Concrete Reinforcement, Current Edition.

- 27 c. ASTM A615 - Standard Specification for Deformed and Plain
28 Carbon-Steel Bars for Concrete Reinforcement, Current Edition.

- 29 d. ASTM A1064 - Standard Specification for Carbon-Steel Wire and
30 Welded Wire Reinforcement, Plain and Deformed, for Concrete,
31 Current Edition.

32 3. American Association of State Highway Transportation Officials
33 (AASHTO), Specifications and Standards:

- 34 a. AASHTO M182 - Specification for Burlap Cloth Made from Jute or
35 Kenaf, Current Edition

36 4. Concrete Reinforcing Steel Institute (CRSI) Specifications and Standards:

- 37 a. CRSI - Manual of Standard Practice, Current Edition.

- b. CRSI - Recommended Practice for Placing Reinforcing Bars, Current Edition.
- c. CRSI - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature, Current Edition.
- d. CRSI - Recommended Practice for Reinforcing Bar Splices, Current Edition.

1.05 SUBMITTALS

- A. Contractor shall submit such product literature and catalog cuts of materials to be supplied to relate these materials to the specification. Information shall be in conformance with requirements of City submittals.
 - 1. Submit detailed reinforcing drawings prepared in accordance with ACI 315, including bar schedule with bar marks and bends indicated.
 - 2. Comply with CRSI Manual of Standard Practice showing bar schedules, stirrup spacing, diagrams of bent bars and arrangements of concrete reinforcement. Include special reinforcement required at openings through concrete.
 - 3. Verify dimensions and make proper allowance for fitting together work of other trades.
- B. Submit a certification attesting that reinforcing steel meets the requirements of ASTM A615, including Supplementary Requirements S1, and that welded steel wire fabric meets the requirements of ASTM A185.
 - 1. Submit certified copies of mill reports, tensile and bend tests for reinforcing steel on projects where the quantity of reinforcing exceeds 15 tons.
 - 2. For information only, submit manufacturer's data and instruction for proprietary items, including reinforcement and accessories.

PART 2 PRODUCTS AND MATERIALS

2.01 REINFORCEMENT

- A. Steel Bar Reinforcement. Main reinforcing and stirrups; ASTM A615, Grade 60.
- B. Welded Wire Fabric. Welded wire fabric, flat sheets, ASTM A1064, 6x6-W2.9xW2.9, unless otherwise specified or indicated on the contract drawings.
- C. Steel Tie Wire. Steel tie wire, ASTM A82, plain, cold-drawn, 16 gauge or heavier.
- D. Supports For Reinforcement. Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place complying with CRSI Manual of Standard Practice. For slabs on grade where base material will not support chairs, use supports with sand plates or horizontal runners to locate mesh properly in slab.

1 PART 3 CONSTRUCTION METHODS

2 3.01 FABRICATION

- 3 A. Fabricate and place to shapes and dimensions indicated or required to carry out intent
4 of contract drawings and these specifications.
- 5 B. Bends for stirrups and ties shall be made around a pin having a diameter not less than
6 four times the diameter of reinforcing bar. Bends for other bars shall be made around
7 a pin having a diameter not less than six times diameter of bar, except that for bars
8 larger than 1 inch, pin shall be not less than eight times diameter of bar.
- 9 1. Perform cutting and bending in the shop; bend and cut steel cold. Heating of
10 reinforcement will not be permitted. Do not bend or straighten bars in a
11 manner that will injure the material.
- 12 2. Field bending of bars shall not be allowed without the Engineer's approval.
- 13 C. Tagging shall be with metal, linen, or rope fiber tags filled in with machine or
14 waterproof ink. Paper tags shall not be allowed.
- 15 D. Reinforcing bars shall conform accurately to the dimensions shown on the contract
16 drawings.

17 3.02 PRODUCT DELIVERY, STORAGE AND HANDLING

- 18 A. For reinforcing steel fabricated on-site, shop from the mill in bundles, limited to one
19 size and length, tagged with a waterproof tag showing the name of the mill, heat
20 number, grade and size of the bars and identifying number.
- 21 B. For reinforcing steel fabricated off-site, deliver in bundles identified as to structure
22 and shop drawing number. Identify each individual bar with a waterproof tag
23 showing the grade, size and bar mark from the approved bar schedule.
- 24 C. Protect reinforcing steel and wire fabric from damage and from dirt, oil grease, other
25 foreign matter, and rust-causing condition. Do not store reinforcement in direct
26 contact with the ground.

27 3.03 CLEANING

- 28 A. Before placing and before pouring concrete, all reinforcement shall be thoroughly
29 cleaned of all oil, dirt, loose mill scale, loose rust, or foreign matter that will destroy
30 or reduce bond.

31 3.04 PLACING REINFORCEMENT

- 32 A. Placement. Metal reinforcement shall be accurately placed in accordance with
33 approved Submittals and adequately secured in position by concrete or metal chairs

1 or spacers. Nails shall not be driven into forms to support reinforcement nor shall
2 wire ties come in contact with forms.

3 B. Splicing. Lap at splices shall be sufficient to transfer stress between bars by bond
4 and shear.

- 5 1. Furnish reinforcing bars in full lengths as indicated on the contract drawings
6 and approved Submittals.
- 7 2. Do not splice bars unless indicated on the contract drawings or approved by
8 the Engineer in writing. When authorized, make splices in accordance with
9 ACI 318; perform welding in accordance with AWS D12.1.
- 10 3. Splices generally shall be avoided at points of maximum stress. Minimum
11 splice lap for stressed bars shall be forty times bar diameter.

12 C. Offsets in longitudinal bars at change of cross section shall be placed in region of
13 lateral support. Slope of inclined portion of offset shall not be more than one in six
14 and, in tied columns, ties shall be spaced not over 3 inches on centers for a distance
15 of 1 foot below actual point of offset.

16 D. Embedded Items. The Contractor shall provide for the installation of all items
17 embedded in the concrete, such as coil rod inserts, anchor bolts, dowels, etc., as
18 shown on the contract drawings or as provided for in other Divisions of these
19 specifications.

- 20 1. All dowel bars shall be tied securely in place before pouring concrete.
- 21 2. Provide for clearances with appurtenant materials and devices.

22 E. Drilled and Grouted or Epoxy Dowel Installation. Existing concrete which will be
23 incorporated into new work and requiring integration with new concrete will be
24 doweled as indicated on the contract drawings and as follows:

- 25 1. Drill hole in existing concrete of size that is 3/4 inch larger in diameter than
26 diameter of dowel bar. Incline the hole in the concrete such that the non-
27 shrink grouting or epoxy will be retained in the hole.
- 28 2. Fill hole with non-shrink grouting or epoxy.
- 29 3. Immediately place dowel bar into hole.
- 30 4. Allow grout or epoxy to take initial set before disturbing dowel bar.

31 F. Steel Reinforcing Fabric. Reinforce as detailed on the contract drawings; and where
32 not indicated, reinforce with wire fabric, place 2 inches from the top of the slab.

- 33 1. Flat sheets shall be used whenever available. Wire fabric shall lap 6 inches
34 on side joints and 12 inches on end joints. Properly secure with annealed
35 wire. Fabric shall be raised and secured in the correct location using
36 permanent supports. Raising the fabric by hook during placement of
37 concrete shall NOT be permitted.
- 38 2. Alternately, in tight quarters and around appurtenances and openings, lap
39 mesh reinforcement not less than one mesh space plus 2 inches, and tie.

1 G. Concrete Cover. The minimum cover of concrete for all reinforcement shall conform
2 to the dimensions indicated on the contract drawings, which indicate the clear
3 distance from the edge and end of the reinforcement to the face of the concrete
4 surface. Provide clearance and spacing indicated on the contract drawings and
5 approved Submittals, where so indicated.

6 1. Where no clearances are indicated, the thickness of the concrete cover over
7 reinforcement shall be as follows:

- 8 a. Concrete cast against and permanently exposed to earth - 3 inches;
- 9 b. Formed concrete exposed to earth or weather - 2 inches;
- 10 c. Formed concrete not exposed to earth or weather - 1-1/2 inches;
- 11 d. Slabs not exposed to earth or weather - 1 inch.

12 PART 4 MEASUREMENT AND PAYMENT

13 4.01 GENERAL

14 A. Concrete reinforcing shall be paid for at the bid price in accordance with one of the
15 following methods, unless indicated otherwise in the Bid Schedule.

16 B. All work specified herein shall be considered in each of the measurement and
17 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule.

18 4.02 CONCRETE REINFORCING

19 A. Concrete Reinforcing, Inclusive. When no quantity is provided, concrete reinforcing
20 shall be considered inclusive to payment for work associated with cast-in-place
21 concrete.
22

23 END OF SECTION

1 SECTION 03 30 00

2
3 CAST-IN-PLACE CONCRETE

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work covered under this section shall cover furnishing all materials, equipment
7 and labor required to construct all cast-in-place concrete as shown on the contract
8 drawings and as specified.

9 1.02 RELATED WORK ELSEWHERE

- 10 A. Structural Cast-in-Place Concrete Forming - Division 03
11 B. Concrete Accessories - Division 03
12 C. Concrete Reinforcing - Division 03

13 1.03 APPLICABLE PROVISIONS (NONE)

14 1.04 APPLICABLE PUBLICATIONS

- 15 A. The following publications of the issues listed below, but referred to thereafter by
16 basic designation only, form a part of this specification to the extent indicated by the
17 reference thereto.

- 18 1. American Concrete Institute (ACI), Annual Book of ACI Standards:
19 a. ACI 117/177R - Standard Specification for Tolerances for Concrete
20 Construction and Materials and Commentary, Current Edition.
21 b. ACI 211.1 - Standard Practice for Selecting Proportions for Normal,
22 Heavyweight, and Mass Concrete, Current Edition.
23 c. ACI 209.1R - Report on Factors Affecting Shrinkage and Creep of
24 Hardened Concrete, Current Edition.
25 d. ACI 301 - Specification for Structural Concrete, Current Edition.
26 e. ACI 302.1R - Guide for Concrete Floor and Slab Construction,
27 Current Edition.
28 f. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing
29 Concrete, Current Edition.
30 g. ACI 305R - Hot Weather Concreting, Current Edition.
31 h. ACI 306.1 (R2002) - Standard Specification for Cold Weather
32 Concreting, Current Edition.
33 i. ACI 308R - Guide to Curing Concrete, Current Edition.
34 j. ACI 309R - Guide for Consolidation of Concrete, Current Edition.
35 k. ACI 311.4R - Guide for Concrete Inspection, Current Edition.
36 l. ACI 318/318R - Building Code Requirements for Structural Concrete
37 and Commentary, Current Edition.

- 1 m. ACI 530/530.1/530R/530.1R - Building Code Requirements for
2 Commentary for Masonry Structures and Specification for Masonry
3 Structures and Related Commentaries, Current Edition.
4 n. ACI ASCC-1(05) - The Contractor's Guide to Quality Concrete
5 Construction, Third Edition.
6 o. ACI CP-10/PACK - Craftsman Study Package for ACI Certification
7 of Concrete Flatwork Technician/Finisher, Current Edition.
8 p. ACI MCP06 - ACI Manual of Concrete Practice, Parts 1 through 6,
9 and Index, 2006 Edition.
10 q. ACI SCM-24 - Concrete Repair Basics, Current Edition.
11 r. ACI SP15 - Field Reference Manual: Standard Specifications for
12 Structural Concrete ACI 301 with Selected ACI Reference, Current
13 Edition.
14 s. ACI SP-71 - ASTM Standards in ACI 318, Current Edition.
15 2. American Society for Testing and Materials (ASTM), Annual Book of
16 ASTM Standards:
17 a. ASTM C33 - Standard Specification for Concrete Aggregates,
18 Current Edition.
19 b. ASTM C70 - Standard Test Method for Surface Moisture in Fine
20 Aggregate, Current Edition.
21 c. ASTM C94 - Standard Specification for Ready-Mixed Concrete,
22 Current Edition.
23 d. ASTM C109 - Standard Test Method for Compressive Strength of
24 Hydraulic Cement Mortars (using 2-inch or [50 mm] Cube
25 Specimens), Current Edition.
26 e. ASTM C125 - Standard Terminology Relating to Concrete and
27 Concrete Aggregates, Current Edition.
28 f. ASTM C127 - Standard Test Method for Density, Relative Density
29 (Specific Gravity) and Absorption of Coarse Aggregate, Current
30 Edition.
31 g. ASTM C128 - Standard Test Method for Density, Relative Density
32 (Specific Gravity) and Absorption of Fine Aggregate, Current
33 Edition.
34 h. ASTM C131 - Standard Test Method for Resistance to Degradation
35 of Small-Size Coarse Aggregate by Abrasion and Impact in the Los
36 Angeles Machine, Current Edition.
37 i. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement
38 Concrete, Current Edition.
39 j. ASTM C150 - Standard Specification for Portland Cement, Current
40 Edition.
41 k. ASTM C171 - Standard Specification for Sheet Materials for Curing
42 Concrete, Current Edition.
43 l. ASTM C191 - Standard Test Methods for Time Setting of Hydraulic
44 Cement by Vicat Needle, Current Edition.
45 m. ASTM C219 - Standard Terminology Relating to Hydraulic Cement,
46 Current Edition.

- 1 n. ASTM C226 - Standard Specification for Air-Entraining Additions
2 for Use in the Manufacture of Air-Entraining Hydraulic Cement,
3 Current Edition.
4 o. ASTM C233 - Standard Test Method for Air-Entraining Admixtures
5 in Concrete, Current Edition.
6 p. ASTM C260 - Standard Specification for Air-Entraining Admixtures
7 for Concrete, Current Edition.
8 q. ASTM C311 - Standard Test Methods for Sampling and Testing Fly
9 Ash or Natural Pozzolans for use as a Mineral Admixture in Portland-
10 Cement Concrete, Current Edition.
11 r. ASTM C309 - Standard Specification for Liquid Membrane-Forming
12 Compounds for Curing Concrete, Current Edition.
13 s. ASTM C494 - Standard Specification for Chemical Admixtures for
14 Concrete, Current Edition.
15 t. ASTM C535 - Standard Test Method for Resistance to Degradation
16 of Large-Size Coarse Aggregate by Abrasion and Impact in the Los
17 Angeles Machine, Current Edition.
18 u. ASTM C566 - Standard Test Method for Total Evaporable Moisture
19 Content of Aggregate by Drying, Current Edition.
20 v. ASTM C595 - Standard Specification for Blended Hydraulic Cement,
21 Current Edition.
22 w. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or
23 Calcined Natural Pozzolan for Use in Concrete, Current Edition.
24 x. ASTM C688 - Standard Specification for Functional Additions for
25 Use in Hydraulic Cements, Current Edition.
26 y. ASTM C989 - Standard Specification for Slag Cement for Use in
27 Cement and Mortars, current edition.
28 3. Portland Cement Association (PCA) Standards and Specifications:
29 a. PCA - Design and Control of Concrete Mixtures, Current Edition.

30 1.05 SUBMITTALS

- 31 A. Submit such product literature and catalog cuts of materials to be supplied to relate
32 these materials to the specification. Information shall be in conformance with
33 requirements of City submittals.
- 34 B. Concrete Design Mix
- 35 1. Prior to the start of placing of concrete, submit the design mix for each class
36 of concrete, indicating that the concrete constituents and proportions will
37 result in a concrete mix meeting the physical requirements for each class of
38 concrete specified. Submit with the design mix, laboratory test reports and
39 manufacturer's certificates attesting the conformance of constituents with
40 these specifications.
- 41 2. Do not vary the proportions of the constituents or source of material of the
42 approved mix without submitting corresponding test result documentation to
43 the Engineer for review and approval.

3. Design mix shall indicate proportions of cement, aggregate and water, and names and proportions of admixtures and air-entraining agents.
4. Provide certification that the design mix complies with all ACI and ASTM requirements.

PART 2 PRODUCTS AND MATERIALS

2.01 CEMENT

- A. Cement shall be Portland Cement ASTM C150 Type I or IA, except as otherwise noted or approved. Type III cement shall only be used for Class L concrete, or when approved by the Engineer.
- B. A singular brand and manufacturer of cement shall be used for the entire work.

2.02 FLY ASH

- A. Fly ash shall conform to ASTM C618 Class C.
- B. A singular source of fly ash shall be used for the entire work.

2.03 SLAG

- A. Slag shall be ground granulated blast furnace slag conforming to ASTM C989.

2.04 AGGREGATE

- A. Aggregate shall consist of clean, hard durable sand, gravel, crushed gravel or crushed rock.
- B. Aggregate shall conform to the requirements of ASTM C33. Fine and coarse aggregate shall meet ASTM C33 grading requirements. Coarse aggregates shall be graded in accordance with ASTM gradations as follows:
 1. 3/4 inch maximum coarse aggregate - ASTM No. 67
 2. 1-1/2 inch maximum coarse aggregate - ASTM No. 4
- C. Maximum aggregate size shall be as defined in the Concrete Schedule, or where not defined in the Concrete Schedule, as defined by dimensional constraints for cast-in-place concrete as follows:
 1. Not larger than one-fifth of the narrowest dimension between sides of the forms;
 2. Not larger than one-third the thickness of the slab;
 3. Not larger than three-fourths of the minimum clear spacing between individual reinforcing bars or wire, bundles of bars, or prestressing tendons or ducts.

1 2.05 MIXING WATER

- 2 A. Mixing water shall be natural or treated water, clean and free from injurious amount
3 of oil, acid, alkali, chlorides and sulfates, other common salts, organic matter or other
4 deleterious substances.
- 5 B. Mixing water shall yield cement paste complying with the requirements ASTM C109
6 and ASTM C191.

7 2.06 ADMIXTURES

- 8 A. All admixtures are subject to the written approval of the Engineer and shall be used
9 in strict accordance with the manufacturer's recommendations.
- 10 1. Air-Entraining Admixture
- 11 a. All concrete exposed to weather and freeze-thaw cycles shall be air-
12 entrained, unless otherwise specified.
- 13 b. Air-Entraining admixture shall conform to ASTM C260.
- 14 c. Air-Entrainment shall be as indicated for each class as in the
15 Concrete Schedule.
- 16 2. Water-Reducing, Set-Controlling Admixtures
- 17 a. Water-Reducing, Set-Controlling admixtures shall conform to ASTM
18 C494, Type A for water-reducing, Type C for accelerating, Type D
19 for water-reducing and retarding, and Type E for water-reducing and
20 accelerating.
- 21 B. Admixtures containing calcium chloride or soluble chloride shall not be used.

22 2.07 CURING COMPOUND - EXTERIOR

- 23 A. Curing compound shall comply with ASTM C309, Type 2; resin, white pigmented.

24 PART 3 CONSTRUCTION METHODS

25 3.01 COORDINATION

- 26 A. Examine the drawings and specifications for work of other sections or other
27 contractors and coordinate such work with the requirements of this Section; make
28 provisions for installation of such items as sleeves, pipes, conduits, inserts and
29 hangers in a manner that will not impair or weaken concrete construction.

30 3.02 READI-MIX CONCRETE

- 31 A. Acceptability and Use. Read-mix concrete shall be designed on the basis of
32 strength, durability, impermeability, and exposure condition, as required for the
33 intended use of the structure by methods specified in ACI 211.1 and ACI 318. All
34 read-mix concrete shall comply with the water-cement ratio for each specific class
35 of concrete as specified in the Concrete Schedule. Concrete design mix, complete

1 with sample test results shall be submitted to the Engineer for approval prior to
2 placing any concrete.

3 1. Failure to Meet Strength Requirements. Failure to meet strength
4 requirements shall be as defined in Concrete Quality Control.

5 2. Watertight Concrete. All concrete exposed to earth or water shall be
6 watertight, shall have a water-cement ratio as specified, and shall be air-
7 entrained as specified in the Concrete Schedule.

8 a. Construct keyways as indicated on the contract drawings.

9 B. Mix Proportioning. Mix proportioning shall be the responsibility of the Contractor
10 and shall be submitted for review and approval by the Engineer, in accordance with
11 these specifications.

12 1. Select proportions for concrete to obtain the quality requirements for the
13 class of concrete as specified in the Concrete Schedule. Contractor, at their
14 expense, shall have an approved independent laboratory prepare design
15 mixes for each specified concrete class.

16 2. Slump. Slump for class of concrete shall be as specified in the Concrete
17 Schedule. The Contractor shall at their expense, make field slump tests in
18 accordance with ASTM C143 and Concrete Quality Control.

19 3. Adjustment to Concrete Mixes. Design mix adjustments may be requested
20 by the Contractor when characteristics of materials, conditions, weather, test
21 results, or other circumstances warrant. Laboratory test data for revised
22 design mixes and strength results shall be submitted and approved before
23 using in the work. No change in contract price will be allowed for these
24 changes.

25 4. Addition of Water to the Batch. Addition of water to the batch delivered to
26 the site shall be in strict accordance with ASTM C94. This shall be the
27 Contractor's responsibility and by their direction, following consultation with
28 the Engineer.

29 a. Addition of water to the batch shall be one time only. Total gallons
30 of water added to the batch shall be recorded on the load ticket,
31 which shall be supplied to the Engineer prior to that delivery truck
32 leaving the site. If water is permitted to be added to mixed concrete
33 upon arrival at the job, an additional mixing of 30 revolutions of the
34 drum shall be required.

35 b. Contractor shall adjust the water-cement ratio of the batch to the
36 corresponding value based on the addition of water to the batch and
37 shall submit this information to the Engineer with adjusted strength
38 data for the final batch proportion.

39 c. At no time shall the addition of water cause the water-cement ratio
40 specified in the concrete class schedule to be exceeded.

41 3.03 GENERAL

42 A. Unless otherwise specified, conform to ACI 304, 305, and 306 for concrete
43 installation requirements such as preparation, mixing, conveying, depositing, curing,

1 and cold and hot weather requirements; consolidate concrete in accordance with ACI
2 309.

3 B. Concrete not placed within 90 minutes or 300 revolutions, whichever occurs first,
4 after the first mixing of the cement and aggregates will be rejected.

5 C. Contractor shall indicate on record set of Drawings at site, for review prior to
6 installation, a pouring program for concrete work showing unit of operation, method
7 of pouring, installation of construction/control joints, expansion joints and all
8 necessary work.

9 D. Proper grade marker or stakes shall be used by Contractor to establish grades for
10 ramps, platforms, sidewalks, slopes to drains, inlets, etc.

11 E. Trenches, forms, conveying equipment shall be prepared to receive concrete in
12 accordance with ACI 304.

13 F. Place concrete footings upon undistributed clean surfaces, free from frost, ice, mud
14 and water; when foundation is on dry soil or pervious material, lay waterproof
15 sheathing paper over earth surfaces to receive concrete.

16 G. Rock surfaces upon which concrete is to be placed, make level, clean, free from all
17 objectionable coatings, water, mud, debris, loose semi-detached or unsound
18 fragments; level surfaces to receive sand cushion placed to minimum thickness of
19 2 inches.

20 H. Immediately after placement, protect concrete from premature drying, excessively
21 hot or cold temperature and mechanical injury; maintain with minimum moisture loss
22 and relatively constant temperature for the period necessary for hydration of the
23 cement and hardening of the concrete.

24 I. All freshly cast concrete shall be protected from damaging effects of the elements
25 freezing, rapid drop in temperature and loss of moisture and from future construction
26 operations.

27 3.04 PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT

28 A. Before placement, clean equipment for mixing and transporting the concrete; remove
29 debris and ice from all surfaces upon which concrete is placed; clean reinforcement
30 of dirt, loose rust, and mill scale, or other coatings.

31 B. Remove water from all areas before depositing concrete; before depositing new
32 concrete on or against concrete that has set, thoroughly roughen; clean existing
33 surfaces of laitance, foreign matter or loose particles; retighten forms; slush existing
34 surfaces with neat cement grout coat; place new concrete before grout has attained
35 initial set; give horizontal construction joints grout brush coat of cement, fine
36 aggregate, in same proportions as concrete to be placed.

- 1 C. Thoroughly wet the stone base on which slabs are to be placed where no vapor
2 barrier is indicated.
- 3 D. Check compaction of fill and proper grade for slabs-on-grade. Check screeds and
4 exercise care to prevent disturbing screeds during placement. Provide for
5 construction joints in slabs-on-grade at 20 feet maximum in each direction unless
6 shown otherwise on the contract drawings. Place expansion joint material at
7 junctures of slabs-on-grade with vertical walls and as otherwise shown.
- 8 E. Remove debris, excess form oil, and water from formwork; avoid washing newly
9 deposited concrete.

10 3.05 MIXING

- 11 A. Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94
12 and ACI 304. The production facilities shall comply with the requirements of the
13 National Ready Mixed Concrete Association Certification Plan as regards materials
14 storage and handling, batching equipment, central mixer, truck mixers, agitators,
15 non-agitating units, ticketing system, etc.
- 16 B. Do not over-mix; do not use concrete which is retained in mixers so long as to
17 require additional water in excess of design mix water to permit satisfactory placing;
18 retempering of mix is not permitted.
- 19 C. Concrete shall be delivered to the site of the work and the mixed concrete discharged
20 completely within 1-1/2 hours after water has been added to cement. In hot weather,
21 or under conditions contributing to quick stiffening of concrete, this time may be
22 reduced by the Engineer.
- 23 D. Concrete delivered shall arrive at the site having a temperature not less than
24 50 Degrees F nor greater than 85 Degrees F, unless otherwise permitted by the
25 Engineer.

26 3.06 CONVEYING

- 27 A. Convey concrete from the mixer to the final deposit by methods that will prevent
28 segregation or loss of materials.
- 29 B. Use of aluminum conveyances is not permitted.

30 3.07 CONCRETE PLACEMENT

- 31 A. Place concrete, including drops greater than 60 inches using recommended practices
32 in accordance with ACI 304 and ACI 318. Once pouring operation commences, it
33 shall be carried out as a continuous operation until a section is completed.

- 1 B. Deposit concrete as nearly as practical in its final position to avoid segregation due to
2 rehandling or flowing; do not use vibrators to move concrete horizontally within the
3 forms.
- 4 C. Do not use retempered concrete or concrete contaminated by foreign material.
- 5 D. Plan and conduct concrete placement to insure that the concrete is kept plastic and
6 that the concrete is free of cold joints.
- 7 E. Where there is a time delay greater than 45-minutes between adjacent concrete
8 placement, a bulkhead construction joint, complete with waterstops where required,
9 must be installed.
- 10 F. Do not commence placing when the sun, heat, wind or limitations of facilities
11 provided prevent proper finishing or curing.
- 12 G. Discontinue concreting when the descending natural air temperature falls lower than
13 40 Degrees Fahrenheit unless preparations are made and in place to heat or insulate
14 concrete in accordance with the cold weather concreting requirements of this
15 specification.
- 16 H. Concrete for walls shall be deposited in approximately horizontal layers not to
17 exceed 24 inches in height to avoid segregation due to rehandling and flowing.
- 18 I. Concrete shall not be placed or poured in water. Water level shall be removed or
19 lowered in a manner approved by Engineer. Excess water shall not be permitted.
20 Powdering a mixture of cement to absorb excess water shall not be permitted.
- 21 J. Concrete shall be placed before initial set has occurred. Placing should be carried on
22 in such manner that the concrete in the form is still plastic and can be integrated with
23 fresh concrete.
- 24 K. Contractor shall notify Engineer of concrete pouring schedule one day in advance of
25 pour to allow for inspection of reinforcing and forms.
- 26 L. Bottom dump buckets may be used for transporting mixed concrete to the desired
27 location. Particular care shall be taken to avoid jarring or bumping as this may cause
28 segregation.
- 29 M. Where chutes are used to transport concrete, they shall be of metal or wood with
30 metal lining and should have a slope not exceeding 1 vertical to 2 horizontal and not
31 less than 1 vertical to 3 horizontal so that the concrete will travel fast enough to keep
32 the chute clean but slow enough to avoid segregation of materials. The end of each
33 chute shall be provided with a baffle to help prevent segregation, or the concrete
34 should be discharged through a tremie or elephant trunk directly into the form.

1 N. Elephant trunks and/or tremies shall be used in walls and columns to prevent free fall
2 of the concrete and to allow the concrete to be placed through the cage of reinforcing
3 steel.

4 O. Pumping equipment shall be of suitable type, without Y-sections, and with adequate
5 pumping capacity. Loss of slump in pumping shall not exceed 1-1/2 inches.

6 3.08 CONSOLIDATION

7 A. Each concrete layer placed shall be compacted by mechanical internal vibrating
8 equipment supplemented by hand spading, rodding, or tamping.

9 B. The period of concrete vibration shall not be less than two seconds nor more than
10 five seconds at any one point.

11 C. Consolidate concrete thoroughly as it is placed in order to secure a dense mass; work
12 concrete well around the reinforcement and embedded items and into the corners of
13 the forms.

14 D. Use internal vibrators inserted vertically over the entire area of the placement; form
15 vibrators not permitted; internal vibrators shall maintain a minimum of 5000
16 impulses when submerged in concrete.

17 E. Vibrate until voids are eliminated, coarse aggregate is suspended in mortar, and
18 entrapped air bubbles begin to rise to the surface; concrete should move back into the
19 space vacated by the vibrator; vibration duration shall be limited only to the time
20 necessary to produce consolidation without causing segregation.

21 F. Space vibrator insertions such that the area visibly affected by the vibrator overlaps
22 the adjacent just-vibrated area by a few inches.

23 G. Penetrate at least 6 inches into previously placed layers in order to bond between
24 layers and avoid cold joints.

25 H. Take care not to over-vibrate air entrained concrete; place vibrator to eliminate
26 honeycombing but avoid excess vibrating that bleeds all entrapped air from the mix.

27 I. Do not use vibrators to transport concrete.

28 3.09 JOINTS AND KEYWAYS

29 A. Construct expansion, control, and isolation joints and keyways only where indicated
30 on the drawings or at additional locations approved by the Engineer (and as shown
31 on the Standard Details).

32 B. Where the placing of concrete is discontinued, clean off laitance and other
33 objectionable material to a sufficient depth to expose sound concrete as soon as

1 concrete is firm enough to retain its form; smooth the top surface of concrete
2 adjacent to the forms with a trowel to minimize visible joints on exposed faces.

3 C. Immediately upon completion of the work of placing concrete, remove
4 accumulations splashed upon the reinforcement and the surfaces of the forms;
5 perform this removal before concrete takes its initial set; clean reinforcing steel
6 carefully to prevent damage to the concrete steel bond.

7 D. Do not halt work within 18 inches of the top of any face.

8 E. For bonded horizontal joint construction, roughen the surface and expose the
9 aggregate; clean the surface thoroughly by wet sandblasting, by cutting with high-
10 pressure water jet or by other approved methods; perform cleaning after the concrete
11 has hardened to prevent raveling of the surface below the desired depth.

12 F. Before bonding concrete is placed, clean the surface of loose or soft particles or other
13 objectionable materials and keep wet for a minimum period of 12 hours.

14 G. Cover the cleaned and saturated surface with a coating of neat cement grout and
15 deposit new concrete before the grout has attained its initial set.

16 3.10 CURING

17 A. Concrete shall be wet cured by immersion of moisture-retaining covers in
18 conformance with ACI 308 or shall receive curing compound in accordance with
19 ACI 309.

20 B. Water curing is the preferred method of protection for curing concrete other than
21 under hot weather conditions; cover exposed surfaces with a saturated material
22 (burlap or cotton mats) and keep wet continuously with a soil soaker hose for 7
23 curing days for all concrete except high early strength concrete; leave covering in
24 place, without wetting, for an additional 3 days.

25 C. A curing day is defined as 24-hour day when the concrete surfaces are kept moist and
26 the uniform temperature of the concrete mass is between 55 Degrees Fahrenheit and
27 75 Degrees Fahrenheit.

28 D. Curing shall start as soon as free surface water disappears after finishing. Where
29 forms are not removed immediately, curing shall be accomplished in a manner
30 acceptable to the Engineer.

31 E. Curing compounds may not be used on surfaces that are to receive additional
32 concrete, paint or tile.

33 F. Curing and sealing compound shall not be applied to steel reinforcing anchors, water
34 stops, construction joints, or surfaces to be bonded to other concrete.

- 1 G. When using a curing compound, keep surfaces moist after the forms are removed,
2 and the form tie holes repaired; after the surfaces are finished, apply the curing
3 compound according to the manufacturer's recommendations; remove forms only as
4 required to advance repair of tie holes and minor defects.
- 5 H. Slabs: Immediately following slab finishing, apply liquid membrane-forming curing
6 compound or begin water curing before the surface becomes dry.
- 7 I. Vertical Surfaces: When the forms are removed entirely, spray the surface with
8 water and allow it to reach a uniformly damp appearance with no free water on the
9 surface; apply curing compound or begin water curing.
- 10 J. For curing concrete under hot weather conditions, see Hot Weather Requirements in
11 this section.
- 12 K. For curing concrete under cold weather conditions, see Cold Weather Requirements
13 in this section.

14 3.11 CONCRETE WALL FINISHES

- 15 A. Complete screeding and darbying of top of walls before excess moisture or bleeding
16 water is present on the surface.
- 17 B. Do not begin subsequent finishing operations until surface water has disappeared.
- 18 C. Refer to Concrete Schedule, included in this specification section, for finish type at
19 each location, defined as follows:
- 20 1. Rough Form Finish: (Type W1)
21 a. No form facing materials specified.
22 b. Patch tie holes and defects.
23 c. Chip off fins 1/4 inch or more in height.
- 24 2. Smooth Form Finish: (Type W2)
25 a. Use a form facing material that will produce a smooth, hard, uniform
26 texture on the concrete.
27 b. Keep seams to a practical minimum.
28 c. Patch tie holes and defects.
29 d. Remove all fins.
- 30 3. Smooth Rubbed Finish: (Type W3)
31 a. Produce a Smooth Form Finish.
32 b. Wet surface and rub with a Carborundum brick until uniform color
33 and texture are produced.
34 c. Perform rubbing no later than 24 hours after forms are removed.
35 d. Do not use any cement grout other than the paste drawn from the
36 concrete itself by rubbing.
37 e. Thoroughly wash the surface with water.
- 38 4. Smooth Troweled Finish: (Type W4)
39 a. Produce a Smooth Rubbed Finish.
40 b. After wet-rubbing, finish with a steel trowel to increase compaction
41 of fines and to provide maximum density.

1 5. Smooth Finish (Grout Cleaned): (Type W5)

- 2 a. Use for architectural surfaces exposed to general view, unless other
3 indicated.
- 4 b. Mix 1 part portland cement and 1-1/2 parts fine sand with sufficient
5 water to produce grout having consistency of thick paint; use white
6 portland cement in combination with normal portland cement to
7 achieve uniform surface color after drying.
- 8 c. Wet surface of concrete and uniformly apply grout with brush or
9 spray gun completely filling air bubbles; surface with a wood float
10 scouring wall vigorously.
- 11 d. Allow grout to partially set for one to two hours, depending on
12 weather conditions; in hot dry weather, keep damp, using fine fog
13 spray.
- 14 e. When grout has hardened sufficiently to be scraped from wall with
15 edge of steel trowel without removing grout from small air holes, cut
16 off all grout that can be removed with trowel.
- 17 f. Allow surface to dry thoroughly then rub vigorously with dry burlap
18 to completely remove dried grout; there shall be no visible film or
19 grout remaining after this rubbing.
- 20 g. The entire cleaning operation for any area must be completed the day
21 it is started; no grout shall be left on overnight, and sufficient time
22 shall be allowed for grout to dry after it has been cut with trowel so it
23 can be wiped off clean with burlap.
- 24 h. After entire surface has been grout cleaned, wipe off any slightly dark
25 spots or streaks with fine abrasive hone.

26 3.12 CONCRETE SLAB FINISHING

- 27 A. Complete screeding and darbying slabs before excess moisture or bleeding water is
28 present on the surface.
- 29 B. Do not begin subsequent finishing operations until surface water has disappeared and
30 the concrete will sustain foot pressure with only approximately 1/4 inch indentation.
- 31 C. Refer to Concrete Schedule, included in this specification section, for finish type at
32 each location, defined as follows:
- 33 1. Smooth Float Finish: (Type S1)
- 34 a. Consolidate concrete with a power-driven disc-type float or a
35 combination floating-troweling machine with metal float shoes
36 attached.
- 37 b. Machines which have a water attachment for wetting the concrete
38 during the finishing operation are prohibited.
- 39 c. Check and level surface plane to a tolerance not exceeding 1/4 inch in
40 10 feet when tested with a 10-foot straightedge. Cut down high spots
41 and fill low spots; immediately after re-leveling, refloat surface to a
42 uniform, smooth, granular texture.

- 1 d. Where slab drainage is indicated, take care to maintain accurate
2 slopes for drainage.
- 3 2. Steel Troweled Finish: (Type S2)
- 4 a. Produce a Smooth Float Finish.
- 5 b. After float finishing, steel trowel surface as specified in Concrete
6 Schedule to increase the compaction of fines and to provide
7 maximum density and wear resistance.
- 8 c. Steel Troweled Finish: Screed and bull float or darby. Give
9 preliminary float finish, true, even and free from depressions; float
10 surface with hand or machine floats; compact surface with not less
11 than 2 thorough and complete steel troweling operations.
- 12 d. Tolerance on finished steel troweled floors in no instance shall
13 exceed 1/8 inch in 10'-0" on surface; where floor drains occur, slope
14 floors to drains.
- 15 e. Buffing: After concrete floors have been properly cured, buff
16 thoroughly to remove soluble salt incrustation or other foreign
17 substances.
- 18 3. Broom Finish: (Type S4)
- 19 a. Draw stiff broom over previous Smooth Float Finish, to obtain non-
20 slip finish.

21 3.13 CONCRETE SIDEWALKS

- 22 A. Concrete sidewalk construction shall be as specified in City specifications.

23 3.14 CONCRETE CURB AND GUTTER

- 24 A. Concrete curb and gutter construction shall be as specified in City specifications.

25 3.15 HOT WEATHER REQUIREMENTS

- 26 A. Comply with ACI 305R unless otherwise specified herein below.
- 27 B. Hot weather conditions are deemed to exist when the temperature in the forms is
28 75 Degrees Fahrenheit or above, or a combination of high air temperature, low
29 relative humidity and wind velocity impair the quality of fresh or hardened concrete;
30 take protective measures for mixing, transporting and placing concrete in accordance
31 with ACI 305R.
- 32 C. The temperature of the concrete at the place of discharge may not exceed 85 Degrees
33 Fahrenheit.
- 34 1. If ice is used to lower temperature, place crushed, shaved or chipped ice
35 directly into the mixer as part or all of the mixing water; mix until ice is
36 completely melted.
- 37 2. Record the concrete temperature at the time of discharge.

- 1 D. Do not add water that will cause the proportions to exceed the maximum water-
2 cement ratio shown in Table I.
3 1. Notify the Engineer before adding any water to the concrete mix.
4 2. Record the amount of water added to the concrete at the jobsite.
- 5 E. Discharge concrete within 45 minutes or 100 revolutions, whichever occurs first,
6 after the first mixing of cement and aggregates.
- 7 F. Placing and Curing:
8 1. Place concrete promptly upon arrival.
9 2. Provide at least one standby vibrator for each 3 vibrators in use.
10 3. Protect concrete from direct sunlight; keep forms covered and moist by
11 means of water sprinkling or the application of continuously wetted burlap or
12 cotton mats for a minimum of 24 hours. Windbreaks and/or sunshades shall
13 be provided as directed by the Engineer.
14 4. When forms are removed, provide wet cover to the newly exposed surfaces
15 to avoid exposure to hot sun and wind.
16 5. Continue specified water curing methods for 10 days; leave covering in place
17 4 additional days; do not permit alternate wetting and drying cycles.
18 6. For slabs on grade, beam and deck concrete, and other horizontal placements
19 protect the surface between finishing operations using one or more of the
20 following methods:
21 a. Careful use of a fog nozzle.
22 b. Spreading and removing polyethylene sheeting between finishing
23 operations.
24 c. Application of mono-molecular film after the strike-off.
- 25 G. During extremes in weather, floor slabs shall not be cast unless the slab is protected
26 by a roof and other suitable protective measures are provided. After curing has been
27 completed, the floor shall be exposed to the air for 48 hours prior to allowing traffic
28 on the floors.

29 3.16 COLD WEATHER REQUIREMENTS

- 30 A. Comply with ACI 306.1 (R2002) unless otherwise specified herein below.
- 31 B. Cold weather is defined any time when the daily temperature is 40 Degrees
32 Fahrenheit or lower during placement and the protection period. If at any time
33 during the progress of the work, the temperature drops below 40 Degrees F., the
34 Contractor shall make suitable provisions to protect the concrete by use of insulation
35 materials such as blankets, mats, etc., and equipment for providing artificial heat.
- 36 C. Combustion type temporary heating devices shall be vented outside of any temporary
37 enclosure and building envelope. Combustion gases shall not be allowed in any
38 temporary enclosure and building envelope.
- 39 D. Protect concrete surfaces from freezing for at least 24 hours after placement.

- 1 E. All surfaces in contact with newly-placed concrete including formwork,
2 reinforcement and subgrade must be above 35 Degrees Fahrenheit.
- 3 F. Use preparation methods capable of producing concrete with a temperature not more
4 than 85 Degrees Fahrenheit, and not less than 55 Degrees Fahrenheit, at the time of
5 placement.
- 6 G. Do not heat concrete ingredients to a temperature higher than that necessary to keep
7 the temperature of the mixed concrete, as placed, within the specified temperatures.
8 (Do not heat water in excess of 140 Degrees Fahrenheit.)
- 9 H. Concrete shall have a temperature of not less than 55 Degrees Fahrenheit when
10 placed; mix concrete at a temperature between:
11 1. 60 Degrees Fahrenheit and 70 Degrees Fahrenheit when outside air
12 temperature is above 30 Degrees Fahrenheit.
13 2. 65 Degrees Fahrenheit and 75 Degrees Fahrenheit when outside air
14 temperature is between 0 Degrees Fahrenheit and 30 Degrees Fahrenheit.
15 3. 70 Degrees Fahrenheit and 80 Degrees Fahrenheit when outside air
16 temperature is below 0 Degrees Fahrenheit.
- 17 I. Follow concrete placement with tarpaulins or other readily movable coverings, so
18 only a few feet of concrete is exposed to the outside air at any time.
- 19 J. Maintain the temperature and moisture conditions specified in all parts of the newly
20 placed concrete by covering, insulating, housing or heating; arrange for protection
21 methods in advance of placement.
- 22 K. Maintain concrete at a temperature of not less than 55 Degrees Fahrenheit nor more
23 than 70 Degrees Fahrenheit for a period of 3 days after placement.
- 24 L. A thermometer accurate to plus or minus 2 Degrees F shall be placed under the
25 curing blanket. Additional insulation shall be supplied as required to maintain the
26 temperature above 55 Degrees F.
- 27 M. After the curing period, the temperature of the exposed surface shall not be permitted
28 to drop faster than 30 Degrees F in 24 hours.
- 29 N. Do not remove forms during the initial protection period.
- 30 O. Protect insulation against wetting that will impair its insulating value using moisture-
31 proof cover material; keep insulation in close contact with concrete.
- 32 P. Construct enclosure to withstand wind and snow loads and be reasonably airtight;
33 provide sufficient space between the concrete and enclosure to permit free circulation
34 of heated air.
- 35 Q. Use vented heaters; do not permit heaters to heat or dry concrete locally. Unvented
36 salamanders or other heaters which produce carbon dioxide as by-products shall not

1 be permitted within enclosures or inside buildings. If heaters are used, precautions
2 shall be taken to prevent drying of the slab through the use of water jackets or other
3 suitable methods.

4 R. Maintain relative humidity above 40% within heated enclosures before construction
5 supports are removed.

6 S. Monitor temperature to insure concrete is kept within specified limits recording time
7 and concrete temperature every 8 hours.

8 T. Assure concrete has developed necessary strength before removing forms; provide
9 additional test cylinders with the same protection as the structure they represent to
10 verify concrete strength before construction supports are removed.

11 U. If water curing is used, terminate at least 12-hours before end of temperature
12 protection period. Permit concrete to dry.

13 V. After the required protection period gradually reduce the concrete temperature within
14 an enclosure or insulation at a rate not to exceed 20 Degrees Fahrenheit per day until
15 the outside temperature has been reached.

16 W. Apply membrane forming curing compound to concrete surfaces during the first
17 period of above-freezing temperatures after forms are stripped and before air
18 temperature rises to 50 Degrees Fahrenheit; apply membrane forming curing
19 compound to slabs as soon as finishing operations are completed, except where live
20 steam curing is used.

21 3.17 DELIVERY TICKETS

22 A. With each load of concrete delivered to the job there shall be furnished by the
23 ready-mixed concrete producer duplicate delivery tickets, one for the Contractor and
24 one for the Engineer. Delivery tickets shall provide the following information:

- 25 1. Date and serial number of ticket;
 - 26 2. Name of ready-mixed concrete plant;
 - 27 3. Job location;
 - 28 4. Contractor;
 - 29 5. Type and brand name of cement;
 - 30 6. Mix number or specified cement content in bags per cubic yard of concrete;
 - 31 7. Truck number;
 - 32 8. Time dispatched stamped by a time clock;
 - 33 9. Amount of concrete in load in cubic yards;
 - 34 10. Admixtures in concrete, if any;
 - 35 11. Maximum size of aggregate;
 - 36 12. Water added at job, if any;
 - 37 13. Slump of concrete ordered
- 38

TABLE 1
CONCRETE CLASS SCHEDULE

Parameter Value	Compressive Strength (PSI) 28-Day	Water-Cement Ratio Maximum	Air Content Range (%) Minimum-Maximum	Slump Range (Inches) Minimum-Maximum	Coarse Aggregate (Inches) Maximum
Class A	4,000	0.5	1 to 2	2 to 4	3/4
Class B	4,000	0.5	1 to 2	2 to 4	1-1/2
Class C	4,000	0.5	5 to 7	2 to 4	3/4
Class D	4,000	0.5	4 to 6	2 to 4	1-1/2
Class E (Interior)	3,000	0.5	1 to 2	2 to 4	3/4
Class F (Exterior)	3,000	0.5	5 to 7	2 to 4	1-1/2
Class G	2,000	0.67	1 to 2	4 to 6	1-1/2
Class H	5,000	0.45	1 to 2	2 to 4	3/4
Class I	5,000	0.45	1 to 2	2 to 4	1-1/2
Class J	5,000	0.45	5 to 7	2 to 4	3/4
Class K (Exterior)	5,000	0.45	4 to 6	2 to 4	1-1/2
Class L	3,000 psi @24 hours	0.40	5 to 7 4 to 6	2 to 4 2 to 4	3/4 1-1/2

TABLE 2
CONCRETE SCHEDULE
USES AND PROPERTIES

Use	Finish	Class and Considerations
Structural (not including water-retaining structures)		
Exposed foundations and walls	S2 Top, W5 Sides	Class C
	S2 Top, W5 Sides	Class D
Buried walls and footing walls, (Exterior)	W1	Class C
	W1	Class D
Slabs (Exterior)	S4	Class C
	S4	Class D
Equipment pads and bases	S4 Top, W5 Sides	Class F (Exterior)
Curbing, sidewalk, endwalls, driveways and ramps	S4 Top, W5 Sides	Class C
	S4 Top, W5 Sides	Class D
Manhole bases and benches	Special Construction	Class E
Pavement base, cradles and inlet walls	Special Construction	Class E
		Class F
Mass and fill	None	Class G
Traffic areas requiring early access or use	Special Construction	Class L

END OF SECTION

SECTION 03 62 00

NON-SHRINK GROUTING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. The work under this section shall cover furnishing and installing a non-shrink fluid precision grout material, forming, placing and curing where shown on the contract drawings or required by equipment manufacturers, equipment bases shall be grouted in position.

1.02 RELATED WORK ELSEWHERE

1.03 APPLICABLE PROVISIONS (NONE)

1.04 APPLICABLE PUBLICATIONS (NONE)

1.05 SUBMITTALS

- A. Contractor shall submit such product literature and catalog cuts of materials to be supplied to relate these materials to the specification. Information shall be in conformance with requirements of City submittals.

PART 2 PRODUCTS AND MATERIALS

2.01 NON-SHRINK GROUTING

- A. Non-shrink grouting shall be as manufactured by Master Builders, U.S. Grout Corporation, or equal.

PART 3 CONSTRUCTION METHODS

3.01 PREPARATION AND INSTALLATION

- A. Concrete foundation shall be rough and relatively level. Contractor shall remove laitance down to sound concrete and prepare concrete in accordance with manufactured recommendations.
- B. Preparation of grout shall be in paddle type mortar mixer or other suitable mechanical mixer.
- C. Placing of grout shall be at temperatures of 45 Degrees Fahrenheit to 75 Degrees Fahrenheit. Temperature shall be maintained above 40 Degrees Fahrenheit until strength exceeds 4000 psi.

1 PART 4 MEASUREMENT AND PAYMENT

2 4.01 GENERAL

3 A. Non-shrink grouting shall be paid for at the bid price in accordance with one of the
4 following methods, unless indicated otherwise in the Bid Schedule.

5 B. All work specified herein shall be considered in each of the measurement and
6 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule.

7 4.02 NON-SHRINK GROUTING

8 A. Non-Shrink Grouting, Inclusive. When no quantity is provided, non-shrink grouting
9 shall be considered inclusive to payment for work associated with the related
10 equipment.

11

12

END OF SECTION

1 SECTION 05 05 23

2
3 METAL FASTENINGS

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover furnishing and installing metal fastenings as
7 shown on the contract drawings and as required by equipment manufacturers.

8 1.02 RELATED WORK ELSEWHERE

- 9 A. Cast-in-Place Concrete - Division 03
10 B. Metal Fabrications - Division 05
11 C. Handrails and Railings - Division 05

12 1.03 APPLICABLE PROVISIONS (NONE)

13 1.04 APPLICABLE PUBLICATIONS

- 14 A. The following publications of the issues listed below, but referred to thereafter by
15 basic designation only, form a part of this specification to the extent indicated by the
16 reference thereto.
17 1. American Society for Testing and Materials (ASTM), Annual Book of
18 ASTM Standards, Current Edition.
19 a. ASTM A193 - Standard Specification for Alloy-Steel and Stainless
20 Steel Bolting Materials for High Temperature or High Pressure
21 Service and Other Special Purpose Applications.
22 b. ASTM A307 - Standard Specification for Carbon Steel Bolts and
23 Studs, 60,000 PSI Tensile Strength.
24 c. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat
25 Treated, 120/105 ksi Minimum Tensile Strength.

26 PART 2 PRODUCTS AND MATERIALS

27 2.01 METAL FASTENINGS

- 28 A. Stainless Steel. Metal fastenings shall be B8T, Stabilized 18 Chromium 8 Nickel
29 conforming to the requirements of ASTM A193, furnished with brass nuts.
30 B. Zinc Plated Steel. Metal fastenings shall be S.A.E. Grade 5.
31 C. High-Strength. Metal fastenings shall be ASTM A325.

1 D. Standard Metal Fastenings shall be ASTM A307.

2 PART 3 CONSTRUCTION METHODS

3 3.01 METAL FASTENINGS

4 A. Stainless steel, high strength, and standard metal fastenings shall be used where
5 shown on contract drawings.

6 B. Metal fastenings furnished by equipment manufacturers shall be installed in
7 accordance with manufacturer recommendations.

8 C. Zinc plated steel Metal Fastenings shall be installed in all other locations.

9 PART 4 MEASUREMENT AND PAYMENT

10 4.01 METAL FASTENINGS

11 A. General. Metal fastenings shall be paid for at the bid price in accordance with one of
12 the following methods, unless indicated otherwise in the Bid Schedule.

13 1. Metal Fastenings, Inclusive. When no quantity is provided, metal fastenings
14 shall be considered inclusive to payment for work associated with the related
15 equipment or construction.

16
17 END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. The work under this section shall cover furnishing and installing the fabricated metal hot-dip galvanized guardrails as described in this section and as shown on the contract drawings.

1.02 RELATED WORK ELSEWHERE

- A. Metal Fastenings - Division 05
B. Handrails and Railings - Division 05

1.03 APPLICABLE PROVISIONS (NONE)

1.04 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.

1. ~~The Aluminum Association (AA)~~ American Institute of Steel Construction (AISC), Specifications and Standards:
 - a. ~~AA Sections 6~~ AISC Section 1.23 - Specification for the Design, Fabrication and 7—Aluminum Erection of Structural Steel for Buildings (Riveted, Bolted and Arc-Welded Construction Manual, Specifications for Aluminum Structures,), Current Edition Editions.
 2. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards, Current Editions.
 - a. ASTM B209A36 - Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Carbon Structural Steel, Current Edition.
 - b. ASTM B240A123 - Standard Specification for Aluminum and Aluminum Alloy Drawn Seamless Tubes Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products, Current Edition.
 - c. ASTM B214A153 - Standard Specification for Aluminum and Aluminum Alloy Bar, Rod, and Wire Zinc Coating (Hot-Dip) on Iron and Steel Hardware, Current Edition.
 - d. ASTM B221A283 - Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes Low and Intermediate Tensile Strength Carbon Steel Plates, Current Edition.

- 1 e. ASTM B308A380 - Standard Practice for Cleaning, Descaling, and
2 Passivation of Stainless Steel Parts, Equipment, and Systems,
3 Current Edition.
4 f. ASTM A385 - Standard Practice for Providing High-Quality Zinc
5 Coatings (Hot-Dip), Current Edition.
6 e.g. ASTM A530 - Standard Specification for Aluminum Alloy 6061-
7 T6 Standard Structural Profiles General Requirements for
8 Specialized Carbon and Alloy Steel Pipe, Current Edition.
9 h. ASTM B429A633 - Standard Specification for
10 Aluminum Normalized High-Strength Low-Alloy Extruded
11 Structural Pipe and Tube Steel Plates, Current Edition.
12 i. ASTM B633 - Standard Specification for Electrodeposited Coatings
13 of Zinc on Iron and Steel, Current Edition.
14 f.j. ASTM B766 - Standard Specification for Electrodeposited Coatings
15 of Cadmium, Current Edition.
16 3. American Welding Society (AWS) Specifications and Standards, Current
17 Edition.
18 a. AWS A5.101 - Specification for Bare Aluminum and
19 Aluminum Alloy Welding Carbon Steel Electrodes and Rods for
20 Shielded Metal Arc Welding, Current Edition.

21 1.05 SUBMITTALS

- 22 A. The Contractor shall submit such submittals and/or catalog cuts required for the
23 construction and installation of the materials. These drawings shall be accurate in
24 every detail and shall contain all information necessary to relate the materials to the
25 specifications.
- 26 B. Submittals shall indicate the intended materials arrangement, major support
27 requirements, plot area and all intricate or detailed construction requirements.
28 Information shall be in conformance with requirements of City submittals.

29 PART 2 PRODUCTS AND MATERIALS

30 2.01 METAL SURFACES, GENERAL

- 31 A. For fabrication of miscellaneous metal work which will be exposed to view, use
32 only materials which are smooth and free of surface blemishes including pitting,
33 seam marks, roller marks, rolled trade names and roughness.

1 ~~2.02~~ ALUMINUM ALLOY

2 ~~2.02~~ Aluminum alloy products, unless otherwise specified, shall be Alloy 6061-T6. Aluminum
3 alloy products ~~STEEL~~

4 A. Steel for structural components and assemblies shall meet the requirements of the
5 applicable ASTM StandardStandards as follows:

<u>Product and</u>	<u>Standard</u>
<u>Material</u>	
<u>Sheet and plate</u>	<u>ASTM B209</u>
<u>Drawn seamless tubesCarbon Steel Plates of Structural</u>	
<u>Quality</u>	<u>ASTM A283, Grade C</u>
<u>Structural Steel</u>	<u>ASTM B210A36</u>
<u>Rolled or cold-finished bars, rods and wire</u>	<u>ASTM B211</u>
<u>Extruded bars, rods, wire, shapes and tubes</u>	<u>ASTM B221</u>
<u>Extruded structural pipe and tube</u>	<u>ASTM B429</u>

16 ~~2.03~~ GALVANIZING

17 A. Zinc coatings on products fabricated from rolled, pressed, and forged steel shapes,
18 plates, bars and strip, 1/8 inch thick and heavier shall conform to ASTM A123.

19 B. Zinc coatings on assembled steel products shall meet the requirements of ASTM
20 A123 and shall be applied in conformance with ASTM A385 for the recommended
21 practice for providing high quality zinc coatings on assembled products, unless
22 otherwise specified.

23 C. Zinc coatings on iron and steel hardware shall meet the requirements of ASTM
24 A153, except that bolts, screws and other fasteners, 1/2 inch or less in diameter,
25 may be coated with electro-deposited zinc or cadmium coating meeting the
26 requirements of ASTM B633, Type RS, or ASTM B766, Type TS unless otherwise
27 specified.

28 D. Hot-Dip Galvanizing Touch-Up Paint: Yield shall be 94% pure zinc metallic
29 powder; meet ASTM B-117-64 salt spray (2000 hours); meets performance
30 requirements of MIL-D-46105 and DOD-P-21035A.

31 1. Crown Premium 7007 by Aevoe Industries

32 2. Or equal approved prior to bidding

33 ~~2.032.04~~ WELDING ELECTRODES

34 A. ~~Aluminum~~Steel welding electrodes shall conform to the requirements of AWS
35 A5.101, "Specification for ~~Aluminum and Aluminum Alloy Mild Steel Covered~~
36 ~~Arc-Welding Rods and Bare Electrodes~~," except that they shall be uniformly and

1 heavily coated (not washed) and shall be of such a nature that the coating will not
2 chip or peel while being used with the maximum amperage specified by the
3 manufacturer.

4 PART 3 CONSTRUCTION METHODS

5 3.01 QUALITY ASSURANCE

6 A. Take field measurements prior to preparation of submittals and fabrication, where
7 possible without delay to job progress. Allow for trimming and fitting wherever
8 taking field measurements before fabrication.

9 B. Preassemble items in shop to greatest extent possible to minimize field splicing and
10 assembly. Disassemble units only as necessary for shipping and handling
11 limitations. Clearly mark units for reassembly and installation.

12 3.02 FABRICATION

13 A. Steel shall be structural quality unless otherwise specified. Castings shall be
14 thoroughly cleaned and subjected to careful inspection before installation. Finished
15 surfaces shall be smooth and true to assure proper fit.

16 ~~B. Fabrication of structural aluminum shall meet the requirements of Sections 6 and 7~~
17 ~~of the Aluminum Construction Manual, "Specifications for Aluminum Structures";~~
18 ~~The Aluminum Association.~~

19 3.03 PROTECTIVE COATINGS

20 A. Items specified to be hot-dip galvanized shall be completely fabricated for field
21 assembly before the application of the zinc coatings.

22 ~~B. All aluminum items to be in contact with concrete shall have a bituminous coating.~~

23
24 END OF SECTION

SECTION 05 52 00

RAILINGS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. The work under this section shall cover furnishing and installing all handrails and toe plates at all locations shown on contract drawings and specified herein.

1.02 APPLICABLE PROVISIONS (NONE)

1.03 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.

1. ~~The Aluminum Association (AA), Specifications and Standards:~~
 - a. ~~AA Sections 6 and 7 Aluminum Construction Manual, Specifications for Aluminum Structures, Current Edition.~~
2. ~~American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards:~~
 - a. ~~ASTM B136 Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum, Current Edition.~~
 - b. ~~ASTM B137 Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum, Current Edition.~~
 - c. ~~ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate, Current Edition.~~
 - d. ~~ASTM B210 Standard Specification for Aluminum and Aluminum Alloy Drawn Seamless Tubes, Current Edition.~~
 - e. ~~ASTM B211 Standard Specification for Aluminum and Aluminum Alloy Bar, Rod, and Wire, Current Edition.~~
 - f. ~~ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes, Current Edition.~~
 - g. ~~ASTM B308 Standard Specification for Aluminum Alloy 6061-T6 Standard Structural Profiles, Current Edition.~~
 - h. ~~ASTM B429 Standard Specification for Aluminum Alloy Extruded Structural Pipe and Tube, Current Edition.~~
 - i. ~~ASTM B457 Standard Test Method for Measurement of Impedance of Anodic Coatings on Aluminum, Current Edition.~~
 - j. ~~ASTM B580 Standard Specification for Anodic Oxide Coatings on Aluminum, Current Edition.~~

1 3-1. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational
2 Safety and Health Administration (OSHA), Department of Labor, Part 1926
3 Regulations, Current Edition.

4 1.04 RELATED WORK ELSEWHERE

- 5 A. Metal Fastenings - Division 05
6 B. Metal Fabrications - Division 05

7 1.05 SUBMITTALS

- 8 A. Contractor shall submit such shop drawings and/or catalog cuts required for the
9 construction and installation of the materials and all components. These drawings
10 shall be accurate in every detail and shall contain all information necessary to relate
11 the materials to the specifications. Submittals shall include test data showing
12 railings comply with OSHA requirements.
- 13 B. Submittals shall indicate the intended materials arrangement, dimensions, major
14 support requirements, plot area and all intricate or detailed construction
15 requirements. Information shall be in conformance with requirements of City
16 submittals.

17 PART 2 PRODUCTS AND MATERIALS

18 2.01 MATERIALS

- 19 A. Railings shall be 1-1/2 inch round, ~~6063 anodized aluminum alloy~~, ASTM A53,
20 Grade B Schedule 40 pipe size. Use only materials which are smooth and free of
21 surface blemishes including pitting, seam marks, roller marks, rolled trade names
22 and roughness. Remove such blemishes by grinding or by welding and grinding.
- 23 B. Post members shall be one continuous piece and spaced not more than 6-feet on
24 center.
- 25 C. Railing and connection shall be designed to resist a 200 pound load applied at any
26 point on the handrail system per OSHA requirements.

27 PART 3 CONSTRUCTION METHODS

28 3.01 QUALITY ASSURANCE

- 29 A. Take field measurements prior to preparation of shop drawings and fabrication,
30 where possible, without delay to job progress. Allow for trimming and fitting
31 wherever taking field measurements before fabrications.

- 1 B. Preassemble items in shop to greatest extent possible to minimize field splicing and
2 assembly. Disassemble units only as necessary for shipping and handling
3 limitations. Clearly mark units for reassembly and installation.

4 3.02 FABRICATION

- 5 A. Where details are not shown, top of top guardrail shall be 42 inches above floor.
- 6 B. Fit and shop assemble components in largest practical sizes, for delivery to site.
- 7 C. Fabricate components with joints tightly fitted and secured.
- 8 D. Supply components required for anchorage of fabrications. Fabricate anchors and
9 related components of same material and finish as fabrication, except where
10 specifically noted otherwise.
- 11 E. Railings shall have mechanical connections consisting of internal plugs with
12 stainless steel screws or rivets. Railings shall be mechanically fastened to the
13 building structure.
- 14 F. Continuously seal joined pieces by continuous welds.
- 15 G. Form exposed work true to line and level with accurate angles and surfaces and
16 straight, true edges. Ease exposed edges to a radius of approximately 1/32 inch,
17 unless otherwise shown on the contract drawings. Form bent-metal corners to the
18 smallest radius possible without causing grain separation or otherwise impairing
19 the work. Grind exposed joints flush and smooth with adjacent finish surface.
20 Make exposed joints butt tight, flush, and hairline.
- 21 H. Accurately form components, to each other and to building structure.
- 22 I. ~~Fabrication of structural aluminum shall meet the requirements of Sections 6 and 7~~
23 ~~of the Aluminum Construction Manual, "Specifications for Aluminum Structures",~~
24 ~~The Aluminum Association.~~

25 3.03 INSTALLATION

- 26 A. Perform cutting, welding and fitting required for installation. Set the work
27 accurately in location, alignment and elevation, plumb, level, true and free of rack.
28 Fit exposed connections accurately together to form tight hairline joints.
- 29 B. Do not weld, cut or abrade the surfaces of units which have been coated or finished
30 after fabrication, and are intended for field connections.
- 31 C. Adjust railings prior to securing in place to ensure proper matching at butting joints
32 and correct alignment throughout their length.

1 D. Space posts not more than 6 feet on centers, unless otherwise shown on the contract
2 drawings. Plumb posts in each direction. Secure posts and rail ends to building
3 construction as shown on drawings.

4 E. Expansion joints shall be installed at 24 feet maximum centers.
5
6

END OF SECTION

1 SECTION 07 92 00

2
3 JOINT SEALANTS

4 PART 1 GENERAL

5 1.01 SECTION INCLUDES

- 6 A. Preparing sealant substrate surfaces.
7 B. Sealant and joint backing.

8 1.02 RELATED SECTIONS

- 9 A. Division 03 - Concrete: Sealants used in conjunction with cast-in-place concrete.
10 B. Division 26 - Electrical: Sealants used in conjunction with electrical penetrations.
11 C. Section 33 51 13 – Natural-Gas Piping: Sealants used in conjunction with pipe
12 penetrations.
13 D. Division 40 – Process Integration: Sealants used in conjunction with water, sewer,
14 and wastewater piping penetrations.
15 E. Division 44 – Pollution Control Equipment: Sealants used in conjunction with
16 process mechanical penetrations.

17 1.03 REFERENCES

- 18 A. American Society for Testing and Materials (ASTM) International:
19 1. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
20 2. ASTM C1193 - Standard Guide for Use of Joint Sealants.
21 3. ASTM D1667 - Standard Specification for Flexible Cellular Materials – Poly
22 (Vinyl Chloride) Foam (Closed-Cell).
23 4. ASTM D1056 – Standard Specification for Flexible Cellular Materials -
24 Sponge or Expanded Rubber.
25 B. Sealing and Waterproofers Institute (SWI):
26 1. SWI - Sealant and Caulking Guide Specification.

27 1.04 SUBMITTALS

- 28 A. Product Data: Indicate sealant chemical characteristics, performance criteria,
29 substrate preparation, limitations, and color availability.
30 B. Manufacturer Installation Instructions: Submit special procedures, surface
31 preparation, and perimeter conditions requiring special attention.

- 1 C. Warranty: Include coverage for installed sealants and accessories failing to achieve
2 watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

3 1.05 QUALITY ASSURANCE

- 4 A. Conform to Sealant and Waterproofers Institute requirements for materials.
- 5 B. Use adequate numbers of skilled workmen thoroughly trained and experienced in the
6 necessary crafts and completely familiar with the specified requirements and
7 methods needed for proper performance of the work of this Section.
- 8 C. Applicator qualifications:
- 9 1. Applicator shall have at least three (3) years experience in installing
10 materials of types specified and shall have successfully completed at least
11 three (3) projects of similar scope and complexity.
- 12 2. Applicator shall designate a single individual as project foreman who shall be
13 on site at all times during installation.
- 14 D. Single source responsibility for joint sealants:
- 15 1. Obtain joint sealants from single manufacturer for each different product
16 required to ensure compatibility.
- 17 2. Manufacturer shall instruct applicator in procedures for intersecting sealants.
- 18 E. Perform work in accordance with ASTM C1193 guidelines, except where more
19 stringent requirements are indicated or specified.

20 1.06 ENVIRONMENTAL REQUIREMENTS

- 21 A. Section 01 60 00 - Material and Equipment.
- 22 B. Do not install solvent curing sealants in enclosed building spaces.
- 23 C. Maintain temperature and humidity recommended by the sealant manufacturer
24 during and after installation.

25 1.07 PRODUCT STORAGE AND HANDLING

- 26 A. Section 01 60 00 - Material and Equipment: Product storage and handling
27 provisions.
- 28 B. Deliver the materials to the job site in the manufacturer's unopened containers with
29 all labels intact and legible at time of use.
- 30 C. Store materials in accordance with manufacturer's recommendations with proper
31 precautions to ensure fitness of material when installed.

1 1.08 SEQUENCING AND SCHEDULING

- 2 A. Section 01 31 13 - Project Coordination: Work coordination provisions.
3 B. Coordinate the work of this Section with all Sections referencing this Section.

4 1.09 SUBSTRATE CONDITIONS

- 5 A. Provide joints properly dimensioned to receive the approved sealant system.
6 B. Provide joint surfaces that are clean, dry, sound and free of voids, deformations,
7 protrusions, and contaminants which may inhibit application or performance of the
8 joint sealant.

9 1.10 WARRANTY

- 10 A. Deliver to the Architect signed copies of the following written warranties against
11 adhesive and cohesive failure of the sealant and against infiltration of water and air
12 through the sealed joint for a period of three (3) years from date of completion.
13 1. Manufacturer's standard warranty covering sealant materials.
14 2. Applicator's standard warranty covering workmanship.

15 PART 2 PRODUCTS

16 2.01 GENERAL

- 17 A. Compatibility:
18 1. Provide joint sealants, joint fillers, and accessory joint materials that are
19 compatible with one another and with joint substrates under project
20 conditions.
21 2. Install joint sealants, joint fillers, and related joint materials that are
22 nonstaining to visible joint surfaces and surrounding substrate surfaces.
23 B. Provide colors selected by Architect from manufacturer's standard color range,
24 unless noted otherwise.

25 2.02 SEALANTS

- 26 A. Polyurethane Sealant:
27 1. Tremco Dymeric or BASF MasterSeal NP2.
28 B. Self-Leveling Polyurethane Sealant:
29 1. BASF MasterSeal SL 1, Tremco THC-900, or Vulkem 45SSL.
30 2. For areas where the slope of the slab makes self-leveling material impractical
31 BASF MasterSeal SL 2, Tremco THC-901, or Vulkem 45SSL may be used.
32 3. Color: Match concrete color.

1 2.03 ACCESSORIES

- 2 A. Primer: Non-staining type, as recommended by sealant manufacturer to suit
3 application.
- 4 B. Joint Cleaner: Non-corrosive and non-staining type, as recommended by sealant
5 manufacturer; compatible with joint forming materials.
- 6 C. Backer Rod: Polyethylene foam rod or rope or other compatible non-waxing, non-
7 extruding, non-staining resilient material as recommended by sealant manufacturer,
8 closed cell, sized 25 percent wider than joint width.
- 9 D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit
10 application.
- 11 E. Masking Tape: Non-staining, non-absorbent tape product compatible with joint
12 sealants and adjacent joint surfaces that is suitable for masking.

13 PART 3 EXECUTION

14 3.01 EXAMINATION

- 15 A. Verify that joint openings are ready to receive work and field measurements are as
16 shown on Drawings and recommended by the manufacturer.
- 17 B. Beginning of installation means acceptance of substrates.

18 3.02 PREPARATION

- 19 A. Prepare surfaces to receive sealants in accordance with sealant manufacturer's
20 instructions and recommendations.
- 21 B. Examine joint sizes and correct as required to allow for anticipated movement and to
22 achieve proper width/depth ratio per manufacturer's recommendations for specified
23 sealant.
- 24 C. Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer,
25 whether primers are required or not.
- 26 1. Remove all traces of previous sealant and joint backer by mechanical
27 methods, such as by cutting, grinding and wire brushing, in manner not
28 damaging to surrounding surfaces.
- 29 2. Remove paints from joint surfaces except for permanent, protective coatings.
- 30 3. Remove wax, oil, grease, dirt film residues, temporary protective coatings
31 and other residues by wiping with cleaner recommended for that purpose.
32 Use clean, white, lint-free cloths and change cloths frequently.
- 33 4. Remove loose materials and foreign matter.
- 34 5. Remove dust by blowing clean with oil-free, compressed air.

- 1 D. Verify that joint backing and release tapes are compatible with sealant.
- 2 E. Measure joint dimensions and size materials to achieve required width/depth ratios.
- 3 F. Protect elements surrounding the work of this Section from damage or disfiguration.

4 3.03 INSTALLATION

- 5 A. Install sealant in accordance with manufacturer's instructions, and SWI "Sealant:
6 The Professional's Guide".
- 7 B. Where necessary to protect adjacent surfaces, mask adjacent surfaces with tape prior
8 to priming and/or caulking.
 - 9 1. Use masking tape where required to prevent sealant or primer contact with
10 adjoining surfaces that would be permanently stained or otherwise damaged
11 by such contact or the cleaning methods required for removal.
 - 12 2. Apply tape so as not to shift readily and remove tape immediately after
13 tooling without disturbing joint seal.
- 14 C. Provide backer rod uniformly to depth required by sealant manufacturer for proper
15 joint design using a blunt instrument.
 - 16 1. Fit securely by compressing backer material 25 percent to 50 percent so no
17 displacement occurs during tooling.
 - 18 2. Avoid stretching or twisting joint backer.
 - 19 3. Install to achieve a neck dimension no greater than 1/3 the joint width.
- 20 D. Install bond breaker where backer rod is not used or where recommended by sealant
21 manufacturer, adhering strictly to the manufacturers installation requirements.
- 22 E. Prime joint substrates where required.
 - 23 1. Use and apply primer according to sealant manufacturers recommendations.
 - 24 2. Confine primers to sealant bond surfaces; do not allow spillage or migration
25 onto adjoining surfaces.
 - 26 3. Prime immediately prior to caulking.
- 27 F. Install sealants immediately after joint preparation.
- 28 G. Install sealants to fill joints completely from the back, without voids or entrapped air,
29 using proven techniques, proper nozzles, and sufficient force that result in sealants
30 directly contacting and fully wetting joint surfaces.
- 31 H. Apply sealant within recommended application temperature ranges. Consult
32 manufacturer when sealant cannot be applied within these temperature ranges.
- 33 I. Install sealants to uniform cross-sectional shapes with depths relative to joint widths
34 that allow optimum sealant movement capability as recommended by sealant
35 manufacturer.

- 1 J. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- 2 K. Tool sealants in manner that forces sealant against back of joint, ensures firm, full
3 contact at joint interfaces and leaves a finish that is smooth, uniform and free of
4 ridges, wrinkles, sags, air pockets and embedded impurities. Provide concave tooled
5 joints.
- 6 L. Remove sealant from adjacent surfaces in accord with sealant and substrate
7 manufacturer recommendations as work progresses.
- 8 M. Protect joint sealants from contact with contaminating substances and from damages.
9 Cut out, remove, and replace contaminated or damaged sealants, immediately, so that
10 they are without contamination or damage at time of substantial completion.
- 11 N. Clean adjacent surfaces immediately and leave work neat and clean. Remove excess
12 and droppings using recommended cleaners as work progresses. Remove masking
13 tape immediately after tooling of joints.

14 3.04 CLEANING AND REPAIRING

- 15 A. Clean adjacent soiled surfaces.
- 16 B. Repair or replace defaced or disfigured finishes caused by work of this Section.

17 3.05 PROTECTION OF FINISHED WORK

- 18 A. Protect sealants until cured.
- 19
- 20

END OF SECTION

SECTION 09 96 00

HIGH PERFORMANCE COATINGS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. Work includes field painting of all exposed gas piping and preparation of surfaces to receive coatings.

1.02 WORK NOT INCLUDED

- A. Pre-Finished Items: Unless otherwise indicated, do not paint factory-finished or pre-finished items.
- B. Operating Parts: Do not paint any moving parts of operating units, mechanical and electrical parts such as valve operators, unless otherwise directed or; machined or polished surfaces of equipment where such surfaces are susceptible to rolling or sliding friction.
- C. Labels: Do not paint over any required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates. (This does not include cast or embossed names on equipment castings.)

1.03 APPLICABLE PROVISIONS (NONE)

1.04 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.
 - 1. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards:
 - a. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer and Related Products, Current Edition.
 - 2. Steel Structures Painting Council (SSPC), Specification and Standards:
 - a. Steel Structures Painting Manual, Volume 2, "Systems & Specifications", Current Edition.

1.05 RELATED WORK ELSEWHERE

- A. Section 33 51 13 - Natural-Gas Piping

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Material and Equipment: Product storage and handling provisions.

- 1 B. Deliver products to site in sealed and labeled containers; inspect to verify
2 acceptance.
- 3 C. Container labeling to include manufacturer's name, type of paint, brand name, brand
4 code, coverage, surface preparation, drying time, cleanup, color designation, and
5 instructions for mixing and reducing.
- 6 D. Paint Materials: Store paint materials at minimum ambient temperature of
7 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in well
8 ventilated area, unless required otherwise by manufacturer's instructions.
- 9 E. Store products in ventilated dry areas, protected from contact with soil and from
10 exposure to the elements; keep products dry at all times; restrict storage to paint
11 materials and related equipment; comply with health and fire regulations.
- 12 F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

13 1.07 ENVIRONMENTAL REQUIREMENTS

- 14 A. Material and Equipment: Environmental provisions.
- 15 B. Do not apply materials when surface and ambient temperatures are outside
16 temperature ranges required by paint product manufacturer.
- 17 C. Do not apply exterior coatings during rain or snow, or when relative humidity is
18 above 50 percent, unless required otherwise by manufacturer's instructions.
- 19 D. Minimum Application Temperatures for Paints: 50 degrees F, unless required
20 otherwise by manufacturer's instructions.

21 1.08 CLOSEOUT SUBMITTALS

- 22 A. Closeout Procedures: Project closeout provisions.

23 1.09 EXTRA MATERIAL

- 24 A. Closeout Procedures: Extra material provisions.
- 25 B. Provide one (1) unopened quart container to Owner.
- 26 C. Label each container with color, texture, and room locations in addition to the
27 manufacturer's label.

1 PART 2 PRODUCTS AND MATERIALS

2 2.01 ACCEPTABLE MANUFACTURERS

- 3 A. The products listed are intended to establish a basis for comparison of products of
4 other manufacturers. Substitutions will be permitted but only with the prior written
5 approval of the Engineer.
- 6 B. All materials specified herein, and approved for use under this Contract shall be
7 manufactured by one of the Manufacturers listed as follows: Tnemec, Carboline,
8 Ameron, Dupont, Sherwin-Williams, or equal.

9 2.02 MATERIALS

- 10 A. Provide the best grade (quality) of the various types of coatings as regularly
11 manufactured by approved paint materials manufacturers. Materials not displaying
12 the manufacturer's identification as a standard, best-grade product will not be
13 acceptable. Refer to the "PAINTING/COATING SCHEDULE" in this section for
14 the types of paint and finishes to be applied to the various surfaces throughout the
15 project.
- 16 B. Use only thinners recommended by the manufacturer and then only to the extent
17 expressed on the latest printed data sheet.

18 PART 3 CONSTRUCTION METHODS

19 3.01 JOB CONDITIONS

- 20 A. Environmental Requirements: Comply with manufacturer's recommendations as to
21 environmental conditions under which coating and coating systems may be applied.
22 Do not apply paint in areas where dust is being generated.
- 23 B. Protection: Cover or otherwise protect finished work, surfaces not being painted
24 concurrently, or not to be painted.
- 25 C. Factory Painted Surfaces: The surface preparation and painting of materials and
26 equipment will be to manufacturer's standard unless otherwise specified in
27 applicable portions of these specifications.

28 3.02 SUBSTRATE EXAMINATION

- 29 A. Examine all surfaces to which paint is to be applied, and the conditions under which
30 the work is to be performed. The Applicator shall notify the Contractor and Engineer
31 in writing, of any conditions detrimental to the performance of this work.
- 32 B. Do not proceed with this work until unsatisfactory conditions have been corrected
33 and are acceptable to the Applicator. Starting of painting work will be construed as
34 the Applicator's acceptance of the surfaces and conditions.

1 3.03 SURFACE PREPARATION, GENERAL

2 A. Perform preparation and cleaning procedures in strict accordance with the paint
3 manufacturer's instructions and as herein specified, for each particular substrate
4 condition.

5 B. Remove all hardware, hardware accessories, machined surfaces, plates, and similar
6 items not to be painted, or provide surface applied protection prior to preparation and
7 painting operations. Remove obstructions as necessary to permit complete painting
8 of the items and adjacent surfaces. Following completion of painting of each space
9 or area, install the removed items by workmen skilled in the trades involved.

10 C. Clean surfaces to be painted before applying surface treatments. Remove oil and
11 grease prior to mechanical cleaning. Program the cleaning and painting so that
12 contaminants from the cleaning process will not fall onto wet, newly painted
13 surfaces.

14 3.04 PREPARATION, FERROUS METALS

15 A. Wash steel and iron surfaces with turpentine or mineral spirits to remove dirt and
16 grease. Where rust or scale is present, prepare surface in accordance with the
17 requirements as specified below:

- 18 1. Clean galvanized metal surfaces with turpentine or mineral spirits to remove
19 oily residue. Dry with a clean cloth;
- 20 2. Touch-up paint structural steel, miscellaneous metal, hollow metal doors and
21 frames and other materials which have been prime coated, as required, where
22 shop coat has been damaged by welding or handling and erection; paint
23 rivets, bolts and welds which are unpainted after assembly and erection.
- 24 3. Prepare steel substrates in accordance with the Steel Structures Painting
25 Council surface preparation number indicated in the application schedule and
26 as outlined below, unless otherwise required by the paint manufacturer's
27 most recent printed application instructions:
 - 28 a. SSPC-SP-1-thoroughly wipe with aromatic/ketone solvent using
29 clean rags and solvent;
 - 30 b. SSPC-SP-6-good Commercial Finish;
 - 31 c. SSPC-SP-7-surface Brush Blast using fine sand or grit to obtain
32 finish similar to medium sand paper;
 - 33 d. SSPC-SP-10-surface blast Near-White Metal Finish.

34 B. Apply primer immediately after surface preparation. Clean and touch up shop primer
35 that has become marred.

36 3.05 MATERIAL PREPARATION

37 A. Mix and prepare painting materials in accordance with the manufacturer's directions.
38 Stir materials before application to produce a mixture of uniform density, and stir as

1 required during the application of the materials. Do not stir surface film into the
2 material. Remove the film and, if necessary, strain the material before using.

3 3.06 COLORS

- 4 A. Intermediate coats of paint shall be tinted slightly darker than each preceding coat
5 unless otherwise directed. Undercoats shall be tinted slightly lighter than finish
6 coats.

7 3.07 APPLICATION

- 8 A. Apply paint in accordance with the manufacturer's directions. Use applicators and
9 techniques best suited for the type of material being applied.

- 10 B. Apply each coat at the rate specified by the manufacturer; if material has thickened
11 or must be diluted for application by spray gun, build up coat to the same film
12 thickness achieved with undiluted material; correct deficiencies in film thickness by
13 application of additional coats of paint.

- 14 C. Do not apply exterior paint in cold, foggy, damp or rainy weather. Do not apply
15 paint when temperature is lower than 50 degrees Fahrenheit.

- 16 D. Brush or roll materials smoothly in solid, even colors without drops, runs, lumps,
17 defective brushing, discoloration or clogging of lines and angles. Make edges of
18 paint adjoining other materials or colors sharp and clean without overlapping by
19 masking edges of paint adjoining other materials or colors to obtain sharp, clean
20 division.

- 21 E. Coats shall be thoroughly dry before applying succeeding coats. Unless otherwise
22 approved, allow 48 hours minimum drying time between coats for interior work
23 during favorable drying conditions. (Drying time shall be construed to mean "under
24 normal conditions"; where conditions are other than normal because of weather or
25 because painting must be done in confined spaces, longer drying times will be
26 required.) Do not apply additional coats of paint or place unit in service until paint is
27 thoroughly dry.

- 28 F. Where thinning is necessary, only the products of the manufacturer furnishing the
29 paint, and for the particular purpose, will be allowed; thin paint in strict accordance
30 with the manufacturer's instructions and only with the full knowledge and approval
31 of the Engineer.

- 32 G. Do not apply finish coats until after other trades, whose operations would be
33 detrimental to finish painting, have completed work in the areas to be painted, and
34 the areas have been approved by the Engineer for painting.

- 35 H. At completion, touch up and restore finish where damaged.

1 3.08 PROTECTION

2 A. Protect work of other trades, whether to be painted or not, against damage by
3 painting and finishing work. Correct any damages by cleaning, repairing or
4 replacing, and repainting, as directed by the Engineer. Provide "Wet Paint" signs as
5 required to protect newly painted finishes. Remove temporary protective wrappings
6 provided by others for protection of their work after completion of painting
7 operations.

8 3.09 CLEAN-UP

9 A. During the progress of the work, remove from the project all discarded paint
10 materials, rubbish, cans and rags. Upon completion of painting work, clean all
11 window glass and other paint-spattered surfaces. Remove spattered paint by proper
12 methods of washing and scraping, using care not to scratch or otherwise damage
13 finished surfaces.

14 3.10 PAINTING SCHEDULE

- 15 A. Gas Piping:
- 16 1. Surface Preparation: Blast to the extent of an SSPC-SP-6 Commercial-Grade
17 level of cleanliness and prime before any rust bloom reforms.
 - 18 2. Primer: Spray apply one even coat of Manufacturer, Color, Polyamidoamine
19 Epoxy, to a DFT of 5.0 mils.
 - 20 a. Dupont 25P
 - 21 b. Tnemec Series 69
 - 22 c. Carboline 890
 - 23 d. Ameron Amerlock 400
 - 24 e. Sherwin Williams Macropoxy 646
 - 25 3. Intermediate: Spray apply one even coat of Manufacturer, Color,
26 Polyamidoamine Epoxy, to a DFT of 5.0 mils.
 - 27 a. Dupont 25P
 - 28 b. Tnemec Series 69
 - 29 c. Carboline 890
 - 30 d. Ameron Amerlock 400
 - 31 e. Sherwin Williams Macropoxy 646
 - 32 4. Field Finish: Apply one field finish coat of Manufacturer, Color, Acrylic
33 Polyurethane, to a minimum DFT of 2.0 to 3.0 mils.
 - 34 a. Dupont 326 Imron
 - 35 b. Tnemec Series 73
 - 36 c. Carboline Carbothane 134 HG
 - 37 d. Ameron Amershield
 - 38 e. Sherwin Williams Acrolon 218

39 3.11 COLORS SCHEDULE

40 A. Paint for components listed shall be of the colors scheduled as follows:

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COMPONENT

1. Gas Piping, Natural

COLOR

Orange

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

1.03 DESCRIPTION OF WORK

A. General Requirements

1. Furnish and install complete and operable electrical systems as indicated on the drawings and as specified herein. This includes everything necessary for and incidental to completing the electrical work as specified including but not limited to the following.
2. Provide all electrical work, including conduit, field wiring, and connections by the electrical subcontractor under the provisions of the Electrical Specifications for all aspects of the work, including heating, ventilating, and air conditioning.
3. Coordinate all aspects of the work with the electrical subcontractor and other subcontractors before bidding in order to ensure that all costs associated with a complete installation are included. The owner is not responsible for any change orders due to lack of coordination of the contractor, the electrical subcontractor, the other subcontractors, or suppliers.
4. Provide all trenching, forming, rebar, concrete, back filling, hard surface removal and replacement, for all items associated with the electrical work and installation.

18 B. Design Requirements:

1. The Conduit and Boxes table included in the plan set specifies the usage requirements for the hardware and equipment specified in the following sections:
 - a. Section 26 05 29 Hangars and Supports for Electrical Systems
 - b. Section 26 05 34 Conduit
 - c. Section 26 05 37 Boxes

25 C. Electrical Work Specified Elsewhere:

1. Every attempt has been made to indicate in these specifications and drawings all work required under Division 26. However, there may be additional specific requirements in the specifications, drawings, or addenda of other trades which pertain to the work of this trade, and any such requirements are hereby made a part of the requirements for this trade.

31 D. Design Intent:

1. The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.
2. If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or Drawings, the Contractor shall furnish the item, system, or workmanship that is the highest quality, largest, or most closely fits the design intent.
3. Refer to the General Conditions of the Contract for further clarification of Design Intent.

4. The details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
5. All sizes as given are minimum except as noted.
6. Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to inspections, tests and approval from the commencement until the acceptance of the completed work.
7. Electrical requirements for equipment are based on design data. It shall be the responsibility of the Contractor to verify actual requirements with the provider of the equipment and adjust electrical installation based upon actual requirements.

E. Substitution of Materials:

1. Refer to General Conditions of the Contract.
2. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the specified performance from the system into which these items are placed.

F. Continuity Of Existing Services And Systems:

1. No outages shall be permitted on existing systems except at the time and during the interval(s) coordinated and approved by the Owner and the Engineer. Any outage must be scheduled when the interruption causes the least interference with normal schedules and routines. No extra costs will be paid to the Contractor for such outages that must occur outside of regular weekly working hours.
2. This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible.
3. Contractor shall submit plan for owner and engineer review detailing the proposed sequencing of the installation as it pertains to the continuity of electrical service.

1.04 RELATED WORK ELSEWHERE

- A. Article 102 – Bidding Requirements and Conditions
- B. Article 103 – Award and Execution of the Contract
- C. Concrete – Division 03
- D. Metals – Division 05
- E. Electrical - Division 26
- F. Earthwork – Division 31

- 1 G. Utilities – Division 33
- 2 1.05 SUBMITTALS
- 3 A. Submit shop drawings.
- 4 B. Submittal Requirements for Division 26 Shop Drawings:
- 5 1. Submit individual shop drawings for each section requiring submittal.
- 6 2. Mark general catalog sheets and drawings to indicate specific items being
- 7 submitted and proper identification of equipment by name and/or number,
- 8 as indicated in the contract documents.
- 9 3. Mark dimensions and values in units to match those specified. Include
- 10 wiring diagrams of electrically powered or controlled equipment.
- 11 4. Clearly notate any exceptions taken to these specifications.
- 12 5. Do not release equipment for construction until submittal has been reviewed
- 13 and received engineer approval.
- 14 6. Failure to comply with these requirements does not relieve the Contractor
- 15 of responsibility for meeting the project schedule.
- 16 C. Review of shop drawings shall be for conformance with design concept only and
- 17 will not release the Contractor from fulfilling the terms and intent of the contract
- 18 documents.
- 19 D. Shop Drawings shall be prepared and submitted for the following work:
- 20 1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- 21 (600 V and Less)
- 22 2. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- 23 3. Section 26 05 29 - Hangers and Supports for Electrical Systems
- 24 4. Section 26 05 34 - Conduit
- 25 5. Section 26 05 37 – Boxes
- 26 6. Section 26 05 41 – Wiring Devices
- 27 7. Section 26 05 53 – Identification for Electrical Systems
- 28 8. Section 26 05 73 – Electrical Systems Analysis
- 29 9. Section 26 09 07 – Automatic Transfer Control
- 30 10. Section 26 24 16 – Panelboards
- 31 11. Section 26 28 11 – Circuit Breakers
- 32 12. Section 26 29 13 – Motor Controllers
- 33 13. Section 26 32 13 – Standby Engine Generator Set
- 34 14. Section 26 36 23 – Transfer Switch
- 35 15. Section 26 43 13 – Surge Protection
- 36 16. Section 26 90 00 - Process Instrumentation & Control
- 37 17. Section 26 90 10 – Control Panel Construction
- 38 18. Section 26 90 11 – Control Panel Components
- 39 19. Section 26 90 30 – Programmable Logic Controllers
- 40 20. Section 26 90 60 – Ethernet Networking Equipment

1 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

2 A. Submit operation & maintenance manuals.

3 B. Submittal Requirements for Division 26 Operation/Maintenance Manuals and
4 Instructions:

5 1. Assemble material in three-ring or post binders, using an index at the front
6 of each volume and tabs for each system or type of equipment. In addition
7 to the data indicated in the General Requirements, include the following
8 information:

- 9 a. Copies of as-built shop drawings.
- 10 b. Wiring diagrams for electrically powered or controlled equipment.
11 Drawings to be supplied on 11-inch by 17-inch paper.
- 12 c. Records of tests performed to certify compliance with system
13 requirements
- 14 d. Certificates of inspection by regulatory agencies
- 15 e. Parts lists for manufactured equipment
- 16 f. Preventive maintenance recommendations
- 17 g. Warranties
- 18 h. Additional information as indicated in the technical specification
19 sections

20 1) Test Reports and Demonstration Log:

- 21 a) Permanently record checks and tests and
22 demonstrations.
- 23 b) Submit copy of complete testing or demonstration
24 report no later than 30 days after testing or
25 demonstration is complete.

26 C. Operation & Maintenance Manuals and Instructions shall be prepared and
27 submitted for the following equipment:

- 28 1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
29 (600 V and Less)
- 30 2. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- 31 3. Section 26 05 29 - Hangers and Supports for Electrical Systems
- 32 4. Section 26 05 34 - Conduit
- 33 5. Section 26 05 37 – Boxes
- 34 6. Section 26 05 41 – Wiring Devices
- 35 7. Section 26 05 53 – Identification for Electrical Systems
- 36 8. Section 26 05 73 – Electrical Systems Analysis
- 37 9. Section 26 09 07 – Automatic Transfer Control
- 38 10. Section 26 24 16 – Panelboards
- 39 11. Section 26 28 11 – Circuit Breakers
- 40 12. Section 26 29 13 – Motor Controllers
- 41 13. Section 26 32 13 – Standby Engine Generator Set
- 42 14. Section 26 36 23 – Transfer Switch
- 43 15. Section 26 43 13 – Surge Protection

- 16. Section 26 90 00 - Process Instrumentation & Control
- 17. Section 26 90 10 – Control Panel Construction
- 18. Section 26 90 11 – Control Panel Components
- 19. Section 26 90 30 – Programmable Logic Controllers
- 20. Section 26 90 60 – Ethernet Networking Equipment

6 1.07 FACTORY TESTING

- 7 A. Refer to the requirements the individual technical sections.

8 1.08 QUALITY ASSURANCE

- 9 A. All work and materials shall conform to or exceed in every detail the applicable
10 rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2,
11 the National Electrical Code (ANSI/NFPA 70), other applicable National Fire
12 Protection Association standards, the National Electrical Safety Code, and present
13 manufacturing standards.

- 14 B. All work shall be performed under the direction of a State of Wisconsin Licensed
15 Master Electrician.

- 16 C. All materials shall be listed by and shall bear the label of an approved electrical
17 testing laboratory. If none of the approved electrical testing laboratories has
18 published standards for a particular item, then other national independent testing
19 standards shall apply and such items shall bear those labels. Where one of the
20 approved electrical testing laboratories has an applicable system listing and label,
21 the entire system shall be so labeled.

- 22 D. The following laboratories are approved for providing electrical product safety
23 testing and listing services as required in these specifications:

- 24 1. Underwriters Laboratories Inc.
- 25 2. Electrical Testing Laboratories, Inc.

- 26 E. Certificates And Inspections:

- 27 1. Refer to the General Conditions of the Contract.
- 28 2. Obtain and pay for all required inspections including but not limited to state
29 or local electrical inspections and fuel tank inspections. Deliver original
30 inspection certificates to the Engineer.

31 1.09 WARRANTY

32 1.10 EXTRA MATERIALS

33 1.11 MAINTENANCE

- 34 A. Before substantial completion, perform all maintenance activities required by any
35 sections of the specifications including any calibrations, final adjustments,

1 component replacements or other routine service required before placing
2 equipment or systems into service.

3 B. Furnish all spare parts as required by other sections of the specifications.

4 PART 2 PRODUCTS AND MATERIALS

5 2.01 ACCESS PANELS AND DOORS

6 A. Lay-in Ceilings:

7 1. Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration are
8 sufficient; no additional access provisions are required unless specifically
9 indicated.

10 B. Drywall and Plaster Walls and Ceilings:

11 1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime
12 coated steel for general applications, stainless steel for use in toilets,
13 showers and similar wet areas, concealed hinges, screwdriver operated cam
14 latch for general application, key lock for use in public areas, UL listed for
15 use in fire rated partitions if required by the application. Use the largest size
16 access opening possible, consistent with the space and the equipment
17 needed service; minimum size is 12 x 12 inch.

18 2.02 SEALING AND FIRE-STOPPING

19 A. Refer to Architectural requirements.

20 B. Sealing and fire stopping of sleeves/openings between conduits, cable trays, wire
21 ways, troughs, cable bus, bus duct, etc. and the structural or partition opening shall
22 be the responsibility of the Contractor whose work penetrates the opening.
23 Individuals skilled in such work shall perform the sealing and fire stopping.

24 C. Whenever possible, avoid penetrations of fire and smoke rated partitions. When
25 they cannot be avoided, verify that sufficient space is available for the penetration
26 to be effectively fire and smoke stopped.

27 D. Manufacturers:

28 1. 3M, STI/SpecSeal, Tremco, or approved equal.
29 2. The same manufacturer shall provide all fire stopping systems.
30 3. The Contractor will be responsible for selecting the appropriate UL tested
31 fire stop system for each application required on the project.

32 E. Use a product that has a rating not less than the rating of the wall or floor being
33 penetrated. Reference architectural drawings for identification of fire and/or smoke
34 rated walls and floors.

- 1 F. Contractor shall use fire stop putty, caulk sealant, intumescent wrap strips,
2 intumescent fire stop collars, fire stop mortar or a combination of these products to
3 provide a UL listed system for each application required for this project. Provide
4 mineral wool backing where specified in manufacturer's application detail.

5 2.03 NON-RATED PENETRATIONS

6 A. Conduit Penetrations Through Concrete Wall and Foundation:

- 7 1. In exterior wall openings below grade, use a modular mechanical type seal
8 consisting of interlocking synthetic rubber links shaped to continuously fill
9 the annular space between the uninsulated conduit and the cored opening or
10 a water-stop type wall sleeve.

11 B. Conduit and Cable Tray Penetrations:

- 12 1. At conduit and cable tray penetrations of non-rated interior partitions, floors
13 and exterior walls above grade, use urethane caulk in annular space between
14 conduit and sleeve, or the core drilled opening.

15 PART 3 CONSTRUCTION METHODS

16 3.01 DIVISION OF WORK

- 17 A. The Contractor shall be responsible for coordinating conductor marking and color
18 coding requirements with control system equipment supplier(s).

19 3.02 FIELD MEASUREMENTS

- 20 A. The Contractor shall obtain from the appropriate trades and review shop drawings
21 for all equipment requiring electrical connections.

- 22 B. Field verify all measurements. Do not base electrical installation or equipment
23 locations on the contract drawings. Actual field conditions govern all final installed
24 locations, distances, and levels.

- 25 C. Identify conflicts with the work of other trades prior to installation of electrical
26 system.

- 27 D. Electrical installation shall be based upon shop drawing requirements and field
28 verified measurements. Adjust electrical system installation to satisfy field
29 requirements.

30 3.03 DELIVERY, STORAGE, AND HANDLING

- 31 A. Accept electrical equipment on site. Inspect for damage.

- 32 B. Take precautions to protect electrical equipment from weather, corrosion, and
33 entrance of debris.

1 3.04 INSTALLATION

2 A. Excavation And Backfill:

- 3 1. Perform all excavation and backfill work to accomplish indicated electrical
4 systems installation in accordance with other sections of this specification.

5 B. Concrete Work:

- 6 1. Coordinate the quantity and location of all cast-in-place concrete work with
7 the architectural drawings.
8 2. All cast-in-place concrete will be performed by the General Contractor
9 unless noted otherwise. Provide all layout drawings, anchor bolts, metal
10 shapes, and/or templates required to be cast into concrete or used to form
11 concrete for the support of electrical equipment.

12 C. Cutting And Patching:

- 13 1. Cutting, patching, channeling, and core drilling shall be performed in
14 accordance with the requirements for architectural work.
15 a. Secure the permission of the Engineer before performing any
16 operation likely to affect the strength of a structural member.
17 b. Before cutting, channeling, or core drilling any surface, ensure that
18 no penetration of any other systems will be made.
19 2. Perform all patching to the same quality and appearance as the original
20 work. Employ the proper tradesmen to secure the desired results. Seal
21 around all conduits, wires, and cables penetrating walls, ceilings, and floors
22 in all locations with a fire stop material.
23 3. Seal around conduit penetrations of below grade walls with a waterproof,
24 non-shrink, non-metallic grout, unless otherwise indicated on the typical
25 installation detail.

26 D. Building Access:

- 27 1. Arrange for the necessary openings in the building to allow for admittance
28 of all apparatus. When the building access was not previously arranged and
29 must be provided by this Contractor, restore any opening to its original
30 condition after the apparatus has been brought into the building.

31 E. Equipment Access:

- 32 1. Install all piping, conduit, ductwork, and accessories to permit access to
33 equipment for maintenance. Coordinate the exact location of wall and
34 ceiling access panels and doors, making sure that access is available for all
35 equipment and specialties. Where access is required in plaster or drywall
36 walls or ceilings, furnish access doors and arrange for installation by
37 appropriate trades.

38 F. Working Clearances:

- 39 1. Minimum installed equipment working clearances as required by the NEC
40 shall be maintained.

2. Minimum required dedicated electrical equipment space as required by the NEC shall be maintained.
3. Coordinate these requirements with the work of other trades.
4. Identify conflicts with working space requirements prior to installation of equipment.

G. Coordination:

1. Cooperate with other trades in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the Owner. The Contractor shall check location of electrical outlets with respect to other installations before installing.
2. Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, light fixtures, panel boards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.
3. Coordinate all work prior to installation. Any installed work that is not coordinated and that interferes with the work of another trade shall be removed or relocated at no additional cost to the Owner.
4. Verify the integrity of fire or smoke ratings where penetrations are required.

H. Sleeves:

1. Process Equipment Areas:
 - a. New poured concrete construction: cast in place, Schedule 40, PVC sleeve.
 - b. All other construction: core drill sleeve openings large enough to insert Schedule 40 PVC sleeve and grout around the sleeve.
 - c. Floor penetrations:
 - 1) Extend top of sleeve two inches above the floor.
 - 2) Where installation of sleeve in floor is not practical, provide two inch deep housekeeping pad extending three inches around cast in place conduits.
 - d. Hazardous locations:
 - 1) Sleeve(s) shall be installed per engineer details.
 - 2) Sleeve(s) shall be properly sealed to protect against the passage of flammable gases.
2. Non-Process Equipment Areas:
 - a. Hollow walls: Schedule 40, PVC sleeves, grout around sleeve in masonry construction.
 - b. All other Areas: core drill sleeve openings large enough to insert Schedule 40 PVC sleeve and utilize the core drilled opening as the sleeve.
3. Conduit Support:
 - a. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to the floor structure.

- 1 I. Sealing And Firestopping:
2 1. Fire and/or Smoke Penetrations:
3 a. Install approved product in accordance with the manufacturer's
4 instructions where a pipe (i.e. cable tray, bus, cable bus, conduit,
5 wire way, trough, etc.) penetrates a fire rated surface.
6 b. Where fire stop mortar is used to infill large fire-rated floor openings
7 that could be required to support weight, provide permanent
8 structural forming. Fire stop mortar alone is not adequate to support
9 any substantial weight.
10 2. Non-Rated Surfaces:
11 a. When the opening is through a non-fire rated wall, floor, ceiling or
12 roof the opening must be sealed using an approved type of material.
13 b. Install escutcheons or floor/ceiling plates where conduit,
14 penetrates non-fire rated surfaces in occupied spaces. Occupied
15 spaces for this paragraph include only those rooms with finished
16 ceilings and the penetration occurs below the ceiling.
17 c. In exterior wall openings below grade, assemble rubber links of
18 mechanical seal to the proper size for the conduit and tighten in
19 place, in accordance with the manufacturer's instructions.
20 d. At interior partitions, conduit penetrations are required to be sealed
21 for all areas. Apply sealant to both sides of the penetration in such
22 a manner that the annular space between the conduit sleeve and the
23 conduit is completely filled.
- 24 J. Housekeeping and Clean-up
25 1. On a daily basis, clean up and remove all debris and rubbish resulting from
26 work and repair all damage to new and existing equipment resulting from
27 work.
28 2. Remove all tools, excess material, and unused equipment from the site when
29 job is complete.
- 30 K. General Inspection and Cleaning of Electrical Equipment
31 1. Inspect for physical damage and abnormal mechanical or electrical
32 conditions.
33 2. Any item found to be out of tolerance, or in any other way defective as a
34 result of the required testing, shall be reported to the Engineer. Procedure
35 for repair and/or replacement will be outlined. After appropriate corrective
36 action is completed the item shall be re-tested.
37 3. Compare equipment nameplate information with the Contract Drawings and
38 report any discrepancies.
39 4. Verify proper auxiliary device operation and indicators.
40 5. Check tightness of accessible bolted electrical joints. Use torque wrench
41 method.
42 6. Make a close examination of equipment and remove any shipping brackets,
43 insulation, packing, etc. that may not have been removed during original
44 installation.

- 1 7. Make a close examination of equipment and remove any dirt or other forms
2 of debris that may have collected in existing equipment or in new equipment
3 during installation.
4 8. Vacuum inside of panelboards, switchboards, switchgear, transformer core
5 and coils, horizontal and vertical busducts, MCC's, control panels, and any
6 other similar equipment
7 9. Clean All Equipment:
8 a. Loosen attached particles and vacuum them away.
9 b. Remove any remaining packing material adhesives with suitable
10 cleaning solution.
11 c. Touch-up factory applied finishes damaged during installation using
12 manufacturer approved means to match original finish.

13 3.05 TESTING AND START-UP SERVICES

- 14 A. Refer to the requirements the individual technical sections.
15 B. Make adjustments to the systems furnished under Division 26 in accordance with
16 the equipment manufacturers requirements/recommendations.

17 3.06 TRAINING

- 18 A. Refer to the requirements the individual technical sections.

19 END OF SECTION

1 SECTION 26 05 01

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3 ELECTRICAL DEMOLITION

4 PART 1. GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent applicable. The
9 latest edition accepted by the Authority Having Jurisdiction of the referenced
10 publications in effect at the time of the bid governs.

- 11 1. American National Standards Institute/National Fire Protection Agency
12 (ANSI/NFPA), Specifications and Standards, current edition:
- 13 2. NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
- 14 3. ASTM International (ASTM)
- 15 4. Illuminating Engineering Society (IES). Institute of Electrical and
16 Electronics Engineers (IEEE)
- 17 5. Insulated Cable Engineers Association (ICEA)
- 18 6. International Society of Automation (ISA)
- 19 7. National Electrical Manufacturers Association (NEMA)
- 20 8. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
21 current edition.
- 22 9. Wisconsin Department of Safety and Professional Services (DSPS)
- 23 10. National Electrical Contractors Association (NECA), current edition.
 - 24 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
25 Contracting.
- 26 11. International Electrical Testing Association (NETA)
 - 27 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
28 Power Distribution Equipment and Systems.
- 29 12. Canadian Standards Association (CSA), Specifications and Standards,
30 current edition.
- 31 13. Electrical and Electronic Manufacturers Association Canada (EEMAC),
32 Specifications and Standards, Current Edition.
- 33 14. International Electrotechnical Association (IEC), Specifications and
34 Standards, Current Edition.

35 1.03 DESCRIPTION OF WORK

36 A. General Requirements

- 37 1. Furnish labor and materials to demolish and remodel existing electrical
38 systems as indicated on the drawings and as specified herein. Design
39 Intent:

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- 2. Every effort has been made to identify major demolition and remodeling work required as part of this project. There may, however be minor work items not specifically identified for demolition or remodeling.
- 3. The Contractor shall thoroughly review the demolition drawings and shall include work associated with demolition and remodeling of minor items such as receptacles, exit lights, and control stations affected by the work shown on the demolition drawings.
- 4. Because of the demolition and remodeling work required as part of this project, the Contractor is required to investigate the extent of work on site prior to bidding. Failure to perform this investigation will not relieve the Contractor of responsibility for demolition and remodeling of the minor work items described.

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- B. Construction Methods:
 - 1. Where detailed construction methods are identified for demolition and remodeling of electrical equipment (for example, methods for implementing service change), it is not intended that the methods proposed be the only acceptable methods for completing the work. The Contractor is encouraged to investigate and propose alternate methods which simplify the work.
 - 2. Alternate methods shall be reviewed by the Engineer prior to commencing the work.
 - 3. Only alternate methods which adequately accomplish the goals of the specified methods will be allowed.

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C. Contractor shall furnish labor and materials to demolish all existing electrical gear. All equipment shall be delivered in good condition by the contractor to the Nine Springs Wastewater Treatment Plant at 1610 Moorland Road in the City of Madison. The contractor shall provide two full work days for MMSD to salvage other equipment once the station is off-line. The contact from MMSD regarding salvaging equipment is contact Dan McAdams at MMSD at 608-222-1201 ext 248

30 1.04 RELATED WORK ELSEWHERE

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- A. Article 102 – Bidding Requirements and Conditions
- B. Article 103 – Award and Execution of the Contract
- C. Concrete – Division 03
- D. Metals – Division 05
- E. Electrical - Division 26
- F. Earthwork – Division 31

- 1 G. Utilities – Division 33
- 2 1.05 SUBMITTALS – (NOT USED)
- 3 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 4 1.07 FACTORY TESTING (NOT USED)
- 5 1.08 QUALITY ASSURANCE
- 6 A. All work and materials shall conform to or exceed in every detail the applicable
7 rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2,
8 the National Electrical Code (ANSI/NFPA 70), other applicable National Fire
9 Protection Association standards, the National Electrical Safety Code, and present
10 manufacturing standards
- 11 B. All materials and labor required under this section shall be compatible with existing
12 equipment and conditions.
- 13 1.09 WARRANTY (NOT USED)
- 14 1.10 EXTRA MATERIALS (NOT USED)
- 15 1.11 DESIGN REQUIREMENTS (NOT USED)
- 16 1.12 MAINTENANCE (NOT USED)
- 17 PART 2 PRODUCTS AND MATERIALS (NOT USED)
- 18 PART 3 CONSTRUCTION METHODS
- 19 3.01 DIVISION OF WORK
- 20 A. Contractor shall be responsible for coordinating demolition with subcontractors or
21 other trades.
- 22 3.02 FIELD MEASUREMENTS
- 23 A. Field verify all measurements. Do not base electrical installation or equipment
24 locations on the contract drawings. Actual field conditions govern all final installed
25 locations, distances, and levels.
- 26 B. Verify all circuiting arrangements
- 27 C. Verify that abandoned wiring and equipment serve only abandoned facilities.

1 D. Demolition Drawings are based on casual field observation and existing record
2 documents. Report discrepancies to Engineer before disturbing existing
3 installation.

4 E. The Contractor shall review demolition drawings and existing conditions for the
5 extent of demolition work required.

6 F. Commencement of demolition work indicates that Contractor accepts existing
7 conditions and fully comprehends the extent of demolition work.

8 3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)

9 3.04 INSTALLATION

10 A. Preparation

- 11 1. Identify existing electrical equipment which is to be removed.
- 12 2. Identify existing electrical equipment which is to remain but will be affected
13 by demolition or new construction work.
- 14 3. Identify existing equipment which is to be removed and which the Owner
15 wishes to retain. Owner shall have first right to all removed equipment not
16 specifically being re-used. If Owner retains equipment, Contractor shall
17 transport to designated storage facility located on site. If Owner refuses
18 equipment, Contractor shall be responsible for disposal.
- 19 4. Identify damaged or inoperable existing equipment prior to performing
20 work.
- 21 5. Coordinate utility service outages with user and engineer as well as the
22 Utility Company if applicable.
- 23 6. Maintain access to existing electrical installations, which are to remain
24 active.
- 25 7. Utilize materials and methods compatible with existing electrical
26 installations. Verify existing requirements for compatibility.

27 3.05 GENERAL DEMOLITION OF ELECTRICAL WORK

28 A. Demolition of Electrical Work, Structure Modified:

- 29 1. This paragraph defines requirements for electrical demolition where the
30 surfaces or areas containing the work are to be removed.
- 31 2. Disconnect electrical equipment which is to be removed.
- 32 3. Remove surface mounted and free-standing electrical equipment.
- 33 4. Remove existing wiring to source of supply.
- 34 5. Remove surface mounted conduits and raceways.
- 35 6. Disconnect concealed conduits from equipment which is to remain.
- 36 7. Concealed conduits may be removed with structure which is to be removed.
- 37 8. Transport Owner retained equipment to on-site location as directed by
38 Owner.

1 9. Dispose of all other removed equipment.

2 B. Demolition of Electrical Work, Structure Not Modified:

- 3 1. This paragraph defines requirements for electrical demolition where the
4 surfaces or areas containing the work are to remain.
5 2. Disconnect electrical equipment which is to be removed.
6 3. Remove surface mounted and free-standing electrical equipment.
7 4. Remove existing wiring to source of supply.
8 5. Remove surface mounted conduits and raceways.
9 6. Concealed conduit which is abandoned shall be cut flush with walls and
10 floors. Patch surfaces to match existing finish.
11 7. Transport Owner retained equipment to on-site location as directed by
12 Owner.
13 8. Dispose of all other removed equipment.

14 3.06 GENERAL REMODELING OF ELECTRICAL WORK

15 A. Reconnection of Electrical Equipment

- 16 1. This paragraph defines requirements for electrical remodeling where the
17 conduit and/or conductors connecting existing equipment must be replaced
18 because of remodeling work in the area.
19 2. Thoroughly investigate existing wiring and conduit to determine
20 requirements for reconnection.
21 3. Provide temporary wiring and connections to maintain existing systems in
22 service during construction. Minimize and coordinate necessary outages
23 with the Owner. When work must be performed on energized equipment
24 or circuits, use personnel experienced in such operations.
25 4. Install new conduit and/or wiring as indicated to maintain existing
26 operational characteristics or to provide new operational characteristics.
27 5. Demolish abandoned conduit and wiring as described above.
28 6. Remove temporary work upon completion of the permanent work.

29 B. Relocation of Electrical Equipment

- 30 1. This paragraph defines requirements for electrical remodeling where the
31 existing equipment must be removed and re-installed in a new location and
32 new conduit and conductors must be provided to reconnect the equipment.
33 2. Thoroughly investigate existing wiring and conduit to determine
34 requirements for reconnection.
35 3. Provide temporary wiring and connections to maintain existing systems in
36 service during construction. Minimize and coordinate necessary outages
37 with the Owner. When work must be performed on energized equipment
38 or circuits, use personnel experienced in such operations.
39 4. Remove equipment which is to be relocated.
40 5. Install equipment in designated new location.

SECTION 26 05 02

UTILITY SERVICES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs.

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards current edition:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto
2. ASTM International (ASTM)
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), Standard of Installation, Current Edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

1.03 DESCRIPTION OF WORK

A. Provide and install complete and operable utility services as required on the drawings and as specified herein.

- 1 B. Payment of Electric Utility Company charges for service will be paid by an
2 allowance of \$3,000 which will be adjusted up or down by a change order to the
3 Contract to reflect actual utility company invoices. Contractor handling charges,
4 overhead, and mark-up shall be included in the base bid and are not included under
5 this allowance.
- 6 C. Payment of Gas Utility Company charges for service will be covered by Utility as
7 a new service.
- 8 D. Arrange with Electric Utility for permanent and temporary electric service.
9 1. Electric Service:
10 a. Utility Company: Madison Gas and Electric
11 1) Contact: Tim Cole 608-252-4709
12 b. System Characteristics:
13 1) Facility type: Pump Station
14 2) Required service voltage: 120/208V 3-phase, 4-wire.
15 3) Required service size: 200A.
- 16 E. Arrange with gas utility for permanent and temporary natural gas service as
17 specified herein.
18 1. Natural Gas Service:
19 a. Service Provider: Madison Gas and Electric
20 1) Contact: Holly Powell 608-252-7214
21 b. System Characteristics:
22 1) Required Service Type: Standby Generator
23

24 1.04 RELATED WORK ELSEWHERE

- 25 A. Article 102 – Bidding Requirements and Conditions
26 B. Article 103 – Award and Execution of the Contract
27 C. Concrete – Division 03
28 D. Metals – Division 05
29 E. Electrical - Division 26
30 F. Earthwork – Division 31
31 G. Utilities – Division 33

32 1.05 SUBMITTALS

- 33 A. Submit shop drawings.

- 1 B. The following information shall be submitted specifically for utility services:
2 1. Manufacturer literature sufficient in scope to demonstrate compliance with
3 the requirements of this specification.
4 a. Clearly notate any exceptions taken to these specifications.
5 2. Documentation required by utility company for approval.
6 3. Failure to comply with these requirements does not relieve the Contractor
7 of responsibility for meeting the project schedule.

8 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

9 1.07 FACTORY TESTING (NOT USED)

10 1.08 QUALITY ASSURANCE

11 A. All work and materials shall conform to or exceed in every detail the applicable
12 rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2,
13 the National Electrical Code (ANSI/NFPA 70), other applicable National Fire
14 Protection Association standards, the National Electrical Safety Code, and present
15 manufacturing standards.

16 B. All work shall be performed under the direction of a State of Wisconsin Licensed
17 Master Electrician.

18 C. Service entrance and metering equipment provided under this section shall be UL
19 Listed for the service intended and shall be approved by the utility company.

20 D. All materials, equipment, and parts shall be new and unused of current manufacture.

21 E. Contractor shall be responsible for providing all necessary accessories required for
22 a complete and operable system.

23 1.09 WARRANTY (NOT USED)

24 1.10 EXTRA MATERIALS (NOT USED)

25 1.11 DESIGN REQUIREMENTS (NOT USED)

26 1.12 MAINTENANCE

27 A. Before substantial completion, perform all maintenance activities required by any
28 sections of the specifications including any calibrations, final adjustments,
29 component replacements or other routine service required before placing
30 equipment or systems into service.

31 B. Furnish all spare parts as required by other sections of the specifications.

32 PART 2 PRODUCTS AND MATERIALS (NOT USED)

1 PART 3 CONSTRUCTION METHODS

2 3.01 DIVISION OF WORK

- 3 A. The Contractor shall be responsible for coordinating the division of work as it
4 relates to Utility Services .

5 3.02 FIELD MEASUREMENTS

- 6 A. Field verify all measurements. Do not base electrical installation or equipment
7 locations on the contract drawings. Actual field conditions govern all final installed
8 locations, distances, and levels.

- 9 B. Verify that service equipment is ready to be connected and energized.

- 10 C. Make arrangements with utility company and obtain required inspections before
11 energizing service(s).

- 12 D. Coordinate location of utility company facilities to ensure proper access is
13 available.

14 3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)

15 3.04 INSTALLATION

- 16 A. Install service entrance conduit and conductors in accordance with utility company
17 instructions.

- 18 B. Install metering equipment in accordance with utility company instructions.

19 3.05 TESTING AND START-UP SERVICES

- 20 A. Coordinate start-up and testing with utility company, and ensure proper inspections
21 are completed prior to energizing service(s).

22 3.06 TRAINING (NOT USED)

23 END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS
AND CABLES (600V AND LESS)

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - a. ASTM B800-05 Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers
 - b. ASTM B801-99 Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
 - a. NEMA WC 70/ICEA S-95-658-1999 – Standard for Non-shielded power cables rated 2000 volts or less for the distribution of electrical energy
 - b. NEMA WC 57/ICEA S-73-532 – Standard for control, thermocouple extension, and instrumentation cables.
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA)
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. U.L. 44 - Rubber-Insulated Wires and Cables.
 - b. U.L. 50 - Enclosures for Electrical Equipment.
 - c. U.L. 83 - Thermoplastic-Insulated Wires.
 - d. U.L. 514B - Conduit, Tubing, and Cable Fittings.
 - e. U.L. 758 - 105 degree C Appliance Wiring Materials.
 - f. U.L. 854 - Service Entrance Cables.

- 1 g. U.L. 1063 - Machine-Tool Wires and Cables.
- 2 h. U.L. 1277 - Type TC Power and Control Tray Cables.
- 3 i. U.L. 1569 - Metal-Clad Cables.
- 4 j. U.L. 1581 - Vertical Tray.
- 5 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 6 9. National Electrical Contractors Association (NECA), current edition.
- 7 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
- 8 Contracting.
- 9 10. International Electrical Testing Association (NETA)
- 10 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
- 11 Power Distribution Equipment and Systems.
- 12 11. Canadian Standards Association (CSA), Specifications and Standards,
- 13 current edition.
- 14 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
- 15 Specifications and Standards, Current Edition.
- 16 13. International Electrotechnical Association (IEC), Specifications and
- 17 Standards, Current Edition.

18 1.03 DESCRIPTION OF WORK

- 19 A. Furnish and install complete and operable wire and cable systems as indicated on
- 20 the drawings and as specified herein.

21 1.04 RELATED WORK ELSEWHERE

- 22 A. Article 102 – Bidding Requirements and Conditions
- 23 B. Article 103 – Award and Execution of the Contract
- 24 C. Concrete – Division 03
- 25 D. Metals – Division 05
- 26 E. Electrical - Division 26
- 27 F. Earthwork – Division 31
- 28 G. Utilities – Division 33

29 1.05 SUBMITTALS

- 30 A. Submit shop drawings.
- 31 B. Review of shop drawings shall be for conformance with design concept only and
- 32 will not release the Contractor for fulfilling the terms and intent of the contract
- 33 documents.

- 1 C. The following information shall be submitted specifically for wire and cable:
2 1. Literature sufficient in scope to demonstrate compliance with the
3 requirements of this specification.
4 2. Clearly identify the types, voltage class, and size of wire and cable
5 proposed.
- 6 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
7 1.07 FACTORY TESTING (NOT USED)
8 1.08 QUALITY ASSURANCE
- 9 A. Products: Listed and classified by UL or testing firm acceptable to the authority
10 having jurisdiction as suitable for the purpose specified and indicated.
- 11 B. Wire and cable manufacturers shall be certified to ISO 9001 International Quality
12 Standard and shall have third party certification verifying quality assurance in
13 design/development and production in accordance with ISO 9001.
- 14 C. All materials, equipment, and parts shall be new and unused of current manufacture.
- 15 D. Contractor shall be responsible for providing all necessary accessories required for
16 a complete and operable system.
- 17 1.09 WARRANTY (NOT USED)
18 1.10 EXTRA MATERIALS (NOT USED)
19 1.11 DESIGN REQUIREMENTS (NOT USED)
20 1.12 MAINTENANCE (NOT USED)
- 21 PART 2 PRODUCTS AND MATERIALS
- 22 2.01 WIRE AND CABLE - GENERAL PURPOSE (600V, COPPER)
- 23 A. Manufacturer: Contractor option.
- 24 B. General:
25 1. THWN/THHN general purpose building wire insulated with polyvinyl
26 chloride (PVC) and covered with protective sheath of nylon intended for
27 lighting and power circuits at 600 volts or less, in residential, commercial
28 and industrial buildings.
29 2. The wire shall be suitable for 90 degree C maximum continuous conductor
30 temperature in dry locations and 75 degree C in wet locations and listed by

1 Underwriters Laboratories for use in accordance with the National
2 Electrical Code.

- 3 3. All wire for permanent installation shall be new stranded copper wire
4 delivered to project in unopened cartons or reels, except where specifically
5 noted and be UL listed for the use intended. No wire smaller than 12 AWG
6 shall be used unless specifically noted. The use of multiconductore cable is
7 NOT ALLOWED.

8 C. Conductors:

- 9 1. Class B or Class C stranded, annealed uncoated copper per UL Standard 83
10 or 1063.

11 D. Insulation:

- 12 1. Each conductor shall be insulated with PVC and sheathed with nylon
13 complying with the requirements of UL Standard 83 for Types
14 THHN/THWN and UL Standard 1063 for Type MTW and CSA C22.2 No.
15 75 for T90 Nylon.
16 2. Types THWN/THHN shall comply with the optional Gasoline and Oil
17 Resistant rating of UL Standard 83. The insulation shall also comply with
18 UL requirements for 105 degree C Appliance Wiring Material.
19 3. The average thickness of PVC insulation, for a given conductor size, shall
20 be as specified in UL Standard 83 for Types THWN or THHN. The
21 minimum thickness at any point, of the PVC insulation, shall be not less
22 than 90 percent of the specified average thickness.
23 4. The minimum thickness at any point of the nylon sheath shall be as specified
24 in UL Standard 83 for Types THWN or THHN.
25 5. The PVC insulation shall be applied tightly to the conductor and shall be
26 free-stripping.

27 E. Identification:

- 28 1. The wire shall be identified by surface marking indicating manufacturer's
29 identification, conductor size and metal, voltage rating, UL Symbol, type
30 designations and optional ratings. The wire shall also be identified as C(UL)
31 Type T90 Nylon or TWN75, FT1.

32 F. Tests:

- 33 1. Wire shall be tested in accordance with the requirements of UL Standard 83
34 for Types THWN or THHN wire and for the optional Gasoline and Oil
35 Resistant listings; as Type MTW to UL Standard 1063 (stranded items); as
36 AWM to UL Standard 758 (stranded items); and as C(UL) Type T90 Nylon
37 or TWN75.

38 G. Usage:

- 39 1. General use power wiring, minimum size No.12 AWG.

2. General use for field wiring associated with starter enclosures, control panels and supervisory control systems, minimum size No.14 AWG.
3. Control wiring within control panels and supervisory control stations shall be minimum size No. 18 AWG.
4. All connections and feeders to rotating and/or vibrating equipment.-
5. All control wiring within starter enclosures, control panels, and supervisory control stations shall be 600-volt, insulation type THHN/THWN/TFFN or MTW. All field control wiring shall be 600-volt rated, insulation-type THHN/THWN.
6. Minimum size for field wiring associated with control panels and supervisory control stations shall be 14 AWG. Control wiring within control panels and supervisory control stations shall be minimum 18 AWG
7. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on drawings.

2.02 WIRE AND CABLE - GENERAL PURPOSE (~~600V, ALUMINUM~~)

A. Manufacturer: Contractor option. (Follow schedule and provisions set on the plans.)

B. General:

1. XHHW-2 general purpose building wire insulated with cross linked polyethylene intended for service and feeder circuits at 600 volts or less, in residential, commercial and industrial buildings.
2. The wire shall be suitable for 90 degree C maximum continuous conductor temperature in wet or dry locations and listed by Underwriters Laboratories for use in accordance with the National Electrical Code.
3. All wire for permanent installation shall be new stranded copper wire delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multiconductore cable is NOT ALLOWED.

C. Conductors:

1. Compact stranded aluminum AA-8000 series alloy conductors of a recognized Aluminum Association 8000 Series aluminum alloy per ASTM B800-05 and constructed in accordance with the specifications of ASTM B801-99.

D. Insulation:

1. Each conductor shall be insulated with cross linked polyethylene complying with the requirements of UL Standard 83 for Type XHHW-2.
2. Type XHHW-2 shall comply with the optional Gasoline and Oil Resistant rating of UL Standard 83.

1 3. The average thickness of cross linked polyethylene insulation, for a given
2 conductor size, shall be as specified in UL Standard 83 for Types XHHW-
3 2. The minimum thickness at any point shall be not less than 90 percent of
4 the specified average thickness.

5 E. Identification:

6 1. The wire shall be identified by surface marking indicating manufacturer's
7 identification, conductor size and metal, voltage rating, UL Symbol, type
8 designations and optional ratings.

9 F. Tests:

10 1. Wire shall be tested in accordance with the requirements of UL Standard 83
11 for Types XHHW-2 wire and for the optional Gasoline and Oil Resistant
12 listings.

13 G. Usage:

- 14 1. Service and feeder circuit wiring, minimum size No.2 AWG.
15 2. All connections and feeders to rotating and/or vibrating equipment.
16 3. Wiring for feeders and branch circuits 12 AWG and larger shall be 600 volt
17 insulation type XHHW-2.

18 2.03 SHIELDED POWER CABLE (600V)

19 A. Manufacturer: Contractor option.

20 B. General:

- 21 1. Three conductor type TC Tray Cable insulated with cross linked
22 polyethylene and PVC jacket overall, for use on circuits rated 600 volts and
23 90 degree C maximum continuous conductor temperature in wet or dry
24 locations.
25 2. Cables approved for installation in cable trays in accordance with the NEC
26 and for installation in air, in ducts or conduits, in tray or trough, in open
27 wiring or direct buried.

28 C. Conductors:

- 29 1. Shall be Class B stranded uncoated soft copper.
30 2. Suitable separator over the conductor may be used at the option of the
31 manufacturer.
32 3. Three phase conductors shall be cabled together with a Class B stranded,
33 uncoated copper grounding conductor and suitable non-hygroscopic fillers
34 to make round.
35 4. Length of lay shall not exceed 35 times the phase conductor diameter.
36 5. The grounding conductor shall comply with the requirements of UL
37 Standard 1277.

1 6. The cable assembly shall be covered with a copper tape shield with drain
2 wire, applied with a 10 percent minimum lap.

3 D. Insulation:

- 4 1. Each phase conductor shall be insulated with chemically cross linked
5 polyethylene, meeting Type XHHW-2 requirements of Underwriters
6 Laboratories.
7 2. The average thickness of insulation shall be as specified in UL Standard 44
8 for Type XHHW-2 conductors. The minimum thickness at any point shall
9 be not less than 90 percent of the specified average thickness.
10 3. The insulated phase conductors shall be black in color and shall be printed
11 with the numerals "1", "2", and "3" on their surface.
12 4. Each cable shall have a PVC protective jacket applied over the taped
13 assembly. The jacket shall meet the Sunlight Resistant requirements of UL
14 Standard 1277.
15 5. The average jacket thickness shall be in accordance with UL Standard 1277.
16 The minimum thickness at any point shall be not less than 80 percent of the
17 specified average thickness.

18 E. Identification:

- 19 1. Cables shall be identified by means of surface ink printing indicating
20 manufacturer, number of conductors, size, voltage rating, and required UL
21 information.

22 F. Tests:

- 23 1. Individual conductors and completed cables shall be tested in accordance
24 with UL requirements for Type TC Power Control Tray Cables having
25 XHHW-2 conductors.
26 2. Cables shall be capable of passing the ribbon burner cable tray flame test
27 requirements of UL and IEEE.

28 G. Usage:

- 29 1. Power wiring for motor loads controlled by adjustable frequency drives,
30 where so indicated on the drawings.

31 2.04 SHIELDED POWER CABLE - ARMORED (600V)

32 A. Manufacturer: Contractor option.

33 B. General:

- 34 1. Three conductor type TC Tray Cable insulated and armored, with cross
35 linked polyethylene and PVC jacket overall, for use on circuits rated 600
36 volts and 90 degree C maximum continuous conductor temperature in wet
37 or dry locations.

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2. Cables approved for installation in cable trays in accordance with the NEC and for installation in air, in ducts or conduits, in tray or trough, in open wiring or direct buried.

4 C. Conductors:

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1. Shall be Class B stranded uncoated soft copper.
 2. Suitable separator over the conductor may be used at the option of the manufacturer.
 3. Three phase conductors shall be cabled together with a Class B stranded, uncoated copper grounding conductor and suitable non-hygroscopic fillers to make round.
 4. Length of lay shall not exceed 35 times the phase conductor diameter.
 5. The grounding conductor shall comply with the requirements of UL Standard 1277.
 6. The cable assembly shall be covered with a copper tape shield with drain wire, applied with a 10 percent minimum lap.

16 D. Insulation:

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1. Each phase conductor shall be insulated with chemically cross linked polyethylene, meeting Type XHHW-2 requirements of Underwriters Laboratories.
 2. The average thickness of insulation shall be as specified in UL Standard 44 for Type XHHW-2 conductors. The minimum thickness at any point shall be not less than 90 percent of the specified average thickness.
 3. The insulated phase conductors shall be black in color and shall be printed with the numerals "1", "2", and "3" on their surface.
 4. Each cable shall have a PVC protective jacket applied over the taped assembly. The jacket shall meet the Sunlight Resistant requirements of UL Standard 1277.
 5. The average jacket thickness shall be in accordance with UL Standard 1277. The minimum thickness at any point shall be not less than 80 percent of the specified average thickness.

31 E. Armor:

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1. Impervious, corrugated continuous seam-welded aluminum alloy sheath per UL 1569.
 2. Armor shall be pressure tested and shall meet grounding requirements of NEC article 250.

36 F. Cable end fittings:

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1. Manufacturer:
 - a. Hubbell Killark Clencher 2000 MCR series.
 - b. Or equal.
 2. Fittings shall be designed for termination of continuously corrugated or interlocked armor type cables.

- 1 3. Fittings shall comply with the following:
2 a. Heavy-duty nickel-plated brass construction.
3 b. Moisture-sealing O-ring to prevent entry of moisture under cable
4 armor.
5 c. Cable jacket and O-ring seals.
6 d. Stainless-steel compression spring for positive electrical connection
7 and compliance with UL requirements.
8 4. Testing:
9 a. Short-circuit testing shall comply with requirements of UL-514B.
10 b. Corrosion testing shall comply with requirements of UL-50.

- 11 G. Identification:
12 1. Cables shall be identified by means of surface ink printing indicating
13 manufacturer, number of conductors, size, voltage rating, and required UL
14 information.

- 15 H. Tests:
16 1. Individual conductors and completed cables shall be tested in accordance
17 with UL requirements for Type TC Power Control Tray Cables having
18 XHHW-2 conductors.
19 2. Cables shall be capable of passing the ribbon burner cable tray flame test
20 requirements of UL and IEEE.

- 21 I. Usage:
22 1. Power wiring for motor loads controlled by adjustable frequency drives,
23 where so indicated on the drawings.

24 2.05 SHIELDED INSTRUMENTATION CABLE (300V)

- 25 A. Manufacturer: CONTRACTOR option.

26 B. General

- 27 1. Power limited tray cable - two conductor, No.16 AWG (7x24) bare copper,
28 PVC insulation, overall shield with No.18 AWG (7x26) tinned copper drain
29 wire, PVC jacket with nylon ripcord.
30 2. Power limited tray cable - three conductor, No.16 AWG (7x24) bare copper,
31 PVC insulation, overall shield with No.18 AWG (7x26) tinned copper drain
32 wire, PVC jacket with nylon ripcord.

33 C. Electrical Characteristics:

- 34 1. Max. Operating voltage: 300Vrms.
35 2. Conductor DC resistance at 20 deg. C: 3.7 Ohms/1000 ft.
36 3. Shield DC resistance at 20 degrees C: 5.1 Ohms/1000 ft.
37 4. Capacitance between conductors at 1 kHz: 61 pF/ft.
38 5. Capacitance between conductor and shield at 1 kHz: 114 pF/ft.

- 1 6. Inductance: 0.19 uH/ft.
- 2 D. Physical Characteristics:
- 3 1. Temperature rating: -30 to 105 degrees C.
- 4 2. Insulation material: PVC.
- 5 3. Average insulation thickness: 0.016-in.
- 6 4. Jacket material: Sun resistant PVC.
- 7 5. Jacket thickness: 0.037-in. nominal.
- 8 6. Shield: Aluminum/Polyester, 100 percent coverage.
- 9 7. Overall lay length: 2-in. (6 twists/ft).
- 10 8. Maximum pulling tension: 94 lbs.
- 11 9. Minimum bend radius: 2.6-in.
- 12 10. Flame resistance: UL 1581 vertical tray.
- 13 E. Usage:
- 14 1. Instrumentation cable.
- 15 2. Control wiring for supervisory equipment shall be shielded, sized per
- 16 equipment manufacturer's recommendations, or as shown on drawings.

17 PART 3 CONSTRUCTION METHODS

18 3.01 DIVISION OF WORK (NOT USED)

19 3.02 FIELD MEASUREMENTS

- 20 A. Field verify all measurements. Do not base electrical installation or equipment
- 21 locations on the contract drawings. Actual field conditions govern all final installed
- 22 locations, distances, and levels.
- 23 B. Identify conflicts with the work of other trades prior to installation of electrical
- 24 system.
- 25 C. Adjust electrical system installation to satisfy field requirements.

26 3.03 DELIVERY, STORAGE, AND HANDLING

- 27 A. Accept electrical equipment on site. Inspect for damage.
- 28 B. Take precautions to protect electrical equipment from weather, corrosion, and
- 29 entrance of debris.

30 3.04 INSTALLATION

- 31 A. Pre-Installation:
- 32 1. Verify that interior of building has been protected from weather.
- 33 2. Verify that mechanical work likely to damage wire has been completed.

- 1 3. Completely and thoroughly swab raceway prior to installation.
- 2 4. Verify that field measurements are as shown on drawings.
- 3 5. Wire and cable routing shown on drawings is approximate unless
- 4 dimensioned. Route wire and cable to satisfy project conditions.
- 5 6. Where wire and cable routing is not shown, and destination only is
- 6 indicated, determine exact routing and lengths required.
- 7 7. Determine required separation between cable and other work.
- 8 8. Determine cable routing to avoid interference with other work.
- 9 9. Any single conduit or raceway utilized for a feeder circuit shall contain only
- 10 power conductors of a single feeder circuit. Do not combine feeder circuits
- 11 without engineer's written approval.
- 12 10. Contract drawings indicate individual homerun equipment connections.
- 13 Contractor may combine branch circuits of common types in single conduits
- 14 provided the following conditions are met:
- 15 a. NEC requirements for conductor de-rating are satisfied.
- 16 b. Conduit fill does not exceed thirty percent. Ten percent fill shall be
- 17 reserved for future use.
- 18 11. No more than eight 24VDC analog circuits may be combined in a single
- 19 conduit unless specifically stated otherwise on the drawings.

- 20 B. Conductor Sizing:
- 21 1. Conductor sizes are based on copper unless otherwise noted.
 - 22 2. Use conductor not smaller than No.12 AWG for power and lighting circuits.
 - 23 3. Use No.10 AWG conductors for 20 ampere, 120-volt branch circuits longer
 - 24 than 75 feet.
 - 25 4. Where circuit wiring length exceeds length identified on the feeder
 - 26 schedule, increase wire size as needed to maintain a maximum voltage drop
 - 27 of three percent.
 - 28 5. Use conductor not smaller than No.14 AWG for control circuits.
 - 29 6. Unless shown otherwise on the contract drawings, power wiring shall be
 - 30 No.12 AWG.

- 31 C. Color-coding
- 32 1. See Section 26 05 53 – Identification for Electrical Systems for additional
 - 33 requirements.
 - 34 2. All wire shall be color coded using electrical tape in sizes where colored
 - 35 insulation is not available. Where tape is used as the identification system,
 - 36 it shall be applied in all junction boxes, manholes and other accessible
 - 37 intermediate locations as well as at each termination.
 - 38 3. The following color coding shall be used:

System	Wire	Color
240/120 Volts	Neutral	White
Single-Phase, 3 Wire	Line 1	Black
	Line 2	Red

1	208Y/120 Volts	Neutral	White
2	3-Phase, 4 Wire	Phase A	Black
3		Phase B	Red
4		Phase C	Blue
5	480Y/277 Volts	Neutral	Gray
6	3-Phase, 4 Wire	Phase A	Brown
7		Phase B	Orange
8		Phase C	Yellow
9	120 Volt	Control	Red
10	24 Volt	Positive	Purple
11		Common	Purple/White Stripe

- 12 D. Wire Pulling:
- 13 1. Pull all conductors into raceway at same time.
- 14 2. No.4 AWG and larger wire and power cables shall lubricated with UL
- 15 approved pulling lubricant to reduce pulling tension and abrasion damage.
- 16 The lubricant shall be water or wax based containing no oils or greases that
- 17 may adversely affect cable jackets.
- 18 3. The minimum bend radius and maximum pulling tension ratings of the wire
- 19 and cable shall not be exceeded.

- 20 E. Splices and Terminations:
- 21 1. Splices and terminations shall not be made within raceways.
- 22 2. Clean conductor surfaces before splicing or terminating.
- 23 3. Make splices, taps, and terminations to carry full amp capacity of
- 24 conductors with no perceptible temperature rise.
- 25 4. Insulated spring wire connectors may be used to splice 120V power circuits.
- 26 5. Control, communication, and data transmission wire and cable shall not be
- 27 spliced.
- 28 6. Use split bolt connectors for copper conductor splices and taps, 6 AWG and
- 29 larger. Tape uninsulated conductors and connector with electrical tape to
- 30 150 percent of insulation rating of conductor.
- 31 7. Use solderless pressure connectors with insulating covers for copper
- 32 conductor splices and taps, 8 AWG and smaller.
- 33 8. Use insulated spring wire connectors with plastic caps for copper conductor
- 34 splices and taps, 10 AWG and smaller.

- 35 F. Motors:
- 36 1. Motor wiring to motors less than 10 horsepower shall be spliced and
- 37 terminated with fully insulated crimp-on end cap with a layer of self-
- 38 vulcanizing rubber tape, followed by five layers of vinyl electrical tape.
- 39 "SkotchLocks" and similar devices shall not be used.
- 40 2. Motor wiring to motors 10 horsepower or larger shall be spliced and
- 41 terminated with crimp-on ring terminal lugs, brass nuts, bolts and washers

1 with a layer of self-vulcanizing rubber tape, followed by five layers of vinyl
2 electrical tape. "SkotchLocks" and similar devices shall not be used.

3 G. Unshielded power cables:

- 4 1. Unshielded power cables shall be spliced and terminated with crimp-on ring
5 terminal lugs, brass nuts, bolts and washers with a layer of self-vulcanizing
6 rubber tape, followed by five layers of vinyl electrical tape. "SkotchLocks"
7 and similar devices shall not be used.

8 H. Aluminum Conductor Connections:

- 9 1. Do not transition from copper to aluminum conductor when extending
10 existing copper conductors.
- 11 2. Mechanical Screw Type Connectors:
- 12 a. Connectors shall be dual rated (AL7CU or AL9CU) and Listed by
13 UL for use with aluminum and copper conductors and sized to
14 accept aluminum conductors of the ampacity specified.
- 15 b. Using a suitable stripping tool, to avoid damage to the conductor,
16 remove insulation from the required length of the conductor.
- 17 c. Clean the conductor surface using a wire brush and apply a listed
18 joint compound.
- 19 d. Tighten the connection per the connector manufacturer's
20 recommendation.
- 21 e. Wipe off any excess joint compound.
- 22 3. Mechanical Compression Type Connectors:
- 23 a. Connectors shall be dual rated (AL7CU or AL9CU) and Listed by
24 UL for use with aluminum and copper conductors and sized to
25 accept aluminum conductors of the ampacity specified.
- 26 b. The lugs shall be marked with wire size, die index, number and
27 location of crimps and shall be suitably color coded. Lug barrel shall
28 be factory prefilled with a joint compound Listed by UL.
- 29 c. Using a suitable stripping tool, to avoid damage to the conductor,
30 remove insulation from the required length of the conductor.
- 31 d. Clean conductor surface using a wire brush.
- 32 e. Crimp the connection per the connector manufacturer's
33 recommendation.
- 34 f. Wipe off any excess joint compound.
- 35 4. Termination of Aluminum Conductor to Aluminum Bus:
- 36 a. Prepare a mechanical screw or compression type connection.
- 37 b. Hardware:
- 38 1) Bolts: Anodized aluminum alloy 2024-T4 and conforming
39 to ANSI B18.2.1 and to ASTM B211 or B221 chemical and
40 mechanical property limits.
- 41 2) Nuts: Aluminum alloys 6061-T6 or 6262-T9 and
42 conforming to ANSI B18.2.2.

1 G. Perform an infrared survey of all aluminum conductor connections after the
2 installation is complete and in normal service. Infrared surveys shall be performed
3 with a minimum of 30 percent of rated full load. All connections with elevated
4 temperatures shall be corrected by the contractor.

5 3.06 TRAINING (NOT USED)

6 END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
 - b. ANSI/NFPA 99 - Health Care Facilities.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE), Specifications and Standards, current edition
 - a. IEEE 837 – Standard for Qualifying Permanent Connections Used in Substation Grounding.
 4. Insulated Cable Engineers Association (ICEA)
 5. International Society of Automation (ISA)
 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, Current Edition
 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL 467 – Ground and Bonding Equipment
 8. Wisconsin Department of Safety and Professional Services (DSPS)
 9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
 10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
 12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
 13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

- 1 1.03 DESCRIPTION OF WORK
- 2 A. Furnish and install complete and operable grounding and bonding systems as
3 indicated on the drawings and as specified herein including but not limited to:
4 1. Grounding electrodes.
5 2. Bonding jumpers.
6 3. Ground connections.
- 7 B. Provide bonding jumpers and wire, grounding bushings, clamps and
8 appurtenances required for complete grounding system to bond equipment and
9 raceways to equipment grounding conductors.
- 10 1.04 RELATED WORK ELSEWHERE
- 11 A. Article 102 – Bidding Requirements and Conditions
- 12 B. Article 103 – Award and Execution of the Contract
- 13 C. Concrete – Division 03
- 14 D. Metals – Division 05
- 15 E. Electrical - Division 26
- 16 F. Earthwork – Division 31
- 17 G. Utilities – Division 33
- 18 1.05 SUBMITTALS
- 19 A. Submit shop drawings.
- 20 B. Review of shop drawings shall be for conformance with design concept only and
21 will not release the Contractor for fulfilling the terms and intent of the contract
22 documents.
- 23 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 24 1.07 FACTORY TESTING (NOT USED)
- 25 1.08 QUALITY ASSURANCE
- 26 A. Measure ground resistance from system neutral connection at service entrance to
27 convenient ground reference point using suitable ground testing equipment.
28 Resistance shall not exceed 2 ohms. Additional grounding electrodes shall be
29 used to satisfy ground resistance requirements where required by earth conditions.
- 30 B. All grounding components and materials shall be UL listed and labeled.

1 1.09 WARRANTY (NOT USED)

2 1.10 EXTRA MATERIALS (NOT USED)

3 1.11 DESIGN REQUIREMENTS (NOT USED)

4 1.12 MAINTENANCE

5 A. Before substantial completion, perform all maintenance activities required by any
6 sections of the specifications including any calibrations, final adjustments,
7 component replacements or other routine service required before placing
8 equipment or systems into service.

9 PART 2 PRODUCTS AND MATERIALS

10 2.01 ROD ELECTRODE

11 A. Material: Copper-clad steel.

12 B. Diameter: 3/4-inch minimum.

13 C. Length: 10-feet minimum. Rod shall be driven at least 9.5-feet deep.

14 D. Use one or more ground rods to obtain the minimum specified ground resistance.
15 This applies to manholes, padmount switches, transformers, service entrances,
16 and all other equipment requiring a supplemental grounding electrode. Minimum
17 of three ground rods shall be used to ground the service entrance as indicated on
18 plans.

19 2.02 MECHANICAL CONNECTORS

20 A. The mechanical connector bodies shall be manufactured from high strength, high
21 conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers
22 shall be made of silicon bronze and supplied as a part of the connector body and
23 shall be of the two bolt type.

24 B. Split bolt connector types are not allowed.

25 C. The connectors shall meet or exceed UL 467 and be clearly marked with the
26 catalog number, conductor size and manufacturer.

27 2.03 COMPRESSION CONNECTORS

28 A. The compression connectors shall be manufactured from pure wrought copper.
29 The conductivity of this material shall be no less than 99 percent.

30 B. The connectors shall meet or exceed the performance requirements of IEEE 837,
31 latest revision.

- 1 C. The installation of the connectors shall be made with a compression, tool and die
2 system, as recommended by the manufacturer of the connectors.
- 3 D. The connectors shall be clearly marked with the manufacturer, catalog number,
4 conductor size and the required compression tool settings.
- 5 E. Each connector shall be factory filled with an oxide-inhibiting compound.
- 6 F. Connector to be suitable for direct burial in earth and concrete.

7 2.04 EXOTHERMIC CONNECTIONS

- 8 A. Select the appropriate kit for specific types, sizes, and combinations of conductors
9 and other items to be connected. Field personnel shall be trained in execution of
10 welds.

11 2.05 WIRE

- 12 A. Material: Stranded copper (aluminum not permitted).
- 13 B. Grounding Electrode Conductor: Size as shown on drawings, specifications or as
14 required by NFPA 70, whichever is larger.
- 15 C. Manhole and Vault Bonding: No. 4/0 minimum.
- 16 D. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings,
17 specifications or as required by NFPA 70, whichever is larger. Differentiate
18 between the normal ground and the isolated ground when both are used on the
19 same facility.

20 PART 3 CONSTRUCTION METHODS

21 3.01 DIVISION OF WORK (NOT USED)

22 3.02 FIELD MEASUREMENTS

- 23 A. Field verify all measurements. Do not base electrical installation or equipment
24 locations on the contract drawings. Actual field conditions govern all final
25 installed locations, distances, and levels.
- 26 B. Identify conflicts with the work of other trades prior to installation of electrical
27 system.
- 28 C. Adjust electrical system installation to satisfy field requirements.

1 3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)

2 3.04 INSTALLATION

3 A. General:

- 4 1. Verify that final backfill and compaction has been completed before
5 driving rod electrodes.
- 6 2. Install products in accordance with manufacturer instructions.
- 7 3. Mechanical connections shall be accessible for inspection and checking.
8 No insulation shall be installed over mechanical ground connections.
- 9 4. Ground connection surfaces shall be cleaned and all connections shall be
10 made so that it is impossible to move them.
- 11 5. Attach grounds permanently before permanent building service is
12 energized.
- 13 6. Install rod electrodes at locations indicated or as required by local code,
14 whichever requires the most rods. Install additional rod electrodes as
15 required to achieve specified resistance to ground.
- 16 7. Connect grounding electrode conductor and reinforcing steel in foundation
17 footing. Bond steel together.
- 18 8. Bond all conductive components to meet Regulatory Requirements.
- 19 9. Bond together metal siding not attached to grounded structure; bond to
20 ground.
- 21 10. All separate ground wires shall be enclosed in rigid galvanized steel
22 conduit and bonded at both ends to the rigid galvanized steel conduit with
23 an approved fitting.
- 24 11. Provide a separate grounding conductor for each motor and connect at
25 motor terminal box. Do not use bolts securing motor box to frame or cover
26 for grounding conductors:
 - 27 a. When grounding motors driven by variable frequency drives
28 (VFD) comply with the requirements of the VFD manufacturer.

29 B. Less than 600 volt system grounding:

- 30 1. Supplementary Grounding Electrode: Use driven ground rod on exterior
31 of building.
- 32 2. Copper grounding electrode conductor shall be sized as indicated or as
33 required by NEC, whichever is larger and shall be extended from
34 secondary service system neutral to street side of water meter, building
35 steel, ground rod, and any concrete encased electrodes. Bonding jumper
36 shall be installed around water meter. Install conductor in separate rigid
37 conduit. Bond conduit as described above.
- 38 3. Receptacle Grounding: All receptacles installed shall have a separate
39 grounding contact.
- 40 4. Bond together system neutrals, service equipment enclosures, exposed
41 non-current carrying metal parts of electrical equipment, metal raceway
42 systems, grounding conductor in raceways and cables, receptacle ground
43 connectors, and plumbing systems.

- 1 5. Bond together each metallic raceway, pipe, duct and other metal objects.
- 2 6. Equipment Grounding Conductor: Separate, insulated green conductor
- 3 shall be installed within each raceway and cable tray, sized per NEC or as
- 4 indicated in the contract documents whichever is larger. Terminate each
- 5 end on suitable lug, bus, enclosure or bushing, per NEC. Install a ground
- 6 wire from each device to the respective enclosure.

7 3.05 TESTING AND START-UP SERVICES

- 8 A. Inspect grounding and bonding system conductors and connections for tightness
- 9 and proper installation.

10 3.06 TRAINING (NOT USED)

11 END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

1. American Iron and Steel Institute (AISI), Specifications and Standards, current edition.
2. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
3. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - a. ASTM A653 - General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process.
 - b. ASTM A1011 - Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability (Formerly ASTM A570).
 - c. ASTM F1136 - Standard Specification for Chromium/Zinc Corrosion Protective Coatings for Fasteners.
 - d. ASTM A907 - Standard Specification for Steel, Sheet, and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled, Structural Quality.
 - e. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - f. ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - g. ASTM A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - h. ASTM A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
4. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
5. Insulated Cable Engineers Association (ICEA)
6. International Society of Automation (ISA)
7. National Electrical Manufacturers Association (NEMA)

- 1 8. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
2 current edition.
- 3 9. Wisconsin Department of Safety and Professional Services (DSPS)
- 4 10. National Electrical Contractors Association (NECA), current edition.
 - 5 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
6 Contracting.
 - 7 b. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC,
8 EMT).
- 9 11. Metal Framing Manufacturers Association (MFMA), Specifications and
10 Standards, current edition.

11 1.03 DESCRIPTION OF WORK

- 12 A. Furnish and install supporting devices as indicated on the drawings, scheduled in
13 Section 26 05 00, and as specified herein.
- 14 B. Demonstrate the following using generally accepted engineering methods:
 - 15 1. That the anchors to the structure are adequate to resist the loads generated
16 in accordance with the Building Code and equipment requirements.
 - 17 2. That the required load capacity of the anchors can be fully developed in
18 the structural materials to which they are attached.

19 1.04 RELATED WORK ELSEWHERE

- 20 A. Article 102 – Bidding Requirements and Conditions
- 21 B. Article 103 – Award and Execution of the Contract
- 22 C. Concrete – Division 03
- 23 D. Metals – Division 05
- 24 E. Electrical - Division 26
- 25 F. Earthwork – Division 31
- 26 G. Utilities – Division 33

27 1.05 SUBMITTALS

- 28 A. Submit shop drawings.
- 29 B. Review of shop drawings shall be for conformance with design concept only and
30 will not release the Contractor from fulfilling the terms and intent of the contract
31 documents.
- 32 C. The following information shall be submitted specifically for supporting devices:
 - 33 1. Submit outline drawings and dimensions for equipment support racks.

1 2. Include data on attachment hardware and construction methods that will
2 satisfy the design loading and anchoring criteria.

3 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

4 1.07 FACTORY TESTING (NOT USED)

5 1.08 QUALITY ASSURANCE

6 A. Bolted framing channels and fittings shall have the manufacturers' name, part
7 number, and material heat code identification number stamped in the part itself
8 for identification. Material certification sheets and test reports must be made
9 available by the manufacturer upon request

10 B. Stainless steel bolted framing parts shall be stamped to identify the material.
11 Material certification sheets and test reports must be made available by the
12 manufacturer upon request.

13 C. All materials, equipment, and parts shall be new and unused of current
14 manufacture.

15 D. Contractor shall be responsible for providing all necessary accessories required
16 for a complete and operable system.

17 1.09 WARRANTY (NOT USED)

18 1.10 EXTRA MATERIALS (NOT USED)

19 1.11 DESIGN REQUIREMENTS (NOT USED)

20 1.12 MAINTENANCE (NOT USED)

21 PART 2 PRODUCTS AND MATERIALS

22 2.01 STRUT, CHANNELS, TRAPEZES AND CONNECTORS

23 A. Manufacturers:
24 1. Cooper B-Line, Inc.
25 2. or equal.

26 B. General:
27 1. Strut shall be 1-5/8-inches wide in varying heights and welded
28 combinations as required to meet load capacities and designs indicated on
29 the drawings.
30 2. Minimum sized threaded rod for supports shall be 3/8" for trapezes and
31 single conduits 1-1/4" and larger, and 1/4" for single conduits 1" and
32 smaller.

1 C. Materials and Finish:

- 2 1. Hot-dip Galvanized Steel: Strut shall be made from steel meeting the
3 minimum mechanical properties of ASTM A1011 SS, Grade 33 and shall
4 be hot-dip galvanized after fabrication in accordance with ASTM A123.
5 Fittings shall be manufactured from steel meeting the minimum
6 requirements of ASTM A907 SS, Grade 33, and hot-dip galvanized after
7 fabrication in accordance with ASTM A123. All hardware shall be
8 stainless steel Type 304 or chromium zinc ASTM F1136 Gr. 3. All hot-dip
9 galvanized after fabrication products must be returned to point of
10 manufacture after coating for inspection and removal of all sharp burrs.
11 2. Stainless Steel: All strut, fittings and hardware shall be made of AISI Type
12 304 stainless steel.

13 2.02 ANCHORS AND FASTENERS

- 14 A. Concrete and Structural Elements: Use stainless steel precast insert system,
15 expansion anchors and preset inserts.
- 16 B. Steel Structural Elements: Use stainless steel beam clamps.
- 17 C. Concrete Surfaces: Use stainless steel self-drilling anchors and expansion
18 anchors.
- 19 D. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or
20 hollow wall fasteners.
- 21 E. Solid Masonry Walls: Use stainless steel expansion anchors and preset inserts.
- 22 F. Sheet Metal: Use stainless steel sheet metal screws.
- 23 G. Wood: Use stainless steel wood screws.
- 24 H. All other fasteners: stainless steel screws, suitable for the required usage.

25 2.03 HARDWARE

- 26 A. Conduit and equipment supports, clamps, and other miscellaneous materials shall
27 be constructed of the following materials as scheduled in Section 26 05 00.
28 1. Galvanized, malleable iron.
29 2. PVC coated, galvanized, malleable iron.
30 3. Stainless steel.
31 4. PVC.

1 PART 3 CONSTRUCTION METHODS

2 3.01 DIVISION OF WORK

- 3 A. The Contractor shall be responsible for coordinating raceway installation and
4 means of support with all applicable trades.

5 3.02 FIELD MEASUREMENTS

- 6 A. Field verify all measurements. Do not base locations and dimensions on the
7 contract drawings. Actual field conditions govern all final installed locations,
8 distances, and levels.

- 9 B. Identify conflicts with the work of other trades prior to installation of electrical
10 equipment.

- 11 C. Adjust equipment support rack installation to satisfy field requirements.

12 3.03 DELIVERY, STORAGE, AND HANDLING

- 13 A. Accept supporting devices on site. Inspect for damage.

- 14 B. Protect supporting devices from corrosion and damage. Do not install damaged
15 materials.

16 3.04 INSTALLATION

- 17 A. General:

- 18 1. Furnish and install supports and fasteners for all electrical components
19 required for the project, including free standing supports required for those
20 items remotely mounted from the building structure, catwalks, walkways
21 etc.
22 2. Thoroughly clean and remove construction debris from installation.

- 23 B. Strut Channel:

- 24 1. Install strut in accordance with MFMA-102 "Guidelines for the Use of
25 Metal Framing"; in accordance with equipment manufacturer's
26 recommendations, and with recognized industry practices.
27 2. Fabricate supports from channel. Rigidly weld members or use hexagon
28 head bolts to present a neat appearance with adequate strength and
29 rigidity. Use spring lock washers under all nuts.
30 3. File and de-bur cut ends of galvanized support channel and spray paint
31 with cold galvanized paint to prevent rusting.
32 4. Bridge studs top and bottom with channels to support flush-mounted
33 cabinets and panelboards in stud walls.

- 34 C. Anchors and Fasteners:

- 1 1. Provide anchors, fasteners, and supports in accordance with NECA
- 2 "Standard Practices for Good Workmanship in Electrical Contracting".
- 3 2. Do not fasten supports to piping, ductwork, mechanical equipment, cable
- 4 tray or conduit.
- 5 3. Do not use spring steel clips and anchors.
- 6 4. Do not use powder-actuated anchors.
- 7 5. Obtain permission from Engineer before drilling or cutting structural
- 8 members.
- 9 6. Install surface-mounted cabinets and panelboards with minimum of four
- 10 anchors.
- 11 7. Use channel supports to stand cabinets and panelboards 1-5/8-inch off
- 12 interior or exterior surfaces of exterior walls.
- 13 8. Fasten hanger rods, conduit clamps, and outlet and junction boxes to
- 14 building structure using anchors and fasteners.
- 15 9. Install free-standing electrical equipment on 3-inch concrete pads unless
- 16 indicated otherwise on the drawings.
- 17 10. Use threaded rod, minimum size 3/8-inch, for supports where indicated on
- 18 the drawings.
- 19 11. Install products in accordance with manufacturer instructions.

20 3.05 TESTING AND START-UP SERVICES (NOT USED)

21 3.06 TRAINING (NOT USED)

22 END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI C80.1 - Electrical Rigid Steel Conduit (ERSC).
 - b. ANSI C80.3 - Steel Electrical Metallic Tubing (EMT).
 - c. ANSI C80.5 - Electrical Rigid Aluminum Conduit (ERAC).
 - d. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - a. ASTM F2160 - Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter.
 - b. ASTM D2239 - Polyethylene (PE) Plastic Pipe (SIDR) Based on Controlled Inside Diameter.
 - c. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR) Based on Controlled Outside Diameter.
 - d. ASTM D3350 - Polyethylene Plastics Pipe and Fittings Materials.
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 4. Insulated Cable Engineers Association (ICEA)
 5. International Society of Automation (ISA)
 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition:
 - a. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association.
 - b. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association.
 - c. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit; National Electrical Manufacturers Association.

- d. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association.
- e. NEMA TC 7 - Smooth Wall Coilable Polyethylene Electrical Plastic Conduit.
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition:
 - a. UL 1 - Standard for Flexible Metal Conduit
 - b. UL 6 - Electrical Rigid Metal Conduit - Steel.
 - c. UL 6A - Standard for Electrical Rigid Metal Conduit - Aluminum and Stainless Steel.
 - d. UL 651A Type EB and A Rigid PVC Conduit and HDPE conduit.
 - e. UL 651B Continuous Length HDPE.
 - f. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit.
 - g. UL 2239 - Standard for Safety for Hardware for the Support of Conduit, Tubing, and Cable.
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
 - b. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC, EMT).
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

1.03 DESCRIPTION OF WORK

- A. Furnish and install complete and operable conduit system as indicated on the drawings, scheduled in Section 26 05 00, and as specified herein.
- B. Home runs indicated are to assist the Contractor in identifying conduits to be installed concealed or exposed. Conduits identified to be installed exposed shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors, and hatches. Conduits indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

1.04 RELATED WORK ELSEWHERE

- 1 A. Article 102 – Bidding Requirements and Conditions
- 2 B. Article 103 – Award and Execution of the Contract
- 3 C. Concrete – Division 03
- 4 D. Metals – Division 05
- 5 E. Electrical - Division 26
- 6 F. Earthwork – Division 31
- 7 G. Utilities – Division 33

8 1.05 SUBMITTALS

- 9 A. Submit shop drawings.
- 10 B. Submit the following information specifically for conduit:
 - 11 1. Manufacturer literature sufficient in scope to demonstrate compliance with
 - 12 the requirements of this specification.
 - 13 2. Clearly identify the types and sizes of conduit and fittings proposed.
 - 14 3. Incorporate all changes in conduit routing on electrical plan drawings.
 - 15 4. Dimension underground and concealed conduit from building lines.

16 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

17 1.07 FACTORY TESTING (NOT USED)

18 1.08 QUALITY ASSURANCE

- 19 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 20 B. System supplier shall be responsible for providing all necessary accessories
- 21 required for a complete and operable system.
- 22 C. Manufacturer Qualifications: Company specializing in manufacturing products
- 23 specified in this section, with not less than three years of documented experience.
- 24 D. Products: Listed and classified by UL or testing firm acceptable to the authority
- 25 having jurisdiction as suitable for the purpose specified and indicated.

26 1.09 WARRANTY

- 27 A. See Division 01 for additional requirements.

1 1.10 EXTRA MATERIALS (NOT USED)

2 1.11 DESIGN REQUIREMENTS (NOT USED)

3 1.12 MAINTENANCE (NOT USED)

4 PART 2 PRODUCTS AND MATERIALS

5 2.01 GALVANIZED RIGID METAL CONDUIT (TYPE GRS)

6 A. Manufacturer: Contractor option.

7 B. Conduit:

- 8 1. Impact and crush resistant mild steel tube with an accurate circular cross
9 section, a uniform wall thickness, a defect free interior surface, and a
10 continuous welded seam.
- 11 2. Interior and exterior surfaces thoroughly and evenly coated with zinc using
12 the hot-dip galvanizing process.
- 13 3. Top-coated with a compatible organic layer to inhibit white rust and
14 increase corrosion resistance.
- 15 4. Factory cut threads, 0.75-inch taper per foot, protected after cutting with an
16 application of molten zinc.

17 C. Conduit Bodies:

- 18 1. Ferrous metal construction electro-galvanized inside and out and coated
19 with aluminum acrylic paint.
- 20 2. Tapered, threaded hubs with integral bushing.
- 21 3. Stainless steel hardware.
- 22 4. Cover constructed of same material with solid gasket.

23 D. Fittings:

- 24 1. Ferrous metal construction electro-galvanized inside and out.
- 25 2. Components critical to performance such as set screws, split rings, and
26 locknuts constructed of hardened steel or adequately designed to insure
27 positive bonds.

28 2.02 PVC COATED GALVANIZED RIGID METAL CONDUIT (TYPE PGRS)

29 A. Manufacturer:

- 30 1. Perma-Cote Industries.
- 31 2. Robroy.
- 32 3. Or equal.

33 B. General:

1. Conduit shall be UL Listed and the coating shall have been investigated by UL as providing the primary corrosion protection for the rigid metal conduit.
2. Independent certified test results shall be available to confirm coating adhesion under the following conditions:
3. Conduit immersed in boiling water with a minimum mean time to adhesion failure of 200 hours.
4. Conduit and conduit exposure to 150 degrees F and 95 percent relative humidity with a minimum mean time to failure of 30 days.
5. No trace of internal coating shall be visible on a white cloth following six wipes over the coating that has been wetted with acetone.
6. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.

C. Conduit:

1. Impact and crush resistant mild steel tube with an accurate circular cross section, a uniform wall thickness, and a defect free interior surface, and a continuous welded seam.
2. Interior and exterior surfaces thoroughly and evenly coated with zinc using the hot-dip galvanizing process.
3. Factory cut threads, 0.75-inch taper per foot, protected after cutting with an application of molten zinc.
4. Coating:
 - a. External: PVC, 40 mils nominal, free of blisters, bubbles, and pinholes.
 - b. Internal: Urethane, 2 mils minimum.
5. Threaded connections:
 - a. Factory threads: factory coated.
 - b. Field threads: protected by coating sleeve extension on female fitting. Sleeve extension shall be equivalent in length to the nominal conduit size and the inside diameter less than the outside diameter of the coated conduit.
6. Strength:
 - a. Coating bond to conduit shall be stronger than tensile strength of coating. Field cut, thread, and bent conduit shall not damage conduit.

D. Conduit Bodies:

1. Ferrous metal construction electro-galvanized inside and out and PVC coated to match the conduit.
2. Tapered, threaded hubs with integral bushing.

3. Stainless steel or encapsulated stainless steel hardware.
4. PVC coated cover constructed of same material with solid tongue-in-groove gasket.

E. Fittings:

1. Ferrous metal construction electro-galvanized inside and out and PVC coated to match conduit.
2. All fittings are to be from the same manufacturer as the conduit.

2.03 RIGID NON-METALLIC CONDUIT (TYPE PVC)

A. Manufacturer:

1. Carlon.
2. Or equal.

B. Conduit:

1. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.
2. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-2.
3. The conduit and fittings shall be homogeneous plastic material free from visible cracks, holes or foreign inclusions. The conduit bore shall be smooth and free of blisters, nicks or other imperfections, which could mar conductors or cables.
4. Conduit, fittings and cement shall be produced by the same manufacturer to assure system integrity.
5. Schedule 80 non-metallic conduit shall be used in locations subject to physical damage.

C. Conduit Bodies:

1. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.
2. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-3.
3. Stainless steel hardware.
4. Cover constructed of same material with solid gasket.

D. Fittings:

1. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.
2. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-3.

2.04 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (TYPE LMFC)

- 1 A. Manufacturer: CONTRACTOR option.
- 2 B. Usage:
- 3 1. Use in conjunction with galvanized rigid metal conduit.
- 4 2. Use in conjunction with PVC coated galvanized rigid metal conduit.
- 5 3. Use in conjunction with rigid aluminum conduit.
- 6 C. Conduit:
- 7 1. Single strip, helically wound, galvanized steel core inside and outside with
- 8 smooth interior surface with sunlight resistant thermoplastic jacket suitable
- 9 for ambient environmental conditions conforming to applicable UL
- 10 Standards.
- 11 2. Jacket shall be positively locked to core to prevent sleeving.
- 12 3. All runs of flexible conduit shall be as short as practicable, of the same size
- 13 as the conduit it extends and with enough slack to reduce the effects of
- 14 expansion and vibration.
- 15 D. Fittings:
- 16 1. Where used in conjunction with galvanized rigid metal conduit, connectors
- 17 shall be malleable iron or steel, electro zinc plated, with insulated throat and
- 18 taper threaded hub.
- 19 2. Where used in conjunction with PVC coated galvanized rigid metal or rigid
- 20 aluminum conduit connectors shall be malleable iron or steel, electro zinc
- 21 plated and PVC coated, with insulated throat and taper threaded hub.
- 22 3. Particular attention shall be given to maintaining ground bond and firm
- 23 support through flexible connections.
- 24 4. All fittings shall be liquid tight.

25 2.05 LIQUIDTIGHT FLEXIBLE NON-METALLIC CONDUIT (TYPE LFNC)

- 26 A. Manufacturer:
- 27 1. Carlon Carflex.
- 28 2. Or equal.
- 29 B. Usage:
- 30 1. Use in conjunction with rigid nonmetallic PVC conduit.
- 31 C. Conduit:
- 32 1. Conduit shall have a smooth inner surface with integral reinforcement
- 33 within the conduit wall.
- 34 2. Conduit shall be designated as a Type LFNC-B (or FNMC-B), listed to UL
- 35 standard UL1660 and suitable for use at conduit temperatures of 80 degrees
- 36 C (dry), 60 degrees C (wet and oil resistant).

- 1 3. Conduit shall be flame resistant and when used with listed fittings, approved
- 2 for the installation of electrical conductors.
- 3 4. Conduit shall be installed in accordance with applicable sections of the NEC
- 4 and/or local electrical codes.
- 5 5. Conduit shall be marked OUTDOOR for outdoor applications exposed to
- 6 sunlight and weathering conditions and marked DIRECT BURIAL for
- 7 direct burial applications.
- 8 6. The National Evaluation Service, Inc. shall evaluate conduit for installation
- 9 within a three-hour or less fire-resistive floor/ceiling and two-hour fire-
- 10 resistive wall construction.

11 D. Fittings:

- 12 1. Molded from high strength, chemical resistant, glass filled thermoplastic.
- 13 2. Fittings shall be listed for the use with liquid tight flexible nonmetallic
- 14 conduit and shall be marked LFNC-B (FNMC-B).
- 15 3. Fittings uses for direct burial applications shall be listed for wet locations.
- 16 4. Particular attention shall be given to maintaining ground bond and firm
- 17 support through flexible connections.
- 18 5. All fittings shall be liquid tight.

19 2.06 LIQUIDTIGHT HAZARDOUS LOCATION FLEXIBLE CONDUIT (STAINLESS

20 STEEL BRAID)

21 A. Manufacturer:

- 22 1. Crouse-Hinds EC Coupling.
- 23 2. Or equal.

24 B. Usage:

- 25 1. Use for all non-intrinsically safe, hazardous location installations.
- 26 2. Use in hazardous locations for motor terminations and any other equipment
- 27 where vibration is present.

28 C. Conduit:

- 29 1. Conduit shall have an insulating wire duct with smooth inner surface inside
- 30 a flexible brass inner core. Packing material shall be woven cotton
- 31 impregnated with asphalt.
- 32 2. Flexible portion of coupling shall be covered with stainless steel braid.
- 33 3. Conduit shall bear U.L. label indicating suitability for use in hazardous
- 34 location as identified on the drawings.

35 D. Fittings:

- 36 1. Integral stainless steel end fittings shall be included with coupling.
- 37 2. Coupling shall be available with two threaded male end fittings or one
- 38 female union and one threaded male end fitting.

3. Particular attention shall be given to maintaining ground bond and firm support through flexible connections.
4. All fittings shall be liquid tight.

2.07 RIGID ALUMINUM CONDUIT (TYPE RAL)

- A. Manufacturer: Contractor option.
- B. Conduit:
 1. Heavy wall tube manufactured of 6063 aluminum allow in temper designation T-1 with accurate circular cross section, uniform wall thickness and defect free interior surface.
 2. Factory cut threads, 0.75-inch taper per foot.
- C. Conduit Bodies:
 1. Cast aluminum device boxes shall by Type FD. Boxes shall be copper free aluminum with cast aluminum covers.
 2. Tapered, threaded hubs with integral bushing.
 3. Stainless steel hardware.
- D. Fittings:
 1. Fittings shall be composed of copper free aluminum.

2.08 HIGH DENSITY POLYETHYLENE CONDUIT (TYPE HDPE)

- A. Manufacturer:
 1. Contractor Option
- B. Usage:
 1. Direct buried for use in routing Fiber Optic Cable.
- C. Conduit:
 1. Smooth wall construction
 2. Comprised of high-density polyethylene meeting the properties of ASTM D-3350.
 3. Conduit shall meet the dimensional specifications and wall thicknesses set forth in the applicable ASTM and/or NEMA standards.
 4. There shall be no foreign particles embedded into the plastic surface as a result of the extrusion process.
 5. There shall not be any holes, visible cracks or defects that could cause damage or compromise the physical strength of the conduit.

PART 3 CONSTRUCTION METHODS

3.01 DIVISION OF WORK

- 1 A. The Contractor shall be responsible for coordinating raceway installation and
2 means of support with all applicable trades.

3 3.02 FIELD MEASUREMENTS

- 4 A. The Contractor shall obtain from the appropriate trades and review shop drawings
5 for all equipment requiring electrical connections. Conduit rough-in shall be based
6 upon shop drawing requirements.

- 7 B. The Contractor shall be responsible for coordinating conduit location and rough-in
8 with actual equipment conditions and requirements.

- 9 C. Field verify all measurements. Do not base conduit rough-in or equipment
10 locations on the contract drawings. Actual field conditions govern all final installed
11 locations, distances, and levels.

- 12 D. Identify conflicts with the work of other trades prior to installation of electrical
13 equipment and conduit work.

- 14 E. Adjust conduit system installation to satisfy field requirements.

15 3.03 DELIVERY, STORAGE, AND HANDLING

- 16 A. Accept conduit on site. Inspect for damage.

- 17 B. Protect conduit from corrosion and entrance of debris.

- 18 C. Store conduit above grade. Protect from environment with suitable covering.

- 19 D. Protect PVC and PVC coated conduit from sunlight.

20 3.04 INSTALLATION

- 21 A. General:

- 22 1. Install conduit in accordance with NECA "Standard Practices for Good
23 Workmanship in Electrical Contracting", all requirements of the NEC, and
24 manufacturer recommended practices.

- 25 2. Arrange conduit to maintain headroom and present neat appearance.

- 26 3. Design raceway systems to minimize the number of fittings, couplings,
27 kicks, and offsets.

- 28 4. Raceways located above lowest floor level:

- 29 a. Route conduit parallel and perpendicular to walls.

- 30 b. All raceways shall be level and straight.

- 31 c. Vertical conduits shall be plumb.

- 32 5. Raceways located in or under lowest level floor:

- 1 a. Route conduit in and under slab from point-to-point.
- 2 b. Do not cross conduits in slab.
- 3 6. Do not use flexible conduit in place of bends, conduit bodies, or expansion
- 4 fittings.
- 5 7. Flexible conduit shall be used at all equipment terminations. Maximum
- 6 length of 24-inches unless specifically allowed otherwise by Engineer based
- 7 upon field conditions.
- 8 8. Do not use cords for equipment connections unless specifically allowed
- 9 otherwise by Engineer based upon field conditions.

- 10 B. Raceway sizing:
- 11 1. Size raceways as indicated on drawings.
 - 12 2. Where raceways sizes are not indicated on drawings, size in accordance
 - 13 with NEC requirements. Minimum size 3/4-inch.
 - 14 3. Exposed conduit runs not longer than 10-feet in length and terminating at a
 - 15 single device may be 1/2-inch unless prohibited by NEC.

- 16 C. Raceway Installation:
- 17 1. Maintain adequate clearance between conduit and piping.
 - 18 2. Maintain 12-inch clearance between conduit and surfaces with temperatures
 - 19 exceeding 104 degrees F.
 - 20 3. Cut conduit square using saw or pipe cutter; de-burr cut ends.
 - 21 4. Bring conduit to shoulder of fittings; fasten securely.
 - 22 5. Use conduit hubs to fasten conduit to NEMA 3R, NEMA 4, NEMA 4X and
 - 23 NEMA 12 boxes.
 - 24 6. Install no more than equivalent of three 90-degree bends between boxes.
 - 25 Use conduit bodies to make sharp changes in direction, as around beams.
 - 26 Use hydraulic factory elbows for bends in metal conduit larger than 2-inch
 - 27 size.
 - 28 7. Avoid moisture traps; install junction box with drain fitting at low points in
 - 29 conduit system.
 - 30 8. Suitable pull string shall be installed in each empty conduit, sleeves and
 - 31 nipples excepted.
 - 32 9. Use suitable caps to protect installed conduit against entrance of dirt and
 - 33 moisture.
 - 34 10. Remove all debris and moisture from raceways prior to installing
 - 35 conductors.
 - 36 11. Ground and bond conduit under provisions of Section 26 05 26.
 - 37 12. Identify conduit under provisions of Section 26 05 53.
 - 38 13. Install plastic coated conduit in accordance with manufacturer's
 - 39 instructions. All 90 degree bends shall be manufactured elbows. Touch-up
 - 40 PVC coating after installation.

- 1 14. All field cut threads shall be coated with Thomas & Betts Kopr-Shield prior
2 to assembly.
3 15. The contractor is responsible for any deviations in general location, conduit
4 size, routing, or changes to the conduit schedule without the express written
5 approval or direction by the Engineer.

6 D. Structural Coordination:

- 7 1. Suitable fittings, designed and listed for the purpose, shall be used to
8 accommodate expansion and deflection where conduit crosses seismic,
9 control and expansion joints.
10 2. Install conduit to preserve fire resistance rating of partitions and other
11 elements.
12 3. Route conduit through roof openings for piping and ductwork or through
13 suitable roof jack with pitch pocket. Coordinate location with roofing
14 installation.
15 4. Where conduit passes between areas subject to variable temperatures, seal
16 conduits to prevent air interchange and condensation formation. Use
17 conduit fitting specifically manufactured for this purpose.

18 E. Raceway Support:

- 19 1. General:
20 a. Arrange supports to prevent misalignment during wiring
21 installation.
22 b. Do not permanently support conduit with wire or perforated pipe
23 straps.
24 c. Remove wire used for temporary supports.
25 d. Do not attach conduit to ceiling support wires.
26 e. Channel, rod, and hardware shall comply with the requirements of
27 Section 26 05 29.
28 2. Hardware:
29 a. Construct conduit support rack with channel and rod to support
30 conduits not supported from structure.
31 b. Support conduit with channel anchored to structure when conduit
32 offset from structure is required.
33 c. Secure conduits to channel with pipe straps.
34 d. Support conduit from structure when conduit offset from structure
35 is not required.
36 e. Secure conduits directly to structure with one-hole strap and conduit
37 spacer.

38 F. Conduit Separation:

- 39 1. Separate conduit systems shall be used for the following circuit categories:
40 a. 120-volt power circuits.
41 b. 480-volt power circuits.

- 1 c. 120-volt control circuits.
- 2 d. 24 VDC analog control circuits.
- 3 e. Intrinsically safe control circuits.
- 4 f. UTP control cables.
- 5 g. Manufacturer supplied cables (for example, magnetic flow meter
- 6 cables).
- 7 h. Radio frequency coaxial cables (for example, antenna cables).
- 8 2. The contract drawings show individual homerun equipment connections.
- 9 The Contractor may combine circuits of common types (as identified above)
- 10 into single conduits provided the following conditions are met:
- 11 a. NEC requirements for conductor de-rating are satisfied.
- 12 b. Conduit fill does not exceed thirty percent. Ten percent fill shall be
- 13 reserved for future use.
- 14 c. No more than eight 24VDC analog circuits are combined in a single
- 15 conduit, unless specifically stated otherwise on the drawings.

16 3.05 TESTING AND START-UP SERVICES (NOT USED)

17 3.06 TRAINING (NOT USED)

18 END OF SECTION

SECTION 26 05 37

BOXES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition.
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association.
 - b. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - c. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
 - b. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC, EMT).
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- 1 11. Canadian Standards Association (CSA), Specifications and Standards,
2 current edition.
- 3 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
4 Specifications and Standards, Current Edition.
- 5 13. International Electrotechnical Association (IEC), Specifications and
6 Standards, Current Edition.

7 1.03 DESCRIPTION OF WORK

- 8 A. Furnish and install complete and operable box systems as indicated on the
9 drawings, scheduled in Section 26 05 00, and as specified herein.
- 10 B. This includes outlet boxes for devices such as switches, receptacles, telephone
11 and computer jacks, security systems, junction and pullboxes for use in the
12 raceway system, etc.

13 1.04 RELATED WORK ELSEWHERE

- 14 A. Article 102 – Bidding Requirements and Conditions
- 15 B. Article 103 – Award and Execution of the Contract
- 16 C. Concrete – Division 03
- 17 D. Metals – Division 05
- 18 E. Electrical - Division 26
- 19 F. Earthwork – Division 31
- 20 G. Utilities – Division 33

21 1.05 SUBMITTALS

- 22 A. Submit shop drawings.
- 23 B. Review of shop drawings shall be for conformance with design concept only and
24 will not release the Contractor from fulfilling the terms and intent of the contract
25 documents.
- 26 C. Submit the following information specifically for boxes:
27 1. Manufacturer literature sufficient in scope to demonstrate compliance with
28 the requirements of this specification.
29 2. Clearly identify the size and types of boxes proposed. Also include the
30 materials of construction, conduit entry locations and NEMA rating of the
31 proposed.

- 1 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 2 1.07 FACTORY TESTING (NOT USED)
- 3 1.08 QUALITY ASSURANCE
- 4 A. All materials, equipment, and parts shall be new and unused of current
5 manufacture.
- 6 B. System supplier shall be responsible for providing all necessary accessories
7 required for a complete and operable system.
- 8 C. Manufacturer Qualifications: Company specializing in manufacturing products
9 specified in this section, with not less than three years of documented experience.
- 10 D. Products: Listed and classified by UL or testing firm acceptable to the authority
11 having jurisdiction as suitable for the purpose specified and indicated.
- 12 1.09 WARRANTY (NOT USED)
- 13 1.10 EXTRA MATERIALS (NOT USED)
- 14 1.11 DESIGN REQUIREMENTS (NOT USED)
- 15 1.12 MAINTENANCE (NOT USED)
- 16 PART 2 PRODUCTS AND MATERIALS
- 17 2.01 OUTLET BOXES
- 18 A. Sheet Metal Outlet Boxes:
- 19 1. Galvanized steel, with stamped knockouts.
- 20 2. Gangable, suitable for number of devices shown.
- 21 3. Suitable for flush mounting with drywall, FRP panel, masonry block, and
22 poured concrete wall and ceiling finishes.
- 23 B. Luminaire and Equipment Supporting Boxes:
- 24 1. Rated for weight of equipment supported; include 3/8-inch male fixture
25 studs where required.
- 26 C. Cast Boxes:
- 27 1. Cast ferralloy or aluminum, deep type, gasketed cover, threaded hubs.
- 28 2. Suitable for surface or flush mounting with drywall, FRP panel, masonry
29 block, and poured concrete wall and ceiling finishes.
- 30 D. PVC Coated Cast Boxes:
- 31 1. PVC coated cast ferralloy, deep type, gasketed cover, threaded hubs.

2. Suitable for surface mounting with drywall, FRP panel, masonry block, and poured concrete wall and ceiling finishes.
3. Of the same manufacturer as the associated PVC coated conduit.

2.02 PULL AND JUNCTION BOXES

A. General:

1. Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).
2. For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic systems with conduits of 1 1/4" and larger, shall be sized per the NEC conduit requirements. For determining box size, the conduit is the determining factor not the wire size.

B. Galvanized Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.

1. Door:
 - a. Rolled lip around 3 sides
 - b. Attached to enclosure by means of a continuous stainless steel hinge and pin.
2. Neoprene door gasket to provide a watertight, dust tight, oil tight seal.
 - a. Attached with an adhesive.
3. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel.
 - a. With a hasp and staple for padlocking

C. Painted Sheet Metal Boxes: code gauge sheet steel with ANSI-61 gray powder-coated finish, flanged and spot welded joints and corners.

1. Door:
 - a. Rolled lip around 3 sides
 - b. Attached to enclosure by means of a continuous stainless steel hinge and pin.
2. Neoprene door gasket to provide a watertight, dust tight, oil tight seal.
 - a. Attached with an adhesive.
3. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel.
 - a. With a hasp and staple for padlocking

D. Fiberglass Reinforced Plastic Boxes: fiberglass reinforced plastic construction with stainless steel hardware and gasketed covers. Boxes shall be finished with

1 hinged doors, terminal mounting straps and brackets. Box shall hold NEMA 4X
2 environmental rating.

3 E. Boxes Larger than 12 Inches (300 mm) in any dimension shall have a hinged
4 cover, be rated NEMA 4X, and constructed of stainless steel. Door and body
5 stiffeners to be provided as required for extra rigidity on larger enclosure.

6 1. Fabricated from grade 316 stainless steel

7 2. Door:

8 a. Rolled lip around 3 sides

9 b. Attached to enclosure by means of a continuous stainless steel
10 hinge and pin.

11 3. Neoprene door gasket to provide a watertight, dust tight, oil tight seal.

12 a. Attached with an adhesive.

13 4. Fabricate all external removable hardware for clamping the door to the
14 enclosure body from heavy gauge stainless steel.

15 a. With a hasp and staple for padlocking

16 F. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type
17 6, flat-flanged, surface-mounted junction box, UL listed as rain-tight. Galvanized
18 cast iron or aluminum box and cover with ground flange, neoprene gasket, and
19 stainless steel cover screws.

20 G. Cast Metal Boxes for Hazardous Locations: Type 7, cast malleable iron with
21 drilled and tapped conduit entrance. Cast malleable iron cover, non-hinged with
22 Type 316 stainless steel screws and gasketed.

23 H. Cast Metal Boxes for Underground Installations: Type 4, inside flanged, recessed
24 cover box for flush mounting, UL listed as rain tight. Hot dipped galvanized cast
25 iron box and plain cover with neoprene gasket and stainless steel cover screws.
26 Cover Legend: ELECTRIC.

27 I. Fiberglass Handholes for Underground Installations: Die- molded with pre-cut 6 x
28 6 inch (150 x 150 mm) cable entrance at center bottom of each side; fiberglass
29 weatherproof cover with non-skid finish.

30 J. Box extensions and adjacent boxes within 48" of each other are not allowed for
31 the purpose of creating more capacity.

32 K. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.

33 L. Wireways shall not be used in lieu of junction boxes.

34 PART 3 CONSTRUCTION METHODS

35 3.01 DIVISION OF WORK (NOT USED)

1 3.02 FIELD MEASUREMENTS

- 2 A. The Contractor shall obtain from the appropriate trades and review shop drawings
3 for all equipment requiring electrical connections. Box rough-in shall be based
4 upon shop drawing requirements.
- 5 B. The Contractor shall be responsible for coordinating box location and rough-in
6 with actual equipment conditions and requirements.
- 7 C. Field verify all measurements. Do not base box rough-in or equipment locations
8 on the contract drawings. Actual field conditions govern all final installed
9 locations, distances, and levels.
- 10 D. Identify conflicts with the work of other trades prior to installation of electrical
11 equipment and conduit work.
- 12 E. Adjust box locations to satisfy field requirements.

13 3.03 DELIVERY, STORAGE, AND HANDLING

- 14 A. Accept boxes on site. Inspect for damage.
- 15 B. Protect boxes from corrosion and entrance of debris.
- 16 C. Store boxes above grade. Protect from environment with suitable covering.

17 3.04 INSTALLATION

- 18 A. General:
- 19 1. Install conduit in accordance with NECA "Standard Practices for Good
20 Workmanship in Electrical Contracting", all requirements of the NEC, and
21 manufacturer recommended practices.
- 22 B. Box Installation:
- 23 1. Install electrical boxes as shown on Drawings, and as required for splices,
24 taps, wire pulling, equipment connections and compliance with regulatory
25 requirements.
- 26 2. Install electrical boxes to maintain headroom and to present neat
27 mechanical appearance.
- 28 3. Install pull boxes and junction boxes above accessible ceilings and in
29 unfinished areas only.
- 30 4. Align adjacent wall-mounted outlet boxes for switches, thermostats, and
31 similar devices with each other.
- 32 5. Use flush mounting outlet boxes in all areas.

SECTION 26 05 41

WIRING DEVICES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA70 - National Electrical Code, (NEC) and state amendments thereto.
 - b. ANSI/NFPA 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 4. Insulated Cable Engineers Association (ICEA)
 5. International Society of Automation (ISA)
 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA WD 1 - General Purpose Wiring Devices.
 - b. NEMA WD 6 - Wiring Device Configurations.
 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 8. Wisconsin Department of Safety and Professional Services (DSPS)
 9. National Electrical Contractors Association (NECA), Standard of Installation, current edition.
 10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
 12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
 13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

- 1 1.03 DESCRIPTION OF WORK
- 2 A. Provide and install complete and operable wiring devices as required on the
3 drawings and as specified herein.
- 4 1.04 RELATED WORK ELSEWHERE
- 5 A. The following divisions may include work which is related to wiring devices, but
6 which is not included under the scope of this section:
- 7 B. Article 102 – Bidding Requirements and Conditions
- 8 C. Article 103 – Award and Execution of the Contract
- 9 D. Concrete – Division 03
- 10 E. Metals – Division 05
- 11 F. Electrical - Division 26
- 12 G. Earthwork – Division 31
- 13 H. Utilities – Division 33
- 14 1.05 SUBMITTALS
- 15 A. Submit shop drawings.
- 16 B. Review of shop drawings shall be for conformance with design concept only and
17 will not release the Contractor from fulfilling the terms and intent of the contract
18 documents.
- 19 C. The following information shall be submitted specifically for wiring devices:
- 20 1. Manufacturer literature sufficient in scope to demonstrate compliance with
21 the requirements of this specification.
- 22 2. Clearly identify the types of wiring devices proposed.
- 23 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 24 1.07 FACTORY TESTING (NOT USED)
- 25 1.08 QUALITY ASSURANCE
- 26 A. All materials, equipment, and parts shall be new and unused of current
27 manufacture.

- 1 B. Contractor shall be responsible for providing all necessary accessories required
2 for a complete and operable system.
- 3 C. Furnish products listed and classified by Underwriters Laboratories, Inc. as
4 suitable for purpose specified and shown.
- 5 D. Manufacturer shall specialize in manufacture of products specified in this Section
6 with minimum three years experience.

7 1.09 WARRANTY (NOT USED)

8 1.10 EXTRA MATERIALS (NOT USED)

9 1.11 DESIGN REQUIREMENTS (NOT USED)

10 1.12 MAINTENANCE

11 A. Before substantial completion, perform all maintenance activities required by any
12 sections of the specifications including any calibrations, final adjustments,
13 component replacements or other routine service required before placing
14 equipment or systems into service.

15 B. Furnish all spare parts as required by other sections of the specifications.

16 PART 2 PRODUCTS AND MATERIALS

17 2.01 120V SPECIFICATION GRADE WALL SWITCHES

18 A. Single Pole Switch:

- 19 1. Hubbell.
20 2. Or equal.

21 B. Double Pole Switch:

- 22 1. Hubbell.
23 2. Or equal.

24 C. Three-way Switch:

- 25 1. Hubbell.
26 2. Or equal.

27 D. Four-way Switch:

- 28 1. Hubbell.
29 2. Or equal.

30 E. Indicator Switch:

- 31 1. Hubbell.
32 2. Or equal.

1 F. Weather-proof Switch:

- 2 1. Hubbell.
- 3 2. Or equal.

4 G. Explosion Proof Switch:

- 5 1. Appleton.
- 6 2. Crouse-Hinds.
- 7 3. Or equal.

8 2.02 120V SPECIFICATION GRADE RECEPTACLES

9 A. Duplex Convenience Receptacle:

- 10 1. Hubbell.
- 11 2. Or equal.

12 B. GFCI Receptacle:

- 13 1. Hubbell.
- 14 2. Or equal.

15 2.03 USB CHARGING STATION

16 A. Single-gang 4-port USB Charging Station

- 17 1. Hubbell.
- 18 2. Or equal.

19 2.04 OCCUPANCY SENSORS

20 A. Wall Mounted

- 21 1. WattStopper
- 22 2. Or equal.

23 B. Ceiling Mounted

- 24 1. WattStopper
- 25 2. Or equal.

26 C.

27 2.05 WALL PLATES

28 A. Wall plates shall be installed as follows:

- 29 1. Use smooth stainless steel plates for receptacles and switches in sheet steel
- 30 or PVC boxes.
- 31 2. Use multi-screw gasketed cast plate where cast outlet boxes are required.
- 32 Covers shall not be attached by using a single screw mounting into the
- 33 wiring device, but shall be attached by mounting directly to the box.

- 1 3. Use Crouse Hinds WLRS or WLRD wet location covers for receptacles
- 2 identified as "WP" which are located inside structures.
- 3 4. Use aluminum or cast metal cover rated for "Constant Use" for receptacles
- 4 identified as "WP" and that are exposed to the weather.
- 5 5. Use Crouse-Hinds OS185 cover for all switches identified as "WP".

6 PART 3 CONSTRUCTION METHODS

7 3.01 DIVISION OF WORK

- 8 A. The Contractor shall have overall system responsibility and shall provide all
- 9 materials and labor necessary provide a complete and operable system and
- 10 comply with all requirements of this section.
- 11 B. The Contractor shall be responsible for coordinating device locations with actual
- 12 equipment conditions and requirements.

13 3.02 FIELD MEASUREMENTS

- 14 A. Field verify all measurements. Do not base exact wiring device locations on the
- 15 contract drawings. Actual field conditions govern all final installed locations,
- 16 distances, and levels.
- 17 B. Adjust location of wiring devices to satisfy field requirements.

18 3.03 DELIVERY, STORAGE AND HANDLING

- 19 A. Accept electrical equipment on site. Inspect for damage.
- 20 B. Take precautions to protect electrical equipment from weather, corrosion, and
- 21 entrance of debris.

22 3.04 INSTALLATION

- 23 A. Wiring Device Installation:
- 24 1. Verify branch circuit wiring installation is completed, tested, and ready for
- 25 connection to wiring devices.
- 26 2. Provide extension rings to bring outlet boxes flush with finished surface.
- 27 3. Clean debris from outlet boxes.
- 28 4. Install products in accordance with manufacturer's instructions.
- 29 5. Install devices plumb and level.
- 30 6. Install switches with OFF position down.
- 31 7. Install receptacles with grounding pole on top.
- 32 8. Connect wiring device grounding terminal to branch circuit equipment
- 33 grounding conductor.
- 34 9. Install plates on switch, receptacle, and blank outlets in all areas.

- 1 10. Connect wiring devices by wrapping conductor around screw terminal.
- 2 11. Provide stainless steel hardware.
- 3 12. Install wall switch 46 inches above finished floor.
- 4 13. Install convenience receptacle 18 inches above finished floor.
- 5 14. Install convenience receptacle 6 inches above counter.
- 6 15. Adjust devices and wall plates to be flush and level.

- 7 B. Structural Coordination:
- 8 1. Verify outlet boxes are installed at proper height.
- 9 2. Verify wall openings are neatly cut and will be completely covered by
- 10 wall plates.
- 11 3. Verify floor boxes are adjusted properly.

12 3.05 TESTING AND STARTUP SERVICES

- 13 A. Inspect each wiring device for defects.
- 14 B. Operate each wall switch with circuit energized and verify proper operation.
- 15 C. Verify that each receptacle device is energized.
- 16 D. Test each receptacle device for proper polarity.
- 17 E. Test each GFCI receptacle device for proper operation.

18 3.06 TRAINING (NOT USED)

19 END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
 - b. ANSI Z535.4 - Product Safety Signs and Labels.
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA)
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

1.03 DESCRIPTION OF WORK

- 1 A. Furnish and install electrical identification systems as indicated on the drawings
2 and as specified herein.
- 3 1.04 RELATED WORK ELSEWHERE
- 4 A. Article 102 – Bidding Requirements and Conditions
- 5 B. Article 103 – Award and Execution of the Contract
- 6 C. Concrete – Division 03
- 7 D. Metals – Division 05
- 8 E. Electrical - Division 26
- 9 F. Earthwork – Division 31
- 10 G. Utilities – Division 33
- 11 1.05 SUBMITTALS
- 12 A. Submit shop drawings.
- 13 B. Submit literature sufficient in scope to demonstrate compliance with the
14 requirements of this specification.
- 15 1. Nameplates:
- 16 a. Color
- 17 b. Size
- 18 1) Outside dimensions
- 19 2) Lettering
- 20 c. Material
- 21 d. Mounting means
- 22 2. Nameplate Schedule
- 23 a. Show exact wording for each nameplate.
- 24 b. Include nameplate and letter sizes.
- 25 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 26 1.07 FACTORY TESTING (NOT USED)
- 27 1.08 QUALITY ASSURANCE (NOT USED)
- 28 1.09 WARRANTY (NOT USED)
- 29 1.10 EXTRA MATERIALS (NOT USED)

1 1.11 DESIGN REQUIREMENTS (NOT USED)

2 1.12 MAINTENANCE (NOT USED)

3 PART 2 PRODUCTS AND MATERIALS

4 2.01 NAMEPLATES

5 A. Engraved three-layer laminated plastic, black letters on white background.

6 B. Lettering:

7 1. 1/4-inch letters for identifying individual equipment and loads.

8 2. 1/2-inch letters for identifying grouped equipment and loads.

9 C. Control panel nameplates to be attached with two stainless steel screws.

10 D. Where mounting screws would de-rate an enclosure, UV resistant adhesive is
11 permissible.

12 2.02 CONDUCTOR MARKING

13 A. The ends of each conductor shall be marked with circuit number, motor number,
14 wire or terminal number.

15 B. Control system wire marking shall be coordinated with control system and
16 equipment shop drawings.

17 C. Labels shall be typed in black lettering with indelible ribbons on a white, heat shrink
18 sleeve. Markers shall be shrunk around the wire to ensure a tight, non-slip bond
19 with a compatible heat gun.

20 D. Heat shrink wire markers shall be Brady Bradysleeve Type B-321 or B-322.

21 2.03 CONDUCTOR COLOR CODING

22 A. Conductors No.6 AWG and smaller shall be provided with color coded insulation
23 as described herein. Conductors larger than No.6 AWG may be color coded with
24 appropriately colored Scotch No.35 tape at each end.

25 B. Color Coding:

26 1. 277/480 vac system shall be colored brown, orange, yellow, and gray for
27 phases A, B, C, and neutral respectively.

28 2. 120/208 vac system shall be colored black, red, blue, and white for phases
29 A, B, C, and neutral respectively.

3. 120/240 vac shall be colored black, red, and white for Line 1, Line 2, and neutral respectively.
4. 120 vac control wiring shall be colored red.
5. 24 VDC control wiring shall be colored ~~purple~~blue and ~~purple~~blue with white stripe for positive and negative conductors respectively.
6. Intrinsically safe control wiring shall be colored light blue.
7. Conductors within control cabinets and motor control centers carrying voltage supplied from an external source shall be colored yellow.
8. Grounding conductor and equipment ground conductors shall be colored green.

11 2.04 CONDUIT MARKING

- A. Colored band markers shall be field painted.
- B. Color:
 1. 480 Volt System: Yellow.
 2. 208 Volt and 240 Volt System: White.
 3. Fire Alarm System: Red.
 4. Low Voltage Communication System: Black.
 5. Process Instrumentation and Control System: Blue.

19 2.05 EQUIPMENT, ENCLOSURE, AND CABINET WARNING SIGNS

- A. Electrical Voltage and Shock Hazard Signs
 1. Provide OSHA Voltage and Shock Hazard sign for each electrical enclosure, cabinet, or other piece of equipment that presents an electrical hazard under normal operating circumstances or presents an electrical hazard while the enclosure is open.
- B. Electrical Arc Flash Hazard Signs
 1. Provide Arc Flash Hazard sign for each electrical enclosure, cabinet, or other piece of equipment that presents an arc flash hazard in accordance with NEC and ANSI Z535.4.
- C. Electrical Source Signs
 1. Provide sign indicating voltage level and source for each component of the power distribution system and for all control panels.
 2. Provide indicating multiple sources where equipment is fed from multiple sources or where signal wiring is present that is powered from a source external to the equipment

35 PART 3 CONSTRUCTION METHODS

- 1 3.01 DIVISION OF WORK (NOT USED)
- 2 3.02 FIELD MEASUREMENTS (NOT USED)
- 3 3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)
- 4 3.04 INSTALLATION

5 A. Nameplates:

- 6 1. Provide nameplates for grouped equipment such as panelboards,
7 transformers, motor control centers, and control panels. Nameplate shall
8 identify tag number, voltage, ampere rating, and description.
- 9 2. Provide nameplates for individual equipment such as motor control center
10 compartments, field instruments, and field control stations. Nameplate shall
11 identify tag number and description.
- 12 3. Provide nameplates for individual receptacles. Nameplate shall identify
13 panel and circuit number supplying the receptacle.
- 14 4. Provide nameplates for control cabinets and motor control center
15 compartments which contain wiring supplied from an external source.
16 Nameplate shall state: Multiple power sources within, verify all power
17 supplies are disconnected before servicing equipment.
- 18 5. Nameplates shall be secured to the front of equipment enclosures with
19 stainless steel screws or rivets, or epoxy-based cement. Double sided tape
20 will not be acceptable.
- 21 6. Secure nameplates for flush mounted panelboards behind the panelboard
22 door.
- 23 7. Nameplates shall be aligned and level or plumb. Misaligned or crooked
24 nameplates shall be remounted, or provide new enclosures at the discretion
25 of the Engineer.

26 B. Conductor Marking:

- 27 1. Mark conductors at every termination and splice point.
- 28 2. Mark conductors with wire numbers identified by control system supplier,
29 with panel and circuit identification, or with MCC compartment and wire
30 numbers.
- 31 3. Character markings shall face the open panel and shall read from left to right
32 or top to bottom.

33 C. Conduit Marking:

- 34 1. Furnish colored band markers for each conduit longer than six feet and mark
35 each conduit a minimum of twenty feet on center.
- 36 2. Mark conduits where they penetrate a wall or other structure, or emerge
37 from the ground, slab, etc.
- 38 3. Position conduit markers so they can easily be read from the floor.

1 3.05 TESTING AND START-UP SERVICES (NOT USED)

2 3.06 TRAINING (NOT USED)

3 END OF SECTION

SECTION 26 05 75

ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
 - b. ANSI/NFPA 70E - Standard for Electrical Safety in the Workplace
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE), Specifications and Standards, current edition:
 - a. IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - b. IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings
 - c. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - d. IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
 - e. IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - f. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA)
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)

- a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

1.03 DESCRIPTION OF WORK

- A. Furnish short-circuit and protective device coordination studies.
- B. Furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current issue of NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 - 2002, the IEEE Guide for Performing Arc-Flash Calculations.
- C. The electrical power system studies shall encompass the following electrical equipment:
 1. James Street Pump Station Electrical Infrastructure
 - a. Utility service entrance
 - b. Meter socket & fused disconnect
 - c. Pump Station components including starters
 - d. Automatic Transfer Switch
 - e. Generator
 2. James Street Pump Station Ground System Analysis
 - a. Ground Resistance Test

1.04 RELATED WORK ELSEWHERE

- A. Article 102 – Bidding Requirements and Conditions
- B. Article 103 – Award and Execution of the Contract
- C. Concrete – Division 03
- D. Metals – Division 05
- E. Electrical - Division 26
- F. Earthwork – Division 31
- G. Utilities – Division 33

1.05 SUBMITTALS

- 1 A. Submit shop drawings.
- 2 B. Preliminary short-circuit and protective device coordination studies shall be
3 submitted and approved prior to the approval of any electrical equipment submittals
4 that may be affected by the results of the study.
- 5 C. Final short-circuit, protective device coordination, and arc flash hazard analysis
6 studies shall be prepared and submitted based upon actual installed system
7 characteristics.
- 8 D. Submit the following information specifically for Electrical Systems Analysis:
9 1. The results of the short-circuit, protective device coordination, and arc flash
10 hazard analysis studies shall be summarized in a final report. A minimum
11 of five (6) bound copies of the complete final report shall be submitted.
12 Electronic PDF copies of the report shall be provided.
13 2. The report shall include the following sections:
14 a. Executive Summary including Introduction, Scope of Work and
15 Results/Recommendations.
16 b. Short-Circuit Methodology Analysis Results and Recommendations
17 c. Short-Circuit Device Evaluation Table
18 d. Protective Device Coordination Methodology Analysis Results and
19 Recommendations
20 e. Protective Device Settings Table
21 f. Time-Current Coordination Graphs and Recommendations
22 g. Arc Flash Hazard Methodology Analysis Results and
23 Recommendations including the details of the incident energy and
24 flash protection boundary calculations, along with Arc Flash
25 boundary distances, working distances, Incident Energy levels and
26 Personal Protection Equipment levels.
27 h. Arc Flash Labeling section showing types of labels to be provided.
28 Section shall contain descriptive information as well as typical label
29 images.
30 i. One-line system diagram that shall be computer generated and will
31 clearly identify individual equipment buses, bus numbers used in the
32 short-circuit analysis, cable and bus connections between the
33 equipment, calculated maximum short-circuit current at each bus
34 location, device numbers used in the time-current coordination
35 analysis, and other information pertinent to the computer analysis.
36 3. Submit an electronic version of the software model used to prepare the final
37 short-circuit, protective device coordination, and arc flash hazard analysis
38 studies.
39 4. Submit written certification, sealed, and signed by a professional engineer
40 conducting the study, equipment supplier, and electrical subcontractor
41 stating that the data used in the study is correct.

42 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

1 1.07 FACTORY TESTING (NOT USED)

2 1.08 QUALITY ASSURANCE

3 A. The short-circuit, protective device coordination and arc flash hazard analysis
4 studies shall be conducted under the responsible charge and approval of a
5 Registered Professional Electrical Engineer skilled in performing and interpreting
6 the power system studies.

7 B. The Registered Professional Electrical Engineer shall be an employee of the
8 approved engineering firm.

9 C. The Registered Professional Electrical Engineer shall have a minimum of five (5)
10 years of experience in performing power system studies.

11 D. The approved engineering firm shall demonstrate experience with Arc Flash
12 Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses
13 it has performed.

14 E. The studies shall be performed using SKM Systems Analysis Power*Tools for
15 Windows (PTW) software program or an approved equivalent software tool.

16 PART 2 PRODUCTS AND MATERIALS

17 2.01 DATA COLLECTION

18 A. Field data collection shall be performed by a technician, qualified (as defined by
19 NFPA 70E - 2014) to ensure accurate equipment modeling. The technician shall
20 have completed an 8-hour instructor-led Electrical Safety Training Course. The
21 course shall include NFPA 70E training which includes the selection and use of
22 personal protective equipment.

23 B. The technician shall visually inspect to verify the equipment ratings, conductor
24 ratings and overcurrent device data by removing panels, covers and doors where
25 required to document the necessary data used in the analysis. The technician shall
26 be qualified to perform these inspections with the equipment energized provided
27 the incident energy values are less than 40cal/cm², greater values or unusual site
28 conditions will require an equipment shutdown so the equipment can be inspected
29 de-energized.

30 C. The Owner or Contractor shall provide qualified personnel to show the technician
31 the equipment locations and to open all equipment doors, locks, etc. necessary to
32 collect nameplate data.

33 D. Verify one-line drawings and provide marked corrections where discrepancies are
34 found.

1 E. Data collection shall begin downstream from the utility service and continue down
2 through the electrical distribution system as defined under scope of work. The
3 study shall not include any single phase AC circuits or DC distribution systems as
4 these types of circuits and systems are excluded from IEEE 1584-2002 Arc Flash
5 calculation guidelines.

6 F. Obtain from the utility the minimum, normal, and maximum operating service
7 voltage levels, three-phase short circuit MVA and X/R ratio, as well as line-to-
8 ground short circuit MVA and X/R ratio at the point of connection as shown on the
9 drawings.

10 2.02 SHORT-CIRCUIT ANALYSIS

11 A. Transformer design impedances shall be used when test impedances are not
12 available.

13 B. Provide the following:

- 14 1. Calculation methods and assumptions
- 15 2. Selected base per unit quantities
- 16 3. One-line diagram of the system being evaluated that clearly identifies
17 individual equipment buses, bus numbers used in the short-circuit analysis,
18 cable and bus connections between the equipment, calculated maximum
19 short-circuit current at each bus location and other information pertinent to
20 the computer analysis
- 21 4. The study shall include input circuit data including electric utility system
22 characteristics, source impedance data, conductor lengths, number of
23 conductors per phase, conductor impedance values, insulation types,
24 transformer impedances and X/R ratios, motor contributions, and other
25 circuit information as related to the short-circuit calculations.
- 26 5. Tabulations of calculated quantities including short-circuit currents, X/R
27 ratios, equipment short-circuit interrupting or withstand current ratings and
28 notes regarding adequacy or inadequacy of the equipment rating.
- 29 6. Results, conclusions, and recommendations. A comprehensive discussion
30 section evaluating the adequacy or inadequacy of the equipment must be
31 provided and include recommendations as appropriate for improvements to
32 the system.

33 C. For solidly-grounded systems, provide a bolted line-to-ground fault current study
34 for applicable buses as determined by the engineer performing the study.

35 D. Protective Device Evaluation:

- 36 1. Evaluate equipment and protective devices and compare to short circuit
37 ratings
- 38 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to
39 withstand short-circuit stresses

1 devices, and device identification numbers to aid in locating the devices on
2 the log-log plots and the system one-line diagram.

- 3 4. The study shall include a separate, tabular printout containing the
4 recommended settings of all adjustable overcurrent protective devices, the
5 equipment designation where the device is located, and the device number
6 corresponding to the device on the system one-line diagram
- 7 5. A discussion section which evaluates the degree of system protection and
8 service continuity with overcurrent devices, along with recommendations
9 as required for addressing system protection or device coordination
10 deficiencies.
- 11 6. Identify in writing of any significant deficiencies in protection and/or
12 coordination. Provide recommendations for improvements.

13 2.04 ARC FLASH HAZARD ANALYSIS

- 14 A. The arc flash hazard analysis shall be performed according to the IEEE 1584
15 equations that are presented in NFPA70E-2009, Annex D. The arc flash hazard
16 analysis shall be performed in conjunction with the short-circuit analysis and the
17 protective device time-current coordination analysis.
- 18 B. The flash protection boundary and the incident energy shall be calculated at
19 significant locations in the electrical distribution system (switchboards, switchgear,
20 motor-control centers, panelboards, busway and splitters) where work could be
21 performed on energized parts.
- 22 C. Circuits 240V or less fed by single transformer rated less than 125 kVA may be
23 omitted from the computer model and will be assumed to have a hazard risk
24 category 0 per NFPA 70E.
- 25 D. Working distances shall be based on IEEE 1584. The calculated arc flash
26 protection boundary shall be determined using those working distances.
- 27 E. When appropriate, the short circuit calculations and the clearing times of the phase
28 overcurrent devices will be retrieved from the short-circuit and coordination study
29 model. Ground overcurrent relays should not be taken into consideration when
30 determining the clearing time when performing incident energy calculations
- 31 F. The short-circuit calculations and the corresponding incident energy calculations
32 for multiple system scenarios must be compared and the greatest incident energy
33 must be uniquely reported for each equipment location in a single table.
34 Calculations must be performed to represent the maximum and minimum
35 contributions of fault current magnitude for normal and emergency operating
36 conditions. The minimum calculation will assume that the utility contribution is at
37 a minimum. Conversely, the maximum calculation will assume a maximum
38 contribution from the utility. Calculations shall take into consideration the parallel

1 operation of synchronous generators with the electric utility, where applicable as
2 well as any stand-by generator applications.

3 G. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon
4 facility operational conditions, and the final report shall describe, when applicable,
5 how these conditions differ from worst-case bolted fault conditions.

6 H. The incident energy calculations must consider the accumulation of energy over
7 time when performing arc flash calculations on buses with multiple sources.
8 Iterative calculations must take into account the changing current contributions, as
9 the sources are interrupted or decremented with time. Fault contribution from
10 motors should be decremented as follows:

11 1. Fault contribution from induction motors should not be considered beyond
12 5 cycles.

13 I. For each piece of ANSI rated equipment with an enclosed main device, two
14 calculations shall be made. A calculation shall be made for the main cubicle, sides,
15 or rear; and shall be based on a device located upstream of the equipment to clear
16 the arcing fault. A second calculation shall be made for the front cubicles and shall
17 be based on the equipment's main device to clear the arcing fault. For all other non-
18 ANSI rated equipment, only one calculation shall be required and it shall be based
19 on a device located upstream of the equipment to clear the arcing fault.

20 J. When performing incident energy calculations on the line side of a main breaker
21 (as required per above), the line side and load side contributions must be included
22 in the fault calculation.

23 K. Mis-coordination should be checked amongst all devices within the branch
24 containing the immediate protective device upstream of the calculation location and
25 the calculation should utilize the fastest device to compute the incident energy for
26 the corresponding location.

27 L. Arc Flash calculations shall be based on actual overcurrent protective device
28 clearing time. A maximum clearing time of 2 seconds will be used based on IEEE
29 1584-2002 section B.1.2. Where it is not physically possible to move outside of the
30 flash protection boundary in less than 2 seconds during an arc flash event, a
31 maximum clearing time based on the specific location shall be utilized.

32 M. Provide the following:

- 33 1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form,
34 and shall include device or bus name, bolted fault and arcing fault current
35 levels, flash protection boundary distances, working distances, personal-
36 protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
37 a. The Arc-Flash Hazard Analysis shall report incident energy values
38 based on recommended device settings for equipment within the
39 scope of the study.

- 1) The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

PART 3 CONSTRUCTION METHODS

3.01 DIVISION OF WORK (NOT USED)

3.02 FIELD ADJUSTMENT

- A. The Contractor or equipment manufacturer's start-up technician shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- B. The Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Square D shall notify Owner in writing of any required major equipment modifications.

3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)

3.04 INSTALLATION

- A. Provide a 4.0 in. x 4.0 in. thermal transfer type Arc Flash label of high adhesion polyester for each work location analyzed.
- B. The Arc Flash labels shall be designed according to the following standards:
 1. UL969 - Standard for Marking and Labeling Systems
 2. ANSI Z535.4 - Product Safety Signs and Labels
 3. NFPA 70 (National Electric Code) - Article 110.16
- C. The Arc Flash label shall include the following information:
 1. System Voltage
 - a. Flash protection boundary
 - b. Personal Protective Equipment category
 - c. Arc Flash Incident energy value (cal/cm²)
 - d. Limited, restricted, and prohibited Approach Boundaries
 - 1) Study report number and issue date
- D. Labels shall be printed by a thermal transfer type printer, with no field markings.
- E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
 1. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have

1 labels provided on each individual section access area. Equipment line-ups
2 containing sections with multiple incident energy and flash protection
3 boundaries shall be labeled as identified in the Arc Flash Analysis table.

- 4 2. Wall Mounted Equipment - Labels shall be provided on the front cover or a
5 nearby adjacent surface, depending upon equipment configuration.
6 3. General Use Safety labels shall be installed on equipment in coordination
7 with the Arc Flash labels. The General Use Safety labels shall warn of
8 general electrical hazards associated with shock, arc flash, and explosions,
9 and instruct workers to turn off power prior to work.

10 F. Label Installation

- 11 1. Labels shall be field installed by the Contractor. The technician providing
12 the installation shall have completed an 8-Hour instructor led Electrical
13 Safety Training Course with includes NFPA 70E material including the
14 selection of personal protective equipment.

15 3.05 TESTING AND START-UP SERVICES (NOT USED)

16 3.06 TRAINING (NOT USED)

17 END OF SECTION

SECTION 26 08 00

ELECTRICAL EQUIPMENT ACCEPTANCE TESTING AND START-UP

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:

B. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.

C. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:

D. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)

E. Insulated Cable Engineers Association (ICEA)

F. International Society of Automation (ISA)

G. National Electrical Manufacturers Association (NEMA)

H. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.

I. Wisconsin Department of Safety and Professional Services (DSPS).

J. National Electrical Contractors Association (NECA), current edition.

1. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.

K. International Electrical Testing Association (NETA)

L. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

M. Canadian Standards Association (CSA), Specifications and Standards, current edition.

1 N. Electrical and Electronic Manufacturers Association Canada (EEMAC),
2 Specifications and Standards, Current Edition.

3 O. International Electrotechnical Association (IEC), Specifications and Standards,
4 Current Edition.

5 1.03 DESCRIPTION OF WORK

6 A. For the purpose of obtaining a complete and integrated process instrumentation
7 and control system, the work specified herein shall be included under the scope
8 of:

9 1. Section 26 90 00 - Process Instrumentation & Control.

10 a. The Contractor shall engage the acceptance testing and startup
11 services of the field engineering service division of a major
12 electrical distribution equipment manufacturer which maintains
13 division-wide recognized specialized testing capabilities for the
14 purpose of performing tests as herein specified.

15 b. The tests and inspections shall determine suitability for energizing
16 equipment; confirm the equipment is installed per the contract
17 documents and as a benchmark for the Owner to use for future
18 maintenance testing.

19 1.04 RELATED WORK ELSEWHERE

20 A. Article 102 – Bidding Requirements and Conditions

21 B. Article 103 – Award and Execution of the Contract

22 C. Concrete – Division 03

23 D. Metals – Division 05

24 E. Electrical - Division 26

25 F. Earthwork – Division 31

26 G. Utilities – Division 33

27 1.05 SUBMITTALS

28 A. Submit shop drawings.

29 B. Submitted electrical test report shall include the following:

30 C. Summary of project

31 D. Description of equipment tested

- 1 E. Description of test
- 2 F. Test results
- 3 G. Conclusions and recommendations
- 4 H. Appendix, including appropriate test forms
- 5 I. List of test equipment used and calibration date
- 6 J. Conditions for future access to secured computer database of all Test Data.
- 7 K. Furnish three copies of the completed report to the project engineer no later than
- 8 30 days after completion of the project, unless directed otherwise.
- 9 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 10 1.07 FACTORY TESTING (NOT USED)
- 11 1.08 QUALITY ASSURANCE
- 12 A. The testing plan and procedures shall be reviewed and approved by one of the
- 13 field engineering division's registered professional electrical engineers. The
- 14 registered professional engineer shall be a full time employee of the engineering
- 15 service testing group with at least 10 years of field experience testing electrical
- 16 apparatus.
- 17 B. The engineering service testing group shall be an independent division of a major
- 18 electrical equipment manufacturer.
- 19 C. The engineering service division site lead engineer or project manager shall be a
- 20 degreed engineer, who is a full-time employee, with at least 10 years of
- 21 experience testing electrical apparatus, and has obtained factory training. All
- 22 other employees working on this project shall have had specific factory, and/or
- 23 field training in accordance with division-wide standards.
- 24 D. To ensure compliance with quality control standards, the engineering service
- 25 division shall conduct periodic audits of test procedures and test record forms to
- 26 ensure compliance with industry standards. A Quality Assurance Manager, not
- 27 reporting to the operation center completing the field testing services, must
- 28 complete such audits. The name of the Quality Assurance Manager, or separate
- 29 audit agency, shall be submitted for approval prior to award of any contract or
- 30 completion of any fieldwork.
- 31 E. All test records shall be recorded onto standardized test forms. All data shall be
- 32 uploaded to a central computer in a data-secured environment; therefore ensuring
- 33 no changes can be incorporated into the final test records. These records shall be

1 retrievable for a period of not less than five years, based on a mutually agreed
2 periodic maintenance plan, separate from this contract.

3 F. Should repairs be required, the engineering service division shall maintain
4 dedicated locations that perform remanufacturing and reconditioning of electrical
5 equipment. All repairs shall be conducted under the direction of a quality control
6 and reconditioning standard pursuant to ISO9001 compliance. A quality
7 certificate, computer database and final test records shall document the progress
8 of each piece of electrical equipment through the repair or reconditioning process.
9 All work shall be performed in accordance with industry standards.
10 Documentation of periodic audits, as specified in item D above, shall also be
11 maintained for the dedicated remanufacturing and reconditioning facility.

12 G. The engineering service testing group shall have a calibration program which
13 maintains all applicable test instrumentation within rated accuracy.

14 H. The accuracy shall be traceable to the National Bureau of Standards in an
15 unbroken chain.

16 I. Instruments shall be calibrated in accordance with the following frequency
17 schedule:

18 J. Field instruments – six to twelve months

19 K. Laboratory instruments – twelve months

20 L. Dated calibration labels shall be visible on all test equipment.

21 M. Records must be kept up to date, which show date and results of all instruments
22 calibrated or tested.

23 N. An up-to-date instrument calibration instruction and procedure will be maintained
24 for each test instrument.

25 1.09 WARRANTY (NOT USED)

26 1.10 EXTRA MATERIALS (NOT USED)

27 1.11 DESIGN REQUIREMENTS (NOT USED)

28 1.12 MAINTENANCE (NOT USED)

29 1.13 SAFETY AND PRECAUTIONS

30 A. Safety practices shall include, but are not limited to, the following requirements:

31 B. Occupational Safety and Health Act of 1970 – OSHA 29CFR 1910.269

- 1 C. National Fire Protection Association – NFPA 70E
- 2 D. Applicable state and local safety operating procedures.
- 3 E. All tests shall be performed with apparatus de-energized except where otherwise
4 specified.
- 5 F. The engineering service testing group’s lead test engineer for the project shall be
6 a designated safety representative and shall be present on the project and
7 supervise testing operations and safety requirements.
- 8 G. Power circuits shall have conductors shorted to ground by a hotline grounded
9 device approved for the purpose in accordance with the appropriate test
10 procedures.
- 11 H. In all cases, work shall not proceed until the safety representative has determined
12 that it is safe to do so.
- 13 I. The engineering service testing group shall have available sufficient protective
14 barriers and warning signs, where necessary, to conduct specified tests safely.
- 15 J. The owner’s safety procedures shall be reviewed and understood by the
16 engineering service testing group personnel.

17 PART 2 PRODUCTS AND MATERIALS

18 2.01 EQUIPMENT EVALUATION PREPARATION

- 19 A. The electrical contractor shall torque down all accessible bolts; perform
20 continuity checks on all branch and control wiring; and perform rotational tests
21 for all motors prior to and in addition to tests performed by the engineering
22 service testing group, specified herein. Contractor shall remove metal shavings
23 and thoroughly clean and vacuum equipment before testing or energizing.
- 24 B. The electrical contractor shall supply a suitable and stable source of test power for
25 testing at each test site. The engineering service testing group shall specify
26 requirements.
- 27 C. The electrical contractor shall notify the engineering service testing group when
28 equipment becomes available for electrical tests. Work shall be coordinated to
29 expedite project scheduling.
- 30 D. The contractor will supply a complete set of as-built electrical plans,
31 specifications and any pertinent change orders to the engineering service testing
32 group prior to commencement of testing.

1 E. The engineering service testing group shall notify the project engineer prior to
2 commencement of any testing.

3 F. The engineering service testing group shall be responsible for implementing all
4 final settings and adjustments on protective devices and electrical equipment in
5 accordance with the project engineer's specified values or a coordination study
6 performed by the engineer of record or the testing group's licensed professional
7 engineer.

8 G. Any system, material or workmanship which is found defective on the basis of
9 electrical tests shall be reported directly to the project engineer.

10 H. The engineering service testing group shall maintain a written record of all tests
11 and upon completion of the project, assemble and certify a final test report.

12 PART 3 CONSTRUCTION METHODS

13 3.01 FIELD MEASUREMENTS

14 A. The field engineering service testing group shall provide all material, equipment,
15 labor and technical supervision to perform electrical equipment tests and
16 inspections. The field engineering service division of the equipment manufacturer
17 shall administer all acceptance and start-up testing, and power system studies, as
18 referenced in other specification sections.

19 B. Equipment warranty shall be extended to two years from date of commissioning
20 when service representatives employed by the equipment manufacturer perform
21 startup.

22 C. The intent of these tests is to assure that all electrical equipment is operational
23 within industry standards and manufacturer's tolerances and that equipment is
24 installed and functioning in the system in the manner intended by the engineer.

25 D. Upon completion of the tests and inspections noted in these specifications, a label
26 shall be attached to all serviced devices. These labels will indicate date serviced
27 and the engineering service testing group responsible.

28 E. The tests and inspections shall determine suitability for initial continued reliable
29 operation.

30 3.02 DELIVERY, STORAGE, AND HANDLING (NOT USED)

31 3.03 INSTALLATION (NOT USED)

32 3.04 TESTING AND START-UP SERVICES

33 A. MCC and Switchboard Inspection and Testing

- 1 B. Examine the Main MCC, switchboard(s), including breakers, and accessories for:
- 2 C. Doors, panels, and sections for alignment, dents, scratches, fit, and missing
- 3 hardware
- 4 D. Shipped loose and shipped short components.
- 5 E. Shipping damage
- 6 F. Loose or obviously damaged components.
- 7 G. Proper identification.
- 8 H. Physical damage from installation.
- 9 I. If the unit was placed in temporary storage, verify and record that proper
- 10 procedures were observed. Remove temporary heater wiring and shipping braces.
- 11 J. Inspect Shipping Splits to insure that all bus connections were properly connected
- 12 and all control wiring splits have been properly terminated.
- 13 K. Inspect all grounding connections for cleanliness and alignment.
- 14 L. Inspect Main Bonding Jumper for proper size and termination (Refer to NEC
- 15 Article 250, Section 250-102, Equipment Bonding Jumpers).
- 16 M. Inspect Insulators for evidence of physical damage or contaminated surfaces.
- 17 N. Inspect Surge Arrester and/or Surge Suppression size, type, installation and
- 18 connection to determine if they are in accordance with the drawings (Refer to
- 19 NEC Article 280)
- 20 O. Inspect Control power & instrument transformers, if applicable.
- 21 P. Inspect wiring for damaged insulation, broken leads, tightness of connections,
- 22 proper crimping, and overall general condition.
- 23 Q. Verify anchorage (per local codes, wind and seismic considerations).
- 24 R. Inspect and verify required area clearances, correct alignment and cleanliness.
- 25 S. Verify the grounding electrode conductor is properly sized (in accordance with
- 26 NEC Article 250, Table 250-66) and terminated.
- 27 T. Confirm the proper grounding of instruments, panels and connections (Refer to
- 28 NEC Article 250, Part J, Sections 250-170 through 250-178).
- 29 U. Confirm proper conductor identification (as applicable).

- 1 V. Verify cable termination tightness.
- 2 W. Verify that all cables have been properly installed, routed and supported and are
3 clear of energized parts.
- 4 X. Confirm conduits and conduit bushings are correctly installed.
- 5 Y. Confirm tightness of accessible bolted electrical connections, especially shipping
6 splits, by calibrated torque-wrench method in accordance with manufacturers
7 published data.
- 8 Z. Verify that all VT and CT ratios properly correspond to drawings and that
9 polarity is correct.
- 10 AA. Verify that shorting screws and bars are removed from CT's and terminal blocks
11 as required.
- 12 BB. Verify that primary and secondary fuse ratings or circuit breakers match
13 drawings.
- 14 CC. Confirm meter scaling and type match drawings.
- 15 DD. The meter, protective relay, breaker settings (& PFC choices) must be supplied
16 from a Power System Study performed by a licensed professional engineer prior
17 to commissioning.
- 18 EE. Set meter, relay, & breaker trip setting per above study.
- 19 FF. Inspect shipping splits for mechanical connection assuring adequate surface
20 contact.
- 21 GG. Ground bonding & shipping splits shall be tested with ductor tester (Digital low
22 ohm resistance meter) to insure connection is a low resistance connection. Test
23 from one fixed bus to adjacent fixed bus through the shipping split connector to
24 measure both connection points.
- 25 HH. Microhm values shall not vary more than 50% from other phase readings and
26 meet the manufactures published data based on bus size, ampacities and material.
- 27 II. Test the phase loss relay, either separate or integral to the multimeter, to activate
28 contact.
- 29 JJ. Test the undervoltage relay, either separate or integral to the multimeter, to
30 activate contact.
- 31 KK. If contact is hooked to the Capacitor trip & Shunt trip combo on main breaker,
32 insure main breaker trips.

- 1 LL. If contact reports to energy management system, insure energy management
2 system receives loss of phase/voltage signal.
- 3 MM. Inspect switchboard main bonding jumper for proper size and termination on
4 source side of neutral disconnect link.
- 5 NN. Inspect Grounding electrode conductor to assure proper size and secure
6 termination to ground bus.
- 7 OO. Inspect switchboard neutral bus downstream of the neutral disconnect link to
8 verify the absence of ground connections.
- 9 PP. Set Ground fault setting per calculations in E above.
- 10 QQ. Verify Ground Fault System Performance for correct response of the circuit-
11 interrupting device by secondary (or primary if local inspector requires) ground
12 sensor current injection. Record ground fault pickup current. Verify breaker trips
13 and indicator works.
- 14 RR. Verify Ground fault does not pick-up at 90% of pickup setting.
- 15 SS. Record settings, results, and any other notations on the Low Voltage Breaker data
16 form.

17 3.05 CABLE TESTING

- 18 A. Insulation System – To insure integrity of the cable insulation system after
19 shipping, site storage, and pulling through conduit an insulation resistance test
20 will reveal insulation deformities and moisture in the cable that otherwise might
21 cause an untimely premature cable failure possibly damaging equipment or
22 personnel. Perform the following on all customer power cables to and from main
23 switchboard. This would include cables from utility transformer to MSB and
24 cables from MSB to all secondary switchboards or distribution panels.
- 25 B. Visually inspect visible portion of cables for observable defects.
- 26 C. Insure all solid-state devices are disconnected from the system prior to
27 meggering. Typically but not all-inclusive would be Meters, trip units with
28 voltage sensing, and TVSS units.
- 29 D. Isolate cables by opening breakers. Meggering thru equipment like motors or
30 transformers will produce erroneous readings.
- 31 E. Perform insulation-resistance tests on each line and load cable, phase-to-phase,
32 phase-to-ground, phase-to-neutral and neutral-to-ground in each conduit. Megger
33 at 1000 VDC for 600 volt cable and 500 VDC for 300 volt cable for one minute.

1 F. Insulation resistance shall be above 100 ohms and preferably above one megohm.

2 G. Insure cable termination connections are tight after testing.

3 3.06 FOLLOW UP TESTING

4 1. Included in above cost as part of original project.

5 B. One month prior to the expiration of the factory warranty schedule & perform a
6 thermal scan of all breaker to cable, breaker, bus connections, cable to panel
7 chassis. Scope is to include main transformer connections, main switchboard, all
8 secondary switchboards, transformers, and panels. Tests are to be done with
9 building normal loaded for 2 hours, not in with partial or unloaded condition.

10 C. Thermal scans temperatures shall be evaluated as follows (based on comparable
11 size or adjacent phases and loaded breakers, bus connections, and terminations)

12 1. 1-3 degrees C rise, Investigate as to the cause of temp rise.

13 2. 4 – 15 degree C rise, Repair as soon as possible.

14 3. 16 or higher degree C rise, Repair immediately.

15 D. Insure that all bus and breaker to cable connections are tight.

16 E. Note corrective actions taken, deficiencies, recommendations and any general
17 comments.

18 F. Finish recording data on test forms, completely filling in the blanks.

19 G. Turn in 3 copies of report to engineer for approval.

20 3.07 TRAINING (NOT USED)

21
22 END OF SECTION
23

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code.
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA PB 1 - Panelboards
 - b. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
 - c. NEMA AB 1 - Molded Case Circuit Breakers.
 - d. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
 - e. NEMA 250 - Enclosures for Electrical Equipment.
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL 50 - Enclosures for Electrical Equipment
 - b. UL 67 - Panelboards.
 - c. UL 98 - Enclosed and Dead-front Switches
 - d. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- 1 11. Canadian Standards Association (CSA), Specifications and Standards,
2 current edition:
3 a. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed
4 Panelboards
5 b. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
6 12. Federal Specifications and standards, current edition:
7 a. W-P-115C - Type I Class 1
8 b. W-C-375B - Molded Case Circuit Breakers
9 c. W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit
10 and Service.
11 d. W-P115C - Type 1 Class 2 Load Center

12 1.03 DESCRIPTION OF WORK

- 13 A. Furnish and install complete and operable panelboards as indicated on the drawings
14 and as specified herein.

15 1.04 RELATED WORK ELSEWHERE

- 16 A. Article 102 – Bidding Requirements and Conditions
17 B. Article 103 – Award and Execution of the Contract
18 C. Concrete – Division 03
19 D. Metals – Division 05
20 E. Electrical - Division 26
21 F. Earthwork – Division 31
22 G. Utilities – Division 33

23 1.05 SUBMITTALS

- 24 A. Submit shop drawings.
25 B. Submit the following information specifically for panelboards:
26 1. Literature sufficient in scope to demonstrate compliance with the
27 requirements of this specification.
28 2. Overall panelboard dimensions, interior mounting dimensions, and wiring
29 gutter dimensions. The location of the main, branches, and solid neutral
30 shall be clearly shown. Illustrate one line diagrams with applicable voltage
31 systems.
32 3. Equipment ratings for voltage, amperage, and short circuit.

33 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 1 A. Submit operation & maintenance manuals and instructions.
- 2 B. Submit the following information specifically for panelboards:
- 3 1. Manufacturer shall provide installation instructions and NEMA Standards
- 4 Publication PB 1.1 - Instructions for Safe Installation, Operation and
- 5 Maintenance of Panelboards Rated 600 Volts or Less.

6 1.07 FACTORY TESTING (NOT USED)

7 1.08 QUALITY ASSURANCE

- 8 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 9 B. System supplier shall be responsible for providing all necessary accessories
- 10 required for a complete and operable system.
- 11 C. Manufacturer Qualifications: All panelboards provided under this section shall be
- 12 the products of a single company specializing in manufacturing products specified
- 13 in this section, with not less than fifty years of documented experience.
- 14 D. Products: Listed and classified by UL or testing firm acceptable to the authority
- 15 having jurisdiction as suitable for the purpose specified and indicated.
- 16 E. Panelboard manufacturer shall be certified to ISO 9001 International Quality
- 17 Standard and shall have third party certification verifying quality assurance in
- 18 design/development, production, installation, and service, in accordance with ISO
- 19 9001.

20 1.09 WARRANTY

21 1.10 EXTRA MATERIALS

22 1.11 DESIGN REQUIREMENTS (NOT USED)

23 1.12 MAINTENANCE

- 24 A. Before substantial completion, perform all maintenance activities required by any
- 25 sections of the specifications including any calibrations, final adjustments,
- 26 component replacements or other routine service required before placing
- 27 equipment or systems into service.
- 28 B. Furnish all spare parts as required by other sections of the specifications.

29 PART 2 PRODUCTS

30 2.01 240VAC LIGHTING AND APPLIANCE BRANCH CIRCUIT LOAD CENTERS

- 31 A. Manufacturers:

1. Square D Company QO Load Center
- ~~2. Cutler Hammer Type CH~~
- ~~3. or equal~~

4 B. Interiors:

- 5 1. Bus bar connections to the branch circuit breakers shall be the distributed
- 6 phase type and shall accept plug-on circuit breakers. 300-400A load centers
- 7 shall accept a 150A maximum bolt-on breaker in addition to plug-on types.
- 8 2. Short Circuit Current Ratings: shall be provided as indicated on the
- 9 drawings. This rating shall be established by manufacturer testing of a
- 10 representative load center with branch circuit breakers installed.

11 C. Circuit Breakers:

- 12 1. Circuit breakers shall be plug-on thermal magnetic trip, with an integral
- 13 crossbar to ensure simultaneous opening of all poles in multi-pole circuit
- 14 breakers.
- 15 2. Circuit breakers shall have an overcenter, tripfree, toggle-type operating
- 16 mechanism with quick-make, quick-break action and positive handle
- 17 indication.
- 18 3. Handles shall have ON, OFF, and "Tripped" positions. In addition, trip
- 19 indication shall include an indicator appearing in the window of the circuit
- 20 breaker case (through 125 amperes).
- 21 4. Circuit breakers shall be UL Listed in accordance with UL standard 489
- 22 with current ratings as indicated on the plans. Interrupting ratings shall be
- 23 selected to provide the required load center short circuit current rating.
- 24 5. Single-pole, 15 and 20 ampere circuit breakers indicated on the drawings as
- 25 intended to switch fluorescent lighting loads on a regular basis shall have
- 26 the SWD marking.
- 27 6. Two- and three-pole circuit breakers 15-60 amperes indicated on the
- 28 drawings as intended for use with air conditioning, heating, and
- 29 refrigeration equipment having motor group combinations and marked as
- 30 such shall have the HACR marking.
- 31 7. Provide UL Class A ground fault interrupter circuit breakers where
- 32 indicated on drawings.
- 33 8. The following special application circuit breakers or circuit breaker
- 34 accessories shall be provided where indicated on the drawings:
- 35 a. Circuit breakers with remote control switching capability
- 36 b. Circuit breakers for use on high intensity discharge lighting systems
- 37 c. Key operated circuit breakers
- 38 d. Switch neutral circuit breakers
- 39 e. Shunt trip, auxiliary switch, or alarm switch accessories

40 D. Enclosures:

- 41 1. NEMA PB1: Type 1 or Type 3R as indicated on the drawings.
- 42 2. Enclosure shall be fabricated of cold rolled steel for NEMA 1 and
- 43 galvanized steel or equivalent rust-resistant steel for NEMA 3R.

3. Indoor Type I enclosures shall have a flush or surface front as indicated on the drawings and flush cylinder tumble-type lock, all keyed alike, with finish to be gray baked enamel.
4. Outdoor Type 3R enclosures shall have a hasp to secure the cover. Finish to be gray baked enamel.
5. A directory label shall be provided with circuits identified as indicated on the schedule.

E. Manual Transfer Assembly:

1. Provide U.L. Listed manual transfer assembly where indicated on the drawings.
2. Manual transfer shall consist of two backfed main circuit breakers sized as indicated on the drawings complete with retaining kits and mechanical interlock to prevent both circuit breakers from simultaneously being in the "on" position.

2.02 240VAC LIGHTING AND APPLIANCE PANELBOARDS

A. Manufacturers:

1. Square D Company NQ
2. ~~Cutler Hammer Pow-R-Line~~
3. ~~or equal~~

B. Interior:

1. Rated for 240VAC / 48VDC maximum. Continuous main current ratings, as indicated on the drawings, not to exceed 600 amperes maximum.
2. UL Listed short circuit current ratings as indicated on the drawings with a maximum of 200,000 RMS symmetrical amperes.
3. Provide one continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing shall be plated copper. Bus bar plating shall run the entire length of the bus bar. Main lug and main breaker panelboards shall be suitable for use as Service Equipment.
4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
5. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided where indicated on the drawings.
6. Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length. UL Listed panelboards with 200 percent rated solid neutrals shall have plated copper neutral bus for non-linear load applications where indicated on the drawings.

- 1 7. Interior trim shall be of dead-front construction to shield user from
2 energized parts. Dead-front trim shall have pre-formed twist-outs covering
3 unused mounting space.
- 4 8. Nameplates shall contain system information and catalog number or factory
5 order number. Interior wiring diagram, neutral wiring diagram, UL Listed
6 label and short circuit current rating shall be displayed on the interior or in
7 a booklet format.
- 8 9. Interiors shall be field convertible for top or bottom incoming feed. Main
9 lug interiors up to 400 amperes shall be field convertible to main breaker.
10 Interior leveling provisions shall be provided for flush mounted
11 applications.
- 12 10. Circuit Breakers:
 - 13 a. Main circuit breakers shall be vertically mounted.
 - 14 b. Sub-feed circuit breakers shall be vertically mounted.
 - 15 c. Molded case branch circuit breakers shall have bolt-on type bus
16 connectors.
 - 17 d. All unused spaces provided, unless otherwise specified, shall be
18 fully equipped for future devices, including all appropriate
19 connectors and mounting hardware.
 - 20 e. The exposed faceplates of all branch circuit breakers shall be flush
21 with one another.

22 C. Enclosures:

23 1. Type 1:

- 24 a. Boxes shall be galvanized steel constructed in accordance with UL
25 50 requirements. Zinc-coated galvanized steel will not be
26 acceptable.
- 27 b. Boxes shall have removable endwalls with knockouts located on one
28 end. Boxes shall have welded interior mounting studs. Interior
29 mounting brackets are not required.
- 30 c. Box width shall be 26-inch wide maximum.
- 31 d. Type 1 Fronts:
 - 32 1) Front shall meet strength and rigidity requirements per UL
33 50 standards. Front shall have ANSI 49 gray enamel
34 electrodeposited over cleaned phosphatized steel.
 - 35 2) Fronts shall be hinged 1-piece with door. Mounting shall be
36 flush or surface as indicated on the drawings.
 - 37 3) Panelboards shall have fronts with concealed door hinges
38 and mounted with trim screws. Front shall not be removable
39 with the door locked. Doors on front shall have rounded
40 corners and edges shall be free of burrs.
 - 41 4) Front shall have cylindrical tumbler type lock with catch and
42 spring-loaded stainless steel door pull. All lock assemblies
43 shall be keyed alike. One (1) key shall be provided with each
44 lock. A clear plastic directory cardholder shall be mounted
45 on the inside of door.

- 1 2. Type 3R, 5, and 12:
2 a. Enclosures shall be constructed in accordance with UL 50
3 requirements. Enclosures shall be painted with ANSI 49 gray
4 enamel electrodeposited over cleaned phosphatized steel.
5 b. All doors shall be gasketed and equipped with a tumbler type vault
6 lock and two (2) additional quarter turn fasteners on enclosures 59-
7 inches or more in height. All lock assemblies shall be keyed alike.
8 One (1) key shall be provided with each lock. A clear plastic
9 directory cardholder shall be mounted on the inside of door.
10 c. Maximum enclosure dimensions shall not exceed 21-inches wide
11 and 6.5-inches deep.

12 PART 3 CONSTRUCTION METHODS

13 3.01 DIVISION OF WORK (NOT USED)

14 3.02 FIELD MEASUREMENTS

- 15 A. Field verify all measurements. Do not base exact panelboard locations on the
16 contract drawings. Actual field conditions govern all final installed locations,
17 distances, and levels.
18 B. Identify conflicts with the work of other trades prior to installation of electrical
19 equipment.
20 C. Adjust panelboard installation to satisfy field requirements.

21 3.03 DELIVERY, STORAGE, AND HANDLING

- 22 A. Accept panelboard on site. Inspect for damage.
23 B. Protect panelboard from corrosion and entrance of debris.
24 C. Store panelboard above grade. Protect from environment with suitable covering.

25 3.04 INSTALLATION

- 26 A. Install panelboards plumb and flush with wall finishes.
27 B. Install panelboards such that top of panel is located at an elevation of 6-feet above
28 finished floor elevation.
29 C. Provide filler plates for unused spaces in panelboards.
30 D. Provide typed circuit directory for each branch circuit panelboard. Revise directory
31 to reflect circuiting changes required to balance phase loads.

- 1 E. Stub one empty 1.5-inch conduit to accessible location below ground outside
2 concrete slab.
- 3 F. Measure steady state load currents at each panelboard feeder. Should the difference
4 at any panelboard between phases exceed 10 percent, rearrange circuits in the
5 panelboard to balance the phase loads within 10 percent. Take care to maintain
6 proper phasing for multi wire branch circuits.
- 7 G. Inspect for physical damage, proper alignment, anchorage, and grounding. Check
8 proper installation and tightness of connections for circuit breakers, fusible
9 switches, and fuses.
- 10 H. Verify that bonding jumper is properly installed in service entrance rated panels.
- 11 I. Thoroughly clean and remove construction debris from panelboard interior and
12 exterior.

13 3.05 TESTING AND START-UP SERVICES

- 14 A. Refer to the requirements of Section 26 08 00 - Commissioning of Electrical
15 Systems.

16 3.06 TRAINING

- 17 A. Refer to the requirements of Section 26 08 00 - Commissioning of Electrical
18 Systems.

19 END OF SECTION

SECTION 26 28 19

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

1. American National Standards Institute/Instrument Society of America (ANSI/ISA), Specifications and Standards, current edition:
 - a. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - 1) ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA FU 1 - Low Voltage Cartridge Fuses
 - b. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
 - c. NEMA 250 - Enclosures for Electrical Equipment.
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL 98 - Enclosed and Dead Front Switches
 - b. UL 508 - Standard for Industrial Control Equipment
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- 1 11. Canadian Standards Association (CSA), Specifications and Standards,
2 current edition:
- 3 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
4 Specifications and Standards, Current Edition.
- 5 13. International Electrotechnical Association (IEC), Specifications and
6 Standards, Current Edition.

7 1.03 DESCRIPTION OF WORK

- 8 A. Furnish and install complete and operable enclosed switches as indicated on the
9 drawings and as specified herein.
- 10 B. Provide disconnect switches with the number of poles, voltage, current, short
11 circuit, and horsepower ratings as required by the load and the power system.
- 12 C. Furnish one spare set of fuses.

13 1.04 RELATED WORK ELSEWHERE

- 14 A. Article 102 – Bidding Requirements and Conditions
- 15 B. Article 103 – Award and Execution of the Contract
- 16 C. Concrete – Division 03
- 17 D. Metals – Division 05
- 18 E. Electrical - Division 26
- 19 F. Earthwork – Division 31
- 20 G. Utilities – Division 33

21 1.05 SUBMITTALS

- 22 A. Submit shop drawings.
- 23 B. Submit the following information specifically for enclosed switches:
24 1. Manufacturer literature sufficient in scope to demonstrate compliance with
25 the requirements of this specification.
26 2. Outline drawings with dimensions.
27 3. Equipment ratings for voltage, amperage, horsepower and short circuit.

28 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

29 1.07 FACTORY TESTING (NOT USED)

1 1.08 QUALITY ASSURANCE

- 2 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 3 B. System supplier shall be responsible for providing all necessary accessories
4 required for a complete and operable system.
- 5 C. Manufacturer Qualifications: Company specializing in manufacturing products
6 specified in this section, with not less than three years of documented experience.
- 7 D. Products: Listed and classified by UL or testing firm acceptable to the authority
8 having jurisdiction as suitable for the purpose specified and indicated.

9 1.09 WARRANTY

10 1.10 EXTRA MATERIALS

- 11 A. Supply 3 spare fuses of each type supplied for this project

12 1.11 DESIGN REQUIREMENTS (NOT USED)

13 1.12 MAINTENANCE (NOT USED)

14 PART 2 PRODUCTS AND MATERIALS

15 2.01 250VAC/600VAC HEAVY DUTY DISCONNECT SWITCH

16 A. Manufacturers:

- 17 1. Schneider Electric/Square D Company
- 18 2. ~~Eaton/Cutler-Hammer~~
- 19 2. Allen Bradley
- 20 3. or equal

21 B. Switch Interior:

- 22 1. All switches shall have switch blades which are visible when the switch is
23 off and the cover is open.
- 24 2. Lugs shall be front removable and UL Listed for 60 degree C or 75 degree
25 C aluminum or copper conductors as required by the application.
- 26 3. Fusible switches shall be equipped with factory installed or field installed
27 fuse pullers.
- 28 4. Switches shall be equipped with plated copper current carrying parts to
29 resist corrosion.
- 30 5. Switches shall be equipped with removable arc suppressors to facilitate
31 access to line side lugs.
- 32 6. Switches shall have provisions for a field installable electrical interlock.

1 C. Switch Mechanism:

- 2 1. Switch operating mechanism shall be quick-make, quick-break such that,
3 during normal operation of the switch, the operation of the contacts shall
4 not be restrained by the operating handle after the closing or opening action
5 of the contacts has started.
6 2. The operating handle shall be an integral part of the box, not the cover.
7 3. The handle position shall travel at least 90 degrees between off and on
8 positions to clearly distinguish and indicate handle position.
9 4. All switches shall have a dual cover interlock mechanism to prevent
10 unintentional opening of the switch cover when the switch is on and prevent
11 turning the switch on when the cover is open. The cover interlock
12 mechanism shall have an externally operated override but the override shall
13 not permanently disable the interlock mechanism. The tool used to override
14 the cover interlock mechanism shall not be required to enter the enclosure
15 in order to override the interlock.

16 D. Switch Enclosures:

- 17 1. Environmental Rating:
18 a. Service entrance switch, exterior: Type 4X, stainless steel.
19 b. Service entrance switch, interior: Type 1.
20 c. Disconnect switch, exterior: Type 4X, stainless steel.
21 d. Disconnect switch, interior: Type 4X, stainless steel.
22 e. Disconnect switch, interior when EMT conduit is allowed: Type 1.
23 f. Disconnect switch, hazardous location: Type 7/9.
24 2. Covers:
25 a. Type 1, 4X stainless steel enclosures: attached with welded pin-type
26 hinges.
27 b. Type 7/9 enclosures: attached with Type 316 stainless steel bolts.
28 3. Finish:
29 a. Type 1 enclosures: gray baked enamel paint electrodeposited on
30 cleaned, phosphate pre-treated steel.
31 b. Type 4X stainless steel enclosures: brush finish on type 304 stainless
32 steel.
33 c. Type 7/9 enclosures: gray baked enamel on copper free cast
34 aluminum alloy.
35 4. The enclosure shall have on and off markings stamped or cast into the cover.
36 5. The operating handle shall be provided with a dual colored, red/black
37 position indication.
38 6. All switches shall have provisions to accept up to three 3/8-inch hasp
39 padlocks to lock the operating handle in the off position.
40 7. Exterior switches shall have provisions to accept one 3/8-inch hasp
41 padlocks to lock the operating handle in the on position.
42 8. Conduit Entrance:
43 a. Tangential knockouts shall be provided for Type 1 switches rated
44 30-200A.

- 1 b. Watertight conduit hubs for Type 4X stainless steel switches.
- 2 c. Threaded conduit openings in both end walls for Type 7/9
- 3 enclosures.
- 4 9. Cover sealing means for switches rated through 200 amperes shall be quick
- 5 release trunk latches (Type 1, 4X stainless steel enclosures) and type 316
- 6 stainless steel bolts (Type 7/9 enclosures).
- 7 10. Type 7/9 enclosures shall be furnished with a breather and drain kit to allow
- 8 their use in outdoor applications.
- 9 11. Type 4X stainless steel enclosures shall be dual rated as Type 3R to
- 10 facilitate their use in outdoor applications.

- 11 E. Switch Ratings:
- 12 1. Switch shall be suitable for use as service entrance equipment where use is
- 13 indicated on the drawings.
- 14 2. Switches shall be horsepower rated for ac and/or dc as indicated on the
- 15 plans.
- 16 3. Switches shall be rated for the voltage applied.
- 17 4. The UL Listed short circuit current rating of the switches shall be:
- 18 a. 10,000 rms symmetrical amperes when used with or protected by
- 19 Class H or K fuses (30-600 ampere).
- 20 b. 200,000 rms symmetrical amperes when used with or protected by
- 21 Class R or Class J fuses (30-600 ampere switches employing
- 22 appropriate fuse rejection schemes).
- 23 c. 200,000 rms symmetrical amperes when used with or protected by
- 24 Class L fuses (800-1200 ampere).

25 2.02 FUSES

- 26 A. Manufacturers:
- 27 1. Bussmann
- 28 2. or equal

- 29 B. 250 Volt Fuses:
- 30 1. Class RK-1, one end rejection or to fit mountings specified. 0-600 ampere,
- 31 200,000 ampere interrupting rating.
- 32 2. Low-Peak LPN-R, dual element, time delay with short circuit protection for
- 33 motor, transformer, feeder and main service protection.

- 34 C. 600 Volt Fuses:
- 35 1. Class RK-1, one-end rejection or to fit mountings specified, 0-600 ampere,
- 36 200,000 ampere interrupting rating.
- 37 2. Low-Peak LPS-R, dual element, time delay with short circuit protection. 0-
- 38 600 ampere, 200,000 ampere interrupting rating for motor, transformer,
- 39 feeder and main service protection.
- 40 3. Class L, bolt-in, 601-6,000 amperes, 200,000 ampere interrupting rating.

1 4. HI-CAP KRP-C, time delay for overload and short circuit protection. 601-
2 6,000 amperes, 200,000 ampere interrupting rating for motor, transformer,
3 feeder and main service protection.

4 5. Class CC, fast acting, single element, 0-30 amperes, 200,000 ampere
5 interrupting rating.

6 2.03 SPARE FUSES

7 A. Provide one complete set of spare fuses.

8 PART 3 CONSTRUCTION METHODS

9 3.01 DIVISION OF WORK (NOT USED)

10 3.02 FIELD MEASUREMENTS

11 A. Field verify all measurements. Do not base exact enclosed switch locations on the
12 contract drawings. Actual field conditions govern all final installed locations,
13 distances, and levels.

14 B. Identify conflicts with the work of other trades prior to installation of electrical
15 equipment.

16 C. Adjust enclosed switch installation to satisfy field requirements.

17 3.03 DELIVERY, STORAGE, AND HANDLING

18 A. Accept enclosed switches on site. Inspect for damage.

19 B. Protect enclosed switches from corrosion and entrance of debris.

20 C. Store enclosed switches above grade. Protect from environment with suitable
21 covering.

22 3.04 INSTALLATION

23 A. Install fuses where switches are indicated as fusible switches on the drawings.

24 B. Install wall mounted enclosure for spare fuses.

25 C. Install enclosed switches plumb and level.

26 D. Install enclosed switches such that top of enclosure is located at an elevation of 6-
27 feet above finished floor elevation.

28 E. Inspect for physical damage, proper alignment, anchorage, and grounding. Check
29 proper installation and tightness of connections.

1 F. Verify that bonding jumper is properly installed in service entrance rated switches.

2 G. Thoroughly clean and remove construction debris from switch interior and exterior.

3 3.05 TESTING AND START-UP SERVICES

4 A. Refer to the requirements of Section 26 08 00 - Electrical Equipment Acceptance.

5 3.06 TRAINING

6 A. Refer to the requirements of Section 26 08 00 - Electrical Equipment Acceptance.

7 END OF SECTION

SECTION 26 29 13

MOTOR CONTROLLERS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs

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 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - b. ICS 4-2000 - Industrial Control and Systems: Terminal Blocks.
 - c. ICS 5-2000 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - d. ICS 6-1993 - Industrial Control and Systems Enclosures.
7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL 508 – Standard for Industrial Control Equipment.
 - b. UL 508A – Standard for Industrial Control Panels
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.

- 1 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
2 Specifications and Standards, Current Edition.
3 13. International Electrotechnical Association (IEC), Specifications and
4 Standards, Current Edition.
5 a. IEC-60439 - Low Voltage Switchgear and Control Gear
6 Assemblies.
7 14. European Committee for Electrotechnical Standardization (CENELEC),
8 Current Edition.
9 a. EN 60947 - Low-Voltage Switchgear and Controlgear - Part 4-2:
10 Contactors and Motor-Starters - AC Semiconductor Motor
11 Controllers and Starters
12 15. Electrical and Electronic Manufacturers Association Canada (EEMAC),
13 Specifications and Standards, Current Edition.

14 1.03 DESCRIPTION OF WORK

- 15 A. For the purpose of obtaining a complete and integrated process instrumentation and
16 control system, the work specified herein shall be included under the scope of:
17 1. Section 26 90 00 - Process Instrumentation & Control

18 B. Furnish and install complete and operable motor controllers as indicated on the
19 drawings and as specified herein.

20 1.04 RELATED WORK ELSEWHERE

- 21 A. Article 102 – Bidding Requirements and Conditions
22 B. Article 103 – Award and Execution of the Contract
23 C. Concrete – Division 03
24 D. Metals – Division 05
25 E. Electrical - Division 26
26 F. Earthwork – Division 31
27 G. Utilities – Division 33

28 1.05 SUBMITTALS

- 29 A. Submit shop drawings.
30 B. Submit Manufacturer literature sufficient in scope to demonstrate compliance with
31 the requirements of this specification.

- 1 C. Submit shop drawings for the equipment specified herein in accordance with the
2 requirements specified under Section 26 24 19, which state that submittals for all
3 motor control equipment be included as part of the submittal for the complete,
4 integrated process instrumentation and control system and in accordance with the
5 requirements specified under Section 26 90 00.

6 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 7 A. Submit operation & maintenance manuals and instructions.
- 8 B. Submit operation and maintenance manuals for the equipment specified herein in
9 accordance with the requirements specified under Section 26 24 19, which state
10 that submittals for all motor control equipment be included as part of the submittal
11 for the complete, integrated process instrumentation and control system and in
12 accordance with the requirements specified under Section 26 90 00.

13 1.07 QUALITY ASSURANCE

- 14 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 15 B. System supplier shall be responsible for providing all necessary accessories
16 required for a complete and operable system.
- 17 C. Manufacturer Qualifications: All motor controllers provided under this section
18 shall be the products of a single company specializing in manufacturing products
19 specified in this section, with not less than twenty years of documented experience.
- 20 D. Products: Listed and classified by UL or testing firm acceptable to the authority
21 having jurisdiction as suitable for the purpose specified and indicated.
- 22 E. Motor Control Center manufacturer shall be certified to ISO 9001 International
23 Quality Standard and shall have third party certification verifying quality assurance
24 in design/development, production, installation, and service, in accordance with
25 ISO 9001.

26 1.08 WARRANTY

- 27 A. See Division 01 for additional requirements.

28 1.09 EXTRA MATERIALS

- 29 A. See Division 01 for additional requirements.

1 1.10 EXTRA MATERIALS (NOT USED)

2 1.11 DESIGN REQUIREMENTS (NOT USED)

3 1.12 MAINTENANCE

4 A. Before substantial completion, perform all maintenance activities required by any
5 sections of the specifications including any calibrations, final adjustments,
6 component replacements or other routine service required before placing
7 equipment or systems into service.

8 PART 2 PRODUCTS AND MATERIALS

9 2.01 MANUFACTURER

10 A. Allen-Bradley 509 Nema Starter with E300 Overload.

11 2.02 ELECTROMECHANICAL MOTOR CONTROLLERS

12 A. Overload Protection:

13 1. General:

- 14 a. E300 overload
- 15 b. Nema Overload Relay
- 16 c. Sensing Type: Voltage/Current/Ground Fault
- 17 d. Current Range: 0.5A-30A
- 18 e. Mounting: Mounts on Nema size 0-2
- 19 f. Control Voltage: 120 VAC- 4 In/ 3 Out
- 20 g. Ethernet/IP Communications Module
- 21 h. Provide shielded Ethernet cable 600V rated.

22 B. Non-Reversing Starters:

- 23 1. Magnetic starters through NEMA Size 9 shall be equipped with double-
24 break silver alloy contacts. The starter must have straight-through wiring.
25 Each starter shall have one (1) NO auxiliary contact
- 26 2. Coils shall be permanently marked with voltage, frequency and part number
- 27 3. NEMA Size 00 through 2 starters shall be suitable for the addition of at least
28 six (6) external auxiliary contacts of any arrangement normally open or
29 normally closed. Size 3 through 8 starters shall be suitable for the addition
30 of up to eight (8) external auxiliary contacts of any arrangement normally
31 open or normally closed
- 32 4. Allen Bradley 500 Series Nema Starter

33 ~~2.03 SOLID STATE REDUCED VOLTAGE MOTOR CONTROLLERS~~

34 ~~A. Manufacturer:~~

1. ~~Allen Bradley SMC Flex.~~

B. ~~Ratings:~~

1. ~~The solid state reduced voltage controller shall accept an input voltage of 480 VAC, three phase plus or minus 10 percent~~

2. ~~Environmental Ratings~~

a. ~~Storage ambient temperature range: 20 to 75 degrees C.~~

b. ~~Operating ambient temperature range: 0 to 40 degrees C.~~

c. ~~The relative humidity range: 5 to 95 percent non condensing.~~

d. ~~Operating elevation: up to 2000 Meters.~~

C. ~~Design:~~

1. ~~The open type controller device shall be modular, consisting of a power structure and a logic component.~~

2. ~~Power Structure:~~

a. ~~The power structure shall include an SCR bypass.~~

b. ~~The power structure shall include a built in overload.~~

c. ~~For ratings 1 Amps to 1200 Amps, the power structure shall consist of three power poles with integral heatsinks.~~

d. ~~Power poles are to be modular in design that each is easily replaceable.~~

e. ~~Back to back SCR pairs shall be the only power switching semiconductor means acceptable. Diode SCR (Silicon Controlled Rectifier) combinations shall not be acceptable.~~

f. ~~SCRs shall have the following minimum repetitive peak inverse voltage ratings.~~

1) ~~1400V for units rated 200 to 480V~~

2) ~~1600V for units rated 200 to 600V~~

3. ~~Logic Component:~~

a. ~~The logic component shall be a self contained control module, compatible with the full range of power structures. The control module shall mount directly to the power structure.~~

b. ~~The control module shall provide digital microprocessor control and supervision of all controller operation, including pulse firing of the SCRs.~~

e. ~~The control module shall consist of the following.~~

1) ~~Self tuning power supply accepting control power input from 100 to 240 VAC or 24V AC/DC, 50/60 Hz.~~

2) ~~Logic control circuitry incorporating a latch circuit for three-wire control.~~

3) ~~SCR firing circuitry that incorporates an RC snubber network to prevent false firing.~~

4) ~~Input / output circuitry~~

5) ~~Digital programming keypad~~

- 6) Backlit LCD display
- 7) DPI communication port.

- d. The control module shall be easily removed from the power structure, without the need to disassemble associated printed circuit board assemblies.
- e. The control terminals shall be easily accessible and located on the front top of the device. The terminals shall be UL rated for 300 Volts, 10 Amps maximum and accept a maximum of two wires rated number 18 to number 14 AWG.

D. Features:

1. Starting Modes:

- a. The controller shall provide the following starting modes as standard:
 - 1) Soft Start with Selectable Kickstart:
 - a) Programmable initial torque value of 0 to 90 percent of locked rotor torque
 - b) Programmable acceleration ramp time from 0 to 30 seconds
 - c) A selectable kickstart, or boost, shall be provided at the beginning of the voltage ramp. The kickstart shall provide a current pulse of 550 percent of the full load current. The kickstart time shall be adjustable from 0 to 2 seconds.
 - 2) Current Limit Start:
 - a) Provides means of limiting the maximum starting current
 - b) Programmable for 50 to 600 percent of full load current
 - 3) Full Voltage Start:
 - a) Provides across the line starting.
 - b) Ramp time shall be less than 0.25 seconds.
 - 4) Dual Ramp Start:
 - a) Provides two separate soft start profiles with separately adjustable ramp times and initial torque settings.
 - b) Programmable acceleration times from 0 to 30 seconds.
 - c) Programmable initial torque values from 0 to 90 percent of locked rotor torque.
 - 5) Soft Stop:
 - a) The Soft Stop option shall provide a voltage ramp down for an extended motor stopping time.

- 1 b) Soft Stop shall be initiated by a dedicated Soft Stop
2 input. A coast to rest stop shall still be possible with
3 a separate stop input.
4 e) Programmable voltage ramp down time from 0 to 60
5 seconds.
6 d) The load shall stop when the motor voltage drops to
7 a point where the load torque is greater than the
8 motor torque.
- 9 6) Preset Slow Speed:
10 a) Provides a slow speed for applications requiring a
11 slow speed
12 b) The Preset Slow Speed option shall provide two jog
13 speeds in the forward direction: high (15 percent of
14 base speed) and low (7 percent of base speed).
15 e) The Preset Slow Speed option shall provide two jog
16 speeds in the reverse direction: high (20 percent of
17 base speed) and low (10 percent of base speed).
18 Reverse operation of the motor shall be available in
19 the jog mode without the use of a reversing contactor.
20 d) The starting current for the slow speed operation
21 shall be user adjustable from 0 to 450 percent of the
22 motor's full load current rating.
23 e) The running current for the slow speed operation
24 shall be user adjustable from 0 to 450 percent of the
25 motor's full load current rating.
- 26 7) Pump Control:
27 a) The Pump Control option shall be implemented to
28 provide closed loop control of a motor to match the
29 specific torque requirements of centrifugal pumps
30 for both starting and stopping. This shall aid in
31 eliminating the phenomena commonly referred to as
32 "water hammer." Methods utilizing Soft Start with
33 Soft Stop shall not be acceptable.
34 b) Closed loop control shall be achieved without using
35 external sensors or feedback devices.
36 e) Pump Stop shall be initiated by a dedicated Pump
37 Stop input. A coast to rest stop shall still be possible
38 with a separate stop input.
39 d) Programmable starting time from 0 to 30 seconds.
40 e) Programmable stopping time from 0 to 120 seconds.
- 41 2. LCD Display:
42 a. An alphanumeric, backlit LCD display shall be provided for
43 controller set up, diagnostics, status and monitoring. The display
44 shall be four line, 16 characters minimum.

- 1 b. ~~Digital parameter adjustment shall be provided through a keypad.~~
2 ~~Analog potentiometer adjustments are not acceptable.~~
- 3 3. ~~Overload Protection:~~
- 4 a. ~~Shall meet applicable standards as a motor thermal protective~~
5 ~~device.~~
- 6 b. ~~Shall utilize three phase current sensing. The use of two current~~
7 ~~transformers shall be unacceptable.~~
- 8 c. ~~Selectable trip classes of 10, 15, 20 and 30 shall be provided as~~
9 ~~standard.~~
- 10 d. ~~Electronic thermal memory shall provide enhanced motor~~
11 ~~protection.~~
- 12 4. ~~Digital I/O:~~
- 13 a. ~~A minimum of four auxiliary contacts shall be provided for~~
14 ~~customer use.~~
- 15 b. ~~The contacts shall be rated for 240 Volts AC maximum.~~
- 16 c. ~~Contact configuration shall contain:~~
- 17 1) ~~Normal/Up to Speed/Bypass~~
- 18 2) ~~Fault~~
- 19 3) ~~Alarm~~
- 20 4) ~~Normal~~
- 21 5. ~~DPI Serial Communication Port:~~
- 22 a. ~~A DPI serial communication port shall be provided as standard.~~
- 23 b. ~~Provide communication protocol interface modules for connection~~
24 ~~to DeviceNet.~~
- 25 6. ~~Monitoring:~~
- 26 a. ~~The controller shall provide the following monitoring functions~~
27 ~~indicated through the LCD display.~~
- 28 1) ~~Three phase current~~
- 29 2) ~~Three phase voltage~~
- 30 3) ~~Power in kW~~
- 31 4) ~~Power usage in kWh~~
- 32 5) ~~Power factor~~
- 33 6) ~~Motor thermal capacity usage~~
- 34 7) ~~Elapsed time~~
- 35 7. ~~Protection and Diagnostics:~~
- 36 a. ~~The following protection shall be provided as standard with the~~
37 ~~controller.~~
- 38 1) ~~Pre-start line fault advising of shorted SCR or missing load~~
39 ~~connection with phase indication~~
- 40 2) ~~Running line fault advising power loss, shorted SCR or~~
41 ~~missing load connection.~~
- 42 3) ~~Pre-start power loss with phase indication~~
- 43 4) ~~Over temperature~~
- 44 5) ~~Open Gate with phase indication~~

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- b. ~~The following defeatable protection shall be provided as standard with the controller.~~
 - 1) ~~Underload~~
 - 2) ~~Undervoltage~~
 - 3) ~~Overload~~
 - 4) ~~Overvoltage~~
 - 5) ~~Voltage Unbalance~~
 - 6) ~~Excessive Starts Per Hour~~
 - 7) ~~Phase Reversal~~
 - 8) ~~Stall~~
 - 9) ~~Jam~~
- e. ~~When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.~~
- d. ~~Fault diagnostics shall be indicated in descriptive text on the LCD display. The exclusive use of fault codes is unacceptable.~~
- e. ~~An auxiliary contact that is programmable for fault indication shall be provided for customer use.~~

E. ~~System Components:~~

- 1. ~~Transient Protection Modules:~~
 - a. ~~Transient protection with separately mounted protective modules.~~
 - b. ~~Protective modules shall consist of metal oxide varistors (MOVs) in combination with capacitors to protect the power components from electrical transients and / or electrical noise. The capacitors shall be provided to shunt noise energy away from the controllers electronics.~~
 - c. ~~The MOVs and capacitors shall be encapsulated in a clear material for easy inspection.~~
 - d. ~~The protective modules shall be mounted so that they will not cause damage to the power components upon absorbing an electrical transient.~~
 - e. ~~The MOVs shall be rated for a minimum of 220 joules.~~
- 2. ~~Input Circuit Breaker:~~
 - a. ~~Provide a door interlocked thermal magnetic circuit breaker disconnect~~
 - b. ~~Operator Handles:~~
 - 1) ~~Provide flange mounted operator handles for free standing units~~
 - 2) ~~Through the door operating handles are acceptable for wall mounted units~~
 - 3) ~~Refer to requirements of Section 26 24 19 for motor control center mounted equipment.~~
 - 4) ~~Handles shall be padlockable~~

- 1 e. ~~The system shall be rated for the available fault current identified on~~
2 ~~the drawings. The rating shall be shown on the system label.~~
- 3 3. ~~Isolation Contactor~~
- 4 a. ~~Input contactor shall provide positive isolation of the solid state~~
5 ~~controller from line power to prevent leakage current through the~~
6 ~~SCRs.~~
- 7 b. ~~Input contactor shall close when motor is signaled to start,~~
8 ~~energizing the solid state controller and allowing reduced voltage~~
9 ~~starting.~~
- 10 c. ~~Input contactor shall open after the solid state controller has stopped~~
11 ~~the motor and de-energize the solid state controller.~~
- 12 d. ~~Input contactor shall not switch loaded motor under any~~
13 ~~circumstances.~~
- 14 4. ~~Bypass (Shorting) Contactor~~
- 15 a. ~~Bypass contactor shall close and positively short circuit the SCRs~~
16 ~~after the motor has attained full voltage running condition.~~
- 17 b. ~~Bypass contactor shall open when motor is signaled to stop,~~
18 ~~allowing the SCRs to control stopping of the motor.~~
- 19 c. ~~Bypass contactor shall not switch loaded motor under any~~
20 ~~circumstances.~~
- 21 5. ~~Control Power Transformer:~~
- 22 a. ~~Provide a control power transformer mounted and wired inside of~~
23 ~~the system enclosure.~~
- 24 b. ~~The transformer shall be rated for an additional 100 VA for customer~~
25 ~~use.~~
- 26 c. ~~The transformer shall be provided with fused primary and secondary~~
27 ~~protection.~~
- 28 6. ~~Pilot Control Devices:~~
- 29 a. ~~Provide front of panel mounted pilot devices as shown on drawings.~~
- 30 7. ~~Human Interface Module:~~
- 31 a. ~~Provide a door mounted Human Interface Module with integral~~
32 ~~display and programming keys.~~
- 33 b. ~~The display shall show operating conditions, adjustments and fault~~
34 ~~indications.~~
- 35 c. ~~The display shall be backlit LCD and shall consist of four lines of~~
36 ~~16 characters alphanumeric.~~

37 2.042.03 ENCLOSURES

- 38 A. The enclosure shall be NEMA 1 as indicated on the contract drawings.
- 39 B. Starters shall have an adjustable instantaneous motor circuit protector (HMCP) type
40 disconnect device.

1 PART 3 CONSTRUCTION METHODS

2 3.01 DIVISION OF WORK (NOT USED)

3 3.02 FIELD MEASUREMENTS

4 A. Field verify all measurements. Do not base exact motor controller locations on the
5 contract drawings. Actual field conditions govern all final installed locations,
6 distances, and levels.

7 B. Identify conflicts with the work of other trades prior to installation of electrical
8 equipment.

9 C. Identify deviation from physical sizes shown on the drawings to Engineer prior to
10 bid date.

11 D. Contractor shall be responsible for modifications to the installation due to
12 deviations from physical sizes shown on the drawings.

13 E. Identify conflicts with the work of other trades prior to installation of electrical
14 equipment.

15 F. Record nameplate data for each motor served.

16 G. Adjust motor controller installation to satisfy field requirements.

17 3.03 DELIVERY, STORAGE, AND HANDLING

18 A. Accept motor controller on site. Inspect for damage.

19 B. The Contractor shall be responsible for all equipment necessary to receive, unload,
20 move into building, and install motor control centers.

21 C. Conform to written instructions of manufacturer.

22 D. Protect motor controllers from corrosion and entrance of debris.

23 E. Store motor controllers above grade. Protect from environment with suitable
24 covering.

25 3.04 INSTALLATION

26 A. Adjust disconnecting means trip settings to satisfy motor nameplate requirements.

- 1 B. Provide overload relays sized and adjusted for the actual nameplate data recorded
2 for each motor. No additional compensation will be allowed due to failure to select
3 overload devices based upon actual motor nameplate data.
- 4 C. Record information for motor data labels and install motor data labels.
- 5 D. Install motor controllers plumb and flush with wall finishes.
- 6 E. Inspect for physical damage, proper alignment, anchorage, and grounding. Check
7 proper installation and tightness of all connections.
- 8 F. Thoroughly clean and remove construction debris from panelboard interior and
9 exterior.

10 3.05 TESTING AND START-UP SERVICES

- 11 A. Refer to the requirements of Section 26 08 00 - Electrical Equipment Acceptance
- 12 B. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

13 3.06 TRAINING

- 14 A. Refer to the requirements of Section 26 08 00 - Electrical Equipment Acceptance.
- 15 B. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

16 END OF SECTION

SECTION 26 32 13

STANDBY ENGINE/GENERATOR SET

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs.

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. NFPA70 – National Electrical Code (NEC) and state amendments thereto. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
 - b. NFPA99 – Essential Electrical Systems for Health Care Facilities.
 - c. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit; component level type tests will not substitute for this requirement.
2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE), Specifications and Standards, current edition.
 - a. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
4. Insulated Cable Engineers Association (ICEA)
5. International Society of Automation (ISA)
6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA ICS10-1993 – AC Generator sets.
7. Underwriters’ Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL 2200. The genset shall be listed to UL 2200 or submit to an independent third party certification process to verify compliance as installed.
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)

- 1 11. Canadian Standards Association (CSA), Specifications and Standards,
2 current edition.
3 a. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
4 b. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.
5 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
6 Specifications and Standards, Current Edition.
7 a. International Electrotechnical Association (IEC), Specifications
8 and Standards, Current Edition. IEC8528 part 4. Control Systems
9 for Generator Sets.

10 1.03 DESCRIPTION OF WORK

- 11 A. Provide complete factory assembled generator set equipment with standard analog
12 controls.
- 13 B. Provide factory test, startup by a supplier authorized by the manufacturer, and on-
14 site testing of the system.
- 15 C. The generator set manufacturer shall warrant all equipment provided under this
16 section, whether or not is manufactured by the generator set manufacturer, so that
17 there is one source for warranty and product service. Technicians specifically
18 trained and certified by the manufacturer to support the product and employed by
19 the generator set supplier shall service the generator sets.
- 20 D. Standby Engine Generator set shall be provided with the following:
21 1. Certified from the factory for Tier 3 compliance with all emission
22 guidelines. The Supplier shall include all cost related to any test and
23 certifications that are required of natural gas fueled engine-generator sets
24 for the first 5-years of service.
25 2. All units shall be supplied with 5-Year Comprehensive Warranty.
26 3. Unit shall utilize PMG excitation.
27 4. Supplier shall confirm sizes provided herein meet or exceed actual facility
28 electrical requirements. Final size, performance, and operation shall be
29 inclusive to the Contract.
30 5. Unit shall include the following factory installed accessories:
31 a. AC Entrance Box
32 b. Battery(s)
33 c. Weather protective sound attenuated steel enclosure.
34 d. Main Line Circuit Breaker
35 e. Oil drain extension.
36 f. Coolant drain extension.
37 g. Spring Isolator and vermin guard skirts.
38 6. Fuel supply system configuration and coordination. Supplier shall supply
39 required regulator, galvanized piping and hardware, flex pipe connector
40 for vibration isolation.
41 7. Battery charger shall be ATS mounted.

1 1.04 RELATED WORK ELSEWHERE

2 A. For the purpose of obtaining a complete and integrated standby power system, the
3 following sections shall be included under the scope of this section:

- 4 1. Section 26 05 19 – Low-voltage Conductors and Cables
- 5 2. Section 26 09 07 – Automatic Transfer Control
- 6 3. Section 26 09 11 – Protective Relay
- 7 4. Section 26 36 23 - Transfer Switch.

8 B. The following sections include work which is related to the Standby
9 Engine/Generator Set, but which is not included under the scope of this section:

10 C. Article 102 – Bidding Requirements and Conditions

11 D. Article 103 – Award and Execution of the Contract

12 E. Concrete – Division 03

13 F. Metals – Division 05

14 G. Electrical - Division 26

15 H. Earthwork – Division 31

16 I. Utilities – Division 33

17 1.05 SUBMITTALS

18 A. Submit shop drawings.

19 B. General requirements specific to this section include:

- 20 1. Submit complete and integrated document containing all equipment
21 included under the scope of this section.
- 22 2. Submittal shall be complete, neat, orderly, and indexed with tabbed
23 dividers. Partial submittals will not be accepted.
- 24 3. Include a complete list of proposed exceptions to and deviations from
25 these specifications.
- 26 4. Clarity and completeness are of prime importance. Acceptability of
27 submittal drawings shall be at the sole discretion of the Engineer in
28 regards to this requirement.
- 29 5. Additional requirements for the various subsystems are specified in the
30 corresponding sections.

31 C. Submit the following information:

- 32 1. Manufacturer's product literature and performance data, sufficient to
33 verify compliance to specification requirements.
- 34 2. A paragraph-by-paragraph specification compliance statement, describing
35 the differences between the specified and the proposed equipment.

- 1 3. Manufacturer's certification of prototype testing.
- 2 4. Manufacturers published warranty documents signed by an officer of the
- 3 company.
- 4 5. Shop drawings showing plan and elevation views with certified overall
- 5 dimensions, as well as wiring interconnection details.
- 6 6. Interconnection wiring diagrams showing all external connections
- 7 required; with field wiring terminals marked in a consistent point-to-point
- 8 manner.
- 9 7. Manufacturer's installation instructions.
- 10 8. Control descriptions and/or logic diagrams
- 11 9. Detailed list of special tools and recommended spare parts with quantity,
- 12 pricing, and supplier.

13 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 14 A. Submit Operation/Maintenance Manuals.
- 15 B. Submit final revised shop drawings incorporating any modifications made as a
- 16 result of installation, start-up, operational testing, or for any other cause. Submit
- 17 results of all field-testing and corrective actions taken for all operational
- 18 parameters.
- 19 C. Submit manufacturer's standard operation and maintenance information including
- 20 installation manuals and safety instructions.
- 21 D. Submit contact list identifying names, addresses, telephone numbers, and any
- 22 additional contact information for each equipment service organization involved
- 23 with the Standby Engine/Generator Set.
- 24 E. Submit detailed operation and maintenance procedures for each major equipment
- 25 item; include description of operation for all modes of operation, routine
- 26 maintenance procedures, and trouble-shooting guide.
- 27 F. Submit listing spare parts provided under this contract and of recommended
- 28 additional spare parts not provided under this contract along with costs, lead time,
- 29 and supplier.

30 1.07 FACTORY TESTING

- 31 A. The generator set supplier shall perform a complete operational test on the
- 32 generator set prior to shipping from the factory. A certified test report shall be
- 33 provided. Equipment supplied shall be fully tested at the factory for function and
- 34 performance.
- 35 B. Factory testing may be witnessed by the owner and consulting engineer. Costs for
- 36 travel expenses will be the responsibility of the owner and consulting engineer.
- 37 Supplier is responsible to provide two weeks notice for testing.

- 1 C. Generator set factory tests on the equipment shall be performed at rated load and
2 rated power factor. Generator sets that have not been factory tested at rated power
3 factor will not be acceptable. Tests shall include: run at full load, maximum
4 power, voltage regulation, transient and steady-state governing, single step load
5 pickup, and function of safety shutdowns.

6 1.08 QUALITY ASSURANCE

- 7 A. The generator set manufacturer shall be certified to ISO 9001 International
8 Quality Standard and shall have third party certification verifying quality
9 assurance in design/development, production, installation, and service, in
10 accordance with ISO 9001.
- 11 B. All materials, equipment, and parts shall be new and unused of current
12 manufacture.
- 13 C. System supplier shall be responsible for providing all necessary accessories
14 required for a complete and operable system.
- 15 D. The Standby Engine/Generator Set manufacturer shall have been engaged in the
16 manufacture of generator sets for a minimum of ten years and shall have a factory
17 trained service and parts organization located within 100 miles of the jobsite.
- 18 E. All control equipment shall be the standard product of the engine/generator set
19 manufacturer. Controls systems that are supplied by a subcontractor of the
20 manufacturer and which are not incorporated into the standard documentation of
21 the manufacturer will not be acceptable.

22 1.09 WARRANTY

- 23 A. The generator set and associated equipment shall be warranted for a period of not
24 less than 5 years from the date of commissioning against defects in materials and
25 workmanship.
- 26 B. The warranty shall be comprehensive. No deductibles shall be allowed for travel
27 time, service hours, repair parts cost, etc.
- 28 C. The manufacturer of the generator set shall maintain service parts inventory at a
29 central location that is accessible to the service location 24 hours per day, 365
30 days per year.
- 31 D. The generator set shall be serviced by a local service organization that is trained
32 and factory certified in generator set service. The supplier shall maintain an
33 inventory of critical replacement parts at the local service organization, and in
34 service vehicles. The service organization shall be on call 24 hours per day, 365
35 days per year.
- 36 E. The manufacturer shall maintain model and serial number records of each

1 generator set provided for at least 20 years.

2 1.010 EXTRA MATERIALS

- 3 A. Furnish supply of consumables (air cleaner, oil filter, etc.) in sufficient quantity to
4 last for one year from the date of substantial completion.

5 1.011 DESIGN REQUIREMENTS (NOT USED)

6 1.012 MAINTENANCE

- 7 A. Before substantial completion, perform all maintenance activities required by any
8 sections of the specifications including any calibrations, final adjustments,
9 component replacements or other routine service required before placing
10 equipment or systems into service.

11 PART 2 PRODUCTS AND MATERIALS

12 2.01 MANUFACTURER

- 13 A. Acceptable Manufacturers

- 14 1. Cummins/Onan.
15 2. Kohler Power Systems.

- 16 B. These specifications, installation design, the heating/ventilation design, and the
17 fuel system design are based upon the first named manufacturer. If the contractor
18 elects to supply a different manufacturer, then the contractor shall be responsible
19 for adjusting the installation of the standby engine/generator set to satisfy the
20 requirements of that manufacturer's equipment.

- 21 C. Alternate equipment will only be considered if the following information is
22 submitted ten days prior to the bid date:

- 23 1. Certified dimensional data.
24 2. Verification of adequate cooling/combustion air for the installation.
25 3. Complete interconnecting wiring and piping diagrams.
26 4. Manufacturer's certification of prototype testing.
27 5. Load study/profile showing non-overloading of genset under steady-state
28 conditions and during motor starting.
29 6. Manufacturer's product literature and performance data, sufficient to
30 verify compliance to specification requirements.
31 7. A paragraph-by-paragraph specification compliance statement, describing
32 the differences between the specified and the proposed equipment.
33 8. Short circuit study of the load circuits to verify that selective coordination
34 occurs and that thermal-magnetic stresses on components will not exceed
35 the specified ratings.
36 9. Listing of similar projects and owner contact information for projects
37 completed during the previous five years.

1 2.02 GENERATOR SET

2 A. Ratings

- 3 1. The generator set shall operate at 1800 rpm and at a voltage of: 120/208
4 Vots AC, Three-phase, Four-wire, 60 hertz.
- 5 2. The generator set shall have a minimum rating at 40 kW, 50 kVA at 0.8
6 PF, standby rating, based on site conditions of: Altitude 1000 feet, ambient
7 temperatures up to 100 degrees F. Manufacturer shall be responsible for
8 actual application performance.
- 9 3. The generator set rating shall be based on emergency/standby service.

10 B. Performance

- 11 1. Voltage regulation shall be plus or minus 1.0 percent for any constant load
12 between no load and rated load for both parallel and non-parallel
13 applications. Random voltage variation with any steady load from no load
14 to full load shall not exceed plus or minus 0.5 percent.
- 15 2. Frequency regulation shall be isochronous from steady state no load to
16 steady state rated load. Random frequency variation with any steady load
17 from no load to full load shall not exceed plus or minus 0.25%.
- 18 3. The engine-generator set shall be capable of single step load pick up of
19 100% nameplate kW and power factor, less applicable derating factors,
20 with the engine-generator set at operating temperature.
- 21 4. Motor starting capability shall be a minimum of 607 kVA. The generator
22 set shall be capable of sustaining a minimum of 90% of rated no load
23 voltage with the specified kVA load at near zero power factor applied to
24 the generator set.
- 25 5. The alternator shall produce a clean AC voltage waveform, with not more
26 than 5% total harmonic distortion at full linear load, when measured from
27 line to neutral, and with not more than 3% in any single harmonic.
28 Telephone influence factor shall be less than 40.
- 29 6. Generator shall be capable of starting and operating two 5 HP submersible
30 sewerage pump(s) operated with SSRV and 3.3 kVA of misc. single phase
31 load without causing interruption to any facility systems: IE control
32 system, I&C Devices, access control system, etc. In addition, the
33 generator shall be sized to star and run all miscellaneous loads as
34 identified herein.
- 35 a. Step 1: 3.3 KVA of misc. control
- 36 b. Step 2: (1) 5 HP submersible pump on RVSS
- 37 c. Step 3: (1) 5 HP submersible pump on RVSS
- 38 7. Unit shall be sized for maximum starting voltage dip and peak voltage dip
39 shall be less 10%.
- 40 8. Unit shall be sized for maximum frequency dip of 4%.

41 C. Construction

- 42 1. The engine-generator set shall be mounted on a heavy-duty steel base to
43 maintain alignment between components. The base shall incorporate a
44 corrosion resistant battery tray with hold-down clamps within the rails.

- 1 D. Engine-generator base and exterior panels along with applicable accessories shall
2 contain a factory applied finish resistant to corrosion and effects from the unit
3 operating temperature connections.
4 1. The generator set load connections shall be composed of silver or tin
5 plated copper bus bars, drilled to accept mechanical or compression
6 terminations for the number and type cables shown on the drawings.
7 Sufficient lug space shall be provided for use with cables of the number
8 and size as shown on the drawings.
9 2. Power connections to auxiliary devices shall be made at the devices, with
10 required protection located at the power distribution panel as shown on the
11 drawings.
12 3. Generator set control interfaces to other system components shall be made
13 on a common, permanently labeled terminal block assembly.

14 2.03 ENGINE AND ENGINE EQUIPMENT

- 15 A. The engine shall be natural gas fueled, radiator and fan cooled. Minimum
16 displacement shall be 6.2L, with 8-cylinders. The horsepower rating of the
17 engine at its minimum tolerance level shall be sufficient to drive the alternator
18 and all connected accessories.
- 19 B. Engine accessories and features shall include:
20 1. Shall be Tier 3 compliant.
21 2. Complete engine fuel system, including all pressure regulators, strainers,
22 and control valves. The fuel system shall be plumbed to the generator set
23 skid for ease of site connections to the generator set.
24 3. An electronic governor system shall provide automatic isochronous
25 frequency regulation.
26 4. Skid-mounted radiator and cooling system rated for full load operation in
27 104 degrees F (40 degrees C) ambient as measured at the generator air
28 inlet, based on 0.5 inches H₂O external static head. Radiator shall be sized
29 based on a core temperature that is 20 degrees F higher than the rated
30 operation temperature, or prototype tested to verify cooling performance
31 of the engine/radiator/fan operation in a controlled environment. Radiator
32 shall be provided with a duct adapter flange. The equipment manufacturer
33 shall fill the cooling system with a 50/50-ethylene glycol/water mixture.
34 Rotating parts shall be guarded against accidental contact.
35 5. Electric starter(s) capable of three complete cranking cycles without
36 overheating.
37 6. Positive displacement, mechanical, full pressure, lubrication oil pump.
38 7. Full flow lubrication oil filters with replaceable spin-on canister elements
39 and dipstick oil level indicator.
40 8. Replaceable dry element air cleaner with restriction indicator.
41 9. Flexible supply and return fuel lines.
42 10. Engine mounted battery charging alternator, 40-ampere minimum, and
43 solid-state voltage regulator.
44 11. Coolant heater

- 1 a. Engine mounted, thermostatically controlled, coolant heater(s) for
2 each engine. Heater voltage shall be as shown on the project
3 drawings. The coolant heater shall be UL 499 listed and labeled.
4 b. The coolant heater shall be installed on the engine with silicone
5 hose connections. Steel tubing shall be used for connections into
6 the engine coolant system wherever the length of pipe run exceeds
7 12 inches. The coolant heater installation shall be specifically
8 designed to provide proper venting of the system. The coolant
9 heaters shall be installed using quick disconnect couplers to isolate
10 the heater for replacement of the heater element. The quick
11 disconnect/automatic sealing couplers shall allow the heater
12 element to be replaced without draining the engine cooling system
13 or significant coolant loss.
14 c. The coolant heater shall be provided with a 24VDC thermostat,
15 installed at the engine thermostat housing. An AC power
16 connection box shall be provided for a single AC power
17 connection to the coolant heater system.
18 d. The coolant heater(s) shall be sized as recommended by the engine
19 manufacturer to warm the engine to a minimum of 100F (40C) in a
20 40F ambient, in compliance with NFPA 110 requirements, or the
21 temperature required for starting and load pickup requirements of
22 this specification.
23 12. Provide vibration isolators, spring/pad type, quantity as recommended by
24 the generator set manufacturer. Isolators shall include seismic restraints if
25 required by site location.
26 13. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt
27 DC, sized as recommended by the engine manufacturer, complete with
28 battery cables and connectors.
29 C. Battery Charger
30 1. Shall be ATS mounted and connect to skid.

31 2.04 AC GENERATOR

- 32 A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field,
33 drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct
34 drive centrifugal blower fan, and directly connected to the engine with flexible
35 drive disc. All insulation system components shall meet NEMA MG1
36 temperature limits for Class H insulation system. Actual temperature rise
37 measured by resistance method at full load shall not exceed 125 degrees
38 Centigrade.
39 B. The generator shall be capable of delivering rated output (kVA) at rated frequency
40 and power factor, at any voltage not more than 5 percent above or below rated
41 voltage.
42 C. A permanent magnet generator (PMG) shall be included to provide a reliable

1 source of excitation power for optimum motor starting and short circuit
2 performance. The PMG and controls shall be capable of sustaining and regulating
3 current supplied to a single-phase or three-phase fault at approximately 300% of
4 rated current for not more than 10 seconds.

- 5 D. The subtransient reactance of the alternator shall not exceed 12 percent, based on
6 the standby rating of the generator set.

7 2.05 ENGINE GENERATOR SET CONTROL

- 8 A. A NEMA 1/3R/4 enclosed control panel shall be mounted on the generator set
9 with vibration isolators. The control shall be vibration isolated and prototype
10 tested to verify the durability of all components under the vibration conditions
11 encountered.

- 12 B. The generator set mounted control shall include the following features and
13 functions:

- 14 1. Three-position control switch labeled RUN/OFF/AUTO. In the RUN
15 position the generator set shall automatically start, and accelerate to rated
16 speed and voltage. In the OFF position the generator set shall
17 immediately stop, bypassing all time delays. In the AUTO position the
18 generator set shall be ready to accept a signal from a remote device to start
19 and accelerate to rated speed and voltage.
- 20 2. RESET switch. The RESET switch shall be used to clear a fault and
21 allow restarting the generator set after it has shut down for any fault
22 condition.
- 23 3. PANEL LAMP switch. Depressing the panel lamp switch shall cause the
24 entire panel to be lighted with DC control power.
- 25 4. Generator Set AC Output Metering: The generator set shall be provided
26 with a metering set with the following features and functions:
 - 27 a. Analog AC Voltmeter, dual range, 90 degree scale, 2% accuracy;
28 Analog AC Ammeter, dual range, 90 degree scale, 2% accuracy;
29 Analog Frequency/RPM meter, 45-65 Hz, 1350-1950 RPM, 90
30 degree scale, +/- 0.6 Hz accuracy.
 - 31 b. Seven position phase selector switch with OFF position to allow
32 meter display of current and voltage in each generator phase.
33 When supplied with reconnectable generators, the meter panel
34 shall be reconnectable for the voltage specified.
- 35 5. Generator Set Alarm and Status Display: The generator set shall be
36 provided with alarm and status indicating lamps to indicate non-automatic
37 generator status, and existing alarm and shutdown conditions. The non-
38 automatic indicating lamp shall be red, and shall flash to indicate that the
39 generator set is not able to automatically respond to a command to start
40 from a remote location. The lamp condition shall be clearly apparent
41 under bright room lighting conditions. The generator set control shall
42 indicate the existence of the following alarm and shutdown conditions on
43 the display panel:

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- a. Low oil pressure (alarm).
 - b. Low oil pressure (shutdown).
 - c. Low coolant temperature (alarm).
 - d. High coolant temperature (alarm).
 - e. High coolant temperature (shutdown).
 - f. Overcrank (shutdown).
 - g. Overspeed (shutdown).
 - h. Low fuel (alarm).
 - i. In addition, provisions shall be made for indication of two customer-specified alarm or shutdown conditions.
6. Engine Status Monitoring: The following devices shall be provided on the generator set control:
- a. Engine oil pressure gauge.
 - b. Engine coolant temperature gauge.
 - c. Engine operation hour gauge.
 - d. Battery voltage (DC volts).
7. Engine Control Functions. The control system provided shall include a cycle cranking system, which shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods. Fail to start shall be indicated by operation of the overcrank alarm indication lamp. The control system shall also include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification.
8. Alternator Control Functions:
- a. The generator set shall include an automatic voltage regulation system that is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse-width modulated output to the alternator exciter. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ.
 - b. Voltage adjusting rheostat, locking screwdriver type, to adjust voltage +/- 5% from rated value.
9. Control Interfaces for Remote Monitoring. Provide the following features in the control system:
- a. Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
 - b. One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
 - c. A fused 10 amp switched 12VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
 - d. A fused 20 amp 12VDC power supply circuit shall be provided for

1 customer use. DC power shall be available from this circuit at all
2 times from the engine starting/control batteries.

- 3 10. The generator set shall be provided with a mounted main line circuit
4 breaker, sized to carry the rated output current of the generator set on a
5 continuous basis as shown on the drawings. Circuit breaker shall be
6 equipped with shunt trip and shall automatically open on a genset
7 shutdown alarm.

8 C. Sequence of Operation

- 9 1. Generator set shall start on receipt of a start signal from remote
10 equipment.
11 2. The generator set control shall initiate the starting sequence for the
12 generator set.
13 3. The engine shall accelerate to rated speed and the alternator to rated
14 voltage. Excitation shall be disabled until the engine has exceeded
15 programmed idle speed, and regulated to prevent over voltage conditions
16 and oscillation as the engine accelerates and the alternator builds to rated
17 voltage.
18 4. When all start signals have been removed from the generator set, the
19 generator set control shall switch off the excitation system and shall shut
20 down.
21 5. Any start signal received after the time stop sequence has begun shall
22 immediately terminate the stopping sequence and return the generator set
23 to isochronous operation.

24 2.06 ENGINE EXHAUST SYSTEM

- 25 A. Provide exhaust silencer(s) for each engine of size and type as recommended by
26 the generator set manufacturer and approved by the engine manufacturer. The
27 mufflers shall be critical grade. Exhaust system shall be installed according to the
28 engine manufacturer's recommendations and applicable codes and standards.
- 29 B. Provide stainless steel, seamless flexible exhaust manifold connector.
- 30 C. Silencer and exhaust piping shall be insulated with rigid insulation to maintain a
31 surface temperature of not more than 150 degrees F. Provide 0.016-inch
32 aluminum jacket complete with crimped end covers, secured with stainless steel
33 sheet metal screws and rubber coated washers. Insulation system shall not
34 interfere with flexible fittings.
- 35 D. Provide exhaust thimble(s) for exhaust penetration of walls constructed of
36 combustible material. Construction shall be fireproof.

37 2.07 OUTDOOR WEATHER-PROTECTIVE SOUND ATTENUATING HOUSING

- 1 A. The generator set shall be provided with a sound-attenuated housing which allows
2 the generator set to operate at full rated load in the ambient conditions previously
3 specified. The enclosure shall reduce the sound level of the generator set while
4 operating at full rated load to a maximum of 65 dBA at 23 ft from the generator
5 set in a free field environment. Housing configuration and materials used may be
6 of any suitable design which meets application needs, except that acoustical
7 materials used shall be oil and water resistant. No foam materials shall be used
8 unless they can be demonstrated to have the same durability and life as fiberglass.
- 9 B. The enclosure shall include hinged doors for access to both sides of the engine
10 and alternator, and the control equipment. Key-locking and pad-lockable door
11 latches shall be provided for all doors. Door hinges shall be stainless steel.
- 12 C. The enclosure shall be provided with an exhaust silencer that is mounted inside of
13 the enclosure, and allows the generator set package to meet specified sound level
14 requirements. Silencer and exhaust shall include a rain cap and rain shield.
- 15 D. All sheet metal shall be primed for corrosion protection and finish painted with
16 the manufacturer's standard color. All surfaces of all metal parts shall be primed
17 and painted.
- 18 E. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts
19 shall not be acceptable. Fasteners used shall be corrosion resistant, and designed
20 to minimize marring of the painted surface when removed for normal installation
21 or service work.

22 2.08 ACCESSORIES

- 23 A. Provide supply of consumables (air cleaner, oil filter, etc) in sufficient quantity to
24 last for one year from the date of substantial completion.
- 25 B. Provide trouble shooting light inside enclosure.

26 PART 3 - CONSTRUCTION METHODS

27 3.01 DIVISION OF WORK

- 28 A. The Contractor shall have overall system responsibility and shall provide all
29 materials and labor necessary provide a complete and operable system and
30 comply with all requirements of this section.
- 31 B. The engine/generator set manufacturer shall be responsible for certifying the
32 correctness of installation for all work related to the standby power system
33 regardless of who performs the installation work.
- 34 C. The contract drawings are diagrammatic in nature; it shall be the responsibility of
35 the manufacturer to supplement the contract drawings and complete the final
36 design of the standby power system and to coordinate exact requirements with the

1 installing contractors.

2 3.02 FIELD MEASUREMENTS

- 3 A. Field verify with exact measurements, the available mounting space for standby
4 power system equipment. Do not base electrical installation or equipment
5 locations on the contract drawings. Actual field conditions govern all final
6 installed locations, distances, and levels.
- 7 B. Identify conflicts prior to beginning installation of the engine generator system.

8 3.03 DELIVERY STORAGE AND HANDLING

- 9 A. It shall be the responsibility of the installing contractor to receive all standby
10 power system equipment at the job site. Carefully inspect all equipment for
11 damage prior to accepting from the shipping agency. Do not accept shipment if
12 damage is evident.
- 13 B. Exercise due diligence in storing, protecting, and moving standby power system
14 equipment. Damaged or worn equipment will not be accepted and will be
15 replaced at no additional cost to the Owner.

16 3.04 INSTALLATION

- 17 A. Install equipment in locations as indicated on the contract documents. Adjust
18 locations as needed to ensure operability, serviceability, and compliance with all
19 applicable codes and standards.
- 20 B. Installation shall be completely tested prior to start-up. This work includes
21 verification of all field wiring continuity and proper termination of wiring.
- 22 C. Equipment shall be installed by the contractor in accordance with final submittals
23 and contract documents. Installation shall comply with applicable state and local
24 codes as required by the authority having jurisdiction. Install equipment in
25 accordance with manufacturer's instructions and instructions included in the
26 listing or labeling of UL listed products.
- 27 D. Installation of equipment shall include furnishing and installing all
28 interconnecting wiring between all major equipment provided for the on-site
29 power system. The contractor shall also perform interconnecting wiring between
30 equipment sections (when required), under the supervision of the equipment
31 supplier.
- 32 E. Installation of equipment shall include furnishing and installing all fuel piping and
33 vent piping as required. The tank installer shall perform this work under the
34 supervision of the equipment supplier.
- 35 F. Equipment shall be installed on concrete housekeeping pads. Equipment shall be

1 permanently fastened to the pad in accordance with manufacturer's instructions
2 and seismic requirements of the site.

3 G. Equipment shall be initially started and operated by representatives of the
4 manufacturer.

5 H. All equipment shall be physically inspected for damage. Scratches and other
6 installation damage shall be repaired prior to final system testing. Equipment
7 shall be thoroughly cleaned to remove all dirt and construction debris prior to
8 final testing of the system.

9 3.05 TESTING AND START-UP SERVICES

10 A. Standby power system supplier shall provide installation and start-up services
11 required to place the complete system into operation.

12 B. The complete installation shall be tested for compliance with the specification
13 following completion of all site work. Representatives of the manufacturer shall
14 conduct testing, with required fuel supplied by Contractor. The Engineer shall be
15 notified in advance and shall have the option to witness the tests.

16 C. Installation acceptance tests to be conducted on-site shall include a "cold start"
17 test, a two-hour full load test, and a one step rated load pickup test in accordance
18 with NFPA 110. Provide a resistive load bank and make temporary connections
19 for full load test. Provide all required cables and make accommodations for
20 routing of cables to allow for load bank to be located outside of the building.

21 D. Perform a power failure test on the entire installed system. This test shall be
22 conducted by opening the power supply from the utility service, and observing
23 proper operation of the system for at least 2 hours. Coordinate timing and obtain
24 approval for start of test with site personnel.

25 E. Test alarm and shutdown circuits by simulating conditions. Adjust output voltage
26 and engine speed.

27 F. Record kW, Amps, Volts, Frequency, oil pressure, coolant temperature, and room
28 temperature at twenty-minute intervals during the test and report findings to
29 Engineer in writing.

30 G. Verify operation of room ventilation system including interlocks with generator
31 equipment.

32 H. Verify fuel system installation and capacity.

33 3.06 TRAINING

34 A. The equipment supplier shall provide training for the facility operating personnel
35 covering operation and maintenance of the equipment provided. The training

1 program shall be not less than 4 hours in duration and the class size shall be
2 limited to 5 persons. Training date shall be coordinated with the facility owner.

- 3 B. Describe the loads connected to the standby power system along with restrictions
4 for future use. Coordinate this discussion with the process instrumentation
5 control system integrator to include automatic step start control and load control.

6 END OF SECTION

1 SECTION 26 36 23

2 TRANSFER SWITCH

3 PART 1 GENERAL

4 1.01 APPLICABLE PROVISIONS

- 5 A. Applicable provisions of Part I shall govern the work of this section.
- 6 B. The Contract Documents are complementary; what is called for by one is as
7 binding as if called for by all.

8 1.02 APPLICABLE PUBLICATIONS

- 9 A. The following publications of the issues listed below, but referred to thereafter by
10 basic designation only, form a part of this specification to the extent applicable.
11 The latest edition accepted by the Authority Having Jurisdiction of the referenced
12 publications in effect at the time of the bid governs
- 13 1. American National Standards Institute/National Fire Protection Agency
14 (ANSI/NFPA), Specifications and Standards, current edition:
 - 15 a. NFPA20 – Fire Pumps. Transfer switches serving fire pumps shall
16 be specifically listed and labeled for that application.
 - 17 b. NFPA70 – National Electrical Code, (NEC) and state amendments
18 thereto. Equipment shall be suitable for use in systems in
19 compliance to Article 700, 701, and 702.
 - 20 c. NFPA99 – Essential Electrical Systems for Health Care Facilities.
 - 21 d. NFPA110 – Emergency and Standby Power Systems. The transfer
22 switch shall meet all requirements for Level 1 systems.
 - 23 2. ASTM International (ASTM), originally known as the American Society
24 for Testing and Materials, Specifications and Standards, current edition:
 - 25 3. Illuminating Engineering Society (IES). Institute of Electrical and
26 Electronics Engineers (IEEE), Specifications and Standards, current
27 edition.
 - 28 a. IEEE446 – Recommended Practice for Emergency and Standby
29 Power Systems for Commercial and Industrial Applications.
 - 30 4. Insulated Cable Engineers Association (ICEA)
 - 31 5. International Society of Automation (ISA)
 - 32 6. National Electrical Manufacturers Association (NEMA), Specifications
33 and Standards, current edition.
 - 34 a. NEMA ICS10-1993 – AC Automatic Transfer Switches.
 - 35 7. Underwriters’ Laboratories, Inc. (UL), Specifications and Standards,
36 current edition.
 - 37 a. UL 1008. The transfer switch shall be UL listed and labeled.
 - 38 8. Wisconsin Department of Safety and Professional Services (DSPA)
 - 39 9. National Electrical Contractors Association (NECA), current edition.

- 1 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
- 2 Contracting.
- 3 10. International Electrical Testing Association (NETA)
- 4 11. Canadian Standards Association (CSA), Specifications and Standards,
- 5 current edition.
- 6 a. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
- 7 b. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.
- 8 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
- 9 Specifications and Standards, Current Edition.
- 10 13. International Electrotechnical Association (IEC), Specifications and
- 11 Standards, Current Edition.
- 12 a. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity.
- 13 b. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity.
- 14 c. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity.
- 15 d. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity. Similar
- 16 waveforms are described in ANSI/IEEE 62.41-1991.
- 17 e. IEC 1000-4-6 Conducted Field Immunity.
- 18 f. IEC 1000-4-11 Voltage Dip Immunity.
- 19 14. European Committee for Electrotechnical Standardization (CENELEC),
- 20 Specifications and Standards, current edition:
- 21 a. EN55011, Class B Radiated Emissions.
- 22 b. EN55011, Class B Conducted Emissions.

23 1.03 DESCRIPTION OF WORK

- 24 A. Provide complete factory assembled power transfer equipment with field
- 25 programmable digital electronic controls designed for fully automatic operation
- 26 and including: surge voltage isolation, voltage sensors on all phases of both
- 27 sources, linear operator, permanently attached manual handles, positive
- 28 mechanical and electrical interlocking, and mechanically held contacts for both
- 29 sources.
- 30 B. Provide factory test, startup by a supplier authorized by the manufacturer, and on-
- 31 site testing of the system. Technicians specifically trained to support the product
- 32 and employed by the generator set supplier shall service the transfer switches.
- 33 C. The generator set manufacturer shall warrant transfer switches to provide a single
- 34 source of responsibility for all the products provided.
- 35 D. The automatic transfer switch specified herein shall be equipped with a time delay
- 36 in the neutral position (programmed transition). Alternative methods for transfer
- 37 control are not acceptable.
- 38 E. The ATS provide shall be manufactured and supplied by the same Manufacture of
- 39 the Engine generator set.
- 40 F. Provide ATS as NEMA1 enclosure.

1 G. The automatic transfer switch specified herein shall be equipped with a time delay
2 in the neutral position (programmed transition). Alternative methods for transfer
3 control are not acceptable.

4 H. Provide ATS as shown.

5 1.04 RELATED WORK ELSEWHERE

6 A. For the purpose of obtaining a complete and integrated standby power system, the
7 following sections shall be included under the scope of this section:

8 1. Section 26 32 13 – Standby Engine/Generator Set.

9 B. The following sections include work which is related to the Standby
10 Engine/Generator Set, but which is not included under the scope of this section:

11 C. Article 102 – Bidding Requirements and Conditions

12 D. Article 103 – Award and Execution of the Contract

13 E. Concrete – Division 03

14 F. Metals – Division 05

15 G. Electrical - Division 26

16 1.05 SUBMITTALS

17 A. Submit shop drawings as specified herein.

18 B. General requirements specific to this section include:

19 1. Submit complete and integrated document containing all equipment
20 included under the scope of this section as part of the submittal document
21 for the Standby Engine/Generator Set.

22 2. Submittal shall be complete, neat, orderly, and indexed with tabbed
23 dividers. Partial submittals will not be accepted.

24 3. Clarity and completeness are of prime importance. Acceptability of
25 submittal drawings shall be at the sole discretion of the Engineer in
26 regards to this requirement.

27 4. Additional requirements for the various subsystems are specified in the
28 corresponding sections.

29 C. Submit the following information:

30 1. Manufacturer's product literature and performance data, sufficient to
31 verify compliance to specification requirements.

32 2. A paragraph-by-paragraph specification compliance statement, describing
33 the differences between the specified and the proposed equipment.

34 3. Manufacturers published warranty documents signed by an officer of the
35 company.

- 1 4. Shop drawings showing plan and elevation views with certified overall
- 2 dimensions, as well as wiring interconnection details.
- 3 5. Interconnection wiring diagrams showing all external connections
- 4 required; with field wiring terminals marked in a consistent point-to-point
- 5 manner.
- 6 6. Manufacturer's installation instructions.

7 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 8 A. Submit Operation/Maintenance Manuals and Instructions as specified herein.
- 9 B. Submit final revised shop drawings incorporating any modifications made as a
- 10 result of installation, start-up, operational testing, or for any other cause. Submit
- 11 results of all field-testing and corrective actions taken for all operational
- 12 parameters.
- 13 C. Submit manufacturer's standard operation & maintenance information including
- 14 installation manuals and safety instructions.
- 15 D. Submit contact list identifying names, addresses, telephone numbers, and any
- 16 additional contact information for each equipment service organization involved
- 17 with the Standby Engine/Generator Set.
- 18 E. Submit detailed operation and maintenance procedures for each major equipment
- 19 item; include description of operation for all modes of operation, routine
- 20 maintenance procedures, and trouble-shooting guide.
- 21 F. Submit listing spare parts provided under this contract and of recommended
- 22 additional spare parts not provided under this contract along with lead time and
- 23 costs.

24 1.07 FACTORY TESTING

- 25 A. The generator set supplier shall perform a complete operational test on the
- 26 automatic transfer switch prior to shipping from the factory. A certified test
- 27 report shall be provided. Equipment supplied shall be fully tested at the factory
- 28 for function and performance.
- 29 B. Factory testing may be witnessed by the owner and consulting engineer. Costs for
- 30 travel expenses will be the responsibility of the owner and consulting engineer.
- 31 Supplier is responsible to provide two weeks notice for testing.
- 32 C. Test process shall include calibration of voltage sensors.

33 1.08 QUALITY ASSURANCE

- 34 A. The Automatic Transfer Switch manufacturer shall be certified to ISO 9001
- 35 International Quality Standard and shall have third party certification verifying

1 quality assurance in design/development, production, installation, and service, in
2 accordance with ISO 9001.

3 B. All materials, equipment, and parts shall be new and unused of current
4 manufacture.

5 C. System supplier shall be responsible for providing all necessary accessories
6 required for a complete and operable system.

7 D. The Automatic Transfer Switch manufacturer shall have been engaged in the
8 manufacture of generator sets for a minimum of ten years and shall have a factory
9 trained service and parts organization located within 100 miles of the jobsite.

10 E. All control equipment shall be the standard product of the engine/generator set
11 manufacturer. Controls systems that are supplied by a subcontractor of the
12 manufacturer and which are not incorporated into the standard documentation of
13 the manufacturer will not be acceptable.

14 1.09 WARRANTY

15 A. The generator set and associated equipment shall be warranted for a period of not
16 less than five years from the date of commissioning against defects in materials
17 and workmanship.

18 B. The warranty shall be comprehensive. No deductibles shall be allowed for travel
19 time, service hours, repair parts cost, etc.

20 C. The manufacturer of the transfer switch shall maintain service parts inventory at a
21 central location that is accessible to the service location twenty-four hours per
22 day, three hundred sixty-five days per year.

23 D. The generator set shall be serviced by a local service organization that is trained
24 and factory certified in generator set service. The supplier shall maintain an
25 inventory of critical replacement parts at the local service organization, and in
26 service vehicles. The service organization shall be on call 24 hours per day, 365
27 days per year.

28 E. The manufacturer shall maintain model and serial number records of each transfer
29 switch provided for at least twenty years.

30 1.10 EXTRA MATERIALS (NOT USED)

31 1.11 DESIGN REQUIREMENTS (NOT USED)

32 1.12 MAINTENANCE

33 A. Before substantial completion, perform all maintenance activities required by any
34 sections of the specifications including any calibrations, final adjustments,

1 component replacements or other routine service required before placing
2 equipment or systems into service.

3 PART 2 PRODUCTS AND MATERIALS

4 2.01 MANUFACTURER

5 A. Acceptable Manufacturers

- 6 1. Cummins/Onan.
7 2. Kohler Power Systems.

8 B. The automatic transfer switch shall be provided as part of a complete, integrated
9 standby power system. As such, the manufacturer of the Standby
10 Engine/Generator Set shall provide it.

11 2.02 POWER TRANSFER SWITCH

12 A. Ratings

- 13 1. Refer to the project drawings for specifications on the sizes and types of
14 transfer switch equipment, withstand and closing ratings, number of poles,
15 voltage and ampere ratings, enclosure type, and accessories.
16 2. Main contacts shall be rated for 600 Volts AC, minimum.
17 3. Transfer switches shall be rated to carry 100 percent of rated current
18 continuously in the enclosure supplied, in ambient temperatures of -40 to
19 +60 degrees C, relative humidity up to 95 percent (non-condensing), and
20 altitudes up to 10,000 feet (3000M).
21 4. Transfer switch equipment shall have with stand and closing ratings
22 (WCR) in RMS symmetrical amperes greater than the available fault
23 currents shown on the drawings and at the specified voltage. The transfer
24 switch and its upstream protection shall be coordinated. The transfer
25 switch shall be third party listed and labeled for use with the specific
26 protective device(s) installed in the application.

27 B. Construction

- 28 1. Transfer switches shall be double-throw, electrically and mechanically
29 interlocked, and mechanically held in the source 1 and source 2 positions.
30 The transfer switch shall be specifically designed to transfer to the best
31 available source if it inadvertently stops in a neutral position.
32 2. Transfer switches rated through 1000 amperes shall be equipped with
33 permanently attached manual operating handles and quick break, quick
34 make over center contact mechanisms. Transfer switches over 1000
35 amperes shall be equipped with manual operators for service use only
36 under de energized conditions. Main switch contacts shall be
37 high-pressure silver alloy. Contact assemblies shall have arc chutes for
38 positive arc extinguishing. Arc chutes shall have insulating covers to
39 prevent inter-phase flashover.
40 3. Transfer switch internal wiring shall be composed of pre-manufactured

1 harnesses that are permanently marked for source and destination.
2 Harnesses shall be connected to the control system by means of locking
3 disconnect plug(s), to allow the control system to be easily disconnected
4 and serviced without disconnecting power from the transfer switch
5 mechanism.

- 6 4. Power transfer switch shall be provided with flame retardant transparent
7 covers to allow viewing of switch contact operation but prevent direct
8 contact with components that could be operating at line voltage levels.
- 9 5. Transfer switches designated as 4-pole switches on the drawings shall be
10 provided with a switched neutral pole. The neutral pole shall be of the
11 same construction and have the same ratings as the phase poles. All poles
12 shall be switched simultaneously using a common crossbar. Substitute
13 equipment using overlapping neutral contacts is not acceptable.
- 14 6. Transfer switches designated as 3-pole switches on the drawings shall be
15 provided with a neutral bus and lugs. The neutral bus shall be sized to
16 carry 100 percent of the current designated on the switch rating.

17 C. Connections

- 18 1. Field control connections shall be made on a common terminal block that
19 is clearly and permanently labeled.
- 20 2. Transfer switch shall be provided with AL/CU mechanical lugs sized to
21 accept the full output rating of the switch. Lugs shall be suitable for the
22 number and size of conductors shown on the drawings.

23 2.03 TRANSFER SWITCH CONTROL

24 A. Operator Panel. Each transfer switch shall be provided with a control panel to
25 allow the operator to view the status and control operation of the transfer switch.
26 The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or
27 better (regardless of enclosure rating) that is permanently labeled for switch and
28 control functions.

29 B. Operator panel and features and capabilities shall include:

- 30 1. High intensity LED lamps to indicate the source that the load is connected
31 to (source 1 or source 2); and which source(s) are available. Source
32 available LED indicators shall operate from the control microprocessor to
33 indicate the true condition of the sources as sensed by the control.
- 34 2. High intensity LED lamps to indicate that the transfer switch is "not in
35 auto" (due to control being disabled or due to bypass switch (when used)
36 enabled or in operation) and "Test/Exercise Active" to indicate that the
37 control system is testing or exercising the generator set.
- 38 3. "OVERRIDE" pushbutton to cause the transfer switch to bypass any
39 active time delays for start, transfer, and retransfer and immediately
40 proceed with its next logical operation.
- 41 4. "TEST" pushbutton to initiate a preprogrammed test sequence for the
42 generator set and transfer switch. The transfer switch shall be
43 programmable for test with load or test without load.

- 1 5. "RESET/LAMP TEST" pushbutton that will clear any faults present in the
2 control, or simultaneously test all lamps on the panel by lighting them.
- 3 6. The control system shall continuously log information on the number of
4 hours each source has been connected to the load, the number of times
5 transferred, and the total number of times each source has failed. This
6 information shall be available via a PC-based service tool or an operator
7 display panel.
- 8 7. Security Key Switch to allow the user to inhibit adjustments, manual
9 operation or testing of the transfer switch unless key is in place and
10 operated.
- 11 8. Vacuum fluorescent alphanumeric display panel with push-button
12 navigation switches. The display shall be clearly visible in both bright
13 (sunlight) and no light conditions. It shall be visible over an angle of at
14 least 120 degrees. The Alphanumeric display panel shall be capable of
15 providing the following functions and capabilities:
 - 16 a. Display source condition information, including AC voltage for
17 each phase of normal and emergency source, frequency of each
18 source. Voltage for all three phases shall be displayed on a single
19 screen for easy viewing of voltage balance.
 - 20 b. Display source status, to indicate source is connected or not
21 connected.
 - 22 c. Display load data, including 3-phase AC voltage, 3-phase AC
23 current, frequency, KW, KVA, and power factor. Voltage and
24 current data for all phases shall be displayed on a single screen.
 - 25 d. The display panel shall allow the operator to view and make the
26 following adjustments in the control system, after entering an
27 access code:
 - 28 1) Set nominal voltage and frequency for the transfer switch.
 - 29 2) Adjust voltage and frequency sensor operation set points.
 - 30 3) Set up time clock functions.
 - 31 4) Set up load sequence functions.
 - 32 5) Enable or disable control functions in the transfer switch,
33 including program transition.
 - 34 6) Set up exercise and load test operation conditions, as well
35 as normal system time delays for transfer time, time delay
36 start, stop, transfer, and retransfer.
 - 37 e. Display Real time Clock data, including date, and time in hours,
38 minutes, and seconds. The real time clock shall incorporate
39 provisions for automatic daylight savings time and leap year
40 adjustments. The control shall also log total operating hours for
41 the control system.
 - 42 f. Display service history for the transfer switch. Display source
43 connected hours, to indicate the total number of hours connected to
44 each source. Display number of times transferred, and total
45 number of times each source has failed.
 - 46 g. Display information for other transfer switches in the system,

1 including transfer switch name, real time load in KW on the
2 transfer switch, current source condition, and current operating
3 mode.

- 4 h. Display fault history on the transfer switch, including condition,
5 and date and time of fault. Faults to include controller checksum
6 error, low controller DC voltage, ATS fail to close on transfer,
7 ATS fail to close on retransfer, battery charger malfunction,
8 network battery voltage low, network communications error.

9 C. Internal Controls

- 10 1. The transfer switch control system shall be field-configurable for any
11 operating voltage level up to 600VAC. Provide RMS voltage sensing and
12 metering that is accurate to within +/-1 percent of nominal voltage level.
13 Frequency sensing shall be accurate to within +/-0.2 percent. Voltage
14 sensing shall be monitored based on the normal voltage at the site.
15 Systems that utilize voltage monitoring based on standard voltage
16 conditions that are not field-configurable are not acceptable.
- 17 2. Transfer switch voltage sensors shall be close differential type, providing
18 source availability information to the control system based on the
19 following functions:
- 20 a. Monitoring all phases of the normal service (source 1) for under
21 voltage conditions (adjustable for pickup in a range of 85 to 98
22 percent of the normal voltage level and dropout in a range of 75 to
23 98 percent of normal voltage level).
- 24 b. Monitoring all phases of the emergency service (source 2) for
25 under voltage conditions (adjustable for pickup in a range of 85 to
26 98 percent of the normal voltage level and dropout in a range of 75
27 to 98 percent of pickup voltage level).
- 28 c. Monitoring all phases of the normal service (source 1) and
29 emergency service (source 2) for voltage imbalance.
- 30 d. Monitoring all phases of the normal service (source 1) and
31 emergency service (source 2) for loss of a single phase.
- 32 e. Monitoring all phases of the normal service (source 1) and
33 emergency service (source 2) for phase rotation.
- 34 f. Monitoring all phases of the normal service (source 1) and
35 emergency service (source 2) for overvoltage conditions
36 (adjustable for dropout over a range of 105 to 135 percent of
37 normal voltage, and pickup at 95-99 percent of dropout voltage
38 level).
- 39 g. Monitoring all phases of the normal service (source 1) and
40 emergency service (source 2) for over or under frequency
41 conditions.
- 42 h. Monitoring the neutral current flow in the load side of the transfer
43 switch. The control shall initiate an alarm when the neutral current
44 exceeds a preset adjustable value in the range of 100-150 percent
45 of rated phase current for more than an adjustable period of 10 to
46 60 seconds.

3. All transfer switch sensing shall be configurable from a Windows 95, 98, 2000, or NT PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.
4. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.
5. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cool down) (adjustable in a range of 0-30 minutes).
6. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
7. The transfer switch shall provide a relay contact signal prior to transfer or retransfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.
8. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
9. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

D. Battery Charger

1. The transfer switch shall be provided with a battery charger for the generator set starting batteries. The battery charger shall be a float type charger rated 2 amps. The battery charger shall include an ammeter for display of charging current and shall have fused AC inputs and DC outputs.
2. Provide the transfer switch with a battery charger for the generator set starting batteries. The battery charger shall be a float type charger rated 6 amps minimum. The battery charger shall include an ammeter for display of charging current and shall have fused AC inputs and DC outputs. The charger shall also include fault indications for high and low dc voltage, and supply power failed, and dry contacts for external indication of these fault conditions. Display supply power failed indication on the ATS control panel.

E. Control Interface

1. The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
2. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
3. The transfer switch shall provide relay contacts to indicate the following conditions: source 1 available, load connected to source 1, source 2 available, source 2 connected to load.

2.04 ENCLOSURE

- A. Enclosures shall be UL listed. The enclosure shall provide wire bend space in compliance to the latest version of NFPA 70. The cabinet door shall include permanently mounted key type latches.
- B. Transfer switch equipment shall be provided in a NEMA 4X stainless steel enclosure.
- C. Enclosures shall be the NEMA type specified. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non-key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

2.05 OPERATION

- A. Sequence of Operation
 1. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is source 1 (connected to the utility), and no start signal is supplied to the genset.
 2. Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:
 - a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - b. The transfer switch shall issue a compatible start command to the generator set and cause the generator set to start and run at idle until it has reached normal operating temperature.
 - c. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall adjust the generator set output to rated voltage and frequency.

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- d. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - e. The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the generator set to the normal service.
 - f. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - g. The transfer switch shall operate the generator set unloaded for a cool down period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.
3. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:
- a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - b. The transfer switch shall issue a compatible start command to the generator set and cause the generator set to start and run at idle until it has reached normal operating temperature.
 - c. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
 - d. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.
 - e. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

43 PART 3 CONSTRUCTION METHODS

44 3.01 DIVISION OF WORK

- 1 A. The Contractor shall have overall system responsibility and shall provide all
2 materials and labor necessary provide a complete and operable system and
3 comply with all requirements of this section.
- 4 B. The engine/generator set manufacturer shall be responsible for certifying the
5 correctness of installation for all work related to the standby power system
6 regardless of who performs the installation work.
- 7 C. The contract drawings are diagrammatic in nature; it shall be the responsibility of
8 the manufacturer to supplement the contract drawings and complete the final
9 design of the standby power system and to coordinate exact requirements with the
10 installing contractors.

11 3.02 FIELD MEASUREMENTS

- 12 A. Field verify with exact measurements, the available mounting space for standby
13 power system equipment. Do not base electrical installation or equipment
14 locations on the contract drawings. Actual field conditions govern all final
15 installed locations, distances, and levels.
- 16 B. Identify conflicts prior to beginning installation.

17 3.03 DELIVERY STORAGE AND HANDLING

- 18 A. It shall be the responsibility of the installing contractor to receive all standby
19 power system equipment at the job site. Carefully inspect all equipment for
20 damage prior to accepting from the shipping agency. Do not accept shipment if
21 damage is evident.
- 22 B. Exercise due diligence in storing, protecting, and moving standby power system
23 equipment. Damaged or worn equipment will not be accepted and will be
24 replaced at no additional cost to the Owner.

25 3.04 INSTALLATION

- 26 A. Install equipment in locations as indicated on the contract documents. Adjust
27 locations as needed to ensure operability, serviceability, and compliance with all
28 applicable codes and standards.
- 29 B. Installation shall be completely tested prior to start-up. This work includes
30 verification of all field wiring continuity and proper termination of wiring.
- 31 C. The contractor shall install the equipment in accordance with final submittals and
32 contract documents. Installation shall comply with applicable state and local
33 codes as required by the authority having jurisdiction. Install equipment in
34 accordance with manufacturer's instructions and instructions included in the
35 listing or labeling of UL listed products.

- 1 D. Installation of equipment shall include furnishing and installing all
2 interconnecting wiring between all major equipment provided for the on-site
3 power system. The contractor shall also perform interconnecting wiring between
4 equipment sections (when required), under the supervision of the equipment
5 supplier.
- 6 E. Equipment shall be initially started and operated by representatives of the
7 manufacturer.
- 8 F. All equipment shall be physically inspected for damage. Scratches and other
9 installation damage shall be repaired prior to final system testing. Equipment
10 shall be thoroughly cleaned to remove all dirt and construction debris prior to
11 final testing of the system.

12 3.05 TESTING AND START-UP SERVICES

- 13 A. Standby power system supplier shall provide installation and start-up services
14 required to place the complete system into operation.
- 15 B. The complete installation shall be tested for compliance with the specification
16 following completion of all site work. Representatives of the manufacturer shall
17 conduct testing, with required fuel supplied by Contractor. The Engineer shall be
18 notified in advance and shall have the option to witness the tests.
- 19 C. Installation acceptance tests to be conducted on-site shall include a "cold start"
20 test, a two-hour full load test, and a one step rated load pickup test in accordance
21 with NFPA 110.
- 22 D. Perform a power failure test on the entire installed system. This test shall be
23 conducted by opening the power supply from the utility service, and observing
24 proper operation of the system for at least 2 hours. Coordinate timing and obtain
25 approval for start of test with site personnel.
- 26 E. Test all control functions by simulating conditions.
- 27 F. Provide for one technician follow-up visit to installation site one month after
28 commissioning to consult with Owner, verify correct operation of standby system,
29 and make any required corrections, adjustments, repairs, etc.

30 3.06 TRAINING

- 31 A. The equipment supplier shall provide training for the facility operating personnel
32 covering operation and maintenance of the equipment provided as part of the
33 owner training session specified under Standby Engine Generator Set.

34 END OF SECTION
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1 SECTION 26 43 13

2 SURGE PROTECTIVE DEVICES (SPDs)

3 LOW VOLTAGE AC SURGE PROTECTION FOR ELECTRICAL DISTRIBUTION
4 SYSTEMS

5 PART 1 GENERAL

6 1.01 APPLICABLE PROVISIONS

- 7 A. Applicable provisions of Part I shall govern the work of this section.
- 8 B. The Contract Documents are complementary; what is called for by one is as
9 binding as if called for by all.

10 1.02 APPLICABLE PUBLICATIONS

- 11 A. The following publications of the issues listed below, but referred to thereafter by
12 basic designation only, form a part of this specification to the extent applicable.
13 The latest edition accepted by the Authority Having Jurisdiction of the referenced
14 publications in effect at the time of the bid governs

- 15 1. American National Standards Institute/National Fire Protection Agency
16 (ANSI/NFPA), Specifications and Standards, current edition:
17 a. ANSI/NFPA 70 - National Electrical Code (NEC) and state
18 amendments thereto.
- 19 2. ASTM International (ASTM), originally known as the American Society
20 for Testing and Materials, Specifications and Standards, current edition:
- 21 3. Illuminating Engineering Society (IES). Institute of Electrical and
22 Electronics Engineers (IEEE)
- 23 4. Insulated Cable Engineers Association (ICEA)
- 24 5. International Society of Automation (ISA)
- 25 6. National Electrical Manufacturers Association (NEMA), Specifications
26 and Standards, current edition.
- 27 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
28 current edition.
- 29 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 30 9. National Electrical Contractors Association (NECA), current edition.
31 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
32 Contracting.
- 33 10. International Electrical Testing Association (NETA)
- 34 11. Canadian Standards Association (CSA), Specifications and Standards,
35 current edition.
- 36 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
37 Specifications and Standards, Current Edition.
- 38 13. International Electrotechnical Association (IEC), Specifications and

Standards, Current Edition.

1.03 DESCRIPTION OF WORK

- A. For the purpose of obtaining a complete and integrated process instrumentation and control system, the work specified herein shall be included under the scope of:
 - 1. Section 26 90 00 - Process Instrumentation & Control
- B. Furnish and install complete and operable power system as indicated on the drawings and as specified herein.
- C. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers.

1.04 RELATED SECTIONS

- A. Article 102 – Bidding Requirements and Conditions
- B. Article 103 – Award and Execution of the Contract
- C. Concrete – Division 03
- D. Metals – Division 05
- E. Electrical - Division 26

1.05 SUBMITTALS

- A. Submit shop drawings as specified herein.
- B. The following information shall be submitted specifically for surge protection devices:
 - 1. Manufacturer literature sufficient in scope to demonstrate compliance with the requirements of this specification.
 - 2. Verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage,

1 phases, modes of protection, Voltage Protection Rating (VPR), and
2 Nominal Discharge Current (I_n).

- 3 3. For sidemount mounting applications (SPD mounted external to electrical
4 assembly), electrical/mechanical drawings showing unit dimensions,
5 weights, installation instruction details, and wiring configuration.

6 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 7 A. Submit operation & maintenance manuals and instructions as specified herein.

8 1.07 FACTORY TESTING (NOT USED)

9 1.08 QUALITY ASSURANCE

- 10 A. All materials, equipment, and parts shall be new and unused of current
11 manufacture.

- 12 B. The manufacturer of the assembly shall be the manufacturer of the major
13 components within the assembly.

- 14 C. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002
15 certified.

- 16 D. The manufacturer of this equipment shall have produced similar electrical
17 equipment for a minimum period of five (5) years. When requested by the
18 Engineer, an acceptable list of installations with similar equipment shall be
19 provided demonstrating compliance with this requirement.

- 20 E. The SPD shall be compliant with the Restriction of Hazardous Substances
21 (RoHS) Directive 2002/95/EC.

22 1.09 MAINTENANCE

- 23 A. Before substantial completion, perform all maintenance activities required by any
24 sections of the specifications including any calibrations, final adjustments,
25 component replacements or other routine service required before placing
26 equipment or systems into service.

27 PART 2 PRODUCTS AND MATERIALS

28 2.01 MANUFACTURERS

- 29 A. Allen Bradley 1483-DSx

- 30 B. The listing of specific manufacturers above does not imply acceptance of their
31 products that do not meet the specified ratings, features, and functions.
32 Manufacturers listed above are not relieved from meeting these specifications in

1 their entirety. Products in compliance with the specification and manufactured by
2 others not named will be considered only if pre-approved by the Engineer ten (10)
3 days prior to bid date.

4 2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

- 5 A. AC surge protection device UL 1449
- 6 B. Voltage: Match system system
- 7 C. Provide protection for all 3 phase plus the neutral
- 8 D. Provide 40KA current rating
- 9 E. Provide fused disconnect for SPD.

10 PART 3 CONSTRUCTION METHODS

11 3.01 DIVISION OF WORK

12 3.02 FIELD MEASUREMENTS

- 13 A. Field verify all measurements. Do not base exact SPD installation locations on
14 the contract drawings. Actual field conditions govern all final installed locations,
15 distances, and levels.
- 16 B. Identify conflicts with the work of other trades prior to installation of electrical
17 equipment.

18 3.03 DELIVERY, STORAGE, AND HANDLING

- 19 A. Accept SPD's on site. Inspect for damage.
- 20 B. Protect SPD's from corrosion and entrance of debris.
- 21 C. Store SPD's above grade. Protect from environment with suitable covering.

22 3.04 INSTALLATION

- 23 A. The Contractor shall install all equipment per the manufacturer's
24 recommendations and the contract drawings.

25 3.05 TESTING AND START-UP SERVICES

- 26 A. Refer to the requirements of Section 26 08 00 - Commissioning of Electrical
27 Systems

1 3.06 TRAINING

2 A. Refer to the requirements of Section 26 08 00 - Commissioning of Electrical
3 Systems

4 1.

5 END OF SECTION

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SECTION 26 90 00

PROCESS INSTRUMENTATION AND CONTROL

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 4. Insulated Cable Engineers Association (ICEA)
 5. International Society of Automation (ISA), Specifications and Standards, current edition:
 - a. ANSI/ISA-5.1-1984 - Instrumentation Symbols and Identification.
 - b. ANSI/ISA-5.3-1983 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.
 - c. ANSI/ISA-95.00.01-2000 - Enterprise Control System Integration, Part 1: Models and Terminology.
 - d. ANSI/ISA-TR99.00.01-2004, Security Technologies for Manufacturing and Control Systems.
 - e. ANSI/ISA-TR99.00.02-2004, Integrating Electronic Security into the Manufacturing and Control Systems Environment.
 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition:
 - a. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - b. NEMA ICS 3 - Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC.

7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL508 - Industrial Control Equipment.
 - b. UL508A - Industrial Control Panels.
 - c. UL 913 - Intrinsically Safe Specification.
 - d. UL94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
 - a. CSA C22.2, Industrial Control Equipment.
12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.
 - a. IEC 60529 - Classification of Degrees of Protection Provided by Enclosures
 - 1) EN50005 - for Terminal Markings.
 - 2) EN50081-1 - Generic Emission Standard.
 - 3) EN50082-1 - Generic Immunity Standard.
 - 4) EN61000-4-4 - Electromagnetic compatibility (EMC). Testing and measurement techniques.
 - 5) EN61000-4-5 - Electromagnetic compatibility (EMC). Testing and measurement techniques. Surge immunity test.

1.03 DESCRIPTION OF WORK

- A. For the purpose of obtaining a complete and integrated Process Instrumentation and Control System, the following sections shall be included under the scope of this section:
 1. Section 26 29 13 - Motor Controllers
 2. Section 26 90 10 - Control Panel Construction
 3. Section 26 90 11 - Control Panel Components
 4. Section 26 90 20 - Instrumentation Devices
 5. Section 26 90 30 - Programmable Logic Controllers
 6. Section 26 90 60 - Ethernet Networking Equipment

- 1 B. The work specified herein shall include the furnishing of all materials, equipment,
2 labor, and supervision necessary to fabricate, install, start-up, and test a complete
3 and operable Process Instrumentation and Control System.
- 4 C. The labor specified herein includes but is not limited to engineering, software
5 development, panel fabrication, equipment calibration and adjustment, testing,
6 training, and documentation.
- 7 D. This section identifies the overall functional requirements for the Process
8 Instrumentation and Control System.
- 9 E. This section includes coordination with the work of other sections. This work
10 includes identification of exact interface requirements with motors, control panels,
11 and field instrumentation provided under other portions of this specification. It
12 shall be the responsibility of the system integrator specified under this section to
13 execute this coordination during the shop drawing submittal phase of the work.
14 Additional costs due to inadequate coordination as required herein shall be borne
15 solely by this contractor.
- 16 F. This section includes coordination with electrical contractor to ensure that the
17 proper number of raceways and conductors are installed. It shall be the
18 responsibility of the system integrator to coordinate this work with the installing
19 electrician. Additional costs due to inadequate coordination as required herein shall
20 be borne solely by this contractor.
- 21 G. Provide complete design and installation of a complete and operable pump station
22 as shown and described. System shall utilize a duplex pump station to control the
23 wetwell level via hardwired float control. Status of the station shall be monitored
24 via radio telemetry back at the master SCADA system.

25 1.04 RELATED WORK ELSEWHERE

- 26 A. Article 102 – Bidding Requirements and Conditions
- 27 B. Article 103 – Award and Execution of the Contract
- 28 C. Concrete – Division 03
- 29 D. Metals – Division 05
- 30 E. Electrical - Division 26

31 1.05 SUBMITTALS

- 32 A. Submit shop drawings as specified herein.

1 B. Submit the following information specifically relating to process instrumentation
2 and control:

3 1. General requirements specific to this section include:

- 4 a. Submit complete and integrated document containing all equipment
5 included under the scope of this section.
6 b. Submittal shall be complete, neat, orderly, and indexed with tabbed
7 dividers. Partial submittals will not be accepted.
8 c. Include a complete list of proposed exceptions to and deviations
9 from these specifications.
10 d. Clarity and completeness are of prime importance. Acceptability of
11 submittal drawings shall be at the sole discretion of the Engineer in
12 regards to this requirement.
13 e. Additional requirements for the various subsystems are specified in
14 the corresponding sections.

15 2. Submit the following information:

16 a. Bill of Materials:

- 17 1) Complete listing of all components identifying exact make
18 and model, quantity, and description.

19 b. Component Data Sheets:

- 20 1) Detailed listing for each type of device, identifying
21 Engineer's tag number, manufacturer, model, options,
22 ranges, and other information necessary to supplement
23 component catalog cut sheets and clearly show compliance
24 with these specifications.

25 c. Component Catalog Cut sheets:

- 26 1) Manufacturer's standard catalog information.

27 d. Control Panel Construction Drawings:

- 28 1) Scaled drawings of all control panels and enclosures.
29 2) Front panel elevation complete with nameplate legend.
30 3) Back panel elevation complete with schedule of devices.

31 e. Control Panel Schematic Wiring Diagrams:

- 32 1) Ladder type schematic diagrams.
33 2) Show all devices requiring electrical connections.
34 3) Identify all wire and terminal numbers.
35 4) Identify PLC I/O addresses.
36 5) Reference Engineer's tag number where assigned.
37 6) Cross-reference all relay contacts and coils.
38 7) Identify switching action on all switching devices.
39 8) Common diagrams will not be accepted.

40 f. Analog Loop Diagrams:

- 41 1) Show all devices requiring electrical connections.
42 2) Identify all wire and terminal numbers.
43 3) Identify PLC I/O addresses.
44 4) Identify location of loop power supply.

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- 5) Identify field devices, back-of-panel devices, and front-of panel devices.
- 6) Show tabular summary of transmitter output capability, input impedance of each receiver, total loop impedance, and reserve output capacity.
- 7) Reference Engineer's tag number where assigned.
- 8) Common diagrams will not be accepted.
- g. Control Panel Plumbing Diagrams:
 - 1) Show all devices requiring plumbing connections (air or liquid).
 - 2) Show pipe/tube sizing.
 - 3) Show all control devices (valves, regulators, filters, etc.).
- h. Control Panel Power and Environmental Requirements:
 - 1) Identify voltage and ampacity requirements.
 - 2) Show sizing calculations for environmental controls (ventilation, heat, air conditioning).
- i. Interconnecting Wiring Diagrams:
 - 1) Show all interconnections between control panels.
 - 2) Show all interconnections between control panels and motor control centers.
 - 3) Show all interconnections between control panels and field devices.
 - 4) Show all interconnections between motor control centers and field devices.
 - 5) Identify all wire and terminal numbers, including field terminal junction box terminals.
- j. Control Device Installation Details:
 - 1) Supplement contract documents with additional details necessary for proper installation of control devices.
- k. Configuration Documentation:
 - 1) Submit complete, documented configuration data for all configurable controllers.
 - 2) Additional requirements for PLC systems and PC based SCADA systems are identified in the individual subsystem sections.

36 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 37 A. Submit operation & maintenance manuals and instructions as specified herein.
- 38 B. Submit the following information specifically for hardware alarm notification
- 39 system:
- 40 1. Submit final revised shop drawings incorporating any modifications made
- 41 as a result of factory test, installation, start-up, operational testing, or for
- 42 any other cause. Submit results of all field-testing and corrective actions

- 1 taken for all discrete control devices and for all analog control devices.
2 Submit analog device calibration data sheets.
- 3 2. Submit manufacturers standard operation & maintenance information
4 including installation manuals and safety instructions.
 - 5 3. Submit contact list identifying names, addresses, telephone numbers, and
6 any additional contact information for each equipment service organization
7 involved with the Process Instrumentation and Control System.
 - 8 4. Submit detailed operation and maintenance procedures for each major
9 equipment item; include description of operation for all modes of operation,
10 routine maintenance procedures, and trouble-shooting guide.
 - 11 5. Submit listing spare parts provided under this contract and of recommended
12 additional spare parts not provided under this contract along with costs.

13 1.07 FACTORY TESTING

- 14 A. The entire Process Instrumentation and Control System shall be assembled at the
15 manufacturer's facility and tested to the greatest extent possible. This test shall
16 include simulation of all I/O points, simulation of system alarms, and
17 demonstration of proper system operation. Document the results of this test in
18 writing and submit to the Engineer.
- 19 B. The Engineer and Owner may witness the factory acceptance test. Schedule test
20 date a minimum of two weeks in advance to allow attendance by the Engineer and
21 the Owner.
- 22 C. Correct any deficiencies identified during the test prior to shipping the control
23 system to the job site.

24 1.08 QUALITY ASSURANCE

- 25 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 26 B. System supplier shall be responsible for providing all necessary accessories
27 required for a complete and operable system.
- 28 C. Manufacturer Qualifications: Company specializing in manufacturing products
29 specified in this section, with not less than three years of documented experience.
- 30 D. Products: Listed and classified by UL or testing firm acceptable to the authority
31 having jurisdiction as suitable for the purpose specified and indicated.

32 1.09 WARRANTY

- 33 A. See Division 01 for additional requirements.

1 1.10 EXTRA MATERIALS (NOT USED)

2 1.11 DESIGN REQUIREMENTS (NOT USED)

3 1.12 MAINTENANCE

4 A. Before substantial completion, perform all maintenance activities required by any
5 sections of the specifications including any calibrations, final adjustments,
6 component replacements or other routine service required before placing
7 equipment or systems into service.

8 B. Furnish all spare parts as required by other sections of the specifications.

9 PART 2 PRODUCTS AND MATERIALS

10 2.01 SYSTEM INTEGRATOR

11 A. The system integrator shall be a firm specializing in the integration of control
12 systems with documented experience in the detailed design, construction,
13 configuration, and maintenance of PLC based control systems and motor control
14 centers for the water/wastewater utility market. This experience must include a
15 minimum of five projects similar in nature to this project during the last five years.

16 B. Acceptable system integrators include

- 17 1. Altronex Control Systems, a division of LW Allen, Madison, WI
18 2. Or Equal

19 2.02 GENERAL FUNCTIONAL DESCRIPTION

20 A. Summary of System Improvements:

21 1. New PLC based control systems shall be provided for the James St Pump
22 Station:

23 a. New pump station control panel shall consist of an Allen-Bradley
24 CompactLogix Ethernet processor, associated chassis, power supply
25 and scheduled I/O modules, Ethernet switch, UPS as shown and
26 indicated on the contract drawings.

27 b. Backup permanent generator provided in event of utility failure.

28 B. General Requirements:

29 1. The process instrumentation and control system consists of the following
30 functional divisions which will be defined in detail for each loop under
31 Detailed Functional Description:

32 a. Local Control Functions: includes local control panels, pilot control
33 devices, instruments, and sensors.

- b. Motor Control Center Functions: includes hardwired MCCs, DeviceNet networked MCCs, and pilot control devices located within these MCCs.
 - c. SCADA System Control Functions: includes PLC hardware, interface devices, and PLC logic.
 - d. SCADA System Monitoring Functions: includes graphical user interface hardware and configuration, event monitoring and logging functions, analog parameter trending, and alarm handling.
 - e. SCADA System Historical Data Functions: includes historical database, report configuration, and interface with the existing maintenance management software system.
2. The process instrumentation and control system includes existing PLCs, SCADA system servers and workstations, and network infrastructure. It shall be the responsibility of the system integrator to coordinate all efforts specified herein with these existing systems so as to minimize impact on facility operations.
 3. PLC Programming
 - a. All PLC programming will be provided by Madison Metropolitan Sewerage District, MMSD.
 4. SCADA/HMI Graphical Interface
 - a. All SCADA/HMI functions will be programmed and provided by MMSD.
 5. Historical Data
 - a. All historical data will be developed and recorded by MMSD.

2.03 UNIT PROCESS NO. 1: JAMES STREET PUMP STATION

A. LOOP 1: INFLUENT PUMPING

1. General:
 - a. Provide (5) wetwell floats for level control in the wetwell.
 - b. Control of the pumps will be through the PLC using the floats.
 - c. Backup control will be activated by ~~the high level float and bypass the PLC~~ loss of PLC activity and shall run the pumps in a fixed mode of operation via hard-wired controls.
 - d. Refer to P&ID.
2. Local Control Functions:
 - a. "Pump No. X Service Out/In" Selector switch.
 - 1) With the switch in the "Out of Service" position, the pump is not available to run.
 - 2) With the switch in the "In Service" position, the pump is available to run.
 - b. ~~Station~~ Pump No. X Hand-Off-Auto selector switch
 - 1) ~~In "Hand", the pumps will be called via start/stop pushbuttons, to run~~ as long as the pump is available.

- 1 2)1) ~~“Local” pilot light provides operator indication the system is~~
2 ~~in local control service.~~
- 3 2) In “Off”, the pumps are inoperable.
- 4 3) In “Auto”, the PLC will control the pumps in response to the
5 floats, as long as the pump is in available service.
- 6 a) ~~“Computer” pilot light provides operator indication~~
7 ~~the system is in local control.~~
- 8 b)a) Pump alternation selector switch, “Alternation 1-
9 2/AUTO/2-1” is provided indication of pump
10 alternation to alternate the pumps between service
11 events.
- 12 e)b) In the event of a “High Level Alarm”, PLC failure,
13 the high level float pump control will
14 activate automatically switch to hard wired logic in
15 the control panel. Pump No.1 via hardwire will run
16 as the lead pump and start with the “Lead Pump
17 Start” float and pump down to the “Pumps Off” float.
18 Pump No.2 shall operate as the lag pump and start
19 with the “Lag Pump Start” float and pump the station
20 down to the “Pumps Off” float. The “Pumps Off”
21 float will reset the hardwire backup control shall
22 switch back to normal control once the PLC has re-
23 enabled.
- 24 c. A push-pull normally closed “Emergency Stop” pushbutton, when
25 push in, opening the circuit shall lock out the pumps until the
26 pushbutton is pulled out.
- 27 d. “Running” pilot light shall be provided to indicate the pump is
28 running.
- 29 e. “Stopped” pilot light shall be provided to indicate the pump is not
30 running.
- 31 f. “Failed” pilot light shall be provided to indicate the pump has failed.
- 32 g. “High Level Alarm” pilot light shall be provided to indicate the
33 wetwell has a high level.
- 34 h. “Low Level Alarm” pilot light shall be provided to indicate the
35 wetwell has a high level.
- 36 i. ~~“Backup Control” pilot light shall be provided to indicate the~~
37 ~~wetwell is in backup control.~~
- 38 3. With the switch in the “In Service” position, the pump is available to run
- 39 ~~3.4.~~ Pump Control Panel Functions:
- 40 a. The motor high temperature relay shall be located in the pump
41 control panel. Provide “Motor High Temperature” pilot light in the
42 event of a high motor temperature. Lock the pump out of operation
43 in the event of a high motor temperature, requiring the “Alarm
44 Reset” pushbutton to unlatch to lockout circuit.

- 1 b. The seal fail relay shall be located in the pump control panel.
2 Provide "Seal Fail" pilot light. Do not lock the pump out in the event
3 of a seal fail.

4 4.5. SCADA System Control Functions:

- 5 a. N/A

6 ~~5.6.~~ SCADA System Monitoring Functions:

- 7 a. Station In Auto
8 b. E-Stop
9 c. Pump Alternation 1-2
10 d. Pump No.x In Service
11 e. Pump No.x Running
12 f. Pump No.x Failed
13 g. Pump No.x Motor High Temperature
14 h. Pump No.x Seal Fail
15 i. Pump No.x KW
16 j. Pump No.x Amps
17 k. Pump No.x Start Pushbutton
18 l. Pump No.x Stop Pushbutton
19 m. Alarm Reset
20 n. Wetwell High Level Float
21 o. Wetwell Lag Start Float
22 p. Wetwell Lead Start Float
23 q. Wetwell Pumps Off Float
24 r. Wetwell Low Level Float
25 s. Wetwell In Backup Control

26 ~~6.7.~~ SCADA System Alarm Functions:

- 27 a. Incorporate the following alarm conditions into the alarm log and
28 into the alarm notification system:
29 1) Station In Auto
30 2) E-Stop
31 3) Pump No.x In Service
32 4) Pump No.x Failed
33 5) Pump No.x Motor High Temperature
34 6) Pump No.x Seal Fail
35 7) Wetwell High Level Float
36 8) Wetwell Low Level Float
37 9) Wetwell In Backup Control

38 7.8. SCADA System Historical Data Functions

- 39 a. Display, trend, and record the following parameters:
40 1) Pump No.x Running
41 2) Pump No.x Failed
42 3) Pump No.x Motor High Temperature
43 4) Pump No.x Seal Fail
44 5) Pump No.x KW

- 6) Pump No.x Amps
- 7) Wetwell High Level
- 8) Wetwell Low Level
- 9) Wetwell In Backup Control

B. LOOP 2: STANDBY GENERATOR

1. General:
 - a. A permanent generator will be provided for station power in the event of the utility power outage.
 - b. Refer to P&ID.
2. Local Control Functions:
 - a. ATS to monitor primary power source. If the primary source is lost, the generator shall be started and the ATS shall switch power to the generator.
 - b. ATS to perform weekly exercise of generator
 - c. Provide indicator light for Generator Failed/Not in Auto.
 - d. Provide blue indicator light for "ATS Emergency Source Connected".
3. Motor Control Center Functions:
 - a. N/A
4. SCADA System Control Functions:
 - a. SCADA system shall be set up to perform generator exercise if needed.
5. SCADA System Monitoring Functions:
 - a. Generator Running
 - b. Generator Failed
 - c. Generator Not In Auto
 - d. ATS in Normal Position
 - e. ATS Normal Source Available
 - f. ATS in Emergency Position
 - g. ATS Emergency Source Available
 - h. ATS Not In Auto
 - i. ATS Failed to Transfer
 - j. ATS Initiate Test
6. SCADA System Alarm Functions:
 - a. Incorporate the following alarm conditions into the alarm log and into the alarm notification system:
 - b. Generator Running
 - c. Generator Failed
 - d. ATS Not In Auto
 - e. ATS Failed to Transfer
7. SCADA System Historical Data Functions
 - a. Display, trend, and record the following parameters:
 - b. Generator Running

- 1 c. Generator Failed
- 2 d. Generator Not In Auto
- 3 e. Generator number of starts
- 4 f. Generator ETM
- 5 g. ATS in Normal Position
- 6 h. ATS Normal Source Available
- 7 i. ATS in Emergency Position
- 8 j. ATS Emergency Source Available
- 9 k. ATS Not In Auto
- 10 l. ATS Failed to Transfer
- 11 m. ATS Initiate Test

12 C. LOOP 3: PANEL INTRUSION

- 13 1. General:
 - 14 a. A door limit switch will be provided on the main control panel door
 - 15 to monitor if the door is open. The switch will provide an input to
 - 16 the PLC for notification and to turn the panel lights on.
 - 17 b. Refer to P&ID.
- 18 2. Local Control Functions:
 - 19 a. Door switch activates light
- 20 3. Motor Control Center Functions:
 - 21 a. N/A
- 22 4. SCADA System Control Functions:
 - 23 a. Notification there is a panel entry
- 24 5. SCADA System Monitoring Functions:
 - 25 a. Panel Entry
- 26 6. SCADA System Alarm Functions:
 - 27 a. Incorporate the following alarm conditions into the alarm log and
 - 28 into the alarm notification system:
 - 29 1) Panel Entry
- 30 7. SCADA System Historical Data Functions
 - 31 a. Display, trend, and record the following parameters:
 - 32 1) Panel Entry

33 D. LOOP 4: THREE PHASE POWER FAIL

- 34 1. General:
 - 35 a. Provide voltage monitor to provide failed contact in an event the 3
 - 36 phase power is inadequate.
 - 37 b. Refer to P&ID.
- 38 2. Local Control Functions:
 - 39 a. Provide a pilot light indicating a Station 3 phase power failure.
- 40 3. Motor Control Center Functions:
 - 41 a. N/A
- 42 4. SCADA System Control Functions:
 - 43 a. N/A

- 1 5. SCADA System Monitoring Functions:
- 2 a. Monitor the voltage relay.
- 3 6. SCADA System Alarm Functions:
- 4 a. Incorporate the following alarm conditions into the alarm log and
- 5 into the alarm notification system:
- 6 1) Station 3 Phase Power Failure
- 7 7. SCADA System Historical Data Functions
- 8 a. Display, trend, and record the following parameters:
- 9 1) Station 3 Phase Power Failure
- 10

11 E. LOOP 5: CONTROL POWER MONITORING

- 12 1. General:
- 13 a. Provide a control power relay for indication to SCADA that control
- 14 power is available.
- 15 b. Primary power to the controls shall be provided by the UPS. Provide
- 16 a relay on the UPS output. If the UPS power fails, the power shall
- 17 be switched to regular control power.
- 18 2. Local Control Functions:
- 19 a. ~~None.~~
- 20 a. Provide pilot light for "UPS Failure".
- 21 3. Motor Control Center Functions:
- 22 a. N/A
- 23 4. SCADA System Control Functions
- 24 a. N/A
- 25 5. SCADA System Monitoring Functions
- 26 a. Control Power Available
- 27 b. UPS Low Battery
- 28 c. UPS Power Available
- 29 d. UPS Service Required
- 30 6. SCADA System Alarming
- 31 a. Control Power Failure
- 32 b. UPS Service Required
- 33 c. UPS Low Battery
- 34 7. SCADA System Historical Data Functions
- 35 a. Control Power Available
- 36 b. UPS Low Battery
- 37 c. UPS Power Available
- 38 d. UPS Service Required

39 F. LOOP 6: RADIO COMMUNICATIONS

- 40 1. General:
- 41 a. The Master PLC will pole the pump station PLC in the site rotations.
- 42 If communications cannot be made, a communications failure will
- 43 be generated at the master SCADA.

- 1 2. Local Control Functions:
 - 2 a. None.
 - 3 3. Motor Control Center Functions:
 - 4 a. N/A
 - 5 4. SCADA System Control Functions
 - 6 a. Maintain this site in the radio communications
 - 7 5. SCADA System Monitoring Functions
 - 8 a. Communications
 - 9 6. SCADA System Alarming
 - 10 a. Communications Failure
 - 11 7. SCADA System Historical Data Functions
 - 12 a. Communications Failure
- 13 G. LOOP 7: YARD LIGHT (FUTURE)
- 14 1. General:
 - 15 a. Yard light is left as future, mainly to get a conduit stubbed out for
16 future use.
 - 17 2. Local Control Functions:
 - 18 a. None.
 - 19 3. Motor Control Center Functions:
 - 20 a. N/A
 - 21 4. SCADA System Control Functions
 - 22 a. N/A
 - 23 5. SCADA System Monitoring Functions
 - 24 a. N/A
 - 25 6. SCADA System Alarming
 - 26 a. N/A
 - 27 7. SCADA System Historical Data Functions
 - 28 a. N/A

29 PART 3 CONSTRUCTION METHODS

30 3.01 DIVISION OF WORK (NOT USED)

31 3.02 FIELD MEASUREMENTS

- 32 A. Field verify with exact measurements, the available mounting space for control
33 system equipment. Actual field conditions govern all final installed locations,
34 distances, and levels.
- 35 B. Identify conflicts prior to beginning installation.
- 36 C. Where ranges are indicated on the contract documents, they are to be considered
37 preliminary. Field verify the exact ranges required based on field conditions.

1 3.03 DELIVERY STORAGE AND HANDLING

- 2 A. It shall be the responsibility of the installing contractor to receive all process
3 instrumentation and control equipment at the job site. Carefully inspect all
4 equipment for damage prior to accepting from the shipping agency. Do not accept
5 shipment if damage is evident.
- 6 B. Exercise due diligence in storing, protecting, and moving process instrumentation
7 and control equipment. Damaged or worn equipment will not be accepted and will
8 be replaced at no additional cost to the Owner.

9 3.04 INSTALLATION

- 10 A. Install equipment in locations as indicated on the contract documents. Adjust
11 locations as needed to ensure operability, serviceability, and compliance with all
12 applicable codes and standards.
- 13 B. Installation shall be completely tested prior to start-up. This work includes
14 verification of all field wiring continuity and proper termination of wiring.

15 3.05 TESTING AND START-UP SERVICES

- 16 A. System Integrator shall provide installation and start-up services required to place
17 the complete system into operation.
- 18 B. Each signal and function shall be fully tested. These tests shall be based on actual
19 operation of primary elements and verification of proper control system response.
20 Submit test results as part of Operations and Maintenance Manual.
- 21 C. Record calibrations of all analog devices.
- 22 D. Demonstrate proper operation of the process and instrumentation control system to
23 the Owner and in the presence of the Engineer.

24 3.06 TRAINING

- 25 A. Training shall be suitable for plant operations personnel with limited knowledge of
26 electrical components.
- 27 B. Provide two instructor days of operator training at the job site. Training shall
28 consist of operations instruction and maintenance/trouble-shooting instruction.
- 29 1. Operations instruction shall identify all control loops with description of all
30 interlocks, interface with other loops, and operational input requirements.
31 Describe procedures for re-starting the system.
- 32 2. Maintenance instruction shall identify periodic maintenance that can be
33 performed by the operator. Provide description of procedures and locations

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for replacement of consumable devices such as fuses and for checking the calibration or operation of devices.

3. Trouble-shooting instruction shall identify simple procedures and methods for identifying potential causes in the event of failures. For example, instruct operator on correlation of input signals and PLC I/O module indicator lights.

END OF SECTION

SECTION 26 90 10

CONTROL PANEL CONSTRUCTION

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Part I shall govern the work of this section.
- B. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
 - 1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
 - b. ANSI/NFPA 79 - Electrical Standard for Industrial Machinery.
 - 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 - 4. Insulated Cable Engineers Association (ICEA)
 - 5. American National Standards Institute/Instrument Society of America (ANSI/ISA), Specifications and Standards, current edition.
 - 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
 - b. NEMA ICS6 - Enclosures for Industrial Controls and Systems
 - 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL50 - Cabinets and Boxes
 - b. UL508 - Industrial Control Equipment
 - c. UL508A - Industrial Control Panels
 - d. UL94 - Flammability of Plastic Materials
 - 8. Wisconsin Department of Safety and Professional Services (DSPS)
 - 9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
 - 10. International Electrical Testing Association (NETA)

- 1 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
2 Power Distribution Equipment and Systems.
3 11. Canadian Standards Associates (CSA), Specifications and Standards,
4 Current Edition.
5 a. CSA Standard C22.2 No. 0 - General Requirements - Canadian
6 Electrical Code, Part II
7 b. CSA Standard C22.2 No. 0.4 - Bonding and Grounding of Electrical
8 Equipment (Protective Equipment)
9 c. CSA Standard C22.2 No. 14 - Industrial Control Equipment for Use
10 in Ordinary (Non-Hazardous) Locations
11 d. CSA Standard C22.2 No. 40 - Cutout, Junction, and Pull boxes
12 e. CSA Standard C22.2 No. 94 - Special Purpose Enclosures
13 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
14 Specifications and Standards, Current Edition.
15 13. International Electrotechnical Association (IEC), Specifications and
16 Standards, Current Edition.
17 a. IEC 60529 - Classification of Degrees of Protection Provided by
18 Enclosures
19 b. IEC 60204 - Safety of Machinery - Electrical Equipment of
20 Machines
21 c. IEC 60079 - Electrical Apparatus for Explosive Gas Atmospheres

22 1.03 DESCRIPTION OF WORK

- 23 A. For the purpose of obtaining a complete and integrated process instrumentation and
24 control system, the work specified herein shall be included under the scope of:
25 1. Section 26 90 00 - Process Instrumentation & Control

26 1.04 RELATED WORK ELSEWHERE

- 27 A. Article 102 – Bidding Requirements and Conditions
28 B. Article 103 – Award and Execution of the Contract
29 C. Concrete – Division 03
30 D. Metals – Division 05
31 E. Electrical - Division 26

32 1.05 SUBMITTALS

- 33 A. Submit shop drawings as specified herein.
34 B. Submit shop drawings for the equipment specified herein as part of the complete,
35 integrated submittal for the process instrumentation & control system and in
36 accordance with the requirements specified under Section 26 90 00 - Process
37 Instrumentation and Control.

- 1 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS
- 2 A. Submit operation & maintenance manuals and instructions as specified herein.
- 3 B. Submit operation and maintenance manuals for the equipment specified herein as
- 4 part of the complete, integrated manual for the process instrumentation and control
- 5 system and in accordance with the requirements specified under 26 90 00 - Process
- 6 Instrumentation and Control.
- 7 1.07 FACTORY TESTING
- 8 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
- 9 Control.
- 10 1.08 QUALITY ASSURANCE
- 11 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 12 B. System supplier shall be responsible for providing all necessary accessories
- 13 required for a complete and operable system.
- 14 C. Manufacturer Qualifications: Company specializing in manufacturing products
- 15 specified in this section, with not less than three years of documented experience.
- 16 D. All control panels shall be constructed in accordance with UL 508 standards and
- 17 shall bear the UL 508 listing.
- 18 1.09 WARRANTY
- 19 A. See Division 01 for additional requirements.
- 20 1.10 EXTRA MATERIALS
- 21 A. See Division 01 for additional requirements.
- 22 B. Provide one spare vapor phase corrosion-inhibiting capsule for each control panel.
- 23 C. Provide twenty percent of the total number of terminals as installed spares in each
- 24 control panel.
- 25 D. Provide 3 spare control relays of each type utilized within each control panel.
- 26 E. Provide 3 spare fuses of each type utilized within each control panel
- 27 1.11 DESIGN REQUIREMENTS

CONTROL PANEL(S)				
TAG NUMBER	DESCRIPTION	TYPE	SIZE	NOTES
	JAMES ST PUMP STATION	B	72"H x 86"W x 24" D	1

SCS-1	SUPERVISORY CONTROL SYSTEM	A	36"H x 30"W x 12"D	1
PCP-1	PUMP CONTROL PANEL	A	36"H x 24"W x 12"D	1
PCP-2	PUMP CONTROL PANEL	A	36"H x 24"W x 12"D	1
PDP	POWER DISTRIBUTION PANEL	A	24"H x 24"W x 12"D	1
NOTES: 1. Specified size indicates the physical size anticipated by the ENGINEER. CONTRACTOR shall verify actual size with SYSTEM INTEGRATOR and adjust installation accordingly.				

1 1.12 MAINTENANCE

- 2 A. Before substantial completion, perform all maintenance activities required by any
3 sections of the specifications including any calibrations, final adjustments,
4 component replacements or other routine service required before placing
5 equipment or systems into service.
- 6 B. Furnish all spare parts as required by other sections of the specifications.

7 PART 2 PRODUCTS AND MATERIALS

8 2.01 GENERAL REQUIREMENTS

- 9 A. Fabricate, install instruments, plumb and wire in factory.
- 10 B. Test wiring and plumbing prior to shipment.
- 11 C. Make external connections by way of numbered terminal blocks.
- 12 D. Separate electrical components from pneumatic and hydraulic components by
13 metal barriers.
- 14 E. Conform to ISA standards.

15 2.02 TYPE A - CONTROL PANEL ENCLOSURE, WALL-MOUNTED

- 16 A. Manufacturer:
- 17 1. Hoffman Enclosures, Inc. Concept Wall-Mount Enclosure
- 18 2. Saginaw Control and Engineering, Enviroline Series Wall-Mount Enclosure
- 19 3. or equal
- 20 B. Environmental Rating:
- 21 1. NEMA Type 4/4X/12
- 22 C. Construction:
- 23 1. 16 gauge or 14 gauge steel
- 24 2. Seams continuously welded and ground smooth
- 25 3. Minimum width body flange trough excludes liquids and contaminants

- 1 4. Integral body grounding stud
- 2 5. Panel mounting studs
- 3 6. Mounting holes in back of body for direct mounting
- 4 7. Hidden hinges for clean aesthetic appearance
- 5 8. Standard full access 170 degree door opening
- 6 9. Doors are interchangeable and easily removable by pulling captive hinge
- 7 pins
- 8 10. Door bar on hinge side for wire management and grounding
- 9 11. Additional door bar and stiffener on larger enclosures for extra rigidity
- 10 12. High-impact thermoplastic data pocket
- 11 13. Seamless foam-in-place one-piece gasket provides oil-tight and dust-tight
- 12 seal against contaminants
- 13 14. Self-grounding latch system with double seal provides maximum protection
- 14 against leakage
- 15 15. Quarter-turn door latching system installed on door with a slotted insert
- 16 16. Finish:
- 17 a. Gray painted steel
- 18 b. Steel sub-panels are painted white

19 2.03 TYPE B - CONTROL PANEL ENCLOSURE, FREE-STANDING

- 20 A. Manufacturer:
- 21 1. Hoffman Enclosures, Inc.
- 22 2. Saginaw Control and Engineering, Enviroline Series
- 23 3. or equal

- 24 B. Environmental Rating:
- 25 1. NEMA Type ~~4/4X~~/123R

- 26 C. Construction:
- 27 1. 12 gauge stainless steel
- 28 2. Seams continuously welded and ground smooth
- 29 3. Minimum width body flange trough excludes liquids and contaminants
- 30 4. Integral body grounding stud
- 31 5. Panel mounting studs
- 32 6. 18 inch legs with louvered skirting
- 33 7. Hidden hinges for clean aesthetic appearance
- 34 8. 3-point latching system with padlockable rotating handles
- 35 9. Door stops on exterior doors.
- 36 10. Door bar on hinge side for wire management and grounding
- 37 11. Additional door bar and stiffener on larger enclosures for extra rigidity
- 38 12. High-impact thermoplastic data pocket
- 39 13. Seamless foam-in-place one-piece gasket provides oil-tight and dust-tight
- 40 seal against contaminants
- 41 14. Self-grounding latch system with double seal provides maximum protection
- 42 against leakage
- 43 15. Finish:

- a. Brushed stainless steel
 - b. Steel sub-panels are painted white
16. Two door enclosures shall NOT have a center mullion/divider.
 17. Backpan shall be one piece, not two piece.

PART 3 CONSTRUCTION METHODS

3.01 FIELD MEASUREMENTS

- A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and Control.

3.02 DELIVERY STORAGE AND HANDLING

- A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and Control.

3.03 INSTALLATION

- A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and Control.

3.04 CONTROL PANEL FABRICATION AND ENVIRONMENTAL PROTECTION REQUIREMENTS

- A. Instrument Mounting:
 1. Locate instruments designated for back-of-panel mounting in manner to allow for maintenance and adjustment.
 2. Panels 36" tall or shorter are to be mounted 54" from finished floor to centerline of panel. Panels over 36" tall are to be mounted no higher than 72" from finished floor to top of panel.
 3. Instrument mounting height shall not exceed 70". Minimum height shall be 48".
 4. Operator interface terminals are to be 54" from finished floor to centerline of screen, but the top of the visible screen shall not exceed 60" above finished floor.
 5. Panel cutouts for instruments and other devices, such as lights and switches, shall be cut, punched, or drilled and smoothly finished with rounded edges.
 6. Provide steel angle stiffeners on back of panel face to prevent panel deflection under instrument loading or operation.
 7. Provide internal structural steel framework for instrument support purposes and panel bracing. Internal framework shall permit lifting of panel without racking or distortion.
 8. All components inside pump station enclosure shall be housed in separate control panels. The Supervisory Control System SCS-1, Pump Control Panels PCP-1 and PCP-2, lighting panel LP-1 & the Power Distribution Panel PDP shall all be house in a separate enclosures.

- 1 9. All interconnections between panels inside of the pump station panel shall
2 be done with galvanized rigid steel conduit with LBs.
3 10. UPS to be shelf mounted.

4 B. Corrosion Protection:

- 5 1. Provide vapor phase corrosion inhibiting capsules in each control panel to
6 protect all exposed metal surfaces for a period of at least two years.
7 Corrosion inhibiting modules shall be Northern Instrument Corporation,
8 Zerust vapor capsules Model VC-2-2 or Hoffman Engineering Corporation
9 corrosion inhibitor Model A-HCI-5.
10 2. Provide thermostatically controlled condensation heater in panels located in
11 high humidity areas and in areas in which ambient temperature will vary.
12 Heater shall be sized to prevent condensation within panel.

13 C. Heating, Ventilating, and Air Conditioning:

- 14 1. Provide heating equipment as specified under Part B.
15 2. Provide filtered ventilation fan(s) where needed and sized to dissipate heat
16 generated by components located within control panel.
17 a. Filtered ventilation fans are to push air inward into control panel.
18 3. Provide filtered air conditioning equipment and insulate panel where
19 needed to maintain internal panel temperature within operating parameters
20 of internal panel components.

21 3.05 CONTROL PANEL ELECTRICAL REQUIREMENTS

22 A. Electric Service:

- 23 1. Design control panel to operate on electrical supply indicated on the
24 drawings.
25 a. Three phase service:
26 1) Provide main circuit breaker disconnect switch with through
27 the door operator handle.
28 2) Provide branch circuit breakers for distribution of three
29 phase and single phase power at voltages above 120VAC.
30 a) Provide through the door disconnect handle.
31 3) Control panel and internal components shall be rated to
32 interrupt the available fault current.
33 4) Main circuit breaker and branch circuit breakers shall be
34 coordinated such that a fault in a branch circuit will trip only
35 the branch circuit breaker and not the main circuit breaker.
36 5) Separate 480VAC wiring from control voltage wiring.
37 6) Provide appropriately sized control power transformer.
38 7) Provide miniature circuit breakers for distribution of
39 120VAC control power in accordance with the following:
40 a) No more than 20 devices on any single circuit.
41 b) Where multiple units perform parallel operations, do
42 not group all devices on the same branch circuit. The

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- purpose is to prevent the failure of any single branch circuit from shutting down at entire operation.
 - c) Do not exceed the ampacity of the branch circuit.
 - d) Panel service outlet shall be protected by separate branch circuit breakers and be labeled with ampacity rating.
 - e) Power supplies shall be protected by separate branch circuit breakers.
- 8) Provide 20 amp, 120VAC service outlet circuit within back-of-panel area.
 - 9) Control power transformer fuses and branch circuit breakers shall be coordinated such that a fault in a branch circuit will trip only the branch circuit breaker and not the control power transformer fuses.
 - 10) Branch circuit breakers shall be rated for 15A and 250VAC.
 - 11) Fuses shall not be substituted for circuit breakers.
- b. Single phase service:
- 1) Provide main circuit breaker with disconnect switch.
 - 2) Provide miniature circuit breakers for distribution of 120VAC control power in accordance with the following:
 - a) No more than 20 devices on any single circuit.
 - b) Where multiple units perform parallel operations, do not group all devices on the same branch circuit. The purpose is to prevent the failure of any single branch circuit from shutting down at entire operation.
 - c) Do not exceed the ampacity of the branch circuit.
 - d) Panel service outlet shall be protected by separate branch circuit breakers
 - e) Power supplies shall be protected by separate branch circuit breakers.
 - 3) Provide 20A, 120VAC service outlet circuit within back-of-panel area.
 - 4) Main circuit breaker and branch circuit breakers shall be coordinated such that a fault in a branch circuit will trip only the branch circuit breaker and not the main circuit breaker.
 - 5) Branch circuit breakers shall be rated for 15A and 250VAC.
 - 6) Fuses shall not be substituted for circuit breakers.
- c. Uninterruptible power supply:
- 1) Provide true online uninterruptible power supply, provide distribution of 120VAC power on the line and load sides of the UPS.
 - 2) Panel service outlet, heater and other non-critical loads shall be powered from the line side of the UPS. Critical loads, including but not limited to all digital control equipment, shall be powered from the load side of the UPS.
 - 3) Provide UPS bypass circuitry in the event the UPS fails.

- 1 d. Back-up control systems:
2 1) Where panel includes fail-safe back-up control circuitry, the
3 back-up control circuits shall be fed with a separate circuit
4 from a lighting panel or from a separate control power
5 transformer.

6 B. Output Signal Fusing:

- 7 1. Provide appropriately sized fuses for all output signals to devices located
8 external to the panel in accordance with the following requirements:
9 a. Maximum fuse size: 5A
10 b. Separate fuse for each device
11 c. Fuses shall be installed in indicating type fuse holder terminal
12 blocks.

13 C. Control Panel Wiring:

- 14 1. Wiring within panels, consoles, racks, and cabinets shall meet the following
15 requirements:
16 a. Wires for ac circuits shall be 300V or 600V, Type MTW stranded
17 tin plated copper and shall be sized for the current to be carried but
18 no smaller than No.16 AWG.
19 b. Wires for analog signal circuits shall be 300V stranded tin plated
20 copper and shall be twisted shielded pairs/triads no smaller than
21 No.18 AWG.
22 c. Wires for other dc circuits shall be 300V, Type MTW stranded tin
23 plated copper but no smaller than No.16 AWG.
24 d. Wiring for special signals such as communications, digital data, and
25 multiplexed signals shall use manufacturers' standard cables.
26 e. Every effort is to be made to separate wiring of different voltages.
27 Where wiring of different voltages are near each other, they should
28 cross perpendicular to each other.
29 f. Provide 1-1/2" spacing between wire trough and terminal blocks.
30 g. Provide 1-1/2" spacing between wire trough and components.
31 h. All wiring shall have heat shrink wire numbers.
32 i. All 3 phase wiring shall have phase tape on both ends of the
33 conductors.
34 2. Components/Din Rail
35 a. Provide din rail for panel components.
36 b. Provide 25% spare din rail space
37 c. Fuse holders shall have indicator lights
38 d. Provide 25% spare back panel space for future devices.
39 3. Terminal blocks for panels, consoles, racks, and cabinets shall meet the
40 following requirements:
41 a. Wire all spare or unused panel mounted elements, including PLC
42 input/output points, to terminal blocks.
43 b. Provide open construction terminal blocks for wiring that is entirely
44 internal to the panel.

- c. Provide isolation switch terminal blocks for all wiring that is not entirely internal to the panel.
- d. Rail-mount individual terminals to create a complete assembly. Provide terminals constructed such that jumpers can be installed with no loss of space on terminal or rail.
- e. Size all terminal block components to allow insertion of all necessary wire sizes and types.
- f. Provide power distribution blocks for distribution of control panel power at voltages exceeding 120VAC.
- g. Provide wire troughs on both sides of terminal strips. Provide wire troughs for field wiring. Maximum fill of wire trough shall be 60%.
- h. Any wiring not in a wire trough shall be ran in spiral wrap and secured to panel with tie wraps.
- i. Provide 25% spare terminal blocks of each type. (120VAC, Neutral, DC power, control, 4-20 signals and intrinsic circuits)

4. Grounding:

- a. Panels, consoles, racks, and cabinets shall be provided with an isolated copper grounding bus for all signal and shield ground connections. This ground bus shall be grounded at a common single ground point. The signal grounding system shall meet National Electrical Code requirements.
- b. Each analog loop shall only be grounded at a single point for the loop. This single point shall be at the location of the dc power supply for the loop.

D. Power Supplies:

- 1. Provide dc power supplies as required to power instruments requiring external dc power, including two-wire transmitters and dc relays.
- 2. Power supplies shall be suitable for intrinsically safe circuits where two-wire transmitters are located in a hazardous area.

E. Electrical Transient Protection:

- 1. All electrical and electronic elements of the control system shall be protected against damage due to electrical transients induced in interconnecting lines from lighting discharges and nearby electrical systems.
- 2. Surge Suppressor Locations:
 - a. As a minimum, provide surge suppressors at the following locations:
 - 1) Provide 480VAC, panel mounted surge suppressor on the load side of each 480VAC main circuit breaker in each panel.
 - 2) Provide 120VAC, panel mounted surge suppressor on the load side of each 120VAC main circuit breaker in each panel.
 - 3) Provide 24VDC, panel mounted surge suppressor at the panel connections of all analog signal circuits that have any

1 portion of the circuit extending outside of a protecting
2 building.

- 3 4) Provide 24VDC, field mounted surge suppressor at the field
4 connection of each analog signal transmitter located outside
5 of a protecting building.

6 3.06 STANDARD SIGNAL INTERFACES

7 A. Unless otherwise specified discrete input and output signals shall conform to the
8 following:

- 9 1. Isolated unpowered (dry) contact closures.
10 2. Power contact from panel receiving signal or device receiving signal.

11 B. Unless otherwise specified input and output analog signals shall conform to
12 following:

- 13 1. External to panel: isolated, 4-20 mADC.
14 2. Internal to panel: 4-20 mADC signals.
15 3. For 2-wire transmitter provide isolated type and power with 24VDC from
16 panel or device receiving signal.
17 4. Where isolation is required to interface with particular equipment or
18 because of loop impedance, provide isolated, DC-to-DC transmitter.

19 3.07 TESTING AND START-UP SERVICES

20 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
21 Control.

22 3.08 TRAINING

23 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
24 Control.

25 END OF SECTION

SECTION 26 90 11

CONTROL PANEL COMPONENTS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 shall govern the work of this section.
- B. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs.
 - 1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code and state amendments thereto.
 - b. ANSI/IEEE C37.90 - IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
 - c. ANSI/IEEE C62.11- IEEE Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits.
 - d. ANSI/IEEE C62.34 - IEEE Standard for Performance of Low-Voltage Surge-Protective Devices (Secondary Arresters).
 - e. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - a. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 - b. Insulated Cable Engineers Association (ICEA)
 - c. International Society of Automation (ISA)
 - 3. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition:
 - a. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - b. NEMA ICS 3 - Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC.

- 1 4. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
2 current edition:
 - 3 a. UL508 - Industrial Control Equipment.
 - 4 b. UL508A - Industrial Control Panels.
 - 5 c. UL 913 - Intrinsically Safe Specification.
 - 6 d. UL94 - Tests for Flammability of Plastic Materials for Parts in
7 Devices and Appliances.
- 8 5. Wisconsin Department of Safety and Professional Services (DSPS)
- 9 6. National Electrical Contractors Association (NECA), current edition.
 - 10 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
11 Contracting.
- 12 7. International Electrical Testing Association (NETA)
 - 13 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
14 Power Distribution Equipment and Systems.
- 15 8. Canadian Standards Association (CSA), Specifications and Standards,
16 current edition.
 - 17 a. CSA C22.2, Industrial Control Equipment.
- 18 9. Electrical and Electronic Manufacturers Association Canada (EEMAC),
19 Specifications and Standards, Current Edition.
- 20 10. International Electrotechnical Association (IEC), Specifications and
21 Standards, Current Edition.
 - 22 a. IEC 60529 - Classification of Degrees of Protection Provided by
23 Enclosures
- 24 11. CE - European Community, Applicable Directives.
 - 25 a. EN50005 - for Terminal Markings.
 - 26 b. EN50081-1- Generic Emission Standard.
 - 27 c. EN50082-1 - Generic Immunity Standard.
 - 28 d. EN61000-4-4 - Electromagnetic compatibility (EMC). Testing and
29 measurement techniques.
 - 30 e. EN61000-4-5 - Electromagnetic compatibility (EMC). Testing and
31 measurement techniques. Surge immunity test.

32 1.03 DESCRIPTION OF WORK

- 33 A. For the purpose of obtaining a complete and integrated process instrumentation and
34 control system, the work specified herein shall be included under the scope of:
 - 35 1. Section 26 90 00 - Process Instrumentation & Control

36 1.04 RELATED WORK ELSEWHERE

- 37 A. Article 102 – Bidding Requirements and Conditions
- 38 B. Article 103 – Award and Execution of the Contract
- 39 C. Concrete – Division 03

- 1 D. Metals – Division 05
- 2 E. Electrical - Division 26
- 3 1.05 SUBMITTALS
- 4 A. Submit shop drawings in accordance with Division 01.
- 5 B. Submit shop drawings for the equipment specified herein as part of the complete,
6 integrated submittal for the process instrumentation & control system and in
7 accordance with the requirements specified under Section 26 90 00 - Process
8 Instrumentation & Control.
- 9 1. Furnish manufacturer literature sufficient in scope to demonstrate
10 compliance with the requirements of this specification.
- 11 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS
- 12 A. Submit operation & maintenance manuals and instructions as specified herein.
- 13 B. Submit operation and maintenance manuals for the equipment specified herein as
14 part of the complete, integrated manual for the process instrumentation and control
15 system and in accordance with the requirements specified under 26 90 00 - Process
16 Instrumentation and Control.
- 17 1.07 FACTORY TESTING
- 18 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
19 Control.
- 20 1.08 QUALITY ASSURANCE
- 21 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 22 B. System supplier shall be responsible for providing all necessary accessories
23 required for a complete and operable system.
- 24 C. Manufacturer Qualifications: Company specializing in manufacturing products
25 specified in this section, with not less than three years of documented experience.
- 26 D. Products: Listed and classified by UL or testing firm acceptable to the authority
27 having jurisdiction as suitable for the purpose specified and indicated.
- 28 1.09 EXTRA MATERIALS
- 29 A. Supply five spare fuses of each type supplied for this project
- 30 B. Supply five spare lamps of each type supplied for this project.

1 C. Supply two spare relays of each type supplied for this project.

2 1.10 DESIGN REQUIREMENTS (NOT USED)

3 1.11 MAINTENANCE

4 A. Before substantial completion, perform all maintenance activities required by any
5 sections of the specifications including any calibrations, final adjustments,
6 component replacements or other routine service required before placing
7 equipment or systems into service.

8 B. Furnish all spare parts as required by other sections of the specifications.

9 PART 2 PRODUCTS AND MATERIALS

10 2.01 CIRCUIT BREAKER - MINIATURE

11 A. Manufacturer:

- 12 1. Allen Bradley 1498-M
- 13 2. Or equal

14 B. Agency Approvals:

- 15 1. UL Listed

16 C. General:

- 17 1. DIN rail mounting in one-, two- and three-pole construction.
- 18 2. Used for overcurrent protection and switching on both ac and dc systems.

19 D. Construction:

- 20 1. Terminal lug wire size: 1- No.14 - No.2 AWG Cu or Al
- 21 2. Reversible line and load lugs for convenient flush or surface mount wiring
- 22 3. DIN mounted (symmetrical rail 35 x 7.5 DIN/EN 50 022)
- 23 4. UL Listed as HACR type -- 15A to 70A
- 24 5. Field installable quick connectors
- 25 6. Single handle with internal common trip
- 26 7. UL Listed 48VDC (5,000 AIR)

27 2.02 PILOT DEVICE - INDICATING LIGHT

28 A. Manufacturer:

- 29 1. Allen Bradley Bulletin 800T/800H
- 30 2. Eaton/Cutler-Hammer
- 31 3. Schneider Electric/Square D.
- 32 4. Or equal

33 B. Agency Approvals:

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1. UL Listed
 2. CSA Certified
 3. CE Compliant
- C. Mechanical:
1. Size: 30.5 mm
 2. Environmental rating:
 - a. NEMA 4/13 watertight/oil tight: NEMA 1, 12, 3R, 4 control panels
 - b. NEMA 4/4X corrosion resistant: NEMA 4X control panels and remote control stations
 3. Life expectancy: 200,000 operations
 4. Push-to-test, transformer type, dual input
- D. Electrical:
1. Input power: 120VAC
 2. Lamp:
 - a. High visibility, 28 chip cluster LED
 - b. Color: red, green, amber, as scheduled
 3. Lens: High impact plastic, colored to match lamp
- E. Nameplate: Standard or jumbo with engraved service legend
- F. Field Mounted Control Stations:
1. Type I Enclosure: NEMA 4X polycarbonate enclosure
 2. Type II Enclosure: NEMA 4X stainless steel enclosure
 3. Type III Enclosure: NEMA 7 hazardous location enclosure
- 2.03 PILOT DEVICE - PUSHBUTTON
- A. Manufacturer:
1. Allen Bradley Bulletin 800T/800H
 2. Eaton/Cutler-Hammer
 3. Schneider Electric/Square D
 4. Or equal
- B. Agency Approvals:
1. UL Listed
 2. CSA Certified
 3. CE Compliant
- C. Mechanical:
1. Size: 30.5 mm
 2. Environmental rating:
 - a. NEMA 4/13 watertight/oil tight: NEMA 1, 12, 3R, 4 control panels

- 1 b. NEMA 4/4X corrosion resistant: NEMA 4X control panels and
- 2 remote control stations
- 3 3. Life expectancy: 10,000,000 operations
- 4 4. Momentary contact, non-illuminated

- 5 D. Electrical:
- 6 1. Rated Voltage: 120VAC
- 7 2. Continuous current rating:
- 8 a. AC: 10A
- 9 b. DC: 2.5A
- 10 3. Operational current:
- 11 a. Make: 7200VA
- 12 b. Break: 720VA
- 13 4. Operator:
- 14 a. Mushroom head: Emergency stop service
- 15 b. Flush-head: All other services

- 16 E. Nameplate: Standard or jumbo with engraved service legend

- 17 F. Field Mounted Control Stations:
- 18 1. Type I Enclosure: NEMA 4X polycarbonate enclosure
- 19 2. Type II Enclosure: NEMA 4X stainless steel enclosure
- 20 3. Type III Enclosure: NEMA 7 hazardous location enclosure

21 2.04 PILOT DEVICE - SELECTOR SWITCH

- 22 A. Manufacturer:
- 23 1. Allen Bradley Bulletin 800T/800H
- 24 2. Eaton/Cutler-Hammer
- 25 3. Schneider Electric/Square D.
- 26 4. Or equal

- 27 B. Agency Approvals:
- 28 1. UL Listed
- 29 2. CSA Certified
- 30 3. CE Compliant

- 31 C. Mechanical:
- 32 1. Size: 30.5 mm
- 33 2. Environmental rating:
- 34 a. NEMA 4/13 watertight/oil tight: NEMA 1, 12, 3R, 4 control panels
- 35 b. NEMA 4/4X corrosion resistant: NEMA 4X control panels and
- 36 remote control stations
- 37 3. Life expectancy: 1,000,000 operations

- 1 4. Maintained contact, non-illuminated (spring return from right or left where
2 scheduled)
- 3 D. Electrical:
- 4 1. Rated Voltage: 120VAC
- 5 2. Continuous current rating:
- 6 a. AC: 10A
- 7 b. DC: 2.5A
- 8 3. Operational current:
- 9 a. Make: 7200VA
- 10 b. Break: 720VA
- 11 4. Operator:
- 12 a. Standard knob operator, two-position, or three-position
- 13 b. Keyed operator: where scheduled
- 14 E. Nameplate: Standard or jumbo with engraved service legend
- 15 F. Field Mounted Control Stations:
- 16 1. Type I Enclosure: NEMA 4X polycarbonate enclosure
- 17 2. Type II Enclosure: NEMA 4X stainless steel enclosure
- 18 3. Type III Enclosure: NEMA 7 hazardous location enclosure
- 19 2.05 POWER SUPPLY - 12/24VDC
- 20 A. Manufacturer:
- 21 1. Allen Bradley 1606 family
- 22 B. Agency Approvals:
- 23 1. UL Listed
- 24 2. CE Marked
- 25 C. Mechanical:
- 26 1. Enclosure:
- 27 a. IP20
- 28 b. Sealed plastic
- 29 c. Fine ventilation grid
- 30 2. Mounting: DIN rail
- 31 D. Electrical
- 32 1. Capacity:
- 33 a. Size to power connected loads. Reserve 25 percent of capacity for
- 34 future use.
- 35 b. Provide multiple power supplies where needed to accommodate
- 36 load.
- 37 2. Input:

- 1 a. Voltage: 85-264VAC
- 2 b. Frequency: 43-67Hz
- 3 c. Efficiency: 88.5 percent
- 4 d. Current: 1.0A at 100VAC
- 5 3. Output:
- 6 a. Voltage: 24-28VDC or 10-12VDC
- 7 b. Voltage regulation: 2 percent
- 8 c. Overvoltage protection: 40VDC
- 9 d. Noise suppression: EMI values below EN50081-1
- 10 e. Current: 5.0A at 24VDC or 4.5A at 12VDC
- 11 4. Monitoring:
- 12 a. LED Indicator
- 13 b. Output power good status contact

14 2.06 POWER SUPPLY - 120VAC, Uninterruptible

- 15 A. Manufacturer:
- 16 1. ~~Eaton/Powerware 9130~~
- 17 2. ~~Liebert~~
- 18 1. Allen Bradley
- 19 2. APC
- 20 3. Or equal

- 21 B. Agency Approvals:
- 22 1. UL Listed
- 23 2. CE Marked
- 24 3. FCC Approved

- 25 C. General:
- 26 1. Topology: True online, double-conversion
- 27 2. Diagnostics: Full system self-test on power up
- 28 3. UPS Bypass Automatic: on Overload or UPS failure less than 4 ms
- 29 4. Transfer Time to battery: 0 ms
- 30 5. Overload Capacity:
- 31 a. 125 percent for 10 minutes before transfer to bypass
- 32 b. 150 percent for 10 seconds before transfer to bypass

- 33 D. Input:
- 34 1. Input voltage: 80-144VAC, single phase, 60 Hz
- 35 2. Input power factor: greater than 95 percent
- 36 3. Input Line: NEMA 5-15 plug and cord
- 37 4. Protection: fuse or circuit breaker

- 38 E. Electrical Output:
- 39 1. Voltage Regulation:

- 1 a. On Utility: +/-2 percent of nominal
- 2 b. On Battery: +/-3 percent of nominal
- 3 2. Nominal Output Voltage: Same as selected input voltage
- 4 3. Output Voltage Waveform: Sine Wave
- 5 4. Output Voltage Distortion: less than 3 percent THD
- 6 5. Output Line: 4 NEMA 5-15 receptacles, minimum
- 7 6. Output protection: Electronic overload sensing, and circuit breaker
- 8 protection
- 9 7. Efficiency:
- 10 a. Online Mode: greater than 86 percent
- 11 b. Hi-Efficiency Mode: greater than 90 percent

- 12 F. Battery:
- 13 1. Internal Battery type: Sealed, lead-acid; maintenance free
- 14 2. On Battery Runtime: 125% of rated load for ten minutes
- 15 3. Battery Replacement: Hot-swappable internal batteries
- 16 4. Recharge Time: less than 4 hours to 90 percent capacity
- 17 5. Start-On-Battery: Allows start of UPS without utility input

- 18 G. Environmental:
- 19 1. Temperature:
- 20 a. Operating: 32 to 104 degrees F
- 21 b. Storage: 5 to degrees 122 F
- 22 2. Relative Humidity: 0 to 95 percent non-condensing
- 23 3. Audible Noise at 1 meter: less than 52dB
- 24 4. Altitude: 10,000 feet without deteriorating

- 25 H. Communications:
- 26 1. Relay Output Card:
- 27 a. Line Fail
- 28 b. Low Battery
- 29 c. UPS Fault
- 30 d. Bypass
- 31 2. User Interface: LCD status screen
- 32 3. Audible Alarms UPS alarm conditions, including:
- 33 a. On-Battery
- 34 b. Low Battery
- 35 c. Overload
- 36 d. UPS Fault
- 37 4. Communications: One RS232-Serial Port; One Communications Slot; One
- 38 USB Port
- 39 ~~5. Communications cable: 6-foot communications cable included~~
- 40 ~~6. Power Management Software: Powerware Software Suite CD~~

- 41 I. Manufacturer's Warranty:

1. Warranty: 2 year comprehensive, including battery
2. ~~Equipment Protection Policy: \$25,000 lifetime protection including lightning damage~~

2.07 RELAY - 120V GENERAL PURPOSE

A. Manufacturer:

1. Allen Bradley Bulletin 700-HB
2. IDEC RU Series
3. Or equal

B. Agency Approvals:

1. UL Listed
2. CE Marked

C. Mechanical:

1. Enclosure: Transparent dust cover
2. Contacts: Silver cadmium oxide
3. Insulating Material: Molded, high dielectric
4. Terminal Markings: In accordance with EN50-0005
5. Life expectancy: 10,000,000 operations
6. Operations:
 - a. Pickup: 20 mS
 - b. Dropout: 4 mS
 - c. Maximum Rate: Four operations per second
7. Blade style, quick connect terminals

D. Electrical:

1. Contacts:
 - a. Double-pole, double throw
 - b. Rated thermal current: 15A
 - c. Make: 60A
 - d. Break: 6A
2. Coil:
 - a. 120 VAC + 10, -20 percent
 - b. Consumption:
 - 1) Inrush: 2.85 VA
 - 2) Sealed: 1.9 VA
3. Voltage:
 - a. Rated Insulation Voltage: 250V IEC-300V UL/CSA
 - b. Dielectric Withstand Voltage:
 - 1) Pole-to-Pole: 1500V
 - 2) Contact to Coil: 6000V
 - 3) Contact to Frame: 4000V
4. Push-to-Test Operator

- 1 5. Pilot light
- 2 E. Relay Socket:
- 3 1. 11-blade
- 4 2. Finger-safe terminal
- 5 3. DIN rail mounted
- 6 4. Double tier
- 7 5. Retainer clip
- 8 6. Relay identification snap-in markers

9 2.08 RELAY - SOLID STATE

- 10 A. Manufacturer:
- 11 1. Allen Bradley Bulletin 700-SH
- 12 2. IDEC RSS Series
- 13 3. Or equal

- 14 B. Agency Approvals:
- 15 1. UL Recognized
- 16 2. CE Marked

- 17 C. Electrical:
- 18 1. Input:
- 19 a. Voltage: 4-32VDC
- 20 b. Impedance: 15mA, maximum, voltage dependent
- 21 c. Pick-up voltage: 4VDC
- 22 d. Drop-out Voltage: 1VDC
- 23 e. Dielectric Strength: 2500VACrms
- 24 f. Reverse voltage protection
- 25 2. Output:
- 26 a. Continuous current: 10A
- 27 b. Voltage range: 19-264VAC
- 28 c. Contact: SPST - N.O.
- 29 d. Off State leakage: 5 mA max (at 100VAC)
- 30 e. Turn-On/Turn-Off time; 0.5 cycle
- 31 3. Features:
- 32 a. Photo isolation
- 33 b. Dual SCR output
- 34 c. Built-in snubber

35 2.09 RELAY - TIME DELAY

- 36 A. Manufacturer:
- 37 1. Allen Bradley Bulletin 700-HT
- 38 2. IDEC, RTE Series

- 1 3. Or equal
- 2 B. Agency Approvals:
- 3 1. UL Listed
- 4 2. CE Marked
- 5 C. Mechanical:
- 6 1. Insulation resistance: 100 Mohms, minimum
- 7 2. Dielectric strength: 1500VAC, 1 minute
- 8 3. Vibration resistance: 6N
- 9 4. Shock resistance: 500N
- 10 5. Operating temperature: -20 to 65 degrees C
- 11 6. Operating humidity: 45 to 85 percent, relative
- 12 7. Blade style: quick-connect terminals
- 13 D. Electrical:
- 14 1. Contacts:
- 15 a. Two Form C double-pole, double-throw
- 16 b. 10A, 240VAC, resistive
- 17 2. Timing functions:
- 18 a. Delay on make/interval
- 19 b. Delay on break/single shot
- 20 c. Range: 0.1 seconds - 30 minutes
- 21 3. Accuracy:
- 22 a. Repeat: + 0.25 percent
- 23 b. Voltage: + 1.0 percent
- 24 c. Temperature error: + 2.0 percent
- 25 d. Setting error: + 10.0 percent
- 26 4. Status
- 27 a. Indicator light for timer timed out
- 28 b. Indicator light for timer in progress
- 29 E. Relay Socket:
- 30 1. 8 or 11-blade
- 31 2. Finger-safe terminal
- 32 3. DIN rail mounted
- 33 4. Double tier
- 34 5. Retainer clip
- 35 6. Relay identification snap-in markers

36 2.10 WIRE DUCT

- 37 A. Manufacturer:
- 38 1. Panduit Electro-Duct

- 1 B. General Description:
2 1. Plastic wire duct
3 2. Maximum wire fill to be 60%

4 2.11 SURGE SUPPRESSOR - 24VDC

- 5 A. Manufacturer:
6 1. Allen Bradley 4983-DD
7 2. Or equal

- 8 B. Agency Approvals:
9 1. UL 497B

- 10 C. General Description:
11 1. Transient Protection for Low-Voltage Signal Lines
12 2. Sneak/Fault Current Protection
13 3. Resettable Fusing-PTCs
14 4. Differential and Common Mode Protection
15 5. Automatic Recovery
16 6. Encapsulated in Stainless Steel Pipe Nipples
17 7. Silicon Avalanche Hybrid Technology
18 8. UL 497B Listed
19 9. Protection for One Pair (Two Wires & Shield on SS65)

- 20 D. Electrical:
21 1. Response Time: less than 1 nanosecond
22 2. Maximum Signal Voltage: 28VDC
23 3. DC Clamping Level:
24 a. Line-to-Ground: 36V +/-10 percent
25 b. Line-to-Line: 72V +/-10 percent
26 4. Maximum Let-Thru Voltage:
27 a. Line-to-Ground (10x700 microseconds): 44V at 400A
28 b. Line-to-Line (10x700 microseconds): 90V at 400A
29 5. Series Resistance (per conductor): 5 Ohms (typical)
30 6. Capacitance (zero volts bias):
31 a. Line-to-Line: 600pf typical
32 b. Line-to-Ground: 1200pf typical
33 7. Number of Occurrences: 400 at 500 Amps (10x1000 microseconds)

34 2.12 SURGE SUPPRESSOR - 120VAC SIGNAL, PANEL MOUNTED

- 35 A. Manufacturer:
36 1. Allen Bradley 4983-DS
37 2. Or equal

- 1 B. Agency Approvals:
2 1. UL Listed
- 3 C. General Description:
4 1. Performance exceeds highest class severity level of IEC/EN 61000-4-4 and
5 61000-4-5
6 2. Enhanced filtering to attenuate high frequency and bring equipment into
7 compliance with IEEE /ANSI C37.90.1
8 3. Universal hardwired version for all I/O modules including AC, DC, contact
9 output, current output and signal input
10 4. Multi-stage design provides the most effective suppression and filtering
11 available, and requires no additional secondary protection
12 5. Sub-nano second response time stops failures due to lightning, spikes and
13 over-voltage surges while filtering all other electrical noise
14 6. Plug-in replaceable daughter card modules contain all active surge
15 suppression
16 7. Space efficient protector is hermetically sealed and suitable for the most
17 harsh industrial environments
18 8. Universal DIN-Rail mounting allows easy installation on any standard DIN-
19 Rail configuration
20 9. Automatic reset and fail safe design requires no maintenance. Eliminates
21 "Out of Service" downtime and repair/replacement costs caused by
22 damaging electrical surges
23 10. Protection for current loop instrumentation and low frequency signal/data
24 lines
25 11. UL-497B listed for Data Models (60 VDC or less) UL file E205158
- 26 D. Electrical:
27 1. Signal Channels: 5, 10, 15, or 20
28 2. Operating: +/-30VDC
29 3. Maximum Operating Voltage: 33VDC
30 4. Maximum Operating Current: 0.5A
31 5. Clamping Action Turn-On: 37.1V
32 6. Maximum Clamping (8x20 micro-seconds): 52V
33 7. Maximum Surge Voltage: 6kV
34 8. Maximum Surge Current (8x20 micro-seconds): 2.5kA
35 9. Response Time: Less than 1 nanosecond
36 10. Operating & Storage Temperature: -40 to 85 degrees C.

37 2.13 SURGE SUPPRESSOR - 120VAC/208VAC/480VAC POWER, PANEL MOUNTED

- 38 A. Manufacturer:
39 1. Allen Bradley 4983-DS
40 2. Or equal

- 1 B. Agency Approvals:
2 1. UL 1449
3 2. CSA C22.2 NO.8
- 4 C. General Description
5 1. Din Rail Mounted
6 2. Replaceable modules
- 7 D. Electrical:
8 1. 120,240V single phase
9 2. 208,480V three phase
10 3. Max continuous operating voltage: 150-400VAC
11 4. 40 kA current rating
12 5. 4 pole

13 2.14 TERMINAL BLOCK - INDICATING FUSED

- 14 A. Manufacturer:
15 1. Allen Bradley Bulletin 1492-H4 (AC) or 1492-H5 (DC)
16 2. Or equal
- 17 B. Agency Approvals:
18 1. UL
19 2. CSA
20 3. IEC
- 21 C. Specifications:
22 1. Voltage Rating: 300VAC/VDC
23 2. Maximum Current: 12A
24 3. Wire Range (Rated Cross Section): No.30 to no.12 AWG
25 4. Leakage Current:
26 a. 2 mA at 300VAC
27 b. 2 mA at 24VDC
28 5. Working Voltage:
29 a. 100 to 300VAC
30 b. 10 to 57VAC/VDC
31 6. Fuse Size: 1/4 in x 1-1/4 in
32 7. Wire Strip Length 0.38 in
33 8. Tightening Torque: 3 to 7 lb-in
34 9. Density: 33 pcs./ft
35 10. Insulation Temperature Range: -40 to 221 degrees F
36 11. Accessories:
37 a. Aluminum DIN Rail with Standoff Brackets
38 b. End Barrier and End Anchors
39 c. Side Jumper Insulating Sleeve

1 d. Marking Systems

2 2.15 TERMINAL BLOCK - ISOLATING SWITCH

3 A. Manufacturer:

- 4 1. Allen Bradley Bulletin 1492-H7
5 2. Or equal

6 B. Agency Approvals:

- 7 1. UL
8 2. CSA
9 3. IEC

10 C. Specifications:

- 11 1. Voltage Rating: 300VAC/VDC
12 2. Maximum Current: 15A
13 3. Wire Range (Rated Cross Section): No.30 to No.12 AWG
14 4. Leakage Current:
15 a. 2 mA at 300VAC
16 b. 2 mA at 24VDC
17 5. Working Voltage:
18 a. 100 to 300VAC
19 b. 10 to 57VAC/VDC
20 6. Dummy Fuse Size: 1/4 in x 1-1/4 in
21 7. Wire Strip Length 0.38 in
22 8. Tightening Torque: 3 to 7 lb-in
23 9. Density: 33 pcs./ft
24 10. Insulation Temperature Range: -40 to 221 degrees F
25 11. Accessories:
26 a. Aluminum DIN Rail with Standoff Brackets
27 b. End Barrier and End Anchors
28 c. Side Jumper Insulating Sleeve
29 d. Marking Systems

30 2.16 TERMINAL BLOCK - OPEN STYLE

31 A. Manufacturer:

- 32 1. Allen Bradley Bulletin 1492-CAMI
33 2. Or equal

34 B. Agency Approvals:

- 35 1. UL
36 2. CSA
37 3. IEC

1 C. Specifications:

- 2 1. Voltage Rating: 600VAC/VDC
3 2. Maximum Current: 65A
4 3. Wire Range (Rated Cross Section): No.22 to No.8 AWG
5 4. Wire Strip Length 0.38 in
6 5. Tightening Torque: 10 to 16 lb-in
7 6. Density: 30 pcs./ft
8 7. Insulation Temperature Range: -40 to 221 degrees F
9 8. Accessories:
10 a. Aluminum DIN Rail with Standoff Brackets
11 b. End Barrier and End Anchors
12 c. Side Jumper Insulating Sleeve
13 d. Marking Systems

14 D. Usage:

- 15 1. Allen Bradley Bulletin 1492-CAM1 for power terminal blocks
16 2. Allen Bradley Bulletin 1492-J4 for control wiring terminal blocks

17 PART 3 CONSTRUCTION METHODS

18 3.01 DIVISION OF WORK (NOT USED)

19 3.02 FIELD MEASUREMENTS

- 20 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

21 3.03 DELIVERY STORAGE AND HANDLING

- 22 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

23 3.04 INSTALLATION

- 24 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

25 3.05 TESTING AND START-UP SERVICES

- 26 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

27 3.06 TRAINING

- 28 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

29 END OF SECTION

SECTION 26 90 20

INSTRUMENTATION DEVICES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Part I shall govern the work of this section.
- B. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
 - 1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
 - b. ANSI/IEEE C37.90 - IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
 - c. ANSI/IEEE C62.11 - IEEE Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits.
 - d. ANSI/IEEE C62.34 - IEEE Standard for Performance of Low-Voltage Surge-Protective Devices (Secondary Arresters).
 - e. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 - 4. Insulated Cable Engineers Association (ICEA)
 - 5. International Society of Automation (ISA)
 - 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - b. NEMA ICS 3 - Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC.

- 1 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
2 current edition.
 - 3 a. UL508 - Industrial Control Equipment.
 - 4 b. UL508A - Industrial Control Panels.
 - 5 c. UL 913 - Intrinsically Safe Specification.
 - 6 d. UL94 - Tests for Flammability of Plastic Materials for Parts in
7 Devices and Appliances.
- 8 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 9 9. National Electrical Contractors Association (NECA), current edition.
 - 10 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
11 Contracting.
- 12 10. International Electrical Testing Association (NETA)
 - 13 a. NETA STD ATS - Acceptance Testing Specifications for
14 Electrical Power Distribution Equipment and Systems.
- 15 11. Canadian Standards Association (CSA), Specifications and Standards,
16 current edition.
 - 17 a. CSA C22.2, Industrial Control Equipment.
- 18 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
19 Specifications and Standards, Current Edition.
- 20 13. International Electrotechnical Association (IEC), Specifications and
21 Standards, Current Edition.
 - 22 a. IEC 60529 - Classification of Degrees of Protection Provided by
23 Enclosures
- 24 14. CE - European Community, Applicable Directives.
 - 25 a. EN50005 - for Terminal Markings.
 - 26 b. EN50081-1 - Generic Emission Standard.
 - 27 c. EN50082-1 - Generic Immunity Standard.
 - 28 d. EN61000-4-4 - Electromagnetic compatibility (EMC). Testing and
29 measurement techniques.
 - 30 e. EN61000-4-5 - Electromagnetic compatibility (EMC). Testing and
31 measurement techniques. Surge immunity test.

32 1.03 DESCRIPTION OF WORK

- 33 A. For the purpose of obtaining a complete and integrated process instrumentation
34 and control system, the work specified herein shall be included under the scope
35 of:
 - 36 1. Section 26 90 00 - Process Instrumentation and Control.

37 1.04 RELATED WORK ELSEWHERE

- 38 A. Article 102 – Bidding Requirements and Conditions
- 39 B. Article 103 – Award and Execution of the Contract

- 1 C. Concrete – Division 03
- 2 D. Metals – Division 05
- 3 E. Electrical - Division 26
- 4 1.05 SUBMITTALS
- 5 A. Submit shop drawings in accordance with Division 01.
- 6 B. Submit shop drawings for the equipment specified herein as part of the complete,
7 integrated submittal for the process instrumentation & control system and in
8 accordance with the requirements specified under Section 26 90 00 - Process
9 Instrumentation and Control.
- 10 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS
- 11 A. Submit operation & maintenance manuals and instructions in accordance with
12 Division 01.
- 13 B. Submit operation and maintenance manuals for the equipment specified herein as
14 part of the complete, integrated manual for the process instrumentation and
15 control system and in accordance with the requirements specified under 26 90 00
16 - Process Instrumentation and Control.
- 17 1.07 FACTORY TESTING
- 18 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
19 Control.
- 20 1.08 QUALITY ASSURANCE
- 21 A. All materials, equipment, and parts shall be new and unused of current
22 manufacture.
- 23 B. System supplier shall be responsible for providing all necessary accessories
24 required for a complete and operable system.
- 25 C. Manufacturer Qualifications: Company specializing in manufacturing products
26 specified in this section, with not less than three years of documented experience.
- 27 D. Products: Listed and classified by UL or testing firm acceptable to the authority
28 having jurisdiction as suitable for the purpose specified and indicated.

1 1.09 WARRANTY

2 A. See Division 01 for additional requirements.

3 1.10 EXTRA MATERIALS

4 A. See Division 01 for additional requirements.

5 1.11 MAINTENANCE

6 A. Before substantial completion, perform all maintenance activities required by any
7 sections of the specifications including any calibrations, final adjustments,
8 component replacements or other routine service required before placing
9 equipment or systems into service.

10 B. Furnish all spare parts as required by other sections of the specifications.

11 PART 2 PRODUCTS AND MATERIALS

12 2.01 INSTRUMENTATION AND CONTROL DEVICES

13

INSTRUMENTATION AND CONTROL DEVICES			
TAG NUMBER	DESCRIPTION	CODE	NOTES
LSH-1-1	HIGH LEVEL ALARM	L2	
LSC-1-3	LAG PUMP START	L2	
LSC-1-2	LEAD PUMP START	L2	
LSC-1-1	PUMPS OFF	L2	
LSL-1-1	LOW LEVEL ALARM	L2	
ANT-6-1	ANTENNA	A1	
NOTES: CONTACTOR AND SYSTEM INTEGRATOR SHALL VERIFY SCHEDULE WITH PLANS.			

14 ~~2.02 A1 YAGI ANTENNA~~

15 A. ~~Yagi Directional Antenna Remote Site~~

- 1 1. Manufacturer:
- 2 a. Kafrein Inc. RY-900B.
- 3 b. Or equal
- 4 2. General:
- 5 a. Radome protected Yagi antenna.
- 6 b. Rugged fiberglass radome.
- 7 c. Radiator Material: 3/8 inch, solid 6061-T6 aluminum
- 8 d. Resistant to rain, snow, and ice.
- 9 e. Stainless steel hardware.
- 10 f. Internal connectors. Sealed with foam and potting system.
- 11 g. Capable of V&H polarization.
- 12 h. Lightning Protection: DC grounded
- 13 i. Wind Survival: 120 mph
- 14 j. Mounting Hardware: stainless steel, included
- 15 k. Factory assembled and tuned
- 16 3. Electrical Specifications
- 17 a. Frequency Range: 890-960 MHz
- 18 b. Factory Tuned Frequency: 898 MHz
- 19 c. Gain: 12dB
- 20 d. Bandwidth at 1.5:1 VSWR:-
- 21 e. Maximum Power: 1000 watts
- 22 f. Horizontal Beam width at 1/2 Power: 48 degrees
- 23 g. Vertical Beam width at 1/2 Power: 40 degrees
- 24 h. Nominal Impedance: 50 Ohms
- 25 i. Front to Back Ratio: 20dB
- 26 j. Termination: N female
- 27 4. Mechanical Specifications
- 28 a. Weight: 16 lbs
- 29 b. Length: 29 inches ±
- 30 c. Height: 17 inches

31 B. _____

32 2.032.02 L2 – LEVEL SWITCH, WET WELL FLOAT

- 33 A. Manufacturer
- 34 1. Cox Research, Model OPTI-F160 Float, Model OPTI-TR2 Transceiver
- 35 B. General:
- 36 1. The contractor shall furnish and install all float switches as shown on the
- 37 drawings and as required for a complete and properly operating system.
- 38 C. Reference:
- 39 1. NFPA 70 –National Electrical Code, National Fire Protection Association,
- 40 Latest Edition. B.

- 1 2. U.L. 508 A – Industrial Control Panels, Underwriters Laboratories, Inc.,
2 Latest Edition.

3 D. Float switches and transceivers

- 4 1. The floats shall use fiber optic cable to transmit a beam of light from a
5 transmitter in the control panel to the float where the beam makes and
6 breaks depending on the tilt of the float. The receiver in the control panel
7 shall detect the presence or absence of light and operate a relay in the
8 receiver. The float shall have no electrical components or metallic wires
9 that could cause arcs and sparks in an explosive atmosphere.
- 10 2. The float switch shall be mercury and lead free and shall be made of all
11 safe, recyclable materials. The float switch housing shall be
12 polypropylene. It shall be a simple robust device designed for many years
13 of dependable service. The beam eclipser shall be stainless steel in an inert
14 non-toxic dampening fluid that prevents chatter due to wave action. The
15 viscosity of the fluid shall not change significantly over the range of -50
16 to +155F (-45 to +70C). The transceivers (transmitter and receiver
17 combination) shall be dual din rail mounted units capable of connection to
18 2 floats. Provide one dual transceiver for every 2 floats. The fiber optic
19 cable shall be custom made for the float and shall consist of dual plastic
20 fibers with an overall specially blended PVC sheath for flexibility. No
21 special tools or experience shall be required for connection of the optical
22 cable to the transceivers. The cable shall be connected and sealed at the
23 float housing using a double seal method that will prevent water from
24 entering the float even if the outer sheath is damaged. The float color shall
25 be two tone with the lighter color on the dome for easier viewing
26 underwater when tilted up.
- 27 3. The transceivers shall operate in ambient temperatures of -15 to +130F (-
28 25 to +55C). The transceivers shall operate at 12 VDC and shall be
29 protected against accidental polarity reversal. The system shall operate in
30 the visible and infrared light region with wavelengths between 400 and
31 1200 nm. The output relays in the receivers shall have the capability of
32 being connected normally open or normally closed. The transceivers shall
33 have a green led power-on light and red led lights on each channel
34 indicating that the light beam is being received – float tilted up. The floats
35 shall operate in liquid temperatures of +32 to +130F (0 to +55C). The
36 floats shall have an ambient air standby operating temperature rating of -
37 15 to +155C (-25 to +70C).
- 38 4. The float switches and transceivers shall be the Optical Float® level
39 detection system by Cox Research and Technology, Inc., Baton Rouge,
40 La. The dual transceivers shall be model TR2, and the floats shall be Opti-
41 Float® model F

42 E. Accessories:

- 1 1. 30 foot stainless steel suspension kit including weight.
2 2. Universal attachment bracket OPTI-UAB1
3 3. (2) McMaster Carr model 3177T5 per float

4 ~~2.04~~2.03 CONSTRUCTION METHODS

5 ~~2.05~~2.04 DIVISION OF WORK (NOT USED)

6 ~~2.06~~2.05 FIELD MEASUREMENTS

- 7 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
8 Control.

9 ~~2.07~~2.06 DELIVERY STORAGE AND HANDLING

- 10 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
11 Control.

12 ~~2.08~~2.07 INSTALLATION

- 13 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
14 Control.

15 ~~2.09~~2.08 TESTING AND START-UP SERVICES

- 16 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
17 Control.

18 ~~2.10~~2.09 TRAINING

- 19 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
20 Control.

21 END OF SECTION

SECTION 26 90 30

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 shall govern the work of this section.
- B. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
 - 1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code and state amendments thereto.
 - b. ANSI/IEEE C37.90 - IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
 - 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 - 4. Insulated Cable Engineers Association (ICEA)
 - 5. International Society of Automation (ISA)
 - 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA ICS 2- Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - b. NEMA ICS 3- Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC.
 - 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL508 - Industrial Control Equipment.
 - b. UL508A - Industrial Control Panels.
 - c. UL94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

8. Wisconsin Department of Safety and Professional Services (DSPS)
9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
 - a. CSA C22.2, Industrial Control Equipment.
12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.
 - a. IEC1131-1. Programmable Controllers - Part 1: General Information.
 - b. IEC1131-2. Programmable Controllers - Part 2: Equipment Requirements and Tests.
 - c. IEC1131-3. Programmable Controllers - Part 3: Programming Languages.
 - d. IEC1131-4. Programmable Controllers - Part 4: User Guidelines.
 - e. IEC1131-5. Programmable Controllers - Part 5: Communications.
 - f. IEC 60529 - Classification of Degrees of Protection Provided by Enclosures
14. CE - European Community, Applicable Directives:
 - a. EN50005 - for Terminal Markings.
 - b. EN50081-1 - Generic Emission Standard.
 - c. EN50082-1 - Generic Immunity Standard.
 - d. EN61000-4-4 - Electromagnetic compatibility (EMC). Testing and measurement techniques.
 - e. EN61000-4-5 - Electromagnetic compatibility (EMC). Testing and measurement techniques. Surge immunity test.

1.03 DESCRIPTION OF WORK

- A. For the purpose of obtaining a complete and integrated process instrumentation and control system, the work specified herein shall be included under the scope of:
 1. Section 26 90 00 - Process Instrumentation & Control
- B. Equip programmable logic controllers with memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.
- C. Equip programmable logic controller systems with I/O as scheduled on the drawings and necessary for the system to function as specified.

1 D. All PLC programming by owner.

2 1.04 RELATED WORK ELSEWHERE

3 A. Article 102 – Bidding Requirements and Conditions

4 B. Article 103 – Award and Execution of the Contract

5 C. Concrete – Division 03

6 D. Metals – Division 05

7 E. Electrical - Division 26

8 1.05 SUBMITTALS

9 A. Submit shop drawings in accordance with Division 01.

10 B. Submit shop drawings for the equipment specified herein as part of the complete,
11 integrated submittal for the process instrumentation & control system and in
12 accordance with the requirements specified under Section 26 90 00 - Process
13 Instrumentation & Control.

14 C. Submit the following information specifically for programmable logic controllers:
15 1. Software configuration consisting of data tables, ladder logic, and other
16 parameters.
17 2. Identify coordination requirements with other sections.

18 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

19 A. Submit operation & maintenance manuals and instructions in accordance with
20 Division 01.

21 B. Submit operation and maintenance manuals for the equipment specified herein as
22 part of the complete, integrated manual for the process instrumentation and control
23 system and in accordance with the requirements specified under 26 90 00 - Process
24 Instrumentation & Control.

25 C. Submit the following information specifically for programmable logic controllers:
26 1. As-built printout of all software configuration including data tables, ladder
27 logic, passwords, and other parameters. Document software with English
28 language descriptions and tag numbers where appropriate.
29 2. Electronic documentation shall include fully annotated electronic copies of
30 all PLC programs. As-built documentation shall include all changes made
31 during the first year of operation.
32 3. Software configuration files shall be included in the manual in two forms:

- 1 a. CD ROM.
2 b. Paper.
- 3 D. Submit software license certificates, manufacturer provided software
4 documentation, and software installation media.
- 5 1.07 FACTORY TESTING
- 6 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
7 Control.
- 8 1.08 QUALITY ASSURANCE
- 9 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 10 B. System supplier shall be responsible for providing all necessary accessories
11 required for a complete and operable system.
- 12 C. Manufacturer Qualifications: Company specializing in manufacturing products
13 specified in this section, with not less than three years of documented experience.
- 14 D. Products: Listed and classified by UL or testing firm acceptable to the authority
15 having jurisdiction as suitable for the purpose specified and indicated.
- 16 1.09 WARRANTY
- 17 A. See Division 01 for additional requirements.
- 18 1.10 EXTRA MATERIALS
- 19 A. See Division 01 for additional requirements.
- 20 B. Supply one spare 120VAC discrete input/output module of each type supplied for
21 this project
- 22 C. Supply one spare 24VDC analog input/output module of each type supplied for this
23 project
- 24 D. Supply one spare of each type of analog input/output module supplied for this
25 project.
- 26 E. Supply one spare processor of each type supplied for this project

1 1.11 DESIGN REQUIREMENTS (NOT USED)

2 1.12 MAINTENANCE

3 A. Before substantial completion, perform all maintenance activities required by any
4 sections of the specifications including any calibrations, final adjustments,
5 component replacements or other routine service required before placing
6 equipment or systems into service.

7 B. Furnish all spare parts as required by other sections of the specifications.

8 PART 2 PRODUCTS AND MATERIALS

9 2.01 MANUFACTURER

10 A. Acceptable Manufacturers:

11 1. Allen-Bradley

12 2.02 PROGRAMMABLE LOGIC CONTROLLER SYSTEM, COMPACTLOGIX
13 PLATFORM (EXPANDABLE)

14 A. Processor Unit

15 1. Manufacturer:

16 a. Allen-Bradley CompactLogix L30ER

17 2. Processor requirements:

18 a. Input Power: Supplied via chassis power supply module, 1769-PA2.

19 b. Memory:

20 1) User Memory: 1 Mbytes

21 2) Memory Card: 1 Gbyte secure digital (SD) card

22 c. Communication Ports:

23 1) Two 10/100 Mbps Ethernet Port

24 a) EtherNet/IP messaging only

25 2) One built-in USB

26 B. Expansion I/O:

27 1. Analog input module:

28 a. Manufacturer: Allen-Bradley Model 1769-IF4I

29 b. Input points: four isolated differential, individually selectable as
30 current or voltage

31 2. Analog output module:

32 a. Manufacturer: Allen-Bradley Model 1769-OF4CI

33 b. Output points: four isolated, individually selectable as current or
34 voltage

35 3. Digital Input:

36 a. Allen-Bradley Model 1769-IA8I

37 b. Voltage Category/Type: 100 to 120VAC

- 1 c. Operating Voltage: 79 to 132VAC
- 2 d. Signal Delay, Max.: On: 20.0 ms, Off: 20.0 ms
- 3 e. Off-State Current, Max.: 2.5 mA
- 4 f. IEC Input Compatibility: Type 1
- 5 g. Number of Inputs: 8 isolated
- 6 h. Bus Current Load, Max.: 115 mADC at 5VDC
- 7 i. Non-isolated input modules are acceptable for generator and ATS
- 8 status inputs, 1769-IA16 and 1769-IQ16.
- 9 4. Digital output:
- 10 a. Manufacturer: Allen-Bradley Model 1769-OW8I
- 11 b. Operating Voltage: 5 to 265VAC
- 12 c. Continuous Current per Output, Max: 2.5A
- 13 d. Continuous Current per Module, Max: 20A
- 14 e. Number of Outputs: 8 isolated
- 15 f. Type of Contact Outputs: Normally open
- 16 g. Non-isolated output module, 1769-OW8 is acceptable for loads
- 17 contained within control panel only.
- 18 5. RTD input module:
- 19 a. Manufacturer: Allen-Bradley Model 1769-IR6
- 20 1) Input points: six (0-3000Ω) resistive inputs
- 21 6. Thermocouple input module:
- 22 a. Manufacturer: Allen-Bradley Model 1762-IT6
- 23 1) Input points: four thermocouple inputs (Type J, K, T, E, R,
- 24 S, B, N, C)
- 25 7. HART Capable analog input:
- 26 a. Manufacturer: Spectrum Controls Model 1769sc-IF4IH
- 27 1) Input points: four individually isolated HART protocol
- 28 capable inputs

29 PART 3 CONSTRUCTION METHODS

30 3.01 DIVISION OF WORK (NOT USED)

31 3.02 FIELD MEASUREMENTS

- 32 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
- 33 Control.

34 3.03 DELIVERY STORAGE AND HANDLING

- 35 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
- 36 Control.

1 3.04 INSTALLATION

2 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
3 Control.

4 B. Provide interconnect cables of the appropriate type as needed.

5 3.05 TESTING AND START-UP SERVICES

6 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
7 Control.

8 3.06 TRAINING

9 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
10 Control.

11 END OF SECTION

SECTION 26 90 60

ETHERNET NETWORKING EQUIPMENT

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Part I shall govern the work of this section.
- B. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
 - 1. American National Standards Institute/Instrument Society of America (ANSI/ISA), Specifications and Standards, Current Edition:
 - a. ANSI/ISA-5.1-1984 - Instrumentation Symbols and Identification.
 - b. ANSI/ISA-5.3-1983 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.
 - c. ANSI/ISA-95.00.01-2000 - Enterprise Control System Integration, Part 1: Models and Terminology.
 - d. ANSI/ISA-TR99.00.01-2004, Security Technologies for Manufacturing and Control Systems.
 - e. ANSI/ISA-TR99.00.02-2004, Integrating Electronic Security into the Manufacturing and Control Systems Environment.
 - 2. Telecommunications Industry Association (TIA), Electronic Industries Alliance (EIA), Specifications and Standards, current edition:
 - a. TIA/EIA-568-A - Commercial Building Telecommunications Wiring.
 - b. TIA/EIA-569-A - Commercial Building Standards for Telecommunications Pathways and Spaces.
 - c. TIA/EIA-606 - Documentation.
 - d. TIA/EIA-607 - Commercial Building Bonding and Grounding Requirements.
 - e. TIA/EIA TSB-67 - Transmission Performance for Field Testing of Unshielded Twisted Pair Cabling Systems.
 - f. TIA/EIA TSB-72 - Centralized Optical Fiber Cabling Guidelines.
 - g. TIA/EIA-526-14 - Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant.

- 1 h. TIA/EIA-429-AAA - Detail Specification for 62.5 - UM Core
2 Diameter/125-UM Plating Diameter Class 1A Multimode, Graded
3 Index Optical Wave Guide Fibers.

4 1.03 DESCRIPTION OF WORK

- 5 A. For the purpose of obtaining a complete and integrated process instrumentation and
6 control system, the work specified herein shall be included under the scope of:
7 1. Process Instrumentation and Control - Division 26

8 1.04 RELATED WORK ELSEWHERE

- 9 A. For the purpose of obtaining a complete and integrated process instrumentation and
10 control system, the work specified herein shall be included under the scope of:
11 B. Article 102 – Bidding Requirements and Conditions
12 C. Article 103 – Award and Execution of the Contract
13 D. Concrete – Division 03
14 E. Metals – Division 05
15 F. Electrical - Division 26

16 1.05 Utilities – Division 33SUBMITTALS

- 17 A. Submit shop drawings in accordance with Division 01.
18 B. Submit shop drawings for the equipment specified herein as part of the complete,
19 integrated submittal for the process instrumentation & control system and in
20 accordance with the requirements specified under Section 26 90 00 - Process
21 Instrumentation and Control.
22 C. Submit the following information specifically for Ethernet networking equipment:
23 1. Literature sufficient in scope to demonstrate compliance with the
24 requirements of this specification.
25 2. Identify all software licensing requirements.

26 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 27 A. Submit operation/maintenance manuals and instructions in accordance with
28 Division 01.
29 B. Submit operation and maintenance manuals for the equipment specified herein as
30 part of the complete, integrated manual for the process instrumentation and control
31 system and in accordance with the requirements specified under 26 90 00 - Process
32 Instrumentation & Control.

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- C. Submit the following information specifically for Industrial Ethernet Network:
 - 1. As-built printout of all software configuration including data tables, passwords, and other parameters.
 - 2. Connection diagrams for each individual piece of equipment.
 - 3. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
 - 4. Complete front elevation drawing of equipment rack and exact component layout within rack.
 - 5. Provide copy of written warranty.
 - 6. Complete test reports for fiber optic cable. Provide a fiber test form which includes the following:
 - a. Date and time of:
 - 1) Fiber installation.
 - 2) Fiber termination.
 - 3) Testing.
 - b. Testing equipment used information including:
 - 1) Make.
 - 2) Model.
 - 3) Date of calibration.
 - c. Name of person performing test and the installers.
 - d. dB loss of each connector installed.
 - e. dB loss of each fiber segment.
 - f. End to end attenuation.
 - g. Optical Time Domain Reflectometer (OTDR) Signature trace.
 - h. Cable shall be tested at the following frequencies:
 - 1) 850 nm.
 - 2) 1300 nm.
 - 7. Complete test report for category 6 cabling. Provide test form which includes the following:
 - a. Date and time of:
 - 1) Cable installation.
 - 2) Cable termination.
 - 3) Testing report.
 - b. Testing equipment used information including:
 - 1) Make.
 - 2) Model.
 - 3) Date of calibration.
 - c. Name of person performing test and the installers.
 - d. Provide in spreadsheet format. Cable number with test reporting of cable length at near-end crosstalk and attenuation at frequency MHz at 1, 4, 10, 20 and 100. Also indicate room number of each jack.
 - 8. Submit software license certificates, manufacturer provided software documentation, and software installation media.

1 1.07 FACTORY TESTING

2 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
3 Control.

4 1.08 QUALITY ASSURANCE

5 A. All materials, equipment, and parts shall be new and unused of current manufacture.

6 B. System supplier shall be responsible for providing all necessary accessories
7 required for a complete and operable system.

8 C. Manufacturer Qualifications: Company specializing in manufacturing products
9 specified in this section, with not less than three years of documented experience.

10 D. Products: Listed and classified by UL or testing firm acceptable to the authority
11 having jurisdiction as suitable for the purpose specified and indicated.

12 1.09 WARRANTY

13 A. See Division 01 for additional requirements.

14 1.10 EXTRA MATERIALS

15 A. See Division 01 for additional requirements.

16 1.11 DESIGN REQUIREMENTS (NOT USED)

17 1.12 MAINTENANCE

18 A. Before substantial completion, perform all maintenance activities required by any
19 sections of the specifications including any calibrations, final adjustments,
20 component replacements or other routine service required before placing
21 equipment or systems into service.

22 PART 2 PRODUCTS AND MATERIALS

23 2.01 INDUSTRIAL ETHERNET NETWORK SWITCH, 8-PORT

24 A. Manufacturer:

25 1. Allen Bradley Stratix 2000

26 B. General

27 1. Unmanaged Ethernet switch

28 2. 8 ports minimum

29 3. 25% spare ports minimum

30 4. Din Rail Mount

31 5. IEEE 802.3 Compliance

- 1 2.02 UTP CONTROL CABLE
- 2 A. Manufacturer:
- 3 1. ~~Belden 7953A~~
- 4 2. ~~Or equal.~~
- 5 1. Allen Bradley 1585 Ethernet Cable
- 6 B. General:
- 7 1. DataTuff 6
- 8 2. Bonded pairs
- 9 3. 600V rated cable
- 10 4. Industrial CAT 6
- 11 5. 23 AWG solid bare copper
- 12 6. Gigabit Ethernet
- 13 7. Shielded
- 14

15 PART 3 CONSTRUCTION METHODS

16 3.01 DIVISION OF WORK(NOT USED)

17 3.02 FIELD MEASUREMENTS

- 18 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
- 19 Control.

20 3.03 DELIVERY STORAGE AND HANDLING

- 21 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
- 22 Control.

23 3.04 INSTALLATION

- 24 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
- 25 Control.

26 3.05 TESTING AND START-UP SERVICES

- 27 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
- 28 Control.

29 3.06 TRAINING

- 30 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
- 31 Control.

32 END OF SECTION

1 SECTION 31 05 19.13

2 GEOSYNTHETICS FOR EARTHWORK

3 PART 1 GENERAL

4 1.01 APPLICABLE PROVISIONS

5 A. Applicable provisions of Part I shall govern work of this section.

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent indicated by the
9 reference thereto.

- 10 1. American Society for Testing and Materials (ASTM), Annual Book of
11 ASTM Standards, Current Edition.
- 12 2. State of Wisconsin, Department of Transportation, Standard Specifications
13 for Highway and Structure Construction, Current Edition at time of bid
14 opening.

15 1.03 DESCRIPTION OF WORK

16 A. The work under this section shall cover furnishing and installing geotextile fabrics
17 for structural excavation and backfill of structures in accordance with the contract
18 drawings and specified herein, and in accordance with Section 645 of the State of
19 Wisconsin, Department of Transportation, Standard Specifications.

20 1.04 RELATED WORK ELSEWHERE

- 21 A. Packaged Sewage Lift Station – Division 33
- 22 B. Structural Excavation for Structures – Division 33

23 1.05 SUBMITTALS

24 A. Contractor shall submit such product literature and catalog cuts of materials to be
25 supplied to relate these materials to the specifications. Information shall be in
26 conformance with requirements of Submittals - Division 01 of these specifications.

27 B. The Contractor shall furnish to the Engineer at least ten days prior to use in the work
28 a manufacturer's Certified Report of Test or Analysis that the geotextile fabric
29 delivered for use conforms to this specification. The delivered geotextile fabric shall
30 bear markings to clearly identify it with the applicable test report furnished to the
31 Engineer.

32 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

1 PART 2 PRODUCTS AND MATERIALS

2 2.01 GENERAL

3 A. The geotextile fabric shall consist of either woven or nonwoven polyester,
4 polypropylene, stabilized nylon, polyethylene or polyvinylidene chloride. All fabric
5 shall have the minimum strength values in the weakest principal direction.
6 Nonwoven fabric may be needle punched, heat bonded, resin bonded, or
7 combinations thereof.

8 B. The geotextile fabric shall be insect, rodent, mildew, and rot resistant.

9 C. The geotextile fabric shall be furnished in a wrapping which will protect the fabric
10 from ultraviolet radiation and from abrasion due to shipping and hauling. The
11 geotextile is to be kept dry until installed.

12 D. The geotextile fabric rolls shall be clearly marked showing the type of fabric.

13 E. Samples of fabric for testing may be obtained from the job site as specified herein or
14 as determined by the Engineer.

15 F. If sewn seams are used, the Contractor shall furnish a field sewn seam sample
16 produced from the geotextile fabric and thread and with the equipment to be used on
17 the project, prior to its incorporation into the work.

18 G. All numerical values specified below represent minimum/maximum average roll
19 values (i.e., the average of minimum test results on any roll in a lot should meet or
20 exceed the minimum specified values).

21 2.02 GEOTEXTILE FABRIC

22 A. The fabric shall comply with the following physical properties:

23 Test	Method	Value
24 Grab Tensile Strength, lbs	ASTM D 4632	170 min.
25 Apparent Opening Size, 26 U.S. Standard Sieve	ASTM D 4751	70 max.
27 Permittivity, SEC ⁻¹	ASTM D 4491	0.35 min.

28 B. Acceptable materials are Geotex 701, Thrace-LINQ 160EX, Mirafi 170N, and
29 US 180 NW, or equal.

30 PART 3 CONSTRUCTION METHODS

31 3.01 GENERAL

32 A. Installation procedures shall be in accordance with manufacturer's recommendations
33 and as specified herein.

- 1 B. Sewing. All factory and field seams shall be sewn with a thread having the same or
2 greater durability as the material in the fabric. A 401 stitch conforming to Federal
3 Standard No. 751a shall be used for all seams. All seams shall develop a tensile
4 strength equal to or greater than 60 percent of the specified grab tensile strength of
5 the fabric, unless otherwise specified.

6 3.02 GEOTEXTILE FABRIC

- 7 A. Prior to the placement of the geotextile fabric, the subgrade shall be smoothed,
8 shaped and compacted to the required grade, section, and density. After the fabric
9 has been placed on the subgrade area, no traffic or construction equipment will be
10 permitted to travel directly on the fabric.

- 11 B. The fabric shall be rolled out on the roadway and pulled taut manually to remove
12 wrinkles. Separate pieces of fabric shall be joined by overlapping or sewing. The
13 fabric in the overlapped joints shall be placed with a minimum overlap of 18 inches.

- 14 C. Weight or pins may be required to prevent lifting of the fabric by wind.

- 15 D. After placement, the fabric shall be exposed no longer than 48 hours prior to
16 covering.

- 17 E. The base course material shall be placed over the fabric by back dumping with trucks
18 and leveling with a crawler dozer. Construction equipment shall be such that ruts do
19 not exceed 3 inches in depth. All ruts shall be filled with additional material. The
20 smoothing of ruts without adding additional material will not be permitted.
21 Damaged areas shall be covered with a patch of fabric using a 36 inch overlap in all
22 directions.

23 PART 4 MEASUREMENT AND PAYMENT

24 4.01 GENERAL

- 25 A. Geosynthetics for earthworks shall be paid for at the bid price in accordance with one
26 of the following methods, unless indicated otherwise in the Bid Schedule or Special
27 Provisions.

- 28 B. All work specified herein shall be considered in each of the measurement and
29 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or
30 Special Provisions.

31 4.02 GEOTEXTILE FABRIC

- 32 A. Geotextile Fabric, Inclusive. Geotextile fabric related to the Lift Station as shown on
33 the contract drawings and as outlined in the Project Manual shall be considered
34 inclusive to payment for work associated with the Lift Station, per Lump Sum.

END OF SECTION

1 SECTION 31 23 16.16

2
3 STRUCTURAL EXCAVATION FOR STRUCTURES

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

6 A. Applicable Provisions of Part I shall govern work of this section.

7 1.02 APPLICABLE PUBLICATIONS

8 A. The following publications of the issues listed below, but referred to thereafter by
9 basic designation only, form a part of this specification to the extent indicated by the
10 reference thereto.

- 11 1. American Society for Testing and Materials (ASTM), Annual Book of
12 ASTM Standards, Current Edition.
- 13 2. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational
14 Safety and Health Administration (OSHA), Department of Labor - Part 1926
15 Regulations, Current Edition.
- 16 3. State of Wisconsin, Department of Transportation, Standard Specifications
17 for Highway and Structure Construction, Current Edition at time of bid
18 opening.

19 1.03 DESCRIPTION OF WORK

20 A. The work under this section shall include all excavation, backfill and compaction for
21 structures and other miscellaneous excavation, backfill and compaction required but
22 not designated under other sections.

23 1.04 RELATED WORK ELSEWHERE

24 A. Part II – Earthwork and Miscellaneous Construction

25 B. Part V – Sewers and Sewer Structures

26 C. Packaged Sewage Lift Station – Division 33

27 1.05 SUBMITTALS (NONE)

28 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

1 PART 2 PRODUCTS AND MATERIALS

2 2.01 INSITU BACKFILL MATERIAL

3 A. Previously excavated soil or material free of organic debris, clay balls, and aggregate
4 larger than 1-1/2 inches as approved by the Engineer.

5 2.02 IMPORTED GRANULAR FILL AND GRANULAR FOUNDATION

6 A. Imported granular fill and granular foundation shall be sand conforming to State of
7 Wisconsin, Department of Transportation, Standard Specifications Section 209.2.2,
8 Grade No. 1 Granular Backfill or well-graded sand and gravel conforming to State of
9 Wisconsin, Department of Transportation, Standard Specifications Section 305.2.2.1
10 1-1/4 inch dense graded base with not more than eight percent (8 percent) by weight
11 passing a No. 200 sieve.

12 PART 3 CONSTRUCTION METHODS

13 3.01 BARRICADES

14 A. Provide sufficient barricades and protective devices adjacent to excavations to
15 safeguard against injury. Provide and maintain sufficient safety lanterns at walks,
16 roadways and parking areas to provide safety at night.

17 3.02 EXCESS MATERIAL

18 A. To the extent needed, all suitable excavated materials shall be used for foundation
19 backfill and site grading. The suitability of materials for specific purposes shall be
20 determined by the Engineer. All surplus or unsuitable excavated materials will be
21 designated as waste and used only for site grading or be disposed of by the
22 Contractor.

23 3.03 EXCAVATION

24 A. All structural excavation shall be in accordance with the Geotechnical Investigations
25 & Reports included within the Contract Documents.

26 B. Excavate to achieve necessary dimensions, lines, grades and cross sections. Notify
27 the Engineer of any remaining pockets of organic or unsuitable soil, debris, existing
28 foundations or poorly compacted fill soils. Unsuitable materials shall be removed
29 and replaced with compacted granular fill or backfill material. Bottoms of trenches
30 shall be excavated to proper grade so that structures will be supported on a firm bed
31 of undisturbed natural earth or suitable, compacted backfill.

1 C. The required minimum soil bearing capacities for the new structures shall be as
2 shown in the Contract Drawings, or as listed in the geotechnical report, whichever
3 value is greater.

4 D. At all times when active excavation, backfilling, or other construction work is
5 occurring in the excavations, and lasting until these activities are completed and
6 accepted, ample means and equipment shall be provided with which to remove
7 promptly, and dispose of properly, all water entering any excavation or other parts of
8 the work. The excavations shall be kept dry and groundwater levels shall be kept at a
9 minimum of 2-feet below the bottom of all excavations to prevent a quicksand
10 condition in the excavation bottom.

11 E. All hardpan, stiff soils, and boulders encountered shall be included in the Work
12 specified by this Section. See geotechnical report for further information. It shall be
13 the responsibility of the Contractor to familiarize himself with the subsurface
14 conditions on-site before submitting his bid.

15 3.04 UNAUTHORIZED EXCAVATION

16 A. Consists of removal of materials beyond indicated elevations or dimensions without
17 specific direction of the Engineer. Notify the Engineer when unauthorized
18 excavations are made.

19 3.05 STABILITY OF EXCAVATION

20 A. Slope sides of excavations to comply with local codes and ordinances having
21 jurisdiction. Provide shoring and bracing to retain banks and prevent collapse of
22 excavations as necessary to safeguard workmen, prevent movement of adjacent
23 ground, and avoid damage to existing improvements.

24 B. Means and methods of excavation are the responsibility of the Contractor including
25 dewatering and earth retention systems. See geotechnical report for additional
26 considerations.

27 3.06 COLD WEATHER PROTECTION

28 A. Protect excavation bottoms against freezing when atmospheric temperature is less
29 than 35 degrees Fahrenheit.

30 3.07 BACKFILLING AND COMPACTION

31 A. Fill activities shall be in accordance with the Geotechnical Investigations & Reports
32 included in the Contract Documents.

33 B. Place backfill to bring excavations to natural grade unless otherwise noted. Backfill
34 within foundation walls and outside foundation walls to a distance of 10 feet outside

1 the building line and under pavements and walks shall be spread and compacted
2 uniformly in 6 inch to 8 inch lifts to at least 95 percent maximum dry density per
3 modified proctor (ASTM D1557).

4 C. Place and compact granular fill from the specified over-excavation elevation as
5 shown on the Drawings, or as required by the Geotechnical Engineer, in 8-inch lifts
6 to 95% maximum dry density per modified proctor (ASTM D1557) up to the
7 elevation of the recommended geotextile wrapped, coarse crushed stone layer.

8 D. Site backfill placed outside a distance 10 feet from the building line shall be spread
9 uniformly in 12 inch maximum lifts and trench backfill and similar work shall be
10 with approved excavated material or granular backfill compacted in 8 inch maximum
11 lifts to 93 percent dry density per modified proctor (ASTM D1557).

12 E. Backfill shall not be placed against any concrete structure which retains earth until
13 the concrete has been in place 14 days or until test cylinders show the concrete
14 strength to be at least 3000 pounds per square inch, nor shall high-early-strength
15 concrete structures be backfilled before 6 days after the day of pouring or until test
16 cylinders show the strength of the concrete to be at least 3000 pounds per square
17 inch. Concrete structures which have earth on both sides (i.e., footings, frost walls,
18 etc.), may be backfilled uniformly on both sides after the concrete has been in place 4
19 days, or 2 days for high-early-strength concrete. In no case shall backfilling start
20 before required curing and protection, surface finishing, dampproofing, and
21 waterproofing of the work to be covered by backfilling has been completed. When
22 so permitted by the Engineer, footings may be backfilled uniformly on all sides to the
23 top of such footing immediately upon removal of forms.

24 F. Contractor shall provide all necessary equipment required to obtain specified
25 compaction. Compaction by travel of grading equipment is not considered adequate
26 for uniform compaction. Small vibratory compactors are required wherever fill is
27 placed adjacent to structures, foundation walls, footings and piers.

28 G. Backfilling shall be so performed as to prevent wedging action against the structure.
29 Slopes within ten feet of the structure shall be stepped, terraced, or otherwise treated
30 as necessary to prevent slippage and wedging of the backfill.

31 H. Water shall not be used to expedite settlement of the backfill except to adjust
32 moisture content to optimize compaction. The groundwater level shall be kept below
33 the level of the lift of material being compacted.

34 3:08 SAMPLING

35 A. All required sampling, preparing of specimens, and testing except as modified by
36 these specifications shall be performed by an independent laboratory and paid for by

1 the Owner. The laboratory shall meet the requirements of ASTM E329. The
2 Engineer shall determine when compaction tests shall be made.

3 3.09 TESTING

- 4 A. Any testing required because of failure of backfill to meet specification requirements
5 shall be paid for by the Contractor.

6 PART 4 MEASUREMENT AND PAYMENT

7 4.01 GENERAL

- 8 A. Structural excavation, backfilling and compaction shall be paid for at the bid price in
9 accordance with one of the following methods, unless indicated otherwise in the Bid
10 Schedule or Special Provisions.

- 11 B. All work specified herein shall be considered in each of the measurement and
12 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or
13 Special Provisions.

14 4.02 STRUCTURAL EXCAVATION FOR STRUCTURES

- 15 A. Structural Excavation for Structures, Inclusive. Structural excavation for structures
16 related to the Lift Station as shown on the contract drawings and as outlined in the
17 Project Manual shall be considered inclusive to payment for work associated with
18 Sanitary Sewer Lift Station, per Lump Sum.

19 4.03 IMPORTED GRANULAR FILL AND GRANULAR FOUNDATION

- 20 A. Imported Granular Fill and Granular Foundation, Inclusive Imported granular fill
21 and granular foundation related to the Lift Station as shown on the contract drawings
22 and as outlined in the Project Manual shall be considered inclusive to payment for
23 work associated with Sanitary Sewer Lift Station, per Lump Sum..

24 END OF SECTION

SECTION 33 32 13.15

PACKAGED SUBMERSIBLE LIFT STATION

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of Division 01 and City of Madison Standard Specifications shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.
1. American National Standards Institute (ANSI)
 - a. ANSI B16.1 – Standard Specification for 125 lb. Standard Flat Face Cast Iron Flanges
 - b. ANSI/AWWA C115/ A21.15 - Standard for Flanged Ductile-Iron Pipe With Threaded Flanges
 - c. ANSI/AWWA C111/ A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - d. ANSI/ AWWA C110/A21.10 - American National Standard for Ductile-Iron and Gray-Iron Fittings for Water
 - e. ANSI/AWWA C104/A21.04 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 2. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards:
 - a. ASTM A36 - Specification for Structural Steel, Current Edition
 - b. ASTM A48 - Standard Specification for Gray Iron Castings
 - c. ASTM A126 -Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - d. ASTM A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
 - e. ASTM D883 – Definitions of Terms Relating to Plastics
 - f. ASTM D3753 – Standard Specification for Glass-Fiber-Reinforced Polyester Manholes
 3. American Water Works Association (AWWA), Specifications and Standards, Current Edition.
 - a. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 4. American Welding Society (AWS), Specifications and Standards, Current Edition.
 5. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational Safety and Health Administration (OSHA), Department of Labor, Part 1926-Regulations, Current Edition.

- 1 6. Federal Communications Council (FCC), Specifications and Standards,
2 Current Edition.
- 3 7. National Electric Code (NEC), Specifications and Standards, Current
4 Edition.
- 5 8. National Electrical Manufacturers Associations (NEMA), Specifications and
6 Standards, Current Edition.
- 7 9. State of Wisconsin Administrative Code, Department of Natural Resources
8 Environment Protection General:
9 a. NR 110 - Sewage Systems, Current Edition.
- 10 10. Steel Structures Painting Council (SSPC), Specifications and Standards,
11 Current Edition.

12 1.03 DESCRIPTION OF WORK

- 13 A. The Contractor shall furnish and install a factory built packaged submersible
14 wastewater pumping station complete with all equipment installed in a wet well with
15 integral valve vault, pumps, piping, valves, supports, vent, access covers, and
16 accessories. The work shall include all labor and materials to provide a complete
17 operating lift station to the Owner. Refer to drawings for additional information.
- 18 B. Valves and other appurtenances identified as part of the proposed forcemain shall
19 comply with the Section.
- 20 C. The station shall be the product of a manufacturer who is experienced, skilled and
21 regularly engaged in the design and fabrication of this type of equipment. The
22 general design of the station shall be such that all working parts are readily
23 accessible for inspection and repairs, easily duplicated and replaced, and each and
24 every component suitable for the service required. The lift station shall be in
25 conformance with all requirements of local, state, and federal agencies, and all
26 applicable industry codes. In order to receive consideration, the manufacturer shall
27 submit full descriptive material on the proposed equipment, including detailed
28 structural and equipment specifications, dimension prints, pump performance curves,
29 wiring diagrams and operational data, local service facilities, and list of installations
30 in the State of Wisconsin. The manufacturer must clearly state or show any
31 exceptions taken to the contract drawings and specifications.
- 32 D. The packaged submersible lift station shall be designed for Class 1, Groups C and D,
33 Division 1 hazardous locations as defined by the National Electric Code.
- 34 E. The section includes coordination with electrical contractor to ensure the proper
35 installation of electrical power and control system. Additional costs due to
36 inadequate coordination as required herein shall be borne solely by the Contractor.

37 1.04 RELATED WORK ELSEWHERE

- 38 A. Part I – General Conditions.

1 B. Part V – Sewers and Sewer Structures

2 C. Division 05 - Metals

3 D. Division 26 - Electrical

4 1.05 SUBMITTALS

5 A. The Contractor shall submit such Submittals and/or catalog cuts required for the
6 construction and installation of the equipment. These drawings shall be accurate in
7 every detail and shall contain all information necessary to relate the equipment to the
8 specifications.

9 B. The Contractor shall provide a list, catalog cuts and descriptive information of all
10 instrumentation and control equipment components to be provided with the Package
11 Lift Station.

12 C. Submittals shall indicate the intended equipment arrangement, major support
13 requirements, plot area, and process flow.

14 D. Submittals shall be submitted which indicate the internal control schematics and
15 remote equipment, such as motor starters, flowmeters, etc. Submittals shall be
16 submitted which indicate equipment and terminal block layout for interconnections
17 to remote equipment.

18 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

19 A. The manuals shall include operating and maintenance literature for all components
20 provided. The submitted literature shall be in sufficient detail to allow for the
21 installation, operation, adjustment, calibration, maintenance and removal of each
22 component provided.

23 B. Preparation of this document shall be in conformance with the Submittal
24 requirements specified herein. The Contractor shall submit to the Engineer for
25 review, an outline of any variations of information for the operation and maintenance
26 manuals and other documentation he proposes to prepare.

27 PART 2 PRODUCTS AND MATERIALS

28 2.01 MANUFACTURER

29 A. The packaged submersible lift station shall be as manufactured by Topp Industries,
30 Inc. and shall include pump equipment specified herein as manufactured by Xylem,
31 Inc. or Fairbanks Morse Corporation.

32 B. The specifications and physical layout shown on the drawings are based Topp
33 Industries and Xylem, Inc. equipment.

1 2.02 FIBERGLASS (FRP) STATION STRUCTURE

2 A. Materials: Fiberglass Reinforced Polyester Wet Well (and Integral Valvebox):
3 Unless otherwise indicated the plastic terminology used in this specification shall be
4 in accordance with the definitions given in American Society for Testing and
5 Materials (ASTM) designations D883 - Definitions of Terms Relating to Plastics.

6 B. Resins: The resins used shall be a commercial grade polyester and shall be evaluated
7 as a laminate by test or determined by previous service to be acceptable for the
8 intended environment. The resins used may contain the minimum amount of fillers or
9 additives required to improve handling properties. Up to 5% by weight of thixotropic
10 agent, which will not interfere with visual inspection, may be added to the resin for
11 viscosity control. Resins may contain pigments and dyes by agreement between
12 manufacturer and engineer, recognizing that such additives may interfere with visual
13 inspection of FRP laminate quality

14 C. Reinforced Material: The reinforcing material shall be a commercial grade of glass
15 fiber (continuous strand, chopped-strand, continuous mat and non-continuous mat)
16 having a coupling agent, which will provide a suitable bond between the glass
17 reinforcement material and resin. Pump chamber shall be completely vapor sealed
18 from wetwell.

19 D. Laminate Structure: The FRP laminate shall consist of a resin rich inner surface:
20 chop-spray interior liner; and, a chop-hoop filamentwound structural exterior layer.

21 1. Inner surface:

22 a. The resin rich inner surface shall be free of cracks and crazing with
23 smooth finish and with an average of not over two (2) pits per square
24 foot, providing the pits are less than 0.125 inches in diameter and
25 0.3125 inches in depth and are covered with sufficient resin to avoid
26 exposure of any fiberglass reinforcement material. Some waviness
27 shall be permissible as long as the surface is smooth. Between 0.01 to
28 0.02 inches of resin, rich surface shall be provided.

29 b. Chop-Spray Interior Liner: The interior liner shall be reinforced by
30 25 to 35% by weight of chopped strand glass fiber having fiber
31 lengths from 0.5 to 2.0 inches. The chop-spray interior liner protects
32 the chop-hoop filament-wound structural exterior liner from
33 corrosion damage caused by "wicking" of the wet well liquid
34 contents. A minimum of 0.100 inches of chop-spray interior liner
35 shall be provided.

36 c. Chop-Hoop Filament-Wound Structural Exterior Layer:

37 1) The structural reinforcement of the wet well shall be by the
38 chop-hoop filament-wound manufacturing method only. The
39 axial reinforcement shall be continuous-strand glass fiber.
40 The longitudinal reinforcement shall be chopped-strand glass
41 fiber. The glass fiber reinforcement content of the chop-hoop
42 filament wound structural exterior layer shall be 50 to 80% by

1 weight. The exterior surface of the wet well shall be relatively
2 smooth with no exposed reinforcement fibers or sharp
3 projections. Hand finish work is permissible to prevent
4 reinforcement fiber exposure. The wall thickness of the chop-
5 hoop filament-wound structural exterior layer shall vary with
6 the wet well height to provide the aggregate strength
7 necessary to meet the tensile and flexural physical properties
8 requirements.

9 E. Physical Properties: Wet Well FRP Wall Laminate: The wet well FRP wall laminate
10 must be designed to withstand wall collapse or buckling based on the following
11 assumptions and third party specifications:

- 12 1. Hydrostatic Pressure of 62.4 lbs. per square foot
- 13 2. Saturated soil weight of 120 lbs. per cubic foot
- 14 3. Soil Modulus of 700 pounds per square foot
- 15 4. Pipe stiffness values as specified in ASTM D3753

16 The wet well FRP laminate must be constructed to withstand or exceed two
17 times the assumed loading on any depth of the wet well.

18 F. Wet Well FRP Bottom Laminate: The wet well FRP bottom laminate shall have less
19 than 0.375 inches of center elastic deflection (deformation) when in service in totally
20 submerged conditions.

21 G. FRP Laminate Surface Hardness: The finished FRP laminate will have a Barcol
22 Hardness of at least 90% of the resin manufacturer's specified hardness for the fully
23 cured resin. The Barcol Hardness shall be the same for both interior and exterior
24 surfaces.

25 H. Wet Well Top Flange: The wet well top flange shall have an outside diameter at
26 least 4.0 inches greater than the inside diameter of the well. A six-hole pattern shall
27 accommodate the mounting of a cover with at least 0.375 inches in diameter 300
28 series stainless steel fasteners. Non-corroding stainless steel threaded inserts shall be
29 fully encapsulated with noncontinuous mat or chopped-strand glass fiber
30 reinforcement. The inserts shall have an offset tab to prevent stripping or spinning
31 out when removing and reinserting cover fasteners.

32 I. Steel Anti-Floatation Flange: The steel anti-floatation flange shall be constructed
33 from 0.1875 inches thick ASTM A36 structural steel plate, encapsulated in at least
34 0.125 inches of chopped-strand glass fiber reinforcement on all sides. The steel
35 antifloatation flange shall be square with outside dimensions of at least 4.0 inches
36 greater than the wet well inside diameter. The steel anti-floatation flange shall be
37 attached to the wet well bottom with chopped-strand glass fiber reinforcement.
38 Contractor shall place the wet well on a concrete pad and fill with grout covering the
39 entire steel anti-floatation flange. The amount of grout shall be sufficient to prevent
40 floatation of the wet well based on the jobsite conditions. The steel anti-floatation
41 flange shall not require bolt holes to secure it to the concrete pad.

1 J. Inlet and Discharge Coupling: A sufficient quantity and type of “Link-Seal” type
2 modular, mechanical, inter-locking, synthetic rubber links shaped to continuously fill
3 the annular space between the discharge pipe and the aluminum sleeve shall be used
4 to provide a hydrostatic seal. The aluminum sleeve shall be bolted on the wet well or
5 valvebox wall and sealed with silicone sealer.

6 K. Electrical Coupling: A 304 stainless steel NPT full coupling shall be factory
7 installed with at least 0.375 inches in diameter 300 series stainless steel fasteners.
8 The wet well wall penetrations shall be sealed with silicone sealer.

9 L. Float and Level Transducer Bracket: Bracket shall be fabricated from 300 series
10 stainless steel with compression style cord grips to maintain float and transducer
11 level positions. It shall be factory installed with at least 0.375 inches in diameter 300
12 series stainless steel fasteners. The wet well wall penetrations shall be sealed with
13 silicone sealer.

14 M. Access Covers:

- 15 1. Wet well and integral valvebox covers shall be constructed of 0.250 inches
16 thick mill finish aluminum diamond plate with 300 series stainless steel
17 hardware. The access hatch shall have a recessed handle and locking pin. The
18 hatch shall be held open in the vertical position by means of a hold open arm
19 of corrosion resistant design. Covers shall be mounted to the wet well and
20 integral valvebox with a least six 300 series stainless steel fasteners of at
21 least 0.375 inches in diameter.
- 22 2. Doors shall be provided with stainless steel hinges with tamper-proof
23 fasteners. Doors shall be provided with an aluminum lifting handle, and
24 stainless steel locking bar, or stainless steel snap-lock with removable key
25 handle.
- 26 3. Doors furnished with a frame drain shall have drain piping supplied by
27 contractor to a suitable location as indicated by the Engineer.
- 28 4. When closed the door and all accessories shall provide a smooth surface.
- 29 5. Access lids for pad lock enclosure shall be secured in the flush position.
- 30 6. The door shall have a continuous EPDM debris gasket between door and
31 frame.
- 32 7. Doors shall be single leaf, as required by pump manufacturer.
- 33 8. Each door shall be provided with fall protection. Secondary grating shall be
34 provided below access cover.
 - 35 a. Grating made from aluminum or fiberglass designed to support a live
36 load of 300 PSF. Grate shall be hinged to frame with stainless steel
37 hinges and a hold arm capable of holding grate in the fully open 90-
38 degree position. Stainless steel lifting assists and padlock-able hasp
39 required.
 - 40 b. Grating shall allow for access of sewer cleaning equipment. This
41 access shall consist of a 4” slot between fall protection grating and
42 the hatch frame or provide a minimum of two 4-inch by 4-inch

1 banded opening within the grating. Maximum allowable opening
2 between hatch frame and grating is 6"

- 3 9. A warning sign shall be attached to each door cover reading the following:
4 "CAUTION - Confined Space: Dangerous/hazardous gases. Do not enter
5 without proper equipment and supervision."

6 N. Valve Vault Access Ladder:

- 7 1. Fabricate ladder of Aluminum (ASTM B221, alloy 6063-T6) to dimensions
8 coordinated with pre-fabricated vessel manufacturer.
9 2. Ladders shall conform to the requirements of 29 CFR Chapter XVII, Part
10 1926 OSHA 1926.450 and meet the loading and configuration requirements
11 of the "Safety Code for Fixed Ladders", ANSI A14.3-56.
12 3. Side rails: continuous ½ by 2 ½ inch aluminum flat bars, with eased edges,
13 spaced 18 inches apart.
14 4. Bar rungs: ¾ inch minimum diameter aluminum bars, spaced 12 inches on
15 center. Fit rungs in centerline of side rails; plug-weld and grind smooth on
16 outer rail faces. Each run must support a load of at least 250 lbs. applied in
17 the middle of the rung.
18 5. Support each ladder top and bottom and not more than 60 inches on center
19 with welded or bolted aluminum brackets. Size brackets to support design
20 loads specified in OSHA Standard 1917.118 and ANSI A14.3. The support
21 brackets shall be length such that minim distance between the rung and
22 center line and the nearest permanent object behind the rung is 7 inches.
23 6. Provide corrugated, knurled, or dimpled rungs or provide non-slip surfaces
24 on top of each rung by coating with abrasive material metallically bonded to
25 rung.
26 7. Furnish & install below hatch cover, LadderUP safety post Model LU-4 as
27 manufactured by The Bilco Company or approved equal. Device shall be
28 aluminum with mill finish. It shall be designed with telescoping tubular
29 section that locks automatically when fully extended. Upward and downward
30 movement shall be controlled by a stainless steel spring balancing
31 mechanism. Unit shall be completely assembled with fasteners for securing
32 to the ladder rungs in accordance with the manufacturers instructions.

- 33 O. Vent: Provide 4-inch diameter stainless steel vent with insect screen and
34 weatherhood.

35 2.03 PUMPS

- 36 A. The system shall be designed to permit surface level removal of the pumping unit for
37 inspection or service without dewatering the pump chamber or interrupting operation
38 of the other units in the pumping system. The pumps, when lowered into place, shall
39 automatically connect to the discharge piping with a positive action.

- 40 B. Submersible pumps shall be manufactured by Xylem-Flygt or Fairbanks-Nijhuis.

1 C. The specifications and physical layout shown on the drawings are based upon Topp
2 Industries Lift Station and Xylem-Flygt pumping system.

3 D. Operating Criteria: Each pump shall meet or exceed design pumping conditions as
4 follows:

5	Pump Application	Municipal Wastewater			
6	Pump Location	Lift Station			
7	Model#:	Flygt Model NP3102 SH			
8		Fairbanks Model 5432MVK			
9	Quantity of Pumps	Two (2)			
10	Discharge Size:	4-inch			
11	Design Points	<u>Condition</u>	<u>Flow (gpm)</u>	<u>TDH (ft.)</u>	<u>Eff. (%)</u>
12		#1	100	29	39
13		#2	140	24	45
14		#3	200	16	53
15	Minimum Shutoff Head	33 feet			
16	Pump Speed	1750 RPM max.			
17	Maximum Motor HP	Five (5)			

18
19 Each unit shall produce the specified flow at given head, a minimum efficiency, and
20 maximum speed for each operating condition specified above.

21 E. Each pump shall be designed for pumping storm water/raw sewage/septic effluent.

22 F. The pump shall be non-overloading throughout the entire range of operation without
23 employing service factor. The pump shall reserve a minimum service factor of 1.15.
24 The performance curve submitted for approval shall state in addition to head and
25 capacity performance, the pump efficiency, pump speed, solids handling capacity
26 and reflect motor service factor.

27 G. Pump Construction:

28 1. Pump volute shall be single piece, gray iron ASTM A48, Class 30 with
29 smooth internal surfaces free of rough spots, gas holes, or flashing. Scroll
30 type volute design which tends to unbalance from wear resulting in shaft
31 stress shall not be considered equal or acceptable. All exposed nuts or bolts
32 shall be AISI Grade 304 stainless steel or brass construction. All metal
33 surfaces coming into contact with the liquid, other than stainless steel or
34 brass, shall be protected by a factory applied spray coating of alkyd primer
35 with a chlorinated rubber paint finish on the exterior of the pump.

36
37 2. Pump shall be automatically and firmly connected to the discharge. Sealing
38 of the pump to the discharge connection shall be accomplished by a
39 machined metal-to-metal watertight contact. Critical mating surfaces where
40 watertight sealing is required shall be machined and fitted with Nitrile or
41 Viton rubber O-rings. Fittings will be the result of controlled compression of

1 rubber O-rings in two planes and O-ring contact of four sides without the
2 requirement of a specific torque limit. Rectangular cross-sectioned gaskets
3 requiring specific torque limits to achieve compression shall not be
4 considered adequate or equal. No secondary sealing compounds, grease or
5 other devices shall be used. Sealing of the discharge interface with a
6 diaphragm, O-ring or profile gasket will not be acceptable. No portion of the
7 pump shall bear directly on the sump floor.
8

- 9 3. The solid handling type impeller shall be gray iron, ASTM A48, Class 30,
10 dynamically-balanced, double-shrouded non-clogging design having a long
11 through let without acute turns. The impeller shall be one or two vane fully
12 enclosed and the nose of the impeller shall extend into the volute so that the
13 diameter may be trimmed to meet various Special Procedures of head and
14 capacity while still retaining the factory balance. All impellers shall have
15 pump out vanes on the back shroud. Mass moment of inertia calculations
16 shall be provided by the pump manufacturer upon request. All impellers shall
17 be retained with an allen head bolt and shall be capable of passing a 3 inch
18 solid. All impellers shall be coated with alkyd resin primer.
19
- 20 4. A wear ring system shall be used to provide efficient sealing between the
21 volute and suction inlet of the impellers. The wear ring shall be stationary
22 and made of brass, which is drive fitted to the volute inlet.
23
- 24 5. Pump and motor shaft shall be the same unit. The pump shaft shall be an
25 extension of the motor shaft. Couplings shall not be acceptable. The pump
26 shaft shall be AISI Grade 304 stainless steel.

27 H. Motors:

- 28 1. The submersible pump shall be driven by a completely sealed electric
29 submersible motor of 5 horsepower, 1.15 service factor, 1750 rpm, for
30 operation on 208 volts, 3 phase power. The motor nameplate horsepower
31 rating shall not be exceeded by the brake horsepower requirements of the
32 pump for the specified head and GPM conditions.
33
- 34 2. The submersible pump motor shall be designed for a Class 1 Groups C and
35 D, Division 01 hazardous location as defined by the National Electric Code.
36 The motor shall be listed with Underwriters Laboratories as Class 1, Groups
37 C and D, Division 01, explosion-proof, for installation in water or sewage.
38 The motor shall be housed in an air filled, watertight chamber, NEMA B
39 rated. The stator winding and stator leads shall be insulated with moisture
40 resistant Class F insulation rated for 311 degrees F (155 degrees C). The
41 stator shall be dipped and baked with Class F varnish and shall be heat-shrink
42 fitted to the stator housing. The use of bolts, pins or other fastening devices
43 requiring penetration of the stator housing is not acceptable.
44

- 1 3. The motor shall be designed for continuous duty handling liquid media of
2 104 degrees F (40 degrees C) and capable of up to 15 starts per hour. The
3 rotor bars and short circuit rings shall be a made of cast aluminum. Thermal
4 switches set to open at 260 degrees F (125 degrees C) shall be embedded in
5 the stator lead coils to monitor the temperature of each phase winding. These
6 thermal switches shall be used in conjunction with and supplemental to
7 external motor overload protection and shall be connected to the control
8 panel.
9
- 10 4. The combined service factor (combined effect of voltage, frequency and
11 specific gravity) shall be a minimum of 1.15. The motor shall have a voltage
12 tolerance of plus or minus 10 percent. The motor shall be designed for
13 operation up to 104 degrees F (40 degrees C) ambient and with a temperature
14 rise up to 176 degrees F (80 degrees C). A performance chart shall be
15 provided showing curves for torque, current, power factor, input/output kW
16 and efficiency. This chart shall also include data on starting and no-load
17 characteristics. The motor horsepower shall be adequate so that the pump is
18 non-overloading throughout the entire pump performance curve from shut-off
19 through run-out.
20
- 21 5. The motor shaft shall be stainless steel, impervious to the liquid and waste
22 materials being handled. All external hardware including the motor
23 nameplate shall also be made of stainless steel.
24
- 25 6. The pump shall be provided with an oil chamber for the shaft sealing system.
26 The oil chamber shall be designed to prevent overfilling and to provide oil
27 expansion capacity. The drain and inspection plug with positive anti-leak
28 seal shall be easily accessible from the outside. The seal system shall not
29 rely upon the pumped liquid for lubrication. The motor shall be capable of
30 operating dry without damage while pumping under load.
31
- 32 a. Tandem mechanical shaft seal system consisting of two independent
33 seal assemblies, inside an oil chamber that hydrodynamically
34 lubricates the lapped seal faces at a constant rate. The lower, primary
35 seal unit, located between the pump and the oil chamber, shall
36 contain one stationary and one positively driven rotating tungsten
37 carbide ring. The upper secondary seal unit, located between the oil
38 chamber and the motor housing, shall contain one stationary ceramic
39 seal ring and one positively driven rotating carbon seal ring. Each
40 seal interface shall be held in contact by its own ring system. The
41 seals shall require neither maintenance nor adjustment nor depend on
42 the direction of rotation for sealing, and one outside shall provide
43 double protection for the electrical parts. Two moisture-sensing
44 probes shall be used to detect any influx of conductive liquid past the
45 outer seal and provide ample warning of first seal failure.

1 b. Shaft seals without positively driven rotating members, or
2 conventional double mechanical seals containing either a common
3 single or double spring acting between the upper and lower seal
4 faces. Cartridge type systems will not be acceptable. No system
5 requiring a pressure differential to offset pressure and to effect
6 sealing shall be used.
7

8 7. Motor bearings shall be permanently pre-lubricated at the factory. The upper
9 bearing shall be a single groove ball bearing. The lower bearing shall be a
10 two row angular contact bearing to compensate for axial thrust and radial
11 forces.
12

13 8. Motor winding shall have a special Class F insulation system providing 1.15
14 service factor and extended life. Automatic reset, normally closed thermal
15 overloads shall be installed in adjacent phases of the motor winding to
16 provide the overheating protection.
17

18 9. The stator shall be securely held in place with a removable end ring and
19 threaded fasteners so that it may be easily removed. Pumps that require the
20 stator to be removed using heat or press fit are not considered acceptable.
21 Air filled motors that require additional external cooling methods are also not
22 considered acceptable. The pumps are to be explosion-proof and meet all
23 requirements for Class I, Group D, Division I hazardous location.

24 I. Power Cord:

25 1. Electrical power cord shall be sized per the NEC and ICEA standards and
26 shall have sufficient length to reach the junction box without splices.
27 Electrical power cord shall have an outer jacket which is resistant to oil and
28 other materials normally found in sewage. Power cord is to be sealed, not
29 only by use of a cord grip, but shall have individual conductors sealed into
30 the cord cap assembly with epoxy sealing compound. The epoxy seal shall
31 be repeated where the conductors enter the motor from the connection box
32 which is mounted on top of the motor housing. The cord cap and connection
33 box shall be sealed with an O-ring. Power cord shall run continuously from
34 motor to control panel.
35

36 2. Power cord shall run continuously from motor to control panel.

37 J. Seal Sensor:

38 1. A leakage seal sensor shall be provide to sense water in the stator chamber
39 shall be fitted with a float switch. When activated, the Float Leakage Sensor
40 (FLS) shall stop the motor and send an alarm. The use of voltage sensitive
41 solid-state sensors shall not be acceptable. A separate or panel mounted
42 alarm shall be supplied to indicate water in the sealed chamber.

43 K. Heat Sensor:

- 1 1. All stators shall incorporate thermal switches in series to monitor the
2 temperature of each phase winding. At 260-degrees F (125 degrees C) the
3 thermal switches shall open, stop the motor and activate an alarm. The use of
4 voltage sensitive solid-state sensors and trip temperature above 260 degrees F
5 (125 degrees C) shall not be acceptable. A separate or panel mounted alarm
6 shall be supplied to indicate pump overheating.

7 L. Factory Testing:

- 8 1. Commercial testing shall be required and include the following:
9 a. The pump shall be visually inspected to confirm that it is built in
10 accordance with the specification as to HP, voltage, phase, and hertz.
11 b. The motor seal and housing chambers shall be Megger-ed for infinity
12 to test for moisture content or insulation defects.
13 c. Pump shall be allowed to run dry to check for proper rotation.
14 d. Discharge pipe shall be attached, the pump submerged in water, and
15 amp readings shall be taken in each leg to check for an imbalanced
16 stator winding. If there is a significant difference in readings, the
17 stator windings shall be checked with a bridge to determine if an
18 unbalanced resistance exists. If so, the stator shall be replaced.
19 e. The pump shall be removed from the water, Megger-ed again, dried
20 and the motor housing filled with dielectric oil.
21 2. In addition to the above commercial testing, a special megger test shall be
22 performed and include the following:
23 a. The pump shall be submerged in water and allowed to run at
24 maximum load for 30 minutes.
25 b. A written report on the above shall be prepared by the test engineer,
26 certified, and submitted to the Engineer.
27 3. A hydrostatic test shall also be performed on the pump. The hydrostatic test
28 shall require that the volute and impeller be removed and a fixture installed
29 to hold the spring and lower mechanical seal in place. A double plate,
30 gasket, and through-bolt shall be installed on the pump. A discharge mating
31 flange, gasket and pressure fitting shall be installed. The inlet port, volute,
32 and discharge nozzle shall then be pressurized with water to 150 percent of
33 the maximum pump shut off pressure. This hydrostatic pressure shall be
34 maintained for at least 5 minutes and the housing checked for leaks and/or
35 loss of pressure.
36 4. A non-witnessed Hydraulic Institute performance test shall be performed.
37 This shall include the following:
38 a. The pump shall be tested at the design point as well as at least four
39 other points to develop a curve. Data shall be collected to plot the
40 head-capacity curve as well as a KW input and amperage curve.
41 b. In making these tests, no minus tolerance or margin shall be allowed
42 with respect to capacity, total head, or efficiency at the specified
43 design condition. Pump shall be held within a tolerance of 10 percent
44 of rated capacity or at rated capacity with a tolerance of 5 percent of
45 rated head. The pump shall be tested at shut-off but not be plotted

1 and only used as a reference point when plotting the performance
2 curve.

3 c. Complete records shall be kept of all information relevant to the test
4 as well as the manufacturer's serial number, type and size of pump as
5 well as any impeller modifications made to meet the design
6 conditions.

7 d. A written test report shall be prepared, signed and dated by the test
8 engineer, incorporating three curves (head-capacity, KW input, and
9 amperage) along with the pump serial number, test number, date,
10 speed, volts, phase, impeller diameter, and certification number. This
11 report shall then be submitted to the Engineer.

12 M. Pump Base and Guide Rails:

13 1. A separate mounting plate shall be furnished for each pump. These shall
14 include guide rail supports and pump discharge elbow to align with hydraulic
15 seal flange and pump discharge. Plates and fittings shall be coated with a tar
16 base epoxy. Sealing face of discharge elbow shall be heavily coated with
17 zinc to provide a smooth corrosion resistant surface. The carrier shall be
18 designed such that lifting is done from the carrier and no strain is placed on
19 the pump or guide rails.

20 2. The guide rails shall be 2 inch Schedule 40 stainless steel pipe. Each pump
21 shall be furnished with 5/32 inch minimum diameter stainless steel cable for
22 lifting out the pumps. The cable shall be of sufficient length and attach to the
23 pump so as to provide a direct pull over the center of weight.

24 2.04 ELECTRICAL POWER AND CONTROL SYSTEM

25 A. The electrical and control system shall be as specified in Division 26.

26 2.05 PIPING

27 A. Exposed Ductile Iron (DI): Pipe shall meet the requirements of ANSI/AWWA
28 C115/A21.15; Class 53. Joint construction shall be flanged type with required bolts
29 and full face gasket, meeting the requirements of ANSI/AWWA C111/ A21.11.
30 Fittings shall be ductile iron, meeting the requirements of ANSI/ AWWA
31 C110/A21.10. Where stainless steel bolts are used, they shall be installed with a
32 heavy coating of anti-seize compound. Standard cement mortar lining shall meet the
33 requirements of ANSI/AWWA C104/A21.04. All exposed ductile iron pipe shall be
34 primed and painted in accordance with manufacturer recommendations and these
35 specifications.

36 B. Buried Ductile Iron (DI). Pipe shall meet the requirements of ANSI AWWA C151/
37 A21.51; Class 52. Fully body fittings shall be ductile iron, meeting the requirements
38 of ANSI/AWWA C110/A21.10. Compact fittings shall be ductile iron, meeting the
39 requirements of ANSI/AWWA C153/A21.53. Standard cement mortar lining shall
40 meet the requirements of ANSI/AWWA C104/A21.04. Joint construction shall be
41 either push-on type or mechanical joint type (meeting the requirements of

1 ANSI/AWWA C111/A21.11). Push-on type shall be rubber gasket type slip joint;
2 "Fastite", "Bell-Tite", "Tyton", or equal. Mechanical joints shall have plain rubber
3 gaskets. Water pipe and other piping as designated shall receive conductivity straps.
4 Metal wedges are not acceptable.

- 5 C. All buried ductile iron pipe and fittings shall receive polyethylene encasement.
6 Polyethylene encasement shall be polyethylene film tube conforming to
7 ANSI/AWWA C105/A21.5. Polyethylene film sheet conforming to ANSI/AWWA
8 C105/A21.5 may be used at odd-shaped appurtenances where the use of tube is not
9 practical. The polyethylene film shall be clearly marked with the information
10 required in ANSI/AWWA C105/A21.5.

11 2.06 VALVES

- 12 A. All buried valves shall be furnished with extension stems which extend to within one
13 foot of the finished grade elevation. The extension stem shall have a 2-inch
14 operating nut and be mechanically connected to the valve operator. Furnish one
15 valve operating key with the same required key length per every ten buried valves.

- 16 B. Buried valves shall have polyethylene encasement conforming to AWWA C105,
17 Type I, 8 mil thickness.

- 18 C. All valves to be tagged with 1-1/2 inch diameter brass valve tags with 1/4 high black
19 enamel filled letters. Each valve number shall consist of an identifying letter prefix
20 with a maximum of five characters followed by a number with a maximum of four
21 characters. Valve numbers to be supplied by Engineer.

- 22 D. Valve ends shall conform to ANSI B16.1, Class 125 flanges or mechanical joints to
23 match the piping system.

- 24 E. Only manufacturers with a local state certified factory representative shall be
25 allowed to supply equipment.

26 F. Plug Valves:

- 27 1. Plug valves shall be of the non-lubricated eccentric type with resilient faced
28 plugs and shall be furnished with end connections as shown on the plans.
29 Port areas for all valves shall be minimum 80 percent full pipe area for
30 rectangular port, and 100 percent of pipe diameter area. Plug valves shall be
31 Val-Matic, or equal.

- 32 2. Valve Bodies shall be of ASTM A126 Class B cast iron compliance with
33 AWWA C504 Section 2.2. Bodies in 3 inch and larger shall be furnished
34 with a welded overlay seat of not less than 90 percent pure nickel, minimum
35 thickness of 1/8 inch and in accordance with AWWA C507 Section 7.2. Seat
36 area shall be raised, with raised surface completely covered with weld to
37 insure that the plug face contacts only nickel. Valves utilizing resilient seats
38 attached to the body shall not be acceptable. As per AWWA C504 Section

1 35.2 and AWWA C507 Section 7.2, sprayed or plated seats are not
2 acceptable, nor shall screwed-in seats be acceptable.

3 3. Plugs shall be of ASTM A126 Class B cast iron in compliance with AWWA
4 C504, Section 2.2. The plug shall be of one-piece construction and shall be
5 capable of withstanding the full pressure rating of the valve without the use
6 of additional structural reinforcing ribs that extend beyond the profile of the
7 plug itself. Plugs shall be resilient faced with neoprene or hycar, suitable for
8 use with sewage. Plugs with cast inlays shall not be acceptable.

9 4. Valves shall have sleeve type metal bearings conforming to AWWA C504,
10 Section 3.6 and AWWA C507, Section 8. Bearings shall be of sintered, oil
11 impregnated and permanently lubricated type 316 ASTM A743 Grade CF-
12 8M or AISI Type 317L stainless steel in 1/2 inch through 36 inch sizes. Grit
13 seals shall be required in the upper and lower journals to protect the bearings.
14 Non-metallic bearings shall not be acceptable.

15 5. Valve shaft seals shall be of the multiple V-ring type or U-cup and shall be
16 externally adjustable or self-adjustable, repackable without removing the
17 bonnet or actuator from the valve, and repackable under pressure. Shaft seals
18 shall conform to AWWA C504, Section 3.7 and AWWA C507, Section 10.2.
19 Valves utilizing O-ring seals shall not be acceptable. All exposed nuts,
20 bolts, springs, washers, etc., shall be stainless steel for buried or submerged
21 valves and zinc plated for all others.

22 6. Valve pressure ratings shall be 175 psi. Each valve shall be given a
23 hydrostatic and seat test with test results being certified when required by the
24 specifications. Valves shall provide driptight shut off with pressure in either
25 direction.

26 7. Manual valves shall have enclosed worm gear actuators with seals and
27 gaskets rated for corrosive, wet duty, stainless steel bolts and fasteners, tee
28 wrenches, extensions stems, and supports. Worm gears shall be designed and
29 certified to withstand input loads of up to 300 ft.lbs. minimum at the stops,
30 without damage. Gear actuators shall be rated for bi-directional shutoff at
31 the design pressure rating of the valve. All gearing shall be enclosed in a
32 semi-steel housing and be suitable for running in a lubricant with seals
33 provided on all shafts to prevent entry of dirt and water into the actuator.
34 The actuator shaft and the quadrant shall be supported on permanently
35 lubricated bronze bearings. Actuators shall clearly indicate valve position
36 and an adjustable stop shall be provided to set closing torque. All exposed
37 nuts, bolts, and washers shall be zinc plated.

38 8. Buried valves shall be furnished with solid cast iron or hot-dipped galvanized
39 steel hollow shaft extension stems for increased corrosion resistance. Stems
40 shall extend to within one foot of the finished grade elevation. The extension
41 stem shall have a 2-inch operating nut and be mechanically connected to the
42 valve operator. Minimum of two (2) wrenches for each plant site area (50 ft
43 x 50 ft area) with buried valves. Valves shall include stainless steel stem
44 guides at 5 ft O.C.

1 G. Check Valves:

- 2 1. Provide Swing-Flex Series 500, ASTM A536 Grade 65-14-12, Class B
3 ductile iron body and cover, molded Buna-N (NBR) ASTM D2000-BG disc,
4 flanges per ANSI B16.1, Class 125, interior and exterior coated with fusion
5 bonded epoxy, manual operator, mechanical disc position indicator and
6 backflow actuator as manufactured by Val-Matic, or equal.
- 7 2. The valve shall have a 150 psi rated body constructed of high-strength cast
8 iron conforming to ASTM A126 Class B with integral flanges, faced and
9 drilled per ANSI B16.1 Class 125 and be suitable for horizontal or vertical
10 installation. Valve materials and construction certified for wastewater and
11 sludge use.
- 12 3. The valve body shall be the full waterway type, designed to provide an open
13 flow area not less than the nominal inlet pipe size when swung open no more
14 than 25 degrees. The valve shall have a replaceable stainless steel body seat.
- 15 4. Valve disc shall be cast iron and faced with a renewable resilient seat ring of
16 rubber or other suitable material, held in place by a follower ring and
17 stainless steel screws.
- 18 5. The disc arm shall be ductile iron or steel, suspended from and keyed to an
19 austenitic stainless steel shaft located completely above the waterway and
20 supported at each end by heavy bronze bushings. The shaft shall rotate freely
21 without the need for external lubrication. The shaft shall be sealed where it
22 passes through the body by means of a stuffing box and adjustable packing.
23 Simple o-ring shaft seals are not acceptable.
- 24 6. The valve shall be supplied with an outside lever and adjustable
25 counterweight to initiate valve closure. Valve closure shall be dampened by
26 means of a single, side-mounted, stationary, bronze air-cushion assembly
27 directly mounted to the valve body on machined pads. The amount of
28 cushioning shall be easily adjustable without the need for pre-charged air
29 chambers.
- 30 7. The valve shall swing open smoothly at pump start and close quickly and
31 quietly upon pump shutdown to prevent flow reversal. When closed, the
32 valve shall seat drop tight.

33 2.07 PIPING IDENTIFICATION

- 34 A. Identify all process piping with its process designation and direction of flow; identify
35 with semi-rigid, snap-on acrylic-plastic identification markers at 15 foot intervals, at
36 each change of direction, and adjacent to each point it passes through a wall, floor or
37 ceiling; comply with ANSI and OSHA pipe mark requirements.
- 38 B. Identify pipes less than 1 inch in diameter with brass tags, 1-1/2 inch in diameter
39 with depressed 1/4 inch high black enamel-filled letters, securely fastened at 5 foot
40 intervals.

1 2.08 PIPE HANGERS & SUPPORTS

- 2 A. Pipe hangers shall consist of ceiling flange threaded rod, and adjustable clevis type
3 hanger constructed of carbon steel.
- 4 B. Vertical piping shall be supported at each floor and at intervals determined by the
5 vertical load involved. Riser clamps shall be supported on spring hangers. Short
6 risers shall include a saddle at the bottom and may require an additional hanger at the
7 top. Longer risers may require over-sized U-bolts or similar devices to prevent
8 lateral motion.
- 9 C. Pipe supports where ceiling mounted to concrete surfaces shall consist of a base
10 flange, support rod with threaded ends for height adjustment, and a saddle type or
11 stanchion type support as required.
- 12 D. Pipe supports shall be wall-mounted brackets where pipelines are located within 3-
13 feet of walls. Maintain minimum of 7-foot clearance under supports.
14 1. Provide U-bolt attachment, roller, or pipe saddle above the bracket.
15 2. Where clearance is limited, suspend clevis hanger from wall bracket.
16 3. Provide floor-mounted type support stands with adjustable pipe column,
17 circular cradle, and floor attachment flange where wall or ceiling mount are
18 not feasible and maintenance access will not be interrupted.
- 19 E. Install hangers and supports as required to support piping shown on plans; conform
20 to American Standard Code for Pressure Piping, ANSI B31.1. Provide galvanized or
21 stainless structural steel members required for supporting or anchoring piping and
22 accessories.
23 1. Exterior and underwater pipe supports shall be type 316 stainless steel.
24 2. Pipe supports in wet atmosphere or corrosive chemical areas, shall be type
25 316 stainless steel.
26 3. Interior room locations not subject to wet or corrosive conditions shall have
27 pipe supports of hot-dipped galvanized steel construction.
- 28 F. Design and locate supports, anchors, rollers and guides and show on shop drawing
29 submittal subject to acceptance of Engineer.
30 1. Absence of pipe support and details on the drawings shall not relieve the
31 Contractor of responsibility for providing supports.
32 2. Maintain equipment maintenance clearance around all equipment and
33 operator and equipment removal egress paths throughout all Rooms.

34 2.09 FIXTURE SUPPORTS

- 35 A. Wall hung fixtures, hanger plates, support arms or mounting lugs shall be fastened to
36 the wall by through bolts where appearance of the bolts is not objectionable. Exposed
37 bolt heads in finished areas shall be hexagonal and painted. Exposed nuts shall be
38 chromium plated hexagonal cap nuts. Washers shall be painted or chromium plated
39 to match bolt heads or nuts.

1 2.10 EXPANSION JOINTS

- 2 A. Expansion joints shall be of the bellow type with filled arches suitable for
3 temperatures of minus 20 degrees F to plus 180 degrees F equipped with limit bolts
4 to restrict maximum extension.

5 2.11 PIPELINE TAPS

- 6 A. Pipeline Tapping Saddles: Sizes ½ inch through 3 inch diameter, provide double-
7 strap bronze body saddle with gasket and two stainless steel clamping bands,
8 assembly rated for 150 psig. Provide saddles at all locations, unless indicated
9 otherwise on the drawings.

10 2.12 PAINTING

- 11 A. All exposed metal piping, exposed fittings, all valves and bollards shall be painted.
12 Stainless steel surfaces, code-required labels or equipment name, identification,
13 performance rating, or nomenclature plates should not be painted.

- 14 B. Painting of all exposed piping, valves, and fittings shall be completed prior to start-
15 up and performance testing of the lift station.

- 16 C. Submit product data for paint system. Product data shall include, but not be limited
17 to, manufacturer's information on products intended use, application procedures, and
18 material properties.

- 19 D. Paint System: the following system is based on Tnemec brand productions.
20 Contractor may use alternate brands only if approved by the Engineer.

- 21 1. Shop surface preparation: Abrasive blast clean in accordance with SSPC-
22 SP10 near-white blast cleaning standards. Apply primer before any rust
23 bloom appears.
24 2. Shop prime coat: apply one even coat of Tnemec Series N69-Color at 3.0 to
25 5.0 mils DFT.
26 3. Field touch-up: spot blast in accordance with SSPC-SP10 near-white blast
27 cleaning standards. Apply one coat of Tnemec Series N69-Color at 3.0 to 5.0
28 mils DFT.
29 4. Intermediate coat: apply one even coat of Tnemec Series N69-Color at 4.0 to
30 6.0 mils DFT.
31 5. Finish coat: apply one even coat of Tnemec Series N69-Color at 4.0 to 6.0
32 mils DFT.

1 PART 3 CONSTRUCTION METHODS

2 3.01 INSPECTION AND TESTING

- 3 A. Leakage is not permissible on any exposed line or any line that will be placed under
4 pressure or suction. The Contractor shall at his own expense locate and repair the
5 defective joints.
- 6 B. Inspection and testing requirements shall comply with City of Madison Standard
7 Specifications, Part V – Sewers and Sewer Structures.

8 3.02 PUMP FIELD PERFORMANCE TEST

- 9 A. Each pump shall be tested after installation to check the guaranteed performance.
10 The Contractor shall furnish and install all gauges and accessories required for this
11 test and shall run each pump in the duplex system as directed by the Engineer. The
12 Contractor shall provide field data taken from at least three different operating points
13 for comparison with pump curves. The Contractor shall record the individual shutoff
14 head for each pump for comparison with pump curves. The Contractor shall also
15 record amp readings in each leg for each pump to check for motor imbalance and
16 excessive amp draw by the motor. The Contractor shall be responsible for all
17 adjustments or replacements necessary.
- 18 B. Any defects in the equipment or failure to meet the guarantees or requirements of the
19 specifications shall be promptly corrected by the Contractor by replacements or
20 otherwise. The decision of the Engineer as to whether or not the Contractor has
21 fulfilled his obligations under the contract shall be final. If the Contractor fails or
22 refuses to make these corrections or if the improved equipment, when tested shall
23 again fail to meet the guarantees of the Contractor, the Owner, notwithstanding its
24 ownership of work and materials which have entered into the manufacture of said
25 equipment, shall have the option of rejecting said equipment or of accepting the same
26 at such reduced price as may be agreed upon by the parties hereto.

27 3.03 INSTALLATION

- 28 A. From the time the lift station is delivered to site until final acceptance, the Contractor
29 shall protect the lift station from flooding, freezing, or excessive humidity. If
30 temporary electric power is necessary, that expense shall be borne by this Contractor.
31 The Contractor shall make periodic inspections of the lift station to check for any
32 possible problems including flooding or equipment failure. In the event of damage
33 due to the Contractor failing to maintain the lift station as outlined above, all
34 expenses necessary to restore the lift station in first class working order shall be
35 borne by the Contractor.
- 36 B. After the job installation is completed, a qualified factory representative shall place
37 the station in operation, conduct a complete functional check, and make all necessary
38 adjustments for regular service. The Owner shall be given four complete operating

1 and maintenance manuals. Factory representative shall provide four man-hours of
2 startup service and four hours of operator training. Factory representative shall
3 provide four copies of certified station operation report.

4 3.04 GUARANTEE

5 A. The manufacturer of the lift station shall guarantee for one year from the date of start
6 up that the entire station and all equipment therein shall be free from defects in
7 design, materials and workmanship. In the event a component fails or is proven
8 defective during the guarantee period, the manufacturer shall provide replacement
9 parts without cost. The labor required to repair or replace major items including the
10 structure, sewage pumps and/or motors, valves or fittings shall also be furnished
11 without charge. The labor to replace accessory items such as the dehumidifier, sump
12 pump, alternator, etc., that should become defective during this period, shall be
13 provided by the Contractor. Normal use items such as grease, light bulbs,
14 mechanical seals, packing and belts are excluded.

15 B. The station manufacturer shall maintain a permanent service station in the State of
16 Wisconsin equipped with the necessary repair parts, shop and field service facilities,
17 and trained personnel to guarantee continuous operation of this installation.

18 PART 4 MEASUREMENT AND PAYMENT

19 4.01 PACKAGE LIFT STATION

20 A. Lift Station will be paid for on a lump sum basis at the contract price. Price shall be
21 paid in full for all excavation, bedding, by-pass pumping, back filling, compaction,
22 testing, startup, and furnishing of all materials, fittings, tools, equipment, labor and
23 incidentals necessary to complete the work in accordance with the contract
24 documents. Electrical connection to utility, back-up generator, fencing, and all valves
25 and piping necessary for proper lift station functionality shall be included in the lump
26 sum price.

27 B. All Dewatering required for lift station construction shall be included in the trench
28 dewatering bid item.

29
30 END OF SECTION

1 SECTION 33 51 13

2
3 NATURAL-GAS PIPING

4 PART 1 GENERAL

5 1.01 WORK INCLUDED

- 6 A. Natural gas piping from meter to generator as specified herein, and as needed for a
7 complete and proper installation including, but not necessarily limited to:
8 1. Gas service.
9 2. Piping, fittings, valves, regulators, appurtenances, etc.
10 3. Mechanical Identification. Sleeves.
11 4. Caulking of penetrations, openings, and fixtures.
- 12 B. Coordinate service, with required meter, with local gas utility.
13 1. Verify gas service pressure at connection.
14 2. Coordinate installation of concrete pad for gas service.

15 1.02 RELATED SECTIONS

- 16 A. Documents affecting work of this section include, but are not necessarily limited to,
17 General Conditions, Supplementary Conditions, and Sections in Division 01 of these
18 specifications.
- 19 B. Division 31 – Earthwork: Requirements for trenching and backfilling.

20 1.03 WORK OF OTHER SECTIONS

- 21 A. Openings for work in walls, floor, roof, ceiling, etc., required by this section shall be
22 provided under other sections. Locations and size of these openings shall be the
23 responsibility of this Contractor.
- 24 B. Division 03 - Concrete.
- 25 C. Division 07 – Joint Sealeants
- 26 D. Division 09 – High Performance Coatings
- 27 E. Division 26 - Electrical

28 1.04 GENERAL PROVISIONS

- 29 A. Everything essential for the completion of the work implied to be covered by these
30 Specifications to make the System ready for normal and proper operation must be
31 furnished and installed by the Contractor. Accordingly, any omission from either the
32 plans or the Specifications, or both, of details necessary for the proper installation

1 and operation of the system shall not relieve the Contractor from furnishing such
2 detail in full and proper manner.

- 3 B. The plans show various details indicating the general arrangement of the gas piping
4 work, sizes and locations of piping, etc. The said plans with figures, lettering, etc.,
5 shall be considered a part of these Specifications and no charge or alternation shall
6 be made in either case unless ordered by the Engineer.

7 1.05 QUALITY ASSURANCE

- 8 A. Perform work in accordance with State of Wisconsin and industry standards.

9 B. Qualification of Installer:

- 10 1. Company specializing in performing the work of this section with minimum
11 three (3) years documented experience.
12 2. In acceptance or rejection of installed work, the Architect or Engineer shall
13 make no allowances for lack of skill on part of the installers.
14 3. Use adequate numbers of skilled workers who are thoroughly trained and
15 experienced in the necessary crafts and who are completely familiar with the
16 specified requirements and the methods needed for proper performance of the
17 work of this Section.
18 4. All work shall be installed in a first class manner by State of Wisconsin
19 licensed plumbers.

20 C. Qualification of Manufacturer:

- 21 1. Company specializing in manufacturing products specified in this section
22 with a minimum of 10 years experience. Manufacturer shall conform to the
23 ratings and certifications indicated.
24 2. Equal products shall be of similar quality, be functionally similar, and have
25 the controls specified. Where more than one type of product is specified in a
26 particular section, the listed acceptable manufacturers may not have an equal
27 product for every type of product specified.

28 D. Codes and regulations:

- 29 1. In addition to complying with the specified requirements, comply with
30 pertinent regulations of governmental agencies having jurisdiction.
31 2. In the event of conflict between or among specified requirements and
32 pertinent regulations, the more stringent requirement will govern when so
33 directed by the Engineer.

- 34 E. The following standards, referred hereafter by basic designation only, are imposed,
35 as applicable to work in each instance, and form a part of this specification to the
36 extent indicated by the reference thereto:

- 37 1. ANSI - American National Standards Institute
38 2. ASME - American Society of Mechanical Engineers
39 3. ASTM - American Society for Testing and Materials

1 1.06 COORDINATION

- 2 A. Cooperate and coordinate with other trades to assure that all systems in the work may
- 3 be installed in the best arrangement. Coordinate as required with all other trades to
- 4 share space in common areas and to provide the maximum of access to each system.
- 5 B. Locate equipment properly to provide easy access, and arrange entire work with
- 6 adequate access for operation and maintenance.
- 7 C. Give right-of-way to piping which must slope for drainage.

8 1.07 DELIVERY, STORAGE, AND HANDLING

- 9 A. Accept valves, regulators, etc., on site in factory packaging. Inspect for damage.

10 1.08 CLOSEOUT SUBMITTALS

- 11 A. Section Project Closeout: Closeout provisions.
- 12 B. Project Record Documents and As-Builts: Record actual location of equipment and
- 13 fixtures including items remotely within walls or above ceilings, etc.
- 14 C. Operation and Maintenance Data and Instructions:
- 15 1. Submit manufacturer's descriptive literature, operating instructions, service
- 16 instructions, installation instructions, maintenance and repair data, parts
- 17 listing, warranties, and wiring diagrams.
- 18 2. Assemble two (2) complete sets. Prepare in bound copies complete with
- 19 index tabs.
- 20 3. Submit bound copies to Engineer for disbursement.

21 1.09 SPECIAL PROJECT CONDITIONS

- 22 A. Allowances:
- 23 1. Section 01 21 00 – Allowances.
- 24 2. The allowance amount shown is the invoice amount from the utility.
- 25 3. The plumbing contract will be adjusted up or down by change order by the
- 26 amount listed for the allowance, less the actual cost of the utility fee. No
- 27 additional compensation for mark-ups or handling will be allowed by the
- 28 contractor. Any such costs shall be included in the bid.
- 29 B. Utility Coordination:
- 30 1. Be responsible for utility coordination on behalf of the Owner.

1 PART 2 PRODUCTS

2 2.01 PIPES AND TUBES

3 A. Natural Gas Piping:

- 4 1. Piping and tubing shall have a minimum working pressure of 150 psig.
- 5 2. Buried beyond below the building and outside within 5 feet of building:
- 6 a. By gas utility.
- 7 b. Polyethylene Pipe: ASTM D2513, SDR 11.5, with socket type
- 8 fittings and fusion welded joints.
- 9 c. Materials and installation shall conform to AWWA C203
- 10 requirements.
- 11 3. Above ground:
- 12 a. Steel Pipe: ASTM A53, Schedule 40 black, with malleable iron or
- 13 forged steel fittings, screwed or welded. Threaded joints shall
- 14 comply with ASME B1.20.1.
- 15 b. Equipment Connections:
- 16 1) Flexible connector, minimum 12-inch long.
- 17 2) Tested and listed in compliance with the construction,
- 18 installation, and performance requirements of ANSI/AGA LC
- 19 1.
- 20 3) Tubing joints: Shall be made with approved gas tubing
- 21 fittings or brazed with a material having a melting point in
- 22 excess of 1,000° F. Brazing alloys shall not contain more
- 23 than 0.05% phosphorus.

24 2.02 VALVES

- 25 A. Valves must be trademarked on body with manufacturer's name or trademark and
- 26 pressure rating.
- 27 B. Minimum design pressure of 200 psig and certified for water-oil-gas (WOG)
- 28 operation.
- 29 C. Gas shut-off valves:
- 30 1. Ball valve: bronze body, threaded ends, stainless steel ball, full or
- 31 conventional port, Teflon seat, blow-proof stem, two-piece construction.
- 32 2. UL listed for use as a gas shut-off.
- 33 3. Acceptable Manufacturers: American Valve, Red-White Valve Corp., or
- 34 equal.
- 35 D. Gas Cocks:
- 36 1. Sizes 1/2 inch to 4 inches: DeZurik Fig. 425 gas valve, cast iron body,
- 37 screwed or flanged ends, bronze bearings, bronze plug and resilient seal ring
- 38 for bubble-tight shut-off to 175 psig working pressure.
- 39 2. UL approved for natural gas.

- 1 3. Acceptable manufacturers: Crane, DeZurik, Jenkins, Milwaukee, Nibco, and
2 Walworth.

3 2.03 PIPING SPECIALTIES

4 A. Flanges, Unions, and Couplings:

- 5 1. Pipe Size 2 inches and Under: Malleable iron unions for threaded ferrous
6 piping; bronze unions for copper pipe, soldered joints.
7 2. Grooved and Shouldered Pipe End Couplings: Malleable iron housing, C-
8 shape elastomer composition sealing gasket, steel bolts, nuts, and washers.
9 3. Dielectric Connections: Union with galvanized or plated steel threaded end,
10 copper solder end, water impervious isolation barrier.

11 B. Gas Regulators:

- 12 1. Sizes 3/4 inch to 2 inch: Quick reacting with internal relief for overpressure
13 protection, self-operated regulation with cast iron body, relief, spring steel
14 case, and Nitrile diaphragm.
15 2. Regulators shall reduce gas supply line (PSIG) pressure to equipment
16 operating pressure (W.C.). Verify supply line pressure with Gas Utility.
17 Verify equipment operating pressure with manufacturer.
18 3. Gas regulators shall be sized for pressure and flow requirements for all of the
19 equipment it serves.
20 4. Acceptable manufacturers: Fisher, Leslie, Maxitrol, Nibco and Spence.

21 2.04 SLEEVES

22 A. Sleeves: 18 gage thick galvanized steel

23 B. All sleeves shall be of sufficient diameter such that the bare pipe with unbroken pipe
24 covering or wrapping, where specified, can pass through and allow for expansion and
25 contraction in all directions.

- 26 1. Sleeve shall be two pipe sizes larger than the pipe passing through; or
27 provide a minimum of 1/2 inch clearance between inside of sleeve and
28 outside of the pipe.

29 2.05 MECHANICAL IDENTIFICATION

30 A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, UV resistant
31 and stable, preformed to fit around pipe or pipe covering. Larger sizes may have a
32 minimum sheet size with stainless steel spring fastener. Minimum width of 3 inches,
33 to comply with State of Wisconsin Plumbing Code. Color and Lettering: Conform
34 to ASME A13.1 and State of Wisconsin Plumbing Code.

- 35 1. Acceptable Manufacturer: Seton Nameplate Corporation, Kolbi Pipe
36 Markers Co., or equal.

- 1 B. Plastic Underground Pipe Markers: Bright colored continuously printed plastic
2 ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial
3 service.
- 4 C. Valve Tags: minimum 1 1/2 inches diameter, lettering shall be a minimum of 1/2
5 inch in height.
- 6 1. Material:
7 a. Brass.
8 2. Shape:
9 a. Gas Service: Square/diamond shape.

10 PART 3 EXECUTION

11 3.01 JOB CONDITIONS

- 12 A. Surface Conditions: Examine the areas and conditions under which work will be
13 performed. Correct conditions detrimental to timely and proper completion of the
14 Work. Do not proceed until unsatisfactory conditions are corrected.
- 15 B. Measurements:
16 1. Field measuring existing conditions.
17 2. Lay out work, properly locate all apparatus, pipe, fittings, sleeves, etc.
18 Adjust work, as necessary, to insure that work shall fit into the spaces that
19 have been allotted for such work. Due regard shall be taken for the work of
20 other trades.

21 3.02 SYSTEM LAYOUT

- 22 A. Lay out the system in careful coordination with the Drawings; determine proper
23 elevations for all components of the system and using only the minimum number of
24 bends to produce a satisfactorily functioning system.
- 25 B. Follow the general layout shown on the Drawings in all cases, except where other
26 work may interfere.

27 3.03 TRENCHING AND BACKFILLING

- 28 A. Perform trenching and backfilling associated with the work of this Section in strict
29 accordance with the provisions of Division 31 of these Specifications.

30 3.04 SERVICE CONNECTIONS

- 31 A. Install gas service complete with gas meter and regulators. Verify gas utility pressure
32 at building service connection. Install regulators on each line serving gravity type
33 appliances, sized in accordance with equipment.

1 3.05 INSTALLATION – SLEEVES

- 2 A. Sleeves shall be fastened securely in place.
- 3 B. Section 07 92 00: Caulk the space between the sleeve and pipe.

4 3.06 INSTALLATION - PIPE

- 5 A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- 6 B. Remove scale and dirt, on inside and outside piping before assembly.
- 7 C. Prepare piping connections to equipment with flanges or unions.

8 3.07 INSTALLATION - PIPING SYSTEMS

- 9 A. Install dielectric connections wherever jointing dissimilar metals.
- 10 B. Install unions downstream of valves and at equipment connections.
- 11 C. Route piping parallel to structure and maintain gradient.
- 12 D. Install piping to allow for expansion and contraction without stressing pipe, joints, or
- 13 connected equipment.
- 14 E. Thoroughly clean items before installation.
- 15 F. Cut pipe accurately, and work into place without springing or forcing. Excessive
- 16 cutting or other weakening of the building will not be permitted.
- 17 G. Install piping, valves, and other items to permit access for maintenance. Relocate
- 18 items as necessary to provide such access, and without additional cost to the Owner.
- 19 H. Install identification on piping systems, including underground piping.
- 20 I. Protect piping systems from entry of foreign materials by temporary covers,
- 21 completing sections of the work, and isolating parts of completed system.
- 22 J. Make changes in directions with fittings; make changes in main sizes with eccentric
- 23 reducing fittings.
- 24 K. Pipe Joints:
 - 25 1. Screwed Piping:
 - 26 a. Deburr cuts.
 - 27 1) Do not ream exceeding internal diameter of the pipe.
 - 28 2) Thread to requirements of ANSI B2.1.
 - 29 b. Use Teflon tape on male thread prior to joining other services.

1 c. Use litharge and glycerin on joint prior to cleaning for air and oil
2 piping.

3 2. Leaky Joints:

4 a. Remake with new material.

5 b. Remove leaking section and/or fitting as directed.

6 c. Do not use thread cement or sealant to tighten joint.

7 3.08 INSTALLATION - VALVES

8 A. Install valves with stems upright or horizontal, not inverted.

9 B. Install valves for shut-off and to isolate equipment.

10 3.09 INSTALLATION - FUEL PIPING

11 A. Install natural gas piping in accordance with NFPA 54.

12 B. Provide clearance for installation of and access to valves and fittings.

13 C. Establish elevations of buried piping outside building to provide not less than 18-
14 inch of cover.

15 D. Provide support for utility meters in accordance with requirements of utility
16 company.

17 E. Terminate vent from gas pressure reducing valves or regulators per manufacturer's
18 instructions.

19 3.10 INSTALLATION - MECHANICAL IDENTIFICATION

20 A. Install adequate marking of exposed accessible piping, per ANSI A13.1.

21 B. Install tags with corrosion resistant metal chain.

22 C. Valves:

23 1. Tag all valves.

24 D. Pipes:

25 1. Install pipe markers on all pipes.

26 2. Space no more than 25 feet apart, with a minimum of one marker on each
27 straight section of pipe.

28 3. Color of bands:

29 a. Gas Pipe: Red

1 3.11 PAINTING

2 A. Section 09 96 00: All exposed piping, fittings, valves, etc., without factory finish or
3 finished cover, shall be painted.

4 B. Touch-up all factory finishes damaged during construction.

5 3.12 TESTING AND ADJUSTING

6 A. Section 01 77 00 - Closeout Procedures: Testing and adjusting provisions.

7 B. Contractor shall notify any inspectors required to observe test, when test is ready to
8 be performed. Contractor shall advise A/E field representative that notification has
9 been given.

10 C. All equipment required for testing, including fittings for additional openings, shall be
11 provided by Contractor. Contractor shall provide all personnel required for testing.
12 Contractor shall pay the cost of all required tests and retests and inspections if
13 required.

14 D. Tests shall be witnessed and approved by Owner's representatives and A/E field
15 representative. Contractor shall certify in writing the time, date, name, and title of
16 person approving test. This shall also include the description and what portion of the
17 system has been approved. Person approving test shall sign certification.

18 E. A complete record shall be maintained of all testing that has been approved, and shall
19 be made available at the job site to all authorities concerned.

20 F. Upon completion of the work, all records and certifications approving testing
21 requirements shall be submitted to the A/E Field Representative before final payment
22 is made.

23 G. Test natural gas piping in accordance with NFPA 54.

24 H. Notify A/E in advance regarding time and date of all tests.

25 I. Defective work or material shall be replaced or repaired, as necessary, and the
26 inspection and test repeated. Repairs shall be made with new materials. Caulking of
27 screwed joints or holes will not be acceptable.

28 J. Adjust the system to optimum standards of operation.

29 3.13 CLOSEOUT OPERATIONS

30 A. Closeout Equipment/System Operations: Sequence operations properly so that work
31 of the project will not be damaged or endangered.

32 1. Adjust and correct operations as required for proper performance.



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 Bryan Cooper, Principal Architect
Mapping Section Manager
 Eric T. Pederson, P.S.
Financial Manager
 Steven B. Danner-Rivers

February 26, 2019

**NOTICE OF ADDENDUM
 ADDENDUM NO. 1
 CONTRACT NO. 8119**

**S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET
 RECONSTRUCTION DISTRICT – 2018**

Revise and amend the contract document(s) for the above project as stated in this addendum, otherwise, the original document shall remain in effect.

SPECIAL PROVISIONS:

DELETE THE METHOD OF MEASUREMENTS SECTION UNDER THE HEADING BID ITEM 90033 – CANOE/KAYAK LAUNCH AT JAMES STREET AND REPLACE WITH THE FOLLOWING:

The Canoe/Kayak Launch at James Street will be measured as a Lump Sum, acceptably completed.

DELETE THE ENTIRE ARTICLE 1000 SANITARY SEWER STATION SPECIAL PROVISIONS AND REPLACE WITH THE NEW ARTICLE WITHIN THIS ADDENDUM.

Changes to the original Special Provisions are indicated in **RED** text.

PROPOSAL:

See below for a summary of items that have been removed, added or revised. Refer to the proposal for updated quantities. See proposal on bidexpress.com.

ITEMS:

Action	Bid Item	Description
NEW	21110	TERRACE RAIN GARDEN
REVISE	70002	FURNISH AND INSTALL 6-INCH PIPE & FITTINGS
REVISE	70031	FURNISH AND INSTALL 6-INCH WATER VALVE
REVISE	70040	FURNISH, INSTALL AND SALVAGE HYDRANT

PLANS:

Title Sheet: Update index of sheets.
 RG-1 & RG-2: Rain Garden Plans, new sheets.
 LS-3: Revised lift station foundation and location of antenna tower.
 LS-6: Revised key notes and lift station foundation.
 LS-7: Revised lift station foundation section 1/LS-7. Revised removable post mounted detail 2/LS-7. Removed toe-plate and revised post to go over top of mounting plate vertical member. Revised guardrail elevation detail 3/LS-7. Changed diameter elevation of guardrail. Remove typical slab on grade detail 5/LS-7.

LS-9: Revised lift station foundation and location of antenna tower.

LS-14: Revised electrical plan notes.

LS-15: Revised note 8 for owner furnished antenna equipment and deleted station hand/auto and start/stop push button.

LS-16: Added note to generator to ground per NEC code.

LS-17: Deleted station hand/auto. Deleted start/stop push buttons. Added pilot lights.

LS-18: Revised conduit and box schedule.

LS-21: Revised generator pad detail. Revised free standing control panel detail.

LS-22: Revised antenna base.

W-7: An additional fire hydrant and associated fittings have been added to the 3000-block of Thorp Street.

W-10: Updating material estimates based on changes to sheet W-7.

Please acknowledge this addendum on page E1 of the contract documents and/or in Section E: Bidder's Acknowledgement on Bid Express.

Electronic version of these documents can be found on the Bid Express web site at:

<http://www.bidexpress.com>

If you are unable to download plan revisions associated with the addendum, please contact the Engineering office at 608-266-4751 receive the material by another route.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert Phillips". The signature is written in a cursive style with large, looping letters.

Robert F. Phillips, P.E.
City Engineer

RFP:AJZ

ARTICLE 1000 SANITARY SEWER LIFT STATION SPECIAL PROVISIONS

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

- A. Applicable provisions of the City’s Standard Specifications shall govern work of this section.

1.02 APPLICABLE PUBLICATIONS (NONE)

1.03 DESCRIPTION OF WORK

- A. Provide quality control for all work performed under this contract as described in this section.

1.04 RELATED WORK ELSEWHERE

- A. Structural Excavation for Structures – Division 31

1.05 SUBMITTALS (NONE)

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

1.07 QUALITY ASSURANCE

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers’ instructions, including each step in sequence.
- C. Should manufacturers’ instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

ARTICLE 1000 SANITARY SEWER LIFT STATION SPECIAL PROVISIONS

1 1.08 TOLERANCES

- 2 A. Monitor tolerance control of installed products to produce acceptable work. Do not
3 permit tolerances to accumulate.
- 4 B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict
5 with Contract Documents, request clarification from Engineer before proceeding.
- 6 C. Adjust products to appropriate dimensions; position before securing products in
7 place.

8 1.09 REFERENCES

- 9 A. For products or workmanship specified by association, trade, or other consensus
10 standards, comply with requirements of the standard, except when more rigid
11 requirements are specified or are required by applicable codes.
- 12 B. Conform to reference standard by date of issue current on date of Contract
13 Documents, except where a specific date is established by code.
- 14 C. Obtain copies of standards where required by product specification sections.
- 15 D. The contractual relationship, duties, and responsibilities of the parties in Contract nor
16 those of the Engineer shall not be altered from the Contract Documents by mention
17 or inference otherwise in any reference document.

18 1.10 INSPECTING AND TESTING LABORATORY SERVICES

- 19 A. Contractor shall be responsible for concrete testing as outlined in Section
20 01 45 16.11 and Division 03 of these specifications. For other testing not related to
21 defective work issues, Owner will appoint, contract, and pay for the services of an
22 independent firm to perform inspecting and testing.
- 23 B. Geotechnical services and soil testing shall be required to meet performance
24 requirements specified in Divisions 31, and 33 and in other Sections related to this
25 work. Geotechnical services and soil testing shall be procured and paid for by the
26 Owner.
- 27 C. The independent firm will perform inspections, tests, and other services specified in
28 individual specification sections and as required by the Engineer or the Owner.
- 29 D. Inspecting, testing, and source quality control may occur on or off the project site.
30 Perform off-site inspecting or testing as required by the Engineer or the Owner.

ARTICLE 1000 SANITARY SEWER LIFT STATION SPECIAL PROVISIONS

- 1 E. Reports will be submitted by the independent firm to the Engineer indicating
2 observations and results of tests and indicating compliance or non-compliance with
3 Contract Documents.

- 4 F. Cooperate with independent firm; furnish samples of materials, design mix,
5 equipment, tools, storage, safe access, and assistance by incidental labor as
6 requested.
 - 7 1. Notify Engineer and independent firm 24 hours prior to expected time for
8 operations requiring services.
 - 9 2. Make arrangements with independent firm and pay for additional samples
10 and tests required for Contractor's use.

- 11 G. Testing or inspecting does not relieve Contractor from the responsibility to perform
12 Work to contract requirements.

- 13 H. Retesting required because of non-conformance to specified requirements shall be
14 performed by the same independent firm on instructions by the Engineer. Payment
15 for retesting will be charged to the Contractor by deducting inspecting or testing
16 charges from the Contract Sum/Price.

17 1.11 MANUFACTURERS' FIELD SERVICES AND REPORTS

- 18 A. When specified in individual specification sections, require material or product
19 suppliers or manufacturers to provide qualified staff personnel to observe site
20 conditions, conditions of surfaces and installation, quality of workmanship, start-up
21 of equipment, and test, adjust and balance of equipment as applicable, and to initiate
22 instructions when necessary.

- 23 B. Report observations and site decisions or instructions given to applicators or
24 installers that are supplemental or contrary to manufacturers' written instructions.

- 25 C. Submit report within 30 days of observation to Engineer for information.

26 PART 2 PRODUCTS AND MATERIALS (N/A)

27 PART 3 CONSTRUCTION METHODS (N/A)

28 PART 4 MEASUREMENT AND PAYMENT (N/A)

29

30

END OF SECTION

1 SECTION 01 45 16.11

2
3 CONCRETE QUALITY CONTROL

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover sampling and testing of concrete to
7 determine the materials conformance and work conformance to the requirements
8 specified for cast-in-place concrete.

9 1.02 RELATED WORK ELSEWHERE

- 10 A. Concrete Accessories - Division 03
11 B. Cast-in-Place Concrete - Division 03

12 1.03 APPLICABLE PROVISIONS

- 13 A. Applicable provisions of Division 01 shall govern work of this section.

14 1.04 APPLICABLE PUBLICATIONS

- 15 A. The following publications of the issues listed below, but referred to thereafter by
16 basic designation only, form a part of this specification to the extent indicated by the
17 reference thereto.

- 18 1. American Society for Testing and Materials (ASTM), Annual Book of
19 ASTM Standards:
- 20 a. ASTM C31 - Standard Practice for Making and Curing Concrete Test
21 Specimens in the Field, Current Edition.
 - 22 b. ASTM C39 - Standard Test Method for Compressive Strength of
23 Cylindrical Concrete Specimens, Current Edition.
 - 24 c. ASTM C42 - Standard Test Method for Obtaining and Testing
25 Drilled Cores and Sawed Beams of Concrete, Current Edition.
 - 26 d. ASTM C78 - Standard Test Method for Flexural Strength of Concrete
27 (Using Simple Beam with Third-Point Loading), Current Edition.
 - 28 e. ASTM C114 - Standard Test Methods for Chemical Analysis of
29 Hydraulic Cement, Current Edition.
 - 30 f. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement
31 Concrete, Current Edition.
 - 32 g. ASTM C172 - Standard Practice for Sampling Freshly Mixed
33 Concrete, Current Edition.
 - 34 h. ASTM C173 - Standard Test Method for Air Content of Freshly
35 Mixed Concrete by the Volumetric Method, Current Edition.

- 1 i. ASTM C183 - Standard Practice for Sampling and the Amount of
2 Testing of Hydraulic Cement, Current Edition.
3 j. ASTM C186 - Standard Test Method for Heat of Hydration of
4 Hydraulic Cement, Current Edition.
5 k. ASTM C187 - Standard Test Method for Normal Consistency of
6 Hydraulic Cement, Current Edition.
7 l. ASTM C188 - Standard Test Method for Density of Hydraulic
8 Cement, Current Edition.
9 m. ASTM C192 - Standard Practice for Making and Curing Concrete
10 Test Specimens in the Laboratory, Current Edition.
11 n. ASTM C219 - Standard Terminology Relating to Hydraulic Cement,
12 Current Edition.
13 o. ASTM C231 - Standard Test Method for Air Content of Freshly
14 Mixed Concrete by the Pressure Method, Current Edition.
15 p. ASTM C470 - Standard Specification for Molds for Forming
16 Concrete Test Cylinders Vertically, Current Edition.
17 q. ASTM C823 - Standard Practice for Examination and Sampling of
18 Hardened Concrete in Constructions, Current Edition.
19 r. ASTM E329 - Standard Specification for Agencies Engaged in
20 Construction Inspection and/or Testing, Current Edition.

21 PART 2 PRODUCTS AND MATERIALS (N/A)

22 PART 3 CONSTRUCTION METHODS

23 3.01 TESTING FOR ACCEPTANCE

- 24 A. Samples of concrete shall be delivered to a location on the site where material
25 conformance tests can be performed.
26 1. Samples of concrete shall be obtained in accordance with ASTM C172.
27 2. Test specimens shall be stored without being disturbed for the first 24 hours.
28 3. Sampling and Testing. An independent testing laboratory, engaged and paid
29 for by the Owner, shall conduct tests on the proposed concrete mixture to
30 determine the slump, entrained air content, compressive strength, or other
31 appropriate tests to determine conformance with these specifications.
- 32 B. Contractor shall cooperate with independent firm; furnish samples of materials,
33 design mix, equipment, tools, storage, safe access, and assistance by incidental labor
34 as requested.
35 1. Notify Engineer and independent firm 24 hours prior to expected time for
36 operations requiring services.
37 2. Make arrangements with independent firm and pay for additional samples
38 and tests required for Contractor's use.
- 39 C. Slump and Air Content Tests

1. Slump tests shall be made in accordance with ASTM C143. Air content tests shall be made in accordance with ASTM C173 or ASTM C231. Slump tests and air tests shall always be performed from the same batch from which strength tests are performed.
2. If the measured slump or air content falls outside the limits specified, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the requirements of the specifications and shall not be used in the work.

D. Strength Tests (Contractor's Sampling and Testing for Acceptance). Results from tests conducted by the Contractor shall be considered evidence of compliance of Contractor's materials used in the work, when strength is used as the basis for acceptance.

1. Cylinders for strength tests shall be made in accordance with ASTM C31. During the first 24 hours all test specimens shall be covered and kept at air temperatures between 60 Degrees Fahrenheit and 80 Degrees Fahrenheit in facilities provided on the job site by the Contractor. At the end of 24 hours, specimens will be carefully transported to the testing laboratory, where molds shall be removed, and cylinders shall be cured in a moist condition at 73.4 Degrees Fahrenheit \pm 3.0 Degrees Fahrenheit until time of test.
2. A strength test for any class of concrete shall consist of four standard cylinders made from a composite sample secured from a single load of concrete in accordance with ASTM C172, with one cylinder tested at 7 days, two at 28 days, and the fourth used as a spare. The test results at 28 days shall be the average of the strength of two specimens determined in accordance with ASTM C39, except that if one specimen in a test shows manifest evidence of improper sampling, molding or testing, it shall be disregarded and the spare cylinder shall be tested.

E. Strength Test (For Early Formwork or Shoring Removal). If the Contractor wishes to remove formwork or shoring prior to the minimum time as specified in Structural Cast-In-Place Concrete Forming - Division 03, they shall, at their expense, prepare test cylinders as evidence of concrete strength as follows:

1. Cylinders shall be made in accordance with ASTM C31. During the period of time from completion of the pour to removal of protective cover and stripping of forms, all test specimens shall be kept with the pour and be subjected to ambient conditions resulting from the curing and protection facilities provided on the job site by the Contractor. At the end of this period, specimens will be carefully transported to the testing laboratory, where molds shall be removed and cylinders shall be stored in outdoor ambient conditions to simulate on job site conditions until time of test.
2. A minimum of two cylinders made from a composite sample secured from a single load of concrete in accordance with ASTM C172. The test results shall be the average of the strength of two specimens determined in accordance with ASTM C39, except that if one specimen in a test shows

1 manifest evidence of improper sampling, molding or testing, it shall be
2 disregarded.

3 3.02 SELECTION OF TESTING LABORATORY

- 4 A. An independent testing laboratory to perform Concrete Quality Control shall meet
5 the requirements of ASTM E329. The laboratory shall be selected by the Owner.

6 3.03 TEST REPORTS

- 7 A. Test reports will be directly distributed by the laboratory to the Owner, Engineer, and
8 Contractor.

9 3.04 TESTING REQUIREMENTS

- 10 A. Tests shall be required to perform one test for each 50 cubic yards of concrete
11 poured, or fraction thereof, for each class of concrete used. Each test shall consist of
12 four (4) cylinders; one (1) to be tested at seven (7) days, two (2) to be tested at
13 twenty-eight (28) days, and one (1) to be a spare.
- 14 B. Compliance testing shall be performed on every single load, or portion thereof,
15 where water addition to the single load, or portion thereof, takes place on site.
- 16 C. A minimum of one (1) test shall be performed per day for each class of concrete
17 placed.

18 3.05 CONDITIONS OF COMPLIANCE AND NON-COMPLIANCE

19 A. Compliance of Contractor's Materials Used in the Work.

- 20 1. To conform to the requirements of this specification, every 28-day test
21 representing each mix must be equal to or greater than the specified
22 minimum strength without exception. If a specimen shows manifest
23 evidence of improper sampling, molding, or testing, it will be disregarded.
24 Note, however, that the anticipated strength for all mixes is appreciably
25 above the specified minimum strength due to quality required by the water-
26 cement ratio specified.

27 B. Non-Compliance of Contractor's Materials Used in the Work

- 28 1. When strength is used as the basis for acceptance, should individual tests of
29 the Contractor's specimens produce strengths less than 90% of the specified
30 strength ($f'c$), tests of cores drilled from the area in question may be required
31 in accordance with ASTM C42. Three cores shall be taken for each cylinder
32 test less than 90% of the specified strength ($f'c$). If the concrete in the
33 structure will be dry under service conditions, the cores shall be air dried
34 (temperature 60 to 80°F, relative humidity less than 60 percent) for seven (7)
35 days before test and shall be tested dry. If the concrete in the structure will

1 be more than superficially wet under service conditions, the cores shall be
2 immersed in water for at least 48 hours and tested wet.

- 3 2. Concrete represented by the core tests will be considered structurally
4 adequate and meet the requirements of this specification if the average of the
5 three cores is equal to at least 95 percent of the specified strength ($f'c$) and if
6 no single core is less than 90 percent of $f'c$. To check testing accuracy,
7 locations represented by erratic core strengths may be retested. If these
8 strength acceptance criteria are not met by the core tests, the Engineer shall
9 order appropriate action at no additional cost to the Owner.

10 PART 4 MEASUREMENT AND PAYMENT

11 4.01 GENERAL

- 12 A. All work specified herein shall be considered in the measurement and payment
13 method stipulated.

14 4.02 CONCRETE QUALITY CONTROL

- 15 A. Concrete Quality Control, Inclusive. All required sampling, preparing of specimen
16 and testing, except as modified by these specifications shall be performed by an
17 independent testing laboratory engaged and paid for by the Owner. Contractor shall
18 assist the independent laboratory by making the site and sampling locations
19 accessible for the specified testing. All costs shall be inclusive to the lump sum bid
20 item for the Lift Station.

21 B. Additional Testing.

- 22 1. The cost of any additional testing required because of failure of concrete to
23 meet specification requirements shall be borne by the Contractor for tests
24 which fail to comply with the specifications. All tests required under
25 Paragraph 3.05 "Conditions of Compliance and Non-Compliance", above
26 shall be borne by the Contractor.
27

28 END OF SECTION

SECTION 01 73 00

EXECUTION

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS (NONE)

1.03 DESCRIPTION OF WORK

A. The Work included under this section is related to the replacement of the James Street Lift Station as specified herein.

B. The Contractor shall be responsible for performing the work according to a sequence of construction that will not adversely affect the continued operation, performance, or reliability of the sewage conveyance systems and related systems during construction. The Contractor shall provide temporary facilities, including bypass pumping equipment and bypass piping as necessary to ensure that the existing sewage conveyance system continues to provide service required during the construction of the new facilities. If interruption of sewage conveyance systems or power outage is proposed/required, the Contractor shall provide temporary facilities to replace the disrupted operations.

1. The Contractor will be responsible to provide and operate all temporary pumps, automatic controls, equipment, and temporary piping to maintain operation of the existing wastewater conveyance facility during construction and implement phased construction in the recommended sequence.

C. The Work includes selective demolition and the replacement of the existing Lift Station, controls, electrical services, sanitary sewer, force main, various equipment and piping, along with the demolition of the existing structures, and the construction of new structures, equipment and piping that will impact the operation of the existing facilities.

D. Contractor shall provide manpower, labor, and equipment as needed to implement the start-up of newly constructed and modified facilities and implement the shutdown of existing facilities one-at-a-time prior to construction modifications.

1.04 RELATED WORK ELSEWHERE

A. All Sections of this Project Manual

1.05 SUBMITTALS

A. Where the work impacts the operation of the existing facilities and new construction, the Contractor shall submit a detailed sequence of construction and daily schedule

1 that demonstrates the ability to maintain the necessary reliability and performance of
2 the sewage conveyance system. Where temporary facilities are required, the
3 Contractor shall submit detail of the equipment and materials that will be provided to
4 ensure the reliability and performance of the facilities.

5 1.06 CRITICAL DELIVERY OF EQUIPMENT AND MATERIALS

- 6 A. No extra time or additional costs will be allowed by the Owner for any cause for
7 delay in the delivery of products, materials, and equipment required in this Project.

8 1.07 OPERATION/MAINTENANCE MANUALS AND INSTRUCTION (NONE)

9 PART 2 PRODUCTS AND MATERIALS (N/A)

10 PART 3 CONSTRUCTION METHODS

11 3.01 SEQUENCE OF CONSTRUCTION

- 12 A. The following sequence of construction is included as a guide for the Contractor for
13 construction of the lift station and forcemain. Contractor may need to consider other
14 factors in the overall sequence and schedule that are not discussed in the Section but
15 are specified in the Contract Documents.

- 16 B. The Contractor is responsible for their sequence of construction and the construction
17 schedule. The Contractor shall clearly define their intended sequence of construction
18 in the submitted construction schedule. The intent of the following sequence of
19 construction is to ensure the continued performance and reliability of the existing
20 facilities during construction and to ensure the successful start-up of all new
21 facilities. Deviations from the following sequence of construction shall be identified
22 by the Contractor at the Pre-Construction Meeting for discussion and approval by
23 Owner and Engineer.

24 C. Suggested Sequence of Construction

- 25 1. Removal and Replacement of Sanitary Sewer on East James Street (3100
26 block)
- 27 a. Remove/Replace Sanitary Sewer beginning at SAS#1 until
28 approximately 17+50. Connect all laterals to new Sanitary Sewer.
29 b. Relocate lateral for residence at 3137 James Street
30 c. Provide temporary sanitary sewer to connect SAS #1 into existing lift
31 station.
- 32 2. Relocate watermain on James Street
- 33 3. Construct the proposed Forcemain on James Street
- 34 a. Construct proposed forcemain beginning at approximately STA.
35 15+75 to STA. 22+60.96 including construction of SAS #100.
36 b. Install temporary piping and connection for use with bypass pumping
37 equipment at STA. 15+75.

- 1 4. Complete remaining utility work as specified in the Contract Documents
- 2 5. Install Temporary Bypass Pumping System
- 3 a. Install temporary bypass pumps in SAS #1. A minimum of two (2)
- 4 pumps shall be utilized including automated operation with a float
- 5 tree. Contractor shall submit information on pump model, capacity,
- 6 and proposed layout.
- 7 b. Pumps shall be connected through temporary piping to the new
- 8 forcemain. Contractor shall utilize quick-connects, isolation valves,
- 9 and check valves for reliability. Contractor shall submit the proposed
- 10 bypass piping layout for review by the Owner and Engineer.
- 11 c. Temporary pumping system shall remain in-place until the new lift
- 12 station is commissioned.
- 13 6. Demolish Existing Lift Station
- 14 a. Contractor shall provide a minimum of seven (7) days' notice to the
- 15 Owner prior to beginning demolition of the existing lift station.
- 16 Contractor shall disconnect all utilities from existing lift station prior
- 17 to beginning demolition.
- 18 7. Construct new Lift Station
- 19 8. Construct remaining proposed forcemain from new lift station to forcemain
- 20 previously installed to STA 15+75.
- 21 9. Start up, and test the new lift station including pumps, controls and standby
- 22 generator.
- 23 10. Discontinue and disconnect Temporary Bypass Pumping System after the
- 24 new lift station is commissioned.
- 25 a. Commissioning of new lift station shall include all controls, back-up
- 26 power, monitoring, alarms, and telemetry.

- 27 D. Utilities (new water, gas and electric service) associated with lift station and
- 28 generator structures shall be installed and operational for start-up of new pollution
- 29 control equipment and prior to abandonment and/or demolition of existing utilities in
- 30 accordance with the demolition plan.

- 31 E. The Contractor shall coordinate all work to be completed without disruption to the
- 32 collection and pumping of sewage. Contractor shall not cause a sewer system
- 33 overflow, or back-up of the sewage system. Contractor is responsible for all costs
- 34 that may be incurred due to a disruption in the collection and pumping of sewage.

35 PART 4 MEASUREMENT AND PAYMENT

36 4.01 EXECUTION

- 37 A. General. Execution of the project shall be paid for at the bid price in accordance
- 38 with one of the following methods, unless indicated otherwise in the Bid Schedule or
- 39 Special Provisions.
- 40 1. Execution, Inclusive. All costs associated with execution of the project in a
- 41 manner that ensures the continued performance and reliability of the sewage

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conveyance systems shall be included in the Lump Sum bid price for the Lift Station.

END OF SECTION

1 SECTION 02 41 16

2
3 STRUCTURE DEMOLITION

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent indicated by the
9 reference thereto.

- 10 1. American National Standards Institute (ANSI) Specifications and Standards:
11 a. ANSI A10.6 - Safety Requirements for Demolition, Current Edition.
12 2. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational
13 Safety and Health Administration (OSHA), Department of Labor, Part 1926
14 Regulations, Current Edition.

15 1.03 DESCRIPTION OF WORK

16 A. The work under this section shall cover furnishing all materials, equipment, tools,
17 labor and supervision necessary to remove equipment, adapt for new equipment, and
18 dispose of unused materials as indicated upon contract drawings and as specified
19 herein.

20 B. Comply with applicable rules, regulations, codes, and ordinances of local, state, and
21 federal authorities including ANSI A10.6, Safety Requirements for Demolition.

22 C. Contractor shall sequence work to enable uninterrupted operation of the facility to
23 the extent of practical limits, and as determined by Engineer.

24 1.04 RELATED WORK ELSEWHERE

25 A. Article 203 – Removal of Miscellaneous Structures

26 B. Packaged Sewage Lift Station – Division 33

27 1.05 SUBMITTALS

28 A. Submit detailed sequence of operation for structure demolition and removal work in
29 accordance with City submittal to ensure minimum interruptions of Owner's
30 operations. Submit timeline indicating removal and placement of proposed
31 equipment.

32 B. Submit detailed information for weather protection, dust protection, openings
33 required if any in protection walls, sealing system for perimeter of opening and wall.

1 C. Submit certificates and/or letters as evidence of discontinuation of services to
2 building or structure requiring removal from appropriate agencies and evidence of
3 discontinuation of water or electrical lines used for structure demolition purposes.

4 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

5 PART 2 PRODUCTS AND MATERIALS

6 2.01 EQUIPMENT

7 A. Use normal equipment for structure demolition purposes which meet all safety
8 requirements imposed on such equipment.

9 2.02 REMOVAL OF ITEMS

10 A. Items noted to be turned over to Owner shall be delivered to location on property
11 where designated by Owner.

12 B. Refer to contract drawings and Special Provisions for a list of items to be removed.

13 2.03 ITEMS FOR STORAGE

14 A. Items noted for storage shall be delivered to location on site at Contractor's
15 discretion until reincorporated into the Work.

16 PART 3 CONSTRUCTION METHODS

17 3.01 GENERAL

18 A. Conditions existing at time of inspection for bidding purposes will be maintained by
19 the Owner to the extent practicable. Owner shall have the right to salvage any
20 existing equipment and furnishings.

21 B. Owner assumes no responsibility for subsurface conditions on site. Become familiar
22 with subsurface conditions at the site. Owner assumes no responsibility for actual
23 conditions of structures and appurtenances to be demolished. Become familiar with
24 actual condition of structures and appurtenances.

25 C. Perform structure demolition work required in connection with this project with due
26 care, including shoring and bracing. Be responsible for any damage which may be
27 caused by such work to any part or parts of existing building which is to remain.
28 Where necessary to prevent collapse of any construction, install temporary shores,
29 struts, or bracing. Do not commence structure demolition work until all temporary
30 construction is complete.

1 3.02 POLLUTION CONTROLS

- 2 A. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust
3 and dirt rising and scattering in air to lowest level practical. Clean adjacent
4 structures and improvements of dust, dirt, and debris caused by structure demolition
5 operations. Return adjacent areas to condition existing prior to start of the work.
- 6 B. Comply with governing regulations pertaining to environmental protection.

7 3.03 BELOW-GRADE DEMOLITION

- 8 A. Demolish and remove below-grade wood, metal construction, and floor construction
9 as directed upon contract drawings. Demolish all abandoned structures to a depth of
10 not less than 24 inches below the existing ground surface, or 24 inches below
11 planned finish grade, whichever is lower.
- 12 B. All abandoned structures or tanks which could hold moisture shall have drain holes
13 cut through the bottom, or the structures or tanks shall be otherwise breached to
14 allow moisture to pass.
- 15 C. Cap, with appropriate thrust restraint, all abandoned piping and conduit for a
16 complete, permanent abandonment. Provide thrust restraint with a poured concrete
17 reaction block in accordance with the contract drawings.
- 18 D. Completely fill below-grade areas and voids resulting from demolition. Use
19 satisfactory soil materials consisting of stone, gravel, and sand, free from debris,
20 trash, frozen materials, roots and other organic matter. Prior to placement of fill
21 materials, ensure that areas to be filled are free of standing water, trash and debris.
22 Place fill materials in horizontal layers not exceeding 6 inches in loose depth.
23 Compact each layer at optimum moisture content of fill material to a density equal to
24 original adjacent ground, unless subsequent excavation for new work is required.
- 25 E. Coordinate activities to permit access by other trades required for the work, enabling
26 them to complete work which is assigned to them. Accomplish all work required by
27 contract drawings, including work specifically noted plus additional work related to
28 specific work noted.

29 3.04 SELECTIVE DEMOLITION

- 30 A. Demolish masonry and concrete in small sections. Use braces and shores as
31 necessary to support the structure of the building and protect it from damage. Where
32 limits of demolition are exposed in the finish work, cut with saws, providing a
33 straight line, plumb, true, and square.
- 34 B. Disconnect services to equipment at unions, flanges, valves, or fittings. Remove
35 and/or demolish plumbing, mechanical, and electrical components not requiring

1 salvage or reuse. Remove and/or demolish to penetration point at floor, ceiling, and
2 wall or surface, as applicable. Cut fire electrical systems in such a manner as to
3 insure continued operation of the systems in remaining buildings.

- 4 C. Leave exposed existing floor, ceiling, and wall or surface in suitable condition for
5 receiving new finish.

6 3.05 PROTECTION

- 7 A. Make such explorations and probes as necessary to ascertain any required protection
8 measures before proceeding with demolition and removal work. Provide protection
9 for workmen, public, adjacent construction, and occupants of existing building(s).
10 Provide protection for adjacent private property. Promptly repair damages caused to
11 adjacent facilities at no cost to Owner.

- 12 B. Provide and maintain adequate catch platforms, warning lights, barricades, guards,
13 weather protection, dust protection, fences, planking, bracing, shoring, piling, signs,
14 and other items required for proper protection.

- 15 C. Explosives shall not be used. Use no equipment or methods of operation which will
16 cause damage to adjoining buildings either by direct contact or by transmission.

17 3.06 UTILITY SERVICES

- 18 A. Maintain existing utilities indicated to remain, keep in service, and protect against
19 damage during demolition operations.

20 3.07 DISPOSAL

- 21 A. Remove all disposable material and equipment indicated and properly dispose of at
22 off-site location of Contractor's choice. Storage of disposable materials and
23 equipment on site shall not be permitted.

- 24 B. Burning of debris on site is not permitted.

25 3.08 RESTORATION

- 26 A. Restore the site after demolition operations are complete.

- 27 B. Restore interior and exterior building surfaces with similar materials and to a
28 condition equal to or better than previously existed. Refer to the finish schedules of
29 the contract drawings and specifications for materials and finishes specified.

- 30 C. Restore site with similar materials, and to a condition equal to or better than
31 previously existed. Perform grading in accordance with final grading requirements
32 as indicated on the contract drawings.

1 SECTION 03 11 13

2
3 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

6 A. The work covered under this section shall consist of furnishing all materials,
7 equipment and labor required to furnish all formwork for cast-in-place concrete as
8 shown on the contract drawings and specified herein.

9 B. The work shall include formwork, shoring for cast-in-place concrete, and installation
10 into formwork of items by other such as anchor bolts, setting plates, bearing plates,
11 anchorages, inserts, frames, nosings and other items to be embedded in concrete.

12 1.02 RELATED WORK ELSEWHERE

13 A. Concrete Accessories - Division 03

14 B. Concrete Reinforcing - Division 03

15 C. Cast-in-Place Concrete - Division 03

16 1.03 APPLICABLE PROVISIONS (NONE)

17 1.04 APPLICABLE PUBLICATIONS

18 A. The following publications of the issues listed below, but referred to thereafter by
19 basic designation only, form a part of this specification to the extent indicated by the
20 reference thereto.

- 21 1. American Concrete Institute (ACI) Annual Book of ACI Standards:
22 a. ACI 117/177R - Specifications for Tolerances for Concrete
23 Construction and Materials and Commentary, Current Edition.
24 b. ACI 347 - Guide to Formwork for Concrete, Current Edition.
25 c. ACI SP-4 - Formwork for Concrete, Current Edition.
26 2. American Plywood Association (APA) Specifications and Standards:
27 a. APA PS1 - Plywood Design Specification, Current Edition.

28 PART 2 PRODUCTS AND MATERIALS

29 2.01 DESIGN

30 A. The design and engineering of the formwork and its accessories shall be the
31 responsibility of the Contractor. Formwork shall be designed, erected, supported,
32 braced and maintained so as to safely support all vertical and lateral loads until such
33 loads can be supported by the concrete structure.

1 B. Determination of loads and design shall be in accordance with ACI 301 and ACI
2 347.

3 2.02 FORMS

- 4 A. Forms may be wood, plywood, concrete-form-grade hardboard, metal or other
5 acceptable material which will produce smooth, true surfaces.
6 1. Provide lumber dressed on at least two edges and one side for tight fit.
7 2. Metal forms shall have smooth surfaces free from any pattern, irregularities,
8 dents, bends and sags.

9 2.03 SHORING

- 10 A. All shoring members shall be of such design and material to safely support all dead
11 and working loads throughout the placing and curing period. Shoring shall be placed
12 to prevent sagging and settlement.

13 2.04 FORM TIES AND ACCESSORIES

- 14 A. Form ties shall be factory-fabricated, adjustable-length, removable or snapoff metal,
15 designed to prevent form deflection, and to prevent spalling concrete surfaces upon
16 removal.
17 B. For exposed concrete surfaces, provide ties so that the portion remaining with the
18 concrete after removal is 1 inch to 1-1/2 inches inside the finished face of the
19 concrete.
20 C. Unless otherwise indicated, provide form ties which will not leave holes larger than 1
21 inch in diameter in concrete surfaces.

22 2.05 FORM COATING COMPOUND

- 23 A. Form coating compound shall be a commercial formulation that will not bond with,
24 stain, nor adversely affect concrete surfaces and not impede the wetting of surfaces
25 to be cured with water or curing compounds. Forms for concrete surfaces requiring
26 subsequent treatment shall receive a type of coating that will not impair bond or
27 adhesion.
28 B. Form coating compound for steel forms shall conform with all requirements stated
29 above and shall be of rust-preventative type.

30 PART 3 CONSTRUCTION METHODS

31 3.01 GENERAL

- 32 A. Responsibility. The design and construction of formwork shall be the sole
33 responsibility of the Contractor.

- 1 B. Earth forms are not acceptable or permitted.
- 2 C. Construct forms to the exact sizes, shapes, lines and dimensions shown, as required
3 to obtain accurate alignment, location, grades, level and plumb in finished
4 construction and to maintain tolerances in accordance with ACI 301. Provide for
5 openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets,
6 chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features
7 required. Chamfer all corners of concrete exposed to view using chamfer strips. Use
8 selected materials to obtain required finishes.
- 9 D. Forms shall be sufficiently tight to prevent leakage of concrete. Temporary openings
10 shall be provided in the inside form of all wall forms and in column forms to
11 facilitate cleaning and inspection immediately before placing concrete.
- 12 E. Assemble forms so their removal will not damage concrete and adjacent materials.

13 3.02 FORMWORK

- 14 A. Forms shall conform in general to shape, line, grade and dimensions of members as
15 shown on contract drawings, and shall have the strength and stability to insure
16 finished concrete within the tolerances specified in ACI 347.
- 17 1. Provide openings in concrete formwork to accommodate work of other
18 trades. Determine size and location of openings, recesses and chases from
19 those other trades.
- 20 2. Exterior edges of all exposed concrete, unless otherwise specified, shall have
21 a chamfer strip placed in form to provide bevel of sharp edges. Chamfer
22 strips shall be 3/4-inch by 3/4-inch by 45° wood, plastic, or rubber.
- 23 3. Accurately place and secure in position, prior to placing concrete, all
24 anchors, bolts, inserts and other items furnished under other sections of the
25 specifications and for other contractors on the project.
- 26 B. Formwork shall be mortar-tight and sufficiently rigid to prevent displacement or
27 sagging between supports.
- 28 C. Formwork shall be properly braced or tied together so as to maintain position and
29 shape and insure safety to workman and passersby.
- 30 D. Temporary openings may be provided on all wall and column forms to limit the free
31 fall of the concrete to less than 4 feet and should be so located as to facilitate the
32 placing and consolidation of the concrete. The ports shall be spaced no more than
33 6 feet apart to limit the horizontal flow of concrete.
- 34 E. All forms shall be cleaned and rubbed smooth prior to placing to insure true forming
35 surfaces for all concrete surfaces.

1 3.03 FORM TIES AND ACCESSORIES

- 2 A. Internal wall ties shall contain positive stops at the required wall thickness. The
3 exterior clamp portions of the pipe shall be adjustable to permit tightening of forms.
4 Ties shall provide a positive disconnection 1 inch to 1-1/2 inches inside the finished
5 face of the concrete. Cutting ties back from face of wall or use of wire ties will not
6 be permitted. All tie and plug holes shall be filled with non-shrink grout after forms
7 are removed.
- 8 B. All concrete tie locations shall be watertight. Wall ties shall be fitted with tapered
9 rubber plugs at all locations.
- 10 C. Accessories shall be used only for the purpose intended and shall in no way interfere
11 with the placing of concrete. Removal of accessories shall in no way impair or
12 disturb finish concrete surfaces. Accessories shall be compatible with formwork and
13 ties and shall maintain the watertight integrity of the formwork system.
- 14 D. Design of all form ties and accessories shall be adequate for all concrete placement,
15 horizontal and vertical, to prevent failures and blowouts.

16 3.04 FORM COATINGS

- 17 A. Coat form contact surfaces with form bond breaker compound before reinforcement
18 is placed. Do not allow excess form coating material to accumulate in the forms or
19 to come into contact with surfaces against which fresh concrete will be placed.
20 Apply in compliance with manufacturer's instructions.
- 21 B. Coat steel forms with form oil or otherwise protect against rusting. Rust-stained
22 steel formwork is not acceptable.
- 23 C. Clean reinforcing steel that has become contaminated with form coating to the
24 satisfaction of the Engineer prior to placing concrete.

25 3.05 EMBEDDED ITEMS

- 26 A. Items embedded in concrete shall be properly cleaned to be free from oil or foreign
27 matter that would weaken the bond of the concrete to these items.
- 28 B. Install in the formwork requisite inserts, anchors, sleeves and other items specified
29 under other sections of these specifications; close end conduits, piping and sleeves
30 embedded in concrete with caps or plugs.
- 31 C. Conduits or pipes embedded in slabs of larger outside diameter than 1-1/2 inches, or
32 when pipes and conduits come closer than 1 inch from either the upper or lower
33 surface of the slab, provide expanded metal or wire mesh laid and extended beyond
34 conduit or piping at least 8 inches on all sides; space conduits or pipes closer than 3

1 diameters on centers, place to avoid changing locations of reinforcement for
2 indicated locations.

3 3.06 CONSTRUCTION JOINTS

- 4 A. Make construction joints where indicated on the contract drawings; additional
5 construction joints are subject to prior approval of the Engineer; locate additional
6 construction joints to least impair the strength of the structure.
- 7 B. Form keyways and joints as indicated on the contract drawings.
- 8 C. Continue reinforcing steel and wire fabric across construction joints, unless noted
9 otherwise.
- 10 D. Install joint filler at locations indicated on the contract drawings; extend filler from
11 bottom of concrete; joints shall be carefully cleaned, free from dust, mortar or other
12 loose materials before installation; seal as indicated on the contract drawings.

13 3.07 EXPANSION JOINTS

- 14 A. Expansion joints shall be placed where indicated on the contract drawings;
15 reinforcement, corner protection angles or other fixed metal items embedded in or
16 banded to continuously shall not extend through expansion joints; finish concrete slab
17 edges along expansion joints neatly with slightly rounded edging tool; leave joints in
18 the completed work carefully tooled and free of mortar and concrete.
- 19 B. Joints between slabs on earth and vertical surfaces, including columns, piers, walls,
20 machinery foundation and other fixed structures shall have expansion joint material
21 placed on abutting vertical surfaces.
- 22 C. Joints to receive joint compound shall have premolded expansion filler strips at
23 proper level placed below finished floor with slightly tapered, dressed, oiled wood
24 strip secured temporarily to top thereof; install wood strip of depth to form groove at
25 least 1 inch deep; after concrete has set, remove strip; fill groove with light colored
26 joint compound for poured application; fill joint grooves flush, to be slightly
27 concave, after drying as specified in Joint Sealers - Division 07.

28 3.08 CONTROL JOINTS

- 29 A. Install vertical control joints as indicated on the contract drawings, and where not
30 indicated not more than 20 feet apart; locate specifically as follows:
 - 31 1. Place not over 10 feet from corners or offsets; where concrete walls change
32 either thickness or height; where change in wall sections occurs.
 - 33 2. At each control joint, extend only alternate horizontal reinforcement bars
34 through the joint; seal control joints with concrete colored joint compound.

- 1 B. Install control (contraction) joints in slabs as indicated on the contract drawings, and
2 where not indicated locate specifically as follows:
3 1. Space at a minimum of 25 feet on center; at each joint, cut reinforcing mesh
4 so only alternate wires extend through joint.
5 2. Resulting panels shall be approximately square; elongated and L-shaped
6 panels shall not be acceptable.
7 3. Provide 1/4 inch wide saw - cut control joints to a depth equivalent to 1/3 the
8 slab thickness; cut as soon as the slab will support the weight of the saw and
9 operator and not damage the surface and not more than 8 hours after
10 completion of concrete placement.
- 11 C. Apply joint compound to all control and construction joints after concrete has
12 sufficiently cured; clean joint slot; fill joint with light colored compound for poured
13 application; fill joint grooves flush, to be slightly concave after drying, as specified
14 in Joint Sealers - Division 07.

15 3.09 FORM/SHORING REMOVAL

- 16 A. Arrange forms to allow stripping without removal of principal shores, where required
17 to remain in place.
- 18 B. Removal of forms shall be accomplished in such a manner as will prevent injury to
19 concrete and insure complete safety of structure. Removal times listed below are
20 minimum and may be increased by the Engineer as job conditions warrant.
21 1. Where structure as a whole is supported on shores, vertical forms such as
22 beam and girder sides, columns, and similar vertical forms may be removed
23 24 hours after completion of pour, providing concrete has hardened
24 sufficiently to sustain its own weight and to prevent injury.
25 2. Wall forms shall not be removed in less than 24 hours after pouring, unless
26 otherwise required for curing.
27 3. Supporting forms and shoring must remain in place until concrete can carry
28 any loads to be imposed upon it and in no case shall be removed in less than
29 seven (7) days.
30 4. Forms ties, requiring any operation in removal of forms which would tend to
31 destroy bond between tie and concrete in order to remove form, shall not be
32 disturbed for seven (7) days after completion of pour.
33 5. The time periods stipulated above may be reduced if strength results of
34 concrete so indicate adequate conditions.
- 35 C. Notify the Engineer before the forms are removed in order that an examination of the
36 newly-stripped surfaces may be made prior to patching.

37 3.10 REPAIR TIE HOLES

- 38 A. After removal of form tie, the holes shall be filled as follows:
39 1. Thoroughly clean and dampen.

- 1 2. Fill solid with patching mortar.
- 2 B. Make repairs uniform in color and finish with surrounding concrete.

3 3.11 EXPOSED SURFACES

- 4 A. Exposed surfaces shall be Carborundum rubbed to take off fins; fill pores, stone
5 pickets, honeycombs, etc., with non shrink grout as follows:
- 6 1. Repair immediately after form removal and inspection by the Engineer.
- 7 2. Remove concrete surrounding defect to sound concrete, then wet affected
8 area.
- 9 3. Brush on bonding agent, mixed and applied in accordance with
10 manufacturer's recommendations.
- 11 4. Consolidate patch grout and strike off to leave the patch slightly higher than
12 the surrounding surface.
- 13 5. Finish the repaired area flush with the surrounding area after the patch has
14 been in place for one hour, or as prescribed by the manufacturer.
- 15 B. Perform patching before curing compound is applied; cure patched areas in the same
16 manner as adjacent concrete; make repairs uniform in color and finish with
17 surrounding concrete.
- 18 C. Exposed surfaces shall be protected from excessive sun, wind and rain, and kept wet
19 until curing compound is applied. When ambient temperature falls below 40°F heat
20 aggregate and mixing water; clear all forms, reinforcement and subgrade of snow and
21 ice; cover all freshly placed concrete with tarpaulins, and provide heat to maintain a
22 temperature of 70°F for at least three days or 50°F for five days; rate of cooling after
23 end of protection period shall be accomplished in a manner approved by the
24 Engineer.

25 3.12 REUSE OF FORMS

- 26 A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed,
27 delaminated or otherwise damaged form facing material will not be acceptable.
28 Apply new form coating compound material to concrete contact surfaces as specified
29 for the new formwork.
- 30 B. When forms are extended for successive concrete placement, thoroughly clean
31 surfaces, remove fins and laitance, and tighten forms to close all joints. Align and
32 secure joints to avoid offsets.
- 33 C. Do not use "patched" forms for concrete surfaces exposed to view.

1 PART 4 MEASUREMENT AND PAYMENT

2 4.01 GENERAL

3 A. Structural cast-in-place concrete forming shall be paid for at the bid price in
4 accordance with one of the following methods, unless indicated otherwise in the Bid
5 Schedule.

6 B. All work specified herein shall be considered in each of the measurement and
7 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule.

8 4.02 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

9 A. Structural Cast-in-Place Concrete Forming, Inclusive. When no quantity is provided,
10 structural cast-in-place concrete forming shall be considered inclusive to payment for
11 work associated with cast-in-place concrete.
12

13 END OF SECTION

1 SECTION 03 15 00

2
3 CONCRETE ACCESSORIES

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover furnishing and installing concrete accessories
7 as shown on the contract drawings and specified herein.

8 1.02 RELATED WORK ELSEWHERE

- 9 A. Structural Cast-In-Place Concrete Forming - Division 03
10 B. Cast-in-Place Concrete - Division 03

11 1.03 APPLICABLE PROVISIONS (NONE)

12 1.04 APPLICABLE PUBLICATIONS

- 13 A. The following publications of the issues listed below, but referred to thereafter by
14 basic designation only, form a part of this specification to the extent indicated by the
15 reference thereto.
- 16 1. American Society for Testing and Materials (ASTM), Annual Book of
17 ASTM Standards:
 - 18 a. ASTM C171 - Standard Specification for Sheet Materials for Curing
19 Concrete, Current Edition.
 - 20 b. ASTM C272 - Standard Test Method for Water Absorption of Core
21 Materials for Structural Sandwich Constructions, Current Edition.
 - 22 c. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding
23 Systems for Concrete, Current Edition.
 - 24 d. ASTM C882 - Standard Test Method for Bond Strength for Epoxy-
25 Resin Systems Used with Concrete by Slant Shear, Current Edition.
 - 26 e. ASTM D6 – Standard Test Method for Loss on Heating of Oil and
27 Asphaltic Compounds, Current Edition.
 - 28 f. ASTM D297 – Standard Test Methods for Rubber Products -
29 Chemical Analysis, Current Edition.
 - 30 g. ASTM D994 – Standard Specification for Preformed Expansion Joint
31 Filler for Concrete (Bituminous Type), Current Edition.
 - 32 h. ASTM D1751 – Standard Specification for Preformed Expansion
33 Joint Filler for Concrete Paving and Structural Construction
34 (Nonextruding and Resilient Bituminous Types), Current Edition.
 - 35 i. ASTM D1752 – Standard Specification for Preformed Sponge
36 Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete
37 Paving and Structural Construction, Current Edition.

2. Federal Specification TTS 227 and TTS 230, Current Edition.

1.05 SUBMITTALS

A. Contractor shall submit such product literature and catalog cuts of materials to be supplied to the rate these materials to the specifications. Information shall be in conformance with requirements of City submittals.

1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

PART 2 PRODUCTS AND MATERIALS

2.01 EXPANSION AND CONTRACTION JOINT FILLER

A. Preformed Bituminous. Bituminous expansion and contraction joint filler shall be preformed bituminous strips which complies with ASTM D994.

B. Removable Plastic Expansion Joint Cap: Snap-Cap by W.R. Meadows.

2.02 BOND BREAKER

A. Cast-in-Place Concrete Flatwork. Asphalt impregnated felts, 15 pound.

B. Cast-in-Place Concrete Formwork. Non-staining liquid product which imparts a waterproof film to prevent adhesion of concrete and will not leave a paint-impeding coating on the face of the concrete.

2.03 WATERPROOF SHEET MATERIAL FOR CURING

A. Provide one of the following, complying with ASTM C171: waterproof paper, polyethylene film or polyethylene-coated burlap.

B. Use only materials which are resistant to decay when tested in accordance with ASTM E154, as follows:

1. Polyethylene sheet not less than 6 mils thick; or
2. Water resistant barrier paper consisting of heavy papers laminated together with glass fiber reinforcement and overcoated with black polyethylene on each side.

2.04 CONCRETE REPAIR COMPOUND

A. Concrete repair compound shall be Sonopatch, Sonneborn Building Products; Embecco 411 Mortar, Master Builders, or equal.

2.05 PIPE SLEEVES AND ANCHOR BOLTS

A. Shall be furnished, installed, and anchored solid in their final location.

1 PART 3 CONSTRUCTION METHODS

2 3.01 INSTALLATION

- 3 A. Install accessories where shown on contract drawings and as specified herein.
- 4 B. Place bond breaker at junctures of slabs-on-grade with vertical walls.
- 5 C. Install expansion joint according to manufacturer's instructions; brace securely to
6 prevent displacement.
- 7 D. Seal all exposed surfaces of expansion and contraction joints with joint sealer
8 (3/4 inch deep and hold 1/8 inch below surface of concrete).

9 PART 4 MEASUREMENT AND PAYMENT

10 4.01 GENERAL

- 11 A. Concrete accessories shall be paid for at the bid price in accordance with one of the
12 following methods, unless indicated otherwise in the Bid Schedule.
- 13 B. All work specified herein shall be considered in each of the measurement and
14 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule.

15 4.02 CONCRETE ACCESSORIES

- 16 A. Concrete Accessories, Inclusive. When no quantity is provided, concrete accessories
17 shall be considered inclusive to payment for work associated with cast-in-place
18 concrete.

19
20

END OF SECTION

1 SECTION 03 20 00

2
3 CONCRETE REINFORCING

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover furnishing and installing concrete reinforcing
7 as shown on the contract drawings and as specified herein.

8 1.02 RELATED WORK ELSEWHERE

- 9 A. Concrete Accessories - Division 03
10 B. Cast-in-Place Concrete - Division 03

11 1.03 APPLICABLE PROVISIONS (NONE)

12 1.04 APPLICABLE PUBLICATIONS

- 13 A. The following publications of the issues listed below, but referred to thereafter by
14 basic designation only, form a part of this specification to the extent indicated by the
15 reference thereto.
- 16 1. American Concrete Institute (ACI) Specifications and Standards:
 - 17 a. ACI 315 - Manual of Standard Practice for Detailing Reinforced
18 Concrete Structures, Current Edition.
 - 19 b. ACI 318 - Building Code Requirements for Structural Concrete and
20 Commentary, Current Edition.
 - 21 2. American Society for Testing and Materials (ASTM), Annual Book of
22 ASTM Standards:
 - 23 a. ASTM A82 - Standard Specification for Steel Wire, Plain, for
24 Concrete Reinforcement, Current Edition.
 - 25 b. ASTM A184 - Standard Specification for Welded Deformed Steel
26 Bar Mats for Concrete Reinforcement, Current Edition.
 - 27 c. ASTM A615 - Standard Specification for Deformed and Plain
28 Carbon-Steel Bars for Concrete Reinforcement, Current Edition.
 - 29 d. ASTM A1064 - Standard Specification for Carbon-Steel Wire and
30 Welded Wire Reinforcement, Plan and Deformed, for Concrete,
31 Current Edition.
 - 32 3. American Association of State Highway Transportation Officials
33 (AASHTO), Specifications and Standards:
 - 34 a. AASHTO M182 - Specification for Burlap Cloth Made from Jute or
35 Kenaf, Current Edition
 - 36 4. Concrete Reinforcing Steel Institute (CRSI) Specifications and Standards:
 - 37 a. CRSI - Manual of Standard Practice, Current Edition.

1 PART 3 CONSTRUCTION METHODS

2 3.01 FABRICATION

3 A. Fabricate and place to shapes and dimensions indicated or required to carry out intent
4 of contract drawings and these specifications.

5 B. Bends for stirrups and ties shall be made around a pin having a diameter not less than
6 four times the diameter of reinforcing bar. Bends for other bars shall be made around
7 a pin having a diameter not less than six times diameter of bar, except that for bars
8 larger than 1 inch, pin shall be not less than eight times diameter of bar.

9 1. Perform cutting and bending in the shop; bend and cut steel cold. Heating of
10 reinforcement will not be permitted. Do not bend or straighten bars in a
11 manner that will injure the material.

12 2. Field bending of bars shall not be allowed without the Engineer's approval.

13 C. Tagging shall be with metal, linen, or rope fiber tags filled in with machine or
14 waterproof ink. Paper tags shall not be allowed.

15 D. Reinforcing bars shall conform accurately to the dimensions shown on the contract
16 drawings.

17 3.02 PRODUCT DELIVERY, STORAGE AND HANDLING

18 A. For reinforcing steel fabricated on-site, shop from the mill in bundles, limited to one
19 size and length, tagged with a waterproof tag showing the name of the mill, heat
20 number, grade and size of the bars and identifying number.

21 B. For reinforcing steel fabricated off-site, deliver in bundles identified as to structure
22 and shop drawing number. Identify each individual bar with a waterproof tag
23 showing the grade, size and bar mark from the approved bar schedule.

24 C. Protect reinforcing steel and wire fabric from damage and from dirt, oil grease, other
25 foreign matter, and rust-causing condition. Do not store reinforcement in direct
26 contact with the ground.

27 3.03 CLEANING

28 A. Before placing and before pouring concrete, all reinforcement shall be thoroughly
29 cleaned of all oil, dirt, loose mill scale, loose rust, or foreign matter that will destroy
30 or reduce bond.

31 3.04 PLACING REINFORCEMENT

32 A. Placement. Metal reinforcement shall be accurately placed in accordance with
33 approved Submittals and adequately secured in position by concrete or metal chairs

1 or spacers. Nails shall not be driven into forms to support reinforcement nor shall
2 wire ties come in contact with forms.

3 B. Splicing. Lap at splices shall be sufficient to transfer stress between bars by bond
4 and shear.

- 5 1. Furnish reinforcing bars in full lengths as indicated on the contract drawings
6 and approved Submittals.
- 7 2. Do not splice bars unless indicated on the contract drawings or approved by
8 the Engineer in writing. When authorized, make splices in accordance with
9 ACI 318; perform welding in accordance with AWS D12.1.
- 10 3. Splices generally shall be avoided at points of maximum stress. Minimum
11 splice lap for stressed bars shall be forty times bar diameter.

12 C. Offsets in longitudinal bars at change of cross section shall be placed in region of
13 lateral support. Slope of inclined portion of offset shall not be more than one in six
14 and, in tied columns, ties shall be spaced not over 3 inches on centers for a distance
15 of 1 foot below actual point of offset.

16 D. Embedded Items. The Contractor shall provide for the installation of all items
17 embedded in the concrete, such as coil rod inserts, anchor bolts, dowels, etc., as
18 shown on the contract drawings or as provided for in other Divisions of these
19 specifications.

- 20 1. All dowel bars shall be tied securely in place before pouring concrete.
- 21 2. Provide for clearances with appurtenant materials and devices.

22 E. Drilled and Grouted or Epoxy Dowel Installation. Existing concrete which will be
23 incorporated into new work and requiring integration with new concrete will be
24 doweled as indicated on the contract drawings and as follows:

- 25 1. Drill hole in existing concrete of size that is 3/4 inch larger in diameter than
26 diameter of dowel bar. Incline the hole in the concrete such that the non-
27 shrink grouting or epoxy will be retained in the hole.
- 28 2. Fill hole with non-shrink grouting or epoxy.
- 29 3. Immediately place dowel bar into hole.
- 30 4. Allow grout or epoxy to take initial set before disturbing dowel bar.

31 F. Steel Reinforcing Fabric. Reinforce as detailed on the contract drawings; and where
32 not indicated, reinforce with wire fabric, place 2 inches from the top of the slab.

- 33 1. Flat sheets shall be used whenever available. Wire fabric shall lap 6 inches
34 on side joints and 12 inches on end joints. Properly secure with annealed
35 wire. Fabric shall be raised and secured in the correct location using
36 permanent supports. Raising the fabric by hook during placement of
37 concrete shall NOT be permitted.
- 38 2. Alternately, in tight quarters and around appurtenances and openings, lap
39 mesh reinforcement not less than one mesh space plus 2 inches, and tie.

1 G. Concrete Cover. The minimum cover of concrete for all reinforcement shall conform
2 to the dimensions indicated on the contract drawings, which indicate the clear
3 distance from the edge and end of the reinforcement to the face of the concrete
4 surface. Provide clearance and spacing indicated on the contract drawings and
5 approved Submittals, where so indicated.

6 1. Where no clearances are indicated, the thickness of the concrete cover over
7 reinforcement shall be as follows:

- 8 a. Concrete cast against and permanently exposed to earth - 3 inches;
- 9 b. Formed concrete exposed to earth or weather - 2 inches;
- 10 c. Formed concrete not exposed to earth or weather - 1-1/2 inches;
- 11 d. Slabs not exposed to earth or weather - 1 inch.

12 PART 4 MEASUREMENT AND PAYMENT

13 4.01 GENERAL

14 A. Concrete reinforcing shall be paid for at the bid price in accordance with one of the
15 following methods, unless indicated otherwise in the Bid Schedule.

16 B. All work specified herein shall be considered in each of the measurement and
17 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule.

18 4.02 CONCRETE REINFORCING

19 A. Concrete Reinforcing, Inclusive. When no quantity is provided, concrete reinforcing
20 shall be considered inclusive to payment for work associated with cast-in-place
21 concrete.

22
23 END OF SECTION

1 SECTION 03 30 00

2
3 CAST-IN-PLACE CONCRETE

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work covered under this section shall cover furnishing all materials, equipment
7 and labor required to construct all cast-in-place concrete as shown on the contract
8 drawings and as specified.

9 1.02 RELATED WORK ELSEWHERE

- 10 A. Structural Cast-in-Place Concrete Forming - Division 03
11 B. Concrete Accessories - Division 03
12 C. Concrete Reinforcing - Division 03

13 1.03 APPLICABLE PROVISIONS (NONE)

14 1.04 APPLICABLE PUBLICATIONS

- 15 A. The following publications of the issues listed below, but referred to thereafter by
16 basic designation only, form a part of this specification to the extent indicated by the
17 reference thereto.
- 18 1. American Concrete Institute (ACI), Annual Book of ACI Standards:
 - 19 a. ACI 117/177R - Standard Specification for Tolerances for Concrete
20 Construction and Materials and Commentary, Current Edition.
 - 21 b. ACI 211.1 - Standard Practice for Selecting Proportions for Normal,
22 Heavyweight, and Mass Concrete, Current Edition.
 - 23 c. ACI 209.1R - Report on Factors Affecting Shrinkage and Creep of
24 Hardened Concrete, Current Edition.
 - 25 d. ACI 301 - Specification for Structural Concrete, Current Edition.
 - 26 e. ACI 302.1R - Guide for Concrete Floor and Slab Construction,
27 Current Edition.
 - 28 f. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing
29 Concrete, Current Edition.
 - 30 g. ACI 305R - Hot Weather Concreting, Current Edition.
 - 31 h. ACI 306.1 (R2002) - Standard Specification for Cold Weather
32 Concreting, Current Edition.
 - 33 i. ACI 308R - Guide to Curing Concrete, Current Edition.
 - 34 j. ACI 309R - Guide for Consolidation of Concrete, Current Edition.
 - 35 k. ACI 311.4R - Guide for Concrete Inspection, Current Edition.
 - 36 l. ACI 318/318R - Building Code Requirements for Structural Concrete
37 and Commentary, Current Edition.

- 1 m. ACI 530/530.1/530R/530.1R - Building Code Requirements for
2 Commentary for Masonry Structures and Specification for Masonry
3 Structures and Related Commentaries, Current Edition.
- 4 n. ACI ASCC-1(05) - The Contractor's Guide to Quality Concrete
5 Construction, Third Edition.
- 6 o. ACI CP-10/PACK - Craftsman Study Package for ACI Certification
7 of Concrete Flatwork Technician/Finisher, Current Edition.
- 8 p. ACI MCP06 - ACI Manual of Concrete Practice, Parts 1 through 6,
9 and Index, 2006 Edition.
- 10 q. ACI SCM-24 - Concrete Repair Basics, Current Edition.
- 11 r. ACI SP15 - Field Reference Manual: Standard Specifications for
12 Structural Concrete ACI 301 with Selected ACI Reference, Current
13 Edition.
- 14 s. ACI SP-71 - ASTM Standards in ACI 318, Current Edition.
- 15 2. American Society for Testing and Materials (ASTM), Annual Book of
16 ASTM Standards:
- 17 a. ASTM C33 - Standard Specification for Concrete Aggregates,
18 Current Edition.
- 19 b. ASTM C70 - Standard Test Method for Surface Moisture in Fine
20 Aggregate, Current Edition.
- 21 c. ASTM C94 - Standard Specification for Ready-Mixed Concrete,
22 Current Edition.
- 23 d. ASTM C109 - Standard Test Method for Compressive Strength of
24 Hydraulic Cement Mortars (using 2-inch or [50 mm] Cube
25 Specimens), Current Edition.
- 26 e. ASTM C125 - Standard Terminology Relating to Concrete and
27 Concrete Aggregates, Current Edition.
- 28 f. ASTM C127 - Standard Test Method for Density, Relative Density
29 (Specific Gravity) and Absorption of Coarse Aggregate, Current
30 Edition.
- 31 g. ASTM C128 - Standard Test Method for Density, Relative Density
32 (Specific Gravity) and Absorption of Fine Aggregate, Current
33 Edition.
- 34 h. ASTM C131 - Standard Test Method for Resistance to Degradation
35 of Small-Size Coarse Aggregate by Abrasion and Impact in the Los
36 Angeles Machine, Current Edition.
- 37 i. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement
38 Concrete, Current Edition.
- 39 j. ASTM C150 - Standard Specification for Portland Cement, Current
40 Edition.
- 41 k. ASTM C171 - Standard Specification for Sheet Materials for Curing
42 Concrete, Current Edition.
- 43 l. ASTM C191 - Standard Test Methods for Time Setting of Hydraulic
44 Cement by Vicat Needle, Current Edition.
- 45 m. ASTM C219 - Standard Terminology Relating to Hydraulic Cement,
46 Current Edition.

- 1 n. ASTM C226 - Standard Specification for Air-Entraining Additions
2 for Use in the Manufacture of Air-Entraining Hydraulic Cement,
3 Current Edition.
4 o. ASTM C233 - Standard Test Method for Air-Entraining Admixtures
5 in Concrete, Current Edition.
6 p. ASTM C260 - Standard Specification for Air-Entraining Admixtures
7 for Concrete, Current Edition.
8 q. ASTM C311 - Standard Test Methods for Sampling and Testing Fly
9 Ash or Natural Pozzolans for use as a Mineral Admixture in Portland-
10 Cement Concrete, Current Edition.
11 r. ASTM C309 - Standard Specification for Liquid Membrane-Forming
12 Compounds for Curing Concrete, Current Edition.
13 s. ASTM C494 - Standard Specification for Chemical Admixtures for
14 Concrete, Current Edition.
15 t. ASTM C535 - Standard Test Method for Resistance to Degradation
16 of Large-Size Coarse Aggregate by Abrasion and Impact in the Los
17 Angeles Machine, Current Edition.
18 u. ASTM C566 - Standard Test Method for Total Evaporable Moisture
19 Content of Aggregate by Drying, Current Edition.
20 v. ASTM C595 - Standard Specification for Blended Hydraulic Cement,
21 Current Edition.
22 w. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or
23 Calcined Natural Pozzolan for Use in Concrete, Current Edition.
24 x. ASTM C688 - Standard Specification for Functional Additions for
25 Use in Hydraulic Cements, Current Edition.
26 y. ASTM C989 - Standard Specification for Slag Cement for Use in
27 Cement and Mortars, current edition.
28 3. Portland Cement Association (PCA) Standards and Specifications:
29 a. PCA - Design and Control of Concrete Mixtures, Current Edition.

30 1.05 SUBMITTALS

- 31 A. Submit such product literature and catalog cuts of materials to be supplied to relate
32 these materials to the specification. Information shall be in conformance with
33 requirements of City submittals.
- 34 B. Concrete Design Mix
- 35 1. Prior to the start of placing of concrete, submit the design mix for each class
36 of concrete, indicating that the concrete constituents and proportions will
37 result in a concrete mix meeting the physical requirements for each class of
38 concrete specified. Submit with the design mix, laboratory test reports and
39 manufacturer's certificates attesting the conformance of constituents with
40 these specifications.
- 41 2. Do not vary the proportions of the constituents or source of material of the
42 approved mix without submitting corresponding test result documentation to
43 the Engineer for review and approval.

- 1 3. Design mix shall indicate proportions of cement, aggregate and water, and
- 2 names and proportions of admixtures and air-entraining agents.
- 3 4. Provide certification that the design mix complies with all ACI and ASTM
- 4 requirements.

5 PART 2 PRODUCTS AND MATERIALS

6 2.01 CEMENT

- 7 A. Cement shall be Portland Cement ASTM C150 Type I or IA, except as otherwise
- 8 noted or approved. Type III cement shall only be used for Class L concrete, or when
- 9 approved by the Engineer.
- 10 B. A singular brand and manufacturer of cement shall be used for the entire work.

11 2.02 FLY ASH

- 12 A. Fly ash shall conform to ASTM C618 Class C.
- 13 B. A singular source of fly ash shall be used for the entire work.

14 2.03 SLAG

- 15 A. Slag shall be ground granulated blast furnace slag conforming to ASTM C989.

16 2.04 AGGREGATE

- 17 A. Aggregate shall consist of clean, hard durable sand, gravel, crushed gravel or crushed
- 18 rock.
- 19 B. Aggregate shall conform to the requirements of ASTM C33. Fine and coarse
- 20 aggregate shall meet ASTM C33 grading requirements. Coarse aggregates shall be
- 21 graded in accordance with ASTM gradations as follows:
- 22 1. 3/4 inch maximum coarse aggregate - ASTM No. 67
- 23 2. 1-1/2 inch maximum coarse aggregate - ASTM No. 4
- 24 C. Maximum aggregate size shall be as defined in the Concrete Schedule, or where not
- 25 defined in the Concrete Schedule, as defined by dimensional constraints for cast-in-
- 26 place concrete as follows.
- 27 1. Not larger than one-fifth of the narrowest dimension between sides of the
- 28 forms;
- 29 2. Not larger than one-third the thickness of the slab;
- 30 3. Not larger than three-fourths of the minimum clear spacing between
- 31 individual reinforcing bars or wire, bundles of bars, or prestressing tendons
- 32 or ducts.

1 2.05 MIXING WATER

2 A. Mixing water shall be natural or treated water, clean and free from injurious amount
3 of oil, acid, alkali, chlorides and sulfates, other common salts, organic matter or other
4 deleterious substances.

5 B. Mixing water shall yield cement paste complying with the requirements ASTM C109
6 and ASTM C191.

7 2.06 ADMIXTURES

8 A. All admixtures are subject to the written approval of the Engineer and shall be used
9 in strict accordance with the manufacturer's recommendations.

10 1. Air-Entraining Admixture

11 a. All concrete exposed to weather and freeze-thaw cycles shall be air-
12 entrained, unless otherwise specified.

13 b. Air-Entraining admixture shall conform to ASTM C260.

14 c. Air-Entrainment shall be as indicated for each class as in the
15 Concrete Schedule.

16 2. Water-Reducing, Set-Controlling Admixtures

17 a. Water-Reducing, Set-Controlling admixtures shall conform to ASTM
18 C494, Type A for water-reducing, Type C for accelerating, Type D
19 for water-reducing and retarding, and Type E for water-reducing and
20 accelerating.

21 B. Admixtures containing calcium chloride or soluble chloride shall not be used.

22 2.07 CURING COMPOUND - EXTERIOR

23 A. Curing compound shall comply with ASTM C309, Type 2; resin, white pigmented.

24 PART 3 CONSTRUCTION METHODS

25 3.01 COORDINATION

26 A. Examine the drawings and specifications for work of other sections or other
27 contractors and coordinate such work with the requirements of this Section; make
28 provisions for installation of such items as sleeves, pipes, conduits, inserts and
29 hangers in a manner that will not impair or weaken concrete construction.

30 3.02 READI-MIX CONCRETE

31 A. Acceptability and Use. Readmix concrete shall be designed on the basis of
32 strength, durability, impermeability, and exposure condition, as required for the
33 intended use of the structure by methods specified in ACI 211.1 and ACI 318. All
34 readmix concrete shall comply with the water-cement ratio for each specific class
35 of concrete as specified in the Concrete Schedule. Concrete design mix, complete

1 with sample test results shall be submitted to the Engineer for approval prior to
2 placing any concrete.

- 3 1. Failure to Meet Strength Requirements. Failure to meet strength
4 requirements shall be as defined in Concrete Quality Control.
- 5 2. Watertight Concrete. All concrete exposed to earth or water shall be
6 watertight, shall have a water-cement ratio as specified, and shall be air-
7 entrained as specified in the Concrete Schedule.
 - 8 a. Construct keyways as indicated on the contract drawings.

9 B. Mix Proportioning. Mix proportioning shall be the responsibility of the Contractor
10 and shall be submitted for review and approval by the Engineer, in accordance with
11 these specifications.

- 12 1. Select proportions for concrete to obtain the quality requirements for the
13 class of concrete as specified in the Concrete Schedule. Contractor, at their
14 expense, shall have an approved independent laboratory prepare design
15 mixes for each specified concrete class.
- 16 2. Slump. Slump for class of concrete shall be as specified in the Concrete
17 Schedule. The Contractor shall at their expense, make field slump tests in
18 accordance with ASTM C143 and Concrete Quality Control.
- 19 3. Adjustment to Concrete Mixes. Design mix adjustments may be requested
20 by the Contractor when characteristics of materials, conditions, weather, test
21 results, or other circumstances warrant. Laboratory test data for revised
22 design mixes and strength results shall be submitted and approved before
23 using in the work. No change in contract price will be allowed for these
24 changes.
- 25 4. Addition of Water to the Batch. Addition of water to the batch delivered to
26 the site shall be in strict accordance with ASTM C94. This shall be the
27 Contractor's responsibility and by their direction, following consultation with
28 the Engineer.
 - 29 a. Addition of water to the batch shall be one time only. Total gallons
30 of water added to the batch shall be recorded on the load ticket,
31 which shall be supplied to the Engineer prior to that delivery truck
32 leaving the site. If water is permitted to be added to mixed concrete
33 upon arrival at the job, an additional mixing of 30 revolutions of the
34 drum shall be required.
 - 35 b. Contractor shall adjust the water-cement ratio of the batch to the
36 corresponding value based on the addition of water to the batch and
37 shall submit this information to the Engineer with adjusted strength
38 data for the final batch proportion.
 - 39 c. At no time shall the addition of water cause the water-cement ratio
40 specified in the concrete class schedule to be exceeded.

41 3.03 GENERAL

- 42 A. Unless otherwise specified, conform to ACI 304, 305, and 306 for concrete
43 installation requirements such as preparation, mixing, conveying, depositing, curing,

1 and cold and hot weather requirements; consolidate concrete in accordance with ACI
2 309.

3 B. Concrete not placed within 90 minutes or 300 revolutions, whichever occurs first,
4 after the first mixing of the cement and aggregates will be rejected.

5 C. Contractor shall indicate on record set of Drawings at site, for review prior to
6 installation, a pouring program for concrete work showing unit of operation, method
7 of pouring, installation of construction/control joints, expansion joints and all
8 necessary work.

9 D. Proper grade marker or stakes shall be used by Contractor to establish grades for
10 ramps, platforms, sidewalks, slopes to drains, inlets, etc.

11 E. Trenches, forms, conveying equipment shall be prepared to receive concrete in
12 accordance with ACI 304.

13 F. Place concrete footings upon undistributed clean surfaces, free from frost, ice, mud
14 and water; when foundation is on dry soil or pervious material, lay waterproof
15 sheathing paper over earth surfaces to receive concrete.

16 G. Rock surfaces upon which concrete is to be placed, make level, clean, free from all
17 objectionable coatings, water, mud, debris, loose semi-detached or unsound
18 fragments; level surfaces to receive sand cushion placed to minimum thickness of
19 2 inches.

20 H. Immediately after placement, protect concrete from premature drying, excessively
21 hot or cold temperature and mechanical injury; maintain with minimum moisture loss
22 and relatively constant temperature for the period necessary for hydration of the
23 cement and hardening of the concrete.

24 I. All freshly cast concrete shall be protected from damaging effects of the elements
25 freezing, rapid drop in temperature and loss of moisture and from future construction
26 operations.

27 3.04 PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT

28 A. Before placement, clean equipment for mixing and transporting the concrete; remove
29 debris and ice from all surfaces upon which concrete is placed; clean reinforcement
30 of dirt, loose rust, and mill scale, or other coatings.

31 B. Remove water from all areas before depositing concrete; before depositing new
32 concrete on or against concrete that has set, thoroughly roughen; clean existing
33 surfaces of laitance, foreign matter or loose particles; retighten forms; slush existing
34 surfaces with neat cement grout coat; place new concrete before grout has attained
35 initial set; give horizontal construction joints grout brush coat of cement, fine
36 aggregate, in same proportions as concrete to be placed.

- 1 C. Thoroughly wet the stone base on which slabs are to be placed where no vapor
2 barrier is indicated.
- 3 D. Check compaction of fill and proper grade for slabs-on-grade. Check screeds and
4 exercise care to prevent disturbing screeds during placement. Provide for
5 construction joints in slabs-on-grade at 20 feet maximum in each direction unless
6 shown otherwise on the contract drawings. Place expansion joint material at
7 junctures of slabs-on-grade with vertical walls and as otherwise shown.
- 8 E. Remove debris, excess form oil, and water from formwork; avoid washing newly
9 deposited concrete.

10 3.05 MIXING

- 11 A. Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94
12 and ACI 304. The production facilities shall comply with the requirements of the
13 National Ready Mixed Concrete Association Certification Plan as regards materials
14 storage and handling, batching equipment, central mixer, truck mixers, agitators,
15 non-agitating units, ticketing system, etc.
- 16 B. Do not over-mix; do not use concrete which is retained in mixers so long as to
17 require additional water in excess of design mix water to permit satisfactory placing;
18 retempering of mix is not permitted.
- 19 C. Concrete shall be delivered to the site of the work and the mixed concrete discharged
20 completely within 1-1/2 hours after water has been added to cement. In hot weather,
21 or under conditions contributing to quick stiffening of concrete, this time may be
22 reduced by the Engineer.
- 23 D. Concrete delivered shall arrive at the site having a temperature not less than
24 50 Degrees F nor greater than 85 Degrees F, unless otherwise permitted by the
25 Engineer.

26 3.06 CONVEYING

- 27 A. Convey concrete from the mixer to the final deposit by methods that will prevent
28 segregation or loss of materials.
- 29 B. Use of aluminum conveyances is not permitted.

30 3.07 CONCRETE PLACEMENT

- 31 A. Place concrete, including drops greater than 60 inches using recommended practices
32 in accordance with ACI 304 and ACI 318. Once pouring operation commences, it
33 shall be carried out as a continuous operation until a section is completed.

- 1 B. Deposit concrete as nearly as practical in its final position to avoid segregation due to
2 rehandling or flowing; do not use vibrators to move concrete horizontally within the
3 forms.
- 4 C. Do not use retempered concrete or concrete contaminated by foreign material.
- 5 D. Plan and conduct concrete placement to insure that the concrete is kept plastic and
6 that the concrete is free of cold joints.
- 7 E. Where there is a time delay greater than 45-minutes between adjacent concrete
8 placement, a bulkhead construction joint, complete with waterstops where required,
9 must be installed.
- 10 F. Do not commence placing when the sun, heat, wind or limitations of facilities
11 provided prevent proper finishing or curing.
- 12 G. Discontinue concreting when the descending natural air temperature falls lower than
13 40 Degrees Fahrenheit unless preparations are made and in place to heat or insulate
14 concrete in accordance with the cold weather concreting requirements of this
15 specification.
- 16 H. Concrete for walls shall be deposited in approximately horizontal layers not to
17 exceed 24 inches in height to avoid segregation due to rehandling and flowing.
- 18 I. Concrete shall not be placed or poured in water. Water level shall be removed or
19 lowered in a manner approved by Engineer. Excess water shall not be permitted.
20 Powdering a mixture of cement to absorb excess water shall not be permitted.
- 21 J. Concrete shall be placed before initial set has occurred. Placing should be carried on
22 in such manner that the concrete in the form is still plastic and can be integrated with
23 fresh concrete.
- 24 K. Contractor shall notify Engineer of concrete pouring schedule one day in advance of
25 pour to allow for inspection of reinforcing and forms.
- 26 L. Bottom dump buckets may be used for transporting mixed concrete to the desired
27 location. Particular care shall be taken to avoid jarring or bumping as this may cause
28 segregation.
- 29 M. Where chutes are used to transport concrete, they shall be of metal or wood with
30 metal lining and should have a slope not exceeding 1 vertical to 2 horizontal and not
31 less than 1 vertical to 3 horizontal so that the concrete will travel fast enough to keep
32 the chute clean but slow enough to avoid segregation of materials. The end of each
33 chute shall be provided with a baffle to help prevent segregation, or the concrete
34 should be discharged through a tremie or elephant trunk directly into the form.

1 N. Elephant trunks and/or tremies shall be used in walls and columns to prevent free fall
2 of the concrete and to allow the concrete to be placed through the cage of reinforcing
3 steel.

4 O. Pumping equipment shall be of suitable type, without Y-sections, and with adequate
5 pumping capacity. Loss of slump in pumping shall not exceed 1-1/2 inches.

6 3.08 CONSOLIDATION

7 A. Each concrete layer placed shall be compacted by mechanical internal vibrating
8 equipment supplemented by hand spading, rodding, or tamping.

9 B. The period of concrete vibration shall not be less than two seconds nor more than
10 five seconds at any one point.

11 C. Consolidate concrete thoroughly as it is placed in order to secure a dense mass; work
12 concrete well around the reinforcement and embedded items and into the corners of
13 the forms.

14 D. Use internal vibrators inserted vertically over the entire area of the placement; form
15 vibrators not permitted; internal vibrators shall maintain a minimum of 5000
16 impulses when submerged in concrete.

17 E. Vibrate until voids are eliminated, coarse aggregate is suspended in mortar, and
18 entrapped air bubbles begin to rise to the surface; concrete should move back into the
19 space vacated by the vibrator; vibration duration shall be limited only to the time
20 necessary to produce consolidation without causing segregation.

21 F. Space vibrator insertions such that the area visibly affected by the vibrator overlaps
22 the adjacent just-vibrated area by a few inches.

23 G. Penetrate at least 6 inches into previously placed layers in order to bond between
24 layers and avoid cold joints.

25 H. Take care not to over-vibrate air entrained concrete; place vibrator to eliminate
26 honeycombing but avoid excess vibrating that bleeds all entrapped air from the mix.

27 I. Do not use vibrators to transport concrete.

28 3.09 JOINTS AND KEYWAYS

29 A. Construct expansion, control, and isolation joints and keyways only where indicated
30 on the drawings or at additional locations approved by the Engineer (and as shown
31 on the Standard Details).

32 B. Where the placing of concrete is discontinued, clean off laitance and other
33 objectionable material to a sufficient depth to expose sound concrete as soon as

1 concrete is firm enough to retain its form; smooth the top surface of concrete
2 adjacent to the forms with a trowel to minimize visible joints on exposed faces.

3 C. Immediately upon completion of the work of placing concrete, remove
4 accumulations splashed upon the reinforcement and the surfaces of the forms;
5 perform this removal before concrete takes its initial set; clean reinforcing steel
6 carefully to prevent damage to the concrete steel bond.

7 D. Do not halt work within 18 inches of the top of any face.

8 E. For bonded horizontal joint construction, roughen the surface and expose the
9 aggregate; clean the surface thoroughly by wet sandblasting, by cutting with high-
10 pressure water jet or by other approved methods; perform cleaning after the concrete
11 has hardened to prevent raveling of the surface below the desired depth.

12 F. Before bonding concrete is placed, clean the surface of loose or soft particles or other
13 objectionable materials and keep wet for a minimum period of 12 hours.

14 G. Cover the cleaned and saturated surface with a coating of neat cement grout and
15 deposit new concrete before the grout has attained its initial set.

16 3.10 CURING

17 A. Concrete shall be wet cured by immersion of moisture-retaining covers in
18 conformance with ACI 308 or shall receive curing compound in accordance with
19 ACI 309.

20 B. Water curing is the preferred method of protection for curing concrete other than
21 under hot weather conditions; cover exposed surfaces with a saturated material
22 (burlap or cotton mats) and keep wet continuously with a soil soaker hose for 7
23 curing days for all concrete except high early strength concrete; leave covering in
24 place, without wetting, for an additional 3 days.

25 C. A curing day is defined as 24-hour day when the concrete surfaces are kept moist and
26 the uniform temperature of the concrete mass is between 55 Degrees Fahrenheit and
27 75 Degrees Fahrenheit.

28 D. Curing shall start as soon as free surface water disappears after finishing. Where
29 forms are not removed immediately, curing shall be accomplished in a manner
30 acceptable to the Engineer.

31 E. Curing compounds may not be used on surfaces that are to receive additional
32 concrete, paint or tile.

33 F. Curing and sealing compound shall not be applied to steel reinforcing anchors, water
34 stops, construction joints, or surfaces to be bonded to other concrete.

- 1 G. When using a curing compound, keep surfaces moist after the forms are removed,
2 and the form tie holes repaired; after the surfaces are finished, apply the curing
3 compound according to the manufacturer's recommendations; remove forms only as
4 required to advance repair of tie holes and minor defects.
- 5 H. Slabs: Immediately following slab finishing, apply liquid membrane-forming curing
6 compound or begin water curing before the surface becomes dry.
- 7 I. Vertical Surfaces: When the forms are removed entirely, spray the surface with
8 water and allow it to reach a uniformly damp appearance with no free water on the
9 surface; apply curing compound or begin water curing.
- 10 J. For curing concrete under hot weather conditions, see Hot Weather Requirements in
11 this section.
- 12 K. For curing concrete under cold weather conditions, see Cold Weather Requirements
13 in this section.

14 3.11 CONCRETE WALL FINISHES

- 15 A. Complete screeding and darbying of top of walls before excess moisture or bleeding
16 water is present on the surface.
- 17 B. Do not begin subsequent finishing operations until surface water has disappeared.
- 18 C. Refer to Concrete Schedule, included in this specification section, for finish type at
19 each location, defined as follows:
- 20 1. Rough Form Finish: (Type W1)
21 a. No form facing materials specified.
22 b. Patch tie holes and defects.
23 c. Chip off fins 1/4 inch or more in height.
- 24 2. Smooth Form Finish: (Type W2)
25 a. Use a form facing material that will produce a smooth, hard, uniform
26 texture on the concrete.
27 b. Keep seams to a practical minimum.
28 c. Patch tie holes and defects.
29 d. Remove all fins.
- 30 3. Smooth Rubbed Finish: (Type W3)
31 a. Produce a Smooth Form Finish.
32 b. Wet surface and rub with a Carborundum brick until uniform color
33 and texture are produced.
34 c. Perform rubbing no later than 24 hours after forms are removed.
35 d. Do not use any cement grout other than the paste drawn from the
36 concrete itself by rubbing.
37 e. Thoroughly wash the surface with water.
- 38 4. Smooth Troweled Finish: (Type W4)
39 a. Produce a Smooth Rubbed Finish.
40 b. After wet-rubbing, finish with a steel trowel to increase compaction
41 of fines and to provide maximum density.

- 1 5. Smooth Finish (Grout Cleaned): (Type W5)
- 2 a. Use for architectural surfaces exposed to general view, unless other
- 3 indicated.
- 4 b. Mix 1 part portland cement and 1-1/2 parts fine sand with sufficient
- 5 water to produce grout having consistency of thick paint; use white
- 6 portland cement in combination with normal portland cement to
- 7 achieve uniform surface color after drying.
- 8 c. Wet surface of concrete and uniformly apply grout with brush or
- 9 spray gun completely filling air bubbles; surface with a wood float
- 10 scouring wall vigorously.
- 11 d. Allow grout to partially set for one to two hours, depending on
- 12 weather conditions; in hot dry weather, keep damp, using fine fog
- 13 spray.
- 14 e. When grout has hardened sufficiently to be scraped from wall with
- 15 edge of steel trowel without removing grout from small air holes, cut
- 16 off all grout that can be removed with trowel.
- 17 f. Allow surface to dry thoroughly then rub vigorously with dry burlap
- 18 to completely remove dried grout; there shall be no visible film or
- 19 grout remaining after this rubbing.
- 20 g. The entire cleaning operation for any area must be completed the day
- 21 it is started; no grout shall be left on overnight, and sufficient time
- 22 shall be allowed for grout to dry after it has been cut with trowel so it
- 23 can be wiped off clean with burlap.
- 24 h. After entire surface has been grout cleaned, wipe off any slightly dark
- 25 spots or streaks with fine abrasive hone.

26 3.12 CONCRETE SLAB FINISHING

- 27 A. Complete screeding and darbying slabs before excess moisture or bleeding water is
- 28 present on the surface.
- 29 B. Do not begin subsequent finishing operations until surface water has disappeared and
- 30 the concrete will sustain foot pressure with only approximately 1/4 inch indentation.
- 31 C. Refer to Concrete Schedule, included in this specification section, for finish type at
- 32 each location, defined as follows:
- 33 1. Smooth Float Finish: (Type S1)
- 34 a. Consolidate concrete with a power-driven disc-type float or a
- 35 combination floating-troweling machine with metal float shoes
- 36 attached.
- 37 b. Machines which have a water attachment for wetting the concrete
- 38 during the finishing operation are prohibited.
- 39 c. Check and level surface plane to a tolerance not exceeding 1/4 inch in
- 40 10 feet when tested with a 10-foot straightedge. Cut down high spots
- 41 and fill low spots; immediately after re-leveling, refloat surface to a
- 42 uniform, smooth, granular texture.

- 1 d. Where slab drainage is indicated, take care to maintain accurate
2 slopes for drainage.
- 3 2. Steel Troweled Finish: (Type S2)
- 4 a. Produce a Smooth Float Finish.
- 5 b. After float finishing, steel trowel surface as specified in Concrete
6 Schedule to increase the compaction of fines and to provide
7 maximum density and wear resistance.
- 8 c. Steel Troweled Finish: Screed and bull float or darby. Give
9 preliminary float finish, true, even and free from depressions; float
10 surface with hand or machine floats; compact surface with not less
11 than 2 thorough and complete steel troweling operations.
- 12 d. Tolerance on finished steel troweled floors in no instance shall
13 exceed 1/8 inch in 10'-0" on surface; where floor drains occur, slope
14 floors to drains.
- 15 e. Buffing: After concrete floors have been properly cured, buff
16 thoroughly to remove soluble salt incrustation or other foreign
17 substances.
- 18 3. Broom Finish: (Type S4)
- 19 a. Draw stiff broom over previous Smooth Float Finish, to obtain non-
20 slip finish.

21 3.13 CONCRETE SIDEWALKS

- 22 A. Concrete sidewalk construction shall be as specified in City specifications.

23 3.14 CONCRETE CURB AND GUTTER

- 24 A. Concrete curb and gutter construction shall be as specified in City specifications.

25 3.15 HOT WEATHER REQUIREMENTS

- 26 A. Comply with ACI 305R unless otherwise specified herein below.
- 27 B. Hot weather conditions are deemed to exist when the temperature in the forms is
28 75 Degrees Fahrenheit or above, or a combination of high air temperature, low
29 relative humidity and wind velocity impair the quality of fresh or hardened concrete;
30 take protective measures for mixing, transporting and placing concrete in accordance
31 with ACI 305R.
- 32 C. The temperature of the concrete at the place of discharge may not exceed 85 Degrees
33 Fahrenheit.
- 34 1. If ice is used to lower temperature, place crushed, shaved or chipped ice
35 directly into the mixer as part or all of the mixing water; mix until ice is
36 completely melted.
- 37 2. Record the concrete temperature at the time of discharge.

- 1 D. Do not add water that will cause the proportions to exceed the maximum water-
2 cement ratio shown in Table I.
- 3 1. Notify the Engineer before adding any water to the concrete mix.
4 2. Record the amount of water added to the concrete at the jobsite.
- 5 E. Discharge concrete within 45 minutes or 100 revolutions, whichever occurs first,
6 after the first mixing of cement and aggregates.
- 7 F. Placing and Curing:
- 8 1. Place concrete promptly upon arrival.
9 2. Provide at least one standby vibrator for each 3 vibrators in use.
10 3. Protect concrete from direct sunlight; keep forms covered and moist by
11 means of water sprinkling or the application of continuously wetted burlap or
12 cotton mats for a minimum of 24 hours. Windbreaks and/or sunshades shall
13 be provided as directed by the Engineer.
14 4. When forms are removed, provide wet cover to the newly exposed surfaces
15 to avoid exposure to hot sun and wind.
16 5. Continue specified water curing methods for 10 days; leave covering in place
17 4 additional days; do not permit alternate wetting and drying cycles.
18 6. For slabs on grade, beam and deck concrete, and other horizontal placements
19 protect the surface between finishing operations using one or more of the
20 following methods:
21 a. Careful use of a fog nozzle.
22 b. Spreading and removing polyethylene sheeting between finishing
23 operations.
24 c. Application of mono-molecular film after the strike-off.
- 25 G. During extremes in weather, floor slabs shall not be cast unless the slab is protected
26 by a roof and other suitable protective measures are provided. After curing has been
27 completed, the floor shall be exposed to the air for 48 hours prior to allowing traffic
28 on the floors.

29 3.16 COLD WEATHER REQUIREMENTS

- 30 A. Comply with ACI 306.1 (R2002) unless otherwise specified herein below.
- 31 B. Cold weather is defined any time when the daily temperature is 40 Degrees
32 Fahrenheit or lower during placement and the protection period. If at any time
33 during the progress of the work, the temperature drops below 40 Degrees F., the
34 Contractor shall make suitable provisions to protect the concrete by use of insulation
35 materials such as blankets, mats, etc., and equipment for providing artificial heat.
- 36 C. Combustion type temporary heating devices shall be vented outside of any temporary
37 enclosure and building envelope. Combustion gases shall not be allowed in any
38 temporary enclosure and building envelope.
- 39 D. Protect concrete surfaces from freezing for at least 24 hours after placement.

- 1 E. All surfaces in contact with newly-placed concrete including formwork,
2 reinforcement and subgrade must be above 35 Degrees Fahrenheit.
- 3 F. Use preparation methods capable of producing concrete with a temperature not more
4 than 85 Degrees Fahrenheit, and not less than 55 Degrees Fahrenheit, at the time of
5 placement.
- 6 G. Do not heat concrete ingredients to a temperature higher than that necessary to keep
7 the temperature of the mixed concrete, as placed, within the specified temperatures.
8 (Do not heat water in excess of 140 Degrees Fahrenheit.)
- 9 H. Concrete shall have a temperature of not less than 55 Degrees Fahrenheit when
10 placed; mix concrete at a temperature between:
11 1. 60 Degrees Fahrenheit and 70 Degrees Fahrenheit when outside air
12 temperature is above 30 Degrees Fahrenheit.
13 2. 65 Degrees Fahrenheit and 75 Degrees Fahrenheit when outside air
14 temperature is between 0 Degrees Fahrenheit and 30 Degrees Fahrenheit.
15 3. 70 Degrees Fahrenheit and 80 Degrees Fahrenheit when outside air
16 temperature is below 0 Degrees Fahrenheit.
- 17 I. Follow concrete placement with tarpaulins or other readily movable coverings, so
18 only a few feet of concrete is exposed to the outside air at any time.
- 19 J. Maintain the temperature and moisture conditions specified in all parts of the newly
20 placed concrete by covering, insulating, housing or heating; arrange for protection
21 methods in advance of placement.
- 22 K. Maintain concrete at a temperature of not less than 55 Degrees Fahrenheit nor more
23 than 70 Degrees Fahrenheit for a period of 3 days after placement.
- 24 L. A thermometer accurate to plus or minus 2 Degrees F shall be placed under the
25 curing blanket. Additional insulation shall be supplied as required to maintain the
26 temperature above 55 Degrees F.
- 27 M. After the curing period, the temperature of the exposed surface shall not be permitted
28 to drop faster than 30 Degrees F in 24 hours.
- 29 N. Do not remove forms during the initial protection period.
- 30 O. Protect insulation against wetting that will impair its insulating value using moisture-
31 proof cover material; keep insulation in close contact with concrete.
- 32 P. Construct enclosure to withstand wind and snow loads and be reasonably airtight;
33 provide sufficient space between the concrete and enclosure to permit free circulation
34 of heated air.
- 35 Q. Use vented heaters; do not permit heaters to heat or dry concrete locally. Unvented
36 salamanders or other heaters which produce carbon dioxide as by-products shall not

1 be permitted within enclosures or inside buildings. If heaters are used, precautions
2 shall be taken to prevent drying of the slab through the use of water jackets or other
3 suitable methods.

4 R. Maintain relative humidity above 40% within heated enclosures before construction
5 supports are removed.

6 S. Monitor temperature to insure concrete is kept within specified limits recording time
7 and concrete temperature every 8 hours.

8 T. Assure concrete has developed necessary strength before removing forms; provide
9 additional test cylinders with the same protection as the structure they represent to
10 verify concrete strength before construction supports are removed.

11 U. If water curing is used, terminate at least 12-hours before end of temperature
12 protection period. Permit concrete to dry.

13 V. After the required protection period gradually reduce the concrete temperature within
14 an enclosure or insulation at a rate not to exceed 20 Degrees Fahrenheit per day until
15 the outside temperature has been reached.

16 W. Apply membrane forming curing compound to concrete surfaces during the first
17 period of above-freezing temperatures after forms are stripped and before air
18 temperature rises to 50 Degrees Fahrenheit; apply membrane forming curing
19 compound to slabs as soon as finishing operations are completed, except where live
20 steam curing is used.

21 3.17 DELIVERY TICKETS

22 A. With each load of concrete delivered to the job there shall be furnished by the
23 ready-mixed concrete producer duplicate delivery tickets, one for the Contractor and
24 one for the Engineer. Delivery tickets shall provide the following information:

- 25 1. Date and serial number of ticket;
 - 26 2. Name of ready-mixed concrete plant;
 - 27 3. Job location;
 - 28 4. Contractor;
 - 29 5. Type and brand name of cement;
 - 30 6. Mix number or specified cement content in bags per cubic yard of concrete;
 - 31 7. Truck number;
 - 32 8. Time dispatched stamped by a time clock;
 - 33 9. Amount of concrete in load in cubic yards;
 - 34 10. Admixtures in concrete, if any;
 - 35 11. Maximum size of aggregate;
 - 36 12. Water added at job, if any;
 - 37 13. Slump of concrete ordered
- 38

TABLE 1
CONCRETE CLASS SCHEDULE

Parameter Value	Compressive Strength (PSI) 28-Day	Water-Cement Ratio Maximum	Air Content Range (%) Minimum-Maximum	Slump Range (Inches) Minimum-Maximum	Coarse Aggregate (Inches) Maximum
Class A	4,000	0.5	1 to 2	2 to 4	3/4
Class B	4,000	0.5	1 to 2	2 to 4	1-1/2
Class C	4,000	0.5	5 to 7	2 to 4	3/4
Class D	4,000	0.5	4 to 6	2 to 4	1-1/2
Class E (Interior)	3,000	0.5	1 to 2	2 to 4	3/4
Class F (Exterior)	3,000	0.5	5 to 7	2 to 4	1-1/2
Class G	2,000	0.67	1 to 2	4 to 6	1-1/2
Class H	5,000	0.45	1 to 2	2 to 4	3/4
Class I	5,000	0.45	1 to 2	2 to 4	1-1/2
Class J	5,000	0.45	5 to 7	2 to 4	3/4
Class K (Exterior)	5,000	0.45	4 to 6	2 to 4	1-1/2
Class L	3,000 psi @24 hours	0.40	5 to 7 4 to 6	2 to 4 2 to 4	3/4 1-1/2

**TABLE 2
CONCRETE SCHEDULE
USES AND PROPERTIES**

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Use	Finish	Class and Considerations
Structural (not including water-retaining structures)		
Exposed foundations and walls	S2 Top, W5 Sides	Class C
	S2 Top, W5 Sides	Class D
Buried walls and footing walls, (Exterior)	W1	Class C
	W1	Class D
Slabs (Exterior)	S4	Class C
	S4	Class D
Equipment pads and bases	S4 Top, W5 Sides	Class F (Exterior)
Curbing, sidewalk, endwalls, driveways and ramps	S4 Top, W5 Sides	Class C
	S4 Top, W5 Sides	Class D
Manhole bases and benches	Special Construction	Class E
Pavement base, cradles and inlet walls	Special Construction	Class E
		Class F
Mass and fill	None	Class G
Traffic areas requiring early access or use	Special Construction	Class L

END OF SECTION

1 SECTION 03 62 00

2
3 NON-SHRINK GROUTING

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover furnishing and installing a non-shrink fluid
7 precision grout material, forming, placing and curing where shown on the contract
8 drawings or required by equipment manufacturers, equipment bases shall be grouted
9 in position.

10 1.02 RELATED WORK ELSEWHERE

11 1.03 APPLICABLE PROVISIONS (NONE)

12 1.04 APPLICABLE PUBLICATIONS (NONE)

13 1.05 SUBMITTALS

- 14 A. Contractor shall submit such product literature and catalog cuts of materials to be
15 supplied to relate these materials to the specification. Information shall be in
16 conformance with requirements of City submittals.

17 PART 2 PRODUCTS AND MATERIALS

18 2.01 NON-SHRINK GROUTING

- 19 A. Non-shrink grouting shall be as manufactured by Master Builders, U.S. Grout
20 Corporation, or equal.

21 PART 3 CONSTRUCTION METHODS

22 3.01 PREPARATION AND INSTALLATION

- 23 A. Concrete foundation shall be rough and relatively level. Contractor shall remove
24 laitance down to sound concrete and prepare concrete in accordance with
25 manufactured recommendations.

- 26 B. Preparation of grout shall be in paddle type mortar mixer or other suitable
27 mechanical mixer.

- 28 C. Placing of grout shall be at temperatures of 45 Degrees Fahrenheit to 75 Degrees
29 Fahrenheit. Temperature shall be maintained above 40 Degrees Fahrenheit until
30 strength exceeds 4000 psi.

1 PART 4 MEASUREMENT AND PAYMENT

2 4.01 GENERAL

3 A. Non-shrink grouting shall be paid for at the bid price in accordance with one of the
4 following methods, unless indicated otherwise in the Bid Schedule.

5 B. All work specified herein shall be considered in each of the measurement and
6 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule.

7 4.02 NON-SHRINK GROUTING

8 A. Non-Shrink Grouting, Inclusive. When no quantity is provided, non-shrink grouting
9 shall be considered inclusive to payment for work associated with the related
10 equipment.

11
12

END OF SECTION

1 SECTION 05 05 23

2
3 METAL FASTENINGS

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover furnishing and installing metal fastenings as
7 shown on the contract drawings and as required by equipment manufacturers.

8 1.02 RELATED WORK ELSEWHERE

- 9 A. Cast-in-Place Concrete - Division 03
10 B. Metal Fabrications - Division 05
11 C. Handrails and Railings - Division 05

12 1.03 APPLICABLE PROVISIONS (NONE)

13 1.04 APPLICABLE PUBLICATIONS

- 14 A. The following publications of the issues listed below, but referred to thereafter by
15 basic designation only, form a part of this specification to the extent indicated by the
16 reference thereto.
17 1. American Society for Testing and Materials (ASTM), Annual Book of
18 ASTM Standards, Current Edition.
19 a. ASTM A193 - Standard Specification for Alloy-Steel and Stainless
20 Steel Bolting Materials for High Temperature or High Pressure
21 Service and Other Special Purpose Applications.
22 b. ASTM A307 - Standard Specification for Carbon Steel Bolts and
23 Studs, 60,000 PSI Tensile Strength.
24 c. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat
25 Treated, 120/105 ksi Minimum Tensile Strength.

26 PART 2 PRODUCTS AND MATERIALS

27 2.01 METAL FASTENINGS

- 28 A. Stainless Steel. Metal fastenings shall be B8T, Stabilized 18 Chromium 8 Nickel
29 conforming to the requirements of ASTM A193, furnished with brass nuts.
30 B. Zinc Plated Steel. Metal fastenings shall be S.A.E. Grade 5.
31 C. High-Strength. Metal fastenings shall be ASTM A325.

1 D. Standard Metal Fastenings shall be ASTM A307.

2 PART 3 CONSTRUCTION METHODS

3 3.01 METAL FASTENINGS

4 A. Stainless steel, high strength, and standard metal fastenings shall be used where
5 shown on contract drawings.

6 B. Metal fastenings furnished by equipment manufacturers shall be installed in
7 accordance with manufacturer recommendations.

8 C. Zinc plated steel Metal Fastenings shall be installed in all other locations.

9 PART 4 MEASUREMENT AND PAYMENT

10 4.01 METAL FASTENINGS

11 A. General. Metal fastenings shall be paid for at the bid price in accordance with one of
12 the following methods, unless indicated otherwise in the Bid Schedule.

13 1. Metal Fastenings, Inclusive. When no quantity is provided, metal fastenings
14 shall be considered inclusive to payment for work associated with the related
15 equipment or construction.

16
17 END OF SECTION

1 SECTION 05 50 00

2
3 METAL FABRICATIONS

4 PART 1 GENERAL

5 1.01 DESCRIPTION OF WORK

- 6 A. The work under this section shall cover furnishing and installing the ~~fabricated~~
7 ~~metal~~hot-dip galvanized guardrails as described in this section and as shown on the
8 contract drawings.

9 1.02 RELATED WORK ELSEWHERE

- 10 A. Metal Fastenings - Division 05
11 B. Handrails and Railings - Division 05

12 1.03 APPLICABLE PROVISIONS (NONE)

13 1.04 APPLICABLE PUBLICATIONS

- 14 A. The following publications of the issues listed below, but referred to thereafter by
15 basic designation only, form a part of this specification to the extent indicated by
16 the reference thereto.
- 17 1. ~~The Aluminum Association (AA~~American Institute of Steel Construction
18 (AISC), Specifications and Standards:
 - 19 a. ~~AA Sections 6~~AISC Section 1.23 - Specification for the Design,
20 Fabrication and ~~7—Aluminum~~Erection of Structural Steel for
21 Buildings (Riveted, Bolted and Arc-Welded Construction Manual,
22 Specifications for Aluminum Structures,), Current ~~Edition~~Editions.
 - 23 2. American Society for Testing and Materials (ASTM), Annual Book of
24 ASTM Standards, Current Editions.
 - 25 a. ASTM ~~B209~~A36 - Standard Specification for ~~Aluminum and~~
26 ~~Aluminum Alloy Sheet and Plate~~Carbon Structural Steel, Current
27 Edition.
 - 28 b. ASTM ~~B210~~A123 - Standard Specification for ~~Aluminum and~~
29 ~~Aluminum Alloy Drawn Seamless Tubes~~Zinc (Hot-Dipped
30 Galvanized) Coatings on Iron and Steel Products, Current Edition.
 - 31 c. ASTM ~~B211~~A153 - Standard Specification for ~~Aluminum and~~
32 ~~Aluminum Alloy Bar, Rod, and Wire~~Zinc Coating (Hot-Dip) on
33 Iron and Steel Hardware, Current Edition.
 - 34 d. ASTM ~~B221~~A283 - Standard Specification for ~~Aluminum and~~
35 ~~Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and~~
36 ~~Tubes~~Low and Intermediate Tensile Strength Carbon Steel Plates,
37 Current Edition.

- 1 e. ASTM ~~B308~~A380 - Standard Practice for Cleaning, Descaling, and
2 Passivation of Stainless Steel Parts, Equipment, and Systems,
3 Current Edition.
4 f. ASTM A385 - Standard Practice for Providing High-Quality Zinc
5 Coatings (Hot-Dip), Current Edition.
6 e.g. ASTM A530 - Standard Specification for ~~Aluminum Alloy 6061-~~
7 ~~T6 - Standard Structural Profiles~~General Requirements for
8 Specialized Carbon and Alloy Steel Pipe, Current Edition.
9 h. ASTM ~~B429~~A633 - Standard Specification for
10 ~~Aluminum~~Normalized High-Strength Low-Alloy ~~Extruded~~
11 Structural ~~Pipe and Tube~~Steel Plates, Current Edition.
12 i. ASTM B633 - Standard Specification for Electrodeposited Coatings
13 of Zinc on Iron and Steel, Current Edition.
14 f.j. ASTM B766 - Standard Specification for Electrodeposited Coatings
15 of Cadmium, Current Edition.
16 3. American Welding Society (AWS) Specifications and Standards, Current
17 Edition.
18 a. AWS A5.~~101~~ - Specification for ~~Bare Aluminum and~~
19 Aluminum Alloy WeldingCarbon Steel Electrodes ~~and Rods~~for
20 Shielded Metal Arc Welding, Current Edition.

21 1.05 SUBMITTALS

- 22 A. The Contractor shall submit such submittals and/or catalog cuts required for the
23 construction and installation of the materials. These drawings shall be accurate in
24 every detail and shall contain all information necessary to relate the materials to the
25 specifications.
- 26 B. Submittals shall indicate the intended materials arrangement, major support
27 requirements, plot area and all intricate or detailed construction requirements.
28 Information shall be in conformance with requirements of City submittals.

29 PART 2 PRODUCTS AND MATERIALS

30 2.01 METAL SURFACES, GENERAL

- 31 A. For fabrication of miscellaneous metal work which will be exposed to view, use
32 only materials which are smooth and free of surface blemishes including pitting,
33 seam marks, roller marks, rolled trade names and roughness.

1 ~~2.02~~ ALUMINUM ALLOY

2 ~~2.02~~ Aluminum alloy products, unless otherwise specified, shall be Alloy 6061-T6. Aluminum
3 alloy products~~STEEL~~

4 A. Steel for structural components and assemblies shall meet the requirements of the
5 applicable ASTM ~~Standard~~Standards as follows:

<u>Product and</u> <u>Material</u>	<u>Standard</u>
Sheet and plate	ASTM B209
Drawn seamless tubes <u>Carbon Steel Plates of Structural</u> <u>Quality</u>	<u>ASTM A283, Grade C</u>
<u>Structural Steel</u>	<u>ASTM B210A36</u>
Rolled or cold finished bars, rods and wire	ASTM B211
Extruded bars, rods, wire, shapes and tubes	ASTM B221
Extruded structural pipe and tube	ASTM B429

16 2.03 GALVANIZING

17 A. Zinc coatings on products fabricated from rolled, pressed, and forged steel shapes,
18 plates, bars and strip, 1/8 inch thick and heavier shall conform to ASTM A123.

19 B. Zinc coatings on assembled steel products shall meet the requirements of ASTM
20 A123 and shall be applied in conformance with ASTM A385 for the recommended
21 practice for providing high quality zinc coatings on assembled products, unless
22 otherwise specified.

23 C. Zinc coatings on iron and steel hardware shall meet the requirements of ASTM
24 A153, except that bolts, screws and other fasteners, 1/2 inch or less in diameter,
25 may be coated with electro-deposited zinc or cadmium coating meeting the
26 requirements of ASTM B633, Type RS, or ASTM B766, Type TS unless otherwise
27 specified.

28 D. Hot-Dip Galvanizing Touch-Up Paint: Yield shall be 94% pure zinc metallic
29 powder; meet ASTM B-117-64 salt spray (2000 hours); meets performance
30 requirements of MIL-D-46105 and DOD-P-21035A.

31 1. Crown Premium 7007 by Aevoe Industries

32 2. Or equal approved prior to bidding

33 ~~2.03~~2.04 WELDING ELECTRODES

34 A. ~~Aluminum~~Steel welding electrodes shall conform to the requirements of AWS
35 A5.401, "Specification for Aluminum and Aluminum Alloy Mild Steel Covered
36 Arc-Welding Rods and Bare Electrodes", except that they shall be uniformly and

1 heavily coated (not washed) and shall be of such a nature that the coating will not
2 chip or peel while being used with the maximum amperage specified by the
3 manufacturer.

4 PART 3 CONSTRUCTION METHODS

5 3.01 QUALITY ASSURANCE

6 A. Take field measurements prior to preparation of submittals and fabrication, where
7 possible without delay to job progress. Allow for trimming and fitting wherever
8 taking field measurements before fabrication.

9 B. Preassemble items in shop to greatest extent possible to minimize field splicing and
10 assembly. Disassemble units only as necessary for shipping and handling
11 limitations. Clearly mark units for reassembly and installation.

12 3.02 FABRICATION

13 A. Steel shall be structural quality unless otherwise specified. Castings shall be
14 thoroughly cleaned and subjected to careful inspection before installation. Finished
15 surfaces shall be smooth and true to assure proper fit.

16 ~~B. Fabrication of structural aluminum shall meet the requirements of Sections 6 and 7~~
17 ~~of the Aluminum Construction Manual, "Specifications for Aluminum Structures",~~
18 ~~The Aluminum Association.~~

19 3.03 PROTECTIVE COATINGS

20 A. Items specified to be hot-dip galvanized shall be completely fabricated for field
21 assembly before the application of the zinc coatings.

22 ~~B. All aluminum items to be in contact with concrete shall have a bituminous coating.~~

23
24 END OF SECTION

SECTION 05 52 00

RAILINGS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The work under this section shall cover furnishing and installing all handrails and toe plates at all locations shown on contract drawings and specified herein.

1.02 APPLICABLE PROVISIONS (NONE)

1.03 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.

- ~~1. The Aluminum Association (AA), Specifications and Standards:

 - ~~a. AA Sections 6 and 7 Aluminum Construction Manual, Specifications for Aluminum Structures, Current Edition.~~~~
- ~~2. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards:

 - ~~a. ASTM B136 Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum, Current Edition.~~
 - ~~b. ASTM B137 Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum, Current Edition.~~
 - ~~c. ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate, Current Edition.~~
 - ~~d. ASTM B210 Standard Specification for Aluminum and Aluminum Alloy Drawn Seamless Tubes, Current Edition.~~
 - ~~e. ASTM B211 Standard Specification for Aluminum and Aluminum Alloy Bar, Rod, and Wire, Current Edition.~~
 - ~~f. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes, Current Edition.~~
 - ~~g. ASTM B308 Standard Specification for Aluminum Alloy 6061-T6 Standard Structural Profiles, Current Edition.~~
 - ~~h. ASTM B429 Standard Specification for Aluminum Alloy Extruded Structural Pipe and Tube, Current Edition.~~
 - ~~i. ASTM B457 Standard Test Method for Measurement of Impedance of Anodic Coatings on Aluminum, Current Edition.~~
 - ~~j. ASTM B580 Standard Specification for Anodic Oxide Coatings on Aluminum, Current Edition.~~~~

1 3-1. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational
2 Safety and Health Administration (OSHA), Department of Labor, Part 1926
3 Regulations, Current Edition.

4 1.04 RELATED WORK ELSEWHERE

- 5 A. Metal Fastenings - Division 05
- 6 B. Metal Fabrications - Division 05

7 1.05 SUBMITTALS

- 8 A. Contractor shall submit such shop drawings and/or catalog cuts required for the
9 construction and installation of the materials and all components. These drawings
10 shall be accurate in every detail and shall contain all information necessary to relate
11 the materials to the specifications. Submittals shall include test data showing
12 railings comply with OSHA requirements.
- 13 B. Submittals shall indicate the intended materials arrangement, dimensions, major
14 support requirements, plot area and all intricate or detailed construction
15 requirements. Information shall be in conformance with requirements of City
16 submittals.

17 PART 2 PRODUCTS AND MATERIALS

18 2.01 MATERIALS

- 19 A. Railings shall be 1-1/2 inch round, ~~6063 anodized aluminum alloy~~, ASTM A53,
20 Grade B Schedule 40 pipe size. Use only materials which are smooth and free of
21 surface blemishes including pitting, seam marks, roller marks, rolled trade names
22 and roughness. Remove such blemishes by grinding or by welding and grinding.
- 23 B. Post members shall be one continuous piece and spaced not more than 6-feet on
24 center.
- 25 C. Railing and connection shall be designed to resist a 200 pound load applied at any
26 point on the handrail system per OSHA requirements.

27 PART 3 CONSTRUCTION METHODS

28 3.01 QUALITY ASSURANCE

- 29 A. Take field measurements prior to preparation of shop drawings and fabrication,
30 where possible, without delay to job progress. Allow for trimming and fitting
31 wherever taking field measurements before fabrications.

1 B. Preassemble items in shop to greatest extent possible to minimize field splicing and
2 assembly. Disassemble units only as necessary for shipping and handling
3 limitations. Clearly mark units for reassembly and installation.

4 3.02 FABRICATION

5 A. Where details are not shown, top of top guardrail shall be 42 inches above floor.

6 B. Fit and shop assemble components in largest practical sizes, for delivery to site.

7 C. Fabricate components with joints tightly fitted and secured.

8 D. Supply components required for anchorage of fabrications. Fabricate anchors and
9 related components of same material and finish as fabrication, except where
10 specifically noted otherwise.

11 E. Railings shall have mechanical connections consisting of internal plugs with
12 stainless steel screws or rivets. Railings shall be mechanically fastened to the
13 building structure.

14 F. Continuously seal joined pieces by continuous welds.

15 G. Form exposed work true to line and level with accurate angles and surfaces and
16 straight, true edges. Ease exposed edges to a radius of approximately 1/32 inch,
17 unless otherwise shown on the contract drawings. Form bent-metal corners to the
18 smallest radius possible without causing grain separation of otherwise impairing
19 the work. Grind exposed joints flush and smooth with adjacent finish surface.
20 Make exposed joints butt tight, flush, and hairline.

21 H. Accurately form components, to each other and to ~~building~~ structure.

22 ~~I. Fabrication of structural aluminum shall meet the requirements of Sections 6 and 7~~
23 ~~of the Aluminum Construction Manual, "Specifications for Aluminum Structures",~~
24 ~~The Aluminum Association.~~

25 3.03 INSTALLATION

26 A. Perform cutting, welding and fitting required for installation. Set the work
27 accurately in location, alignment and elevation, plumb, level, true and free of rack.
28 Fit exposed connections accurately together to form tight hairline joints.

29 B. Do not weld, cut or abrade the surfaces of units which have been coated or finished
30 after fabrication, and are intended for field connections.

31 C. Adjust railings prior to securing in place to ensure proper matching at butting joints
32 and correct alignment throughout their length.

1 D. Space posts not more than 6 feet on centers, unless otherwise shown on the contract
2 drawings. Plumb posts in each direction. Secure posts and rail ends to building
3 construction as shown on drawings.

4 E. Expansion joints shall be installed at 24 feet maximum centers.
5
6

END OF SECTION

1 SECTION 07 92 00

2
3 JOINT SEALANTS

4 PART 1 GENERAL

5 1.01 SECTION INCLUDES

- 6 A. Preparing sealant substrate surfaces.
- 7 B. Sealant and joint backing.

8 1.02 RELATED SECTIONS

- 9 A. Division 03 - Concrete: Sealants used in conjunction with cast-in-place concrete.
- 10 B. Division 26 - Electrical: Sealants used in conjunction with electrical penetrations.
- 11 C. Section 33 51 13 – Natural-Gas Piping: Sealants used in conjunction with pipe
12 penetrations.
- 13 D. Division 40 – Process Integration: Sealants used in conjunction with water, sewer,
14 and wastewater piping penetrations.
- 15 E. Division 44 – Pollution Control Equipment: Sealants used in conjunction with
16 process mechanical penetrations.

17 1.03 REFERENCES

- 18 A. American Society for Testing and Materials (ASTM) International:
- 19 1. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- 20 2. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- 21 3. ASTM D1667 - Standard Specification for Flexible Cellular Materials – Poly
22 (Vinyl Chloride) Foam (Closed-Cell).
- 23 4. ASTM D1056 – Standard Specification for Flexible Cellular Materials -
24 Sponge or Expanded Rubber.
- 25 B. Sealing and Waterproofers Institute (SWI):
- 26 1. SWI - Sealant and Caulking Guide Specification.

27 1.04 SUBMITTALS

- 28 A. Product Data: Indicate sealant chemical characteristics, performance criteria,
29 substrate preparation, limitations, and color availability.
- 30 B. Manufacturer Installation Instructions: Submit special procedures, surface
31 preparation, and perimeter conditions requiring special attention.

1 C. Warranty: Include coverage for installed sealants and accessories failing to achieve
2 watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

3 1.05 QUALITY ASSURANCE

4 A. Conform to Sealant and Waterproofers Institute requirements for materials.

5 B. Use adequate numbers of skilled workmen thoroughly trained and experienced in the
6 necessary crafts and completely familiar with the specified requirements and
7 methods needed for proper performance of the work of this Section.

8 C. Applicator qualifications:

9 1. Applicator shall have at least three (3) years experience in installing
10 materials of types specified and shall have successfully completed at least
11 three (3) projects of similar scope and complexity.

12 2. Applicator shall designate a single individual as project foreman who shall be
13 on site at all times during installation.

14 D. Single source responsibility for joint sealants:

15 1. Obtain joint sealants from single manufacturer for each different product
16 required to ensure compatibility.

17 2. Manufacturer shall instruct applicator in procedures for intersecting sealants.

18 E. Perform work in accordance with ASTM C1193 guidelines, except where more
19 stringent requirements are indicated or specified.

20 1.06 ENVIRONMENTAL REQUIREMENTS

21 A. Section 01 60 00 - Material and Equipment.

22 B. Do not install solvent curing sealants in enclosed building spaces.

23 C. Maintain temperature and humidity recommended by the sealant manufacturer
24 during and after installation.

25 1.07 PRODUCT STORAGE AND HANDLING

26 A. Section 01 60 00 - Material and Equipment: Product storage and handling
27 provisions.

28 B. Deliver the materials to the job site in the manufacturer's unopened containers with
29 all labels intact and legible at time of use.

30 C. Store materials in accordance with manufacturer's recommendations with proper
31 precautions to ensure fitness of material when installed.

1 1.08 SEQUENCING AND SCHEDULING

2 A. Section 01 31 13 - Project Coordination: Work coordination provisions.

3 B. Coordinate the work of this Section with all Sections referencing this Section.

4 1.09 SUBSTRATE CONDITIONS

5 A. Provide joints properly dimensioned to receive the approved sealant system.

6 B. Provide joint surfaces that are clean, dry, sound and free of voids, deformations,
7 protrusions, and contaminants which may inhibit application or performance of the
8 joint sealant.

9 1.10 WARRANTY

10 A. Deliver to the Architect signed copies of the following written warranties against
11 adhesive and cohesive failure of the sealant and against infiltration of water and air
12 through the sealed joint for a period of three (3) years from date of completion.

13 1. Manufacturer's standard warranty covering sealant materials.

14 2. Applicator's standard warranty covering workmanship.

15 PART 2 PRODUCTS

16 2.01 GENERAL

17 A. Compatibility:

18 1. Provide joint sealants, joint fillers, and accessory joint materials that are
19 compatible with one another and with joint substrates under project
20 conditions.

21 2. Install joint sealants, joint fillers, and related joint materials that are
22 nonstaining to visible joint surfaces and surrounding substrate surfaces.

23 B. Provide colors selected by Architect from manufacturer's standard color range,
24 unless noted otherwise.

25 2.02 SEALANTS

26 A. Polyurethane Sealant:

27 1. Tremco Dymeric or BASF MasterSeal NP2.

28 B. Self-Leveling Polyurethane Sealant:

29 1. BASF MasterSeal SL 1, Tremco THC-900, or Vulkem 45SSL.

30 2. For areas where the slope of the slab makes self-leveling material impractical
31 BASF MasterSeal SL 2, Tremco THC-901, or Vulkem 45SSL may be used.

32 3. Color: Match concrete color.

1 2.03 ACCESSORIES

- 2 A. Primer: Non-staining type, as recommended by sealant manufacturer to suit
3 application.
- 4 B. Joint Cleaner: Non-corrosive and non-staining type, as recommended by sealant
5 manufacturer; compatible with joint forming materials.
- 6 C. Backer Rod: Polyethylene foam rod or rope or other compatible non-waxing, non-
7 extruding, non-staining resilient material as recommended by sealant manufacturer,
8 closed cell, sized 25 percent wider than joint width.
- 9 D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit
10 application.
- 11 E. Masking Tape: Non-staining, non-absorbent tape product compatible with joint
12 sealants and adjacent joint surfaces that is suitable for masking.

13 PART 3 EXECUTION

14 3.01 EXAMINATION

- 15 A. Verify that joint openings are ready to receive work and field measurements are as
16 shown on Drawings and recommended by the manufacturer.
- 17 B. Beginning of installation means acceptance of substrates.

18 3.02 PREPARATION

- 19 A. Prepare surfaces to receive sealants in accordance with sealant manufacturer's
20 instructions and recommendations.
- 21 B. Examine joint sizes and correct as required to allow for anticipated movement and to
22 achieve proper width/depth ratio per manufacturer's recommendations for specified
23 sealant.
- 24 C. Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer,
25 whether primers are required or not.
 - 26 1. Remove all traces of previous sealant and joint backer by mechanical
27 methods, such as by cutting, grinding and wire brushing, in manner not
28 damaging to surrounding surfaces.
 - 29 2. Remove paints from joint surfaces except for permanent, protective coatings.
 - 30 3. Remove wax, oil, grease, dirt film residues, temporary protective coatings
31 and other residues by wiping with cleaner recommended for that purpose.
32 Use clean, white, lint-free cloths and change cloths frequently.
 - 33 4. Remove loose materials and foreign matter.
 - 34 5. Remove dust by blowing clean with oil-free, compressed air.

- 1 D. Verify that joint backing and release tapes are compatible with sealant.
- 2 E. Measure joint dimensions and size materials to achieve required width/depth ratios.
- 3 F. Protect elements surrounding the work of this Section from damage or disfiguration.

4 3.03 INSTALLATION

- 5 A. Install sealant in accordance with manufacturer’s instructions, and SWI “Sealant:
6 The Professional’s Guide”.
- 7 B. Where necessary to protect adjacent surfaces, mask adjacent surfaces with tape prior
8 to priming and/or caulking.
 - 9 1. Use masking tape where required to prevent sealant or primer contact with
10 adjoining surfaces that would be permanently stained or otherwise damaged
11 by such contact or the cleaning methods required for removal.
 - 12 2. Apply tape so as not to shift readily and remove tape immediately after
13 tooling without disturbing joint seal.
- 14 C. Provide backer rod uniformly to depth required by sealant manufacturer for proper
15 joint design using a blunt instrument.
 - 16 1. Fit securely by compressing backer material 25 percent to 50 percent so no
17 displacement occurs during tooling.
 - 18 2. Avoid stretching or twisting joint backer.
 - 19 3. Install to achieve a neck dimension no greater than 1/3 the joint width.
- 20 D. Install bond breaker where backer rod is not used or where recommended by sealant
21 manufacturer, adhering strictly to the manufacturers installation requirements.
- 22 E. Prime joint substrates where required.
 - 23 1. Use and apply primer according to sealant manufacturers recommendations.
 - 24 2. Confine primers to sealant bond surfaces; do not allow spillage or migration
25 onto adjoining surfaces.
 - 26 3. Prime immediately prior to caulking.
- 27 F. Install sealants immediately after joint preparation.
- 28 G. Install sealants to fill joints completely from the back, without voids or entrapped air,
29 using proven techniques, proper nozzles, and sufficient force that result in sealants
30 directly contacting and fully wetting joint surfaces.
- 31 H. Apply sealant within recommended application temperature ranges. Consult
32 manufacturer when sealant cannot be applied within these temperature ranges.
- 33 I. Install sealants to uniform cross-sectional shapes with depths relative to joint widths
34 that allow optimum sealant movement capability as recommended by sealant
35 manufacturer.

- 1 J. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- 2 K. Tool sealants in manner that forces sealant against back of joint, ensures firm, full
3 contact at joint interfaces and leaves a finish that is smooth, uniform and free of
4 ridges, wrinkles, sags, air pockets and embedded impurities. Provide concave tooled
5 joints.
- 6 L. Remove sealant from adjacent surfaces in accord with sealant and substrate
7 manufacturer recommendations as work progresses.
- 8 M. Protect joint sealants from contact with contaminating substances and from damages.
9 Cut out, remove, and replace contaminated or damaged sealants, immediately, so that
10 they are without contamination or damage at time of substantial completion.
- 11 N. Clean adjacent surfaces immediately and leave work neat and clean. Remove excess
12 and droppings using recommended cleaners as work progresses. Remove masking
13 tape immediately after tooling of joints.

14 3.04 CLEANING AND REPAIRING

- 15 A. Clean adjacent soiled surfaces.
- 16 B. Repair or replace defaced or disfigured finishes caused by work of this Section.

17 3.05 PROTECTION OF FINISHED WORK

- 18 A. Protect sealants until cured.

19
20

END OF SECTION

1 SECTION 09 96 00

2 HIGH PERFORMANCE COATINGS

3 PART 1 GENERAL

4 1.01 DESCRIPTION OF WORK

- 5 A. Work includes field painting of all exposed gas piping and preparation of surfaces to
6 receive coatings.

7 1.02 WORK NOT INCLUDED

- 8 A. Pre-Finished Items: Unless otherwise indicated, do not paint factory-finished or
9 pre-finished items.

- 10 B. Operating Parts: Do not paint any moving parts of operating units, mechanical and
11 electrical parts such as valve operators, unless otherwise directed or; machined or
12 polished surfaces of equipment where such surfaces are susceptible to rolling or
13 sliding friction.

- 14 C. Labels: Do not paint over any required labels, such as Underwriters' Laboratories
15 and Factory Mutual, or any equipment identification, performance rating, name, or
16 nomenclature plates. (This does not include cast or embossed names on equipment
17 castings.)

18 1.03 APPLICABLE PROVISIONS (NONE)

19 1.04 APPLICABLE PUBLICATIONS

- 20 A. The following publications of the issues listed below, but referred to thereafter by
21 basic designation only, form a part of this specification to the extent indicated by the
22 reference thereto.

- 23 1. American Society for Testing and Materials (ASTM), Annual Book of
24 ASTM Standards:
25 a. ASTM D16 - Definitions of Terms Relating to Paint, Varnish,
26 Lacquer and Related Products, Current Edition.
27 2. Steel Structures Painting Council (SSPC), Specification and Standards:
28 a. Steel Structures Painting Manual, Volume 2, "Systems &
29 Specifications", Current Edition.

30 1.05 RELATED WORK ELSEWHERE

- 31 A. Section 33 51 13 – Natural-Gas Piping

32 1.06 DELIVERY, STORAGE, AND HANDLING

- 33 A. Material and Equipment: Product storage and handling provisions.

1 B. Deliver products to site in sealed and labeled containers; inspect to verify
2 acceptance.

3 C. Container labeling to include manufacturer's name, type of paint, brand name, brand
4 code, coverage, surface preparation, drying time, cleanup, color designation, and
5 instructions for mixing and reducing.

6 D. Paint Materials: Store paint materials at minimum ambient temperature of
7 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in well
8 ventilated area, unless required otherwise by manufacturer's instructions.

9 E. Store products in ventilated dry areas, protected from contact with soil and from
10 exposure to the elements; keep products dry at all times; restrict storage to paint
11 materials and related equipment; comply with health and fire regulations.

12 F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

13 1.07 ENVIRONMENTAL REQUIREMENTS

14 A. Material and Equipment: Environmental provisions.

15 B. Do not apply materials when surface and ambient temperatures are outside
16 temperature ranges required by paint product manufacturer.

17 C. Do not apply exterior coatings during rain or snow, or when relative humidity is
18 above 50 percent, unless required otherwise by manufacturer's instructions.

19 D. Minimum Application Temperatures for Paints: 50 degrees F, unless required
20 otherwise by manufacturer's instructions.

21 1.08 CLOSEOUT SUBMITTALS

22 A. Closeout Procedures: Project closeout provisions.

23 1.09 EXTRA MATERIAL

24 A. Closeout Procedures: Extra material provisions.

25 B. Provide one (1) unopened quart container to Owner.

26 C. Label each container with color, texture, and room locations in addition to the
27 manufacturer's label.

1 PART 2 PRODUCTS AND MATERIALS

2 2.01 ACCEPTABLE MANUFACTURERS

- 3 A. The products listed are intended to establish a basis for comparison of products of
4 other manufacturers. Substitutions will be permitted but only with the prior written
5 approval of the Engineer.
- 6 B. All materials specified herein, and approved for use under this Contract shall be
7 manufactured by one of the Manufacturers listed as follows: Tnemec, Carboline,
8 Ameron, Dupont, Sherwin-Williams, or equal.

9 2.02 MATERIALS

- 10 A. Provide the best grade (quality) of the various types of coatings as regularly
11 manufactured by approved paint materials manufacturers. Materials not displaying
12 the manufacturer's identification as a standard, best-grade product will not be
13 acceptable. Refer to the "PAINTING/COATING SCHEDULE" in this section for
14 the types of paint and finishes to be applied to the various surfaces throughout the
15 project.
- 16 B. Use only thinners recommended by the manufacturer and then only to the extent
17 expressed on the latest printed data sheet.

18 PART 3 CONSTRUCTION METHODS

19 3.01 JOB CONDITIONS

- 20 A. Environmental Requirements: Comply with manufacturer's recommendations as to
21 environmental conditions under which coating and coating systems may be applied.
22 Do not apply paint in areas where dust is being generated.
- 23 B. Protection: Cover or otherwise protect finished work, surfaces not being painted
24 concurrently, or not to be painted.
- 25 C. Factory Painted Surfaces: The surface preparation and painting of materials and
26 equipment will be to manufacturer's standard unless otherwise specified in
27 applicable portions of these specifications.

28 3.02 SUBSTRATE EXAMINATION

- 29 A. Examine all surfaces to which paint is to be applied, and the conditions under which
30 the work is to be performed. The Applicator shall notify the Contractor and Engineer
31 in writing, of any conditions detrimental to the performance of this work.
- 32 B. Do not proceed with this work until unsatisfactory conditions have been corrected
33 and are acceptable to the Applicator. Starting of painting work will be construed as
34 the Applicator's acceptance of the surfaces and conditions.

1 3.03 SURFACE PREPARATION, GENERAL

2 A. Perform preparation and cleaning procedures in strict accordance with the paint
3 manufacturer's instructions and as herein specified, for each particular substrate
4 condition.

5 B. Remove all hardware, hardware accessories, machined surfaces, plates, and similar
6 items not to be painted, or provide surface applied protection prior to preparation and
7 painting operations. Remove obstructions as necessary to permit complete painting
8 of the items and adjacent surfaces. Following completion of painting of each space
9 or area, install the removed items by workmen skilled in the trades involved.

10 C. Clean surfaces to be painted before applying surface treatments. Remove oil and
11 grease prior to mechanical cleaning. Program the cleaning and painting so that
12 contaminants from the cleaning process will not fall onto wet, newly painted
13 surfaces.

14 3.04 PREPARATION, FERROUS METALS

15 A. Wash steel and iron surfaces with turpentine or mineral spirits to remove dirt and
16 grease. Where rust or scale is present, prepare surface in accordance with the
17 requirements as specified below:

18 1. Clean galvanized metal surfaces with turpentine or mineral spirits to remove
19 oily residue. Dry with a clean cloth;

20 2. Touch-up paint structural steel, miscellaneous metal, hollow metal doors and
21 frames and other materials which have been prime coated, as required, where
22 shop coat has been damaged by welding or handling and erection; paint
23 rivets, bolts and welds which are unpainted after assembly and erection.

24 3. Prepare steel substrates in accordance with the Steel Structures Painting
25 Council surface preparation number indicated in the application schedule and
26 as outlined below, unless otherwise required by the paint manufacturer's
27 most recent printed application instructions:

28 a. SSPC-SP-1-thoroughly wipe with aromatic/ketone solvent using
29 clean rags and solvent;

30 b. SSPC-SP-6-good Commercial Finish;

31 c. SSPC-SP-7-surface Brush Blast using fine sand or grit to obtain
32 finish similar to medium sand paper;

33 d. SSPC-SP-10-surface blast Near-White Metal Finish.

34 B. Apply primer immediately after surface preparation. Clean and touch up shop primer
35 that has become marred.

36 3.05 MATERIAL PREPARATION

37 A. Mix and prepare painting materials in accordance with the manufacturer's directions.
38 Stir materials before application to produce a mixture of uniform density, and stir as

1 required during the application of the materials. Do not stir surface film into the
2 material. Remove the film and, if necessary, strain the material before using.

3 3.06 COLORS

- 4 A. Intermediate coats of paint shall be tinted slightly darker than each preceding coat
5 unless otherwise directed. Undercoats shall be tinted slightly lighter than finish
6 coats.

7 3.07 APPLICATION

- 8 A. Apply paint in accordance with the manufacturer's directions. Use applicators and
9 techniques best suited for the type of material being applied.

- 10 B. Apply each coat at the rate specified by the manufacturer; if material has thickened
11 or must be diluted for application by spray gun, build up coat to the same film
12 thickness achieved with undiluted material; correct deficiencies in film thickness by
13 application of additional coats of paint.

- 14 C. Do not apply exterior paint in cold, foggy, damp or rainy weather. Do not apply
15 paint when temperature is lower than 50 degrees Fahrenheit.

- 16 D. Brush or roll materials smoothly in solid, even colors without drops, runs, lumps,
17 defective brushing, discoloration or clogging of lines and angles. Make edges of
18 paint adjoining other materials or colors sharp and clean without overlapping by
19 masking edges of paint adjoining other materials or colors to obtain sharp, clean
20 division.

- 21 E. Coats shall be thoroughly dry before applying succeeding coats. Unless otherwise
22 approved, allow 48 hours minimum drying time between coats for interior work
23 during favorable drying conditions. (Drying time shall be construed to mean "under
24 normal conditions"; where conditions are other than normal because of weather or
25 because painting must be done in confined spaces, longer drying times will be
26 required.) Do not apply additional coats of paint or place unit in service until paint is
27 thoroughly dry.

- 28 F. Where thinning is necessary, only the products of the manufacturer furnishing the
29 paint, and for the particular purpose, will be allowed; thin paint in strict accordance
30 with the manufacturer's instructions and only with the full knowledge and approval
31 of the Engineer.

- 32 G. Do not apply finish coats until after other trades, whose operations would be
33 detrimental to finish painting, have completed work in the areas to be painted, and
34 the areas have been approved by the Engineer for painting.

- 35 H. At completion, touch up and restore finish where damaged.

1 3.08 PROTECTION

2 A. Protect work of other trades, whether to be painted or not, against damage by
3 painting and finishing work. Correct any damages by cleaning, repairing or
4 replacing, and repainting, as directed by the Engineer. Provide “Wet Paint” signs as
5 required to protect newly painted finishes. Remove temporary protective wrappings
6 provided by others for protection of their work after completion of painting
7 operations.

8 3.09 CLEAN-UP

9 A. During the progress of the work, remove from the project all discarded paint
10 materials, rubbish, cans and rags. Upon completion of painting work, clean all
11 window glass and other paint-spattered surfaces. Remove spattered paint by proper
12 methods of washing and scraping, using care not to scratch or otherwise damage
13 finished surfaces.

14 3.10 PAINTING SCHEDULE

15 A. Gas Piping:
16 1. Surface Preparation: Blast to the extent of an SSPC-SP-6 Commercial-Grade
17 level of cleanliness and prime before any rust bloom reforms.
18 2. Primer: Spray apply one even coat of Manufacturer, Color, Polyamidoamine
19 Epoxy, to a DFT of 5.0 mils.
20 a. Dupont 25P
21 b. Tnemec Series 69
22 c. Carboline 890
23 d. Ameron Amerlock 400
24 e. Sherwin Williams Macropoxy 646
25 3. Intermediate: Spray apply one even coat of Manufacturer, Color,
26 Polyamidoamine Epoxy, to a DFT of 5.0 mils.
27 a. Dupont 25P
28 b. Tnemec Series 69
29 c. Carboline 890
30 d. Ameron Amerlock 400
31 e. Sherwin Williams Macropoxy 646
32 4. Field Finish: Apply one field finish coat of Manufacturer, Color, Acrylic
33 Polyurethane, to a minimum DFT of 2.0 to 3.0 mils.
34 a. Dupont 326 Imron
35 b. Tnemec Series 73
36 c. Carboline Carbothane 134 HG
37 d. Ameron Amershield
38 e. Sherwin Williams Acrolon 218

39 3.11 COLORS SCHEDULE

40 A. Paint for components listed shall be of the colors scheduled as follows:

	<u>COMPONENT</u>	<u>COLOR</u>
1		
2	1. Gas Piping, Natural	Orange
3	END OF SECTION	

1 SECTION 26 05 00

2
3 COMMON WORK RESULTS FOR ELECTRICAL

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent applicable. The
9 latest edition accepted by the Authority Having Jurisdiction of the referenced
10 publications in effect at the time of the bid governs

- 11 1. American National Standards Institute/National Fire Protection Agency
12 (ANSI/NFPA), Specifications and Standards, current edition:
 - 13 a. ANSI/NFPA 70 - National Electrical Code (NEC) and state
14 amendments thereto.
- 15 2. ASTM International (ASTM), originally known as the American Society
16 for Testing and Materials, Specifications and Standards, current edition:
- 17 3. Illuminating Engineering Society (IES). Institute of Electrical and
18 Electronics Engineers (IEEE)
- 19 4. Insulated Cable Engineers Association (ICEA)
- 20 5. International Society of Automation (ISA)
- 21 6. National Electrical Manufacturers Association (NEMA), Specifications and
22 Standards, current edition.
- 23 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
24 current edition.
- 25 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 26 9. National Electrical Contractors Association (NECA), current edition.
 - 27 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
28 Contracting.
- 29 10. International Electrical Testing Association (NETA)
 - 30 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
31 Power Distribution Equipment and Systems.
- 32 11. Canadian Standards Association (CSA), Specifications and Standards,
33 current edition.
- 34 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
35 Specifications and Standards, Current Edition.
- 36 13. International Electrotechnical Association (IEC), Specifications and
37 Standards, Current Edition.

38 1.03 DESCRIPTION OF WORK

39 A. General Requirements

1. Furnish and install complete and operable electrical systems as indicated on the drawings and as specified herein. This includes everything necessary for and incidental to completing the electrical work as specified including but not limited to the following.
2. Provide all electrical work, including conduit, field wiring, and connections by the electrical subcontractor under the provisions of the Electrical Specifications for all aspects of the work, including heating, ventilating, and air conditioning.
3. Coordinate all aspects of the work with the electrical subcontractor and other subcontractors before bidding in order to ensure that all costs associated with a complete installation are included. The owner is not responsible for any change orders due to lack of coordination of the contractor, the electrical subcontractor, the other subcontractors, or suppliers.
4. Provide all trenching, forming, rebar, concrete, back filling, hard surface removal and replacement, for all items associated with the electrical work and installation.

18 B. Design Requirements:

1. The Conduit and Boxes table included in the plan set specifies the usage requirements for the hardware and equipment specified in the following sections:
 - a. Section 26 05 29 Hangars and Supports for Electrical Systems
 - b. Section 26 05 34 Conduit
 - c. Section 26 05 37 Boxes

25 C. Electrical Work Specified Elsewhere:

1. Every attempt has been made to indicate in these specifications and drawings all work required under Division 26. However, there may be additional specific requirements in the specifications, drawings, or addenda of other trades which pertain to the work of this trade, and any such requirements are hereby made a part of the requirements for this trade.

31 D. Design Intent:

1. The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.
2. If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or Drawings, the Contractor shall furnish the item, system, or workmanship that is the highest quality, largest, or most closely fits the design intent.
3. Refer to the General Conditions of the Contract for further clarification of Design Intent.

- 1 4. The details and drawings are diagrammatic. The Contractor shall verify all
- 2 dimensions at the site and be responsible for their accuracy.
- 3 5. All sizes as given are minimum except as noted.
- 4 6. Materials and labor shall be new (unless noted or stated otherwise), first
- 5 class, and workmanlike, and shall be subject at all times to inspections, tests
- 6 and approval from the commencement until the acceptance of the completed
- 7 work.
- 8 7. Electrical requirements for equipment are based on design data. It shall be
- 9 the responsibility of the Contractor to verify actual requirements with the
- 10 provider of the equipment and adjust electrical installation based upon
- 11 actual requirements.

12 E. Substitution of Materials:

- 13 1. Refer to General Conditions of the Contract.
- 14 2. Where equipment or accessories are used which differ in arrangement,
- 15 configuration, dimensions, ratings, or engineering parameters from those
- 16 indicated on the contract documents, the Contractor is responsible for all
- 17 costs involved in integrating the equipment or accessories into the system
- 18 and the assigned space and for obtaining the specified performance from the
- 19 system into which these items are placed.

20 F. Continuity Of Existing Services And Systems:

- 21 1. No outages shall be permitted on existing systems except at the time and
- 22 during the interval(s) coordinated and approved by the Owner and the
- 23 Engineer. Any outage must be scheduled when the interruption causes the
- 24 least interference with normal schedules and routines. No extra costs will
- 25 be paid to the Contractor for such outages that must occur outside of regular
- 26 weekly working hours.
- 27 2. This Contractor shall restore any circuit interrupted as a result of this work
- 28 to proper operation as soon as possible.
- 29 3. Contractor shall submit plan for owner and engineer review detailing the
- 30 proposed sequencing of the installation as it pertains to the continuity of
- 31 electrical service.

32 1.04 RELATED WORK ELSEWHERE

- 33 A. Article 102 – Bidding Requirements and Conditions
- 34 B. Article 103 – Award and Execution of the Contract
- 35 C. Concrete – Division 03
- 36 D. Metals – Division 05
- 37 E. Electrical - Division 26
- 38 F. Earthwork – Division 31

- 1 G. Utilities – Division 33
- 2 1.05 SUBMITTALS
- 3 A. Submit shop drawings.
- 4 B. Submittal Requirements for Division 26 Shop Drawings:
- 5 1. Submit individual shop drawings for each section requiring submittal.
- 6 2. Mark general catalog sheets and drawings to indicate specific items being
- 7 submitted and proper identification of equipment by name and/or number,
- 8 as indicated in the contract documents.
- 9 3. Mark dimensions and values in units to match those specified. Include
- 10 wiring diagrams of electrically powered or controlled equipment.
- 11 4. Clearly notate any exceptions taken to these specifications.
- 12 5. Do not release equipment for construction until submittal has been reviewed
- 13 and received engineer approval.
- 14 6. Failure to comply with these requirements does not relieve the Contractor
- 15 of responsibility for meeting the project schedule.
- 16 C. Review of shop drawings shall be for conformance with design concept only and
- 17 will not release the Contractor from fulfilling the terms and intent of the contract
- 18 documents.
- 19 D. Shop Drawings shall be prepared and submitted for the following work:
- 20 1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- 21 (600 V and Less)
- 22 2. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- 23 3. Section 26 05 29 - Hangers and Supports for Electrical Systems
- 24 4. Section 26 05 34 - Conduit
- 25 5. Section 26 05 37 – Boxes
- 26 6. Section 26 05 41 – Wiring Devices
- 27 7. Section 26 05 53 – Identification for Electrical Systems
- 28 8. Section 26 05 73 – Electrical Systems Analysis
- 29 9. Section 26 09 07 – Automatic Transfer Control
- 30 10. Section 26 24 16 – Panelboards
- 31 11. Section 26 28 11 – Circuit Breakers
- 32 12. Section 26 29 13 – Motor Controllers
- 33 13. Section 26 32 13 – Standby Engine Generator Set
- 34 14. Section 26 36 23 – Transfer Switch
- 35 15. Section 26 43 13 – Surge Protection
- 36 16. Section 26 90 00 - Process Instrumentation & Control
- 37 17. Section 26 90 10 – Control Panel Construction
- 38 18. Section 26 90 11 – Control Panel Components
- 39 19. Section 26 90 30 – Programmable Logic Controllers
- 40 20. Section 26 90 60 – Ethernet Networking Equipment

- 1 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS
- 2 A. Submit operation & maintenance manuals.
- 3 B. Submittal Requirements for Division 26 Operation/Maintenance Manuals and
- 4 Instructions:
- 5 1. Assemble material in three-ring or post binders, using an index at the front
- 6 of each volume and tabs for each system or type of equipment. In addition
- 7 to the data indicated in the General Requirements, include the following
- 8 information:
- 9 a. Copies of as-built shop drawings.
- 10 b. Wiring diagrams for electrically powered or controlled equipment.
- 11 Drawings to be supplied on 11-inch by 17-inch paper.
- 12 c. Records of tests performed to certify compliance with system
- 13 requirements
- 14 d. Certificates of inspection by regulatory agencies
- 15 e. Parts lists for manufactured equipment
- 16 f. Preventive maintenance recommendations
- 17 g. Warranties
- 18 h. Additional information as indicated in the technical specification
- 19 sections
- 20 1) Test Reports and Demonstration Log:
- 21 a) Permanently record checks and tests and
- 22 demonstrations.
- 23 b) Submit copy of complete testing or demonstration
- 24 report no later than 30 days after testing or
- 25 demonstration is complete.
- 26 C. Operation & Maintenance Manuals and Instructions shall be prepared and
- 27 submitted for the following equipment:
- 28 1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- 29 (600 V and Less)
- 30 2. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- 31 3. Section 26 05 29 - Hangers and Supports for Electrical Systems
- 32 4. Section 26 05 34 - Conduit
- 33 5. Section 26 05 37 – Boxes
- 34 6. Section 26 05 41 – Wiring Devices
- 35 7. Section 26 05 53 – Identification for Electrical Systems
- 36 8. Section 26 05 73 – Electrical Systems Analysis
- 37 9. Section 26 09 07 – Automatic Transfer Control
- 38 10. Section 26 24 16 – Panelboards
- 39 11. Section 26 28 11 – Circuit Breakers
- 40 12. Section 26 29 13 – Motor Controllers
- 41 13. Section 26 32 13 – Standby Engine Generator Set
- 42 14. Section 26 36 23 – Transfer Switch
- 43 15. Section 26 43 13 – Surge Protection

- 1 16. Section 26 90 00 - Process Instrumentation & Control
- 2 17. Section 26 90 10 – Control Panel Construction
- 3 18. Section 26 90 11 – Control Panel Components
- 4 19. Section 26 90 30 – Programmable Logic Controllers
- 5 20. Section 26 90 60 – Ethernet Networking Equipment

6 1.07 FACTORY TESTING

- 7 A. Refer to the requirements the individual technical sections.

8 1.08 QUALITY ASSURANCE

- 9 A. All work and materials shall conform to or exceed in every detail the applicable
- 10 rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2,
- 11 the National Electrical Code (ANSI/NFPA 70), other applicable National Fire
- 12 Protection Association standards, the National Electrical Safety Code, and present
- 13 manufacturing standards.

- 14 B. All work shall be performed under the direction of a State of Wisconsin Licensed
- 15 Master Electrician.

- 16 C. All materials shall be listed by and shall bear the label of an approved electrical
- 17 testing laboratory. If none of the approved electrical testing laboratories has
- 18 published standards for a particular item, then other national independent testing
- 19 standards shall apply and such items shall bear those labels. Where one of the
- 20 approved electrical testing laboratories has an applicable system listing and label,
- 21 the entire system shall be so labeled.

- 22 D. The following laboratories are approved for providing electrical product safety
- 23 testing and listing services as required in these specifications:
- 24 1. Underwriters Laboratories Inc.
- 25 2. Electrical Testing Laboratories, Inc.

- 26 E. Certificates And Inspections:
- 27 1. Refer to the General Conditions of the Contract.
- 28 2. Obtain and pay for all required inspections including but not limited to state
- 29 or local electrical inspections and fuel tank inspections. Deliver original
- 30 inspection certificates to the Engineer.

31 1.09 WARRANTY

32 1.10 EXTRA MATERIALS

33 1.11 MAINTENANCE

- 34 A. Before substantial completion, perform all maintenance activities required by any
- 35 sections of the specifications including any calibrations, final adjustments,

1 component replacements or other routine service required before placing
2 equipment or systems into service.

3 B. Furnish all spare parts as required by other sections of the specifications.

4 PART 2 PRODUCTS AND MATERIALS

5 2.01 ACCESS PANELS AND DOORS

6 A. Lay-in Ceilings:

- 7 1. Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration are
8 sufficient; no additional access provisions are required unless specifically
9 indicated.

10 B. Drywall and Plaster Walls and Ceilings:

- 11 1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime
12 coated steel for general applications, stainless steel for use in toilets,
13 showers and similar wet areas, concealed hinges, screwdriver operated cam
14 latch for general application, key lock for use in public areas, UL listed for
15 use in fire rated partitions if required by the application. Use the largest size
16 access opening possible, consistent with the space and the equipment
17 needed service; minimum size is 12 x 12 inch.

18 2.02 SEALING AND FIRE-STOPPING

19 A. Refer to Architectural requirements.

20 B. Sealing and fire stopping of sleeves/openings between conduits, cable trays, wire
21 ways, troughs, cable bus, bus duct, etc. and the structural or partition opening shall
22 be the responsibility of the Contractor whose work penetrates the opening.
23 Individuals skilled in such work shall perform the sealing and fire stopping.

24 C. Whenever possible, avoid penetrations of fire and smoke rated partitions. When
25 they cannot be avoided, verify that sufficient space is available for the penetration
26 to be effectively fire and smoke stopped.

27 D. Manufacturers:

- 28 1. 3M, STI/SpecSeal, Tremco, or approved equal.
29 2. The same manufacturer shall provide all fire stopping systems.
30 3. The Contractor will be responsible for selecting the appropriate UL tested
31 fire stop system for each application required on the project.

32 E. Use a product that has a rating not less than the rating of the wall or floor being
33 penetrated. Reference architectural drawings for identification of fire and/or smoke
34 rated walls and floors.

- 1 F. Contractor shall use fire stop putty, caulk sealant, intumescent wrap strips,
2 intumescent fire stop collars, fire stop mortar or a combination of these products to
3 provide a UL listed system for each application required for this project. Provide
4 mineral wool backing where specified in manufacturer's application detail.

5 2.03 NON-RATED PENETRATIONS

6 A. Conduit Penetrations Through Concrete Wall and Foundation:

- 7 1. In exterior wall openings below grade, use a modular mechanical type seal
8 consisting of interlocking synthetic rubber links shaped to continuously fill
9 the annular space between the uninsulated conduit and the cored opening or
10 a water-stop type wall sleeve.

11 B. Conduit and Cable Tray Penetrations:

- 12 1. At conduit and cable tray penetrations of non-rated interior partitions, floors
13 and exterior walls above grade, use urethane caulk in annular space between
14 conduit and sleeve, or the core drilled opening.

15 PART 3 CONSTRUCTION METHODS

16 3.01 DIVISION OF WORK

- 17 A. The Contractor shall be responsible for coordinating conductor marking and color
18 coding requirements with control system equipment supplier(s).

19 3.02 FIELD MEASUREMENTS

- 20 A. The Contractor shall obtain from the appropriate trades and review shop drawings
21 for all equipment requiring electrical connections.

- 22 B. Field verify all measurements. Do not base electrical installation or equipment
23 locations on the contract drawings. Actual field conditions govern all final installed
24 locations, distances, and levels.

- 25 C. Identify conflicts with the work of other trades prior to installation of electrical
26 system.

- 27 D. Electrical installation shall be based upon shop drawing requirements and field
28 verified measurements. Adjust electrical system installation to satisfy field
29 requirements.

30 3.03 DELIVERY, STORAGE, AND HANDLING

- 31 A. Accept electrical equipment on site. Inspect for damage.

- 32 B. Take precautions to protect electrical equipment from weather, corrosion, and
33 entrance of debris.

1 3.04 INSTALLATION

2 A. Excavation And Backfill:

- 3 1. Perform all excavation and backfill work to accomplish indicated electrical
4 systems installation in accordance with other sections of this specification.

5 B. Concrete Work:

- 6 1. Coordinate the quantity and location of all cast-in-place concrete work with
7 the architectural drawings.
8 2. All cast-in-place concrete will be performed by the General Contractor
9 unless noted otherwise. Provide all layout drawings, anchor bolts, metal
10 shapes, and/or templates required to be cast into concrete or used to form
11 concrete for the support of electrical equipment.

12 C. Cutting And Patching:

- 13 1. Cutting, patching, channeling, and core drilling shall be performed in
14 accordance with the requirements for architectural work.
15 a. Secure the permission of the Engineer before performing any
16 operation likely to affect the strength of a structural member.
17 b. Before cutting, channeling, or core drilling any surface, ensure that
18 no penetration of any other systems will be made.
19 2. Perform all patching to the same quality and appearance as the original
20 work. Employ the proper tradesmen to secure the desired results. Seal
21 around all conduits, wires, and cables penetrating walls, ceilings, and floors
22 in all locations with a fire stop material.
23 3. Seal around conduit penetrations of below grade walls with a waterproof,
24 non-shrink, non-metallic grout, unless otherwise indicated on the typical
25 installation detail.

26 D. Building Access:

- 27 1. Arrange for the necessary openings in the building to allow for admittance
28 of all apparatus. When the building access was not previously arranged and
29 must be provided by this Contractor, restore any opening to its original
30 condition after the apparatus has been brought into the building.

31 E. Equipment Access:

- 32 1. Install all piping, conduit, ductwork, and accessories to permit access to
33 equipment for maintenance. Coordinate the exact location of wall and
34 ceiling access panels and doors, making sure that access is available for all
35 equipment and specialties. Where access is required in plaster or drywall
36 walls or ceilings, furnish access doors and arrange for installation by
37 appropriate trades.

38 F. Working Clearances:

- 39 1. Minimum installed equipment working clearances as required by the NEC
40 shall be maintained.

2. Minimum required dedicated electrical equipment space as required by the NEC shall be maintained.
3. Coordinate these requirements with the work of other trades.
4. Identify conflicts with working space requirements prior to installation of equipment.

G. Coordination:

1. Cooperate with other trades in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the Owner. The Contractor shall check location of electrical outlets with respect to other installations before installing.
2. Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, light fixtures, panel boards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.
3. Coordinate all work prior to installation. Any installed work that is not coordinated and that interferes with the work of another trade shall be removed or relocated at no additional cost to the Owner.
4. Verify the integrity of fire or smoke ratings where penetrations are required.

H. Sleeves:

1. Process Equipment Areas:
 - a. New poured concrete construction: cast in place, Schedule 40, PVC sleeve.
 - b. All other construction: core drill sleeve openings large enough to insert Schedule 40 PVC sleeve and grout around the sleeve.
 - c. Floor penetrations:
 - 1) Extend top of sleeve two inches above the floor.
 - 2) Where installation of sleeve in floor is not practical, provide two inch deep housekeeping pad extending three inches around cast in place conduits.
 - d. Hazardous locations:
 - 1) Sleeve(s) shall be installed per engineer details.
 - 2) Sleeve(s) shall be properly sealed to protect against the passage of flammable gases.
2. Non-Process Equipment Areas:
 - a. Hollow walls: Schedule 40, PVC sleeves, grout around sleeve in masonry construction.
 - b. All other Areas: core drill sleeve openings large enough to insert Schedule 40 PVC sleeve and utilize the core drilled opening as the sleeve.
3. Conduit Support:
 - a. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to the floor structure.

- 1 I. Sealing And Firestopping:
2 1. Fire and/or Smoke Penetrations:
3 a. Install approved product in accordance with the manufacturer's
4 instructions where a pipe (i.e. cable tray, bus, cable bus, conduit,
5 wire way, trough, etc.) penetrates a fire rated surface.
6 b. Where fire stop mortar is used to infill large fire-rated floor openings
7 that could be required to support weight, provide permanent
8 structural forming. Fire stop mortar alone is not adequate to support
9 any substantial weight.
10 2. Non-Rated Surfaces:
11 a. When the opening is through a non-fire rated wall, floor, ceiling or
12 roof the opening must be sealed using an approved type of material.
13 b. Install escutcheons or floor/ceiling plates where conduit,
14 penetrates non-fire rated surfaces in occupied spaces. Occupied
15 spaces for this paragraph include only those rooms with finished
16 ceilings and the penetration occurs below the ceiling.
17 c. In exterior wall openings below grade, assemble rubber links of
18 mechanical seal to the proper size for the conduit and tighten in
19 place, in accordance with the manufacturer's instructions.
20 d. At interior partitions, conduit penetrations are required to be sealed
21 for all areas. Apply sealant to both sides of the penetration in such
22 a manner that the annular space between the conduit sleeve and the
23 conduit is completely filled.
- 24 J. Housekeeping and Clean-up
25 1. On a daily basis, clean up and remove all debris and rubbish resulting from
26 work and repair all damage to new and existing equipment resulting from
27 work.
28 2. Remove all tools, excess material, and unused equipment from the site when
29 job is complete.
- 30 K. General Inspection and Cleaning of Electrical Equipment
31 1. Inspect for physical damage and abnormal mechanical or electrical
32 conditions.
33 2. Any item found to be out of tolerance, or in any other way defective as a
34 result of the required testing, shall be reported to the Engineer. Procedure
35 for repair and/or replacement will be outlined. After appropriate corrective
36 action is completed the item shall be re-tested.
37 3. Compare equipment nameplate information with the Contract Drawings and
38 report any discrepancies.
39 4. Verify proper auxiliary device operation and indicators.
40 5. Check tightness of accessible bolted electrical joints. Use torque wrench
41 method.
42 6. Make a close examination of equipment and remove any shipping brackets,
43 insulation, packing, etc. that may not have been removed during original
44 installation.

1 SECTION 26 05 01

2
3 ELECTRICAL DEMOLITION

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent applicable. The
9 latest edition accepted by the Authority Having Jurisdiction of the referenced
10 publications in effect at the time of the bid governs.

- 11 1. American National Standards Institute/National Fire Protection Agency
12 (ANSI/NFPA), Specifications and Standards, current edition:
- 13 2. NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
- 14 3. ASTM International (ASTM)
- 15 4. Illuminating Engineering Society (IES). Institute of Electrical and
16 Electronics Engineers (IEEE)
- 17 5. Insulated Cable Engineers Association (ICEA)
- 18 6. International Society of Automation (ISA)
- 19 7. National Electrical Manufacturers Association (NEMA)
- 20 8. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
21 current edition.
- 22 9. Wisconsin Department of Safety and Professional Services (DSPS)
- 23 10. National Electrical Contractors Association (NECA), current edition.
 - 24 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
25 Contracting.
- 26 11. International Electrical Testing Association (NETA)
 - 27 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
28 Power Distribution Equipment and Systems.
- 29 12. Canadian Standards Association (CSA), Specifications and Standards,
30 current edition.
- 31 13. Electrical and Electronic Manufacturers Association Canada (EEMAC),
32 Specifications and Standards, Current Edition.
- 33 14. International Electrotechnical Association (IEC), Specifications and
34 Standards, Current Edition.

35 1.03 DESCRIPTION OF WORK

36 A. General Requirements

- 37 1. Furnish labor and materials to demolish and remodel existing electrical
38 systems as indicated on the drawings and as specified herein. Design
39 Intent:

- 1 2. Every effort has been made to identify major demolition and remodeling
2 work required as part of this project. There may, however be minor work
3 items not specifically identified for demolition or remodeling.
- 4 3. The Contractor shall thoroughly review the demolition drawings and shall
5 include work associated with demolition and remodeling of minor items
6 such as receptacles, exit lights, and control stations affected by the work
7 shown on the demolition drawings.
- 8 4. Because of the demolition and remodeling work required as part of this
9 project, the Contractor is required to investigate the extent of work on site
10 prior to bidding. Failure to perform this investigation will not relieve the
11 Contractor of responsibility for demolition and remodeling of the minor
12 work items described.

13 B. Construction Methods:

- 14 1. Where detailed construction methods are identified for demolition and
15 remodeling of electrical equipment (for example, methods for
16 implementing service change), it is not intended that the methods proposed
17 be the only acceptable methods for completing the work. The Contractor is
18 encouraged to investigate and propose alternate methods which simplify the
19 work.
- 20 2. Alternate methods shall be reviewed by the Engineer prior to commencing
21 the work.
- 22 3. Only alternate methods which adequately accomplish the goals of the
23 specified methods will be allowed.

24 C. Contractor shall furnish labor and materials to demolish all existing electrical gear.
25 All equipment shall be delivered in good condition by the contractor to the Nine
26 Springs Wastewater Treatment Plant at 1610 Moorland Road in the City of
27 Madison. The contractor shall provide two full work days for MMSD to salvage
28 other equipment once the station is off-line. The contact from MMSD regarding
29 salvaging equipment is contact Dan McAdams at MMSD at 608-222-1201 ext 248

30 1.04 RELATED WORK ELSEWHERE

- 31 A. Article 102 – Bidding Requirements and Conditions
- 32 B. Article 103 – Award and Execution of the Contract
- 33 C. Concrete – Division 03
- 34 D. Metals – Division 05
- 35 E. Electrical - Division 26
- 36 F. Earthwork – Division 31

- 1 G. Utilities – Division 33
- 2 1.05 SUBMITTALS – (NOT USED)
- 3 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 4 1.07 FACTORY TESTING (NOT USED)
- 5 1.08 QUALITY ASSURANCE
- 6 A. All work and materials shall conform to or exceed in every detail the applicable
7 rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2,
8 the National Electrical Code (ANSI/NFPA 70), other applicable National Fire
9 Protection Association standards, the National Electrical Safety Code, and present
10 manufacturing standards
- 11 B. All materials and labor required under this section shall be compatible with existing
12 equipment and conditions.
- 13 1.09 WARRANTY (NOT USED)
- 14 1.10 EXTRA MATERIALS (NOT USED)
- 15 1.11 DESIGN REQUIREMENTS (NOT USED)
- 16 1.12 MAINTENANCE (NOT USED)
- 17 PART 2 PRODUCTS AND MATERIALS (NOT USED)
- 18 PART 3 CONSTRUCTION METHODS
- 19 3.01 DIVISION OF WORK
- 20 A. Contractor shall be responsible for coordinating demolition with subcontractors or
21 other trades.
- 22 3.02 FIELD MEASUREMENTS
- 23 A. Field verify all measurements. Do not base electrical installation or equipment
24 locations on the contract drawings. Actual field conditions govern all final installed
25 locations, distances, and levels.
- 26 B. Verify all circuiting arrangements
- 27 C. Verify that abandoned wiring and equipment serve only abandoned facilities.

1 D. Demolition Drawings are based on casual field observation and existing record
2 documents. Report discrepancies to Engineer before disturbing existing
3 installation.

4 E. The Contractor shall review demolition drawings and existing conditions for the
5 extent of demolition work required.

6 F. Commencement of demolition work indicates that Contractor accepts existing
7 conditions and fully comprehends the extent of demolition work.

8 3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)

9 3.04 INSTALLATION

10 A. Preparation

- 11 1. Identify existing electrical equipment which is to be removed.
- 12 2. Identify existing electrical equipment which is to remain but will be affected
13 by demolition or new construction work.
- 14 3. Identify existing equipment which is to be removed and which the Owner
15 wishes to retain. Owner shall have first right to all removed equipment not
16 specifically being re-used. If Owner retains equipment, Contractor shall
17 transport to designated storage facility located on site. If Owner refuses
18 equipment, Contractor shall be responsible for disposal.
- 19 4. Identify damaged or inoperable existing equipment prior to performing
20 work.
- 21 5. Coordinate utility service outages with user and engineer as well as the
22 Utility Company if applicable.
- 23 6. Maintain access to existing electrical installations, which are to remain
24 active.
- 25 7. Utilize materials and methods compatible with existing electrical
26 installations. Verify existing requirements for compatibility.

27 3.05 GENERAL DEMOLITION OF ELECTRICAL WORK

28 A. Demolition of Electrical Work, Structure Modified:

- 29 1. This paragraph defines requirements for electrical demolition where the
30 surfaces or areas containing the work are to be removed.
- 31 2. Disconnect electrical equipment which is to be removed.
- 32 3. Remove surface mounted and free-standing electrical equipment.
- 33 4. Remove existing wiring to source of supply.
- 34 5. Remove surface mounted conduits and raceways.
- 35 6. Disconnect concealed conduits from equipment which is to remain.
- 36 7. Concealed conduits may be removed with structure which is to be removed.
- 37 8. Transport Owner retained equipment to on-site location as directed by
38 Owner.

1 9. Dispose of all other removed equipment.

2 B. Demolition of Electrical Work, Structure Not Modified:

- 3 1. This paragraph defines requirements for electrical demolition where the
4 surfaces or areas containing the work are to remain.
5 2. Disconnect electrical equipment which is to be removed.
6 3. Remove surface mounted and free-standing electrical equipment.
7 4. Remove existing wiring to source of supply.
8 5. Remove surface mounted conduits and raceways.
9 6. Concealed conduit which is abandoned shall be cut flush with walls and
10 floors. Patch surfaces to match existing finish.
11 7. Transport Owner retained equipment to on-site location as directed by
12 Owner.
13 8. Dispose of all other removed equipment.

14 3.06 GENERAL REMODELING OF ELECTRICAL WORK

15 A. Reconnection of Electrical Equipment

- 16 1. This paragraph defines requirements for electrical remodeling where the
17 conduit and/or conductors connecting existing equipment must be replaced
18 because of remodeling work in the area.
19 2. Thoroughly investigate existing wiring and conduit to determine
20 requirements for reconnection.
21 3. Provide temporary wiring and connections to maintain existing systems in
22 service during construction. Minimize and coordinate necessary outages
23 with the Owner. When work must be performed on energized equipment
24 or circuits, use personnel experienced in such operations.
25 4. Install new conduit and/or wiring as indicated to maintain existing
26 operational characteristics or to provide new operational characteristics.
27 5. Demolish abandoned conduit and wiring as described above.
28 6. Remove temporary work upon completion of the permanent work.

29 B. Relocation of Electrical Equipment

- 30 1. This paragraph defines requirements for electrical remodeling where the
31 existing equipment must be removed and re-installed in a new location and
32 new conduit and conductors must be provided to reconnect the equipment.
33 2. Thoroughly investigate existing wiring and conduit to determine
34 requirements for reconnection.
35 3. Provide temporary wiring and connections to maintain existing systems in
36 service during construction. Minimize and coordinate necessary outages
37 with the Owner. When work must be performed on energized equipment
38 or circuits, use personnel experienced in such operations.
39 4. Remove equipment which is to be relocated.
40 5. Install equipment in designated new location.

1 SECTION 26 05 02

2
3 UTILITY SERVICES

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent applicable.
9 The latest edition accepted by the Authority Having Jurisdiction of the referenced
10 publications in effect at the time of the bid governs.

- 11 1. American National Standards Institute/National Fire Protection Agency
12 (ANSI/NFPA), Specifications and Standards current edition:
 - 13 a. ANSI/NFPA 70 - National Electrical Code (NEC) and state
14 amendments thereto
- 15 2. ASTM International (ASTM)
- 16 3. Illuminating Engineering Society (IES). Institute of Electrical and
17 Electronics Engineers (IEEE)
- 18 4. Insulated Cable Engineers Association (ICEA)
- 19 5. International Society of Automation (ISA)
- 20 6. National Electrical Manufacturers Association (NEMA), Specifications and
21 Standards, current edition.
- 22 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
23 current edition.
- 24 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 25 9. National Electrical Contractors Association (NECA), Standard of
26 Installation, Current Edition.
 - 27 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
28 Contracting.
- 29 10. International Electrical Testing Association (NETA)
 - 30 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
31 Power Distribution Equipment and Systems.
- 32 11. Canadian Standards Association (CSA), Specifications and Standards,
33 current edition.
- 34 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
35 Specifications and Standards, Current Edition.
- 36 13. International Electrotechnical Association (IEC), Specifications and
37 Standards, Current Edition.

38 1.03 DESCRIPTION OF WORK

39 A. Provide and install complete and operable utility services as required on the
40 drawings and as specified herein.

- 1 B. Payment of Electric Utility Company charges for service will be paid by an
- 2 allowance of \$3,000 which will be adjusted up or down by a change order to the
- 3 Contract to reflect actual utility company invoices. Contractor handling charges,
- 4 overhead, and mark-up shall be included in the base bid and are not included under
- 5 this allowance.

- 6 C. Payment of Gas Utility Company charges for service will be covered by Utility as
- 7 a new service.

- 8 D. Arrange with Electric Utility for permanent and temporary electric service.
- 9 1. Electric Service:
- 10 a. Utility Company: Madison Gas and Electric
- 11 1) Contact: Tim Cole 608-252-4709
- 12 b. System Characteristics:
- 13 1) Facility type: Pump Station
- 14 2) Required service voltage: 120/208V 3-phase, 4-wire.
- 15 3) Required service size: 200A.

- 16 E. Arrange with gas utility for permanent and temporary natural gas service as
- 17 specified herein.
- 18 1. Natural Gas Service:
- 19 a. Service Provider: Madison Gas and Electric
- 20 1) Contact: Holly Powell 608-252-7214
- 21 b. System Characteristics:
- 22 1) Required Service Type: Standby Generator
- 23

24 1.04 RELATED WORK ELSEWHERE

- 25 A. Article 102 – Bidding Requirements and Conditions
- 26 B. Article 103 – Award and Execution of the Contract
- 27 C. Concrete – Division 03
- 28 D. Metals – Division 05
- 29 E. Electrical - Division 26
- 30 F. Earthwork – Division 31
- 31 G. Utilities – Division 33

32 1.05 SUBMITTALS

- 33 A. Submit shop drawings.

- 1 B. The following information shall be submitted specifically for utility services:
2 1. Manufacturer literature sufficient in scope to demonstrate compliance with
3 the requirements of this specification.
4 a. Clearly notate any exceptions taken to these specifications.
5 2. Documentation required by utility company for approval.
6 3. Failure to comply with these requirements does not relieve the Contractor
7 of responsibility for meeting the project schedule.

8 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

9 1.07 FACTORY TESTING (NOT USED)

10 1.08 QUALITY ASSURANCE

11 A. All work and materials shall conform to or exceed in every detail the applicable
12 rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2,
13 the National Electrical Code (ANSI/NFPA 70), other applicable National Fire
14 Protection Association standards, the National Electrical Safety Code, and present
15 manufacturing standards.

16 B. All work shall be performed under the direction of a State of Wisconsin Licensed
17 Master Electrician.

18 C. Service entrance and metering equipment provided under this section shall be UL
19 Listed for the service intended and shall be approved by the utility company.

20 D. All materials, equipment, and parts shall be new and unused of current manufacture.

21 E. Contractor shall be responsible for providing all necessary accessories required for
22 a complete and operable system.

23 1.09 WARRANTY (NOT USED)

24 1.10 EXTRA MATERIALS (NOT USED)

25 1.11 DESIGN REQUIREMENTS (NOT USED)

26 1.12 MAINTENANCE

27 A. Before substantial completion, perform all maintenance activities required by any
28 sections of the specifications including any calibrations, final adjustments,
29 component replacements or other routine service required before placing
30 equipment or systems into service.

31 B. Furnish all spare parts as required by other sections of the specifications.

32 PART 2 PRODUCTS AND MATERIALS (NOT USED)

1 PART 3 CONSTRUCTION METHODS

2 3.01 DIVISION OF WORK

3 A. The Contractor shall be responsible for coordinating the division of work as it
4 relates to Utility Services .

5 3.02 FIELD MEASUREMENTS

6 A. Field verify all measurements. Do not base electrical installation or equipment
7 locations on the contract drawings. Actual field conditions govern all final installed
8 locations, distances, and levels.

9 B. Verify that service equipment is ready to be connected and energized.

10 C. Make arrangements with utility company and obtain required inspections before
11 energizing service(s).

12 D. Coordinate location of utility company facilities to ensure proper access is
13 available.

14 3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)

15 3.04 INSTALLATION

16 A. Install service entrance conduit and conductors in accordance with utility company
17 instructions.

18 B. Install metering equipment in accordance with utility company instructions.

19 3.05 TESTING AND START-UP SERVICES

20 A. Coordinate start-up and testing with utility company, and ensure proper inspections
21 are completed prior to energizing service(s).

22 3.06 TRAINING (NOT USED)

23 END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS
AND CABLES (600V AND LESS)

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - a. ASTM B800-05 Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers
 - b. ASTM B801-99 Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 4. Insulated Cable Engineers Association (ICEA)
 - a. NEMA WC 70/ICEA S-95-658-1999 – Standard for Non-shielded power cables rated 2000 volts or less for the distribution of electrical energy
 - b. NEMA WC 57/ICEA S-73-532 – Standard for control, thermocouple extension, and instrumentation cables.
 5. International Society of Automation (ISA)
 6. National Electrical Manufacturers Association (NEMA)
 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. U.L. 44 - Rubber-Insulated Wires and Cables.
 - b. U.L. 50 - Enclosures for Electrical Equipment.
 - c. U.L. 83 - Thermoplastic-Insulated Wires.
 - d. U.L. 514B - Conduit, Tubing, and Cable Fittings.
 - e. U.L. 758 - 105 degree C Appliance Wiring Materials.
 - f. U.L. 854 - Service Entrance Cables.

- 1 g. U.L. 1063 - Machine-Tool Wires and Cables.
- 2 h. U.L. 1277 - Type TC Power and Control Tray Cables.
- 3 i. U.L. 1569 - Metal-Clad Cables.
- 4 j. U.L. 1581 - Vertical Tray.
- 5 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 6 9. National Electrical Contractors Association (NECA), current edition.
- 7 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
- 8 Contracting.
- 9 10. International Electrical Testing Association (NETA)
- 10 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
- 11 Power Distribution Equipment and Systems.
- 12 11. Canadian Standards Association (CSA), Specifications and Standards,
- 13 current edition.
- 14 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
- 15 Specifications and Standards, Current Edition.
- 16 13. International Electrotechnical Association (IEC), Specifications and
- 17 Standards, Current Edition.

18 1.03 DESCRIPTION OF WORK

- 19 A. Furnish and install complete and operable wire and cable systems as indicated on
- 20 the drawings and as specified herein.

21 1.04 RELATED WORK ELSEWHERE

- 22 A. Article 102 – Bidding Requirements and Conditions
- 23 B. Article 103 – Award and Execution of the Contract
- 24 C. Concrete – Division 03
- 25 D. Metals – Division 05
- 26 E. Electrical - Division 26
- 27 F. Earthwork – Division 31
- 28 G. Utilities – Division 33

29 1.05 SUBMITTALS

- 30 A. Submit shop drawings.
- 31 B. Review of shop drawings shall be for conformance with design concept only and
- 32 will not release the Contractor for fulfilling the terms and intent of the contract
- 33 documents.

- 1 C. The following information shall be submitted specifically for wire and cable:
2 1. Literature sufficient in scope to demonstrate compliance with the
3 requirements of this specification.
4 2. Clearly identify the types, voltage class, and size of wire and cable
5 proposed.
- 6 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 7 1.07 FACTORY TESTING (NOT USED)
- 8 1.08 QUALITY ASSURANCE
- 9 A. Products: Listed and classified by UL or testing firm acceptable to the authority
10 having jurisdiction as suitable for the purpose specified and indicated.
- 11 B. Wire and cable manufacturers shall be certified to ISO 9001 International Quality
12 Standard and shall have third party certification verifying quality assurance in
13 design/development and production in accordance with ISO 9001.
- 14 C. All materials, equipment, and parts shall be new and unused of current manufacture.
- 15 D. Contractor shall be responsible for providing all necessary accessories required for
16 a complete and operable system.
- 17 1.09 WARRANTY (NOT USED)
- 18 1.10 EXTRA MATERIALS (NOT USED)
- 19 1.11 DESIGN REQUIREMENTS (NOT USED)
- 20 1.12 MAINTENANCE (NOT USED)
- 21 PART 2 PRODUCTS AND MATERIALS
- 22 2.01 WIRE AND CABLE - GENERAL PURPOSE (600V, COPPER)
- 23 A. Manufacturer: Contractor option.
- 24 B. General:
- 25 1. THWN/THHN general purpose building wire insulated with polyvinyl
26 chloride (PVC) and covered with protective sheath of nylon intended for
27 lighting and power circuits at 600 volts or less, in residential, commercial
28 and industrial buildings.
- 29 2. The wire shall be suitable for 90 degree C maximum continuous conductor
30 temperature in dry locations and 75 degree C in wet locations and listed by

1 Underwriters Laboratories for use in accordance with the National
2 Electrical Code.

3 3. All wire for permanent installation shall be new stranded copper wire
4 delivered to project in unopened cartons or reels, except where specifically
5 noted and be UL listed for the use intended. No wire smaller than 12 AWG
6 shall be used unless specifically noted. The use of multiconductore cable is
7 NOT ALLOWED.

8 C. Conductors:

9 1. Class B or Class C stranded, annealed uncoated copper per UL Standard 83
10 or 1063.

11 D. Insulation:

12 1. Each conductor shall be insulated with PVC and sheathed with nylon
13 complying with the requirements of UL Standard 83 for Types
14 THHN/THWN and UL Standard 1063 for Type MTW and CSA C22.2 No.
15 75 for T90 Nylon.

16 2. Types THWN/THHN shall comply with the optional Gasoline and Oil
17 Resistant rating of UL Standard 83. The insulation shall also comply with
18 UL requirements for 105 degree C Appliance Wiring Material.

19 3. The average thickness of PVC insulation, for a given conductor size, shall
20 be as specified in UL Standard 83 for Types THWN or THHN. The
21 minimum thickness at any point, of the PVC insulation, shall be not less
22 than 90 percent of the specified average thickness.

23 4. The minimum thickness at any point of the nylon sheath shall be as specified
24 in UL Standard 83 for Types THWN or THHN.

25 5. The PVC insulation shall be applied tightly to the conductor and shall be
26 free-stripping.

27 E. Identification:

28 1. The wire shall be identified by surface marking indicating manufacturer's
29 identification, conductor size and metal, voltage rating, UL Symbol, type
30 designations and optional ratings. The wire shall also be identified as C(UL)
31 Type T90 Nylon or TWN75, FT1.

32 F. Tests:

33 1. Wire shall be tested in accordance with the requirements of UL Standard 83
34 for Types THWN or THHN wire and for the optional Gasoline and Oil
35 Resistant listings; as Type MTW to UL Standard 1063 (stranded items); as
36 AWM to UL Standard 758 (stranded items); and as C(UL) Type T90 Nylon
37 or TWN75.

38 G. Usage:

39 1. General use power wiring, minimum size No.12 AWG.

2. General use for field wiring associated with starter enclosures, control panels and supervisory control systems, minimum size No.14 AWG.
3. Control wiring within control panels and supervisory control stations shall be minimum size No. 18 AWG.
4. All connections and feeders to rotating and/or vibrating equipment.-
5. All control wiring within starter enclosures, control panels, and supervisory control stations shall be 600-volt, insulation type THHN/THWN/TFFN or MTW. All field control wiring shall be 600-volt rated, insulation-type THHN/THWN.
6. Minimum size for field wiring associated with control panels and supervisory control stations shall be 14 AWG. Control wiring within control panels and supervisory control stations shall be minimum 18 AWG
7. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on drawings.

2.02 WIRE AND CABLE - GENERAL PURPOSE (~~600V, ALUMINUM~~)

- A. Manufacturer: Contractor option. (Follow schedule and provisions set on the plans.)
- B. General:
 1. XHHW-2 general purpose building wire insulated with cross linked polyethylene intended for service and feeder circuits at 600 volts or less, in residential, commercial and industrial buildings.
 2. The wire shall be suitable for 90 degree C maximum continuous conductor temperature in wet or dry locations and listed by Underwriters Laboratories for use in accordance with the National Electrical Code.
 3. All wire for permanent installation shall be new stranded copper wire delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multiconductore cable is NOT ALLOWED.
- C. Conductors:
 1. Compact stranded aluminum AA-8000 series alloy conductors of a recognized Aluminum Association 8000 Series aluminum alloy per ASTM B800-05 and constructed in accordance with the specifications of ASTM B801-99.
- D. Insulation:
 1. Each conductor shall be insulated with cross linked polyethylene complying with the requirements of UL Standard 83 for Type XHHW-2.
 2. Type XHHW-2 shall comply with the optional Gasoline and Oil Resistant rating of UL Standard 83.

1 3. The average thickness of cross linked polyethylene insulation, for a given
2 conductor size, shall be as specified in UL Standard 83 for Types XHHW-
3 2. The minimum thickness at any point shall be not less than 90 percent of
4 the specified average thickness.

5 E. Identification:

6 1. The wire shall be identified by surface marking indicating manufacturer's
7 identification, conductor size and metal, voltage rating, UL Symbol, type
8 designations and optional ratings.

9 F. Tests:

10 1. Wire shall be tested in accordance with the requirements of UL Standard 83
11 for Types XHHW-2 wire and for the optional Gasoline and Oil Resistant
12 listings.

13 G. Usage:

- 14 1. Service and feeder circuit wiring, minimum size No.2 AWG.
15 2. All connections and feeders to rotating and/or vibrating equipment.
16 3. Wiring for feeders and branch circuits 12 AWG and larger shall be 600 volt
17 insulation type XHHW-2.

18 2.03 SHIELDED POWER CABLE (600V)

19 A. Manufacturer: Contractor option.

20 B. General:

- 21 1. Three conductor type TC Tray Cable insulated with cross linked
22 polyethylene and PVC jacket overall, for use on circuits rated 600 volts and
23 90 degree C maximum continuous conductor temperature in wet or dry
24 locations.
25 2. Cables approved for installation in cable trays in accordance with the NEC
26 and for installation in air, in ducts or conduits, in tray or trough, in open
27 wiring or direct buried.

28 C. Conductors:

- 29 1. Shall be Class B stranded uncoated soft copper.
30 2. Suitable separator over the conductor may be used at the option of the
31 manufacturer.
32 3. Three phase conductors shall be cabled together with a Class B stranded,
33 uncoated copper grounding conductor and suitable non-hygroscopic fillers
34 to make round.
35 4. Length of lay shall not exceed 35 times the phase conductor diameter.
36 5. The grounding conductor shall comply with the requirements of UL
37 Standard 1277.

1 6. The cable assembly shall be covered with a copper tape shield with drain
2 wire, applied with a 10 percent minimum lap.

3 D. Insulation:

- 4 1. Each phase conductor shall be insulated with chemically cross linked
5 polyethylene, meeting Type XHHW-2 requirements of Underwriters
6 Laboratories.
7 2. The average thickness of insulation shall be as specified in UL Standard 44
8 for Type XHHW-2 conductors. The minimum thickness at any point shall
9 be not less than 90 percent of the specified average thickness.
10 3. The insulated phase conductors shall be black in color and shall be printed
11 with the numerals "1", "2", and "3" on their surface.
12 4. Each cable shall have a PVC protective jacket applied over the taped
13 assembly. The jacket shall meet the Sunlight Resistant requirements of UL
14 Standard 1277.
15 5. The average jacket thickness shall be in accordance with UL Standard 1277.
16 The minimum thickness at any point shall be not less than 80 percent of the
17 specified average thickness.

18 E. Identification:

- 19 1. Cables shall be identified by means of surface ink printing indicating
20 manufacturer, number of conductors, size, voltage rating, and required UL
21 information.

22 F. Tests:

- 23 1. Individual conductors and completed cables shall be tested in accordance
24 with UL requirements for Type TC Power Control Tray Cables having
25 XHHW-2 conductors.
26 2. Cables shall be capable of passing the ribbon burner cable tray flame test
27 requirements of UL and IEEE.

28 G. Usage:

- 29 1. Power wiring for motor loads controlled by adjustable frequency drives,
30 where so indicated on the drawings.

31 2.04 SHIELDED POWER CABLE - ARMORED (600V)

32 A. Manufacturer: Contractor option.

33 B. General:

- 34 1. Three conductor type TC Tray Cable insulated and armored, with cross
35 linked polyethylene and PVC jacket overall, for use on circuits rated 600
36 volts and 90 degree C maximum continuous conductor temperature in wet
37 or dry locations.

- 1 2. Cables approved for installation in cable trays in accordance with the NEC
2 and for installation in air, in ducts or conduits, in tray or trough, in open
3 wiring or direct buried.

4 C. Conductors:

- 5 1. Shall be Class B stranded uncoated soft copper.
6 2. Suitable separator over the conductor may be used at the option of the
7 manufacturer.
8 3. Three phase conductors shall be cabled together with a Class B stranded,
9 uncoated copper grounding conductor and suitable non-hygroscopic fillers
10 to make round.
11 4. Length of lay shall not exceed 35 times the phase conductor diameter.
12 5. The grounding conductor shall comply with the requirements of UL
13 Standard 1277.
14 6. The cable assembly shall be covered with a copper tape shield with drain
15 wire, applied with a 10 percent minimum lap.

16 D. Insulation:

- 17 1. Each phase conductor shall be insulated with chemically cross linked
18 polyethylene, meeting Type XHHW-2 requirements of Underwriters
19 Laboratories.
20 2. The average thickness of insulation shall be as specified in UL Standard 44
21 for Type XHHW-2 conductors. The minimum thickness at any point shall
22 be not less than 90 percent of the specified average thickness.
23 3. The insulated phase conductors shall be black in color and shall be printed
24 with the numerals "1", "2", and "3" on their surface.
25 4. Each cable shall have a PVC protective jacket applied over the taped
26 assembly. The jacket shall meet the Sunlight Resistant requirements of UL
27 Standard 1277.
28 5. The average jacket thickness shall be in accordance with UL Standard 1277.
29 The minimum thickness at any point shall be not less than 80 percent of the
30 specified average thickness.

31 E. Armor:

- 32 1. Impervious, corrugated continuous seam-welded aluminum alloy sheath per
33 UL 1569.
34 2. Armor shall be pressure tested and shall meet grounding requirements of
35 NEC article 250.

36 F. Cable end fittings:

- 37 1. Manufacturer:
38 a. Hubbell Killark Clencher 2000 MCR series.
39 b. Or equal.
40 2. Fittings shall be designed for termination of continuously corrugated or
41 interlocked armor type cables.

- 1 3. Fittings shall comply with the following:
2 a. Heavy-duty nickel-plated brass construction.
3 b. Moisture-sealing O-ring to prevent entry of moisture under cable
4 armor.
5 c. Cable jacket and O-ring seals.
6 d. Stainless-steel compression spring for positive electrical connection
7 and compliance with UL requirements.
8 4. Testing:
9 a. Short-circuit testing shall comply with requirements of UL-514B.
10 b. Corrosion testing shall comply with requirements of UL-50.
- 11 G. Identification:
12 1. Cables shall be identified by means of surface ink printing indicating
13 manufacturer, number of conductors, size, voltage rating, and required UL
14 information.
- 15 H. Tests:
16 1. Individual conductors and completed cables shall be tested in accordance
17 with UL requirements for Type TC Power Control Tray Cables having
18 XHHW-2 conductors.
19 2. Cables shall be capable of passing the ribbon burner cable tray flame test
20 requirements of UL and IEEE.
- 21 I. Usage:
22 1. Power wiring for motor loads controlled by adjustable frequency drives,
23 where so indicated on the drawings.

24 2.05 SHIELDED INSTRUMENTATION CABLE (300V)

- 25 A. Manufacturer: CONTRACTOR option.
- 26 B. General
27 1. Power limited tray cable - two conductor, No.16 AWG (7x24) bare copper,
28 PVC insulation, overall shield with No.18 AWG (7x26) tinned copper drain
29 wire, PVC jacket with nylon ripcord.
30 2. Power limited tray cable - three conductor, No.16 AWG (7x24) bare copper,
31 PVC insulation, overall shield with No.18 AWG (7x26) tinned copper drain
32 wire, PVC jacket with nylon ripcord.
- 33 C. Electrical Characteristics:
34 1. Max. Operating voltage: 300Vrms.
35 2. Conductor DC resistance at 20 deg. C: 3.7 Ohms/1000 ft.
36 3. Shield DC resistance at 20 degrees C: 5.1 Ohms/1000 ft.
37 4. Capacitance between conductors at 1 kHz: 61 pF/ft.
38 5. Capacitance between conductor and shield at 1 kHz: 114 pF/ft.

- 1 3. Completely and thoroughly swab raceway prior to installation.
- 2 4. Verify that field measurements are as shown on drawings.
- 3 5. Wire and cable routing shown on drawings is approximate unless
- 4 dimensioned. Route wire and cable to satisfy project conditions.
- 5 6. Where wire and cable routing is not shown, and destination only is
- 6 indicated, determine exact routing and lengths required.
- 7 7. Determine required separation between cable and other work.
- 8 8. Determine cable routing to avoid interference with other work.
- 9 9. Any single conduit or raceway utilized for a feeder circuit shall contain only
- 10 power conductors of a single feeder circuit. Do not combine feeder circuits
- 11 without engineer's written approval.
- 12 10. Contract drawings indicate individual homerun equipment connections.
- 13 Contractor may combine branch circuits of common types in single conduits
- 14 provided the following conditions are met:
- 15 a. NEC requirements for conductor de-rating are satisfied.
- 16 b. Conduit fill does not exceed thirty percent. Ten percent fill shall be
- 17 reserved for future use.
- 18 11. No more than eight 24VDC analog circuits may be combined in a single
- 19 conduit unless specifically stated otherwise on the drawings.

- 20 B. Conductor Sizing:
- 21 1. Conductor sizes are based on copper unless otherwise noted.
 - 22 2. Use conductor not smaller than No.12 AWG for power and lighting circuits.
 - 23 3. Use No.10 AWG conductors for 20 ampere, 120-volt branch circuits longer
 - 24 than 75 feet.
 - 25 4. Where circuit wiring length exceeds length identified on the feeder
 - 26 schedule, increase wire size as needed to maintain a maximum voltage drop
 - 27 of three percent.
 - 28 5. Use conductor not smaller than No.14 AWG for control circuits.
 - 29 6. Unless shown otherwise on the contract drawings, power wiring shall be
 - 30 No.12 AWG.

- 31 C. Color-coding
- 32 1. See Section 26 05 53 – Identification for Electrical Systems for additional
 - 33 requirements.
 - 34 2. All wire shall be color coded using electrical tape in sizes where colored
 - 35 insulation is not available. Where tape is used as the identification system,
 - 36 it shall be applied in all junction boxes, manholes and other accessible
 - 37 intermediate locations as well as at each termination.
 - 38 3. The following color coding shall be used:

System	Wire	Color
240/120 Volts	Neutral	White
Single-Phase, 3 Wire	Line 1	Black
	Line 2	Red

1	208Y/120 Volts	Neutral	White
2	3-Phase, 4 Wire	Phase A	Black
3		Phase B	Red
4		Phase C	Blue
5	480Y/277 Volts	Neutral	Gray
6	3-Phase, 4 Wire	Phase A	Brown
7		Phase B	Orange
8		Phase C	Yellow
9	120 Volt	Control	Red
10	24 Volt	Positive	Purple
11		Common	Purple/White Stripe

- 12 D. Wire Pulling:
- 13 1. Pull all conductors into raceway at same time.
 - 14 2. No.4 AWG and larger wire and power cables shall lubricated with UL
 - 15 approved pulling lubricant to reduce pulling tension and abrasion damage.
 - 16 The lubricant shall be water or wax based containing no oils or greases that
 - 17 may adversely affect cable jackets.
 - 18 3. The minimum bend radius and maximum pulling tension ratings of the wire
 - 19 and cable shall not be exceeded.

- 20 E. Splices and Terminations:
- 21 1. Splices and terminations shall not be made within raceways.
 - 22 2. Clean conductor surfaces before splicing or terminating.
 - 23 3. Make splices, taps, and terminations to carry full amp capacity of
 - 24 conductors with no perceptible temperature rise.
 - 25 4. Insulated spring wire connectors may be used to splice 120V power circuits.
 - 26 5. Control, communication, and data transmission wire and cable shall not be
 - 27 spliced.
 - 28 6. Use split bolt connectors for copper conductor splices and taps, 6 AWG and
 - 29 larger. Tape uninsulated conductors and connector with electrical tape to
 - 30 150 percent of insulation rating of conductor.
 - 31 7. Use solderless pressure connectors with insulating covers for copper
 - 32 conductor splices and taps, 8 AWG and smaller.
 - 33 8. Use insulated spring wire connectors with plastic caps for copper conductor
 - 34 splices and taps, 10 AWG and smaller.

- 35 F. Motors:
- 36 1. Motor wiring to motors less than 10 horsepower shall be spliced and
 - 37 terminated with fully insulated crimp-on end cap with a layer of self-
 - 38 vulcanizing rubber tape, followed by five layers of vinyl electrical tape.
 - 39 "SkotchLocks" and similar devices shall not be used.
 - 40 2. Motor wiring to motors 10 horsepower or larger shall be spliced and
 - 41 terminated with crimp-on ring terminal lugs, brass nuts, bolts and washers

1 with a layer of self-vulcanizing rubber tape, followed by five layers of vinyl
2 electrical tape. “SkotchLocks” and similar devices shall not be used.

3 G. Unshielded power cables:

- 4 1. Unshielded power cables shall be spliced and terminated with crimp-on ring
5 terminal lugs, brass nuts, bolts and washers with a layer of self-vulcanizing
6 rubber tape, followed by five layers of vinyl electrical tape. “SkotchLocks”
7 and similar devices shall not be used.

8 H. Aluminum Conductor Connections:

- 9 1. Do not transition from copper to aluminum conductor when extending
10 existing copper conductors.
- 11 2. Mechanical Screw Type Connectors:
- 12 a. Connectors shall be dual rated (AL7CU or AL9CU) and Listed by
13 UL for use with aluminum and copper conductors and sized to
14 accept aluminum conductors of the ampacity specified.
- 15 b. Using a suitable stripping tool, to avoid damage to the conductor,
16 remove insulation from the required length of the conductor.
- 17 c. Clean the conductor surface using a wire brush and apply a listed
18 joint compound.
- 19 d. Tighten the connection per the connector manufacturer’s
20 recommendation.
- 21 e. Wipe off any excess joint compound.
- 22 3. Mechanical Compression Type Connectors:
- 23 a. Connectors shall be dual rated (AL7CU or AL9CU) and Listed by
24 UL for use with aluminum and copper conductors and sized to
25 accept aluminum conductors of the ampacity specified.
- 26 b. The lugs shall be marked with wire size, die index, number and
27 location of crimps and shall be suitably color coded. Lug barrel shall
28 be factory prefilled with a joint compound Listed by UL.
- 29 c. Using a suitable stripping tool, to avoid damage to the conductor,
30 remove insulation from the required length of the conductor.
- 31 d. Clean conductor surface using a wire brush.
- 32 e. Crimp the connection per the connector manufacturer’s
33 recommendation.
- 34 f. Wipe off any excess joint compound.
- 35 4. Termination of Aluminum Conductor to Aluminum Bus:
- 36 a. Prepare a mechanical screw or compression type connection.
- 37 b. Hardware:
- 38 1) Bolts: Anodized aluminum alloy 2024-T4 and conforming
39 to ANSI B18.2.1 and to ASTM B211 or B221 chemical and
40 mechanical property limits.
- 41 2) Nuts: Aluminum alloys 6061-T6 or 6262-T9 and
42 conforming to ANSI B18.2.2.

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
 - b. ANSI/NFPA 99 - Health Care Facilities.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE), Specifications and Standards, current edition
 - a. IEEE 837 – Standard for Qualifying Permanent Connections Used in Substation Grounding.
 4. Insulated Cable Engineers Association (ICEA)
 5. International Society of Automation (ISA)
 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, Current Edition
 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL 467 – Ground and Bonding Equipment
 8. Wisconsin Department of Safety and Professional Services (DSPS)
 9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
 10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
 12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
 13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

1 1.03 DESCRIPTION OF WORK

- 2 A. Furnish and install complete and operable grounding and bonding systems as
3 indicated on the drawings and as specified herein including but not limited to:
4 1. Grounding electrodes.
5 2. Bonding jumpers.
6 3. Ground connections.
- 7 B. Provide bonding jumpers and wire, grounding bushings, clamps and
8 appurtenances required for complete grounding system to bond equipment and
9 raceways to equipment grounding conductors.

10 1.04 RELATED WORK ELSEWHERE

- 11 A. Article 102 – Bidding Requirements and Conditions
12 B. Article 103 – Award and Execution of the Contract
13 C. Concrete – Division 03
14 D. Metals – Division 05
15 E. Electrical - Division 26
16 F. Earthwork – Division 31
17 G. Utilities – Division 33

18 1.05 SUBMITTALS

- 19 A. Submit shop drawings.
20 B. Review of shop drawings shall be for conformance with design concept only and
21 will not release the Contractor for fulfilling the terms and intent of the contract
22 documents.

23 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

24 1.07 FACTORY TESTING (NOT USED)

25 1.08 QUALITY ASSURANCE

- 26 A. Measure ground resistance from system neutral connection at service entrance to
27 convenient ground reference point using suitable ground testing equipment.
28 Resistance shall not exceed 2 ohms. Additional grounding electrodes shall be
29 used to satisfy ground resistance requirements where required by earth conditions.
- 30 B. All grounding components and materials shall be UL listed and labeled.

1 1.09 WARRANTY (NOT USED)

2 1.10 EXTRA MATERIALS (NOT USED)

3 1.11 DESIGN REQUIREMENTS (NOT USED)

4 1.12 MAINTENANCE

5 A. Before substantial completion, perform all maintenance activities required by any
6 sections of the specifications including any calibrations, final adjustments,
7 component replacements or other routine service required before placing
8 equipment or systems into service.

9 PART 2 PRODUCTS AND MATERIALS

10 2.01 ROD ELECTRODE

11 A. Material: Copper-clad steel.

12 B. Diameter: 3/4-inch minimum.

13 C. Length: 10-feet minimum. Rod shall be driven at least 9.5-feet deep.

14 D. Use one or more ground rods to obtain the minimum specified ground resistance.
15 This applies to manholes, padmount switches, transformers, service entrances,
16 and all other equipment requiring a supplemental grounding electrode. Minimum
17 of three ground rods shall be used to ground the service entrance as indicated on
18 plans.

19 2.02 MECHANICAL CONNECTORS

20 A. The mechanical connector bodies shall be manufactured from high strength, high
21 conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers
22 shall be made of silicon bronze and supplied as a part of the connector body and
23 shall be of the two bolt type.

24 B. Split bolt connector types are not allowed.

25 C. The connectors shall meet or exceed UL 467 and be clearly marked with the
26 catalog number, conductor size and manufacturer.

27 2.03 COMPRESSION CONNECTORS

28 A. The compression connectors shall be manufactured from pure wrought copper.
29 The conductivity of this material shall be no less than 99 percent.

30 B. The connectors shall meet or exceed the performance requirements of IEEE 837,
31 latest revision.

- 1 C. The installation of the connectors shall be made with a compression, tool and die
2 system, as recommended by the manufacturer of the connectors.
- 3 D. The connectors shall be clearly marked with the manufacturer, catalog number,
4 conductor size and the required compression tool settings.
- 5 E. Each connector shall be factory filled with an oxide-inhibiting compound.
- 6 F. Connector to be suitable for direct burial in earth and concrete.

7 2.04 EXOTHERMIC CONNECTIONS

- 8 A. Select the appropriate kit for specific types, sizes, and combinations of conductors
9 and other items to be connected. Field personnel shall be trained in execution of
10 welds.

11 2.05 WIRE

- 12 A. Material: Stranded copper (aluminum not permitted).
- 13 B. Grounding Electrode Conductor: Size as shown on drawings, specifications or as
14 required by NFPA 70, whichever is larger.
- 15 C. Manhole and Vault Bonding: No. 4/0 minimum.
- 16 D. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings,
17 specifications or as required by NFPA 70, whichever is larger. Differentiate
18 between the normal ground and the isolated ground when both are used on the
19 same facility.

20 PART 3 CONSTRUCTION METHODS

21 3.01 DIVISION OF WORK (NOT USED)

22 3.02 FIELD MEASUREMENTS

- 23 A. Field verify all measurements. Do not base electrical installation or equipment
24 locations on the contract drawings. Actual field conditions govern all final
25 installed locations, distances, and levels.
- 26 B. Identify conflicts with the work of other trades prior to installation of electrical
27 system.
- 28 C. Adjust electrical system installation to satisfy field requirements.

1 3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)

2 3.04 INSTALLATION

3 A. General:

- 4 1. Verify that final backfill and compaction has been completed before
5 driving rod electrodes.
- 6 2. Install products in accordance with manufacturer instructions.
- 7 3. Mechanical connections shall be accessible for inspection and checking.
8 No insulation shall be installed over mechanical ground connections.
- 9 4. Ground connection surfaces shall be cleaned and all connections shall be
10 made so that it is impossible to move them.
- 11 5. Attach grounds permanently before permanent building service is
12 energized.
- 13 6. Install rod electrodes at locations indicated or as required by local code,
14 whichever requires the most rods. Install additional rod electrodes as
15 required to achieve specified resistance to ground.
- 16 7. Connect grounding electrode conductor and reinforcing steel in foundation
17 footing. Bond steel together.
- 18 8. Bond all conductive components to meet Regulatory Requirements.
- 19 9. Bond together metal siding not attached to grounded structure; bond to
20 ground.
- 21 10. All separate ground wires shall be enclosed in rigid galvanized steel
22 conduit and bonded at both ends to the rigid galvanized steel conduit with
23 an approved fitting.
- 24 11. Provide a separate grounding conductor for each motor and connect at
25 motor terminal box. Do not use bolts securing motor box to frame or cover
26 for grounding conductors:
 - 27 a. When grounding motors driven by variable frequency drives
28 (VFD) comply with the requirements of the VFD manufacturer.

29 B. Less than 600 volt system grounding:

- 30 1. Supplementary Grounding Electrode: Use driven ground rod on exterior
31 of building.
- 32 2. Copper grounding electrode conductor shall be sized as indicated or as
33 required by NEC, whichever is larger and shall be extended from
34 secondary service system neutral to street side of water meter, building
35 steel, ground rod, and any concrete encased electrodes. Bonding jumper
36 shall be installed around water meter. Install conductor in separate rigid
37 conduit. Bond conduit as described above.
- 38 3. Receptacle Grounding: All receptacles installed shall have a separate
39 grounding contact.
- 40 4. Bond together system neutrals, service equipment enclosures, exposed
41 non-current carrying metal parts of electrical equipment, metal raceway
42 systems, grounding conductor in raceways and cables, receptacle ground
43 connectors, and plumbing systems.

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American Iron and Steel Institute (AISI), Specifications and Standards, current edition.
 2. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
 3. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - a. ASTM A653 - General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process.
 - b. ASTM A1011 - Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability (Formerly ASTM A570).
 - c. ASTM F1136 - Standard Specification for Chromium/Zinc Corrosion Protective Coatings for Fasteners.
 - d. ASTM A907 - Standard Specification for Steel, Sheet, and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled, Structural Quality.
 - e. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - f. ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - g. ASTM A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - h. ASTM A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 4. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 5. Insulated Cable Engineers Association (ICEA)
 6. International Society of Automation (ISA)
 7. National Electrical Manufacturers Association (NEMA)

- 1 8. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
2 current edition.
- 3 9. Wisconsin Department of Safety and Professional Services (DSPS)
- 4 10. National Electrical Contractors Association (NECA), current edition.
 - 5 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
6 Contracting.
 - 7 b. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC,
8 EMT).
- 9 11. Metal Framing Manufacturers Association (MFMA), Specifications and
10 Standards, current edition.

11 1.03 DESCRIPTION OF WORK

- 12 A. Furnish and install supporting devices as indicated on the drawings, scheduled in
13 Section 26 05 00, and as specified herein.
- 14 B. Demonstrate the following using generally accepted engineering methods:
 - 15 1. That the anchors to the structure are adequate to resist the loads generated
16 in accordance with the Building Code and equipment requirements.
 - 17 2. That the required load capacity of the anchors can be fully developed in
18 the structural materials to which they are attached.

19 1.04 RELATED WORK ELSEWHERE

- 20 A. Article 102 – Bidding Requirements and Conditions
- 21 B. Article 103 – Award and Execution of the Contract
- 22 C. Concrete – Division 03
- 23 D. Metals – Division 05
- 24 E. Electrical - Division 26
- 25 F. Earthwork – Division 31
- 26 G. Utilities – Division 33

27 1.05 SUBMITTALS

- 28 A. Submit shop drawings.
- 29 B. Review of shop drawings shall be for conformance with design concept only and
30 will not release the Contractor from fulfilling the terms and intent of the contract
31 documents.
- 32 C. The following information shall be submitted specifically for supporting devices:
 - 33 1. Submit outline drawings and dimensions for equipment support racks.

1 2. Include data on attachment hardware and construction methods that will
2 satisfy the design loading and anchoring criteria.

3 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

4 1.07 FACTORY TESTING (NOT USED)

5 1.08 QUALITY ASSURANCE

6 A. Bolted framing channels and fittings shall have the manufacturers' name, part
7 number, and material heat code identification number stamped in the part itself
8 for identification. Material certification sheets and test reports must be made
9 available by the manufacturer upon request

10 B. Stainless steel bolted framing parts shall be stamped to identify the material.
11 Material certification sheets and test reports must be made available by the
12 manufacturer upon request.

13 C. All materials, equipment, and parts shall be new and unused of current
14 manufacture.

15 D. Contractor shall be responsible for providing all necessary accessories required
16 for a complete and operable system.

17 1.09 WARRANTY (NOT USED)

18 1.10 EXTRA MATERIALS (NOT USED)

19 1.11 DESIGN REQUIREMENTS (NOT USED)

20 1.12 MAINTENANCE (NOT USED)

21 PART 2 PRODUCTS AND MATERIALS

22 2.01 STRUT, CHANNELS, TRAPEZES AND CONNECTORS

23 A. Manufacturers:
24 1. Cooper B-Line, Inc.
25 2. or equal.

26 B. General:
27 1. Strut shall be 1-5/8-inches wide in varying heights and welded
28 combinations as required to meet load capacities and designs indicated on
29 the drawings.
30 2. Minimum sized threaded rod for supports shall be 3/8" for trapezes and
31 single conduits 1-1/4" and larger, and 1/4" for single conduits 1" and
32 smaller.

- 1 C. Materials and Finish:
- 2 1. Hot-dip Galvanized Steel: Strut shall be made from steel meeting the
- 3 minimum mechanical properties of ASTM A1011 SS, Grade 33 and shall
- 4 be hot-dip galvanized after fabrication in accordance with ASTM A123.
- 5 Fittings shall be manufactured from steel meeting the minimum
- 6 requirements of ASTM A907 SS, Grade 33, and hot-dip galvanized after
- 7 fabrication in accordance with ASTM A123. All hardware shall be
- 8 stainless steel Type 304 or chromium zinc ASTM F1136 Gr. 3. All hot-dip
- 9 galvanized after fabrication products must be returned to point of
- 10 manufacture after coating for inspection and removal of all sharp burrs.
- 11 2. Stainless Steel: All strut, fittings and hardware shall be made of AISI Type
- 12 304 stainless steel.

13 2.02 ANCHORS AND FASTENERS

- 14 A. Concrete and Structural Elements: Use stainless steel precast insert system,
- 15 expansion anchors and preset inserts.
- 16 B. Steel Structural Elements: Use stainless steel beam clamps.
- 17 C. Concrete Surfaces: Use stainless steel self-drilling anchors and expansion
- 18 anchors.
- 19 D. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or
- 20 hollow wall fasteners.
- 21 E. Solid Masonry Walls: Use stainless steel expansion anchors and preset inserts.
- 22 F. Sheet Metal: Use stainless steel sheet metal screws.
- 23 G. Wood: Use stainless steel wood screws.
- 24 H. All other fasteners: stainless steel screws, suitable for the required usage.

25 2.03 HARDWARE

- 26 A. Conduit and equipment supports, clamps, and other miscellaneous materials shall
- 27 be constructed of the following materials as scheduled in Section 26 05 00.
- 28 1. Galvanized, malleable iron.
- 29 2. PVC coated, galvanized, malleable iron.
- 30 3. Stainless steel.
- 31 4. PVC.

1 PART 3 CONSTRUCTION METHODS

2 3.01 DIVISION OF WORK

- 3 A. The Contractor shall be responsible for coordinating raceway installation and
4 means of support with all applicable trades.

5 3.02 FIELD MEASUREMENTS

- 6 A. Field verify all measurements. Do not base locations and dimensions on the
7 contract drawings. Actual field conditions govern all final installed locations,
8 distances, and levels.

- 9 B. Identify conflicts with the work of other trades prior to installation of electrical
10 equipment.

- 11 C. Adjust equipment support rack installation to satisfy field requirements.

12 3.03 DELIVERY, STORAGE, AND HANDLING

- 13 A. Accept supporting devices on site. Inspect for damage.

- 14 B. Protect supporting devices from corrosion and damage. Do not install damaged
15 materials.

16 3.04 INSTALLATION

- 17 A. General:

- 18 1. Furnish and install supports and fasteners for all electrical components
19 required for the project, including free standing supports required for those
20 items remotely mounted from the building structure, catwalks, walkways
21 etc.
22 2. Thoroughly clean and remove construction debris from installation.

- 23 B. Strut Channel:

- 24 1. Install strut in accordance with MFMA-102 "Guidelines for the Use of
25 Metal Framing"; in accordance with equipment manufacturer's
26 recommendations, and with recognized industry practices.
27 2. Fabricate supports from channel. Rigidly weld members or use hexagon
28 head bolts to present a neat appearance with adequate strength and
29 rigidity. Use spring lock washers under all nuts.
30 3. File and de-bur cut ends of galvanized support channel and spray paint
31 with cold galvanized paint to prevent rusting.
32 4. Bridge studs top and bottom with channels to support flush-mounted
33 cabinets and panelboards in stud walls.

- 34 C. Anchors and Fasteners:

- 1 1. Provide anchors, fasteners, and supports in accordance with NECA
- 2 "Standard Practices for Good Workmanship in Electrical Contracting".
- 3 2. Do not fasten supports to piping, ductwork, mechanical equipment, cable
- 4 tray or conduit.
- 5 3. Do not use spring steel clips and anchors.
- 6 4. Do not use powder-actuated anchors.
- 7 5. Obtain permission from Engineer before drilling or cutting structural
- 8 members.
- 9 6. Install surface-mounted cabinets and panelboards with minimum of four
- 10 anchors.
- 11 7. Use channel supports to stand cabinets and panelboards 1-5/8-inch off
- 12 interior or exterior surfaces of exterior walls.
- 13 8. Fasten hanger rods, conduit clamps, and outlet and junction boxes to
- 14 building structure using anchors and fasteners.
- 15 9. Install free-standing electrical equipment on 3-inch concrete pads unless
- 16 indicated otherwise on the drawings.
- 17 10. Use threaded rod, minimum size 3/8-inch, for supports where indicated on
- 18 the drawings.
- 19 11. Install products in accordance with manufacturer instructions.

20 3.05 TESTING AND START-UP SERVICES (NOT USED)

21 3.06 TRAINING (NOT USED)

22 END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI C80.1 - Electrical Rigid Steel Conduit (ERSC).
 - b. ANSI C80.3 - Steel Electrical Metallic Tubing (EMT).
 - c. ANSI C80.5 - Electrical Rigid Aluminum Conduit (ERAC).
 - d. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 - a. ASTM F2160 - Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter.
 - b. ASTM D2239 - Polyethylene (PE) Plastic Pipe (SIDR) Based on Controlled Inside Diameter.
 - c. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR) Based on Controlled Outside Diameter.
 - d. ASTM D3350 - Polyethylene Plastics Pipe and Fittings Materials.
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 4. Insulated Cable Engineers Association (ICEA)
 5. International Society of Automation (ISA)
 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition:
 - a. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association.
 - b. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association.
 - c. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit; National Electrical Manufacturers Association.

- 1 d. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and
- 2 Tubing; National Electrical Manufacturers Association.
- 3 e. NEMA TC 7 - Smooth Wall Coilable Polyethylene Electrical Plastic
- 4 Conduit.
- 5 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
- 6 current edition:
- 7 a. UL 1 - Standard for Flexible Metal Conduit
- 8 b. UL 6 - Electrical Rigid Metal Conduit - Steel.
- 9 c. UL 6A - Standard for Electrical Rigid Metal Conduit - Aluminum
- 10 and Stainless Steel.
- 11 d. UL 651A Type EB and A Rigid PVC Conduit and HDPE conduit.
- 12 e. UL 651B Continuous Length HDPE.
- 13 f. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit.
- 14 g. UL 2239 - Standard for Safety for Hardware for the Support of
- 15 Conduit, Tubing, and Cable.
- 16 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 17 9. National Electrical Contractors Association (NECA), current edition.
- 18 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
- 19 Contracting.
- 20 b. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC,
- 21 EMT).
- 22 10. International Electrical Testing Association (NETA)
- 23 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
- 24 Power Distribution Equipment and Systems.
- 25 11. Canadian Standards Association (CSA), Specifications and Standards,
- 26 current edition.
- 27 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
- 28 Specifications and Standards, Current Edition.
- 29 13. International Electrotechnical Association (IEC), Specifications and
- 30 Standards, Current Edition.

31 1.03 DESCRIPTION OF WORK

- 32 A. Furnish and install complete and operable conduit system as indicated on the
- 33 drawings, scheduled in Section 26 05 00, and as specified herein.
- 34 B. Home runs indicated are to assist the Contractor in identifying conduits to be
- 35 installed concealed or exposed. Conduits identified to be installed exposed shall be
- 36 run near the ceilings or along the walls of the areas through which they pass and
- 37 shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting
- 38 fixtures, doors, and hatches. Conduits indicated to be run concealed shall be run in
- 39 the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

40 1.04 RELATED WORK ELSEWHERE

- 1 A. Article 102 – Bidding Requirements and Conditions
- 2 B. Article 103 – Award and Execution of the Contract
- 3 C. Concrete – Division 03
- 4 D. Metals – Division 05
- 5 E. Electrical - Division 26
- 6 F. Earthwork – Division 31
- 7 G. Utilities – Division 33
- 8 1.05 SUBMITTALS
- 9 A. Submit shop drawings.
- 10 B. Submit the following information specifically for conduit:
- 11 1. Manufacturer literature sufficient in scope to demonstrate compliance with
- 12 the requirements of this specification.
- 13 2. Clearly identify the types and sizes of conduit and fittings proposed.
- 14 3. Incorporate all changes in conduit routing on electrical plan drawings.
- 15 4. Dimension underground and concealed conduit from building lines.
- 16 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 17 1.07 FACTORY TESTING (NOT USED)
- 18 1.08 QUALITY ASSURANCE
- 19 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 20 B. System supplier shall be responsible for providing all necessary accessories
- 21 required for a complete and operable system.
- 22 C. Manufacturer Qualifications: Company specializing in manufacturing products
- 23 specified in this section, with not less than three years of documented experience.
- 24 D. Products: Listed and classified by UL or testing firm acceptable to the authority
- 25 having jurisdiction as suitable for the purpose specified and indicated.
- 26 1.09 WARRANTY
- 27 A. See Division 01 for additional requirements.

1 1.10 EXTRA MATERIALS (NOT USED)

2 1.11 DESIGN REQUIREMENTS (NOT USED)

3 1.12 MAINTENANCE (NOT USED)

4 PART 2 PRODUCTS AND MATERIALS

5 2.01 GALVANIZED RIGID METAL CONDUIT (TYPE GRS)

6 A. Manufacturer: Contractor option.

7 B. Conduit:

- 8 1. Impact and crush resistant mild steel tube with an accurate circular cross
9 section, a uniform wall thickness, a defect free interior surface, and a
10 continuous welded seam.
- 11 2. Interior and exterior surfaces thoroughly and evenly coated with zinc using
12 the hot-dip galvanizing process.
- 13 3. Top-coated with a compatible organic layer to inhibit white rust and
14 increase corrosion resistance.
- 15 4. Factory cut threads, 0.75-inch taper per foot, protected after cutting with an
16 application of molten zinc.

17 C. Conduit Bodies:

- 18 1. Ferrous metal construction electro-galvanized inside and out and coated
19 with aluminum acrylic paint.
- 20 2. Tapered, threaded hubs with integral bushing.
- 21 3. Stainless steel hardware.
- 22 4. Cover constructed of same material with solid gasket.

23 D. Fittings:

- 24 1. Ferrous metal construction electro-galvanized inside and out.
- 25 2. Components critical to performance such as set screws, split rings, and
26 locknuts constructed of hardened steel or adequately designed to insure
27 positive bonds.

28 2.02 PVC COATED GALVANIZED RIGID METAL CONDUIT (TYPE PGRS)

29 A. Manufacturer:

- 30 1. Perma-Cote Industries.
- 31 2. Robroy.
- 32 3. Or equal.

33 B. General:

- 1 1. Conduit shall be UL Listed and the coating shall have been investigated by
- 2 UL as providing the primary corrosion protection for the rigid metal
- 3 conduit.
- 4 2. Independent certified test results shall be available to confirm coating
- 5 adhesion under the following conditions:
- 6 3. Conduit immersed in boiling water with a minimum mean time to adhesion
- 7 failure of 200 hours.
- 8 4. Conduit and conduit exposure to 150 degrees F and 95 percent relative
- 9 humidity with a minimum mean time to failure of 30 days.
- 10 5. No trace of internal coating shall be visible on a white cloth following six
- 11 wipes over the coating that has been wetted with acetone.
- 12 6. The exterior coating bond shall be confirmed using the methods described
- 13 in Section 3.8, NEMA RN1. After these tests the physical properties of the
- 14 exterior coating shall exceed the minimum requirements specified in Table
- 15 3.1, NEMA RN1.

16 C. Conduit:

- 17 1. Impact and crush resistant mild steel tube with an accurate circular cross
- 18 section, a uniform wall thickness, and a defect free interior surface, and a
- 19 continuous welded seam.
- 20 2. Interior and exterior surfaces thoroughly and evenly coated with zinc using
- 21 the hot-dip galvanizing process.
- 22 3. Factory cut threads, 0.75-inch taper per foot, protected after cutting with an
- 23 application of molten zinc.
- 24 4. Coating:
- 25 a. External: PVC, 40 mils nominal, free of blisters, bubbles, and
- 26 pinholes.
- 27 b. Internal: Urethane, 2 mils minimum.
- 28 5. Threaded connections:
- 29 a. Factory threads: factory coated.
- 30 b. Field threads: protected by coating sleeve extension on female
- 31 fitting. Sleeve extension shall be equivalent in length to the nominal
- 32 conduit size and the inside diameter less than the outside diameter
- 33 of the coated conduit.
- 34 6. Strength:
- 35 a. Coating bond to conduit shall be stronger than tensile strength of
- 36 coating. Field cut, thread, and bent conduit shall not damage
- 37 conduit.

38 D. Conduit Bodies:

- 39 1. Ferrous metal construction electro-galvanized inside and out and PVC
- 40 coated to match the conduit.
- 41 2. Tapered, threaded hubs with integral bushing.

- 1 3. Stainless steel or encapsulated stainless steel hardware.
- 2 4. PVC coated cover constructed of same material with solid tongue-in-groove
- 3 gasket.

4 E. Fittings:

- 5 1. Ferrous metal construction electro-galvanized inside and out and PVC
- 6 coated to match conduit.
- 7 2. All fittings are to be from the same manufacturer as the conduit.

8 2.03 RIGID NON-METALLIC CONDUIT (TYPE PVC)

9 A. Manufacturer:

- 10 1. Carlon.
- 11 2. Or equal.

12 B. Conduit:

- 13 1. Made from polyvinyl chloride compound (recognized by UL), which
- 14 includes inert modifiers to improve weatherability and heat distortion.
- 15 2. Rated for use with 90 degree C conductors. Material shall comply with
- 16 NEMA Specification TC-2.
- 17 3. The conduit and fittings shall be homogeneous plastic material free from
- 18 visible cracks, holes or foreign inclusions. The conduit bore shall be smooth
- 19 and free of blisters, nicks or other imperfections, which could mar
- 20 conductors or cables.
- 21 4. Conduit, fittings and cement shall be produced by the same manufacturer to
- 22 assure system integrity.
- 23 5. Schedule 80 non-metallic conduit shall be used in locations subject to
- 24 physical damage.

25 C. Conduit Bodies:

- 26 1. Made from polyvinyl chloride compound (recognized by UL), which
- 27 includes inert modifiers to improve weatherability and heat distortion.
- 28 2. Rated for use with 90 degree C conductors. Material shall comply with
- 29 NEMA Specification TC-3.
- 30 3. Stainless steel hardware.
- 31 4. Cover constructed of same material with solid gasket.

32 D. Fittings:

- 33 1. Made from polyvinyl chloride compound (recognized by UL), which
- 34 includes inert modifiers to improve weatherability and heat distortion.
- 35 2. Rated for use with 90 degree C conductors. Material shall comply with
- 36 NEMA Specification TC-3.

37 2.04 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (TYPE LMFC)

- 1 A. Manufacturer: CONTRACTOR option.
- 2 B. Usage:
 - 3 1. Use in conjunction with galvanized rigid metal conduit.
 - 4 2. Use in conjunction with PVC coated galvanized rigid metal conduit.
 - 5 3. Use in conjunction with rigid aluminum conduit.
- 6 C. Conduit:
 - 7 1. Single strip, helically wound, galvanized steel core inside and outside with
 - 8 smooth interior surface with sunlight resistant thermoplastic jacket suitable
 - 9 for ambient environmental conditions conforming to applicable UL
 - 10 Standards.
 - 11 2. Jacket shall be positively locked to core to prevent sleeving.
 - 12 3. All runs of flexible conduit shall be as short as practicable, of the same size
 - 13 as the conduit it extends and with enough slack to reduce the effects of
 - 14 expansion and vibration.
- 15 D. Fittings:
 - 16 1. Where used in conjunction with galvanized rigid metal conduit, connectors
 - 17 shall be malleable iron or steel, electro zinc plated, with insulated throat and
 - 18 taper threaded hub.
 - 19 2. Where used in conjunction with PVC coated galvanized rigid metal or rigid
 - 20 aluminum conduit connectors shall be malleable iron or steel, electro zinc
 - 21 plated and PVC coated, with insulated throat and taper threaded hub.
 - 22 3. Particular attention shall be given to maintaining ground bond and firm
 - 23 support through flexible connections.
 - 24 4. All fittings shall be liquid tight.

25 2.05 LIQUIDTIGHT FLEXIBLE NON-METALLIC CONDUIT (TYPE LFNC)

- 26 A. Manufacturer:
 - 27 1. Carlton Carflex.
 - 28 2. Or equal.
- 29 B. Usage:
 - 30 1. Use in conjunction with rigid nonmetallic PVC conduit.
- 31 C. Conduit:
 - 32 1. Conduit shall have a smooth inner surface with integral reinforcement
 - 33 within the conduit wall.
 - 34 2. Conduit shall be designated as a Type LFNC-B (or FNMC-B), listed to UL
 - 35 standard UL1660 and suitable for use at conduit temperatures of 80 degrees
 - 36 C (dry), 60 degrees C (wet and oil resistant).

- 1 3. Conduit shall be flame resistant and when used with listed fittings, approved
2 for the installation of electrical conductors.
- 3 4. Conduit shall be installed in accordance with applicable sections of the NEC
4 and/or local electrical codes.
- 5 5. Conduit shall be marked OUTDOOR for outdoor applications exposed to
6 sunlight and weathering conditions and marked DIRECT BURIAL for
7 direct burial applications.
- 8 6. The National Evaluation Service, Inc. shall evaluate conduit for installation
9 within a three-hour or less fire-resistive floor/ceiling and two-hour fire-
10 resistive wall construction.

- 11 D. Fittings:
- 12 1. Molded from high strength, chemical resistant, glass filled thermoplastic.
 - 13 2. Fittings shall be listed for the use with liquid tight flexible nonmetallic
14 conduit and shall be marked LFNC-B (FNMC-B).
 - 15 3. Fittings uses for direct burial applications shall be listed for wet locations.
 - 16 4. Particular attention shall be given to maintaining ground bond and firm
17 support through flexible connections.
 - 18 5. All fittings shall be liquid tight.

19 2.06 LIQUIDTIGHT HAZARDOUS LOCATION FLEXIBLE CONDUIT (STAINLESS
20 STEEL BRAID)

- 21 A. Manufacturer:
- 22 1. Crouse-Hinds EC Coupling.
 - 23 2. Or equal.

- 24 B. Usage:
- 25 1. Use for all non-intrinsically safe, hazardous location installations.
 - 26 2. Use in hazardous locations for motor terminations and any other equipment
27 where vibration is present.

- 28 C. Conduit:
- 29 1. Conduit shall have an insulating wire duct with smooth inner surface inside
30 a flexible brass inner core. Packing material shall be woven cotton
31 impregnated with asphalt.
 - 32 2. Flexible portion of coupling shall be covered with stainless steel braid.
 - 33 3. Conduit shall bear U.L. label indicating suitability for use in hazardous
34 location as identified on the drawings.

- 35 D. Fittings:
- 36 1. Integral stainless steel end fittings shall be included with coupling.
 - 37 2. Coupling shall be available with two threaded male end fittings or one
38 female union and one threaded male end fitting.

3. Particular attention shall be given to maintaining ground bond and firm support through flexible connections.
4. All fittings shall be liquid tight.

2.07 RIGID ALUMINUM CONDUIT (TYPE RAL)

A. Manufacturer: Contractor option.

B. Conduit:

1. Heavy wall tube manufactured of 6063 aluminum allow in temper designation T-1 with accurate circular cross section, uniform wall thickness and defect free interior surface.
2. Factory cut threads, 0.75-inch taper per foot.

C. Conduit Bodies:

1. Cast aluminum device boxes shall by Type FD. Boxes shall be copper free aluminum with cast aluminum covers.
2. Tapered, threaded hubs with integral bushing.
3. Stainless steel hardware.

D. Fittings:

1. Fittings shall be composed of copper free aluminum.

2.08 HIGH DENSITY POLYETHYLENE CONDUIT (TYPE HDPE)

A. Manufacturer:

1. Contractor Option

B. Usage:

1. Direct buried for use in routing Fiber Optic Cable.

C. Conduit:

1. Smooth wall construction
2. Comprised of high-density polyethylene meeting the properties of ASTM D-3350.
3. Conduit shall meet the dimensional specifications and wall thicknesses set forth in the applicable ASTM and/or NEMA standards.
4. There shall be no foreign particles embedded into the plastic surface as a result of the extrusion process.
5. There shall not be any holes, visible cracks or defects that could cause damage or compromise the physical strength of the conduit.

PART 3 CONSTRUCTION METHODS

3.01 DIVISION OF WORK

1 A. The Contractor shall be responsible for coordinating raceway installation and
2 means of support with all applicable trades.

3 3.02 FIELD MEASUREMENTS

4 A. The Contractor shall obtain from the appropriate trades and review shop drawings
5 for all equipment requiring electrical connections. Conduit rough-in shall be based
6 upon shop drawing requirements.

7 B. The Contractor shall be responsible for coordinating conduit location and rough-in
8 with actual equipment conditions and requirements.

9 C. Field verify all measurements. Do not base conduit rough-in or equipment
10 locations on the contract drawings. Actual field conditions govern all final installed
11 locations, distances, and levels.

12 D. Identify conflicts with the work of other trades prior to installation of electrical
13 equipment and conduit work.

14 E. Adjust conduit system installation to satisfy field requirements.

15 3.03 DELIVERY, STORAGE, AND HANDLING

16 A. Accept conduit on site. Inspect for damage.

17 B. Protect conduit from corrosion and entrance of debris.

18 C. Store conduit above grade. Protect from environment with suitable covering.

19 D. Protect PVC and PVC coated conduit from sunlight.

20 3.04 INSTALLATION

21 A. General:

22 1. Install conduit in accordance with NECA "Standard Practices for Good
23 Workmanship in Electrical Contracting", all requirements of the NEC, and
24 manufacturer recommended practices.

25 2. Arrange conduit to maintain headroom and present neat appearance.

26 3. Design raceway systems to minimize the number of fittings, couplings,
27 kicks, and offsets.

28 4. Raceways located above lowest floor level:

29 a. Route conduit parallel and perpendicular to walls.

30 b. All raceways shall be level and straight.

31 c. Vertical conduits shall be plumb.

32 5. Raceways located in or under lowest level floor:

- 1 a. Route conduit in and under slab from point-to-point.
- 2 b. Do not cross conduits in slab.
- 3 6. Do not use flexible conduit in place of bends, conduit bodies, or expansion
- 4 fittings.
- 5 7. Flexible conduit shall be used at all equipment terminations. Maximum
- 6 length of 24-inches unless specifically allowed otherwise by Engineer based
- 7 upon field conditions.
- 8 8. Do not use cords for equipment connections unless specifically allowed
- 9 otherwise by Engineer based upon field conditions.

- 10 B. Raceway sizing:
- 11 1. Size raceways as indicated on drawings.
- 12 2. Where raceways sizes are not indicated on drawings, size in accordance
- 13 with NEC requirements. Minimum size 3/4-inch.
- 14 3. Exposed conduit runs not longer than 10-feet in length and terminating at a
- 15 single device may be 1/2-inch unless prohibited by NEC.

- 16 C. Raceway Installation:
- 17 1. Maintain adequate clearance between conduit and piping.
- 18 2. Maintain 12-inch clearance between conduit and surfaces with temperatures
- 19 exceeding 104 degrees F.
- 20 3. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- 21 4. Bring conduit to shoulder of fittings; fasten securely.
- 22 5. Use conduit hubs to fasten conduit to NEMA 3R, NEMA 4, NEMA 4X and
- 23 NEMA 12 boxes.
- 24 6. Install no more than equivalent of three 90-degree bends between boxes.
- 25 Use conduit bodies to make sharp changes in direction, as around beams.
- 26 Use hydraulic factory elbows for bends in metal conduit larger than 2-inch
- 27 size.
- 28 7. Avoid moisture traps; install junction box with drain fitting at low points in
- 29 conduit system.
- 30 8. Suitable pull string shall be installed in each empty conduit, sleeves and
- 31 nipples excepted.
- 32 9. Use suitable caps to protect installed conduit against entrance of dirt and
- 33 moisture.
- 34 10. Remove all debris and moisture from raceways prior to installing
- 35 conductors.
- 36 11. Ground and bond conduit under provisions of Section 26 05 26.
- 37 12. Identify conduit under provisions of Section 26 05 53.
- 38 13. Install plastic coated conduit in accordance with manufacturer's
- 39 instructions. All 90 degree bends shall be manufactured elbows. Touch-up
- 40 PVC coating after installation.

- 1 14. All field cut threads shall be coated with Thomas & Betts Kopr-Shield prior
2 to assembly.
3 15. The contractor is responsible for any deviations in general location, conduit
4 size, routing, or changes to the conduit schedule without the express written
5 approval or direction by the Engineer.

6 D. Structural Coordination:

- 7 1. Suitable fittings, designed and listed for the purpose, shall be used to
8 accommodate expansion and deflection where conduit crosses seismic,
9 control and expansion joints.
10 2. Install conduit to preserve fire resistance rating of partitions and other
11 elements.
12 3. Route conduit through roof openings for piping and ductwork or through
13 suitable roof jack with pitch pocket. Coordinate location with roofing
14 installation.
15 4. Where conduit passes between areas subject to variable temperatures, seal
16 conduits to prevent air interchange and condensation formation. Use
17 conduit fitting specifically manufactured for this purpose.

18 E. Raceway Support:

- 19 1. General:
20 a. Arrange supports to prevent misalignment during wiring
21 installation.
22 b. Do not permanently support conduit with wire or perforated pipe
23 straps.
24 c. Remove wire used for temporary supports.
25 d. Do not attach conduit to ceiling support wires.
26 e. Channel, rod, and hardware shall comply with the requirements of
27 Section 26 05 29.
28 2. Hardware:
29 a. Construct conduit support rack with channel and rod to support
30 conduits not supported from structure.
31 b. Support conduit with channel anchored to structure when conduit
32 offset from structure is required.
33 c. Secure conduits to channel with pipe straps.
34 d. Support conduit from structure when conduit offset from structure
35 is not required.
36 e. Secure conduits directly to structure with one-hole strap and conduit
37 spacer.

38 F. Conduit Separation:

- 39 1. Separate conduit systems shall be used for the following circuit categories:
40 a. 120-volt power circuits.
41 b. 480-volt power circuits.

- 1 c. 120-volt control circuits.
- 2 d. 24 VDC analog control circuits.
- 3 e. Intrinsically safe control circuits.
- 4 f. UTP control cables.
- 5 g. Manufacturer supplied cables (for example, magnetic flow meter
- 6 cables).
- 7 h. Radio frequency coaxial cables (for example, antenna cables).
- 8 2. The contract drawings show individual homerun equipment connections.
- 9 The Contractor may combine circuits of common types (as identified above)
- 10 into single conduits provided the following conditions are met:
- 11 a. NEC requirements for conductor de-rating are satisfied.
- 12 b. Conduit fill does not exceed thirty percent. Ten percent fill shall be
- 13 reserved for future use.
- 14 c. No more than eight 24VDC analog circuits are combined in a single
- 15 conduit, unless specifically stated otherwise on the drawings.

16 3.05 TESTING AND START-UP SERVICES (NOT USED)

17 3.06 TRAINING (NOT USED)

18 END OF SECTION

SECTION 26 05 37

BOXES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code, (NEC) and state amendments thereto.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition.
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 4. Insulated Cable Engineers Association (ICEA)
 5. International Society of Automation (ISA)
 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association.
 - b. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - c. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 8. Wisconsin Department of Safety and Professional Services (DSPS)
 9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
 - b. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC, EMT).
 10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- 1 11. Canadian Standards Association (CSA), Specifications and Standards,
2 current edition.
- 3 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
4 Specifications and Standards, Current Edition.
- 5 13. International Electrotechnical Association (IEC), Specifications and
6 Standards, Current Edition.

7 1.03 DESCRIPTION OF WORK

- 8 A. Furnish and install complete and operable box systems as indicated on the
9 drawings, scheduled in Section 26 05 00, and as specified herein.
- 10 B. This includes outlet boxes for devices such as switches, receptacles, telephone
11 and computer jacks, security systems, junction and pullboxes for use in the
12 raceway system, etc.

13 1.04 RELATED WORK ELSEWHERE

- 14 A. Article 102 – Bidding Requirements and Conditions
- 15 B. Article 103 – Award and Execution of the Contract
- 16 C. Concrete – Division 03
- 17 D. Metals – Division 05
- 18 E. Electrical - Division 26
- 19 F. Earthwork – Division 31
- 20 G. Utilities – Division 33

21 1.05 SUBMITTALS

- 22 A. Submit shop drawings.
- 23 B. Review of shop drawings shall be for conformance with design concept only and
24 will not release the Contractor from fulfilling the terms and intent of the contract
25 documents.
- 26 C. Submit the following information specifically for boxes:
 - 27 1. Manufacturer literature sufficient in scope to demonstrate compliance with
28 the requirements of this specification.
 - 29 2. Clearly identify the size and types of boxes proposed. Also include the
30 materials of construction, conduit entry locations and NEMA rating of the
31 proposed.

- 1 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 2 1.07 FACTORY TESTING (NOT USED)
- 3 1.08 QUALITY ASSURANCE
- 4 A. All materials, equipment, and parts shall be new and unused of current
5 manufacture.
- 6 B. System supplier shall be responsible for providing all necessary accessories
7 required for a complete and operable system.
- 8 C. Manufacturer Qualifications: Company specializing in manufacturing products
9 specified in this section, with not less than three years of documented experience.
- 10 D. Products: Listed and classified by UL or testing firm acceptable to the authority
11 having jurisdiction as suitable for the purpose specified and indicated.
- 12 1.09 WARRANTY (NOT USED)
- 13 1.10 EXTRA MATERIALS (NOT USED)
- 14 1.11 DESIGN REQUIREMENTS (NOT USED)
- 15 1.12 MAINTENANCE (NOT USED)
- 16 PART 2 PRODUCTS AND MATERIALS
- 17 2.01 OUTLET BOXES
- 18 A. Sheet Metal Outlet Boxes:
- 19 1. Galvanized steel, with stamped knockouts.
- 20 2. Gangable, suitable for number of devices shown.
- 21 3. Suitable for flush mounting with drywall, FRP panel, masonry block, and
22 poured concrete wall and ceiling finishes.
- 23 B. Luminaire and Equipment Supporting Boxes:
- 24 1. Rated for weight of equipment supported; include 3/8-inch male fixture
25 studs where required.
- 26 C. Cast Boxes:
- 27 1. Cast ferralloy or aluminum, deep type, gasketed cover, threaded hubs.
- 28 2. Suitable for surface or flush mounting with drywall, FRP panel, masonry
29 block, and poured concrete wall and ceiling finishes.
- 30 D. PVC Coated Cast Boxes:
- 31 1. PVC coated cast ferralloy, deep type, gasketed cover, threaded hubs.

2. Suitable for surface mounting with drywall, FRP panel, masonry block, and poured concrete wall and ceiling finishes.
3. Of the same manufacturer as the associated PVC coated conduit.

2.02 PULL AND JUNCTION BOXES

A. General:

1. Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).
2. For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic systems with conduits of 1 1/4" and larger, shall be sized per the NEC conduit requirements. For determining box size, the conduit is the determining factor not the wire size.

B. Galvanized Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.

1. Door:
 - a. Rolled lip around 3 sides
 - b. Attached to enclosure by means of a continuous stainless steel hinge and pin.
2. Neoprene door gasket to provide a watertight, dust tight, oil tight seal.
 - a. Attached with an adhesive.
3. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel.
 - a. With a hasp and staple for padlocking

C. Painted Sheet Metal Boxes: code gauge sheet steel with ANSI-61 gray powder-coated finish, flanged and spot welded joints and corners.

1. Door:
 - a. Rolled lip around 3 sides
 - b. Attached to enclosure by means of a continuous stainless steel hinge and pin.
2. Neoprene door gasket to provide a watertight, dust tight, oil tight seal.
 - a. Attached with an adhesive.
3. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel.
 - a. With a hasp and staple for padlocking

D. Fiberglass Reinforced Plastic Boxes: fiberglass reinforced plastic construction with stainless steel hardware and gasketed covers. Boxes shall be finished with

1 hinged doors, terminal mounting straps and brackets. Box shall hold NEMA 4X
2 environmental rating.

- 3 E. Boxes Larger than 12 Inches (300 mm) in any dimension shall have a hinged
4 cover, be rated NEMA 4X, and constructed of stainless steel. Door and body
5 stiffeners to be provided as required for extra rigidity on larger enclosure.
6 1. Fabricated from grade 316 stainless steel
7 2. Door:
8 a. Rolled lip around 3 sides
9 b. Attached to enclosure by means of a continuous stainless steel
10 hinge and pin.
11 3. Neoprene door gasket to provide a watertight, dust tight, oil tight seal.
12 a. Attached with an adhesive.
13 4. Fabricate all external removable hardware for clamping the door to the
14 enclosure body from heavy gauge stainless steel.
15 a. With a hasp and staple for padlocking
- 16 F. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type
17 6, flat-flanged, surface-mounted junction box, UL listed as rain-tight. Galvanized
18 cast iron or aluminum box and cover with ground flange, neoprene gasket, and
19 stainless steel cover screws.
- 20 G. Cast Metal Boxes for Hazardous Locations: Type 7, cast malleable iron with
21 drilled and tapped conduit entrance. Cast malleable iron cover, non-hinged with
22 Type 316 stainless steel screws and gasketed.
- 23 H. Cast Metal Boxes for Underground Installations: Type 4, inside flanged, recessed
24 cover box for flush mounting, UL listed as rain tight. Hot dipped galvanized cast
25 iron box and plain cover with neoprene gasket and stainless steel cover screws.
26 Cover Legend: ELECTRIC.
- 27 I. Fiberglass Handholes for Underground Installations: Die- molded with pre-cut 6 x
28 6 inch (150 x 150 mm) cable entrance at center bottom of each side; fiberglass
29 weatherproof cover with non-skid finish.
- 30 J. Box extensions and adjacent boxes within 48" of each other are not allowed for
31 the purpose of creating more capacity.
- 32 K. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
- 33 L. Wireways shall not be used in lieu of junction boxes.

34 PART 3 CONSTRUCTION METHODS

35 3.01 DIVISION OF WORK (NOT USED)

1 3.02 FIELD MEASUREMENTS

- 2 A. The Contractor shall obtain from the appropriate trades and review shop drawings
3 for all equipment requiring electrical connections. Box rough-in shall be based
4 upon shop drawing requirements.
- 5 B. The Contractor shall be responsible for coordinating box location and rough-in
6 with actual equipment conditions and requirements.
- 7 C. Field verify all measurements. Do not base box rough-in or equipment locations
8 on the contract drawings. Actual field conditions govern all final installed
9 locations, distances, and levels.
- 10 D. Identify conflicts with the work of other trades prior to installation of electrical
11 equipment and conduit work.
- 12 E. Adjust box locations to satisfy field requirements.

13 3.03 DELIVERY, STORAGE, AND HANDLING

- 14 A. Accept boxes on site. Inspect for damage.
- 15 B. Protect boxes from corrosion and entrance of debris.
- 16 C. Store boxes above grade. Protect from environment with suitable covering.

17 3.04 INSTALLATION

- 18 A. General:
 - 19 1. Install conduit in accordance with NECA "Standard Practices for Good
20 Workmanship in Electrical Contracting", all requirements of the NEC, and
21 manufacturer recommended practices.
- 22 B. Box Installation:
 - 23 1. Install electrical boxes as shown on Drawings, and as required for splices,
24 taps, wire pulling, equipment connections and compliance with regulatory
25 requirements.
 - 26 2. Install electrical boxes to maintain headroom and to present neat
27 mechanical appearance.
 - 28 3. Install pull boxes and junction boxes above accessible ceilings and in
29 unfinished areas only.
 - 30 4. Align adjacent wall-mounted outlet boxes for switches, thermostats, and
31 similar devices with each other.
 - 32 5. Use flush mounting outlet boxes in all areas.

- 1 6. Do not install flush mounting boxes back-to-back in walls; provide
2 minimum 6-inch separation. Provide minimum 24-inches separation in
3 acoustic rated walls.
- 4 7. Use gang box where more than one device is mounted together. Do not
5 use sectional box.
- 6 8. Electrical boxes are shown on Drawings in approximate locations unless
7 dimensioned. Install at location required for box to serve intended
8 purpose. Include installation within 10 feet of location shown.
- 9 9. Position outlet boxes to locate luminaires as shown on lighting plans.
- 10 10. Adjust flush-mounting outlets to make front flush with finished wall
11 material.
- 12 11. Install knockout closure in unused box opening.

13 C. Structural Coordination:

- 14 1. Install boxes to preserve fire resistance rating of partitions and other
15 elements.
- 16 2. Install flush mounting box without damaging wall insulation vapor barrier
17 or reducing its effectiveness. Provide vapor box or vapor barrier hat for
18 each box flush mounted in an exterior wall.
- 19 3. Locate flush mounting box in masonry wall to require cutting of masonry
20 unit corner only. Coordinate masonry cutting to achieve neat opening.
- 21 4. Coordinate mounting heights and locations of outlets mounted above
22 counters, benches and backsplashes.

23 D. Box Support:

- 24 1. Secure flush mounting box to interior wall and partition studs. Accurately
25 position to allow for surface finish thickness.
- 26 2. Use stamped steel bridges to fasten flush mounting outlet box between
27 studs.
- 28 3. Use adjustable stainless steel channel fasteners for hung ceiling outlet box.
- 29 4. Do not fasten boxes to ceiling support wires.
- 30 5. Support boxes independently of conduit.

31 3.05 TESTING AND START-UP SERVICES (NOT USED)

32 3.06 TRAINING (NOT USED)

33 END OF SECTION

1 SECTION 26 05 41

2
3 WIRING DEVICES

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent applicable.
9 The latest edition accepted by the Authority Having Jurisdiction of the referenced
10 publications in effect at the time of the bid governs

- 11 1. American National Standards Institute/National Fire Protection Agency
12 (ANSI/NFPA), Specifications and Standards, current edition:
 - 13 a. ANSI/NFPA70 - National Electrical Code, (NEC) and state
14 amendments thereto.
 - 15 b. ANSI/NFPA 820 - Standard for Fire Protection in Wastewater
16 Treatment and Collection Facilities.
- 17 2. ASTM International (ASTM), originally known as the American Society
18 for Testing and Materials, Specifications and Standards, current edition:
- 19 3. Illuminating Engineering Society (IES). Institute of Electrical and
20 Electronics Engineers (IEEE)
- 21 4. Insulated Cable Engineers Association (ICEA)
- 22 5. International Society of Automation (ISA)
- 23 6. National Electrical Manufacturers Association (NEMA), Specifications
24 and Standards, current edition.
 - 25 a. NEMA WD 1 - General Purpose Wiring Devices.
 - 26 b. NEMA WD 6 - Wiring Device Configurations.
- 27 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
28 current edition.
- 29 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 30 9. National Electrical Contractors Association (NECA), Standard of
31 Installation, current edition.
- 32 10. International Electrical Testing Association (NETA)
 - 33 a. NETA STD ATS - Acceptance Testing Specifications for
34 Electrical Power Distribution Equipment and Systems.
- 35 11. Canadian Standards Association (CSA), Specifications and Standards,
36 current edition.
- 37 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
38 Specifications and Standards, Current Edition.
- 39 13. International Electrotechnical Association (IEC), Specifications and
40 Standards, Current Edition.

- 1 1.03 DESCRIPTION OF WORK
- 2 A. Provide and install complete and operable wiring devices as required on the
3 drawings and as specified herein.
- 4 1.04 RELATED WORK ELSEWHERE
- 5 A. The following divisions may include work which is related to wiring devices, but
6 which is not included under the scope of this section:
- 7 B. Article 102 – Bidding Requirements and Conditions
- 8 C. Article 103 – Award and Execution of the Contract
- 9 D. Concrete – Division 03
- 10 E. Metals – Division 05
- 11 F. Electrical - Division 26
- 12 G. Earthwork – Division 31
- 13 H. Utilities – Division 33
- 14 1.05 SUBMITTALS
- 15 A. Submit shop drawings.
- 16 B. Review of shop drawings shall be for conformance with design concept only and
17 will not release the Contractor from fulfilling the terms and intent of the contract
18 documents.
- 19 C. The following information shall be submitted specifically for wiring devices:
- 20 1. Manufacturer literature sufficient in scope to demonstrate compliance with
21 the requirements of this specification.
- 22 2. Clearly identify the types of wiring devices proposed.
- 23 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 24 1.07 FACTORY TESTING (NOT USED)
- 25 1.08 QUALITY ASSURANCE
- 26 A. All materials, equipment, and parts shall be new and unused of current
27 manufacture.

1 B. Contractor shall be responsible for providing all necessary accessories required
2 for a complete and operable system.

3 C. Furnish products listed and classified by Underwriters Laboratories, Inc. as
4 suitable for purpose specified and shown.

5 D. Manufacturer shall specialize in manufacture of products specified in this Section
6 with minimum three years experience.

7 1.09 WARRANTY (NOT USED)

8 1.10 EXTRA MATERIALS (NOT USED)

9 1.11 DESIGN REQUIREMENTS (NOT USED)

10 1.12 MAINTENANCE

11 A. Before substantial completion, perform all maintenance activities required by any
12 sections of the specifications including any calibrations, final adjustments,
13 component replacements or other routine service required before placing
14 equipment or systems into service.

15 B. Furnish all spare parts as required by other sections of the specifications.

16 PART 2 PRODUCTS AND MATERIALS

17 2.01 120V SPECIFICATION GRADE WALL SWITCHES

18 A. Single Pole Switch:
19 1. Hubbell.
20 2. Or equal.

21 B. Double Pole Switch:
22 1. Hubbell.
23 2. Or equal.

24 C. Three-way Switch:
25 1. Hubbell.
26 2. Or equal.

27 D. Four-way Switch:
28 1. Hubbell.
29 2. Or equal.

30 E. Indicator Switch:
31 1. Hubbell.
32 2. Or equal.

- 1 F. Weather-proof Switch:
- 2 1. Hubbell.
- 3 2. Or equal.

- 4 G. Explosion Proof Switch:
- 5 1. Appleton.
- 6 2. Crouse-Hinds.
- 7 3. Or equal.

8 2.02 120V SPECIFICATION GRADE RECEPTACLES

- 9 A. Duplex Convenience Receptacle:
- 10 1. Hubbell.
- 11 2. Or equal.

- 12 B. GFCI Receptacle:
- 13 1. Hubbell.
- 14 2. Or equal.

15 2.03 USB CHARGING STATION

- 16 A. Single-gang 4-port USB Charging Station
- 17 1. Hubbell.
- 18 2. Or equal.

19 2.04 OCCUPANCY SENSORS

- 20 A. Wall Mounted
- 21 1. WattStopper
- 22 2. Or equal.

- 23 B. Ceiling Mounted
- 24 1. WattStopper
- 25 2. Or equal.

26 C.

27 2.05 WALL PLATES

- 28 A. Wall plates shall be installed as follows:
- 29 1. Use smooth stainless steel plates for receptacles and switches in sheet steel
- 30 or PVC boxes.
- 31 2. Use multi-screw gasketed cast plate where cast outlet boxes are required.
- 32 Covers shall not be attached by using a single screw mounting into the
- 33 wiring device, but shall be attached by mounting directly to the box.

- 1 3. Use Crouse Hinds WLRS or WLRD wet location covers for receptacles
- 2 identified as “WP” which are located inside structures.
- 3 4. Use aluminum or cast metal cover rated for “Constant Use” for receptacles
- 4 identified as “WP” and that are exposed to the weather.
- 5 5. Use Crouse-Hinds OS185 cover for all switches identified as “WP”.

6 PART 3 CONSTRUCTION METHODS

7 3.01 DIVISION OF WORK

- 8 A. The Contractor shall have overall system responsibility and shall provide all
- 9 materials and labor necessary provide a complete and operable system and
- 10 comply with all requirements of this section.
- 11 B. The Contractor shall be responsible for coordinating device locations with actual
- 12 equipment conditions and requirements.

13 3.02 FIELD MEASUREMENTS

- 14 A. Field verify all measurements. Do not base exact wiring device locations on the
- 15 contract drawings. Actual field conditions govern all final installed locations,
- 16 distances, and levels.
- 17 B. Adjust location of wiring devices to satisfy field requirements.

18 3.03 DELIVERY, STORAGE AND HANDLING

- 19 A. Accept electrical equipment on site. Inspect for damage.
- 20 B. Take precautions to protect electrical equipment from weather, corrosion, and
- 21 entrance of debris.

22 3.04 INSTALLATION

- 23 A. Wiring Device Installation:
- 24 1. Verify branch circuit wiring installation is completed, tested, and ready for
- 25 connection to wiring devices.
- 26 2. Provide extension rings to bring outlet boxes flush with finished surface.
- 27 3. Clean debris from outlet boxes.
- 28 4. Install products in accordance with manufacturer's instructions.
- 29 5. Install devices plumb and level.
- 30 6. Install switches with OFF position down.
- 31 7. Install receptacles with grounding pole on top.
- 32 8. Connect wiring device grounding terminal to branch circuit equipment
- 33 grounding conductor.
- 34 9. Install plates on switch, receptacle, and blank outlets in all areas.

1 SECTION 26 05 53

2 IDENTIFICATION FOR ELECTRICAL SYSTEMS

3

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent applicable. The
9 latest edition accepted by the Authority Having Jurisdiction of the referenced
10 publications in effect at the time of the bid governs

- 11 1. American National Standards Institute/National Fire Protection Agency
12 (ANSI/NFPA), Specifications and Standards, current edition:
 - 13 a. ANSI/NFPA 70 - National Electrical Code, (NEC) and state
14 amendments thereto.
 - 15 b. ANSI Z535.4 - Product Safety Signs and Labels.
- 16 2. ASTM International (ASTM), originally known as the American Society
17 for Testing and Materials, Specifications and Standards, current edition:
- 18 3. Illuminating Engineering Society (IES). Institute of Electrical and
19 Electronics Engineers (IEEE)
- 20 4. Insulated Cable Engineers Association (ICEA)
- 21 5. International Society of Automation (ISA)
- 22 6. National Electrical Manufacturers Association (NEMA)
- 23 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
24 current edition.
- 25 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 26 9. National Electrical Contractors Association (NECA), current edition.
 - 27 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
28 Contracting.
- 29 10. International Electrical Testing Association (NETA)
 - 30 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
31 Power Distribution Equipment and Systems.
- 32 11. Canadian Standards Association (CSA), Specifications and Standards,
33 current edition.
- 34 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
35 Specifications and Standards, Current Edition.
- 36 13. International Electrotechnical Association (IEC), Specifications and
37 Standards, Current Edition.

38 1.03 DESCRIPTION OF WORK

- 1 A. Furnish and install electrical identification systems as indicated on the drawings
2 and as specified herein.
- 3 1.04 RELATED WORK ELSEWHERE
- 4 A. Article 102 – Bidding Requirements and Conditions
- 5 B. Article 103 – Award and Execution of the Contract
- 6 C. Concrete – Division 03
- 7 D. Metals – Division 05
- 8 E. Electrical - Division 26
- 9 F. Earthwork – Division 31
- 10 G. Utilities – Division 33
- 11 1.05 SUBMITTALS
- 12 A. Submit shop drawings.
- 13 B. Submit literature sufficient in scope to demonstrate compliance with the
14 requirements of this specification.
- 15 1. Nameplates:
- 16 a. Color
- 17 b. Size
- 18 1) Outside dimensions
- 19 2) Lettering
- 20 c. Material
- 21 d. Mounting means
- 22 2. Nameplate Schedule
- 23 a. Show exact wording for each nameplate.
- 24 b. Include nameplate and letter sizes.
- 25 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 26 1.07 FACTORY TESTING (NOT USED)
- 27 1.08 QUALITY ASSURANCE (NOT USED)
- 28 1.09 WARRANTY (NOT USED)
- 29 1.10 EXTRA MATERIALS (NOT USED)

1 1.11 DESIGN REQUIREMENTS (NOT USED)

2 1.12 MAINTENANCE (NOT USED)

3 PART 2 PRODUCTS AND MATERIALS

4 2.01 NAMEPLATES

5 A. Engraved three-layer laminated plastic, black letters on white background.

6 B. Lettering:

7 1. 1/4-inch letters for identifying individual equipment and loads.

8 2. 1/2-inch letters for identifying grouped equipment and loads.

9 C. Control panel nameplates to be attached with two stainless steel screws.

10 D. Where mounting screws would de-rate an enclosure, UV resistant adhesive is
11 permissible.

12 2.02 CONDUCTOR MARKING

13 A. The ends of each conductor shall be marked with circuit number, motor number,
14 wire or terminal number.

15 B. Control system wire marking shall be coordinated with control system and
16 equipment shop drawings.

17 C. Labels shall be typed in black lettering with indelible ribbons on a white, heat shrink
18 sleeve. Markers shall be shrunk around the wire to ensure a tight, non-slip bond
19 with a compatible heat gun.

20 D. Heat shrink wire markers shall be Brady Bradysleeve Type B-321 or B-322.

21 2.03 CONDUCTOR COLOR CODING

22 A. Conductors No.6 AWG and smaller shall be provided with color coded insulation
23 as described herein. Conductors larger than No.6 AWG may be color coded with
24 appropriately colored Scotch No.35 tape at each end.

25 B. Color Coding:

26 1. 277/480 vac system shall be colored brown, orange, yellow, and gray for
27 phases A, B, C, and neutral respectively.

28 2. 120/208 vac system shall be colored black, red, blue, and white for phases
29 A, B, C, and neutral respectively.

- 1 3. 120/240 vac shall be colored black, red, and white for Line 1, Line 2, and
2 neutral respectively.
- 3 4. 120 vac control wiring shall be colored red.
- 4 5. 24 VDC control wiring shall be colored ~~purpleblue~~ and ~~purpleblue~~ with
5 white stripe for positive and negative conductors respectively.
- 6 6. Intrinsically safe control wiring shall be colored light blue.
- 7 7. Conductors within control cabinets and motor control centers carrying
8 voltage supplied from an external source shall be colored yellow.
- 9 8. Grounding conductor and equipment ground conductors shall be colored
10 green.

11 2.04 CONDUIT MARKING

- 12 A. Colored band markers shall be field painted.
- 13 B. Color:
 - 14 1. 480 Volt System: Yellow.
 - 15 2. 208 Volt and 240 Volt System: White.
 - 16 3. Fire Alarm System: Red.
 - 17 4. Low Voltage Communication System: Black.
 - 18 5. Process Instrumentation and Control System: Blue.

19 2.05 EQUIPMENT, ENCLOSURE, AND CABINET WARNING SIGNS

- 20 A. Electrical Voltage and Shock Hazard Signs
 - 21 1. Provide OSHA Voltage and Shock Hazard sign for each electrical
22 enclosure, cabinet, or other piece of equipment that presents an electrical
23 hazard under normal operating circumstances or presents an electrical
24 hazard while the enclosure is open.
- 25 B. Electrical Arc Flash Hazard Signs
 - 26 1. Provide Arc Flash Hazard sign for each electrical enclosure, cabinet, or
27 other piece of equipment that presents an arc flash hazard in accordance
28 with NEC and ANSI Z535.4.
- 29 C. Electrical Source Signs
 - 30 1. Provide sign indicating voltage level and source for each component of the
31 power distribution system and for all control panels.
 - 32 2. Provide indicating multiple sources where equipment is fed from multiple
33 sources or where signal wiring is present that is powered from a source
34 external to the equipment

35 PART 3 CONSTRUCTION METHODS

- 1 3.01 DIVISION OF WORK (NOT USED)
- 2 3.02 FIELD MEASUREMENTS (NOT USED)
- 3 3.03 DELIVERY, STORAGE, AND HANDLING (NOT USED)
- 4 3.04 INSTALLATION
- 5 A. Nameplates:
- 6 1. Provide nameplates for grouped equipment such as panelboards,
7 transformers, motor control centers, and control panels. Nameplate shall
8 identify tag number, voltage, ampere rating, and description.
- 9 2. Provide nameplates for individual equipment such as motor control center
10 compartments, field instruments, and field control stations. Nameplate shall
11 identify tag number and description.
- 12 3. Provide nameplates for individual receptacles. Nameplate shall identify
13 panel and circuit number supplying the receptacle.
- 14 4. Provide nameplates for control cabinets and motor control center
15 compartments which contain wiring supplied from an external source.
16 Nameplate shall state: Multiple power sources within, verify all power
17 supplies are disconnected before servicing equipment.
- 18 5. Nameplates shall be secured to the front of equipment enclosures with
19 stainless steel screws or rivets, or epoxy-based cement. Double sided tape
20 will not be acceptable.
- 21 6. Secure nameplates for flush mounted panelboards behind the panelboard
22 door.
- 23 7. Nameplates shall be aligned and level or plumb. Misaligned or crooked
24 nameplates shall be remounted, or provide new enclosures at the discretion
25 of the Engineer.
- 26 B. Conductor Marking:
- 27 1. Mark conductors at every termination and splice point.
- 28 2. Mark conductors with wire numbers identified by control system supplier,
29 with panel and circuit identification, or with MCC compartment and wire
30 numbers.
- 31 3. Character markings shall face the open panel and shall read from left to right
32 or top to bottom.
- 33 C. Conduit Marking:
- 34 1. Furnish colored band markers for each conduit longer than six feet and mark
35 each conduit a minimum of twenty feet on center.
- 36 2. Mark conduits where they penetrate a wall or other structure, or emerge
37 from the ground, slab, etc.
- 38 3. Position conduit markers so they can easily be read from the floor.

1 3.05 TESTING AND START-UP SERVICES (NOT USED)

2 3.06 TRAINING (NOT USED)

3 END OF SECTION

1 SECTION 26 05 75

2
3 ELECTRICAL SYSTEMS ANALYSIS

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

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17 for Testing and Materials, Specifications and Standards, current edition:
- 18 3. Illuminating Engineering Society (IES). Institute of Electrical and
19 Electronics Engineers (IEEE), Specifications and Standards, current
20 edition:
 - 21 a. IEEE 141 - Recommended Practice for Electric Power Distribution
22 and Coordination of Industrial and Commercial Power Systems
 - 23 b. IEEE 241 - Recommended Practice for Electric Power Systems in
24 Commercial Buildings
 - 25 c. IEEE 242 - Recommended Practice for Protection and Coordination
26 of Industrial and Commercial Power Systems
 - 27 d. IEEE 399 - Recommended Practice for Industrial and Commercial
28 Power System Analysis
 - 29 e. IEEE 1015 - Recommended Practice for Applying Low-Voltage
30 Circuit Breakers Used in Industrial and Commercial Power
31 Systems.
 - 32 f. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations
- 33 4. Insulated Cable Engineers Association (ICEA)
- 34 5. International Society of Automation (ISA)
- 35 6. National Electrical Manufacturers Association (NEMA)
- 36 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
37 current edition.
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 - 40 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
41 Contracting.
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- a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
11. Canadian Standards Association (CSA), Specifications and Standards, current edition.
12. Electrical and Electronic Manufacturers Association Canada (EEMAC), Specifications and Standards, Current Edition.
13. International Electrotechnical Association (IEC), Specifications and Standards, Current Edition.

1.03 DESCRIPTION OF WORK

- A. Furnish short-circuit and protective device coordination studies.
- B. Furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current issue of NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 - 2002, the IEEE Guide for Performing Arc-Flash Calculations.
- C. The electrical power system studies shall encompass the following electrical equipment:
 1. James Street Pump Station Electrical Infrastructure
 - a. Utility service entrance
 - b. Meter socket & fused disconnect
 - c. Pump Station components including starters
 - d. Automatic Transfer Switch
 - e. Generator
 2. James Street Pump Station Ground System Analysis
 - a. Ground Resistance Test

1.04 RELATED WORK ELSEWHERE

- A. Article 102 – Bidding Requirements and Conditions
- B. Article 103 – Award and Execution of the Contract
- C. Concrete – Division 03
- D. Metals – Division 05
- E. Electrical - Division 26
- F. Earthwork – Division 31
- G. Utilities – Division 33

1.05 SUBMITTALS

- 1 A. Submit shop drawings.
- 2 B. Preliminary short-circuit and protective device coordination studies shall be
3 submitted and approved prior to the approval of any electrical equipment submittals
4 that may be affected by the results of the study.
- 5 C. Final short-circuit, protective device coordination, and arc flash hazard analysis
6 studies shall be prepared and submitted based upon actual installed system
7 characteristics.
- 8 D. Submit the following information specifically for Electrical Systems Analysis:
- 9 1. The results of the short-circuit, protective device coordination, and arc flash
10 hazard analysis studies shall be summarized in a final report. A minimum
11 of five (6) bound copies of the complete final report shall be submitted.
12 Electronic PDF copies of the report shall be provided.
- 13 2. The report shall include the following sections:
- 14 a. Executive Summary including Introduction, Scope of Work and
15 Results/Recommendations.
- 16 b. Short-Circuit Methodology Analysis Results and Recommendations
- 17 c. Short-Circuit Device Evaluation Table
- 18 d. Protective Device Coordination Methodology Analysis Results and
19 Recommendations
- 20 e. Protective Device Settings Table
- 21 f. Time-Current Coordination Graphs and Recommendations
- 22 g. Arc Flash Hazard Methodology Analysis Results and
23 Recommendations including the details of the incident energy and
24 flash protection boundary calculations, along with Arc Flash
25 boundary distances, working distances, Incident Energy levels and
26 Personal Protection Equipment levels.
- 27 h. Arc Flash Labeling section showing types of labels to be provided.
28 Section shall contain descriptive information as well as typical label
29 images.
- 30 i. One-line system diagram that shall be computer generated and will
31 clearly identify individual equipment buses, bus numbers used in the
32 short-circuit analysis, cable and bus connections between the
33 equipment, calculated maximum short-circuit current at each bus
34 location, device numbers used in the time-current coordination
35 analysis, and other information pertinent to the computer analysis.
- 36 3. Submit an electronic version of the software model used to prepare the final
37 short-circuit, protective device coordination, and arc flash hazard analysis
38 studies.
- 39 4. Submit written certification, sealed, and signed by a professional engineer
40 conducting the study, equipment supplier, and electrical subcontractor
41 stating that the data used in the study is correct.

42 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

1 1.07 FACTORY TESTING (NOT USED)

2 1.08 QUALITY ASSURANCE

3 A. The short-circuit, protective device coordination and arc flash hazard analysis
4 studies shall be conducted under the responsible charge and approval of a
5 Registered Professional Electrical Engineer skilled in performing and interpreting
6 the power system studies.

7 B. The Registered Professional Electrical Engineer shall be an employee of the
8 approved engineering firm.

9 C. The Registered Professional Electrical Engineer shall have a minimum of five (5)
10 years of experience in performing power system studies.

11 D. The approved engineering firm shall demonstrate experience with Arc Flash
12 Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses
13 it has performed.

14 E. The studies shall be performed using SKM Systems Analysis Power*Tools for
15 Windows (PTW) software program or an approved equivalent software tool.

16 PART 2 PRODUCTS AND MATERIALS

17 2.01 DATA COLLECTION

18 A. Field data collection shall be performed by a technician, qualified (as defined by
19 NFPA 70E - 2014) to ensure accurate equipment modeling. The technician shall
20 have completed an 8-hour instructor-led Electrical Safety Training Course. The
21 course shall include NFPA 70E training which includes the selection and use of
22 personal protective equipment.

23 B. The technician shall visually inspect to verify the equipment ratings, conductor
24 ratings and overcurrent device data by removing panels, covers and doors where
25 required to document the necessary data used in the analysis. The technician shall
26 be qualified to perform these inspections with the equipment energized provided
27 the incident energy values are less than 40cal/cm², greater values or unusual site
28 conditions will require an equipment shutdown so the equipment can be inspected
29 de-energized.

30 C. The Owner or Contractor shall provide qualified personnel to show the technician
31 the equipment locations and to open all equipment doors, locks, etc. necessary to
32 collect nameplate data.

33 D. Verify one-line drawings and provide marked corrections where discrepancies are
34 found.

- 1 E. Data collection shall begin downstream from the utility service and continue down
2 through the electrical distribution system as defined under scope of work. The
3 study shall not include any single phase AC circuits or DC distribution systems as
4 these types of circuits and systems are excluded from IEEE 1584-2002 Arc Flash
5 calculation guidelines.
- 6 F. Obtain from the utility the minimum, normal, and maximum operating service
7 voltage levels, three-phase short circuit MVA and X/R ratio, as well as line-to-
8 ground short circuit MVA and X/R ratio at the point of connection as shown on the
9 drawings.

10 2.02 SHORT-CIRCUIT ANALYSIS

- 11 A. Transformer design impedances shall be used when test impedances are not
12 available.
- 13 B. Provide the following:
- 14 1. Calculation methods and assumptions
 - 15 2. Selected base per unit quantities
 - 16 3. One-line diagram of the system being evaluated that clearly identifies
17 individual equipment buses, bus numbers used in the short-circuit analysis,
18 cable and bus connections between the equipment, calculated maximum
19 short-circuit current at each bus location and other information pertinent to
20 the computer analysis
 - 21 4. The study shall include input circuit data including electric utility system
22 characteristics, source impedance data, conductor lengths, number of
23 conductors per phase, conductor impedance values, insulation types,
24 transformer impedances and X/R ratios, motor contributions, and other
25 circuit information as related to the short-circuit calculations.
 - 26 5. Tabulations of calculated quantities including short-circuit currents, X/R
27 ratios, equipment short-circuit interrupting or withstand current ratings and
28 notes regarding adequacy or inadequacy of the equipment rating.
 - 29 6. Results, conclusions, and recommendations. A comprehensive discussion
30 section evaluating the adequacy or inadequacy of the equipment must be
31 provided and include recommendations as appropriate for improvements to
32 the system.
- 33 C. For solidly-grounded systems, provide a bolted line-to-ground fault current study
34 for applicable buses as determined by the engineer performing the study.
- 35 D. Protective Device Evaluation:
- 36 1. Evaluate equipment and protective devices and compare to short circuit
37 ratings
 - 38 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to
39 withstand short-circuit stresses

- 1 3. Identify in writing, any circuit protective devices improperly rated for the
2 calculated available fault current.

3 2.03 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

- 4 A. Protective device coordination time-current curves (TCC) shall be displayed on
5 log-log scale graphs.
- 6 B. Include on each TCC graph, a complete title with descriptive device names.
- 7 C. Terminate device characteristic curves at a point reflecting maximum symmetrical
8 or asymmetrical fault current to which the device is exposed.
- 9 D. Identify the device associated with each curve by manufacturer type, function, and,
10 if applicable, tap, time delay, and instantaneous settings recommended.
- 11 E. Plot the following characteristics on the TCC graphs, where applicable:
- 12 1. Electric utility's overcurrent protective device
- 13 2. Medium voltage equipment overcurrent relays
- 14 3. Medium and low voltage fuses including manufacturer's minimum melt,
15 total clearing, tolerance, and damage bands
- 16 4. Low voltage equipment circuit breaker trip devices, including
17 manufacturer's tolerance bands
- 18 5. Transformer full-load current, magnetizing inrush current, and ANSI
19 through-fault protection curves
- 20 6. Medium voltage conductor damage curves
- 21 7. Ground fault protective devices, as applicable
- 22 8. Pertinent motor starting characteristics and motor damage points, where
23 applicable
- 24 9. Pertinent generator short-circuit decrement curve and generator damage
25 point
- 26 10. The largest feeder circuit breaker in each motor control center and
27 applicable panelboard.
- 28 F. Provide adequate time margins between device characteristics such that selective
29 operation is provided, while providing proper protection.
- 30 G. Provide the following:
- 31 1. A one-line diagram shall be provided which clearly identifies individual
32 equipment buses, bus numbers, device identification numbers and the
33 maximum available short-circuit current at each bus when known.
- 34 2. A sufficient number of log-log plots shall be provided to indicate the degree
35 of system protection and coordination by displaying the time-current
36 characteristics of series connected overcurrent devices and other pertinent
37 system parameters.
- 38 3. Computer printouts shall accompany the log-log plots and will contain
39 descriptions for each of the devices shown, settings of the adjustable

1 devices, and device identification numbers to aid in locating the devices on
2 the log-log plots and the system one-line diagram.

- 3 4. The study shall include a separate, tabular printout containing the
4 recommended settings of all adjustable overcurrent protective devices, the
5 equipment designation where the device is located, and the device number
6 corresponding to the device on the system one-line diagram
- 7 5. A discussion section which evaluates the degree of system protection and
8 service continuity with overcurrent devices, along with recommendations
9 as required for addressing system protection or device coordination
10 deficiencies.
- 11 6. Identify in writing of any significant deficiencies in protection and/or
12 coordination. Provide recommendations for improvements.

13 2.04 ARC FLASH HAZARD ANALYSIS

- 14 A. The arc flash hazard analysis shall be performed according to the IEEE 1584
15 equations that are presented in NFPA70E-2009, Annex D. The arc flash hazard
16 analysis shall be performed in conjunction with the short-circuit analysis and the
17 protective device time-current coordination analysis.
- 18 B. The flash protection boundary and the incident energy shall be calculated at
19 significant locations in the electrical distribution system (switchboards, switchgear,
20 motor-control centers, panelboards, busway and splitters) where work could be
21 performed on energized parts.
- 22 C. Circuits 240V or less fed by single transformer rated less than 125 kVA may be
23 omitted from the computer model and will be assumed to have a hazard risk
24 category 0 per NFPA 70E.
- 25 D. Working distances shall be based on IEEE 1584. The calculated arc flash
26 protection boundary shall be determined using those working distances.
- 27 E. When appropriate, the short circuit calculations and the clearing times of the phase
28 overcurrent devices will be retrieved from the short-circuit and coordination study
29 model. Ground overcurrent relays should not be taken into consideration when
30 determining the clearing time when performing incident energy calculations
- 31 F. The short-circuit calculations and the corresponding incident energy calculations
32 for multiple system scenarios must be compared and the greatest incident energy
33 must be uniquely reported for each equipment location in a single table.
34 Calculations must be performed to represent the maximum and minimum
35 contributions of fault current magnitude for normal and emergency operating
36 conditions. The minimum calculation will assume that the utility contribution is at
37 a minimum. Conversely, the maximum calculation will assume a maximum
38 contribution from the utility. Calculations shall take into consideration the parallel

1 operation of synchronous generators with the electric utility, where applicable as
2 well as any stand-by generator applications.

3 G. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon
4 facility operational conditions, and the final report shall describe, when applicable,
5 how these conditions differ from worst-case bolted fault conditions.

6 H. The incident energy calculations must consider the accumulation of energy over
7 time when performing arc flash calculations on buses with multiple sources.
8 Iterative calculations must take into account the changing current contributions, as
9 the sources are interrupted or decremented with time. Fault contribution from
10 motors should be decremented as follows:

11 1. Fault contribution from induction motors should not be considered beyond
12 5 cycles.

13 I. For each piece of ANSI rated equipment with an enclosed main device, two
14 calculations shall be made. A calculation shall be made for the main cubicle, sides,
15 or rear; and shall be based on a device located upstream of the equipment to clear
16 the arcing fault. A second calculation shall be made for the front cubicles and shall
17 be based on the equipment's main device to clear the arcing fault. For all other non-
18 ANSI rated equipment, only one calculation shall be required and it shall be based
19 on a device located upstream of the equipment to clear the arcing fault.

20 J. When performing incident energy calculations on the line side of a main breaker
21 (as required per above), the line side and load side contributions must be included
22 in the fault calculation.

23 K. Mis-coordination should be checked amongst all devices within the branch
24 containing the immediate protective device upstream of the calculation location and
25 the calculation should utilize the fastest device to compute the incident energy for
26 the corresponding location.

27 L. Arc Flash calculations shall be based on actual overcurrent protective device
28 clearing time. A maximum clearing time of 2 seconds will be used based on IEEE
29 1584-2002 section B.1.2. Where it is not physically possible to move outside of the
30 flash protection boundary in less than 2 seconds during an arc flash event, a
31 maximum clearing time based on the specific location shall be utilized.

32 M. Provide the following:

33 1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form,
34 and shall include device or bus name, bolted fault and arcing fault current
35 levels, flash protection boundary distances, working distances, personal-
36 protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
37 a. The Arc-Flash Hazard Analysis shall report incident energy values
38 based on recommended device settings for equipment within the
39 scope of the study.

1 labels provided on each individual section access area. Equipment line-ups
2 containing sections with multiple incident energy and flash protection
3 boundaries shall be labeled as identified in the Arc Flash Analysis table.
4 2. Wall Mounted Equipment - Labels shall be provided on the front cover or a
5 nearby adjacent surface, depending upon equipment configuration.
6 3. General Use Safety labels shall be installed on equipment in coordination
7 with the Arc Flash labels. The General Use Safety labels shall warn of
8 general electrical hazards associated with shock, arc flash, and explosions,
9 and instruct workers to turn off power prior to work.

10 F. Label Installation
11 1. Labels shall be field installed by the Contractor. The technician providing
12 the installation shall have completed an 8-Hour instructor led Electrical
13 Safety Training Course with includes NFPA 70E material including the
14 selection of personal protective equipment.

15 3.05 TESTING AND START-UP SERVICES (NOT USED)

16 3.06 TRAINING (NOT USED)

17 END OF SECTION

1 SECTION 26 08 00

2 ELECTRICAL EQUIPMENT ACCEPTANCE TESTING AND START-UP

3 PART 1 GENERAL

4 1.01 APPLICABLE PROVISIONS (NONE)

5 1.02 APPLICABLE PUBLICATIONS

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16 Engineers (IEEE)
- 17 E. Insulated Cable Engineers Association (ICEA)
- 18 F. International Society of Automation (ISA)
- 19 G. National Electrical Manufacturers Association (NEMA)
- 20 H. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current
21 edition.
- 22 I. Wisconsin Department of Safety and Professional Services (DSPS).
- 23 J. National Electrical Contractors Association (NECA), current edition.
24 1. NECA 1 - Standard Practices for Good Workmanship in Electrical
25 Contracting.
- 26 K. International Electrical Testing Association (NETA)
- 27 L. NETA STD ATS - Acceptance Testing Specifications for Electrical Power
28 Distribution Equipment and Systems.
- 29 M. Canadian Standards Association (CSA), Specifications and Standards, current
30 edition.

1 N. Electrical and Electronic Manufacturers Association Canada (EEMAC),
2 Specifications and Standards, Current Edition.

3 O. International Electrotechnical Association (IEC), Specifications and Standards,
4 Current Edition.

5 1.03 DESCRIPTION OF WORK

6 A. For the purpose of obtaining a complete and integrated process instrumentation
7 and control system, the work specified herein shall be included under the scope
8 of:

9 1. Section 26 90 00 - Process Instrumentation & Control.

10 a. The Contractor shall engage the acceptance testing and startup
11 services of the field engineering service division of a major
12 electrical distribution equipment manufacturer which maintains
13 division-wide recognized specialized testing capabilities for the
14 purpose of performing tests as herein specified.

15 b. The tests and inspections shall determine suitability for energizing
16 equipment; confirm the equipment is installed per the contract
17 documents and as a benchmark for the Owner to use for future
18 maintenance testing.

19 1.04 RELATED WORK ELSEWHERE

20 A. Article 102 – Bidding Requirements and Conditions

21 B. Article 103 – Award and Execution of the Contract

22 C. Concrete – Division 03

23 D. Metals – Division 05

24 E. Electrical - Division 26

25 F. Earthwork – Division 31

26 G. Utilities – Division 33

27 1.05 SUBMITTALS

28 A. Submit shop drawings.

29 B. Submitted electrical test report shall include the following:

30 C. Summary of project

31 D. Description of equipment tested

- 1 E. Description of test
- 2 F. Test results
- 3 G. Conclusions and recommendations
- 4 H. Appendix, including appropriate test forms
- 5 I. List of test equipment used and calibration date
- 6 J. Conditions for future access to secured computer database of all Test Data.
- 7 K. Furnish three copies of the completed report to the project engineer no later than
- 8 30 days after completion of the project, unless directed otherwise.
- 9 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)
- 10 1.07 FACTORY TESTING (NOT USED)
- 11 1.08 QUALITY ASSURANCE
- 12 A. The testing plan and procedures shall be reviewed and approved by one of the
- 13 field engineering division's registered professional electrical engineers. The
- 14 registered professional engineer shall be a full time employee of the engineering
- 15 service testing group with at least 10 years of field experience testing electrical
- 16 apparatus.
- 17 B. The engineering service testing group shall be an independent division of a major
- 18 electrical equipment manufacturer.
- 19 C. The engineering service division site lead engineer or project manager shall be a
- 20 degreed engineer, who is a full-time employee, with at least 10 years of
- 21 experience testing electrical apparatus, and has obtained factory training. All
- 22 other employees working on this project shall have had specific factory, and/or
- 23 field training in accordance with division-wide standards.
- 24 D. To ensure compliance with quality control standards, the engineering service
- 25 division shall conduct periodic audits of test procedures and test record forms to
- 26 ensure compliance with industry standards. A Quality Assurance Manager, not
- 27 reporting to the operation center completing the field testing services, must
- 28 complete such audits. The name of the Quality Assurance Manager, or separate
- 29 audit agency, shall be submitted for approval prior to award of any contract or
- 30 completion of any fieldwork.
- 31 E. All test records shall be recorded onto standardized test forms. All data shall be
- 32 uploaded to a central computer in a data-secured environment; therefore ensuring
- 33 no changes can be incorporated into the final test records. These records shall be

1 retrievable for a period of not less than five years, based on a mutually agreed
2 periodic maintenance plan, separate from this contract.

3 F. Should repairs be required, the engineering service division shall maintain
4 dedicated locations that perform remanufacturing and reconditioning of electrical
5 equipment. All repairs shall be conducted under the direction of a quality control
6 and reconditioning standard pursuant to ISO9001 compliance. A quality
7 certificate, computer database and final test records shall document the progress
8 of each piece of electrical equipment through the repair or reconditioning process.
9 All work shall be performed in accordance with industry standards.
10 Documentation of periodic audits, as specified in item D above, shall also be
11 maintained for the dedicated remanufacturing and reconditioning facility.

12 G. The engineering service testing group shall have a calibration program which
13 maintains all applicable test instrumentation within rated accuracy.

14 H. The accuracy shall be traceable to the National Bureau of Standards in an
15 unbroken chain.

16 I. Instruments shall be calibrated in accordance with the following frequency
17 schedule:

18 J. Field instruments – six to twelve months

19 K. Laboratory instruments – twelve months

20 L. Dated calibration labels shall be visible on all test equipment.

21 M. Records must be kept up to date, which show date and results of all instruments
22 calibrated or tested.

23 N. An up-to-date instrument calibration instruction and procedure will be maintained
24 for each test instrument.

25 1.09 WARRANTY (NOT USED)

26 1.10 EXTRA MATERIALS (NOT USED)

27 1.11 DESIGN REQUIREMENTS (NOT USED)

28 1.12 MAINTENANCE (NOT USED)

29 1.13 SAFETY AND PRECAUTIONS

30 A. Safety practices shall include, but are not limited to, the following requirements:

31 B. Occupational Safety and Health Act of 1970 – OSHA 29CFR 1910.269

- 1 C. National Fire Protection Association – NFPA 70E
- 2 D. Applicable state and local safety operating procedures.
- 3 E. All tests shall be performed with apparatus de-energized except where otherwise
4 specified.
- 5 F. The engineering service testing group’s lead test engineer for the project shall be
6 a designated safety representative and shall be present on the project and
7 supervise testing operations and safety requirements.
- 8 G. Power circuits shall have conductors shorted to ground by a hotline grounded
9 device approved for the purpose in accordance with the appropriate test
10 procedures.
- 11 H. In all cases, work shall not proceed until the safety representative has determined
12 that it is safe to do so.
- 13 I. The engineering service testing group shall have available sufficient protective
14 barriers and warning signs, where necessary, to conduct specified tests safely.
- 15 J. The owner’s safety procedures shall be reviewed and understood by the
16 engineering service testing group personnel.

17 PART 2 PRODUCTS AND MATERIALS

18 2.01 EQUIPMENT EVALUATION PREPARATION

- 19 A. The electrical contractor shall torque down all accessible bolts; perform
20 continuity checks on all branch and control wiring; and perform rotational tests
21 for all motors prior to and in addition to tests performed by the engineering
22 service testing group, specified herein. Contractor shall remove metal shavings
23 and thoroughly clean and vacuum equipment before testing or energizing.
- 24 B. The electrical contractor shall supply a suitable and stable source of test power for
25 testing at each test site. The engineering service testing group shall specify
26 requirements.
- 27 C. The electrical contractor shall notify the engineering service testing group when
28 equipment becomes available for electrical tests. Work shall be coordinated to
29 expedite project scheduling.
- 30 D. The contractor will supply a complete set of as-built electrical plans,
31 specifications and any pertinent change orders to the engineering service testing
32 group prior to commencement of testing.

1 E. The engineering service testing group shall notify the project engineer prior to
2 commencement of any testing.

3 F. The engineering service testing group shall be responsible for implementing all
4 final settings and adjustments on protective devices and electrical equipment in
5 accordance with the project engineer's specified values or a coordination study
6 performed by the engineer of record or the testing group's licensed professional
7 engineer.

8 G. Any system, material or workmanship which is found defective on the basis of
9 electrical tests shall be reported directly to the project engineer.

10 H. The engineering service testing group shall maintain a written record of all tests
11 and upon completion of the project, assemble and certify a final test report.

12 **PART 3 CONSTRUCTION METHODS**

13 **3.01 FIELD MEASUREMENTS**

14 A. The field engineering service testing group shall provide all material, equipment,
15 labor and technical supervision to perform electrical equipment tests and
16 inspections. The field engineering service division of the equipment manufacturer
17 shall administer all acceptance and start-up testing, and power system studies, as
18 referenced in other specification sections.

19 B. Equipment warranty shall be extended to two years from date of commissioning
20 when service representatives employed by the equipment manufacturer perform
21 startup.

22 C. The intent of these tests is to assure that all electrical equipment is operational
23 within industry standards and manufacturer's tolerances and that equipment is
24 installed and functioning in the system in the manner intended by the engineer.

25 D. Upon completion of the tests and inspections noted in these specifications, a label
26 shall be attached to all serviced devices. These labels will indicate date serviced
27 and the engineering service testing group responsible.

28 E. The tests and inspections shall determine suitability for initial continued reliable
29 operation.

30 **3.02 DELIVERY, STORAGE, AND HANDLING (NOT USED)**

31 **3.03 INSTALLATION (NOT USED)**

32 **3.04 TESTING AND START-UP SERVICES**

33 A. MCC and Switchboard Inspection and Testing

- 1 B. Examine the Main MCC, switchboard(s), including breakers, and accessories for:
- 2 C. Doors, panels, and sections for alignment, dents, scratches, fit, and missing
3 hardware
- 4 D. Shipped loose and shipped short components.
- 5 E. Shipping damage
- 6 F. Loose or obviously damaged components.
- 7 G. Proper identification.
- 8 H. Physical damage from installation.
- 9 I. If the unit was placed in temporary storage, verify and record that proper
10 procedures were observed. Remove temporary heater wiring and shipping braces.
- 11 J. Inspect Shipping Splits to insure that all bus connections were properly connected
12 and all control wiring splits have been properly terminated.
- 13 K. Inspect all grounding connections for cleanliness and alignment.
- 14 L. Inspect Main Bonding Jumper for proper size and termination (Refer to NEC
15 Article 250, Section 250-102, Equipment Bonding Jumpers).
- 16 M. Inspect Insulators for evidence of physical damage or contaminated surfaces.
- 17 N. Inspect Surge Arrester and/or Surge Suppression size, type, installation and
18 connection to determine if they are in accordance with the drawings (Refer to
19 NEC Article 280)
- 20 O. Inspect Control power & instrument transformers, if applicable.
- 21 P. Inspect wiring for damaged insulation, broken leads, tightness of connections,
22 proper crimping, and overall general condition.
- 23 Q. Verify anchorage (per local codes, wind and seismic considerations).
- 24 R. Inspect and verify required area clearances, correct alignment and cleanliness.
- 25 S. Verify the grounding electrode conductor is properly sized (in accordance with
26 NEC Article 250, Table 250-66) and terminated.
- 27 T. Confirm the proper grounding of instruments, panels and connections (Refer to
28 NEC Article 250, Part J, Sections 250-170 through 250-178).
- 29 U. Confirm proper conductor identification (as applicable).

- 1 V. Verify cable termination tightness.
- 2 W. Verify that all cables have been properly installed, routed and supported and are
3 clear of energized parts.
- 4 X. Confirm conduits and conduit bushings are correctly installed.
- 5 Y. Confirm tightness of accessible bolted electrical connections, especially shipping
6 splits, by calibrated torque-wrench method in accordance with manufacturers
7 published data.
- 8 Z. Verify that all VT and CT ratios properly correspond to drawings and that
9 polarity is correct.
- 10 AA. Verify that shorting screws and bars are removed from CT's and terminal blocks
11 as required.
- 12 BB. Verify that primary and secondary fuse ratings or circuit breakers match
13 drawings.
- 14 CC. Confirm meter scaling and type match drawings.
- 15 DD. The meter, protective relay, breaker settings (& PFC choices) must be supplied
16 from a Power System Study performed by a licensed professional engineer prior
17 to commissioning.
- 18 EE. Set meter, relay, & breaker trip setting per above study.
- 19 FF. Inspect shipping splits for mechanical connection assuring adequate surface
20 contact.
- 21 GG. Ground bonding & shipping splits shall be tested with ductor tester (Digital low
22 ohm resistance meter) to insure connection is a low resistance connection. Test
23 from one fixed bus to adjacent fixed bus through the shipping split connector to
24 measure both connection points.
- 25 HH. Microhm values shall not vary more than 50% from other phase readings and
26 meet the manufacturer's published data based on bus size, ampacities and material.
- 27 II. Test the phase loss relay, either separate or integral to the multimeter, to activate
28 contact.
- 29 JJ. Test the undervoltage relay, either separate or integral to the multimeter, to
30 activate contact.
- 31 KK. If contact is hooked to the Capacitor trip & Shunt trip combo on main breaker,
32 insure main breaker trips.

- 1 LL. If contact reports to energy management system, insure energy management
2 system receives loss of phase/voltage signal.
- 3 MM. Inspect switchboard main bonding jumper for proper size and termination on
4 source side of neutral disconnect link.
- 5 NN. Inspect Grounding electrode conductor to assure proper size and secure
6 termination to ground bus.
- 7 OO. Inspect switchboard neutral bus downstream of the neutral disconnect link to
8 verify the absence of ground connections.
- 9 PP. Set Ground fault setting per calculations in E above.
- 10 QQ. Verify Ground Fault System Performance for correct response of the circuit-
11 interrupting device by secondary (or primary if local inspector requires) ground
12 sensor current injection. Record ground fault pickup current. Verify breaker trips
13 and indicator works.
- 14 RR. Verify Ground fault does not pick-up at 90% of pickup setting.
- 15 SS. Record settings, results, and any other notations on the Low Voltage Breaker data
16 form.

17 3.05 CABLE TESTING

- 18 A. Insulation System – To insure integrity of the cable insulation system after
19 shipping, site storage, and pulling through conduit an insulation resistance test
20 will reveal insulation deformities and moisture in the cable that otherwise might
21 cause an untimely premature cable failure possibly damaging equipment or
22 personnel. Perform the following on all customer power cables to and from main
23 switchboard. This would include cables from utility transformer to MSB and
24 cables from MSB to all secondary switchboards or distribution panels.
- 25 B. Visually inspect visible portion of cables for observable defects.
- 26 C. Insure all solid-state devices are disconnected from the system prior to
27 meggering. Typically but not all-inclusive would be Meters, trip units with
28 voltage sensing, and TVSS units.
- 29 D. Isolate cables by opening breakers. Meggering thru equipment like motors or
30 transformers will produce erroneous readings.
- 31 E. Perform insulation-resistance tests on each line and load cable, phase-to-phase,
32 phase-to-ground, phase-to-neutral and neutral-to-ground in each conduit. Megger
33 at 1000 VDC for 600 volt cable and 500 VDC for 300 volt cable for one minute.

1 F. Insulation resistance shall be above 100 ohms and preferably above one megohm.

2 G. Insure cable termination connections are tight after testing.

3 3.06 FOLLOW UP TESTING

4 1. Included in above cost as part of original project.

5 B. One month prior to the expiration of the factory warranty schedule & perform a
6 thermal scan of all breaker to cable, breaker, bus connections, cable to panel
7 chassis. Scope is to include main transformer connections, main switchboard, all
8 secondary switchboards, transformers, and panels. Tests are to be done with
9 building normal loaded for 2 hours, not in with partial or unloaded condition.

10 C. Thermal scans temperatures shall be evaluated as follows (based on comparable
11 size or adjacent phases and loaded breakers, bus connections, and terminations)

12 1. 1-3 degrees C rise, Investigate as to the cause of temp rise.

13 2. 4 – 15 degree C rise, Repair as soon as possible.

14 3. 16 or higher degree C rise, Repair immediately.

15 D. Insure that all bus and breaker to cable connections are tight.

16 E. Note corrective actions taken, deficiencies, recommendations and any general
17 comments.

18 F. Finish recording data on test forms, completely filling in the blanks.

19 G. Turn in 3 copies of report to engineer for approval.

20 3.07 TRAINING (NOT USED)

21

22

END OF SECTION

23

1 SECTION 26 24 16

2
3 PANELBOARDS

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent applicable. The
9 latest edition accepted by the Authority Having Jurisdiction of the referenced
10 publications in effect at the time of the bid governs

- 11 1. American National Standards Institute/National Fire Protection Agency
12 (ANSI/NFPA), Specifications and Standards, current edition:
 - 13 a. ANSI/NFPA 70 - National Electrical Code.
- 14 2. ASTM International (ASTM), originally known as the American Society
15 for Testing and Materials, Specifications and Standards, current edition:
- 16 3. Illuminating Engineering Society (IES). Institute of Electrical and
17 Electronics Engineers (IEEE)
- 18 4. Insulated Cable Engineers Association (ICEA)
- 19 5. International Society of Automation (ISA)
- 20 6. National Electrical Manufacturers Association (NEMA), Specifications and
21 Standards, current edition.
 - 22 a. NEMA PB 1 - Panelboards
 - 23 b. NEMA PB 1.1 - Instructions for Safe Installation, Operation and
24 Maintenance of Panelboards Rated 600 Volts or Less.
 - 25 c. NEMA AB 1 - Molded Case Circuit Breakers.
 - 26 d. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment
27 Switches (600 Volts Maximum)
 - 28 e. NEMA 250 - Enclosures for Electrical Equipment.
- 29 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
30 current edition.
 - 31 a. UL 50 - Enclosures for Electrical Equipment
 - 32 b. UL 67 - Panelboards.
 - 33 c. UL 98 - Enclosed and Dead-front Switches
 - 34 d. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker
35 Enclosures
- 36 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 37 9. National Electrical Contractors Association (NECA), current edition.
 - 38 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
39 Contracting.
- 40 10. International Electrical Testing Association (NETA)
 - 41 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
42 Power Distribution Equipment and Systems.

- 1 11. Canadian Standards Association (CSA), Specifications and Standards,
2 current edition:
 - 3 a. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed
4 Panelboards
 - 5 b. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
- 6 12. Federal Specifications and standards, current edition:
 - 7 a. W-P-115C - Type I Class 1
 - 8 b. W-C-375B - Molded Case Circuit Breakers
 - 9 c. W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit
10 and Service.
 - 11 d. W-P115C - Type 1 Class 2 Load Center

12 1.03 DESCRIPTION OF WORK

- 13 A. Furnish and install complete and operable panelboards as indicated on the drawings
14 and as specified herein.

15 1.04 RELATED WORK ELSEWHERE

- 16 A. Article 102 – Bidding Requirements and Conditions
- 17 B. Article 103 – Award and Execution of the Contract
- 18 C. Concrete – Division 03
- 19 D. Metals – Division 05
- 20 E. Electrical - Division 26
- 21 F. Earthwork – Division 31
- 22 G. Utilities – Division 33

23 1.05 SUBMITTALS

- 24 A. Submit shop drawings.
- 25 B. Submit the following information specifically for panelboards:
 - 26 1. Literature sufficient in scope to demonstrate compliance with the
27 requirements of this specification.
 - 28 2. Overall panelboard dimensions, interior mounting dimensions, and wiring
29 gutter dimensions. The location of the main, branches, and solid neutral
30 shall be clearly shown. Illustrate one line diagrams with applicable voltage
31 systems.
 - 32 3. Equipment ratings for voltage, amperage, and short circuit.

33 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 1 A. Submit operation & maintenance manuals and instructions.
- 2 B. Submit the following information specifically for panelboards:
 - 3 1. Manufacturer shall provide installation instructions and NEMA Standards
 - 4 Publication PB 1.1 - Instructions for Safe Installation, Operation and
 - 5 Maintenance of Panelboards Rated 600 Volts or Less.

6 1.07 FACTORY TESTING (NOT USED)

7 1.08 QUALITY ASSURANCE

- 8 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 9 B. System supplier shall be responsible for providing all necessary accessories
- 10 required for a complete and operable system.
- 11 C. Manufacturer Qualifications: All panelboards provided under this section shall be
- 12 the products of a single company specializing in manufacturing products specified
- 13 in this section, with not less than fifty years of documented experience.
- 14 D. Products: Listed and classified by UL or testing firm acceptable to the authority
- 15 having jurisdiction as suitable for the purpose specified and indicated.
- 16 E. Panelboard manufacturer shall be certified to ISO 9001 International Quality
- 17 Standard and shall have third party certification verifying quality assurance in
- 18 design/development, production, installation, and service, in accordance with ISO
- 19 9001.

20 1.09 WARRANTY

21 1.10 EXTRA MATERIALS

22 1.11 DESIGN REQUIREMENTS (NOT USED)

23 1.12 MAINTENANCE

- 24 A. Before substantial completion, perform all maintenance activities required by any
- 25 sections of the specifications including any calibrations, final adjustments,
- 26 component replacements or other routine service required before placing
- 27 equipment or systems into service.
- 28 B. Furnish all spare parts as required by other sections of the specifications.

29 PART 2 PRODUCTS

30 2.01 240VAC LIGHTING AND APPLIANCE BRANCH CIRCUIT LOAD CENTERS

- 31 A. Manufacturers:

1. Square D Company QO Load Center
- ~~2. Cutler Hammer Type CH~~
- ~~3. or equal~~

4 B. Interiors:

- 5 1. Bus bar connections to the branch circuit breakers shall be the distributed
- 6 phase type and shall accept plug-on circuit breakers. 300-400A load centers
- 7 shall accept a 150A maximum bolt-on breaker in addition to plug-on types.
- 8 2. Short Circuit Current Ratings: shall be provided as indicated on the
- 9 drawings. This rating shall be established by manufacturer testing of a
- 10 representative load center with branch circuit breakers installed.

11 C. Circuit Breakers:

- 12 1. Circuit breakers shall be plug-on thermal magnetic trip, with an integral
- 13 crossbar to ensure simultaneous opening of all poles in multi-pole circuit
- 14 breakers.
- 15 2. Circuit breakers shall have an overcenter, tripfree, toggle-type operating
- 16 mechanism with quick-make, quick-break action and positive handle
- 17 indication.
- 18 3. Handles shall have ON, OFF, and "Tripped" positions. In addition, trip
- 19 indication shall include an indicator appearing in the window of the circuit
- 20 breaker case (through 125 amperes).
- 21 4. Circuit breakers shall be UL Listed in accordance with UL standard 489
- 22 with current ratings as indicated on the plans. Interrupting ratings shall be
- 23 selected to provide the required load center short circuit current rating.
- 24 5. Single-pole, 15 and 20 ampere circuit breakers indicated on the drawings as
- 25 intended to switch fluorescent lighting loads on a regular basis shall have
- 26 the SWD marking.
- 27 6. Two- and three-pole circuit breakers 15-60 amperes indicated on the
- 28 drawings as intended for use with air conditioning, heating, and
- 29 refrigeration equipment having motor group combinations and marked as
- 30 such shall have the HACR marking.
- 31 7. Provide UL Class A ground fault interrupter circuit breakers where
- 32 indicated on drawings.
- 33 8. The following special application circuit breakers or circuit breaker
- 34 accessories shall be provided where indicated on the drawings:
- 35 a. Circuit breakers with remote control switching capability
- 36 b. Circuit breakers for use on high intensity discharge lighting systems
- 37 c. Key operated circuit breakers
- 38 d. Switch neutral circuit breakers
- 39 e. Shunt trip, auxiliary switch, or alarm switch accessories

40 D. Enclosures:

- 41 1. NEMA PB1: Type 1 or Type 3R as indicated on the drawings.
- 42 2. Enclosure shall be fabricated of cold rolled steel for NEMA 1 and
- 43 galvanized steel or equivalent rust-resistant steel for NEMA 3R.

3. Indoor Type I enclosures shall have a flush or surface front as indicated on the drawings and flush cylinder tumble-type lock, all keyed alike, with finish to be gray baked enamel.
4. Outdoor Type 3R enclosures shall have a hasp to secure the cover. Finish to be gray baked enamel.
5. A directory label shall be provided with circuits identified as indicated on the schedule.

E. Manual Transfer Assembly:

1. Provide U.L. Listed manual transfer assembly where indicated on the drawings.
2. Manual transfer shall consist of two backfed main circuit breakers sized as indicated on the drawings complete with retaining kits and mechanical interlock to prevent both circuit breakers from simultaneously being in the “on” position.

2.02 240VAC LIGHTING AND APPLIANCE PANELBOARDS

A. Manufacturers:

1. Square D Company NQ
2. ~~Cutler Hammer Pow R Line~~
3. ~~or equal~~

B. Interior:

1. Rated for 240VAC / 48VDC maximum. Continuous main current ratings, as indicated on the drawings, not to exceed 600 amperes maximum.
2. UL Listed short circuit current ratings as indicated on the drawings with a maximum of 200,000 RMS symmetrical amperes.
3. Provide one continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing shall be plated copper. Bus bar plating shall run the entire length of the bus bar. Main lug and main breaker panelboards shall be suitable for use as Service Equipment.
4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
5. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided where indicated on the drawings.
6. Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length. UL Listed panelboards with 200 percent rated solid neutrals shall have plated copper neutral bus for non-linear load applications where indicated on the drawings.

- 1 7. Interior trim shall be of dead-front construction to shield user from
2 energized parts. Dead-front trim shall have pre-formed twist-outs covering
3 unused mounting space.
- 4 8. Nameplates shall contain system information and catalog number or factory
5 order number. Interior wiring diagram, neutral wiring diagram, UL Listed
6 label and short circuit current rating shall be displayed on the interior or in
7 a booklet format.
- 8 9. Interiors shall be field convertible for top or bottom incoming feed. Main
9 lug interiors up to 400 amperes shall be field convertible to main breaker.
10 Interior leveling provisions shall be provided for flush mounted
11 applications.
- 12 10. Circuit Breakers:
 - 13 a. Main circuit breakers shall be vertically mounted.
 - 14 b. Sub-feed circuit breakers shall be vertically mounted.
 - 15 c. Molded case branch circuit breakers shall have bolt-on type bus
16 connectors.
 - 17 d. All unused spaces provided, unless otherwise specified, shall be
18 fully equipped for future devices, including all appropriate
19 connectors and mounting hardware.
 - 20 e. The exposed faceplates of all branch circuit breakers shall be flush
21 with one another.

22 C. Enclosures:

- 23 1. Type 1:
 - 24 a. Boxes shall be galvanized steel constructed in accordance with UL
25 50 requirements. Zinc-coated galvanized steel will not be
26 acceptable.
 - 27 b. Boxes shall have removable endwalls with knockouts located on one
28 end. Boxes shall have welded interior mounting studs. Interior
29 mounting brackets are not required.
 - 30 c. Box width shall be 26-inch wide maximum.
 - 31 d. Type 1 Fronts:
 - 32 1) Front shall meet strength and rigidity requirements per UL
33 50 standards. Front shall have ANSI 49 gray enamel
34 electrodeposited over cleaned phosphatized steel.
 - 35 2) Fronts shall be hinged 1-piece with door. Mounting shall be
36 flush or surface as indicated on the drawings.
 - 37 3) Panelboards shall have fronts with concealed door hinges
38 and mounted with trim screws. Front shall not be removable
39 with the door locked. Doors on front shall have rounded
40 corners and edges shall be free of burrs.
 - 41 4) Front shall have cylindrical tumbler type lock with catch and
42 spring-loaded stainless steel door pull. All lock assemblies
43 shall be keyed alike. One (1) key shall be provided with each
44 lock. A clear plastic directory cardholder shall be mounted
45 on the inside of door.

- 1 2. Type 3R, 5, and 12:
2 a. Enclosures shall be constructed in accordance with UL 50
3 requirements. Enclosures shall be painted with ANSI 49 gray
4 enamel electrodeposited over cleaned phosphatized steel.
5 b. All doors shall be gasketed and equipped with a tumbler type vault
6 lock and two (2) additional quarter turn fasteners on enclosures 59-
7 inches or more in height. All lock assemblies shall be keyed alike.
8 One (1) key shall be provided with each lock. A clear plastic
9 directory cardholder shall be mounted on the inside of door.
10 c. Maximum enclosure dimensions shall not exceed 21-inches wide
11 and 6.5-inches deep.

12 PART 3 CONSTRUCTION METHODS

13 3.01 DIVISION OF WORK (NOT USED)

14 3.02 FIELD MEASUREMENTS

- 15 A. Field verify all measurements. Do not base exact panelboard locations on the
16 contract drawings. Actual field conditions govern all final installed locations,
17 distances, and levels.
- 18 B. Identify conflicts with the work of other trades prior to installation of electrical
19 equipment.
- 20 C. Adjust panelboard installation to satisfy field requirements.

21 3.03 DELIVERY, STORAGE, AND HANDLING

- 22 A. Accept panelboard on site. Inspect for damage.
- 23 B. Protect panelboard from corrosion and entrance of debris.
- 24 C. Store panelboard above grade. Protect from environment with suitable covering.

25 3.04 INSTALLATION

- 26 A. Install panelboards plumb and flush with wall finishes.
- 27 B. Install panelboards such that top of panel is located at an elevation of 6-feet above
28 finished floor elevation.
- 29 C. Provide filler plates for unused spaces in panelboards.
- 30 D. Provide typed circuit directory for each branch circuit panelboard. Revise directory
31 to reflect circuiting changes required to balance phase loads.

1 E. Stub one empty 1.5-inch conduit to accessible location below ground outside
2 concrete slab.

3 F. Measure steady state load currents at each panelboard feeder. Should the difference
4 at any panelboard between phases exceed 10 percent, rearrange circuits in the
5 panelboard to balance the phase loads within 10 percent. Take care to maintain
6 proper phasing for multi wire branch circuits.

7 G. Inspect for physical damage, proper alignment, anchorage, and grounding. Check
8 proper installation and tightness of connections for circuit breakers, fusible
9 switches, and fuses.

10 H. Verify that bonding jumper is properly installed in service entrance rated panels.

11 I. Thoroughly clean and remove construction debris from panelboard interior and
12 exterior.

13 3.05 TESTING AND START-UP SERVICES

14 A. Refer to the requirements of Section 26 08 00 - Commissioning of Electrical
15 Systems.

16 3.06 TRAINING

17 A. Refer to the requirements of Section 26 08 00 - Commissioning of Electrical
18 Systems.

19 END OF SECTION

1 SECTION 26 28 19

2
3 ENCLOSED SWITCHES

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS (NONE)

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent applicable. The
9 latest edition accepted by the Authority Having Jurisdiction of the referenced
10 publications in effect at the time of the bid governs

- 11 1. American National Standards Institute/Instrument Society of America
12 (ANSI/ISA), Specifications and Standards, current edition:
- 13 a. American National Standards Institute/National Fire Protection
14 Agency (ANSI/NFPA), Specifications and Standards, current
15 edition:
 - 16 1) ANSI/NFPA 70 - National Electrical Code (NEC) and state
17 amendments thereto.
 - 18 2. ASTM International (ASTM), originally known as the American Society
19 for Testing and Materials, Specifications and Standards, current edition:
 - 20 3. Illuminating Engineering Society (IES). Institute of Electrical and
21 Electronics Engineers (IEEE)
 - 22 4. Insulated Cable Engineers Association (ICEA)
 - 23 5. International Society of Automation (ISA)
 - 24 6. National Electrical Manufacturers Association (NEMA), Specifications and
25 Standards, current edition.
 - 26 a. NEMA FU 1 - Low Voltage Cartridge Fuses
 - 27 b. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment
28 Switches (600 Volts Maximum)
 - 29 c. NEMA 250 - Enclosures for Electrical Equipment.
 - 30 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
31 current edition.
 - 32 a. UL 98 - Enclosed and Dead Front Switches
 - 33 b. UL 508 – Standard for Industrial Control Equipment
 - 34 8. Wisconsin Department of Safety and Professional Services (DSPS)
 - 35 9. National Electrical Contractors Association (NECA), current edition.
 - 36 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
37 Contracting.
 - 38 10. International Electrical Testing Association (NETA)
 - 39 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
40 Power Distribution Equipment and Systems.

- 1 11. Canadian Standards Association (CSA), Specifications and Standards,
2 current edition:
- 3 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
4 Specifications and Standards, Current Edition.
- 5 13. International Electrotechnical Association (IEC), Specifications and
6 Standards, Current Edition.

7 1.03 DESCRIPTION OF WORK

- 8 A. Furnish and install complete and operable enclosed switches as indicated on the
9 drawings and as specified herein.
- 10 B. Provide disconnect switches with the number of poles, voltage, current, short
11 circuit, and horsepower ratings as required by the load and the power system.
- 12 C. Furnish one spare set of fuses.

13 1.04 RELATED WORK ELSEWHERE

- 14 A. Article 102 – Bidding Requirements and Conditions
- 15 B. Article 103 – Award and Execution of the Contract
- 16 C. Concrete – Division 03
- 17 D. Metals – Division 05
- 18 E. Electrical - Division 26
- 19 F. Earthwork – Division 31
- 20 G. Utilities – Division 33

21 1.05 SUBMITTALS

- 22 A. Submit shop drawings.
- 23 B. Submit the following information specifically for enclosed switches:
 - 24 1. Manufacturer literature sufficient in scope to demonstrate compliance with
25 the requirements of this specification.
 - 26 2. Outline drawings with dimensions.
 - 27 3. Equipment ratings for voltage, amperage, horsepower and short circuit.

28 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NOT USED)

29 1.07 FACTORY TESTING (NOT USED)

- 1 1.08 QUALITY ASSURANCE
- 2 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 3 B. System supplier shall be responsible for providing all necessary accessories
- 4 required for a complete and operable system.
- 5 C. Manufacturer Qualifications: Company specializing in manufacturing products
- 6 specified in this section, with not less than three years of documented experience.
- 7 D. Products: Listed and classified by UL or testing firm acceptable to the authority
- 8 having jurisdiction as suitable for the purpose specified and indicated.

9 1.09 WARRANTY

10 1.10 EXTRA MATERIALS

- 11 A. Supply 3 spare fuses of each type supplied for this project

12 1.11 DESIGN REQUIREMENTS (NOT USED)

13 1.12 MAINTENANCE (NOT USED)

14 PART 2 PRODUCTS AND MATERIALS

15 2.01 250VAC/600VAC HEAVY DUTY DISCONNECT SWITCH

- 16 A. Manufacturers:
- 17 1. Schneider Electric/Square D Company
- 18 ~~2. Eaton/Cutler Hammer~~
- 19 2. Allen Bradley
- 20 3. or equal
- 21 B. Switch Interior:
- 22 1. All switches shall have switch blades which are visible when the switch is
- 23 off and the cover is open.
- 24 2. Lugs shall be front removable and UL Listed for 60 degree C or 75 degree
- 25 C aluminum or copper conductors as required by the application.
- 26 3. Fusible switches shall be equipped with factory installed or field installed
- 27 fuse pullers.
- 28 4. Switches shall be equipped with plated copper current carrying parts to
- 29 resist corrosion.
- 30 5. Switches shall be equipped with removable arc suppressors to facilitate
- 31 access to line side lugs.
- 32 6. Switches shall have provisions for a field installable electrical interlock.

- 1 C. Switch Mechanism:
2 1. Switch operating mechanism shall be quick-make, quick-break such that,
3 during normal operation of the switch, the operation of the contacts shall
4 not be restrained by the operating handle after the closing or opening action
5 of the contacts has started.
6 2. The operating handle shall be an integral part of the box, not the cover.
7 3. The handle position shall travel at least 90 degrees between off and on
8 positions to clearly distinguish and indicate handle position.
9 4. All switches shall have a dual cover interlock mechanism to prevent
10 unintentional opening of the switch cover when the switch is on and prevent
11 turning the switch on when the cover is open. The cover interlock
12 mechanism shall have an externally operated override but the override shall
13 not permanently disable the interlock mechanism. The tool used to override
14 the cover interlock mechanism shall not be required to enter the enclosure
15 in order to override the interlock.
- 16 D. Switch Enclosures:
17 1. Environmental Rating:
18 a. Service entrance switch, exterior: Type 4X, stainless steel.
19 b. Service entrance switch, interior: Type 1.
20 c. Disconnect switch, exterior: Type 4X, stainless steel.
21 d. Disconnect switch, interior: Type 4X, stainless steel.
22 e. Disconnect switch, interior when EMT conduit is allowed: Type 1.
23 f. Disconnect switch, hazardous location: Type 7/9.
24 2. Covers:
25 a. Type 1, 4X stainless steel enclosures: attached with welded pin-type
26 hinges.
27 b. Type 7/9 enclosures: attached with Type 316 stainless steel bolts.
28 3. Finish:
29 a. Type 1 enclosures: gray baked enamel paint electrodeposited on
30 cleaned, phosphate pre-treated steel.
31 b. Type 4X stainless steel enclosures: brush finish on type 304 stainless
32 steel.
33 c. Type 7/9 enclosures: gray baked enamel on copper free cast
34 aluminum alloy.
35 4. The enclosure shall have on and off markings stamped or cast into the cover.
36 5. The operating handle shall be provided with a dual colored, red/black
37 position indication.
38 6. All switches shall have provisions to accept up to three 3/8-inch hasp
39 padlocks to lock the operating handle in the off position.
40 7. Exterior switches shall have provisions to accept one 3/8-inch hasp
41 padlocks to lock the operating handle in the on position.
42 8. Conduit Entrance:
43 a. Tangential knockouts shall be provided for Type 1 switches rated
44 30-200A.

- b. Watertight conduit hubs for Type 4X stainless steel switches.
 - c. Threaded conduit openings in both end walls for Type 7/9 enclosures.
9. Cover sealing means for switches rated through 200 amperes shall be quick release trunk latches (Type 1, 4X stainless steel enclosures) and type 316 stainless steel bolts (Type 7/9 enclosures).
 10. Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor applications.
 11. Type 4X stainless steel enclosures shall be dual rated as Type 3R to facilitate their use in outdoor applications.

- E. Switch Ratings:
1. Switch shall be suitable for use as service entrance equipment where use is indicated on the drawings.
 2. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
 3. Switches shall be rated for the voltage applied.
 4. The UL Listed short circuit current rating of the switches shall be:
 - a. 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere).
 - b. 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes).
 - c. 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

2.02 FUSES

- A. Manufacturers:
1. Bussmann
 2. or equal
- B. 250 Volt Fuses:
1. Class RK-1, one end rejection or to fit mountings specified. 0-600 ampere, 200,000 ampere interrupting rating.
 2. Low-Peak LPN-R, dual element, time delay with short circuit protection for motor, transformer, feeder and main service protection.
- C. 600 Volt Fuses:
1. Class RK-1, one-end rejection or to fit mountings specified, 0-600 ampere, 200,000 ampere interrupting rating.
 2. Low-Peak LPS-R, dual element, time delay with short circuit protection. 0-600 ampere, 200,000 ampere interrupting rating for motor, transformer, feeder and main service protection.
 3. Class L, bolt-in, 601-6,000 amperes, 200,000 ampere interrupting rating.

- 1 4. HI-CAP KRP-C, time delay for overload and short circuit protection. 601-
2 6,000 amperes, 200,000 ampere interrupting rating for motor, transformer,
3 feeder and main service protection.
- 4 5. Class CC, fast acting, single element, 0-30 amperes, 200,000 ampere
5 interrupting rating.

6 2.03 SPARE FUSES

- 7 A. Provide one complete set of spare fuses.

8 PART 3 CONSTRUCTION METHODS

9 3.01 DIVISION OF WORK (NOT USED)

10 3.02 FIELD MEASUREMENTS

- 11 A. Field verify all measurements. Do not base exact enclosed switch locations on the
12 contract drawings. Actual field conditions govern all final installed locations,
13 distances, and levels.
- 14 B. Identify conflicts with the work of other trades prior to installation of electrical
15 equipment.
- 16 C. Adjust enclosed switch installation to satisfy field requirements.

17 3.03 DELIVERY, STORAGE, AND HANDLING

- 18 A. Accept enclosed switches on site. Inspect for damage.
- 19 B. Protect enclosed switches from corrosion and entrance of debris.
- 20 C. Store enclosed switches above grade. Protect from environment with suitable
21 covering.

22 3.04 INSTALLATION

- 23 A. Install fuses where switches are indicated as fusible switches on the drawings.
- 24 B. Install wall mounted enclosure for spare fuses.
- 25 C. Install enclosed switches plumb and level.
- 26 D. Install enclosed switches such that top of enclosure is located at an elevation of 6-
27 feet above finished floor elevation.
- 28 E. Inspect for physical damage, proper alignment, anchorage, and grounding. Check
29 proper installation and tightness of connections.

1 F. Verify that bonding jumper is properly installed in service entrance rated switches.

2 G. Thoroughly clean and remove construction debris from switch interior and exterior.

3 3.05 TESTING AND START-UP SERVICES

4 A. Refer to the requirements of Section 26 08 00 - Electrical Equipment Acceptance.

5 3.06 TRAINING

6 A. Refer to the requirements of Section 26 08 00 - Electrical Equipment Acceptance.

7 END OF SECTION

SECTION 26 29 13

MOTOR CONTROLLERS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS (NONE)

1.02 APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable. The latest edition accepted by the Authority Having Jurisdiction of the referenced publications in effect at the time of the bid governs
1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
 - a. ANSI/NFPA 70 - National Electrical Code (NEC) and state amendments thereto.
 2. ASTM International (ASTM), originally known as the American Society for Testing and Materials, Specifications and Standards, current edition:
 3. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE)
 4. Insulated Cable Engineers Association (ICEA)
 5. International Society of Automation (ISA)
 6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.
 - a. ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - b. ICS 4-2000 - Industrial Control and Systems: Terminal Blocks.
 - c. ICS 5-2000 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - d. ICS 6-1993 - Industrial Control and Systems Enclosures.
 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards, current edition.
 - a. UL 508 – Standard for Industrial Control Equipment.
 - b. UL 508A – Standard for Industrial Control Panels
 8. Wisconsin Department of Safety and Professional Services (DSPS)
 9. National Electrical Contractors Association (NECA), current edition.
 - a. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
 10. International Electrical Testing Association (NETA)
 - a. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 11. Canadian Standards Association (CSA), Specifications and Standards, current edition.

- 1 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
2 Specifications and Standards, Current Edition.
3 13. International Electrotechnical Association (IEC), Specifications and
4 Standards, Current Edition.
5 a. IEC-60439 - Low Voltage Switchgear and Control Gear
6 Assemblies.
7 14. European Committee for Electrotechnical Standardization (CENELEC),
8 Current Edition.
9 a. EN 60947 - Low-Voltage Switchgear and Controlgear - Part 4-2:
10 Contactors and Motor-Starters - AC Semiconductor Motor
11 Controllers and Starters
12 15. Electrical and Electronic Manufacturers Association Canada (EEMAC),
13 Specifications and Standards, Current Edition.

14 1.03 DESCRIPTION OF WORK

- 15 A. For the purpose of obtaining a complete and integrated process instrumentation and
16 control system, the work specified herein shall be included under the scope of:
17 1. Section 26 90 00 - Process Instrumentation & Control

18 B. Furnish and install complete and operable motor controllers as indicated on the
19 drawings and as specified herein.

20 1.04 RELATED WORK ELSEWHERE

- 21 A. Article 102 – Bidding Requirements and Conditions
22 B. Article 103 – Award and Execution of the Contract
23 C. Concrete – Division 03
24 D. Metals – Division 05
25 E. Electrical - Division 26
26 F. Earthwork – Division 31
27 G. Utilities – Division 33

28 1.05 SUBMITTALS

- 29 A. Submit shop drawings.

30 B. Submit Manufacturer literature sufficient in scope to demonstrate compliance with
31 the requirements of this specification.

1 C. Submit shop drawings for the equipment specified herein in accordance with the
2 requirements specified under Section 26 24 19, which state that submittals for all
3 motor control equipment be included as part of the submittal for the complete,
4 integrated process instrumentation and control system and in accordance with the
5 requirements specified under Section 26 90 00.

6 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

7 A. Submit operation & maintenance manuals and instructions.

8 B. Submit operation and maintenance manuals for the equipment specified herein in
9 accordance with the requirements specified under Section 26 24 19, which state
10 that submittals for all motor control equipment be included as part of the submittal
11 for the complete, integrated process instrumentation and control system and in
12 accordance with the requirements specified under Section 26 90 00.

13 1.07 QUALITY ASSURANCE

14 A. All materials, equipment, and parts shall be new and unused of current manufacture.

15 B. System supplier shall be responsible for providing all necessary accessories
16 required for a complete and operable system.

17 C. Manufacturer Qualifications: All motor controllers provided under this section
18 shall be the products of a single company specializing in manufacturing products
19 specified in this section, with not less than twenty years of documented experience.

20 D. Products: Listed and classified by UL or testing firm acceptable to the authority
21 having jurisdiction as suitable for the purpose specified and indicated.

22 E. Motor Control Center manufacturer shall be certified to ISO 9001 International
23 Quality Standard and shall have third party certification verifying quality assurance
24 in design/development, production, installation, and service, in accordance with
25 ISO 9001.

26 1.08 WARRANTY

27 A. See Division 01 for additional requirements.

28 1.09 EXTRA MATERIALS

29 A. See Division 01 for additional requirements.

1 1.10 EXTRA MATERIALS (NOT USED)

2 1.11 DESIGN REQUIREMENTS (NOT USED)

3 1.12 MAINTENANCE

4 A. Before substantial completion, perform all maintenance activities required by any
5 sections of the specifications including any calibrations, final adjustments,
6 component replacements or other routine service required before placing
7 equipment or systems into service.

8 PART 2 PRODUCTS AND MATERIALS

9 2.01 MANUFACTURER

10 A. Allen-Bradley 509 Nema Starter with E300 Overload.

11 2.02 ELECTROMECHANICAL MOTOR CONTROLLERS

12 A. Overload Protection:

13 1. General:

- 14 a. E300 overload
- 15 b. Nema Overload Relay
- 16 c. Sensing Type: Voltage/Current/Ground Fault
- 17 d. Current Range: 0.5A-30A
- 18 e. Mounting: Mounts on Nema size 0-2
- 19 f. Control Voltage: 120 VAC- 4 In/ 3 Out
- 20 g. Ethernet/IP Communications Module
- 21 h. Provide shielded Ethernet cable 600V rated.

22 B. Non-Reversing Starters:

- 23 1. Magnetic starters through NEMA Size 9 shall be equipped with double-
24 break silver alloy contacts. The starter must have straight-through wiring.
25 Each starter shall have one (1) NO auxiliary contact
- 26 2. Coils shall be permanently marked with voltage, frequency and part number
- 27 3. NEMA Size 00 through 2 starters shall be suitable for the addition of at least
28 six (6) external auxiliary contacts of any arrangement normally open or
29 normally closed. Size 3 through 8 starters shall be suitable for the addition
30 of up to eight (8) external auxiliary contacts of any arrangement normally
31 open or normally closed
- 32 4. Allen Bradley 500 Series Nema Starter

33 ~~2.03—SOLID STATE REDUCED VOLTAGE MOTOR CONTROLLERS~~

34 ~~A.—Manufacturer:~~

1 ~~1. Allen Bradley SMC Flex.~~

2 ~~B. Ratings:~~

3 ~~1. The solid state reduced voltage controller shall accept an input voltage of~~
4 ~~480 VAC, three phase plus or minus 10 percent~~

5 ~~2. Environmental Ratings~~

6 ~~a. Storage ambient temperature range: -20 to 75 degrees C.~~

7 ~~b. Operating ambient temperature range: 0 to 40 degrees C.~~

8 ~~c. The relative humidity range: 5 to 95 percent non-condensing.~~

9 ~~d. Operating elevation: up to 2000 Meters.~~

10 ~~C. Design:~~

11 ~~1. The open type controller device shall be modular, consisting of a power~~
12 ~~structure and a logic component.~~

13 ~~2. Power Structure:~~

14 ~~a. The power structure shall include an SCR bypass.~~

15 ~~b. The power structure shall include a built-in overload.~~

16 ~~c. For ratings 1 Amps to 1200 Amps, the power structure shall consist~~
17 ~~of three power poles with integral heatsinks.~~

18 ~~d. Power poles are to be modular in design that each is easily~~
19 ~~replaceable.~~

20 ~~e. Back-to-back SCR pairs shall be the only power switching~~
21 ~~semiconductor means acceptable. Diode SCR (Silicon Controlled~~
22 ~~Rectifier) combinations shall not be acceptable.~~

23 ~~f. SCRs shall have the following minimum repetitive peak inverse~~
24 ~~voltage ratings.~~

25 ~~1) 1400V for units rated 200 to 480V~~

26 ~~2) 1600V for units rated 200 to 600V~~

27 ~~3. Logic Component:~~

28 ~~a. The logic component shall be a self-contained control module,~~
29 ~~compatible with the full range of power structures. The control~~
30 ~~module shall mount directly to the power structure.~~

31 ~~b. The control module shall provide digital microprocessor control and~~
32 ~~supervision of all controller operation, including pulse firing of the~~
33 ~~SCRs.~~

34 ~~c. The control module shall consist of the following.~~

35 ~~1) Self-tuning power supply accepting control power input~~
36 ~~from 100 to 240 VAC or 24V AC/DC, 50/60 Hz.~~

37 ~~2) Logic control circuitry incorporating a latch circuit for three-~~
38 ~~wire control.~~

39 ~~3) SCR firing circuitry that incorporates an RC snubber~~
40 ~~network to prevent false firing.~~

41 ~~4) Input / output circuitry~~

42 ~~5) Digital programming keypad~~

- 6) ~~Backlit LCD display~~
- 7) ~~DPI communication port.~~
- d. ~~The control module shall be easily removed from the power structure, without the need to disassemble associated printed circuit board assemblies.~~
- e. ~~The control terminals shall be easily accessible and located on the front top of the device. The terminals shall be UL-rated for 300 Volts, 10 Amps maximum and accept a maximum of two wires rated number 18 to number 14 AWG.~~

~~D. Features:~~

~~1. Starting Modes:~~

- a. ~~The controller shall provide the following starting modes as standard.~~
 - 1) ~~Soft Start with Selectable Kickstart:~~
 - a) ~~Programmable initial torque value of 0 to 90 percent of locked rotor torque~~
 - b) ~~Programmable acceleration ramp time from 0 to 30 seconds~~
 - c) ~~A selectable kickstart, or boost, shall be provided at the beginning of the voltage ramp. The kickstart shall provide a current pulse of 550 percent of the full load current. The kickstart time shall be adjustable from 0 to 2 seconds.~~
 - 2) ~~Current Limit Start:~~
 - a) ~~Provides means of limiting the maximum starting current~~
 - b) ~~Programmable for 50 to 600 percent of full load current~~
 - 3) ~~Full Voltage Start:~~
 - a) ~~Provides across the line starting.~~
 - b) ~~Ramp time shall be less than 0.25 seconds.~~
 - 4) ~~Dual Ramp Start:~~
 - a) ~~Provides two separate soft start profiles with separately adjustable ramp times and initial torque settings.~~
 - b) ~~Programmable acceleration times from 0 to 30 seconds.~~
 - c) ~~Programmable initial torque values from 0 to 90 percent of locked rotor torque.~~
 - 5) ~~Soft Stop:~~
 - a) ~~The Soft Stop option shall provide a voltage ramp down for an extended motor stopping time.~~

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- b) ~~Soft Stop shall be initiated by a dedicated Soft Stop input. A coast to rest stop shall still be possible with a separate stop input.~~
 - c) ~~Programmable voltage ramp down time from 0 to 60 seconds.~~
 - d) ~~The load shall stop when the motor voltage drops to a point where the load torque is greater than the motor torque.~~
 - 6) ~~Preset Slow Speed:~~
 - a) ~~Provides a slow speed for applications requiring a slow speed~~
 - b) ~~The Preset Slow Speed option shall provide two jog speeds in the forward direction: high (15 percent of base speed) and low (7 percent of base speed).~~
 - c) ~~The Preset Slow Speed option shall provide two jog speeds in the reverse direction: high (20 percent of base speed) and low (10 percent of base speed). Reverse operation of the motor shall be available in the jog mode without the use of a reversing contactor.~~
 - d) ~~The starting current for the slow speed operation shall be user adjustable from 0 to 450 percent of the motor's full load current rating.~~
 - e) ~~The running current for the slow speed operation shall be user adjustable from 0 to 450 percent of the motor's full load current rating.~~
 - 7) ~~Pump Control:~~
 - a) ~~The Pump Control option shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping. This shall aid in eliminating the phenomena commonly referred to as "water hammer." Methods utilizing Soft Start with Soft Stop shall not be acceptable.~~
 - b) ~~Closed loop control shall be achieved without using external sensors or feedback devices.~~
 - c) ~~Pump Stop shall be initiated by a dedicated Pump Stop input. A coast to rest stop shall still be possible with a separate stop input.~~
 - d) ~~Programmable starting time from 0 to 30 seconds.~~
 - e) ~~Programmable stopping time from 0 to 120 seconds.~~
 - 2. ~~LCD Display:~~
 - a. ~~An alphanumeric, backlit LCD display shall be provided for controller set up, diagnostics, status and monitoring. The display shall be four line, 16 characters minimum.~~

- 1 b. ~~Digital parameter adjustment shall be provided through a keypad.~~
2 Analog potentiometer adjustments are not acceptable.
- 3 ~~3. Overload Protection:~~
- 4 a. ~~Shall meet applicable standards as a motor thermal protective~~
5 device.
- 6 b. ~~Shall utilize three phase current sensing. The use of two current~~
7 transformers shall be unacceptable.
- 8 c. ~~Selectable trip classes of 10, 15, 20 and 30 shall be provided as~~
9 standard.
- 10 d. ~~Electronic thermal memory shall provide enhanced motor~~
11 protection.
- 12 ~~4. Digital I/O:~~
- 13 a. ~~A minimum of four auxiliary contacts shall be provided for~~
14 customer use.
- 15 b. ~~The contacts shall be rated for 240 Volts AC maximum.~~
- 16 c. ~~Contact configuration shall contain:~~
- 17 1) ~~Normal/Up to Speed/Bypass~~
- 18 2) ~~Fault~~
- 19 3) ~~Alarm~~
- 20 4) ~~Normal~~
- 21 ~~5. DPI Serial Communication Port:~~
- 22 a. ~~A DPI serial communication port shall be provided as standard.~~
- 23 b. ~~Provide communication protocol interface modules for connection~~
24 to DeviceNet.
- 25 ~~6. Monitoring:~~
- 26 a. ~~The controller shall provide the following monitoring functions~~
27 indicated through the LCD display.
- 28 1) ~~Three phase current~~
- 29 2) ~~Three phase voltage~~
- 30 3) ~~Power in kW~~
- 31 4) ~~Power usage in kWh~~
- 32 5) ~~Power factor~~
- 33 6) ~~Motor thermal capacity usage~~
- 34 7) ~~Elapsed time~~
- 35 ~~7. Protection and Diagnostics:~~
- 36 a. ~~The following protection shall be provided as standard with the~~
37 controller.
- 38 1) ~~Pre start line fault advising of shorted SCR or missing load~~
39 connection with phase indication
- 40 2) ~~Running line fault advising power loss, shorted SCR or~~
41 missing load connection.
- 42 3) ~~Pre start power loss with phase indication~~
- 43 4) ~~Over temperature~~
- 44 5) ~~Open Gate with phase indication~~

- b. ~~The following defeatable protection shall be provided as standard with the controller:
 - 1) ~~Underload~~
 - 2) ~~Undervoltage~~
 - 3) ~~Overload~~
 - 4) ~~Overvoltage~~
 - 5) ~~Voltage Unbalance~~
 - 6) ~~Excessive Starts Per Hour~~
 - 7) ~~Phase Reversal~~
 - 8) ~~Stall~~
 - 9) ~~Jam~~~~
- c. ~~When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.~~
- d. ~~Fault diagnostics shall be indicated in descriptive text on the LCD display. The exclusive use of fault codes is unacceptable.~~
- e. ~~An auxiliary contact that is programmable for fault indication shall be provided for customer use.~~

~~E. System Components:~~

~~1. Transient Protection Modules:~~

- a. ~~Transient protection with separately mounted protective modules.~~
- b. ~~Protective modules shall consist of metal oxide varistors (MOVs) in combination with capacitors to protect the power components from electrical transients and / or electrical noise. The capacitors shall be provided to shunt noise energy away from the controllers electronics.~~
- c. ~~The MOVs and capacitors shall be encapsulated in a clear material for easy inspection.~~
- d. ~~The protective modules shall be mounted so that they will not cause damage to the power components upon absorbing an electrical transient.~~
- e. ~~The MOVs shall be rated for a minimum of 220 joules.~~

~~2. Input Circuit Breaker:~~

- a. ~~Provide a door interlocked thermal magnetic circuit breaker disconnect~~
- b. ~~Operator Handles:
 - 1) ~~Provide flange mounted operator handles for free standing units~~
 - 2) ~~Through the door operating handles are acceptable for wall mounted units~~
 - 3) ~~Refer to requirements of Section 26 24 19 for motor control center mounted equipment.~~
 - 4) ~~Handles shall be padlockable~~~~

- 1 e. ~~The system shall be rated for the available fault current identified on~~
2 ~~the drawings. The rating shall be shown on the system label.~~
- 3 ~~3. Isolation Contactor~~
- 4 a. ~~Input contactor shall provide positive isolation of the solid state~~
5 ~~controller from line power to prevent leakage current through the~~
6 ~~SCRs.~~
- 7 b. ~~Input contactor shall close when motor is signaled to start,~~
8 ~~energizing the solid state controller and allowing reduced voltage~~
9 ~~starting.~~
- 10 c. ~~Input contactor shall open after the solid state controller has stopped~~
11 ~~the motor and de-energize the solid state controller.~~
- 12 d. ~~Input contactor shall not switch loaded motor under any~~
13 ~~circumstances.~~
- 14 ~~4. Bypass (Shorting) Contactor~~
- 15 a. ~~Bypass contactor shall close and positively short circuit the SCRs~~
16 ~~after the motor has attained full voltage running condition.~~
- 17 b. ~~Bypass contactor shall open when motor is signaled to stop,~~
18 ~~allowing the SCRs to control stopping of the motor.~~
- 19 c. ~~Bypass contactor shall not switch loaded motor under any~~
20 ~~circumstances.~~
- 21 ~~5. Control Power Transformer:~~
- 22 a. ~~Provide a control power transformer mounted and wired inside of~~
23 ~~the system enclosure.~~
- 24 b. ~~The transformer shall be rated for an additional 100 VA for customer~~
25 ~~use.~~
- 26 c. ~~The transformer shall be provided with fused primary and secondary~~
27 ~~protection.~~
- 28 ~~6. Pilot Control Devices:~~
- 29 a. ~~Provide front of panel mounted pilot devices as shown on drawings.~~
- 30 ~~7. Human Interface Module:~~
- 31 a. ~~Provide a door mounted Human Interface Module with integral~~
32 ~~display and programming keys.~~
- 33 b. ~~The display shall show operating conditions, adjustments and fault~~
34 ~~indications.~~
- 35 c. ~~The display shall be backlit LCD and shall consist of four lines of~~
36 ~~16 characters alphanumeric.~~

37 2.042.03 ENCLOSURES

- 38 A. The enclosure shall be NEMA 1 as indicated on the contract drawings.
- 39 B. Starters shall have an adjustable instantaneous motor circuit protector (HMCP) type
40 disconnect device.

1 PART 3 CONSTRUCTION METHODS

2 3.01 DIVISION OF WORK (NOT USED)

3 3.02 FIELD MEASUREMENTS

4 A. Field verify all measurements. Do not base exact motor controller locations on the
5 contract drawings. Actual field conditions govern all final installed locations,
6 distances, and levels.

7 B. Identify conflicts with the work of other trades prior to installation of electrical
8 equipment.

9 C. Identify deviation from physical sizes shown on the drawings to Engineer prior to
10 bid date.

11 D. Contractor shall be responsible for modifications to the installation due to
12 deviations from physical sizes shown on the drawings.

13 E. Identify conflicts with the work of other trades prior to installation of electrical
14 equipment.

15 F. Record nameplate data for each motor served.

16 G. Adjust motor controller installation to satisfy field requirements.

17 3.03 DELIVERY, STORAGE, AND HANDLING

18 A. Accept motor controller on site. Inspect for damage.

19 B. The Contractor shall be responsible for all equipment necessary to receive, unload,
20 move into building, and install motor control centers.

21 C. Conform to written instructions of manufacturer.

22 D. Protect motor controllers from corrosion and entrance of debris.

23 E. Store motor controllers above grade. Protect from environment with suitable
24 covering.

25 3.04 INSTALLATION

26 A. Adjust disconnecting means trip settings to satisfy motor nameplate requirements.

- 1 B. Provide overload relays sized and adjusted for the actual nameplate data recorded
2 for each motor. No additional compensation will be allowed due to failure to select
3 overload devices based upon actual motor nameplate data.
- 4 C. Record information for motor data labels and install motor data labels.
- 5 D. Install motor controllers plumb and flush with wall finishes.
- 6 E. Inspect for physical damage, proper alignment, anchorage, and grounding. Check
7 proper installation and tightness of all connections.
- 8 F. Thoroughly clean and remove construction debris from panelboard interior and
9 exterior.

10 3.05 TESTING AND START-UP SERVICES

- 11 A. Refer to the requirements of Section 26 08 00 - Electrical Equipment Acceptance
- 12 B. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

13 3.06 TRAINING

- 14 A. Refer to the requirements of Section 26 08 00 - Electrical Equipment Acceptance.
- 15 B. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

16 END OF SECTION

1 SECTION 26 32 13

2 STANDBY ENGINE/GENERATOR SET

3 PART 1 GENERAL

4 1.01 APPLICABLE PROVISIONS (NONE)

5 1.02 APPLICABLE PUBLICATIONS

6 A. The following publications of the issues listed below, but referred to thereafter by
7 basic designation only, form a part of this specification to the extent applicable.
8 The latest edition accepted by the Authority Having Jurisdiction of the referenced
9 publications in effect at the time of the bid governs.

- 10 1. American National Standards Institute/National Fire Protection Agency
11 (ANSI/NFPA), Specifications and Standards, current edition:
- 12 a. NFPA70 – National Electrical Code (NEC) and state amendments
13 thereto. Equipment shall be suitable for use in systems in
14 compliance to Article 700, 701, and 702.
 - 15 b. NFPA99 – Essential Electrical Systems for Health Care Facilities.
 - 16 c. NFPA110 – Emergency and Standby Power Systems. The
17 generator set shall meet all requirements for Level 1 systems.
18 Level 1 prototype tests required by this standard shall have been
19 performed on a complete and functional unit; component level type
20 tests will not substitute for this requirement.
- 21 2. ASTM International (ASTM), originally known as the American Society
22 for Testing and Materials, Specifications and Standards, current edition:
- 23 3. Illuminating Engineering Society (IES). Institute of Electrical and
24 Electronics Engineers (IEEE), Specifications and Standards, current
25 edition.
- 26 a. IEEE446 – Recommended Practice for Emergency and Standby
27 Power Systems for Commercial and Industrial Applications.
- 28 4. Insulated Cable Engineers Association (ICEA)
- 29 5. International Society of Automation (ISA)
- 30 6. National Electrical Manufacturers Association (NEMA), Specifications
31 and Standards, current edition.
- 32 a. NEMA ICS10-1993 – AC Generator sets.
- 33 7. Underwriters’ Laboratories, Inc. (UL), Specifications and Standards,
34 current edition.
- 35 a. UL 2200. The genset shall be listed to UL 2200 or submit to an
36 independent third party certification process to verify compliance
37 as installed.
- 38 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 39 9. National Electrical Contractors Association (NECA), current edition.
- 40 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
41 Contracting.
- 42 10. International Electrical Testing Association (NETA)

- 1 11. Canadian Standards Association (CSA), Specifications and Standards,
2 current edition.
 - 3 a. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
 - 4 b. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.
- 5 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
6 Specifications and Standards, Current Edition.
 - 7 a. International Electrotechnical Association (IEC), Specifications
8 and Standards, Current Edition. IEC8528 part 4. Control Systems
9 for Generator Sets.

10 1.03 DESCRIPTION OF WORK

- 11 A. Provide complete factory assembled generator set equipment with standard analog
12 controls.
- 13 B. Provide factory test, startup by a supplier authorized by the manufacturer, and on-
14 site testing of the system.
- 15 C. The generator set manufacturer shall warrant all equipment provided under this
16 section, whether or not is manufactured by the generator set manufacturer, so that
17 there is one source for warranty and product service. Technicians specifically
18 trained and certified by the manufacturer to support the product and employed by
19 the generator set supplier shall service the generator sets.
- 20 D. Standby Engine Generator set shall be provided with the following:
 - 21 1. Certified from the factory for Tier 3 compliance with all emission
22 guidelines. The Supplier shall include all cost related to any test and
23 certifications that are required of natural gas fueled engine-generator sets
24 for the first 5-years of service.
 - 25 2. All units shall be supplied with 5-Year Comprehensive Warranty.
 - 26 3. Unit shall utilize PMG excitation.
 - 27 4. Supplier shall confirm sizes provided herein meet or exceed actual facility
28 electrical requirements. Final size, performance, and operation shall be
29 inclusive to the Contract.
 - 30 5. Unit shall include the following factory installed accessories:
 - 31 a. AC Entrance Box
 - 32 b. Battery(s)
 - 33 c. Weather protective sound attenuated steel enclosure.
 - 34 d. Main Line Circuit Breaker
 - 35 e. Oil drain extension.
 - 36 f. Coolant drain extension.
 - 37 g. Spring Isolator and vermin guard skirts.
 - 38 6. Fuel supply system configuration and coordination. Supplier shall supply
39 required regulator, galvanized piping and hardware, flex pipe connector
40 for vibration isolation.
 - 41 7. Battery charger shall be ATS mounted.

1 1.04 RELATED WORK ELSEWHERE

- 2 A. For the purpose of obtaining a complete and integrated standby power system, the
3 following sections shall be included under the scope of this section:
 - 4 1. Section 26 05 19 – Low-voltage Conductors and Cables
 - 5 2. Section 26 09 07 – Automatic Transfer Control
 - 6 3. Section 26 09 11 – Protective Relay
 - 7 4. Section 26 36 23 - Transfer Switch.
- 8 B. The following sections include work which is related to the Standby
9 Engine/Generator Set, but which is not included under the scope of this section:
- 10 C. Article 102 – Bidding Requirements and Conditions
- 11 D. Article 103 – Award and Execution of the Contract
- 12 E. Concrete – Division 03
- 13 F. Metals – Division 05
- 14 G. Electrical - Division 26
- 15 H. Earthwork – Division 31
- 16 I. Utilities – Division 33

17 1.05 SUBMITTALS

- 18 A. Submit shop drawings.
- 19 B. General requirements specific to this section include:
 - 20 1. Submit complete and integrated document containing all equipment
21 included under the scope of this section.
 - 22 2. Submittal shall be complete, neat, orderly, and indexed with tabbed
23 dividers. Partial submittals will not be accepted.
 - 24 3. Include a complete list of proposed exceptions to and deviations from
25 these specifications.
 - 26 4. Clarity and completeness are of prime importance. Acceptability of
27 submittal drawings shall be at the sole discretion of the Engineer in
28 regards to this requirement.
 - 29 5. Additional requirements for the various subsystems are specified in the
30 corresponding sections.
- 31 C. Submit the following information:
 - 32 1. Manufacturer’s product literature and performance data, sufficient to
33 verify compliance to specification requirements.
 - 34 2. A paragraph-by-paragraph specification compliance statement, describing
35 the differences between the specified and the proposed equipment.

- 1 3. Manufacturer's certification of prototype testing.
- 2 4. Manufacturers published warranty documents signed by an officer of the
- 3 company.
- 4 5. Shop drawings showing plan and elevation views with certified overall
- 5 dimensions, as well as wiring interconnection details.
- 6 6. Interconnection wiring diagrams showing all external connections
- 7 required; with field wiring terminals marked in a consistent point-to-point
- 8 manner.
- 9 7. Manufacturer's installation instructions.
- 10 8. Control descriptions and/or logic diagrams
- 11 9. Detailed list of special tools and recommended spare parts with quantity,
- 12 pricing, and supplier.

13 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 14 A. Submit Operation/Maintenance Manuals.
- 15 B. Submit final revised shop drawings incorporating any modifications made as a
- 16 result of installation, start-up, operational testing, or for any other cause. Submit
- 17 results of all field-testing and corrective actions taken for all operational
- 18 parameters.
- 19 C. Submit manufacturer's standard operation and maintenance information including
- 20 installation manuals and safety instructions.
- 21 D. Submit contact list identifying names, addresses, telephone numbers, and any
- 22 additional contact information for each equipment service organization involved
- 23 with the Standby Engine/Generator Set.
- 24 E. Submit detailed operation and maintenance procedures for each major equipment
- 25 item; include description of operation for all modes of operation, routine
- 26 maintenance procedures, and trouble-shooting guide.
- 27 F. Submit listing spare parts provided under this contract and of recommended
- 28 additional spare parts not provided under this contract along with costs, lead time,
- 29 and supplier.

30 1.07 FACTORY TESTING

- 31 A. The generator set supplier shall perform a complete operational test on the
- 32 generator set prior to shipping from the factory. A certified test report shall be
- 33 provided. Equipment supplied shall be fully tested at the factory for function and
- 34 performance.
- 35 B. Factory testing may be witnessed by the owner and consulting engineer. Costs for
- 36 travel expenses will be the responsibility of the owner and consulting engineer.
- 37 Supplier is responsible to provide two weeks notice for testing.

- 1 C. Generator set factory tests on the equipment shall be performed at rated load and
2 rated power factor. Generator sets that have not been factory tested at rated power
3 factor will not be acceptable. Tests shall include: run at full load, maximum
4 power, voltage regulation, transient and steady-state governing, single step load
5 pickup, and function of safety shutdowns.

6 1.08 QUALITY ASSURANCE

- 7 A. The generator set manufacturer shall be certified to ISO 9001 International
8 Quality Standard and shall have third party certification verifying quality
9 assurance in design/development, production, installation, and service, in
10 accordance with ISO 9001.

- 11 B. All materials, equipment, and parts shall be new and unused of current
12 manufacture.

- 13 C. System supplier shall be responsible for providing all necessary accessories
14 required for a complete and operable system.

- 15 D. The Standby Engine/Generator Set manufacturer shall have been engaged in the
16 manufacture of generator sets for a minimum of ten years and shall have a factory
17 trained service and parts organization located within 100 miles of the jobsite.

- 18 E. All control equipment shall be the standard product of the engine/generator set
19 manufacturer. Controls systems that are supplied by a subcontractor of the
20 manufacturer and which are not incorporated into the standard documentation of
21 the manufacturer will not be acceptable.

22 1.09 WARRANTY

- 23 A. The generator set and associated equipment shall be warranted for a period of not
24 less than 5 years from the date of commissioning against defects in materials and
25 workmanship.

- 26 B. The warranty shall be comprehensive. No deductibles shall be allowed for travel
27 time, service hours, repair parts cost, etc.

- 28 C. The manufacturer of the generator set shall maintain service parts inventory at a
29 central location that is accessible to the service location 24 hours per day, 365
30 days per year.

- 31 D. The generator set shall be serviced by a local service organization that is trained
32 and factory certified in generator set service. The supplier shall maintain an
33 inventory of critical replacement parts at the local service organization, and in
34 service vehicles. The service organization shall be on call 24 hours per day, 365
35 days per year.

- 36 E. The manufacturer shall maintain model and serial number records of each

1 generator set provided for at least 20 years.

2 1.010 EXTRA MATERIALS

- 3 A. Furnish supply of consumables (air cleaner, oil filter, etc.) in sufficient quantity to
4 last for one year from the date of substantial completion.

5 1.011 DESIGN REQUIREMENTS (NOT USED)

6 1.012 MAINTENANCE

- 7 A. Before substantial completion, perform all maintenance activities required by any
8 sections of the specifications including any calibrations, final adjustments,
9 component replacements or other routine service required before placing
10 equipment or systems into service.

11 PART 2 PRODUCTS AND MATERIALS

12 2.01 MANUFACTURER

- 13 A. Acceptable Manufacturers

- 14 1. Cummins/Onan.
15 2. Kohler Power Systems.

- 16 B. These specifications, installation design, the heating/ventilation design, and the
17 fuel system design are based upon the first named manufacturer. If the contractor
18 elects to supply a different manufacturer, then the contractor shall be responsible
19 for adjusting the installation of the standby engine/generator set to satisfy the
20 requirements of that manufacturer's equipment.

- 21 C. Alternate equipment will only be considered if the following information is
22 submitted ten days prior to the bid date:

- 23 1. Certified dimensional data.
24 2. Verification of adequate cooling/combustion air for the installation.
25 3. Complete interconnecting wiring and piping diagrams.
26 4. Manufacturer's certification of prototype testing.
27 5. Load study/profile showing non-overloading of genset under steady-state
28 conditions and during motor starting.
29 6. Manufacturer's product literature and performance data, sufficient to
30 verify compliance to specification requirements.
31 7. A paragraph-by-paragraph specification compliance statement, describing
32 the differences between the specified and the proposed equipment.
33 8. Short circuit study of the load circuits to verify that selective coordination
34 occurs and that thermal-magnetic stresses on components will not exceed
35 the specified ratings.
36 9. Listing of similar projects and owner contact information for projects
37 completed during the previous five years.

1 2.02 GENERATOR SET

2 A. Ratings

- 3 1. The generator set shall operate at 1800 rpm and at a voltage of: 120/208
4 Vots AC, Three-phase, Four-wire, 60 hertz.
- 5 2. The generator set shall have a minimum rating at 40 kW, 50 kVA at 0.8
6 PF, standby rating, based on site conditions of: Altitude 1000 feet, ambient
7 temperatures up to 100 degrees F. Manufacturer shall be responsible for
8 actual application performance.
- 9 3. The generator set rating shall be based on emergency/standby service.

10 B. Performance

- 11 1. Voltage regulation shall be plus or minus 1.0 percent for any constant load
12 between no load and rated load for both parallel and non-parallel
13 applications. Random voltage variation with any steady load from no load
14 to full load shall not exceed plus or minus 0.5 percent.
- 15 2. Frequency regulation shall be isochronous from steady state no load to
16 steady state rated load. Random frequency variation with any steady load
17 from no load to full load shall not exceed plus or minus 0.25%.
- 18 3. The engine-generator set shall be capable of single step load pick up of
19 100% nameplate kW and power factor, less applicable derating factors,
20 with the engine-generator set at operating temperature.
- 21 4. Motor starting capability shall be a minimum of 607 kVA. The generator
22 set shall be capable of sustaining a minimum of 90% of rated no load
23 voltage with the specified kVA load at near zero power factor applied to
24 the generator set.
- 25 5. The alternator shall produce a clean AC voltage waveform, with not more
26 than 5% total harmonic distortion at full linear load, when measured from
27 line to neutral, and with not more than 3% in any single harmonic.
28 Telephone influence factor shall be less than 40.
- 29 6. Generator shall be capable of starting and operating two 5 HP submersible
30 sewerage pump(s) operated with SSRV and 3.3 kVA of misc. single phase
31 load without causing interruption to any facility systems: IE control
32 system, I&C Devices, access control system, etc. In addition, the
33 generator shall be sized to star and run all miscellaneous loads as
34 indentified herein.
- 35 a. Step 1: 3.3 KVA of misc. control
- 36 b. Step 2: (1) 5 HP submersible pump on RVSS
- 37 c. Step 3: (1) 5 HP submersible pump on RVSS
- 38 7. Unit shall be sized for maximum starting voltage dip and peak voltage dip
39 shall be less 10%.
- 40 8. Unit shall be sized for maximum frequency dip of 4%.

41 C. Construction

- 42 1. The engine-generator set shall be mounted on a heavy-duty steel base to
43 maintain alignment between components. The base shall incorporate a
44 corrosion resistant battery tray with hold-down clamps within the rails.

- 1 D. Engine-generator base and exterior panels along with applicable accessories shall
2 contain a factory applied finish resistant to corrosion and effects from the unit
3 operating temperature connections.
- 4 1. The generator set load connections shall be composed of silver or tin
5 plated copper bus bars, drilled to accept mechanical or compression
6 terminations for the number and type cables shown on the drawings.
7 Sufficient lug space shall be provided for use with cables of the number
8 and size as shown on the drawings.
 - 9 2. Power connections to auxiliary devices shall be made at the devices, with
10 required protection located at the power distribution panel as shown on the
11 drawings.
 - 12 3. Generator set control interfaces to other system components shall be made
13 on a common, permanently labeled terminal block assembly.

14 2.03 ENGINE AND ENGINE EQUIPMENT

- 15 A. The engine shall be natural gas fueled, radiator and fan cooled. Minimum
16 displacement shall be 6.2L, with 8-cylinders. The horsepower rating of the
17 engine at its minimum tolerance level shall be sufficient to drive the alternator
18 and all connected accessories.

- 19 B. Engine accessories and features shall include:

- 20 1. Shall be Tier 3 compliant.
- 21 2. Complete engine fuel system, including all pressure regulators, strainers,
22 and control valves. The fuel system shall be plumbed to the generator set
23 skid for ease of site connections to the generator set.
- 24 3. An electronic governor system shall provide automatic isochronous
25 frequency regulation.
- 26 4. Skid-mounted radiator and cooling system rated for full load operation in
27 104 degrees F (40 degrees C) ambient as measured at the generator air
28 inlet, based on 0.5 inches H₂O external static head. Radiator shall be sized
29 based on a core temperature that is 20 degrees F higher than the rated
30 operation temperature, or prototype tested to verify cooling performance
31 of the engine/radiator/fan operation in a controlled environment. Radiator
32 shall be provided with a duct adapter flange. The equipment manufacturer
33 shall fill the cooling system with a 50/50-ethylene glycol/water mixture.
34 Rotating parts shall be guarded against accidental contact.
- 35 5. Electric starter(s) capable of three complete cranking cycles without
36 overheating.
- 37 6. Positive displacement, mechanical, full pressure, lubrication oil pump.
- 38 7. Full flow lubrication oil filters with replaceable spin-on canister elements
39 and dipstick oil level indicator.
- 40 8. Replaceable dry element air cleaner with restriction indicator.
- 41 9. Flexible supply and return fuel lines.
- 42 10. Engine mounted battery charging alternator, 40-ampere minimum, and
43 solid-state voltage regulator.
- 44 11. Coolant heater

- 1 a. Engine mounted, thermostatically controlled, coolant heater(s) for
2 each engine. Heater voltage shall be as shown on the project
3 drawings. The coolant heater shall be UL 499 listed and labeled.
4 b. The coolant heater shall be installed on the engine with silicone
5 hose connections. Steel tubing shall be used for connections into
6 the engine coolant system wherever the length of pipe run exceeds
7 12 inches. The coolant heater installation shall be specifically
8 designed to provide proper venting of the system. The coolant
9 heaters shall be installed using quick disconnect couplers to isolate
10 the heater for replacement of the heater element. The quick
11 disconnect/automatic sealing couplers shall allow the heater
12 element to be replaced without draining the engine cooling system
13 or significant coolant loss.
14 c. The coolant heater shall be provided with a 24VDC thermostat,
15 installed at the engine thermostat housing. An AC power
16 connection box shall be provided for a single AC power
17 connection to the coolant heater system.
18 d. The coolant heater(s) shall be sized as recommended by the engine
19 manufacturer to warm the engine to a minimum of 100F (40C) in a
20 40F ambient, in compliance with NFPA 110 requirements, or the
21 temperature required for starting and load pickup requirements of
22 this specification.
- 23 12. Provide vibration isolators, spring/pad type, quantity as recommended by
24 the generator set manufacturer. Isolators shall include seismic restraints if
25 required by site location.
- 26 13. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt
27 DC, sized as recommended by the engine manufacturer, complete with
28 battery cables and connectors.

- 29 C. Battery Charger
30 1. Shall be ATS mounted and connect to skid.

31 2.04 AC GENERATOR

- 32 A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field,
33 drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct
34 drive centrifugal blower fan, and directly connected to the engine with flexible
35 drive disc. All insulation system components shall meet NEMA MG1
36 temperature limits for Class H insulation system. Actual temperature rise
37 measured by resistance method at full load shall not exceed 125 degrees
38 Centigrade.
- 39 B. The generator shall be capable of delivering rated output (kVA) at rated frequency
40 and power factor, at any voltage not more than 5 percent above or below rated
41 voltage.
- 42 C. A permanent magnet generator (PMG) shall be included to provide a reliable

1 source of excitation power for optimum motor starting and short circuit
2 performance. The PMG and controls shall be capable of sustaining and regulating
3 current supplied to a single-phase or three-phase fault at approximately 300% of
4 rated current for not more than 10 seconds.

- 5 D. The subtransient reactance of the alternator shall not exceed 12 percent, based on
6 the standby rating of the generator set.

7 2.05 ENGINE GENERATOR SET CONTROL

- 8 A. A NEMA 1/3R/4 enclosed control panel shall be mounted on the generator set
9 with vibration isolators. The control shall be vibration isolated and prototype
10 tested to verify the durability of all components under the vibration conditions
11 encountered.

- 12 B. The generator set mounted control shall include the following features and
13 functions:

- 14 1. Three-position control switch labeled RUN/OFF/AUTO. In the RUN
15 position the generator set shall automatically start, and accelerate to rated
16 speed and voltage. In the OFF position the generator set shall
17 immediately stop, bypassing all time delays. In the AUTO position the
18 generator set shall be ready to accept a signal from a remote device to start
19 and accelerate to rated speed and voltage.
- 20 2. RESET switch. The RESET switch shall be used to clear a fault and
21 allow restarting the generator set after it has shut down for any fault
22 condition.
- 23 3. PANEL LAMP switch. Depressing the panel lamp switch shall cause the
24 entire panel to be lighted with DC control power.
- 25 4. Generator Set AC Output Metering: The generator set shall be provided
26 with a metering set with the following features and functions:
 - 27 a. Analog AC Voltmeter, dual range, 90 degree scale, 2% accuracy;
28 Analog AC Ammeter, dual range, 90 degree scale, 2% accuracy;
29 Analog Frequency/RPM meter, 45-65 Hz, 1350-1950 RPM, 90
30 degree scale, +/- 0.6 Hz accuracy.
 - 31 b. Seven position phase selector switch with OFF position to allow
32 meter display of current and voltage in each generator phase.
33 When supplied with reconnectable generators, the meter panel
34 shall be reconnectable for the voltage specified.
- 35 5. Generator Set Alarm and Status Display: The generator set shall be
36 provided with alarm and status indicating lamps to indicate non-automatic
37 generator status, and existing alarm and shutdown conditions. The non-
38 automatic indicating lamp shall be red, and shall flash to indicate that the
39 generator set is not able to automatically respond to a command to start
40 from a remote location. The lamp condition shall be clearly apparent
41 under bright room lighting conditions. The generator set control shall
42 indicate the existence of the following alarm and shutdown conditions on
43 the display panel:

- 1 a. Low oil pressure (alarm).
- 2 b. Low oil pressure (shutdown).
- 3 c. Low coolant temperature (alarm).
- 4 d. High coolant temperature (alarm).
- 5 e. High coolant temperature (shutdown).
- 6 f. Overcrank (shutdown).
- 7 g. Overspeed (shutdown).
- 8 h. Low fuel (alarm).
- 9 i. In addition, provisions shall be made for indication of two
- 10 customer-specified alarm or shutdown conditions.
- 11 6. Engine Status Monitoring: The following devices shall be provided on the
- 12 generator set control:
 - 13 a. Engine oil pressure gauge.
 - 14 b. Engine coolant temperature gauge.
 - 15 c. Engine operation hour gauge.
 - 16 d. Battery voltage (DC volts).
- 17 7. Engine Control Functions. The control system provided shall include a
- 18 cycle cranking system, which shall be for 3 cranking periods of 15
- 19 seconds each, with 15 second rest period between cranking periods. Fail
- 20 to start shall be indicated by operation of the overcrank alarm indication
- 21 lamp. The control system shall also include an engine governor control,
- 22 which functions to provide steady state frequency regulation as noted
- 23 elsewhere in this specification.
- 24 8. Alternator Control Functions:
 - 25 a. The generator set shall include an automatic voltage regulation
 - 26 system that is matched and prototype tested with the governing
 - 27 system provided. It shall be immune from misoperation due to
 - 28 load-induced voltage waveform distortion and provide a pulse-
 - 29 width modulated output to the alternator exciter. The system shall
 - 30 include a torque-matching characteristic, which shall reduce output
 - 31 voltage in proportion to frequency below a threshold of [58-59]
 - 32 HZ.
 - 33 b. Voltage adjusting rheostat, locking screwdriver type, to adjust
 - 34 voltage +/- 5% from rated value.
- 35 9. Control Interfaces for Remote Monitoring. Provide the following features
- 36 in the control system:
 - 37 a. Form "C" dry common alarm contact set rated 2A @ 30VDC to
 - 38 indicate existence of any alarm or shutdown condition on the
 - 39 generator set.
 - 40 b. One set of contacts rated 2A @ 30VDC to indicate generator set is
 - 41 ready to load. The contacts shall operate when voltage and
 - 42 frequency are greater than 90% of rated condition.
 - 43 c. A fused 10 amp switched 12VDC power supply circuit shall be
 - 44 provided for customer use. DC power shall be available from this
 - 45 circuit whenever the generator set is running.
 - 46 d. A fused 20 amp 12VDC power supply circuit shall be provided for

1 customer use. DC power shall be available from this circuit at all
2 times from the engine starting/control batteries.

- 3 10. The generator set shall be provided with a mounted main line circuit
4 breaker, sized to carry the rated output current of the generator set on a
5 continuous basis as shown on the drawings. Circuit breaker shall be
6 equipped with shunt trip and shall automatically open on a genset
7 shutdown alarm.

8 C. Sequence of Operation

- 9 1. Generator set shall start on receipt of a start signal from remote
10 equipment.
11 2. The generator set control shall initiate the starting sequence for the
12 generator set.
13 3. The engine shall accelerate to rated speed and the alternator to rated
14 voltage. Excitation shall be disabled until the engine has exceeded
15 programmed idle speed, and regulated to prevent over voltage conditions
16 and oscillation as the engine accelerates and the alternator builds to rated
17 voltage.
18 4. When all start signals have been removed from the generator set, the
19 generator set control shall switch off the excitation system and shall shut
20 down.
21 5. Any start signal received after the time stop sequence has begun shall
22 immediately terminate the stopping sequence and return the generator set
23 to isochronous operation.

24 2.06 ENGINE EXHAUST SYSTEM

- 25 A. Provide exhaust silencer(s) for each engine of size and type as recommended by
26 the generator set manufacturer and approved by the engine manufacturer. The
27 mufflers shall be critical grade. Exhaust system shall be installed according to the
28 engine manufacturer's recommendations and applicable codes and standards.
- 29 B. Provide stainless steel, seamless flexible exhaust manifold connector.
- 30 C. Silencer and exhaust piping shall be insulated with rigid insulation to maintain a
31 surface temperature of not more than 150 degrees F. Provide 0.016-inch
32 aluminum jacket complete with crimped end covers, secured with stainless steel
33 sheet metal screws and rubber coated washers. Insulation system shall not
34 interfere with flexible fittings.
- 35 D. Provide exhaust thimble(s) for exhaust penetration of walls constructed of
36 combustible material. Construction shall be fireproof.

37 2.07 OUTDOOR WEATHER-PROTECTIVE SOUND ATTENUATING HOUSING

- 1 A. The generator set shall be provided with a sound-attenuated housing which allows
2 the generator set to operate at full rated load in the ambient conditions previously
3 specified. The enclosure shall reduce the sound level of the generator set while
4 operating at full rated load to a maximum of 65 dBA at 23 ft from the generator
5 set in a free field environment. Housing configuration and materials used may be
6 of any suitable design which meets application needs, except that acoustical
7 materials used shall be oil and water resistant. No foam materials shall be used
8 unless they can be demonstrated to have the same durability and life as fiberglass.

- 9 B. The enclosure shall include hinged doors for access to both sides of the engine
10 and alternator, and the control equipment. Key-locking and pad-lockable door
11 latches shall be provided for all doors. Door hinges shall be stainless steel.

- 12 C. The enclosure shall be provided with an exhaust silencer that is mounted inside of
13 the enclosure, and allows the generator set package to meet specified sound level
14 requirements. Silencer and exhaust shall include a rain cap and rain shield.

- 15 D. All sheet metal shall be primed for corrosion protection and finish painted with
16 the manufacturer's standard color. All surfaces of all metal parts shall be primed
17 and painted.

- 18 E. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts
19 shall not be acceptable. Fasteners used shall be corrosion resistant, and designed
20 to minimize marring of the painted surface when removed for normal installation
21 or service work.

22 2.08 ACCESSORIES

- 23 A. Provide supply of consumables (air cleaner, oil filter, etc) in sufficient quantity to
24 last for one year from the date of substantial completion.

- 25 B. Provide trouble shooting light inside enclosure.

26 PART 3 CONSTRUCTION METHODS

27 3.01 DIVISION OF WORK

- 28 A. The Contractor shall have overall system responsibility and shall provide all
29 materials and labor necessary provide a complete and operable system and
30 comply with all requirements of this section.

- 31 B. The engine/generator set manufacturer shall be responsible for certifying the
32 correctness of installation for all work related to the standby power system
33 regardless of who performs the installation work.

- 34 C. The contract drawings are diagrammatic in nature; it shall be the responsibility of
35 the manufacturer to supplement the contract drawings and complete the final
36 design of the standby power system and to coordinate exact requirements with the

1 installing contractors.

2 3.02 FIELD MEASUREMENTS

3 A. Field verify with exact measurements, the available mounting space for standby
4 power system equipment. Do not base electrical installation or equipment
5 locations on the contract drawings. Actual field conditions govern all final
6 installed locations, distances, and levels.

7 B. Identify conflicts prior to beginning installation of the engine generator system.

8 3.03 DELIVERY STORAGE AND HANDLING

9 A. It shall be the responsibility of the installing contractor to receive all standby
10 power system equipment at the job site. Carefully inspect all equipment for
11 damage prior to accepting from the shipping agency. Do not accept shipment if
12 damage is evident.

13 B. Exercise due diligence in storing, protecting, and moving standby power system
14 equipment. Damaged or worn equipment will not be accepted and will be
15 replaced at no additional cost to the Owner.

16 3.04 INSTALLATION

17 A. Install equipment in locations as indicated on the contract documents. Adjust
18 locations as needed to ensure operability, serviceability, and compliance with all
19 applicable codes and standards.

20 B. Installation shall be completely tested prior to start-up. This work includes
21 verification of all field wiring continuity and proper termination of wiring.

22 C. Equipment shall be installed by the contractor in accordance with final submittals
23 and contract documents. Installation shall comply with applicable state and local
24 codes as required by the authority having jurisdiction. Install equipment in
25 accordance with manufacturer's instructions and instructions included in the
26 listing or labeling of UL listed products.

27 D. Installation of equipment shall include furnishing and installing all
28 interconnecting wiring between all major equipment provided for the on-site
29 power system. The contractor shall also perform interconnecting wiring between
30 equipment sections (when required), under the supervision of the equipment
31 supplier.

32 E. Installation of equipment shall include furnishing and installing all fuel piping and
33 vent piping as required. The tank installer shall perform this work under the
34 supervision of the equipment supplier.

35 F. Equipment shall be installed on concrete housekeeping pads. Equipment shall be

1 permanently fastened to the pad in accordance with manufacturer's instructions
2 and seismic requirements of the site.

3 G. Equipment shall be initially started and operated by representatives of the
4 manufacturer.

5 H. All equipment shall be physically inspected for damage. Scratches and other
6 installation damage shall be repaired prior to final system testing. Equipment
7 shall be thoroughly cleaned to remove all dirt and construction debris prior to
8 final testing of the system.

9 3.05 TESTING AND START-UP SERVICES

10 A. Standby power system supplier shall provide installation and start-up services
11 required to place the complete system into operation.

12 B. The complete installation shall be tested for compliance with the specification
13 following completion of all site work. Representatives of the manufacturer shall
14 conduct testing, with required fuel supplied by Contractor. The Engineer shall be
15 notified in advance and shall have the option to witness the tests.

16 C. Installation acceptance tests to be conducted on-site shall include a "cold start"
17 test, a two-hour full load test, and a one step rated load pickup test in accordance
18 with NFPA 110. Provide a resistive load bank and make temporary connections
19 for full load test. Provide all required cables and make accommodations for
20 routing of cables to allow for load bank to be located outside of the building.

21 D. Perform a power failure test on the entire installed system. This test shall be
22 conducted by opening the power supply from the utility service, and observing
23 proper operation of the system for at least 2 hours. Coordinate timing and obtain
24 approval for start of test with site personnel.

25 E. Test alarm and shutdown circuits by simulating conditions. Adjust output voltage
26 and engine speed.

27 F. Record kW, Amps, Volts, Frequency, oil pressure, coolant temperature, and room
28 temperature at twenty-minute intervals during the test and report findings to
29 Engineer in writing.

30 G. Verify operation of room ventilation system including interlocks with generator
31 equipment.

32 H. Verify fuel system installation and capacity.

33 3.06 TRAINING

34 A. The equipment supplier shall provide training for the facility operating personnel
35 covering operation and maintenance of the equipment provided. The training

1 program shall be not less than 4 hours in duration and the class size shall be
2 limited to 5 persons. Training date shall be coordinated with the facility owner.

3 B. Describe the loads connected to the standby power system along with restrictions
4 for future use. Coordinate this discussion with the process instrumentation
5 control system integrator to include automatic step start control and load control.

6 END OF SECTION

1 SECTION 26 36 23

2 TRANSFER SWITCH

3 PART 1 GENERAL

4 1.01 APPLICABLE PROVISIONS

- 5 A. Applicable provisions of Part I shall govern the work of this section.
- 6 B. The Contract Documents are complementary; what is called for by one is as
7 binding as if called for by all.

8 1.02 APPLICABLE PUBLICATIONS

- 9 A. The following publications of the issues listed below, but referred to thereafter by
10 basic designation only, form a part of this specification to the extent applicable.
11 The latest edition accepted by the Authority Having Jurisdiction of the referenced
12 publications in effect at the time of the bid governs
- 13 1. American National Standards Institute/National Fire Protection Agency
14 (ANSI/NFPA), Specifications and Standards, current edition:
 - 15 a. NFPA20 – Fire Pumps. Transfer switches serving fire pumps shall
16 be specifically listed and labeled for that application.
 - 17 b. NFPA70 – National Electrical Code, (NEC) and state amendments
18 thereto. Equipment shall be suitable for use in systems in
19 compliance to Article 700, 701, and 702.
 - 20 c. NFPA99 – Essential Electrical Systems for Health Care Facilities.
 - 21 d. NFPA110 – Emergency and Standby Power Systems. The transfer
22 switch shall meet all requirements for Level 1 systems.
 - 23 2. ASTM International (ASTM), originally known as the American Society
24 for Testing and Materials, Specifications and Standards, current edition:
 - 25 3. Illuminating Engineering Society (IES). Institute of Electrical and
26 Electronics Engineers (IEEE), Specifications and Standards, current
27 edition.
 - 28 a. IEEE446 – Recommended Practice for Emergency and Standby
29 Power Systems for Commercial and Industrial Applications.
 - 30 4. Insulated Cable Engineers Association (ICEA)
 - 31 5. International Society of Automation (ISA)
 - 32 6. National Electrical Manufacturers Association (NEMA), Specifications
33 and Standards, current edition.
 - 34 a. NEMA ICS10-1993 – AC Automatic Transfer Switches.
 - 35 7. Underwriters’ Laboratories, Inc. (UL), Specifications and Standards,
36 current edition.
 - 37 a. UL 1008. The transfer switch shall be UL listed and labeled.
 - 38 8. Wisconsin Department of Safety and Professional Services (DSPS)
 - 39 9. National Electrical Contractors Association (NECA), current edition.

- 1 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
- 2 Contracting.
- 3 10. International Electrical Testing Association (NETA)
- 4 11. Canadian Standards Association (CSA), Specifications and Standards,
- 5 current edition.
- 6 a. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
- 7 b. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.
- 8 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
- 9 Specifications and Standards, Current Edition.
- 10 13. International Electrotechnical Association (IEC), Specifications and
- 11 Standards, Current Edition.
- 12 a. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity.
- 13 b. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity.
- 14 c. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity.
- 15 d. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity. Similar
- 16 waveforms are described in ANSI/IEEE 62.41-1991.
- 17 e. IEC 1000-4-6 Conducted Field Immunity.
- 18 f. IEC 1000-4-11 Voltage Dip Immunity.
- 19 14. European Committee for Electrotechnical Standardization (CENELEC),
- 20 Specifications and Standards, current edition:
- 21 a. EN55011, Class B Radiated Emissions.
- 22 b. EN55011, Class B Conducted Emissions.

23 1.03 DESCRIPTION OF WORK

- 24 A. Provide complete factory assembled power transfer equipment with field
- 25 programmable digital electronic controls designed for fully automatic operation
- 26 and including: surge voltage isolation, voltage sensors on all phases of both
- 27 sources, linear operator, permanently attached manual handles, positive
- 28 mechanical and electrical interlocking, and mechanically held contacts for both
- 29 sources.
- 30 B. Provide factory test, startup by a supplier authorized by the manufacturer, and on-
- 31 site testing of the system. Technicians specifically trained to support the product
- 32 and employed by the generator set supplier shall service the transfer switches.
- 33 C. The generator set manufacturer shall warrant transfer switches to provide a single
- 34 source of responsibility for all the products provided.
- 35 D. The automatic transfer switch specified herein shall be equipped with a time delay
- 36 in the neutral position (programmed transition). Alternative methods for transfer
- 37 control are not acceptable.
- 38 E. The ATS provide shall be manufactured and supplied by the same Manufacture of
- 39 the Engine generator set.
- 40 F. Provide ATS as NEMA1 enclosure.

1 G. The automatic transfer switch specified herein shall be equipped with a time delay
2 in the neutral position (programmed transition). Alternative methods for transfer
3 control are not acceptable.

4 H. Provide ATS as shown.

5 1.04 RELATED WORK ELSEWHERE

6 A. For the purpose of obtaining a complete and integrated standby power system, the
7 following sections shall be included under the scope of this section:

8 1. Section 26 32 13 – Standby Engine/Generator Set.

9 B. The following sections include work which is related to the Standby
10 Engine/Generator Set, but which is not included under the scope of this section:

11 C. Article 102 – Bidding Requirements and Conditions

12 D. Article 103 – Award and Execution of the Contract

13 E. Concrete – Division 03

14 F. Metals – Division 05

15 G. Electrical - Division 26

16 1.05 SUBMITTALS

17 A. Submit shop drawings as specified herein.

18 B. General requirements specific to this section include:

19 1. Submit complete and integrated document containing all equipment
20 included under the scope of this section as part of the submittal document
21 for the Standby Engine/Generator Set.

22 2. Submittal shall be complete, neat, orderly, and indexed with tabbed
23 dividers. Partial submittals will not be accepted.

24 3. Clarity and completeness are of prime importance. Acceptability of
25 submittal drawings shall be at the sole discretion of the Engineer in
26 regards to this requirement.

27 4. Additional requirements for the various subsystems are specified in the
28 corresponding sections.

29 C. Submit the following information:

30 1. Manufacturer’s product literature and performance data, sufficient to
31 verify compliance to specification requirements.

32 2. A paragraph-by-paragraph specification compliance statement, describing
33 the differences between the specified and the proposed equipment.

34 3. Manufacturers published warranty documents signed by an officer of the
35 company.

- 1 4. Shop drawings showing plan and elevation views with certified overall
- 2 dimensions, as well as wiring interconnection details.
- 3 5. Interconnection wiring diagrams showing all external connections
- 4 required; with field wiring terminals marked in a consistent point-to-point
- 5 manner.
- 6 6. Manufacturer's installation instructions.

7 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 8 A. Submit Operation/Maintenance Manuals and Instructions as specified herein.
- 9 B. Submit final revised shop drawings incorporating any modifications made as a
- 10 result of installation, start-up, operational testing, or for any other cause. Submit
- 11 results of all field-testing and corrective actions taken for all operational
- 12 parameters.
- 13 C. Submit manufacturer's standard operation & maintenance information including
- 14 installation manuals and safety instructions.
- 15 D. Submit contact list identifying names, addresses, telephone numbers, and any
- 16 additional contact information for each equipment service organization involved
- 17 with the Standby Engine/Generator Set.
- 18 E. Submit detailed operation and maintenance procedures for each major equipment
- 19 item; include description of operation for all modes of operation, routine
- 20 maintenance procedures, and trouble-shooting guide.
- 21 F. Submit listing spare parts provided under this contract and of recommended
- 22 additional spare parts not provided under this contract along with lead time and
- 23 costs.

24 1.07 FACTORY TESTING

- 25 A. The generator set supplier shall perform a complete operational test on the
- 26 automatic transfer switch prior to shipping from the factory. A certified test
- 27 report shall be provided. Equipment supplied shall be fully tested at the factory
- 28 for function and performance.
- 29 B. Factory testing may be witnessed by the owner and consulting engineer. Costs for
- 30 travel expenses will be the responsibility of the owner and consulting engineer.
- 31 Supplier is responsible to provide two weeks notice for testing.
- 32 C. Test process shall include calibration of voltage sensors.

33 1.08 QUALITY ASSURANCE

- 34 A. The Automatic Transfer Switch manufacturer shall be certified to ISO 9001
- 35 International Quality Standard and shall have third party certification verifying

1 quality assurance in design/development, production, installation, and service, in
2 accordance with ISO 9001.

3 B. All materials, equipment, and parts shall be new and unused of current
4 manufacture.

5 C. System supplier shall be responsible for providing all necessary accessories
6 required for a complete and operable system.

7 D. The Automatic Transfer Switch manufacturer shall have been engaged in the
8 manufacture of generator sets for a minimum of ten years and shall have a factory
9 trained service and parts organization located within 100 miles of the jobsite.

10 E. All control equipment shall be the standard product of the engine/generator set
11 manufacturer. Controls systems that are supplied by a subcontractor of the
12 manufacturer and which are not incorporated into the standard documentation of
13 the manufacturer will not be acceptable.

14 1.09 WARRANTY

15 A. The generator set and associated equipment shall be warranted for a period of not
16 less than five years from the date of commissioning against defects in materials
17 and workmanship.

18 B. The warranty shall be comprehensive. No deductibles shall be allowed for travel
19 time, service hours, repair parts cost, etc.

20 C. The manufacturer of the transfer switch shall maintain service parts inventory at a
21 central location that is accessible to the service location twenty-four hours per
22 day, three hundred sixty-five days per year.

23 D. The generator set shall be serviced by a local service organization that is trained
24 and factory certified in generator set service. The supplier shall maintain an
25 inventory of critical replacement parts at the local service organization, and in
26 service vehicles. The service organization shall be on call 24 hours per day, 365
27 days per year.

28 E. The manufacturer shall maintain model and serial number records of each transfer
29 switch provided for at least twenty years.

30 1.10 EXTRA MATERIALS (NOT USED)

31 1.11 DESIGN REQUIREMENTS (NOT USED)

32 1.12 MAINTENANCE

33 A. Before substantial completion, perform all maintenance activities required by any
34 sections of the specifications including any calibrations, final adjustments,

1 component replacements or other routine service required before placing
2 equipment or systems into service.

3 PART 2 PRODUCTS AND MATERIALS

4 2.01 MANUFACTURER

5 A. Acceptable Manufacturers

- 6 1. Cummins/Onan.
- 7 2. Kohler Power Systems.

8 B. The automatic transfer switch shall be provided as part of a complete, integrated 9 standby power system. As such, the manufacturer of the Standby 10 Engine/Generator Set shall provide it.

11 2.02 POWER TRANSFER SWITCH

12 A. Ratings

- 13 1. Refer to the project drawings for specifications on the sizes and types of
14 transfer switch equipment, withstand and closing ratings, number of poles,
15 voltage and ampere ratings, enclosure type, and accessories.
- 16 2. Main contacts shall be rated for 600 Volts AC, minimum.
- 17 3. Transfer switches shall be rated to carry 100 percent of rated current
18 continuously in the enclosure supplied, in ambient temperatures of -40 to
19 +60 degrees C, relative humidity up to 95 percent (non-condensing), and
20 altitudes up to 10,000 feet (3000M).
- 21 4. Transfer switch equipment shall have with stand and closing ratings
22 (WCR) in RMS symmetrical amperes greater than the available fault
23 currents shown on the drawings and at the specified voltage. The transfer
24 switch and its upstream protection shall be coordinated. The transfer
25 switch shall be third party listed and labeled for use with the specific
26 protective device(s) installed in the application.

27 B. Construction

- 28 1. Transfer switches shall be double-throw, electrically and mechanically
29 interlocked, and mechanically held in the source 1 and source 2 positions.
30 The transfer switch shall be specifically designed to transfer to the best
31 available source if it inadvertently stops in a neutral position.
- 32 2. Transfer switches rated through 1000 amperes shall be equipped with
33 permanently attached manual operating handles and quick break, quick
34 make over center contact mechanisms. Transfer switches over 1000
35 amperes shall be equipped with manual operators for service use only
36 under de energized conditions. Main switch contacts shall be
37 high-pressure silver alloy. Contact assemblies shall have arc chutes for
38 positive arc extinguishing. Arc chutes shall have insulating covers to
39 prevent inter-phase flashover.
- 40 3. Transfer switch internal wiring shall be composed of pre-manufactured

1 harnesses that are permanently marked for source and destination.
2 Harnesses shall be connected to the control system by means of locking
3 disconnect plug(s), to allow the control system to be easily disconnected
4 and serviced without disconnecting power from the transfer switch
5 mechanism.

- 6 4. Power transfer switch shall be provided with flame retardant transparent
7 covers to allow viewing of switch contact operation but prevent direct
8 contact with components that could be operating at line voltage levels.
- 9 5. Transfer switches designated as 4-pole switches on the drawings shall be
10 provided with a switched neutral pole. The neutral pole shall be of the
11 same construction and have the same ratings as the phase poles. All poles
12 shall be switched simultaneously using a common crossbar. Substitute
13 equipment using overlapping neutral contacts is not acceptable.
- 14 6. Transfer switches designated as 3-pole switches on the drawings shall be
15 provided with a neutral bus and lugs. The neutral bus shall be sized to
16 carry 100 percent of the current designated on the switch rating.

17 C. Connections

- 18 1. Field control connections shall be made on a common terminal block that
19 is clearly and permanently labeled.
- 20 2. Transfer switch shall be provided with AL/CU mechanical lugs sized to
21 accept the full output rating of the switch. Lugs shall be suitable for the
22 number and size of conductors shown on the drawings.

23 2.03 TRANSFER SWITCH CONTROL

24 A. Operator Panel. Each transfer switch shall be provided with a control panel to
25 allow the operator to view the status and control operation of the transfer switch.
26 The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or
27 better (regardless of enclosure rating) that is permanently labeled for switch and
28 control functions.

29 B. Operator panel and features and capabilities shall include:

- 30 1. High intensity LED lamps to indicate the source that the load is connected
31 to (source 1 or source 2); and which source(s) are available. Source
32 available LED indicators shall operate from the control microprocessor to
33 indicate the true condition of the sources as sensed by the control.
- 34 2. High intensity LED lamps to indicate that the transfer switch is “not in
35 auto” (due to control being disabled or due to bypass switch (when used)
36 enabled or in operation) and “Test/Exercise Active” to indicate that the
37 control system is testing or exercising the generator set.
- 38 3. “OVERRIDE” pushbutton to cause the transfer switch to bypass any
39 active time delays for start, transfer, and retransfer and immediately
40 proceed with its next logical operation.
- 41 4. “TEST” pushbutton to initiate a preprogrammed test sequence for the
42 generator set and transfer switch. The transfer switch shall be
43 programmable for test with load or test without load.

- 1 5. “RESET/LAMP TEST” pushbutton that will clear any faults present in the
2 control, or simultaneously test all lamps on the panel by lighting them.
- 3 6. The control system shall continuously log information on the number of
4 hours each source has been connected to the load, the number of times
5 transferred, and the total number of times each source has failed. This
6 information shall be available via a PC-based service tool or an operator
7 display panel.
- 8 7. Security Key Switch to allow the user to inhibit adjustments, manual
9 operation or testing of the transfer switch unless key is in place and
10 operated.
- 11 8. Vacuum fluorescent alphanumeric display panel with push-button
12 navigation switches. The display shall be clearly visible in both bright
13 (sunlight) and no light conditions. It shall be visible over an angle of at
14 least 120 degrees. The Alphanumeric display panel shall be capable of
15 providing the following functions and capabilities:
 - 16 a. Display source condition information, including AC voltage for
17 each phase of normal and emergency source, frequency of each
18 source. Voltage for all three phases shall be displayed on a single
19 screen for easy viewing of voltage balance.
 - 20 b. Display source status, to indicate source is connected or not
21 connected.
 - 22 c. Display load data, including 3-phase AC voltage, 3-phase AC
23 current, frequency, KW, KVA, and power factor. Voltage and
24 current data for all phases shall be displayed on a single screen.
 - 25 d. The display panel shall allow the operator to view and make the
26 following adjustments in the control system, after entering an
27 access code:
 - 28 1) Set nominal voltage and frequency for the transfer switch.
 - 29 2) Adjust voltage and frequency sensor operation set points.
 - 30 3) Set up time clock functions.
 - 31 4) Set up load sequence functions.
 - 32 5) Enable or disable control functions in the transfer switch,
33 including program transition.
 - 34 6) Set up exercise and load test operation conditions, as well
35 as normal system time delays for transfer time, time delay
36 start, stop, transfer, and retransfer.
 - 37 e. Display Real time Clock data, including date, and time in hours,
38 minutes, and seconds. The real time clock shall incorporate
39 provisions for automatic daylight savings time and leap year
40 adjustments. The control shall also log total operating hours for
41 the control system.
 - 42 f. Display service history for the transfer switch. Display source
43 connected hours, to indicate the total number of hours connected to
44 each source. Display number of times transferred, and total
45 number of times each source has failed.
 - 46 g. Display information for other transfer switches in the system,

1 including transfer switch name, real time load in KW on the
2 transfer switch, current source condition, and current operating
3 mode.

- 4 h. Display fault history on the transfer switch, including condition,
5 and date and time of fault. Faults to include controller checksum
6 error, low controller DC voltage, ATS fail to close on transfer,
7 ATS fail to close on retransfer, battery charger malfunction,
8 network battery voltage low, network communications error.

9 C. Internal Controls

- 10 1. The transfer switch control system shall be field-configurable for any
11 operating voltage level up to 600VAC. Provide RMS voltage sensing and
12 metering that is accurate to within +/-1 percent of nominal voltage level.
13 Frequency sensing shall be accurate to within +/-0.2 percent. Voltage
14 sensing shall be monitored based on the normal voltage at the site.
15 Systems that utilize voltage monitoring based on standard voltage
16 conditions that are not field-configurable are not acceptable.
- 17 2. Transfer switch voltage sensors shall be close differential type, providing
18 source availability information to the control system based on the
19 following functions:
- 20 a. Monitoring all phases of the normal service (source 1) for under
21 voltage conditions (adjustable for pickup in a range of 85 to 98
22 percent of the normal voltage level and dropout in a range of 75 to
23 98 percent of normal voltage level).
- 24 b. Monitoring all phases of the emergency service (source 2) for
25 under voltage conditions (adjustable for pickup in a range of 85 to
26 98 percent of the normal voltage level and dropout in a range of 75
27 to 98 percent of pickup voltage level).
- 28 c. Monitoring all phases of the normal service (source 1) and
29 emergency service (source 2) for voltage imbalance.
- 30 d. Monitoring all phases of the normal service (source 1) and
31 emergency service (source 2) for loss of a single phase.
- 32 e. Monitoring all phases of the normal service (source 1) and
33 emergency service (source 2) for phase rotation.
- 34 f. Monitoring all phases of the normal service (source 1) and
35 emergency service (source 2) for overvoltage conditions
36 (adjustable for dropout over a range of 105 to 135 percent of
37 normal voltage, and pickup at 95-99 percent of dropout voltage
38 level).
- 39 g. Monitoring all phases of the normal service (source 1) and
40 emergency service (source 2) for over or under frequency
41 conditions.
- 42 h. Monitoring the neutral current flow in the load side of the transfer
43 switch. The control shall initiate an alarm when the neutral current
44 exceeds a preset adjustable value in the range of 100-150 percent
45 of rated phase current for more than an adjustable period of 10 to
46 60 seconds.

- 1 3. All transfer switch sensing shall be configurable from a Windows 95, 98,
2 2000, or NT PC-based service tool, to allow setting of levels, and enabling
3 or disabling of features and functions. Selected functions including
4 voltage sensing levels and time delays shall be configurable using the
5 operator panel. Designs utilizing DIP switches or other electromechanical
6 devices are not acceptable. The transfer control shall incorporate a series
7 of diagnostic LED lamps.
- 8 4. The transfer switch shall be configurable to control the operation time
9 from source to source (program transition operation). The control system
10 shall be capable of enabling or disabling this feature, and adjusting the
11 time period to a specific value. A phase band monitor or similar device is
12 not an acceptable alternate for this feature.
- 13 5. The transfer switch shall incorporate adjustable time delays for generator
14 set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a
15 range from 0-120 seconds); retransfer (adjustable in a range from 0-30
16 minutes); and generator stop (cool down) (adjustable in a range of 0-30
17 minutes).
- 18 6. The transfer switch shall be configurable to accept a relay contact signal
19 and a network signal from an external device to prevent transfer to the
20 generator service.
- 21 7. The transfer switch shall provide a relay contact signal prior to transfer or
22 retransfer. The time period before and after transfer shall be adjustable in
23 a range of 0 to 50 seconds.
- 24 8. The control system shall be designed and prototype tested for operation in
25 ambient temperatures from -40C to +70C. It shall be designed and tested
26 to comply with the requirements of the noted voltage and RFI/EMI
27 standards.
- 28 9. The control shall have optically isolated logic inputs, high isolation
29 transformers for AC inputs, and relays on all outputs, to provide optimum
30 protection from line voltage surges, RFI and EMI.

31 D. Battery Charger

- 32 1. The transfer switch shall be provided with a battery charger for the
33 generator set starting batteries. The battery charger shall be a float type
34 charger rated 2 amps. The battery charger shall include an ammeter for
35 display of charging current and shall have fused AC inputs and DC
36 outputs.
- 37 2. Provide the transfer switch with a battery charger for the generator set
38 starting batteries. The battery charger shall be a float type charger rated 6
39 amps minimum. The battery charger shall include an ammeter for display
40 of charging current and shall have fused AC inputs and DC outputs. The
41 charger shall also include fault indications for high and low dc voltage,
42 and supply power failed, and dry contacts for external indication of these
43 fault conditions. Display supply power failed indication on the ATS
44 control panel.

45 E. Control Interface

- 1 1. The transfer switch will provide an isolated relay contact for starting of a
2 generator set. The relay shall be normally held open, and close to start
3 the generator set. Output contacts shall be form C, for compatibility with
4 any generator set.
- 5 2. Provide one set Form C auxiliary contacts on both sides, operated by
6 transfer switch position, rated 10 amps 250 VAC.
- 7 3. The transfer switch shall provide relay contacts to indicate the following
8 conditions: source 1 available, load connected to source 1, source 2
9 available, source 2 connected to load.

10 2.04 ENCLOSURE

- 11 A. Enclosures shall be UL listed. The enclosure shall provide wire bend space in
12 compliance to the latest version of NFPA 70. The cabinet door shall include
13 permanently mounted key type latches.
- 14 B. Transfer switch equipment shall be provided in a NEMA 4X stainless steel
15 enclosure.
- 16 C. Enclosures shall be the NEMA type specified. The cabinet shall provide code-
17 required wire bend space at point of entry as shown on the drawings. Manual
18 operating handles and all control switches (other than key-operated switches)
19 shall be accessible to authorized personnel only by opening the key-locking
20 cabinet door. Transfer switches with manual operating handles and/or non-
21 key-operated control switches located on outside of cabinet do not meet this
22 specification and are not acceptable.

23 2.05 OPERATION

- 24 A. Sequence of Operation
- 25 1. Transfer switch normally connects an energized utility power source
26 (source 1) to loads and a generator set (source 2) to the loads when normal
27 source fails. The normal position of the transfer switch is source 1
28 (connected to the utility), and no start signal is supplied to the genset.
- 29 2. Generator Set Exercise (Test) With Load Mode. The control system shall
30 be configurable to test the generator set under load. In this mode, the
31 transfer switch shall control the generator set in the following sequence:
 - 32 a. Transfer switch shall initiate the exercise sequence at a time
33 indicated in the exercise timer program, or when manually initiated
34 by the operator.
 - 35 b. The transfer switch shall issue a compatible start command to the
36 generator set and cause the generator set to start and run at idle
37 until it has reached normal operating temperature.
 - 38 c. When the generator set has reached normal operating temperature
39 or after an adjustable time period (whichever is shorter), the
40 control system shall adjust the generator set output to rated voltage
41 and frequency.

- d. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - e. The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the generator set to the normal service.
 - f. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - g. The transfer switch shall operate the generator set unloaded for a cool down period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.
3. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:
- a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - b. The transfer switch shall issue a compatible start command to the generator set and cause the generator set to start and run at idle until it has reached normal operating temperature.
 - c. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
 - d. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.
 - e. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

PART 3 CONSTRUCTION METHODS

3.01 DIVISION OF WORK

- 1 A. The Contractor shall have overall system responsibility and shall provide all
2 materials and labor necessary provide a complete and operable system and
3 comply with all requirements of this section.
- 4 B. The engine/generator set manufacturer shall be responsible for certifying the
5 correctness of installation for all work related to the standby power system
6 regardless of who performs the installation work.
- 7 C. The contract drawings are diagrammatic in nature; it shall be the responsibility of
8 the manufacturer to supplement the contract drawings and complete the final
9 design of the standby power system and to coordinate exact requirements with the
10 installing contractors.

11 3.02 FIELD MEASUREMENTS

- 12 A. Field verify with exact measurements, the available mounting space for standby
13 power system equipment. Do not base electrical installation or equipment
14 locations on the contract drawings. Actual field conditions govern all final
15 installed locations, distances, and levels.
- 16 B. Identify conflicts prior to beginning installation.

17 3.03 DELIVERY STORAGE AND HANDLING

- 18 A. It shall be the responsibility of the installing contractor to receive all standby
19 power system equipment at the job site. Carefully inspect all equipment for
20 damage prior to accepting from the shipping agency. Do not accept shipment if
21 damage is evident.
- 22 B. Exercise due diligence in storing, protecting, and moving standby power system
23 equipment. Damaged or worn equipment will not be accepted and will be
24 replaced at no additional cost to the Owner.

25 3.04 INSTALLATION

- 26 A. Install equipment in locations as indicated on the contract documents. Adjust
27 locations as needed to ensure operability, serviceability, and compliance with all
28 applicable codes and standards.
- 29 B. Installation shall be completely tested prior to start-up. This work includes
30 verification of all field wiring continuity and proper termination of wiring.
- 31 C. The contractor shall install the equipment in accordance with final submittals and
32 contract documents. Installation shall comply with applicable state and local
33 codes as required by the authority having jurisdiction. Install equipment in
34 accordance with manufacturer's instructions and instructions included in the
35 listing or labeling of UL listed products.

- 1 D. Installation of equipment shall include furnishing and installing all
2 interconnecting wiring between all major equipment provided for the on-site
3 power system. The contractor shall also perform interconnecting wiring between
4 equipment sections (when required), under the supervision of the equipment
5 supplier.
- 6 E. Equipment shall be initially started and operated by representatives of the
7 manufacturer.
- 8 F. All equipment shall be physically inspected for damage. Scratches and other
9 installation damage shall be repaired prior to final system testing. Equipment
10 shall be thoroughly cleaned to remove all dirt and construction debris prior to
11 final testing of the system.

12 3.05 TESTING AND START-UP SERVICES

- 13 A. Standby power system supplier shall provide installation and start-up services
14 required to place the complete system into operation.
- 15 B. The complete installation shall be tested for compliance with the specification
16 following completion of all site work. Representatives of the manufacturer shall
17 conduct testing, with required fuel supplied by Contractor. The Engineer shall be
18 notified in advance and shall have the option to witness the tests.
- 19 C. Installation acceptance tests to be conducted on-site shall include a "cold start"
20 test, a two-hour full load test, and a one step rated load pickup test in accordance
21 with NFPA 110.
- 22 D. Perform a power failure test on the entire installed system. This test shall be
23 conducted by opening the power supply from the utility service, and observing
24 proper operation of the system for at least 2 hours. Coordinate timing and obtain
25 approval for start of test with site personnel.
- 26 E. Test all control functions by simulating conditions.
- 27 F. Provide for one technician follow-up visit to installation site one month after
28 commissioning to consult with Owner, verify correct operation of standby system,
29 and make any required corrections, adjustments, repairs, etc.

30 3.06 TRAINING

- 31 A. The equipment supplier shall provide training for the facility operating personnel
32 covering operation and maintenance of the equipment provided as part of the
33 owner training session specified under Standby Engine Generator Set.

34 END OF SECTION
35

1 SECTION 26 43 13
2 SURGE PROTECTIVE DEVICES (SPDs)
3 LOW VOLTAGE AC SURGE PROTECTION FOR ELECTRICAL DISTRIBUTION
4 SYSTEMS

5 PART 1 GENERAL

6 1.01 APPLICABLE PROVISIONS

- 7 A. Applicable provisions of Part I shall govern the work of this section.
- 8 B. The Contract Documents are complementary; what is called for by one is as
9 binding as if called for by all.

10 1.02 APPLICABLE PUBLICATIONS

- 11 A. The following publications of the issues listed below, but referred to thereafter by
12 basic designation only, form a part of this specification to the extent applicable.
13 The latest edition accepted by the Authority Having Jurisdiction of the referenced
14 publications in effect at the time of the bid governs
- 15 1. American National Standards Institute/National Fire Protection Agency
16 (ANSI/NFPA), Specifications and Standards, current edition:
 - 17 a. ANSI/NFPA 70 - National Electrical Code (NEC) and state
18 amendments thereto.
 - 19 2. ASTM International (ASTM), originally known as the American Society
20 for Testing and Materials, Specifications and Standards, current edition:
 - 21 3. Illuminating Engineering Society (IES). Institute of Electrical and
22 Electronics Engineers (IEEE)
 - 23 4. Insulated Cable Engineers Association (ICEA)
 - 24 5. International Society of Automation (ISA)
 - 25 6. National Electrical Manufacturers Association (NEMA), Specifications
26 and Standards, current edition.
 - 27 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
28 current edition.
 - 29 8. Wisconsin Department of Safety and Professional Services (DSPS)
 - 30 9. National Electrical Contractors Association (NECA), current edition.
 - 31 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
32 Contracting.
 - 33 10. International Electrical Testing Association (NETA)
 - 34 11. Canadian Standards Association (CSA), Specifications and Standards,
35 current edition.
 - 36 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
37 Specifications and Standards, Current Edition.
 - 38 13. International Electrotechnical Association (IEC), Specifications and

Standards, Current Edition.

1.03 DESCRIPTION OF WORK

- A. For the purpose of obtaining a complete and integrated process instrumentation and control system, the work specified herein shall be included under the scope of:
 - 1. Section 26 90 00 - Process Instrumentation & Control
- B. Furnish and install complete and operable power system as indicated on the drawings and as specified herein.
- C. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers.

1.04 RELATED SECTIONS

- A. Article 102 – Bidding Requirements and Conditions
- B. Article 103 – Award and Execution of the Contract
- C. Concrete – Division 03
- D. Metals – Division 05
- E. Electrical - Division 26

1.05 SUBMITTALS

- A. Submit shop drawings as specified herein.
- B. The following information shall be submitted specifically for surge protection devices:
 - 1. Manufacturer literature sufficient in scope to demonstrate compliance with the requirements of this specification.
 - 2. Verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL’s website or on any other NRTL’s website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage,

1 phases, modes of protection, Voltage Protection Rating (VPR), and
2 Nominal Discharge Current (I_n).

- 3 3. For sidemount mounting applications (SPD mounted external to electrical
4 assembly), electrical/mechanical drawings showing unit dimensions,
5 weights, installation instruction details, and wiring configuration.

6 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 7 A. Submit operation & maintenance manuals and instructions as specified herein.

8 1.07 FACTORY TESTING (NOT USED)

9 1.08 QUALITY ASSURANCE

- 10 A. All materials, equipment, and parts shall be new and unused of current
11 manufacture.

- 12 B. The manufacturer of the assembly shall be the manufacturer of the major
13 components within the assembly.

- 14 C. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002
15 certified.

- 16 D. The manufacturer of this equipment shall have produced similar electrical
17 equipment for a minimum period of five (5) years. When requested by the
18 Engineer, an acceptable list of installations with similar equipment shall be
19 provided demonstrating compliance with this requirement.

- 20 E. The SPD shall be compliant with the Restriction of Hazardous Substances
21 (RoHS) Directive 2002/95/EC.

22 1.09 MAINTENANCE

- 23 A. Before substantial completion, perform all maintenance activities required by any
24 sections of the specifications including any calibrations, final adjustments,
25 component replacements or other routine service required before placing
26 equipment or systems into service.

27 PART 2 PRODUCTS AND MATERIALS

28 2.01 MANUFACTURERS

- 29 A. Allen Bradley 1483-DSx

- 30 B. The listing of specific manufacturers above does not imply acceptance of their
31 products that do not meet the specified ratings, features, and functions.
32 Manufacturers listed above are not relieved from meeting these specifications in

1 their entirety. Products in compliance with the specification and manufactured by
2 others not named will be considered only if pre-approved by the Engineer ten (10)
3 days prior to bid date.

4 2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

- 5 A. AC surge protection device UL 1449
- 6 B. Voltage: Match system system
- 7 C. Provide protection for all 3 phase plus the neutral
- 8 D. Provide 40KA current rating
- 9 E. Provide fused disconnect for SPD.

10 PART 3 CONSTRUCTION METHODS

11 3.01 DIVISION OF WORK

12 3.02 FIELD MEASUREMENTS

- 13 A. Field verify all measurements. Do not base exact SPD installation locations on
14 the contract drawings. Actual field conditions govern all final installed locations,
15 distances, and levels.
- 16 B. Identify conflicts with the work of other trades prior to installation of electrical
17 equipment.

18 3.03 DELIVERY, STORAGE, AND HANDLING

- 19 A. Accept SPD's on site. Inspect for damage.
- 20 B. Protect SPD's from corrosion and entrance of debris.
- 21 C. Store SPD's above grade. Protect from environment with suitable covering.

22 3.04 INSTALLATION

- 23 A. The Contractor shall install all equipment per the manufacturer's
24 recommendations and the contract drawings.

25 3.05 TESTING AND START-UP SERVICES

- 26 A. Refer to the requirements of Section 26 08 00 - Commissioning of Electrical
27 Systems

1 3.06 TRAINING

2 A. Refer to the requirements of Section 26 08 00 - Commissioning of Electrical
3 Systems

4 1. .

5 END OF SECTION

6

1 SECTION 26 90 00

2
3 PROCESS INSTRUMENTATION AND CONTROL

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

- 6 A. The Contract Documents are complementary; what is called for by one is as binding
7 as if called for by all.

8 1.02 APPLICABLE PUBLICATIONS

- 9 A. The following publications of the issues listed below, but referred to thereafter by
10 basic designation only, form a part of this specification to the extent applicable. The
11 latest edition accepted by the Authority Having Jurisdiction of the referenced
12 publications in effect at the time of the bid governs
- 13 1. American National Standards Institute/National Fire Protection Agency
14 (ANSI/NFPA), Specifications and Standards, current edition:
 - 15 a. ANSI/NFPA 70 - National Electrical Code (NEC) and state
16 amendments thereto.
 - 17 2. ASTM International (ASTM), originally known as the American Society
18 for Testing and Materials, Specifications and Standards, current edition:
 - 19 3. Illuminating Engineering Society (IES). Institute of Electrical and
20 Electronics Engineers (IEEE)
 - 21 4. Insulated Cable Engineers Association (ICEA)
 - 22 5. International Society of Automation (ISA), Specifications and Standards,
23 current edition:
 - 24 a. ANSI/ISA-5.1-1984 - Instrumentation Symbols and Identification.
 - 25 b. ANSI/ISA-5.3-1983 - Graphic Symbols for Distributed
26 Control/Shared Display Instrumentation, Logic, and Computer
27 Systems.
 - 28 c. ANSI/ISA-95.00.01-2000 - Enterprise Control System Integration,
29 Part 1: Models and Terminology.
 - 30 d. ANSI/ISA-TR99.00.01-2004, Security Technologies for
31 Manufacturing and Control Systems.
 - 32 e. ANSI/ISA-TR99.00.02-2004, Integrating Electronic Security into
33 the Manufacturing and Control Systems Environment.
 - 34 6. National Electrical Manufacturers Association (NEMA), Specifications and
35 Standards, current edition:
 - 36 a. NEMA ICS 2 - Industrial Control and Systems: Controllers,
37 Contactors, and Overload Relays, Rated Not More Than 2000 Volts
38 AC or 750 Volts DC.
 - 39 b. NEMA ICS 3 - Industrial Control and Systems: Medium Voltage
40 Controllers Rated 2001 to 7200 Volts AC.

- 1 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
 - 2 current edition.
 - 3 a. UL508 - Industrial Control Equipment.
 - 4 b. UL508A - Industrial Control Panels.
 - 5 c. UL 913 - Intrinsically Safe Specification.
 - 6 d. UL94 - Tests for Flammability of Plastic Materials for Parts in
 - 7 Devices and Appliances.
- 8 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 9 9. National Electrical Contractors Association (NECA), current edition.
 - 10 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
 - 11 Contracting.
- 12 10. International Electrical Testing Association (NETA)
 - 13 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
 - 14 Power Distribution Equipment and Systems.
- 15 11. Canadian Standards Association (CSA), Specifications and Standards,
 - 16 current edition.
 - 17 a. CSA C22.2, Industrial Control Equipment.
- 18 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
 - 19 Specifications and Standards, Current Edition.
- 20 13. International Electrotechnical Association (IEC), Specifications and
 - 21 Standards, Current Edition.
 - 22 a. IEC 60529 - Classification of Degrees of Protection Provided by
 - 23 Enclosures
 - 24 14. CE - European Community, Applicable Directives.
 - 25 1) EN50005 - for Terminal Markings.
 - 26 2) EN50081-1 - Generic Emission Standard.
 - 27 3) EN50082-1 - Generic Immunity Standard.
 - 28 4) EN61000-4-4 - Electromagnetic compatibility (EMC).
 - 29 Testing and measurement techniques.
 - 30 5) EN61000-4-5 - Electromagnetic compatibility (EMC).
 - Testing and measurement techniques. Surge immunity test.

31 1.03 DESCRIPTION OF WORK

- 32 A. For the purpose of obtaining a complete and integrated Process Instrumentation and
 - 33 Control System, the following sections shall be included under the scope of this
 - 34 section:
 - 35 1. Section 26 29 13 - Motor Controllers
 - 36 2. Section 26 90 10 - Control Panel Construction
 - 37 3. Section 26 90 11 - Control Panel Components
 - 38 4. Section 26 90 20 - Instrumentation Devices
 - 39 5. Section 26 90 30 - Programmable Logic Controllers
 - 40 6. Section 26 90 60 - Ethernet Networking Equipment

- 1 B. The work specified herein shall include the furnishing of all materials, equipment,
2 labor, and supervision necessary to fabricate, install, start-up, and test a complete
3 and operable Process Instrumentation and Control System.
- 4 C. The labor specified herein includes but is not limited to engineering, software
5 development, panel fabrication, equipment calibration and adjustment, testing,
6 training, and documentation.
- 7 D. This section identifies the overall functional requirements for the Process
8 Instrumentation and Control System.
- 9 E. This section includes coordination with the work of other sections. This work
10 includes identification of exact interface requirements with motors, control panels,
11 and field instrumentation provided under other portions of this specification. It
12 shall be the responsibility of the system integrator specified under this section to
13 execute this coordination during the shop drawing submittal phase of the work.
14 Additional costs due to inadequate coordination as required herein shall be borne
15 solely by this contractor.
- 16 F. This section includes coordination with electrical contractor to ensure that the
17 proper number of raceways and conductors are installed. It shall be the
18 responsibility of the system integrator to coordinate this work with the installing
19 electrician. Additional costs due to inadequate coordination as required herein shall
20 be borne solely by this contractor.
- 21 G. Provide complete design and installation of a complete and operable pump station
22 as shown and described. System shall utilize a duplex pump station to control the
23 wetwell level via hardwired float control. Status of the station shall be monitored
24 via radio telemetry back at the master SCADA system.

25 1.04 RELATED WORK ELSEWHERE

- 26 A. Article 102 – Bidding Requirements and Conditions
- 27 B. Article 103 – Award and Execution of the Contract
- 28 C. Concrete – Division 03
- 29 D. Metals – Division 05
- 30 E. Electrical - Division 26

31 1.05 SUBMITTALS

- 32 A. Submit shop drawings as specified herein.

- 1 B. Submit the following information specifically relating to process instrumentation
2 and control:
3 1. General requirements specific to this section include:
4 a. Submit complete and integrated document containing all equipment
5 included under the scope of this section.
6 b. Submittal shall be complete, neat, orderly, and indexed with tabbed
7 dividers. Partial submittals will not be accepted.
8 c. Include a complete list of proposed exceptions to and deviations
9 from these specifications.
10 d. Clarity and completeness are of prime importance. Acceptability of
11 submittal drawings shall be at the sole discretion of the Engineer in
12 regards to this requirement.
13 e. Additional requirements for the various subsystems are specified in
14 the corresponding sections.
15 2. Submit the following information:
16 a. Bill of Materials:
17 1) Complete listing of all components identifying exact make
18 and model, quantity, and description.
19 b. Component Data Sheets:
20 1) Detailed listing for each type of device, identifying
21 Engineer's tag number, manufacturer, model, options,
22 ranges, and other information necessary to supplement
23 component catalog cut sheets and clearly show compliance
24 with these specifications.
25 c. Component Catalog Cut sheets:
26 1) Manufacturer's standard catalog information.
27 d. Control Panel Construction Drawings:
28 1) Scaled drawings of all control panels and enclosures.
29 2) Front panel elevation complete with nameplate legend.
30 3) Back panel elevation complete with schedule of devices.
31 e. Control Panel Schematic Wiring Diagrams:
32 1) Ladder type schematic diagrams.
33 2) Show all devices requiring electrical connections.
34 3) Identify all wire and terminal numbers.
35 4) Identify PLC I/O addresses.
36 5) Reference Engineer's tag number where assigned.
37 6) Cross-reference all relay contacts and coils.
38 7) Identify switching action on all switching devices.
39 8) Common diagrams will not be accepted.
40 f. Analog Loop Diagrams:
41 1) Show all devices requiring electrical connections.
42 2) Identify all wire and terminal numbers.
43 3) Identify PLC I/O addresses.
44 4) Identify location of loop power supply.

- 1 5) Identify field devices, back-of-panel devices, and front-of
- 2 panel devices.
- 3 6) Show tabular summary of transmitter output capability,
- 4 input impedance of each receiver, total loop impedance, and
- 5 reserve output capacity.
- 6 7) Reference Engineer's tag number where assigned.
- 7 8) Common diagrams will not be accepted.
- 8 g. Control Panel Plumbing Diagrams:
- 9 1) Show all devices requiring plumbing connections (air or
- 10 liquid).
- 11 2) Show pipe/tube sizing.
- 12 3) Show all control devices (valves, regulators, filters, etc.).
- 13 h. Control Panel Power and Environmental Requirements:
- 14 1) Identify voltage and ampacity requirements.
- 15 2) Show sizing calculations for environmental controls
- 16 (ventilation, heat, air conditioning).
- 17 i. Interconnecting Wiring Diagrams:
- 18 1) Show all interconnections between control panels.
- 19 2) Show all interconnections between control panels and motor
- 20 control centers.
- 21 3) Show all interconnections between control panels and field
- 22 devices.
- 23 4) Show all interconnections between motor control centers
- 24 and field devices.
- 25 5) Identify all wire and terminal numbers, including field
- 26 terminal junction box terminals.
- 27 j. Control Device Installation Details:
- 28 1) Supplement contract documents with additional details
- 29 necessary for proper installation of control devices.
- 30 k. Configuration Documentation:
- 31 1) Submit complete, documented configuration data for all
- 32 configurable controllers.
- 33 2) Additional requirements for PLC systems and PC based
- 34 SCADA systems are identified in the individual subsystem
- 35 sections.

36 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

- 37 A. Submit operation & maintenance manuals and instructions as specified herein.
- 38 B. Submit the following information specifically for hardware alarm notification
- 39 system:
- 40 1. Submit final revised shop drawings incorporating any modifications made
- 41 as a result of factory test, installation, start-up, operational testing, or for
- 42 any other cause. Submit results of all field-testing and corrective actions

- 1 taken for all discrete control devices and for all analog control devices.
2 Submit analog device calibration data sheets.
- 3 2. Submit manufacturers standard operation & maintenance information
4 including installation manuals and safety instructions.
 - 5 3. Submit contact list identifying names, addresses, telephone numbers, and
6 any additional contact information for each equipment service organization
7 involved with the Process Instrumentation and Control System.
 - 8 4. Submit detailed operation and maintenance procedures for each major
9 equipment item; include description of operation for all modes of operation,
10 routine maintenance procedures, and trouble-shooting guide.
 - 11 5. Submit listing spare parts provided under this contract and of recommended
12 additional spare parts not provided under this contract along with costs.

13 1.07 FACTORY TESTING

- 14 A. The entire Process Instrumentation and Control System shall be assembled at the
15 manufacturer's facility and tested to the greatest extent possible. This test shall
16 include simulation of all I/O points, simulation of system alarms, and
17 demonstration of proper system operation. Document the results of this test in
18 writing and submit to the Engineer.
- 19 B. The Engineer and Owner may witness the factory acceptance test. Schedule test
20 date a minimum of two weeks in advance to allow attendance by the Engineer and
21 the Owner.
- 22 C. Correct any deficiencies identified during the test prior to shipping the control
23 system to the job site.

24 1.08 QUALITY ASSURANCE

- 25 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 26 B. System supplier shall be responsible for providing all necessary accessories
27 required for a complete and operable system.
- 28 C. Manufacturer Qualifications: Company specializing in manufacturing products
29 specified in this section, with not less than three years of documented experience.
- 30 D. Products: Listed and classified by UL or testing firm acceptable to the authority
31 having jurisdiction as suitable for the purpose specified and indicated.

32 1.09 WARRANTY

- 33 A. See Division 01 for additional requirements.

1 1.10 EXTRA MATERIALS (NOT USED)

2 1.11 DESIGN REQUIREMENTS (NOT USED)

3 1.12 MAINTENANCE

4 A. Before substantial completion, perform all maintenance activities required by any
5 sections of the specifications including any calibrations, final adjustments,
6 component replacements or other routine service required before placing
7 equipment or systems into service.

8 B. Furnish all spare parts as required by other sections of the specifications.

9 PART 2 PRODUCTS AND MATERIALS

10 2.01 SYSTEM INTEGRATOR

11 A. The system integrator shall be a firm specializing in the integration of control
12 systems with documented experience in the detailed design, construction,
13 configuration, and maintenance of PLC based control systems and motor control
14 centers for the water/wastewater utility market. This experience must include a
15 minimum of five projects similar in nature to this project during the last five years.

16 B. Acceptable system integrators include
17 1. Altronex Control Systems, a division of LW Allen, Madison, WI
18 2. Or Equal

19 2.02 GENERAL FUNCTIONAL DESCRIPTION

20 A. Summary of System Improvements:
21 1. New PLC based control systems shall be provided for the James St Pump
22 Station:
23 a. New pump station control panel shall consist of an Allen-Bradley
24 CompactLogix Ethernet processor, associated chassis, power supply
25 and scheduled I/O modules, Ethernet switch, UPS as shown and
26 indicated on the contract drawings.
27 b. Backup permanent generator provided in event of utility failure.

28 B. General Requirements:
29 1. The process instrumentation and control system consists of the following
30 functional divisions which will be defined in detail for each loop under
31 Detailed Functional Description:
32 a. Local Control Functions: includes local control panels, pilot control
33 devices, instruments, and sensors.

- 1 b. Motor Control Center Functions: includes hardwired MCCs,
- 2 DeviceNet networked MCCs, and pilot control devices located
- 3 within these MCCs.
- 4 c. SCADA System Control Functions: includes PLC hardware,
- 5 interface devices, and PLC logic.
- 6 d. SCADA System Monitoring Functions: includes graphical user
- 7 interface hardware and configuration, event monitoring and logging
- 8 functions, analog parameter trending, and alarm handling.
- 9 e. SCADA System Historical Data Functions: includes historical
- 10 database, report configuration, and interface with the existing
- 11 maintenance management software system.
- 12 2. The process instrumentation and control system includes existing PLCs,
- 13 SCADA system servers and workstations, and network infrastructure. It
- 14 shall be the responsibility of the system integrator to coordinate all efforts
- 15 specified herein with these existing systems so as to minimize impact on
- 16 facility operations.
- 17 3. PLC Programming
- 18 a. All PLC programming will be provided by Madison Metropolitan
- 19 Sewerage District, MMSD.
- 20 4. SCADA/HMI Graphical Interface
- 21 a. All SCADA/HMI functions will be programmed and provided by
- 22 MMSD.
- 23 5. Historical Data
- 24 a. All historical data will be developed and recorded by MMSD.

25 2.03 UNIT PROCESS NO. 1: JAMES STREET PUMP STATION

- 26 A. LOOP 1: INFLUENT PUMPING
- 27 1. General:
- 28 a. Provide (5) wetwell floats for level control in the wetwell.
- 29 b. Control of the pumps will be through the PLC using the floats.
- 30 c. Backup control will be activated by ~~the high level float and bypass~~
- 31 ~~the PLC~~ loss of PLC activity and shall run the pumps in a fixed mode
- 32 of operation via hard-wired controls.
- 33 d. Refer to P&ID.
- 34 2. Local Control Functions:
- 35 a. “Pump No. X Service Out/In” Selector switch.
- 36 1) With the switch in the “Out of Service” position, the pump
- 37 is not available to run.
- 38 2) With the switch in the “In Service” position, the pump is
- 39 available to run.
- 40 b. ~~“Station Pump No. X Hand-Off-Auto”~~ selector switch
- 41 ~~1) In “Hand”, the pumps will be called via start/stop~~
- 42 ~~pushbuttons, to run~~ as long as the pump is ~~available.~~

1 ~~2)1) “Local” pilot light provides operator indication the system is~~
2 ~~in local control service.~~

3 2) In “Off”, the pumps are inoperable.

4 3) In “Auto”, the PLC will control the pumps in response to the
5 floats, as long as the pump is in available service.

6 ~~a) —“Computer” pilot light provides operator indication~~
7 ~~the system is in local control.~~

8 ~~b)a) Pump alternation selector switch, “Alternation 1-~~
9 ~~2/AUTO/2-1” is provided indication of pump~~
10 ~~alternation to alternate the pumps between service~~
11 ~~events.~~

12 ~~e)b) In the event of a “High Level Alarm”, PLC failure,~~
13 ~~the high level float pump control will~~
14 ~~activate automatically switch to hard wired logic in~~
15 ~~the control panel. Pump No.1 via hardwire will run~~
16 ~~as the lead pump and start with the “Lead Pump~~
17 ~~Start” float and pump down to the “Pumps Off” float.~~
18 ~~Pump No.2 shall operate as the lag pump and start~~
19 ~~with the “Lag Pump Start” float and pump the station~~
20 ~~down to the “Pumps Off” float. The “Pumps Off”~~
21 ~~float will reset the hardwire backup control shall~~
22 ~~switch back to normal control once the PLC has re-~~
23 ~~enabled.~~

24 c. A push-pull normally closed “Emergency Stop” pushbutton, when
25 push in, opening the circuit shall lock out the pumps until the
26 pushbutton is pulled out.

27 d. “Running” pilot light shall be provided to indicate the pump is
28 running.

29 e. “Stopped” pilot light shall be provided to indicate the pump is not
30 running.

31 f. “Failed” pilot light shall be provided to indicate the pump has failed.

32 g. “High Level Alarm” pilot light shall be provided to indicate the
33 wetwell has a high level.

34 h. “Low Level Alarm” pilot light shall be provided to indicate the
35 wetwell has a high level.

36 ~~i. —“Backup Control” pilot light shall be provided to indicate the~~
37 ~~wetwell is in backup control.~~

38 3. With the switch in the “In Service” position, the pump is available to run

39 3.4. Pump Control Panel Functions:

40 a. The motor high temperature relay shall be located in the pump
41 control panel. Provide “Motor High Temperature” pilot light in the
42 event of a high motor temperature. Lock the pump out of operation
43 in the event of a high motor temperature, requiring the “Alarm
44 Reset” pushbutton to unlatch to lockout circuit.

- 1 b. The seal fail relay shall be located in the pump control panel.
2 Provide “Seal Fail” pilot light. Do not lock the pump out in the event
3 of a seal fail.

4 4.5. SCADA System Control Functions:

- 5 a. N/A

6 5.6. SCADA System Monitoring Functions:

- 7 a. Station In Auto
8 b. E-Stop
9 c. Pump Alternation 1-2
10 d. Pump No.x In Service
11 e. Pump No.x Running
12 f. Pump No.x Failed
13 g. Pump No.x Motor High Temperature
14 h. Pump No.x Seal Fail
15 i. Pump No.x KW
16 j. Pump No.x Amps
17 k. Pump No.x Start Pushbutton
18 l. Pump No.x Stop Pushbutton
19 m. Alarm Reset
20 n. Wetwell High Level Float
21 o. Wetwell Lag Start Float
22 p. Wetwell Lead Start Float
23 q. Wetwell Pumps Off Float
24 r. Wetwell Low Level Float
25 s. Wetwell In Backup Control

26 6.7. SCADA System Alarm Functions:

- 27 a. Incorporate the following alarm conditions into the alarm log and
28 into the alarm notification system:
29 1) Station In Auto
30 2) E-Stop
31 3) Pump No.x In Service
32 4) Pump No.x Failed
33 5) Pump No.x Motor High Temperature
34 6) Pump No.x Seal Fail
35 7) Wetwell High Level Float
36 8) Wetwell Low Level Float
37 9) Wetwell In Backup Control

38 7.8. SCADA System Historical Data Functions

- 39 a. Display, trend, and record the following parameters:
40 1) Pump No.x Running
41 2) Pump No.x Failed
42 3) Pump No.x Motor High Temperature
43 4) Pump No.x Seal Fail
44 5) Pump No.x KW

- 1 6) Pump No.x Amps
- 2 7) Wetwell High Level
- 3 8) Wetwell Low Level
- 4 9) Wetwell In Backup Control

5 B. LOOP 2: STANDBY GENERATOR

- 6 1. General:
 - 7 a. A permanent generator will be provided for station power in the
 - 8 event of the utility power outage.
 - 9 b. Refer to P&ID.
- 10 2. Local Control Functions:
 - 11 a. ATS to monitor primary power source. If the primary source is lost,
 - 12 the generator shall be started and the ATS shall switch power to the
 - 13 generator.
 - 14 b. ATS to perform weekly exercise of generator
 - 15 c. Provide indicator light for Generator Failed/Not in Auto.
 - 16 d. Provide blue indicator light for “ATS Emergency Source
 - 17 Connected”.
- 18 3. Motor Control Center Functions:
 - 19 a. N/A
- 20 4. SCADA System Control Functions:
 - 21 a. SCADA system shall be set up to perform generator exercise if
 - 22 needed.
- 23 5. SCADA System Monitoring Functions:
 - 24 a. Generator Running
 - 25 b. Generator Failed
 - 26 c. Generator Not In Auto
 - 27 d. ATS in Normal Position
 - 28 e. ATS Normal Source Available
 - 29 f. ATS in Emergency Position
 - 30 g. ATS Emergency Source Available
 - 31 h. ATS Not In Auto
 - 32 i. ATS Failed to Transfer
 - 33 j. ATS Initiate Test
- 34 6. SCADA System Alarm Functions:
 - 35 a. Incorporate the following alarm conditions into the alarm log and
 - 36 into the alarm notification system:
 - 37 b. Generator Running
 - 38 c. Generator Failed
 - 39 d. ATS Not In Auto
 - 40 e. ATS Failed to Transfer
- 41 7. SCADA System Historical Data Functions
 - 42 a. Display, trend, and record the following parameters:
 - 43 b. Generator Running

- 1 c. Generator Failed
- 2 d. Generator Not In Auto
- 3 e. Generator number of starts
- 4 f. Generator ETM
- 5 g. ATS in Normal Position
- 6 h. ATS Normal Source Available
- 7 i. ATS in Emergency Position
- 8 j. ATS Emergency Source Available
- 9 k. ATS Not In Auto
- 10 l. ATS Failed to Transfer
- 11 m. ATS Initiate Test

12 C. LOOP 3: PANEL INTRUSION

- 13 1. General:
- 14 a. A door limit switch will be provided on the main control panel door
- 15 to monitor if the door is open. The switch will provide an input to
- 16 the PLC for notification and to turn the panel lights on.
- 17 b. Refer to P&ID.
- 18 2. Local Control Functions:
- 19 a. Door switch activates light
- 20 3. Motor Control Center Functions:
- 21 a. N/A
- 22 4. SCADA System Control Functions:
- 23 a. Notification there is a panel entry
- 24 5. SCADA System Monitoring Functions:
- 25 a. Panel Entry
- 26 6. SCADA System Alarm Functions:
- 27 a. Incorporate the following alarm conditions into the alarm log and
- 28 into the alarm notification system:
- 29 1) Panel Entry
- 30 7. SCADA System Historical Data Functions
- 31 a. Display, trend, and record the following parameters:
- 32 1) Panel Entry

33 D. LOOP 4: THREE PHASE POWER FAIL

- 34 1. General:
- 35 a. Provide voltage monitor to provide failed contact in an event the 3
- 36 phase power is inadequate.
- 37 b. Refer to P&ID.
- 38 2. Local Control Functions:
- 39 a. Provide a pilot light indicating a Station 3 phase power failure.
- 40 3. Motor Control Center Functions:
- 41 a. N/A
- 42 4. SCADA System Control Functions:
- 43 a. N/A

- 1 5. SCADA System Monitoring Functions:
- 2 a. Monitor the voltage relay.
- 3 6. SCADA System Alarm Functions:
- 4 a. Incorporate the following alarm conditions into the alarm log and
- 5 into the alarm notification system:
- 6 1) Station 3 Phase Power Failure
- 7 7. SCADA System Historical Data Functions
- 8 a. Display, trend, and record the following parameters:
- 9 1) Station 3 Phase Power Failure
- 10

11 E. LOOP 5: CONTROL POWER MONITORING

- 12 1. General:
- 13 a. Provide a control power relay for indication to SCADA that control
- 14 power is available.
- 15 b. Primary power to the controls shall be provided by the UPS. Provide
- 16 a relay on the UPS output. If the UPS power fails, the power shall
- 17 be switched to regular control power.
- 18 2. Local Control Functions:
- 19 ~~a. None.~~
- 20 a. Provide pilot light for "UPS Failure".
- 21 3. Motor Control Center Functions:
- 22 a. N/A
- 23 4. SCADA System Control Functions
- 24 a. N/A
- 25 5. SCADA System Monitoring Functions
- 26 a. Control Power Available
- 27 b. UPS Low Battery
- 28 c. UPS Power Available
- 29 d. UPS Service Required
- 30 6. SCADA System Alarming
- 31 a. Control Power Failure
- 32 b. UPS Service Required
- 33 c. UPS Low Battery
- 34 7. SCADA System Historical Data Functions
- 35 a. Control Power Available
- 36 b. UPS Low Battery
- 37 c. UPS Power Available
- 38 d. UPS Service Required

39 F. LOOP 6: RADIO COMMUNICATIONS

- 40 1. General:
- 41 a. The Master PLC will pole the pump station PLC in the site rotations.
- 42 If communications cannot be made, a communications failure will
- 43 be generated at the master SCADA.

- 1 2. Local Control Functions:
- 2 a. None.
- 3 3. Motor Control Center Functions:
- 4 a. N/A
- 5 4. SCADA System Control Functions
- 6 a. Maintain this site in the radio communications
- 7 5. SCADA System Monitoring Functions
- 8 a. Communications
- 9 6. SCADA System Alarming
- 10 a. Communications Failure
- 11 7. SCADA System Historical Data Functions
- 12 a. Communications Failure

13 G. LOOP 7: YARD LIGHT (FUTURE)

- 14 1. General:
- 15 a. Yard light is left as future, mainly to get a conduit stubbed out for
- 16 future use.
- 17 2. Local Control Functions:
- 18 a. None.
- 19 3. Motor Control Center Functions:
- 20 a. N/A
- 21 4. SCADA System Control Functions
- 22 a. N/A
- 23 5. SCADA System Monitoring Functions
- 24 a. N/A
- 25 6. SCADA System Alarming
- 26 a. N/A
- 27 7. SCADA System Historical Data Functions
- 28 a. N/A

29 PART 3 CONSTRUCTION METHODS

30 3.01 DIVISION OF WORK (NOT USED)

31 3.02 FIELD MEASUREMENTS

- 32 A. Field verify with exact measurements, the available mounting space for control
- 33 system equipment. Actual field conditions govern all final installed locations,
- 34 distances, and levels.
- 35 B. Identify conflicts prior to beginning installation.
- 36 C. Where ranges are indicated on the contract documents, they are to be considered
- 37 preliminary. Field verify the exact ranges required based on field conditions.

1 3.03 DELIVERY STORAGE AND HANDLING

- 2 A. It shall be the responsibility of the installing contractor to receive all process
3 instrumentation and control equipment at the job site. Carefully inspect all
4 equipment for damage prior to accepting from the shipping agency. Do not accept
5 shipment if damage is evident.
- 6 B. Exercise due diligence in storing, protecting, and moving process instrumentation
7 and control equipment. Damaged or worn equipment will not be accepted and will
8 be replaced at no additional cost to the Owner.

9 3.04 INSTALLATION

- 10 A. Install equipment in locations as indicated on the contract documents. Adjust
11 locations as needed to ensure operability, serviceability, and compliance with all
12 applicable codes and standards.
- 13 B. Installation shall be completely tested prior to start-up. This work includes
14 verification of all field wiring continuity and proper termination of wiring.

15 3.05 TESTING AND START-UP SERVICES

- 16 A. System Integrator shall provide installation and start-up services required to place
17 the complete system into operation.
- 18 B. Each signal and function shall be fully tested. These tests shall be based on actual
19 operation of primary elements and verification of proper control system response.
20 Submit test results as part of Operations and Maintenance Manual.
- 21 C. Record calibrations of all analog devices.
- 22 D. Demonstrate proper operation of the process and instrumentation control system to
23 the Owner and in the presence of the Engineer.

24 3.06 TRAINING

- 25 A. Training shall be suitable for plant operations personnel with limited knowledge of
26 electrical components.
- 27 B. Provide two instructor days of operator training at the job site. Training shall
28 consist of operations instruction and maintenance/trouble-shooting instruction.
 - 29 1. Operations instruction shall identify all control loops with description of all
30 interlocks, interface with other loops, and operational input requirements.
31 Describe procedures for re-starting the system.
 - 32 2. Maintenance instruction shall identify periodic maintenance that can be
33 performed by the operator. Provide description of procedures and locations

1 for replacement of consumable devices such as fuses and for checking the
2 calibration or operation of devices.
3 3. Trouble-shooting instruction shall identify simple procedures and methods
4 for identifying potential causes in the event of failures. For example,
5 instruct operator on correlation of input signals and PLC I/O module
6 indicator lights.

7 **END OF SECTION**

1 SECTION 26 90 10

2
3 CONTROL PANEL CONSTRUCTION

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

- 6 A. Applicable provisions of Part I shall govern the work of this section.
- 7 B. The Contract Documents are complementary; what is called for by one is as binding
8 as if called for by all.

9 1.02 APPLICABLE PUBLICATIONS

- 10 A. The following publications of the issues listed below, but referred to thereafter by
11 basic designation only, form a part of this specification to the extent applicable. The
12 latest edition accepted by the Authority Having Jurisdiction of the referenced
13 publications in effect at the time of the bid governs
- 14 1. American National Standards Institute/National Fire Protection Agency
15 (ANSI/NFPA), Specifications and Standards:
 - 16 a. ANSI/NFPA 70 - National Electrical Code (NEC) and state
17 amendments thereto.
 - 18 b. ANSI/NFPA 79 - Electrical Standard for Industrial Machinery.
 - 19 2. ASTM International (ASTM), originally known as the American Society
20 for Testing and Materials, Specifications and Standards, current edition:
 - 21 3. Illuminating Engineering Society (IES). Institute of Electrical and
22 Electronics Engineers (IEEE)
 - 23 4. Insulated Cable Engineers Association (ICEA)
 - 24 5. American National Standards Institute/Instrument Society of America
25 (ANSI/ISA), Specifications and Standards, current edition.
 - 26 6. National Electrical Manufacturers Association (NEMA), Specifications and
27 Standards, current edition.
 - 28 a. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts
29 Maximum)
 - 30 b. NEMA ICS6 - Enclosures for Industrial Controls and Systems
 - 31 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
32 current edition.
 - 33 a. UL50 - Cabinets and Boxes
 - 34 b. UL508 - Industrial Control Equipment
 - 35 c. UL508A - Industrial Control Panels
 - 36 d. UL94 - Flammability of Plastic Materials
 - 37 8. Wisconsin Department of Safety and Professional Services (DSPS)
 - 38 9. National Electrical Contractors Association (NECA), current edition.
 - 39 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
40 Contracting.
 - 41 10. International Electrical Testing Association (NETA)

- 1 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
- 2 Power Distribution Equipment and Systems.
- 3 11. Canadian Standards Associates (CSA), Specifications and Standards,
- 4 Current Edition.
- 5 a. CSA Standard C22.2 No. 0 - General Requirements - Canadian
- 6 Electrical Code, Part II
- 7 b. CSA Standard C22.2 No. 0.4 - Bonding and Grounding of Electrical
- 8 Equipment (Protective Equipment)
- 9 c. CSA Standard C22.2 No. 14 - Industrial Control Equipment for Use
- 10 in Ordinary (Non-Hazardous) Locations
- 11 d. CSA Standard C22.2 No. 40 - Cutout, Junction, and Pull boxes
- 12 e. CSA Standard C22.2 No. 94 - Special Purpose Enclosures
- 13 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
- 14 Specifications and Standards, Current Edition.
- 15 13. International Electrotechnical Association (IEC), Specifications and
- 16 Standards, Current Edition.
- 17 a. IEC 60529 - Classification of Degrees of Protection Provided by
- 18 Enclosures
- 19 b. IEC 60204 - Safety of Machinery - Electrical Equipment of
- 20 Machines
- 21 c. IEC 60079 - Electrical Apparatus for Explosive Gas Atmospheres

22 1.03 DESCRIPTION OF WORK

- 23 A. For the purpose of obtaining a complete and integrated process instrumentation and
- 24 control system, the work specified herein shall be included under the scope of:
- 25 1. Section 26 90 00 - Process Instrumentation & Control

26 1.04 RELATED WORK ELSEWHERE

- 27 A. Article 102 – Bidding Requirements and Conditions
- 28 B. Article 103 – Award and Execution of the Contract
- 29 C. Concrete – Division 03
- 30 D. Metals – Division 05
- 31 E. Electrical - Division 26

32 1.05 SUBMITTALS

- 33 A. Submit shop drawings as specified herein.
- 34 B. Submit shop drawings for the equipment specified herein as part of the complete,
- 35 integrated submittal for the process instrumentation & control system and in
- 36 accordance with the requirements specified under Section 26 90 00 - Process
- 37 Instrumentation and Control.

1 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

2 A. Submit operation & maintenance manuals and instructions as specified herein.

3 B. Submit operation and maintenance manuals for the equipment specified herein as
4 part of the complete, integrated manual for the process instrumentation and control
5 system and in accordance with the requirements specified under 26 90 00 - Process
6 Instrumentation and Control.

7 1.07 FACTORY TESTING

8 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
9 Control.

10 1.08 QUALITY ASSURANCE

11 A. All materials, equipment, and parts shall be new and unused of current manufacture.

12 B. System supplier shall be responsible for providing all necessary accessories
13 required for a complete and operable system.

14 C. Manufacturer Qualifications: Company specializing in manufacturing products
15 specified in this section, with not less than three years of documented experience.

16 D. All control panels shall be constructed in accordance with UL 508 standards and
17 shall bear the UL 508 listing.

18 1.09 WARRANTY

19 A. See Division 01 for additional requirements.

20 1.10 EXTRA MATERIALS

21 A. See Division 01 for additional requirements.

22 B. Provide one spare vapor phase corrosion-inhibiting capsule for each control panel.

23 C. Provide twenty percent of the total number of terminals as installed spares in each
24 control panel.

25 D. Provide 3 spare control relays of each type utilized within each control panel.

26 E. Provide 3 spare fuses of each type utilized within each control panel

27 1.11 DESIGN REQUIREMENTS

CONTROL PANEL(S)				
TAG NUMBER	DESCRIPTION	TYPE	SIZE	NOTES
	JAMES ST PUMP STATION	B	72"H x 86"W x 24" D	1

SCS-1	SUPERVISORY CONTROL SYSTEM	A	36"H x 30"W x 12"D	1
PCP-1	PUMP CONTROL PANEL	A	36"H x 24"W x 12"D	1
PCP-2	PUMP CONTROL PANEL	A	36"H x 24"W x 12"D	1
PDP	POWER DISTRIBUTION PANEL	A	24"H x 24"W x 12"D	1
NOTES: 1. Specified size indicates the physical size anticipated by the ENGINEER. CONTRACTOR shall verify actual size with SYSTEM INTEGRATOR and adjust installation accordingly.				

1 1.12 MAINTENANCE

- 2 A. Before substantial completion, perform all maintenance activities required by any
3 sections of the specifications including any calibrations, final adjustments,
4 component replacements or other routine service required before placing
5 equipment or systems into service.
- 6 B. Furnish all spare parts as required by other sections of the specifications.

7 PART 2 PRODUCTS AND MATERIALS

8 2.01 GENERAL REQUIREMENTS

- 9 A. Fabricate, install instruments, plumb and wire in factory.
- 10 B. Test wiring and plumbing prior to shipment.
- 11 C. Make external connections by way of numbered terminal blocks.
- 12 D. Separate electrical components from pneumatic and hydraulic components by
13 metal barriers.
- 14 E. Conform to ISA standards.

15 2.02 TYPE A - CONTROL PANEL ENCLOSURE, WALL-MOUNTED

- 16 A. Manufacturer:
- 17 1. Hoffman Enclosures, Inc. Concept Wall-Mount Enclosure
- 18 2. Saginaw Control and Engineering, Enviroline Series Wall-Mount Enclosure
- 19 3. or equal
- 20 B. Environmental Rating:
- 21 1. NEMA Type 4/4X/12
- 22 C. Construction:
- 23 1. 16 gauge or 14 gauge steel
- 24 2. Seams continuously welded and ground smooth
- 25 3. Minimum width body flange trough excludes liquids and contaminants

- 1 4. Integral body grounding stud
- 2 5. Panel mounting studs
- 3 6. Mounting holes in back of body for direct mounting
- 4 7. Hidden hinges for clean aesthetic appearance
- 5 8. Standard full access 170 degree door opening
- 6 9. Doors are interchangeable and easily removable by pulling captive hinge
- 7 pins
- 8 10. Door bar on hinge side for wire management and grounding
- 9 11. Additional door bar and stiffener on larger enclosures for extra rigidity
- 10 12. High-impact thermoplastic data pocket
- 11 13. Seamless foam-in-place one-piece gasket provides oil-tight and dust-tight
- 12 seal against contaminants
- 13 14. Self-grounding latch system with double seal provides maximum protection
- 14 against leakage
- 15 15. Quarter-turn door latching system installed on door with a slotted insert
- 16 16. Finish:
- 17 a. Gray painted steel
- 18 b. Steel sub-panels are painted white

19 2.03 TYPE B - CONTROL PANEL ENCLOSURE, FREE-STANDING

20 A. Manufacturer:

- 21 1. Hoffman Enclosures, Inc.
- 22 2. Saginaw Control and Engineering, Enviroline Series
- 23 3. or equal

24 B. Environmental Rating:

- 25 1. NEMA Type ~~4~~4X/~~12~~123R

26 C. Construction:

- 27 1. 12 gauge stainless steel
- 28 2. Seams continuously welded and ground smooth
- 29 3. Minimum width body flange trough excludes liquids and contaminants
- 30 4. Integral body grounding stud
- 31 5. Panel mounting studs
- 32 6. 18 inch legs with louvered skirting
- 33 7. Hidden hinges for clean aesthetic appearance
- 34 8. 3-point latching system with padlockable rotating handles
- 35 9. Door stops on exterior doors.
- 36 10. Door bar on hinge side for wire management and grounding
- 37 11. Additional door bar and stiffener on larger enclosures for extra rigidity
- 38 12. High-impact thermoplastic data pocket
- 39 13. Seamless foam-in-place one-piece gasket provides oil-tight and dust-tight
- 40 seal against contaminants
- 41 14. Self-grounding latch system with double seal provides maximum protection
- 42 against leakage
- 43 15. Finish:

- a. Brushed stainless steel
- b. Steel sub-panels are painted white

16. Two door enclosures shall NOT have a center mullion/divider.

17. Backpan shall be one piece, not two piece.

PART 3 CONSTRUCTION METHODS

3.01 FIELD MEASUREMENTS

- A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and Control.

3.02 DELIVERY STORAGE AND HANDLING

- A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and Control.

3.03 INSTALLATION

- A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and Control.

3.04 CONTROL PANEL FABRICATION AND ENVIRONMENTAL PROTECTION REQUIREMENTS

A. Instrument Mounting:

1. Locate instruments designated for back-of-panel mounting in manner to allow for maintenance and adjustment.
2. Panels 36" tall or shorter are to be mounted 54" from finished floor to centerline of panel. Panels over 36" tall are to be mounted no higher than 72" from finished floor to top of panel.
3. Instrument mounting height shall not exceed 70". Minimum height shall be 48".
4. Operator interface terminals are to be 54" from finished floor to centerline of screen, but the top of the visible screen shall not exceed 60" above finished floor.
5. Panel cutouts for instruments and other devices, such as lights and switches, shall be cut, punched, or drilled and smoothly finished with rounded edges.
6. Provide steel angle stiffeners on back of panel face to prevent panel deflection under instrument loading or operation.
7. Provide internal structural steel framework for instrument support purposes and panel bracing. Internal framework shall permit lifting of panel without racking or distortion.
8. All components inside pump station enclosure shall be housed in separate control panels. The Supervisory Control System SCS-1, Pump Control Panels PCP-1 and PCP-2, lighting panel LP-1 & the Power Distribution Panel PDP shall all be house in a separate enclosures.

- 1 9. All interconnections between panels inside of the pump station panel shall
- 2 be done with galvanized rigid steel conduit with LBs.
- 3 10. UPS to be shelf mounted.

4 B. Corrosion Protection:

- 5 1. Provide vapor phase corrosion inhibiting capsules in each control panel to
- 6 protect all exposed metal surfaces for a period of at least two years.
- 7 Corrosion inhibiting modules shall be Northern Instrument Corporation,
- 8 Zerust vapor capsules Model VC-2-2 or Hoffman Engineering Corporation
- 9 corrosion inhibitor Model A-HCI-5.
- 10 2. Provide thermostatically controlled condensation heater in panels located in
- 11 high humidity areas and in areas in which ambient temperature will vary.
- 12 Heater shall be sized to prevent condensation within panel.

13 C. Heating, Ventilating, and Air Conditioning:

- 14 1. Provide heating equipment as specified under Part B.
- 15 2. Provide filtered ventilation fan(s) where needed and sized to dissipate heat
- 16 generated by components located within control panel.
- 17 a. Filtered ventilation fans are to push air inward into control panel.
- 18 3. Provide filtered air conditioning equipment and insulate panel where
- 19 needed to maintain internal panel temperature within operating parameters
- 20 of internal panel components.

21 3.05 CONTROL PANEL ELECTRICAL REQUIREMENTS

22 A. Electric Service:

- 23 1. Design control panel to operate on electrical supply indicated on the
- 24 drawings.
- 25 a. Three phase service:
- 26 1) Provide main circuit breaker disconnect switch with through
- 27 the door operator handle.
- 28 2) Provide branch circuit breakers for distribution of three
- 29 phase and single phase power at voltages above 120VAC.
- 30 a) Provide through the door disconnect handle.
- 31 3) Control panel and internal components shall be rated to
- 32 interrupt the available fault current.
- 33 4) Main circuit breaker and branch circuit breakers shall be
- 34 coordinated such that a fault in a branch circuit will trip only
- 35 the branch circuit breaker and not the main circuit breaker.
- 36 5) Separate 480VAC wiring from control voltage wiring.
- 37 6) Provide appropriately sized control power transformer.
- 38 7) Provide miniature circuit breakers for distribution of
- 39 120VAC control power in accordance with the following:
- 40 a) No more than 20 devices on any single circuit.
- 41 b) Where multiple units perform parallel operations, do
- 42 not group all devices on the same branch circuit. The

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- purpose is to prevent the failure of any single branch circuit from shutting down at entire operation.
- c) Do not exceed the ampacity of the branch circuit.
- d) Panel service outlet shall be protected by separate branch circuit breakers and be labeled with ampacity rating.
- e) Power supplies shall be protected by separate branch circuit breakers.
- 8) Provide 20 amp, 120VAC service outlet circuit within back-of-panel area.
- 9) Control power transformer fuses and branch circuit breakers shall be coordinated such that a fault in a branch circuit will trip only the branch circuit breaker and not the control power transformer fuses.
- 10) Branch circuit breakers shall be rated for 15A and 250VAC.
- 11) Fuses shall not be substituted for circuit breakers.
- b. Single phase service:
 - 1) Provide main circuit breaker with disconnect switch.
 - 2) Provide miniature circuit breakers for distribution of 120VAC control power in accordance with the following:
 - a) No more than 20 devices on any single circuit.
 - b) Where multiple units perform parallel operations, do not group all devices on the same branch circuit. The purpose is to prevent the failure of any single branch circuit from shutting down at entire operation.
 - c) Do not exceed the ampacity of the branch circuit.
 - d) Panel service outlet shall be protected by separate branch circuit breakers
 - e) Power supplies shall be protected by separate branch circuit breakers.
 - 3) Provide 20A, 120VAC service outlet circuit within back-of-panel area.
 - 4) Main circuit breaker and branch circuit breakers shall be coordinated such that a fault in a branch circuit will trip only the branch circuit breaker and not the main circuit breaker.
 - 5) Branch circuit breakers shall be rated for 15A and 250VAC.
 - 6) Fuses shall not be substituted for circuit breakers.
- c. Uninterruptible power supply:
 - 1) Provide true online uninterruptible power supply, provide distribution of 120VAC power on the line and load sides of the UPS.
 - 2) Panel service outlet, heater and other non-critical loads shall be powered from the line side of the UPS. Critical loads, including but not limited to all digital control equipment, shall be powered from the load side of the UPS.
 - 3) Provide UPS bypass circuitry in the event the UPS fails.

- 1 d. Back-up control systems:
- 2 1) Where panel includes fail-safe back-up control circuitry, the
- 3 back-up control circuits shall be fed with a separate circuit
- 4 from a lighting panel or from a separate control power
- 5 transformer.
- 6 B. Output Signal Fusing:
- 7 1. Provide appropriately sized fuses for all output signals to devices located
- 8 external to the panel in accordance with the following requirements:
- 9 a. Maximum fuse size: 5A
- 10 b. Separate fuse for each device
- 11 c. Fuses shall be installed in indicating type fuse holder terminal
- 12 blocks.
- 13 C. Control Panel Wiring:
- 14 1. Wiring within panels, consoles, racks, and cabinets shall meet the following
- 15 requirements:
- 16 a. Wires for ac circuits shall be 300V or 600V, Type MTW stranded
- 17 tin plated copper and shall be sized for the current to be carried but
- 18 no smaller than No.16 AWG.
- 19 b. Wires for analog signal circuits shall be 300V stranded tin plated
- 20 copper and shall be twisted shielded pairs/triads no smaller than
- 21 No.18 AWG.
- 22 c. Wires for other dc circuits shall be 300V, Type MTW stranded tin
- 23 plated copper but no smaller than No.16 AWG.
- 24 d. Wiring for special signals such as communications, digital data, and
- 25 multiplexed signals shall use manufacturers' standard cables.
- 26 e. Every effort is to be made to separate wiring of different voltages.
- 27 Where wiring of different voltages are near each other, they should
- 28 cross perpendicular to each other.
- 29 f. Provide 1-1/2" spacing between wire trough and terminal blocks.
- 30 g. Provide 1-1/2" spacing between wire trough and components.
- 31 h. All wiring shall have heat shrink wire numbers.
- 32 i. All 3 phase wiring shall have phase tape on both ends of the
- 33 conductors.
- 34 2. Components/Din Rail
- 35 a. Provide din rail for panel components.
- 36 b. Provide 25% spare din rail space
- 37 c. Fuse holders shall have indicator lights
- 38 d. Provide 25% spare back panel space for future devices.
- 39 3. Terminal blocks for panels, consoles, racks, and cabinets shall meet the
- 40 following requirements:
- 41 a. Wire all spare or unused panel mounted elements, including PLC
- 42 input/output points, to terminal blocks.
- 43 b. Provide open construction terminal blocks for wiring that is entirely
- 44 internal to the panel.

- c. Provide isolation switch terminal blocks for all wiring that is not entirely internal to the panel.
- d. Rail-mount individual terminals to create a complete assembly. Provide terminals constructed such that jumpers can be installed with no loss of space on terminal or rail.
- e. Size all terminal block components to allow insertion of all necessary wire sizes and types.
- f. Provide power distribution blocks for distribution of control panel power at voltages exceeding 120VAC.
- g. Provide wire troughs on both sides of terminal strips. Provide wire troughs for field wiring. Maximum fill of wire trough shall be 60%.
- h. Any wiring not in a wire trough shall be ran in spiral wrap and secured to panel with tie wraps.
- i. Provide 25% spare terminal blocks of each type. (120VAC, Neutral, DC power, control, 4-20 signals and intrinsic circuits)

4. Grounding:

- a. Panels, consoles, racks, and cabinets shall be provided with an isolated copper grounding bus for all signal and shield ground connections. This ground bus shall be grounded at a common single ground point. The signal grounding system shall meet National Electrical Code requirements.
- b. Each analog loop shall only be grounded at a single point for the loop. This single point shall be at the location of the dc power supply for the loop.

D. Power Supplies:

- 1. Provide dc power supplies as required to power instruments requiring external dc power, including two-wire transmitters and dc relays.
- 2. Power supplies shall be suitable for intrinsically safe circuits where two-wire transmitters are located in a hazardous area.

E. Electrical Transient Protection:

- 1. All electrical and electronic elements of the control system shall be protected against damage due to electrical transients induced in interconnecting lines from lighting discharges and nearby electrical systems.
- 2. Surge Suppressor Locations:
 - a. As a minimum, provide surge suppressors at the following locations:
 - 1) Provide 480VAC, panel mounted surge suppressor on the load side of each 480VAC main circuit breaker in each panel.
 - 2) Provide 120VAC, panel mounted surge suppressor on the load side of each 120VAC main circuit breaker in each panel.
 - 3) Provide 24VDC, panel mounted surge suppressor at the panel connections of all analog signal circuits that have any

- 1 portion of the circuit extending outside of a protecting
2 building.
3 4) Provide 24VDC, field mounted surge suppressor at the field
4 connection of each analog signal transmitter located outside
5 of a protecting building.

6 3.06 STANDARD SIGNAL INTERFACES

- 7 A. Unless otherwise specified discrete input and output signals shall conform to the
8 following:
9 1. Isolated unpowered (dry) contact closures.
10 2. Power contact from panel receiving signal or device receiving signal.
- 11 B. Unless otherwise specified input and output analog signals shall conform to
12 following:
13 1. External to panel: isolated, 4-20 mADC.
14 2. Internal to panel: 4-20 mADC signals.
15 3. For 2-wire transmitter provide isolated type and power with 24VDC from
16 panel or device receiving signal.
17 4. Where isolation is required to interface with particular equipment or
18 because of loop impedance, provide isolated, DC-to-DC transmitter.

19 3.07 TESTING AND START-UP SERVICES

- 20 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
21 Control.

22 3.08 TRAINING

- 23 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
24 Control.

25 END OF SECTION

1 SECTION 26 90 11

2
3 CONTROL PANEL COMPONENTS

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

- 6 A. Applicable provisions of Division 01 shall govern the work of this section.
- 7 B. The Contract Documents are complementary; what is called for by one is as binding
8 as if called for by all.

9 1.02 APPLICABLE PUBLICATIONS

- 10 A. The following publications of the issues listed below, but referred to thereafter by
11 basic designation only, form a part of this specification to the extent applicable. The
12 latest edition accepted by the Authority Having Jurisdiction of the referenced
13 publications in effect at the time of the bid governs.
- 14 1. American National Standards Institute/National Fire Protection Agency
15 (ANSI/NFPA), Specifications and Standards, current edition:
 - 16 a. ANSI/NFPA 70 - National Electrical Code and state amendments
17 thereto.
 - 18 b. ANSI/IEEE C37.90 - IEEE Standard for Relays and Relay Systems
19 Associated with Electric Power Apparatus.
 - 20 c. ANSI/IEEE C62.11- IEEE Standard for Metal-Oxide Surge
21 Arresters for Alternating Current Power Circuits.
 - 22 d. ANSI/IEEE C62.34 - IEEE Standard for Performance of Low-
23 Voltage Surge-Protective Devices (Secondary Arresters).
 - 24 e. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge
25 Voltages in Low-Voltage AC Power Circuits.
 - 26 2. ASTM International (ASTM), originally known as the American Society
27 for Testing and Materials, Specifications and Standards, current edition:
 - 28 a. Illuminating Engineering Society (IES). Institute of Electrical and
29 Electronics Engineers (IEEE)
 - 30 b. Insulated Cable Engineers Association (ICEA)
 - 31 c. International Society of Automation (ISA)
 - 32 3. National Electrical Manufacturers Association (NEMA), Specifications and
33 Standards, current edition:
 - 34 a. NEMA ICS 2 - Industrial Control and Systems: Controllers,
35 Contactors, and Overload Relays, Rated Not More Than 2000 Volts
36 AC or 750 Volts DC.
 - 37 b. NEMA ICS 3 - Industrial Control and Systems: Medium Voltage
38 Controllers Rated 2001 to 7200 Volts AC.

- 1 4. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
2 current edition:
 - 3 a. UL508 - Industrial Control Equipment.
 - 4 b. UL508A - Industrial Control Panels.
 - 5 c. UL 913 - Intrinsically Safe Specification.
 - 6 d. UL94 - Tests for Flammability of Plastic Materials for Parts in
7 Devices and Appliances.
- 8 5. Wisconsin Department of Safety and Professional Services (DSPS)
- 9 6. National Electrical Contractors Association (NECA), current edition.
 - 10 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
11 Contracting.
- 12 7. International Electrical Testing Association (NETA)
 - 13 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
14 Power Distribution Equipment and Systems.
- 15 8. Canadian Standards Association (CSA), Specifications and Standards,
16 current edition.
 - 17 a. CSA C22.2, Industrial Control Equipment.
- 18 9. Electrical and Electronic Manufacturers Association Canada (EEMAC),
19 Specifications and Standards, Current Edition.
- 20 10. International Electrotechnical Association (IEC), Specifications and
21 Standards, Current Edition.
 - 22 a. IEC 60529 - Classification of Degrees of Protection Provided by
23 Enclosures
- 24 11. CE - European Community, Applicable Directives.
 - 25 a. EN50005 - for Terminal Markings.
 - 26 b. EN50081-1- Generic Emission Standard.
 - 27 c. EN50082-1 - Generic Immunity Standard.
 - 28 d. EN61000-4-4 - Electromagnetic compatibility (EMC). Testing and
29 measurement techniques.
 - 30 e. EN61000-4-5 - Electromagnetic compatibility (EMC). Testing and
31 measurement techniques. Surge immunity test.

32 1.03 DESCRIPTION OF WORK

- 33 A. For the purpose of obtaining a complete and integrated process instrumentation and
34 control system, the work specified herein shall be included under the scope of:
 - 35 1. Section 26 90 00 - Process Instrumentation & Control

36 1.04 RELATED WORK ELSEWHERE

- 37 A. Article 102 – Bidding Requirements and Conditions
- 38 B. Article 103 – Award and Execution of the Contract
- 39 C. Concrete – Division 03

- 1 D. Metals – Division 05
- 2 E. Electrical - Division 26
- 3 1.05 SUBMITTALS
- 4 A. Submit shop drawings in accordance with Division 01.
- 5 B. Submit shop drawings for the equipment specified herein as part of the complete,
6 integrated submittal for the process instrumentation & control system and in
7 accordance with the requirements specified under Section 26 90 00 - Process
8 Instrumentation & Control.
- 9 1. Furnish manufacturer literature sufficient in scope to demonstrate
10 compliance with the requirements of this specification.
- 11 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS
- 12 A. Submit operation & maintenance manuals and instructions as specified herein.
- 13 B. Submit operation and maintenance manuals for the equipment specified herein as
14 part of the complete, integrated manual for the process instrumentation and control
15 system and in accordance with the requirements specified under 26 90 00 - Process
16 Instrumentation and Control.
- 17 1.07 FACTORY TESTING
- 18 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
19 Control.
- 20 1.08 QUALITY ASSURANCE
- 21 A. All materials, equipment, and parts shall be new and unused of current manufacture.
- 22 B. System supplier shall be responsible for providing all necessary accessories
23 required for a complete and operable system.
- 24 C. Manufacturer Qualifications: Company specializing in manufacturing products
25 specified in this section, with not less than three years of documented experience.
- 26 D. Products: Listed and classified by UL or testing firm acceptable to the authority
27 having jurisdiction as suitable for the purpose specified and indicated.
- 28 1.09 EXTRA MATERIALS
- 29 A. Supply five spare fuses of each type supplied for this project
- 30 B. Supply five spare lamps of each type supplied for this project.

1 C. Supply two spare relays of each type supplied for this project.

2 1.10 DESIGN REQUIREMENTS (NOT USED)

3 1.11 MAINTENANCE

4 A. Before substantial completion, perform all maintenance activities required by any
5 sections of the specifications including any calibrations, final adjustments,
6 component replacements or other routine service required before placing
7 equipment or systems into service.

8 B. Furnish all spare parts as required by other sections of the specifications.

9 PART 2 PRODUCTS AND MATERIALS

10 2.01 CIRCUIT BREAKER - MINIATURE

11 A. Manufacturer:

- 12 1. Allen Bradley 1498-M
- 13 2. Or equal

14 B. Agency Approvals:

- 15 1. UL Listed

16 C. General:

- 17 1. DIN rail mounting in one-, two- and three-pole construction.
- 18 2. Used for overcurrent protection and switching on both ac and dc systems.

19 D. Construction:

- 20 1. Terminal lug wire size: 1- No.14 - No.2 AWG Cu or Al
- 21 2. Reversible line and load lugs for convenient flush or surface mount wiring
- 22 3. DIN mounted (symmetrical rail 35 x 7.5 DIN/EN 50 022)
- 23 4. UL Listed as HACR type -- 15A to 70A
- 24 5. Field installable quick connectors
- 25 6. Single handle with internal common trip
- 26 7. UL Listed 48VDC (5,000 AIR)

27 2.02 PILOT DEVICE - INDICATING LIGHT

28 A. Manufacturer:

- 29 1. Allen Bradley Bulletin 800T/800H
- 30 2. Eaton/Cutler-Hammer
- 31 3. Schneider Electric/Square D.
- 32 4. Or equal

33 B. Agency Approvals:

- 1 1. UL Listed
- 2 2. CSA Certified
- 3 3. CE Compliant

- 4 C. Mechanical:
- 5 1. Size: 30.5 mm
- 6 2. Environmental rating:
- 7 a. NEMA 4/13 watertight/oil tight: NEMA 1, 12, 3R, 4 control panels
- 8 b. NEMA 4/4X corrosion resistant: NEMA 4X control panels and
- 9 remote control stations
- 10 3. Life expectancy: 200,000 operations
- 11 4. Push-to-test, transformer type, dual input

- 12 D. Electrical:
- 13 1. Input power: 120VAC
- 14 2. Lamp:
- 15 a. High visibility, 28 chip cluster LED
- 16 b. Color: red, green, amber, as scheduled
- 17 3. Lens: High impact plastic, colored to match lamp

- 18 E. Nameplate: Standard or jumbo with engraved service legend

- 19 F. Field Mounted Control Stations:
- 20 1. Type I Enclosure: NEMA 4X polycarbonate enclosure
- 21 2. Type II Enclosure: NEMA 4X stainless steel enclosure
- 22 3. Type III Enclosure: NEMA 7 hazardous location enclosure

23 2.03 PILOT DEVICE - PUSHBUTTON

- 24 A. Manufacturer:
- 25 1. Allen Bradley Bulletin 800T/800H
- 26 2. Eaton/Cutler-Hammer
- 27 3. Schneider Electric/Square D
- 28 4. Or equal

- 29 B. Agency Approvals:
- 30 1. UL Listed
- 31 2. CSA Certified
- 32 3. CE Compliant

- 33 C. Mechanical:
- 34 1. Size: 30.5 mm
- 35 2. Environmental rating:
- 36 a. NEMA 4/13 watertight/oil tight: NEMA 1, 12, 3R, 4 control panels

- 1 b. NEMA 4/4X corrosion resistant: NEMA 4X control panels and
- 2 remote control stations
- 3 3. Life expectancy: 10,000,000 operations
- 4 4. Momentary contact, non-illuminated

- 5 D. Electrical:
- 6 1. Rated Voltage: 120VAC
- 7 2. Continuous current rating:
- 8 a. AC: 10A
- 9 b. DC: 2.5A
- 10 3. Operational current:
- 11 a. Make: 7200VA
- 12 b. Break: 720VA
- 13 4. Operator:
- 14 a. Mushroom head: Emergency stop service
- 15 b. Flush-head: All other services

- 16 E. Nameplate: Standard or jumbo with engraved service legend

- 17 F. Field Mounted Control Stations:
- 18 1. Type I Enclosure: NEMA 4X polycarbonate enclosure
- 19 2. Type II Enclosure: NEMA 4X stainless steel enclosure
- 20 3. Type III Enclosure: NEMA 7 hazardous location enclosure

21 2.04 PILOT DEVICE - SELECTOR SWITCH

- 22 A. Manufacturer:
- 23 1. Allen Bradley Bulletin 800T/800H
- 24 2. Eaton/Cutler-Hammer
- 25 3. Schneider Electric/Square D.
- 26 4. Or equal

- 27 B. Agency Approvals:
- 28 1. UL Listed
- 29 2. CSA Certified
- 30 3. CE Compliant

- 31 C. Mechanical:
- 32 1. Size: 30.5 mm
- 33 2. Environmental rating:
- 34 a. NEMA 4/13 watertight/oil tight: NEMA 1, 12, 3R, 4 control panels
- 35 b. NEMA 4/4X corrosion resistant: NEMA 4X control panels and
- 36 remote control stations
- 37 3. Life expectancy: 1,000,000 operations

- 1 4. Maintained contact, non-illuminated (spring return from right or left where
2 scheduled)
- 3 D. Electrical:
- 4 1. Rated Voltage: 120VAC
- 5 2. Continuous current rating:
- 6 a. AC: 10A
- 7 b. DC: 2.5A
- 8 3. Operational current:
- 9 a. Make: 7200VA
- 10 b. Break: 720VA
- 11 4. Operator:
- 12 a. Standard knob operator, two-position, or three-position
- 13 b. Keyed operator: where scheduled
- 14 E. Nameplate: Standard or jumbo with engraved service legend
- 15 F. Field Mounted Control Stations:
- 16 1. Type I Enclosure: NEMA 4X polycarbonate enclosure
- 17 2. Type II Enclosure: NEMA 4X stainless steel enclosure
- 18 3. Type III Enclosure: NEMA 7 hazardous location enclosure

19 2.05 POWER SUPPLY - 12/24VDC

- 20 A. Manufacturer:
- 21 1. Allen Bradley 1606 family
- 22 B. Agency Approvals:
- 23 1. UL Listed
- 24 2. CE Marked
- 25 C. Mechanical:
- 26 1. Enclosure:
- 27 a. IP20
- 28 b. Sealed plastic
- 29 c. Fine ventilation grid
- 30 2. Mounting: DIN rail
- 31 D. Electrical
- 32 1. Capacity:
- 33 a. Size to power connected loads. Reserve 25 percent of capacity for
- 34 future use.
- 35 b. Provide multiple power supplies where needed to accommodate
- 36 load.
- 37 2. Input:

- 1 a. Voltage: 85-264VAC
- 2 b. Frequency: 43-67Hz
- 3 c. Efficiency: 88.5 percent
- 4 d. Current: 1.0A at 100VAC
- 5 3. Output:
- 6 a. Voltage: 24-28VDC or 10-12VDC
- 7 b. Voltage regulation: 2 percent
- 8 c. Overvoltage protection: 40VDC
- 9 d. Noise suppression: EMI values below EN50081-1
- 10 e. Current: 5.0A at 24VDC or 4.5A at 12VDC
- 11 4. Monitoring:
- 12 a. LED Indicator
- 13 b. Output power good status contact

14 2.06 POWER SUPPLY - 120VAC, Uninterruptible

15 A. Manufacturer:

- 16 1. ~~Eaton/Powerware 9130~~
- 17 2. ~~Liebert~~
- 18 1. Allen Bradley
- 19 2. APC
- 20 3. Or equal

21 B. Agency Approvals:

- 22 1. UL Listed
- 23 2. CE Marked
- 24 3. FCC Approved

25 C. General:

- 26 1. Topology: True online, double-conversion
- 27 2. Diagnostics: Full system self-test on power up
- 28 3. UPS Bypass Automatic: on Overload or UPS failure less than 4 ms
- 29 4. Transfer Time to battery: 0 ms
- 30 5. Overload Capacity:
- 31 a. 125 percent for 10 minutes before transfer to bypass
- 32 b. 150 percent for 10 seconds before transfer to bypass

33 D. Input:

- 34 1. Input voltage: 80-144VAC, single phase, 60 Hz
- 35 2. Input power factor: greater than 95 percent
- 36 3. Input Line: NEMA 5-15 plug and cord
- 37 4. Protection: fuse or circuit breaker

38 E. Electrical Output:

- 39 1. Voltage Regulation:

- 1 a. On Utility: +/-2 percent of nominal
- 2 b. On Battery: +/-3 percent of nominal
- 3 2. Nominal Output Voltage: Same as selected input voltage
- 4 3. Output Voltage Waveform: Sine Wave
- 5 4. Output Voltage Distortion: less than 3 percent THD
- 6 5. Output Line: 4 NEMA 5-15 receptacles, minimum
- 7 6. Output protection: Electronic overload sensing, and circuit breaker
- 8 protection
- 9 7. Efficiency:
- 10 a. Online Mode: greater than 86 percent
- 11 b. Hi-Efficiency Mode: greater than 90 percent

- 12 F. Battery:
- 13 1. Internal Battery type: Sealed, lead-acid; maintenance free
- 14 2. On Battery Runtime: 125% of rated load for ten minutes
- 15 3. Battery Replacement: Hot-swappable internal batteries
- 16 4. Recharge Time: less than 4 hours to 90 percent capacity
- 17 5. Start-On-Battery: Allows start of UPS without utility input

- 18 G. Environmental:
- 19 1. Temperature:
- 20 a. Operating: 32 to 104 degrees F
- 21 b. Storage: 5 to degrees 122 F
- 22 2. Relative Humidity: 0 to 95 percent non-condensing
- 23 3. Audible Noise at 1 meter: less than 52dB
- 24 4. Altitude: 10,000 feet without deteriorating

- 25 H. Communications:
- 26 1. Relay Output Card:
- 27 a. Line Fail
- 28 b. Low Battery
- 29 c. UPS Fault
- 30 d. Bypass
- 31 2. User Interface: LCD status screen
- 32 3. Audible Alarms UPS alarm conditions, including:
- 33 a. On-Battery
- 34 b. Low Battery
- 35 c. Overload
- 36 d. UPS Fault
- 37 4. Communications: One ~~RS232~~ Serial Port; One Communications Slot; One
- 38 USB Port
- 39 ~~5. Communications cable: 6-foot communications cable included~~
- 40 ~~6. Power Management Software: Powerware Software Suite CD~~

- 41 I. Manufacturer's Warranty:

1. Warranty: 2 year comprehensive, including battery
- ~~2. Equipment Protection Policy: \$25,000 lifetime protection including lightning damage~~

2.07 RELAY - 120V GENERAL PURPOSE

A. Manufacturer:

1. Allen Bradley Bulletin 700-HB
2. IDEC RU Series
3. Or equal

B. Agency Approvals:

1. UL Listed
2. CE Marked

C. Mechanical:

1. Enclosure: Transparent dust cover
2. Contacts: Silver cadmium oxide
3. Insulating Material: Molded, high dielectric
4. Terminal Markings: In accordance with EN50-0005
5. Life expectancy: 10,000,000 operations
6. Operations:
 - a. Pickup: 20 mS
 - b. Dropout: 4 mS
 - c. Maximum Rate: Four operations per second
7. Blade style, quick connect terminals

D. Electrical:

1. Contacts:
 - a. Double-pole, double throw
 - b. Rated thermal current: 15A
 - c. Make: 60A
 - d. Break: 6A
2. Coil:
 - a. 120 VAC + 10, -20 percent
 - b. Consumption.
 - 1) Inrush: 2.85 VA
 - 2) Sealed: 1.9 VA
3. Voltage:
 - a. Rated Insulation Voltage: 250V IEC-300V UL/CSA
 - b. Dielectric Withstand Voltage:
 - 1) Pole-to-Pole: 1500V
 - 2) Contact to Coil: 6000V
 - 3) Contact to Frame: 4000V
4. Push-to-Test Operator

- 1 5. Pilot light
- 2 E. Relay Socket:
- 3 1. 11-blade
- 4 2. Finger-safe terminal
- 5 3. DIN rail mounted
- 6 4. Double tier
- 7 5. Retainer clip
- 8 6. Relay identification snap-in markers

9 2.08 RELAY - SOLID STATE

- 10 A. Manufacturer:
- 11 1. Allen Bradley Bulletin 700-SH
- 12 2. IDEC RSS Series
- 13 3. Or equal

- 14 B. Agency Approvals:
- 15 1. UL Recognized
- 16 2. CE Marked

- 17 C. Electrical:
- 18 1. Input:
- 19 a. Voltage: 4-32VDC
- 20 b. Impedance: 15mA, maximum, voltage dependent
- 21 c. Pick-up voltage: 4VDC
- 22 d. Drop-out Voltage: 1VDC
- 23 e. Dielectric Strength: 2500VACrms
- 24 f. Reverse voltage protection
- 25 2. Output:
- 26 a. Continuous current: 10A
- 27 b. Voltage range: 19-264VAC
- 28 c. Contact: SPST - N.O.
- 29 d. Off State leakage: 5 mA max (at 100VAC)
- 30 e. Turn-On/Turn-Off time; 0.5 cycle
- 31 3. Features:
- 32 a. Photo isolation
- 33 b. Dual SCR output
- 34 c. Built-in snubber

35 2.09 RELAY - TIME DELAY

- 36 A. Manufacturer:
- 37 1. Allen Bradley Bulletin 700-HT
- 38 2. IDEC, RTE Series

- 1 3. Or equal
- 2 B. Agency Approvals:
- 3 1. UL Listed
- 4 2. CE Marked
- 5 C. Mechanical:
- 6 1. Insulation resistance: 100 Mohms, minimum
- 7 2. Dielectric strength: 1500VAC, 1 minute
- 8 3. Vibration resistance: 6N
- 9 4. Shock resistance: 500N
- 10 5. Operating temperature: -20 to 65 degrees C
- 11 6. Operating humidity: 45 to 85 percent, relative
- 12 7. Blade style: quick-connect terminals
- 13 D. Electrical:
- 14 1. Contacts:
- 15 a. Two Form C double-pole, double-throw
- 16 b. 10A, 240VAC, resistive
- 17 2. Timing functions:
- 18 a. Delay on make/interval
- 19 b. Delay on break/single shot
- 20 c. Range: 0.1 seconds - 30 minutes
- 21 3. Accuracy:
- 22 a. Repeat: + 0.25 percent
- 23 b. Voltage: + 1.0 percent
- 24 c. Temperature error: + 2.0 percent
- 25 d. Setting error: + 10.0 percent
- 26 4. Status
- 27 a. Indicator light for timer timed out
- 28 b. Indicator light for timer in progress
- 29 E. Relay Socket:
- 30 1. 8 or 11-blade
- 31 2. Finger-safe terminal
- 32 3. DIN rail mounted
- 33 4. Double tier
- 34 5. Retainer clip
- 35 6. Relay identification snap-in markers

36 2.10 WIRE DUCT

- 37 A. Manufacturer:
- 38 1. Panduit Electro-Duct

- 1 B. General Description:
2 1. Plastic wire duct
3 2. Maximum wire fill to be 60%
- 4 2.11 SURGE SUPPRESSOR - 24VDC
- 5 A. Manufacturer:
6 1. Allen Bradley 4983-DD
7 2. Or equal
- 8 B. Agency Approvals:
9 1. UL 497B
- 10 C. General Description:
11 1. Transient Protection for Low-Voltage Signal Lines
12 2. Sneak/Fault Current Protection
13 3. Resettable Fusing-PTCs
14 4. Differential and Common Mode Protection
15 5. Automatic Recovery
16 6. Encapsulated in Stainless Steel Pipe Nipples
17 7. Silicon Avalanche Hybrid Technology
18 8. UL 497B Listed
19 9. Protection for One Pair (Two Wires & Shield on SS65)
- 20 D. Electrical:
21 1. Response Time: less than 1 nanosecond
22 2. Maximum Signal Voltage: 28VDC
23 3. DC Clamping Level:
24 a. Line-to-Ground: 36V +/-10 percent
25 b. Line-to-Line: 72V +/-10 percent
26 4. Maximum Let-Thru Voltage:
27 a. Line-to-Ground (10x700 microseconds): 44V at 400A
28 b. Line-to-Line (10x700 microseconds): 90V at 400A
29 5. Series Resistance (per conductor): 5 Ohms (typical)
30 6. Capacitance (zero volts bias):
31 a. Line-to-Line: 600pf typical
32 b. Line-to-Ground: 1200pf typical
33 7. Number of Occurrences: 400 at 500 Amps (10x1000 microseconds)
- 34 2.12 SURGE SUPPRESSOR - 120VAC SIGNAL, PANEL MOUNTED
- 35 A. Manufacturer:
36 1. Allen Bradley 4983-DS
37 2. Or equal

- 1 B. Agency Approvals:
- 2 1. UL Listed

- 3 C. General Description:
- 4 1. Performance exceeds highest class severity level of IEC/EN 61000-4-4 and
- 5 61000-4-5
- 6 2. Enhanced filtering to attenuate high frequency and bring equipment into
- 7 compliance with IEEE /ANSI C37.90.1
- 8 3. Universal hardwired version for all I/O modules including AC, DC, contact
- 9 output, current output and signal input
- 10 4. Multi-stage design provides the most effective suppression and filtering
- 11 available, and requires no additional secondary protection
- 12 5. Sub-nano second response time stops failures due to lightning, spikes and
- 13 over-voltage surges while filtering all other electrical noise
- 14 6. Plug-in replaceable daughter card modules contain all active surge
- 15 suppression
- 16 7. Space efficient protector is hermetically sealed and suitable for the most
- 17 harsh industrial environments
- 18 8. Universal DIN-Rail mounting allows easy installation on any standard DIN-
- 19 Rail configuration
- 20 9. Automatic reset and fail safe design requires no maintenance. Eliminates
- 21 “Out of Service” downtime and repair/replacement costs caused by
- 22 damaging electrical surges
- 23 10. Protection for current loop instrumentation and low frequency signal/data
- 24 lines
- 25 11. UL-497B listed for Data Models (60 VDC or less) UL file E205158

- 26 D. Electrical:
- 27 1. Signal Channels: 5, 10, 15, or 20
- 28 2. Operating: +/-30VDC
- 29 3. Maximum Operating Voltage: 33VDC
- 30 4. Maximum Operating Current: 0.5A
- 31 5. Clamping Action Turn-On: 37.1V
- 32 6. Maximum Clamping (8x20 micro-seconds): 52V
- 33 7. Maximum Surge Voltage: 6kV
- 34 8. Maximum Surge Current (8x20 micro-seconds): 2.5kA
- 35 9. Response Time: Less than 1 nanosecond
- 36 10. Operating & Storage Temperature: -40 to 85 degrees C.

37 2.13 SURGE SUPPRESSOR - 120VAC/208VAC/480VAC POWER, PANEL MOUNTED

- 38 A. Manufacturer:
- 39 1. Allen Bradley 4983-DS
- 40 2. Or equal

- 1 B. Agency Approvals:
- 2 1. UL 1449
- 3 2. CSA C22.2 NO.8

- 4 C. General Description
- 5 1. Din Rail Mounted
- 6 2. Replaceable modules

- 7 D. Electrical:
- 8 1. 120,240V single phase
- 9 2. 208,480V three phase
- 10 3. Max continuous operating voltage: 150-400VAC
- 11 4. 40 kA current rating
- 12 5. 4 pole

13 2.14 TERMINAL BLOCK - INDICATING FUSED

- 14 A. Manufacturer:
- 15 1. Allen Bradley Bulletin 1492-H4 (AC) or 1492-H5 (DC)
- 16 2. Or equal

- 17 B. Agency Approvals:
- 18 1. UL
- 19 2. CSA
- 20 3. IEC

- 21 C. Specifications:
- 22 1. Voltage Rating: 300VAC/VDC
- 23 2. Maximum Current: 12A
- 24 3. Wire Range (Rated Cross Section): No.30 to no.12 AWG
- 25 4. Leakage Current:
- 26 a. 2 mA at 300VAC
- 27 b. 2 mA at 24VDC
- 28 5. Working Voltage:
- 29 a. 100 to 300VAC
- 30 b. 10 to 57VAC/VDC
- 31 6. Fuse Size: 1/4 in x 1-1/4 in
- 32 7. Wire Strip Length 0.38 in
- 33 8. Tightening Torque: 3 to 7 lb-in
- 34 9. Density: 33 pcs./ft
- 35 10. Insulation Temperature Range: -40 to 221 degrees F
- 36 11. Accessories:
- 37 a. Aluminum DIN Rail with Standoff Brackets
- 38 b. End Barrier and End Anchors
- 39 c. Side Jumper Insulating Sleeve

1 d. Marking Systems

2 2.15 TERMINAL BLOCK - ISOLATING SWITCH

3 A. Manufacturer:

- 4 1. Allen Bradley Bulletin 1492-H7
- 5 2. Or equal

6 B. Agency Approvals:

- 7 1. UL
- 8 2. CSA
- 9 3. IEC

10 C. Specifications:

- 11 1. Voltage Rating: 300VAC/VDC
- 12 2. Maximum Current: 15A
- 13 3. Wire Range (Rated Cross Section): No.30 to No.12 AWG
- 14 4. Leakage Current:
 - 15 a. 2 mA at 300VAC
 - 16 b. 2 mA at 24VDC
- 17 5. Working Voltage:
 - 18 a. 100 to 300VAC
 - 19 b. 10 to 57VAC/VDC
- 20 6. Dummy Fuse Size: 1/4 in x 1-1/4 in
- 21 7. Wire Strip Length 0.38 in
- 22 8. Tightening Torque: 3 to 7 lb-in
- 23 9. Density: 33 pcs./ft
- 24 10. Insulation Temperature Range: -40 to 221 degrees F
- 25 11. Accessories:
 - 26 a. Aluminum DIN Rail with Standoff Brackets
 - 27 b. End Barrier and End Anchors
 - 28 c. Side Jumper Insulating Sleeve
 - 29 d. Marking Systems

30 2.16 TERMINAL BLOCK - OPEN STYLE

31 A. Manufacturer:

- 32 1. Allen Bradley ~~Bulletin 1492-CAM1~~
- 33 ~~2. Or equal~~

34 B. Agency Approvals:

- 35 1. UL
- 36 2. CSA
- 37 3. IEC

- 1 C. Specifications:
- 2 1. Voltage Rating: 600VAC/VDC
 - 3 2. Maximum Current: 65A
 - 4 3. Wire Range (Rated Cross Section): No.22 to No.8 AWG
 - 5 4. Wire Strip Length 0.38 in
 - 6 5. Tightening Torque: 10 to 16 lb-in
 - 7 6. Density: 30 pcs./ft
 - 8 7. Insulation Temperature Range: -40 to 221 degrees F
 - 9 8. Accessories:
- 10 a. Aluminum DIN Rail with Standoff Brackets
 - 11 b. End Barrier and End Anchors
 - 12 c. Side Jumper Insulating Sleeve
 - 13 d. Marking Systems

14 D. Usage:

- 15 1. Allen Bradley Bulletin 1492-CAM1 for power terminal blocks
- 16 2. Allen Bradley Bulletin 1492-J4 for control wiring terminal blocks

17 PART 3 CONSTRUCTION METHODS

18 3.01 DIVISION OF WORK (NOT USED)

19 3.02 FIELD MEASUREMENTS

- 20 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

21 3.03 DELIVERY STORAGE AND HANDLING

- 22 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

23 3.04 INSTALLATION

- 24 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

25 3.05 TESTING AND START-UP SERVICES

- 26 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

27 3.06 TRAINING

- 28 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation & Control.

29 END OF SECTION

1 SECTION 26 90 20

2
3 INSTRUMENTATION DEVICES

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

- 6 A. Applicable provisions of Part I shall govern the work of this section.
- 7 B. The Contract Documents are complementary; what is called for by one is as
8 binding as if called for by all.

9 1.02 APPLICABLE PUBLICATIONS

- 10 A. The following publications of the issues listed below, but referred to thereafter by
11 basic designation only, form a part of this specification to the extent applicable.
12 The latest edition accepted by the Authority Having Jurisdiction of the referenced
13 publications in effect at the time of the bid governs
- 14 1. American National Standards Institute/National Fire Protection Agency
15 (ANSI/NFPA), Specifications and Standards, current edition:
 - 16 a. ANSI/NFPA 70 - National Electrical Code (NEC) and state
17 amendments thereto.
 - 18 b. ANSI/IEEE C37.90 - IEEE Standard for Relays and Relay Systems
19 Associated with Electric Power Apparatus.
 - 20 c. ANSI/IEEE C62.11- IEEE Standard for Metal-Oxide Surge
21 Arresters for Alternating Current Power Circuits.
 - 22 d. ANSI/IEEE C62.34 - IEEE Standard for Performance of Low-
23 Voltage Surge-Protective Devices (Secondary Arresters).
 - 24 e. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge
25 Voltages in Low-Voltage AC Power Circuits.
 - 26 2. ASTM International (ASTM), originally known as the American Society
27 for Testing and Materials, Specifications and Standards, current edition:
 - 28 3. Illuminating Engineering Society (IES). Institute of Electrical and
29 Electronics Engineers (IEEE)
 - 30 4. Insulated Cable Engineers Association (ICEA)
 - 31 5. International Society of Automation (ISA)
 - 32 6. National Electrical Manufacturers Association (NEMA), Specifications
33 and Standards, current edition.
 - 34 a. NEMA ICS 2 - Industrial Control and Systems: Controllers,
35 Contactors, and Overload Relays, Rated Not More Than 2000
36 Volts AC or 750 Volts DC.
 - 37 b. NEMA ICS 3 - Industrial Control and Systems: Medium Voltage
38 Controllers Rated 2001 to 7200 Volts AC.

- 1 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
2 current edition.
3 a. UL508 - Industrial Control Equipment.
4 b. UL508A - Industrial Control Panels.
5 c. UL 913 - Intrinsically Safe Specification.
6 d. UL94 - Tests for Flammability of Plastic Materials for Parts in
7 Devices and Appliances.
8 8. Wisconsin Department of Safety and Professional Services (DSPS)
9 9. National Electrical Contractors Association (NECA), current edition.
10 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
11 Contracting.
12 10. International Electrical Testing Association (NETA)
13 a. NETA STD ATS - Acceptance Testing Specifications for
14 Electrical Power Distribution Equipment and Systems.
15 11. Canadian Standards Association (CSA), Specifications and Standards,
16 current edition.
17 a. CSA C22.2, Industrial Control Equipment.
18 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
19 Specifications and Standards, Current Edition.
20 13. International Electrotechnical Association (IEC), Specifications and
21 Standards, Current Edition.
22 a. IEC 60529 - Classification of Degrees of Protection Provided by
23 Enclosures
24 14. CE - European Community, Applicable Directives.
25 a. EN50005 - for Terminal Markings.
26 b. EN50081-1- Generic Emission Standard.
27 c. EN50082-1 - Generic Immunity Standard.
28 d. EN61000-4-4 - Electromagnetic compatibility (EMC). Testing and
29 measurement techniques.
30 e. EN61000-4-5 - Electromagnetic compatibility (EMC). Testing and
31 measurement techniques. Surge immunity test.

32 1.03 DESCRIPTION OF WORK

- 33 A. For the purpose of obtaining a complete and integrated process instrumentation
34 and control system, the work specified herein shall be included under the scope
35 of:
36 1. Section 26 90 00 - Process Instrumentation and Control.

37 1.04 RELATED WORK ELSEWHERE

- 38 A. Article 102 – Bidding Requirements and Conditions
39 B. Article 103 – Award and Execution of the Contract

1 C. Concrete – Division 03

2 D. Metals – Division 05

3 E. Electrical - Division 26

4 1.05 SUBMITTALS

5 A. Submit shop drawings in accordance with Division 01.

6 B. Submit shop drawings for the equipment specified herein as part of the complete,
7 integrated submittal for the process instrumentation & control system and in
8 accordance with the requirements specified under Section 26 90 00 - Process
9 Instrumentation and Control.

10 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

11 A. Submit operation & maintenance manuals and instructions in accordance with
12 Division 01.

13 B. Submit operation and maintenance manuals for the equipment specified herein as
14 part of the complete, integrated manual for the process instrumentation and
15 control system and in accordance with the requirements specified under 26 90 00
16 - Process Instrumentation and Control.

17 1.07 FACTORY TESTING

18 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
19 Control.

20 1.08 QUALITY ASSURANCE

21 A. All materials, equipment, and parts shall be new and unused of current
22 manufacture.

23 B. System supplier shall be responsible for providing all necessary accessories
24 required for a complete and operable system.

25 C. Manufacturer Qualifications: Company specializing in manufacturing products
26 specified in this section, with not less than three years of documented experience.

27 D. Products: Listed and classified by UL or testing firm acceptable to the authority
28 having jurisdiction as suitable for the purpose specified and indicated.

1 1.09 WARRANTY
 2 A. See Division 01 for additional requirements.

3 1.10 EXTRA MATERIALS
 4 A. See Division 01 for additional requirements.

5 1.11 MAINTENANCE
 6 A. Before substantial completion, perform all maintenance activities required by any
 7 sections of the specifications including any calibrations, final adjustments,
 8 component replacements or other routine service required before placing
 9 equipment or systems into service.
 10 B. Furnish all spare parts as required by other sections of the specifications.

11 PART 2 PRODUCTS AND MATERIALS

12 2.01 INSTRUMENTATION AND CONTROL DEVICES
 13

INSTRUMENTATION AND CONTROL DEVICES			
TAG NUMBER	DESCRIPTION	CODE	NOTES
LSH-1-1	HIGH LEVEL ALARM	L2	
LSC-1-3	LAG PUMP START	L2	
LSC-1-2	LEAD PUMP START	L2	
LSC-1-1	PUMPS OFF	L2	
LSL-1-1	LOW LEVEL ALARM	L2	
ANT-6-1	ANTENNA	A1	
NOTES: CONTACTOR AND SYSTEM INTEGRATOR SHALL VERIFY SCHEDULE WITH PLANS.			

14 ~~2.02 A1 YAGI ANTENNA~~
 15 ~~A. Yagi Directional Antenna Remote Site~~

1. ~~Manufacturer:~~
 - a. ~~Kafhrein Inc. RY 900B.~~
 - b. ~~Or equal~~
2. ~~General:~~
 - a. ~~Radome protected Yagi antenna.~~
 - b. ~~Rugged fiberglass radome.~~
 - c. ~~Radiator Material: 3/8 inch, solid 6061 T6 aluminum~~
 - d. ~~Resistant to rain, snow, and ice.~~
 - e. ~~Stainless steel hardware.~~
 - f. ~~Internal connectors. Sealed with foam and potting system.~~
 - g. ~~Capable of V&H polarization.~~
 - h. ~~Lightning Protection: DC grounded~~
 - i. ~~Wind Survival: 120 mph~~
 - j. ~~Mounting Hardware: stainless steel, included~~
 - k. ~~Factory assembled and tuned~~
3. ~~Electrical Specifications~~
 - a. ~~Frequency Range: 890-960 MHz~~
 - b. ~~Factory Tuned Frequency: 898 MHz~~
 - c. ~~Gain: 12dB~~
 - d. ~~Bandwidth at 1.5:1 VSWR:-~~
 - e. ~~Maximum Power: 1000 watts~~
 - f. ~~Horizontal Beam width at 1/2 Power: 48 degrees~~
 - g. ~~Vertical Beam width at 1/2 Power: 40 degrees~~
 - h. ~~Nominal Impedance: 50 Ohms~~
 - i. ~~Front to Back Ratio: 20dB~~
 - j. ~~Termination: N female~~
4. ~~Mechanical Specifications~~
 - a. ~~Weight: 16 lbs~~
 - b. ~~Length: 29 inches ±~~
 - c. ~~Height: 17 inches~~

B. _____

2.032.02 L2 – LEVEL SWITCH, WET WELL FLOAT

- A. Manufacturer
 1. Cox Research, Model OPTI-F160 Float, Model OPTI-TR2 Transceiver
- B. General:
 1. The contractor shall furnish and install all float switches as shown on the drawings and as required for a complete and properly operating system. .
- C. Reference:
 1. NFPA 70 –National Electrical Code, National Fire Protection Association, Latest Edition. B.

1 2. U.L. 508 A – Industrial Control Panels, Underwriters Laboratories, Inc.,
2 Latest Edition.

3 D. Float switches and transceivers

- 4 1. The floats shall use fiber optic cable to transmit a beam of light from a
5 transmitter in the control panel to the float where the beam makes and
6 breaks depending on the tilt of the float. The receiver in the control panel
7 shall detect the presence or absence of light and operate a relay in the
8 receiver. The float shall have no electrical components or metallic wires
9 that could cause arcs and sparks in an explosive atmosphere.
- 10 2. The float switch shall be mercury and lead free and shall be made of all
11 safe, recyclable materials. The float switch housing shall be
12 polypropylene. It shall be a simple robust device designed for many years
13 of dependable service. The beam eclipser shall be stainless steel in an inert
14 non-toxic dampening fluid that prevents chatter due to wave action. The
15 viscosity of the fluid shall not change significantly over the range of –50
16 to +155F (-45 to +70C). The transceivers (transmitter and receiver
17 combination) shall be dual din rail mounted units capable of connection to
18 2 floats. Provide one dual transceiver for every 2 floats. The fiber optic
19 cable shall be custom made for the float and shall consist of dual plastic
20 fibers with an overall specially blended PVC sheath for flexibility. No
21 special tools or experience shall be required for connection of the optical
22 cable to the transceivers. The cable shall be connected and sealed at the
23 float housing using a double seal method that will prevent water from
24 entering the float even if the outer sheath is damaged. The float color shall
25 be two tone with the lighter color on the dome for easier viewing
26 underwater when tilted up.
- 27 3. The transceivers shall operate in ambient temperatures of –15 to +130F (-
28 25 to +55C). The transceivers shall operate at 12 VDC and shall be
29 protected against accidental polarity reversal. The system shall operate in
30 the visible and infrared light region with wavelengths between 400 and
31 1200 nm. The output relays in the receivers shall have the capability of
32 being connected normally open or normally closed. The transceivers shall
33 have a green led power-on light and red led lights on each channel
34 indicating that the light beam is being received – float tilted up. The floats
35 shall operate in liquid temperatures of +32 to +130F (0 to +55C). The
36 floats shall have an ambient air standby operating temperature rating of –
37 15 to +155C (-25 to +70C).
- 38 4. The float switches and transceivers shall be the Optical Float® level
39 detection system by Cox Research and Technology, Inc., Baton Rouge,
40 La. The dual transceivers shall be model TR2, and the floats shall be Opti-
41 Float® model F

42 E. Accessories:

1 SECTION 26 90 30

2
3 PROGRAMMABLE LOGIC CONTROLLERS

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

- 6 A. Applicable provisions of Division 01 shall govern the work of this section.
- 7 B. The Contract Documents are complementary; what is called for by one is as binding
8 as if called for by all.

9 1.02 APPLICABLE PUBLICATIONS

- 10 A. The following publications of the issues listed below, but referred to thereafter by
11 basic designation only, form a part of this specification to the extent applicable. The
12 latest edition accepted by the Authority Having Jurisdiction of the referenced
13 publications in effect at the time of the bid governs
- 14 1. American National Standards Institute/National Fire Protection Agency
15 (ANSI/NFPA), Specifications and Standards, current edition:
 - 16 a. ANSI/NFPA 70 - National Electrical Code and state amendments
17 thereto.
 - 18 b. ANSI/IEEE C37.90 - IEEE Standard for Withstand Capability of
19 Relay Systems to Radiated Electromagnetic Interference from
20 Transceivers.
 - 21 2. ASTM International (ASTM), originally known as the American Society
22 for Testing and Materials, Specifications and Standards, current edition:
 - 23 3. Illuminating Engineering Society (IES). Institute of Electrical and
24 Electronics Engineers (IEEE)
 - 25 4. Insulated Cable Engineers Association (ICEA)
 - 26 5. International Society of Automation (ISA)
 - 27 6. National Electrical Manufacturers Association (NEMA), Specifications and
28 Standards, current edition.
 - 29 a. NEMA ICS 2- Industrial Control and Systems: Controllers,
30 Contactors, and Overload Relays, Rated Not More Than 2000 Volts
31 AC or 750 Volts DC.
 - 32 b. NEMA ICS 3- Industrial Control and Systems: Medium Voltage
33 Controllers Rated 2001 to 7200 Volts AC.
 - 34 7. Underwriters' Laboratories, Inc. (UL), Specifications and Standards,
35 current edition.
 - 36 a. UL508 - Industrial Control Equipment.
 - 37 b. UL508A - Industrial Control Panels.
 - 38 c. UL94 - Tests for Flammability of Plastic Materials for Parts in
39 Devices and Appliances.

- 1 8. Wisconsin Department of Safety and Professional Services (DSPS)
- 2 9. National Electrical Contractors Association (NECA), current edition.
- 3 a. NECA 1 - Standard Practices for Good Workmanship in Electrical
- 4 Contracting.
- 5 10. International Electrical Testing Association (NETA)
- 6 a. NETA STD ATS - Acceptance Testing Specifications for Electrical
- 7 Power Distribution Equipment and Systems.
- 8 11. Canadian Standards Association (CSA), Specifications and Standards,
- 9 current edition.
- 10 a. CSA C22.2, Industrial Control Equipment.
- 11 12. Electrical and Electronic Manufacturers Association Canada (EEMAC),
- 12 Specifications and Standards, Current Edition.
- 13 13. International Electrotechnical Association (IEC), Specifications and
- 14 Standards, Current Edition.
- 15 a. IEC1131-1. Programmable Controllers - Part 1: General
- 16 Information.
- 17 b. IEC1131-2. Programmable Controllers - Part 2: Equipment
- 18 Requirements and Tests.
- 19 c. IEC1131-3. Programmable Controllers - Part 3: Programming
- 20 Languages.
- 21 d. IEC1131-4. Programmable Controllers - Part 4: User Guidelines.
- 22 e. IEC1131-5. Programmable Controllers - Part 5: Communications.
- 23 f. IEC 60529 - Classification of Degrees of Protection Provided by
- 24 Enclosures
- 25 14. CE - European Community, Applicable Directives:
- 26 a. EN50005 - for Terminal Markings.
- 27 b. EN50081-1- Generic Emission Standard.
- 28 c. EN50082-1 - Generic Immunity Standard.
- 29 d. EN61000-4-4 - Electromagnetic compatibility (EMC). Testing and
- 30 measurement techniques.
- 31 e. EN61000-4-5 - Electromagnetic compatibility (EMC). Testing and
- 32 measurement techniques. Surge immunity test.

33 1.03 DESCRIPTION OF WORK

- 34 A. For the purpose of obtaining a complete and integrated process instrumentation and
- 35 control system, the work specified herein shall be included under the scope of:
- 36 1. Section 26 90 00 - Process Instrumentation & Control
- 37 B. Equip programmable logic controllers with memory and functional capacity to
- 38 perform the specified sequence of operation with the scheduled input and output
- 39 points.
- 40 C. Equip programmable logic controller systems with I/O as scheduled on the
- 41 drawings and necessary for the system to function as specified.

1 D. All PLC programming by owner.

2 1.04 RELATED WORK ELSEWHERE

3 A. Article 102 – Bidding Requirements and Conditions

4 B. Article 103 – Award and Execution of the Contract

5 C. Concrete – Division 03

6 D. Metals – Division 05

7 E. Electrical - Division 26

8 1.05 SUBMITTALS

9 A. Submit shop drawings in accordance with Division 01.

10 B. Submit shop drawings for the equipment specified herein as part of the complete,
11 integrated submittal for the process instrumentation & control system and in
12 accordance with the requirements specified under Section 26 90 00 - Process
13 Instrumentation & Control.

14 C. Submit the following information specifically for programmable logic controllers:
15 1. Software configuration consisting of data tables, ladder logic, and other
16 parameters.
17 2. Identify coordination requirements with other sections.

18 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

19 A. Submit operation & maintenance manuals and instructions in accordance with
20 Division 01.

21 B. Submit operation and maintenance manuals for the equipment specified herein as
22 part of the complete, integrated manual for the process instrumentation and control
23 system and in accordance with the requirements specified under 26 90 00 - Process
24 Instrumentation & Control.

25 C. Submit the following information specifically for programmable logic controllers:
26 1. As-built printout of all software configuration including data tables, ladder
27 logic, passwords, and other parameters. Document software with English
28 language descriptions and tag numbers where appropriate.
29 2. Electronic documentation shall include fully annotated electronic copies of
30 all PLC programs. As-built documentation shall include all changes made
31 during the first year of operation.
32 3. Software configuration files shall be included in the manual in two forms:

- 1 a. CD ROM.
- 2 b. Paper.

3 D. Submit software license certificates, manufacturer provided software
4 documentation, and software installation media.

5 1.07 FACTORY TESTING

6 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
7 Control.

8 1.08 QUALITY ASSURANCE

9 A. All materials, equipment, and parts shall be new and unused of current manufacture.

10 B. System supplier shall be responsible for providing all necessary accessories
11 required for a complete and operable system.

12 C. Manufacturer Qualifications: Company specializing in manufacturing products
13 specified in this section, with not less than three years of documented experience.

14 D. Products: Listed and classified by UL or testing firm acceptable to the authority
15 having jurisdiction as suitable for the purpose specified and indicated.

16 1.09 WARRANTY

17 A. See Division 01 for additional requirements.

18 1.10 EXTRA MATERIALS

19 A. See Division 01 for additional requirements.

20 B. Supply one spare 120VAC discrete input/output module of each type supplied for
21 this project

22 C. Supply one spare 24VDC analog input/output module of each type supplied for this
23 project

24 D. Supply one spare of each type of analog input/output module supplied for this
25 project.

26 E. Supply one spare processor of each type supplied for this project

1 1.11 DESIGN REQUIREMENTS (NOT USED)

2 1.12 MAINTENANCE

3 A. Before substantial completion, perform all maintenance activities required by any
4 sections of the specifications including any calibrations, final adjustments,
5 component replacements or other routine service required before placing
6 equipment or systems into service.

7 B. Furnish all spare parts as required by other sections of the specifications.

8 PART 2 PRODUCTS AND MATERIALS

9 2.01 MANUFACTURER

10 A. Acceptable Manufacturers:

11 1. Allen-Bradley

12 2.02 PROGRAMMABLE LOGIC CONTROLLER SYSTEM, COMPACTLOGIX
13 PLATFORM (EXPANDABLE)

14 A. Processor Unit

15 1. Manufacturer:

16 a. Allen-Bradley CompactLogix L30ER

17 2. Processor requirements:

18 a. Input Power: Supplied via chassis power supply module, 1769-PA2.

19 b. Memory:

20 1) User Memory: 1 Mbytes

21 2) Memory Card: 1 Gbyte secure digital (SD) card

22 c. Communication Ports:

23 1) Two 10/100 Mbps Ethernet Port

24 a) EtherNet/IP messaging only

25 2) One built-in USB

26 B. Expansion I/O:

27 1. Analog input module:

28 a. Manufacturer: Allen-Bradley Model 1769-IF4I

29 b. Input points: four isolated differential, individually selectable as
30 current or voltage

31 2. Analog output module:

32 a. Manufacturer: Allen-Bradley Model 1769-OF4CI

33 b. Output points: four isolated, individually selectable as current or
34 voltage

35 3. Digital Input:

36 a. Allen-Bradley Model 1769-IA8I

37 b. Voltage Category/Type: 100 to 120VAC

- c. Operating Voltage: 79 to 132VAC
 - d. Signal Delay, Max.: On: 20.0 ms, Off: 20.0 ms
 - e. Off-State Current, Max.: 2.5 mA
 - f. IEC Input Compatibility: Type 1
 - g. Number of Inputs: 8 isolated
 - h. Bus Current Load, Max.: 115 mADC at 5VDC
 - i. Non-isolated input modules are acceptable for generator and ATS status inputs, 1769-IA16 and 1769-IQ16.
4. Digital output:
- a. Manufacturer: Allen-Bradley Model 1769-OW8I
 - b. Operating Voltage: 5 to 265VAC
 - c. Continuous Current per Output, Max: 2.5A
 - d. Continuous Current per Module, Max: 20A
 - e. Number of Outputs: 8 isolated
 - f. Type of Contact Outputs: Normally open
 - g. Non-isolated output module, 1769-OW8 is acceptable for loads contained within control panel only.
5. RTD input module:
- a. Manufacturer: Allen-Bradley Model 1769-IR6
 - 1) Input points: six (0-3000Ω) resistive inputs
6. Thermocouple input module:
- a. Manufacturer: Allen-Bradley Model 1762-IT6
 - 1) Input points: four thermocouple inputs (Type J, K, T, E, R, S, B, N, C)
7. HART Capable analog input:
- a. Manufacturer: Spectrum Controls Model 1769sc-IF4IH
 - 1) Input points: four individually isolated HART protocol capable inputs

29 PART 3 CONSTRUCTION METHODS

30 3.01 DIVISION OF WORK (NOT USED)

31 3.02 FIELD MEASUREMENTS

- 32 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
33 Control.

34 3.03 DELIVERY STORAGE AND HANDLING

- 35 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
36 Control.

1 3.04 INSTALLATION

2 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
3 Control.

4 B. Provide interconnect cables of the appropriate type as needed.

5 3.05 TESTING AND START-UP SERVICES

6 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
7 Control.

8 3.06 TRAINING

9 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
10 Control.

11 END OF SECTION

1 SECTION 26 90 60

2
3 ETHERNET NETWORKING EQUIPMENT

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

- 6 A. Applicable provisions of Part I shall govern the work of this section.
- 7 B. The Contract Documents are complementary; what is called for by one is as binding
8 as if called for by all.

9 1.02 APPLICABLE PUBLICATIONS

- 10 A. The following publications of the issues listed below, but referred to thereafter by
11 basic designation only, form a part of this specification to the extent applicable. The
12 latest edition accepted by the Authority Having Jurisdiction of the referenced
13 publications in effect at the time of the bid governs
- 14 1. American National Standards Institute/Instrument Society of America
15 (ANSI/ISA), Specifications and Standards, Current Edition:
 - 16 a. ANSI/ISA-5.1-1984 - Instrumentation Symbols and Identification.
 - 17 b. ANSI/ISA-5.3-1983 - Graphic Symbols for Distributed
18 Control/Shared Display Instrumentation, Logic, and Computer
19 Systems.
 - 20 c. ANSI/ISA-95.00.01-2000 - Enterprise Control System Integration,
21 Part 1: Models and Terminology.
 - 22 d. ANSI/ISA-TR99.00.01-2004, Security Technologies for
23 Manufacturing and Control Systems.
 - 24 e. ANSI/ISA-TR99.00.02-2004, Integrating Electronic Security into
25 the Manufacturing and Control Systems Environment.
 - 26 2. Telecommunications Industry Association (TIA), Electronic Industries
27 Alliance (EIA), Specifications and Standards, current edition:
 - 28 a. TIA/EIA-568-A - Commercial Building Telecommunications
29 Wiring.
 - 30 b. TIA/EIA-569-A - Commercial Building Standards for
31 Telecommunications Pathways and Spaces.
 - 32 c. TIA/EIA-606 - Documentation.
 - 33 d. TIA/EIA-607 - Commercial Building Bonding and Grounding
34 Requirements.
 - 35 e. TIA/EIA TSB-67 - Transmission Performance for Field Testing of
36 Unshielded Twisted Pair Cabling Systems.
 - 37 f. TIA/EIA TSB-72 - Centralized Optical Fiber Cabling Guidelines.
 - 38 g. TIA/EIA-526-14 - Optical Power Loss Measurement of Installed
39 Multimode Fiber Cable Plant.

1 h. TIA/EIA-429-AAA - Detail Specification for 62.5 - UM Core
2 Diameter/125-UM Plating Diameter Class 1A Multimode, Graded
3 Index Optical Wave Guide Fibers.

4 1.03 DESCRIPTION OF WORK

5 A. For the purpose of obtaining a complete and integrated process instrumentation and
6 control system, the work specified herein shall be included under the scope of:
7 1. Process Instrumentation and Control - Division 26

8 1.04 RELATED WORK ELSEWHERE

9 A. For the purpose of obtaining a complete and integrated process instrumentation and
10 control system, the work specified herein shall be included under the scope of:

11 B. Article 102 – Bidding Requirements and Conditions

12 C. Article 103 – Award and Execution of the Contract

13 D. Concrete – Division 03

14 E. Metals – Division 05

15 F. Electrical - Division 26

16 1.05 Utilities – Division 33SUBMITTALS

17 A. Submit shop drawings in accordance with Division 01.

18 B. Submit shop drawings for the equipment specified herein as part of the complete,
19 integrated submittal for the process instrumentation & control system and in
20 accordance with the requirements specified under Section 26 90 00 - Process
21 Instrumentation and Control.

22 C. Submit the following information specifically for Ethernet networking equipment:
23 1. Literature sufficient in scope to demonstrate compliance with the
24 requirements of this specification.
25 2. Identify all software licensing requirements.

26 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

27 A. Submit operation/maintenance manuals and instructions in accordance with
28 Division 01.

29 B. Submit operation and maintenance manuals for the equipment specified herein as
30 part of the complete, integrated manual for the process instrumentation and control
31 system and in accordance with the requirements specified under 26 90 00 - Process
32 Instrumentation & Control.

- 1 C. Submit the following information specifically for Industrial Ethernet Network:
2 1. As-built printout of all software configuration including data tables,
3 passwords, and other parameters.
4 2. Connection diagrams for each individual piece of equipment.
5 3. Complete riser diagram indicating all equipment and interconnecting
6 components with indication of location of each device.
7 4. Complete front elevation drawing of equipment rack and exact component
8 layout within rack.
9 5. Provide copy of written warranty.
10 6. Complete test reports for fiber optic cable. Provide a fiber test form which
11 includes the following:
12 a. Date and time of:
13 1) Fiber installation.
14 2) Fiber termination.
15 3) Testing.
16 b. Testing equipment used information including:
17 1) Make.
18 2) Model.
19 3) Date of calibration.
20 c. Name of person performing test and the installers.
21 d. dB loss of each connector installed.
22 e. dB loss of each fiber segment.
23 f. End to end attenuation.
24 g. Optical Time Domaine Reflectometer (OTDR) Signature trace.
25 h. Cable shall be tested at the following frequencies:
26 1) 850 nm.
27 2) 1300 nm.
28 7. Complete test report for category 6 cabling. Provide test form which
29 includes the following:
30 a. Date and time of:
31 1) Cable installation.
32 2) Cable termination.
33 3) Testing report.
34 b. Testing equipment used information including:
35 1) Make.
36 2) Model.
37 3) Date of calibration.
38 c. Name of person performing test and the installers.
39 d. Provide in spreadsheet format. Cable number with test reporting of
40 cable length at near-end crosstalk and attenuation at frequency MHz
41 at 1, 4, 10, 20 and 100. Also indicate room number of each jack.
42 8. Submit software license certificates, manufacturer provided software
43 documentation, and software installation media.

1 1.07 FACTORY TESTING

2 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
3 Control.

4 1.08 QUALITY ASSURANCE

5 A. All materials, equipment, and parts shall be new and unused of current manufacture.

6 B. System supplier shall be responsible for providing all necessary accessories
7 required for a complete and operable system.

8 C. Manufacturer Qualifications: Company specializing in manufacturing products
9 specified in this section, with not less than three years of documented experience.

10 D. Products: Listed and classified by UL or testing firm acceptable to the authority
11 having jurisdiction as suitable for the purpose specified and indicated.

12 1.09 WARRANTY

13 A. See Division 01 for additional requirements.

14 1.10 EXTRA MATERIALS

15 A. See Division 01 for additional requirements.

16 1.11 DESIGN REQUIREMENTS (NOT USED)

17 1.12 MAINTENANCE

18 A. Before substantial completion, perform all maintenance activities required by any
19 sections of the specifications including any calibrations, final adjustments,
20 component replacements or other routine service required before placing
21 equipment or systems into service.

22 PART 2 PRODUCTS AND MATERIALS

23 2.01 INDUSTRIAL ETHERNET NETWORK SWITCH, 8-PORT

24 A. Manufacturer:
25 1. Allen Bradley Stratix 2000

26 B. General
27 1. Unmanaged Ethernet switch
28 2. 8 ports minimum
29 3. 25% spare ports minimum
30 4. Din Rail Mount
31 5. IEEE 802.3 Compliance

1 2.02 UTP CONTROL CABLE

2 A. Manufacturer:

3 ~~1. Belden 7953A~~

4 ~~2. Or equal.~~

5 1. Allen Bradley 1585 Ethernet Cable

6 B. General:

7 1. DataTuff 6

8 2. Bonded pairs

9 3. 600V rated cable

10 4. Industrial CAT 6

11 5. 23 AWG solid bare copper

12 6. Gigabit Ethernet

13 7. Shielded

14

15 PART 3 CONSTRUCTION METHODS

16 3.01 DIVISON OF WORK(NOT USED)

17 3.02 FIELD MEASUREMENTS

18 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
19 Control.

20 3.03 DELIVERY STORAGE AND HANDLING

21 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
22 Control.

23 3.04 INSTALLATION

24 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
25 Control.

26 3.05 TESTING AND START-UP SERVICES

27 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
28 Control.

29 3.06 TRAINING

30 A. Refer to the requirements of Section 26 90 00 - Process Instrumentation and
31 Control.

32

END OF SECTION

1 SECTION 31 05 19.13

2 GEOSYNTHETICS FOR EARTHWORK

3 PART 1 GENERAL

4 1.01 APPLICABLE PROVISIONS

5 A. Applicable provisions of Part I shall govern work of this section.

6 1.02 APPLICABLE PUBLICATIONS

7 A. The following publications of the issues listed below, but referred to thereafter by
8 basic designation only, form a part of this specification to the extent indicated by the
9 reference thereto.

- 10 1. American Society for Testing and Materials (ASTM), Annual Book of
11 ASTM Standards, Current Edition.
12 2. State of Wisconsin, Department of Transportation, Standard Specifications
13 for Highway and Structure Construction, Current Edition at time of bid
14 opening.

15 1.03 DESCRIPTION OF WORK

16 A. The work under this section shall cover furnishing and installing geotextile fabrics
17 for structural excavation and backfill of structures in accordance with the contract
18 drawings and specified herein, and in accordance with Section 645 of the State of
19 Wisconsin, Department of Transportation, Standard Specifications.

20 1.04 RELATED WORK ELSEWHERE

- 21 A. Packaged Sewage Lift Station – Division 33
22 B. Structural Excavation for Structures – Division 33

23 1.05 SUBMITTALS

24 A. Contractor shall submit such product literature and catalog cuts of materials to be
25 supplied to relate these materials to the specifications. Information shall be in
26 conformance with requirements of Submittals - Division 01 of these specifications.

27 B. The Contractor shall furnish to the Engineer at least ten days prior to use in the work
28 a manufacturer's Certified Report of Test or Analysis that the geotextile fabric
29 delivered for use conforms to this specification. The delivered geotextile fabric shall
30 bear markings to clearly identify it with the applicable test report furnished to the
31 Engineer.

32 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

1 PART 2 PRODUCTS AND MATERIALS

2 2.01 GENERAL

3 A. The geotextile fabric shall consist of either woven or nonwoven polyester,
4 polypropylene, stabilized nylon, polyethylene or polyvinylidene chloride. All fabric
5 shall have the minimum strength values in the weakest principal direction.
6 Nonwoven fabric may be needle punched, heat bonded, resin bonded, or
7 combinations thereof.

8 B. The geotextile fabric shall be insect, rodent, mildew, and rot resistant.

9 C. The geotextile fabric shall be furnished in a wrapping which will protect the fabric
10 from ultraviolet radiation and from abrasion due to shipping and hauling. The
11 geotextile is to be kept dry until installed.

12 D. The geotextile fabric rolls shall be clearly marked showing the type of fabric.

13 E. Samples of fabric for testing may be obtained from the job site as specified herein or
14 as determined by the Engineer.

15 F. If sewn seams are used, the Contractor shall furnish a field sewn seam sample
16 produced from the geotextile fabric and thread and with the equipment to be used on
17 the project, prior to its incorporation into the work.

18 G. All numerical values specified below represent minimum/maximum average roll
19 values (i.e., the average of minimum test results on any roll in a lot should meet or
20 exceed the minimum specified values).

21 2.02 GEOTEXTILE FABRIC

22 A. The fabric shall comply with the following physical properties:

23 Test	Method	Value
24 Grab Tensile Strength, lbs	ASTM D 4632	170 min.
25 Apparent Opening Size, 26 U.S. Standard Sieve	ASTM D 4751	70 max.
27 Permittivity, SEC ⁻¹	ASTM D 4491	0.35 min.

28 B. Acceptable materials are Geotex 701, Thrace-LINQ 160EX, Mirafi 170N, and
29 US 180 NW, or equal.

30 PART 3 CONSTRUCTION METHODS

31 3.01 GENERAL

32 A. Installation procedures shall be in accordance with manufacturer's recommendations
33 and as specified herein.

- 1 B. Sewing. All factory and field seams shall be sewn with a thread having the same or
2 greater durability as the material in the fabric. A 401 stitch conforming to Federal
3 Standard No. 751a shall be used for all seams. All seams shall develop a tensile
4 strength equal to or greater than 60 percent of the specified grab tensile strength of
5 the fabric, unless otherwise specified.

6 3.02 GEOTEXTILE FABRIC

- 7 A. Prior to the placement of the geotextile fabric, the subgrade shall be smoothed,
8 shaped and compacted to the required grade, section, and density. After the fabric
9 has been placed on the subgrade area, no traffic or construction equipment will be
10 permitted to travel directly on the fabric.
- 11 B. The fabric shall be rolled out on the roadway and pulled taut manually to remove
12 wrinkles. Separate pieces of fabric shall be joined by overlapping or sewing. The
13 fabric in the overlapped joints shall be placed with a minimum overlap of 18 inches.
- 14 C. Weight or pins may be required to prevent lifting of the fabric by wind.
- 15 D. After placement, the fabric shall be exposed no longer than 48 hours prior to
16 covering.
- 17 E. The base course material shall be placed over the fabric by back dumping with trucks
18 and leveling with a crawler dozer. Construction equipment shall be such that ruts do
19 not exceed 3 inches in depth. All ruts shall be filled with additional material. The
20 smoothing of ruts without adding additional material will not be permitted.
21 Damaged areas shall be covered with a patch of fabric using a 36 inch overlap in all
22 directions.

23 PART 4 MEASUREMENT AND PAYMENT

24 4.01 GENERAL

- 25 A. Geosynthetics for earthworks shall be paid for at the bid price in accordance with one
26 of the following methods, unless indicated otherwise in the Bid Schedule or Special
27 Provisions.
- 28 B. All work specified herein shall be considered in each of the measurement and
29 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or
30 Special Provisions.

31 4.02 GEOTEXTILE FABRIC

- 32 A. Geotextile Fabric, Inclusive. Geotextile fabric related to the Lift Station as shown on
33 the contract drawings and as outlined in the Project Manual shall be considered
34 inclusive to payment for work associated with the Lift Station, per Lump Sum.

1 SECTION 31 23 16.16

2
3 STRUCTURAL EXCAVATION FOR STRUCTURES

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

6 A. Applicable Provisions of Part I shall govern work of this section.

7 1.02 APPLICABLE PUBLICATIONS

8 A. The following publications of the issues listed below, but referred to thereafter by
9 basic designation only, form a part of this specification to the extent indicated by the
10 reference thereto.

- 11 1. American Society for Testing and Materials (ASTM), Annual Book of
12 ASTM Standards, Current Edition.
- 13 2. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational
14 Safety and Health Administration (OSHA), Department of Labor - Part 1926
15 Regulations, Current Edition.
- 16 3. State of Wisconsin, Department of Transportation, Standard Specifications
17 for Highway and Structure Construction, Current Edition at time of bid
18 opening.

19 1.03 DESCRIPTION OF WORK

20 A. The work under this section shall include all excavation, backfill and compaction for
21 structures and other miscellaneous excavation, backfill and compaction required but
22 not designated under other sections.

23 1.04 RELATED WORK ELSEWHERE

- 24 A. Part II – Earthwork and Miscellaneous Construction
- 25 B. Part V – Sewers and Sewer Structures
- 26 C. Packaged Sewage Lift Station – Division 33

27 1.05 SUBMITTALS (NONE)

28 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS (NONE)

1 PART 2 PRODUCTS AND MATERIALS

2 2.01 INSITU BACKFILL MATERIAL

3 A. Previously excavated soil or material free of organic debris, clay balls, and aggregate
4 larger than 1-1/2 inches as approved by the Engineer.

5 2.02 IMPORTED GRANULAR FILL AND GRANULAR FOUNDATION

6 A. Imported granular fill and granular foundation shall be sand conforming to State of
7 Wisconsin, Department of Transportation, Standard Specifications Section 209.2.2,
8 Grade No. 1 Granular Backfill or well-graded sand and gravel conforming to State of
9 Wisconsin, Department of Transportation, Standard Specifications Section 305.2.2.1
10 1-1/4 inch dense graded base with not more than eight percent (8 percent) by weight
11 passing a No. 200 sieve.

12 PART 3 CONSTRUCTION METHODS

13 3.01 BARRICADES

14 A. Provide sufficient barricades and protective devices adjacent to excavations to
15 safeguard against injury. Provide and maintain sufficient safety lanterns at walks,
16 roadways and parking areas to provide safety at night.

17 3.02 EXCESS MATERIAL

18 A. To the extent needed, all suitable excavated materials shall be used for foundation
19 backfill and site grading. The suitability of materials for specific purposes shall be
20 determined by the Engineer. All surplus or unsuitable excavated materials will be
21 designated as waste and used only for site grading or be disposed of by the
22 Contractor.

23 3.03 EXCAVATION

24 A. All structural excavation shall be in accordance with the Geotechnical Investigations
25 & Reports included within the Contract Documents.

26 B. Excavate to achieve necessary dimensions, lines, grades and cross sections. Notify
27 the Engineer of any remaining pockets of organic or unsuitable soil, debris, existing
28 foundations or poorly compacted fill soils. Unsuitable materials shall be removed
29 and replaced with compacted granular fill or backfill material. Bottoms of trenches
30 shall be excavated to proper grade so that structures will be supported on a firm bed
31 of undisturbed natural earth or suitable, compacted backfill.

- 1 C. The required minimum soil bearing capacities for the new structures shall be as
2 shown in the Contract Drawings, or as listed in the geotechnical report, whichever
3 value is greater.
- 4 D. At all times when active excavation, backfilling, or other construction work is
5 occurring in the excavations, and lasting until these activities are completed and
6 accepted, ample means and equipment shall be provided with which to remove
7 promptly, and dispose of properly, all water entering any excavation or other parts of
8 the work. The excavations shall be kept dry and groundwater levels shall be kept at a
9 minimum of 2-feet below the bottom of all excavations to prevent a quicksand
10 condition in the excavation bottom.
- 11 E. All hardpan, stiff soils, and boulders encountered shall be included in the Work
12 specified by this Section. See geotechnical report for further information. It shall be
13 the responsibility of the Contractor to familiarize himself with the subsurface
14 conditions on-site before submitting his bid.

15 3.04 UNAUTHORIZED EXCAVATION

- 16 A. Consists of removal of materials beyond indicated elevations or dimensions without
17 specific direction of the Engineer. Notify the Engineer when unauthorized
18 excavations are made.

19 3.05 STABILITY OF EXCAVATION

- 20 A. Slope sides of excavations to comply with local codes and ordinances having
21 jurisdiction. Provide shoring and bracing to retain banks and prevent collapse of
22 excavations as necessary to safeguard workmen, prevent movement of adjacent
23 ground, and avoid damage to existing improvements.
- 24 B. Means and methods of excavation are the responsibility of the Contractor including
25 dewatering and earth retention systems. See geotechnical report for additional
26 considerations.

27 3.06 COLD WEATHER PROTECTION

- 28 A. Protect excavation bottoms against freezing when atmospheric temperature is less
29 than 35 degrees Fahrenheit.

30 3.07 BACKFILLING AND COMPACTION

- 31 A. Fill activities shall be in accordance with the Geotechnical Investigations & Reports
32 included in the Contract Documents.
- 33 B. Place backfill to bring excavations to natural grade unless otherwise noted. Backfill
34 within foundation walls and outside foundation walls to a distance of 10 feet outside

1 the building line and under pavements and walks shall be spread and compacted
2 uniformly in 6 inch to 8 inch lifts to at least 95 percent maximum dry density per
3 modified proctor (ASTM D1557).

4 C. Place and compact granular fill from the specified over-excavation elevation as
5 shown on the Drawings, or as required by the Geotechnical Engineer, in 8-inch lifts
6 to 95% maximum dry density per modified proctor (ASTM D1557) up to the
7 elevation of the recommended geotextile wrapped, coarse crushed stone layer.

8 D. Site backfill placed outside a distance 10 feet from the building line shall be spread
9 uniformly in 12 inch maximum lifts and trench backfill and similar work shall be
10 with approved excavated material or granular backfill compacted in 8 inch maximum
11 lifts to 93 percent dry density per modified proctor (ASTM D1557).

12 E. Backfill shall not be placed against any concrete structure which retains earth until
13 the concrete has been in place 14 days or until test cylinders show the concrete
14 strength to be at least 3000 pounds per square inch, nor shall high-early-strength
15 concrete structures be backfilled before 6 days after the day of pouring or until test
16 cylinders show the strength of the concrete to be at least 3000 pounds per square
17 inch. Concrete structures which have earth on both sides (i.e., footings, frost walls,
18 etc.), may be backfilled uniformly on both sides after the concrete has been in place 4
19 days, or 2 days for high-early-strength concrete. In no case shall backfilling start
20 before required curing and protection, surface finishing, dampproofing, and
21 waterproofing of the work to be covered by backfilling has been completed. When
22 so permitted by the Engineer, footings may be backfilled uniformly on all sides to the
23 top of such footing immediately upon removal of forms.

24 F. Contractor shall provide all necessary equipment required to obtain specified
25 compaction. Compaction by travel of grading equipment is not considered adequate
26 for uniform compaction. Small vibratory compactors are required wherever fill is
27 placed adjacent to structures, foundation walls, footings and piers.

28 G. Backfilling shall be so performed as to prevent wedging action against the structure.
29 Slopes within ten feet of the structure shall be stepped, terraced, or otherwise treated
30 as necessary to prevent slippage and wedging of the backfill.

31 H. Water shall not be used to expedite settlement of the backfill except to adjust
32 moisture content to optimize compaction. The groundwater level shall be kept below
33 the level of the lift of material being compacted.

34 3.08 SAMPLING

35 A. All required sampling, preparing of specimens, and testing except as modified by
36 these specifications shall be performed by an independent laboratory and paid for by

1 the Owner. The laboratory shall meet the requirements of ASTM E329. The
2 Engineer shall determine when compaction tests shall be made.

3 3.09 TESTING

4 A. Any testing required because of failure of backfill to meet specification requirements
5 shall be paid for by the Contractor.

6 PART 4 MEASUREMENT AND PAYMENT

7 4.01 GENERAL

8 A. Structural excavation, backfilling and compaction shall be paid for at the bid price in
9 accordance with one of the following methods, unless indicated otherwise in the Bid
10 Schedule or Special Provisions.

11 B. All work specified herein shall be considered in each of the measurement and
12 payment method(s) stipulated, unless indicated otherwise in the Bid Schedule or
13 Special Provisions.

14 4.02 STRUCTURAL EXCAVATION FOR STRUCTURES

15 A. Structural Excavation for Structures, Inclusive. Structural excavation for structures
16 related to the Lift Station as shown on the contract drawings and as outlined in the
17 Project Manual shall be considered inclusive to payment for work associated with
18 Sanitary Sewer Lift Station, per Lump Sum.

19 4.03 IMPORTED GRANULAR FILL AND GRANULAR FOUNDATION

20 A. Imported Granular Fill and Granular Foundation, Inclusive Imported granular fill
21 and granular foundation related to the Lift Station as shown on the contract drawings
22 and as outlined in the Project Manual shall be considered inclusive to payment for
23 work associated with Sanitary Sewer Lift Station, per Lump Sum..

24 END OF SECTION

1 SECTION 33 32 13.15

2
3 PACKAGED SUBMERSIBLE LIFT STATION

4 PART 1 GENERAL

5 1.01 APPLICABLE PROVISIONS

- 6 A. Applicable provisions of Division 01 and City of Madison Standard Specifications
7 shall govern work of this section.

8 1.02 APPLICABLE PUBLICATIONS

- 9 A. The following publications of the issues listed below, but referred to thereafter by
10 basic designation only, form a part of this specification to the extent indicated by the
11 reference thereto.

- 12 1. American National Standards Institute (ANSI)
- 13 a. ANSI B16.1 – Standard Specification for 125 lb. Standard Flat Face
 - 14 Cast Iron Flanges
 - 15 b. ANSI/AWWA C115/ A21.15 - Standard for Flanged Ductile-Iron
 - 16 Pipe With Threaded Flanges
 - 17 c. ANSI/AWWA C111/ A21.11 - Rubber-Gasket Joints for Ductile-Iron
 - 18 Pressure Pipe and Fittings
 - 19 d. ANSI/ AWWA C110/A21.10 - American National Standard for
 - 20 Ductile-Iron and Gray-Iron Fittings for Water
 - 21 e. ANSI/AWWA C104/A21.04 - Cement-Mortar Lining for Ductile-
 - 22 Iron Pipe and Fittings
- 23 2. American Society for Testing and Materials (ASTM), Annual Book of
24 ASTM Standards:
- 25 a. ASTM A36 - Specification for Structural Steel, Current Edition
 - 26 b. ASTM A48 - Standard Specification for Gray Iron Castings
 - 27 c. ASTM A126 -Standard Specification for Gray Iron Castings for
 - 28 Valves, Flanges, and Pipe Fittings
 - 29 d. ASTM A743 - Standard Specification for Castings, Iron-Chromium,
 - 30 Iron-Chromium-Nickel, Corrosion Resistant, for General Application
 - 31 e. ASTM D883 – Definitions of Terms Relating to Plastics
 - 32 f. ASTM D3753 – Standard Specification for Glass-Fiber-Reinforced
 - 33 Polyester Manholes
- 34 3. American Water Works Association (AWWA), Specifications and Standards,
35 Current Edition.
- 36 a. AWWA C600 - Installation of Ductile-Iron Mains and Their
 - 37 Appurtenances
- 38 4. American Welding Society (AWS), Specifications and Standards, Current
39 Edition.
- 40 5. Code of Federal Regulations (CFR), Title 29, Chapter XVII - Occupational
41 Safety and Health Administration (OSHA), Department of Labor, Part 1926
42 Regulations, Current Edition.

- 1 6. Federal Communications Council (FCC), Specifications and Standards,
2 Current Edition.
- 3 7. National Electric Code (NEC), Specifications and Standards, Current
4 Edition.
- 5 8. National Electrical Manufacturers Associations (NEMA), Specifications and
6 Standards, Current Edition.
- 7 9. State of Wisconsin Administrative Code, Department of Natural Resources
8 Environment Protection General:
9 a. NR 110 - Sewage Systems, Current Edition.
- 10 10. Steel Structures Painting Council (SSPC), Specifications and Standards,
11 Current Edition.

12 1.03 DESCRIPTION OF WORK

- 13 A. The Contractor shall furnish and install a factory built packaged submersible
14 wastewater pumping station complete with all equipment installed in a wet well with
15 integral valve vault, pumps, piping, valves, supports, vent, access covers, and
16 accessories. The work shall include all labor and materials to provide a complete
17 operating lift station to the Owner. Refer to drawings for additional information.

- 18 B. Valves and other appurtenances identified as part of the proposed forcemain shall
19 comply with the Section.

- 20 C. The station shall be the product of a manufacturer who is experienced, skilled and
21 regularly engaged in the design and fabrication of this type of equipment. The
22 general design of the station shall be such that all working parts are readily
23 accessible for inspection and repairs, easily duplicated and replaced, and each and
24 every component suitable for the service required. The lift station shall be in
25 conformance with all requirements of local, state, and federal agencies, and all
26 applicable industry codes. In order to receive consideration, the manufacturer shall
27 submit full descriptive material on the proposed equipment, including detailed
28 structural and equipment specifications, dimension prints, pump performance curves,
29 wiring diagrams and operational data, local service facilities, and list of installations
30 in the State of Wisconsin. The manufacturer must clearly state or show any
31 exceptions taken to the contract drawings and specifications.

- 32 D. The packaged submersible lift station shall be designed for Class 1, Groups C and D,
33 Division 1 hazardous locations as defined by the National Electric Code.

- 34 E. The section includes coordination with electrical contractor to ensure the proper
35 installation of electrical power and control system. Additional costs due to
36 inadequate coordination as required herein shall be borne solely by the Contractor.

37 1.04 RELATED WORK ELSEWHERE

- 38 A. Part I – General Conditions

1 B. Part V – Sewers and Sewer Structures

2 C. Division 05 - Metals

3 D. Division 26 - Electrical

4 1.05 SUBMITTALS

5 A. The Contractor shall submit such Submittals and/or catalog cuts required for the
6 construction and installation of the equipment. These drawings shall be accurate in
7 every detail and shall contain all information necessary to relate the equipment to the
8 specifications.

9 B. The Contractor shall provide a list, catalog cuts and descriptive information of all
10 instrumentation and control equipment components to be provided with the Package
11 Lift Station.

12 C. Submittals shall indicate the intended equipment arrangement, major support
13 requirements, plot area, and process flow.

14 D. Submittals shall be submitted which indicate the internal control schematics and
15 remote equipment, such as motor starters, flowmeters, etc. Submittals shall be
16 submitted which indicate equipment and terminal block layout for interconnections
17 to remote equipment.

18 1.06 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS

19 A. The manuals shall include operating and maintenance literature for all components
20 provided. The submitted literature shall be in sufficient detail to allow for the
21 installation, operation, adjustment, calibration, maintenance and removal of each
22 component provided.

23 B. Preparation of this document shall be in conformance with the Submittal
24 requirements specified herein. The Contractor shall submit to the Engineer for
25 review, an outline of any variations of information for the operation and maintenance
26 manuals and other documentation he proposes to prepare.

27 PART 2 PRODUCTS AND MATERIALS

28 2.01 MANUFACTURER

29 A. The packaged submersible lift station shall be as manufactured by Topp Industries,
30 Inc. and shall include pump equipment specified herein as manufactured by Xylem,
31 Inc. or Fairbanks Morse Corporation.

32 B. The specifications and physical layout shown on the drawings are based Topp
33 Industries and Xylem, Inc. equipment.

1 2.02 FIBERGLASS (FRP) STATION STRUCTURE

- 2 A. Materials: Fiberglass Reinforced Polyester Wet Well (and Integral Valvebox):
3 Unless otherwise indicated the plastic terminology used in this specification shall be
4 in accordance with the definitions given in American Society for Testing and
5 Materials (ASTM) designations D883 - Definitions of Terms Relating to Plastics.
- 6 B. Resins: The resins used shall be a commercial grade polyester and shall be evaluated
7 as a laminate by test or determined by previous service to be acceptable for the
8 intended environment. The resins used may contain the minimum amount of fillers or
9 additives required to improve handling properties. Up to 5% by weight of thixotropic
10 agent, which will not interfere with visual inspection, may be added to the resin for
11 viscosity control. Resins may contain pigments and dyes by agreement between
12 manufacturer and engineer, recognizing that such additives may interfere with visual
13 inspection of FRP laminate quality
- 14 C. Reinforced Material: The reinforcing material shall be a commercial grade of glass
15 fiber (continuous strand, chopped-strand, continuous mat and non-continuous mat)
16 having a coupling agent, which will provide a suitable bond between the glass
17 reinforcement material and resin. Pump chamber shall be completely vapor sealed
18 from wetwell.
- 19 D. Laminate Structure: The FRP laminate shall consist of a resin rich inner surface:
20 chop-spray interior liner; and, a chop-hoop filamentwound structural exterior layer.
- 21 1. Inner surface:
- 22 a. The resin rich inner surface shall be free of cracks and crazing with
23 smooth finish and with an average of not over two (2) pits per square
24 foot, providing the pits are less than 0.125 inches in diameter and
25 0.3125 inches in depth and are covered with sufficient resin to avoid
26 exposure of any fiberglass reinforcement material. Some waviness
27 shall be permissible as long as the surface is smooth. Between 0.01 to
28 0.02 inches of resin, rich surface shall be provided.
- 29 b. Chop-Spray Interior Liner: The interior liner shall be reinforced by
30 25 to 35% by weight of chopped strand glass fiber having fiber
31 lengths from 0.5 to 2.0 inches. The chop-spray interior liner protects
32 the chop-hoop filament-wound structural exterior liner from
33 corrosion damage caused by “wicking” of the wet well liquid
34 contents. A minimum of 0.100 inches of chop-spray interior liner
35 shall be provided.
- 36 c. Chop-Hoop Filament-Wound Structural Exterior Layer:
- 37 1) The structural reinforcement of the wet well shall be by the
38 chop-hoop filament-wound manufacturing method only. The
39 axial reinforcement shall be continuous-strand glass fiber.
40 The longitudinal reinforcement shall be chopped-strand glass
41 fiber. The glass fiber reinforcement content of the chop-hoop
42 filament wound structural exterior layer shall be 50 to 80% by

1 weight. The exterior surface of the wet well shall be relatively
2 smooth with no exposed reinforcement fibers or sharp
3 projections. Hand finish work is permissible to prevent
4 reinforcement fiber exposure. The wall thickness of the chop-
5 hoop filament-wound structural exterior layer shall vary with
6 the wet well height to provide the aggregate strength
7 necessary to meet the tensile and flexural physical properties
8 requirements.

9 E. Physical Properties: Wet Well FRP Wall Laminate: The wet well FRP wall laminate
10 must be designed to withstand wall collapse or buckling based on the following
11 assumptions and third party specifications:

- 12 1. Hydrostatic Pressure of 62.4 lbs. per square foot
- 13 2. Saturated soil weight of 120 lbs. per cubic foot
- 14 3. Soil Modulus of 700 pounds per square foot
- 15 4. Pipe stiffness values as specified in ASTM D3753

16 The wet well FRP laminate must be constructed to withstand or exceed two
17 times the assumed loading on any depth of the wet well.

18 F. Wet Well FRP Bottom Laminate: The wet well FRP bottom laminate shall have less
19 than 0.375 inches of center elastic deflection (deformation) when in service in totally
20 submerged conditions.

21 G. FRP Laminate Surface Hardness: The finished FRP laminate will have a Barcol
22 Hardness of at least 90% of the resin manufacturer's specified hardness for the fully
23 cured resin. The Barcol Hardness shall be the same for both interior and exterior
24 surfaces.

25 H. Wet Well Top Flange: The wet well top flange shall have an outside diameter at
26 least 4.0 inches greater than the inside diameter of the well. A six-hole pattern shall
27 accommodate the mounting of a cover with at least 0.375 inches in diameter 300
28 series stainless steel fasteners. Non-corroding stainless steel threaded inserts shall be
29 fully encapsulated with noncontinuous mat or chopped-strand glass fiber
30 reinforcement. The inserts shall have an offset tab to prevent stripping or spinning
31 out when removing and reinserting cover fasteners.

32 I. Steel Anti-Floatation Flange: The steel anti-floatation flange shall be constructed
33 from 0.1875 inches thick ASTM A36 structural steel plate, encapsulated in at least
34 0.125 inches of chopped-strand glass fiber reinforcement on all sides. The steel
35 antifloatation flange shall be square with outside dimensions of at least 4.0 inches
36 greater than the wet well inside diameter. The steel anti-floatation flange shall be
37 attached to the wet well bottom with chopped-strand glass fiber reinforcement.
38 Contractor shall place the wet well on a concrete pad and fill with grout covering the
39 entire steel anti-floatation flange. The amount of grout shall be sufficient to prevent
40 floatation of the wet well based on the jobsite conditions. The steel anti-floatation
41 flange shall not require bolt holes to secure it to the concrete pad.

- 1 J. Inlet and Discharge Coupling: A sufficient quantity and type of “Link-Seal” type
2 modular, mechanical, inter-locking, synthetic rubber links shaped to continuously fill
3 the annular space between the discharge pipe and the aluminum sleeve shall be used
4 to provide a hydrostatic seal. The aluminum sleeve shall be bolted on the wet well or
5 valvebox wall and sealed with silicone sealer.
- 6 K. Electrical Coupling: A 304 stainless steel NPT full coupling shall be factory
7 installed with at least 0.375 inches in diameter 300 series stainless steel fasteners.
8 The wet well wall penetrations shall be sealed with silicone sealer.
- 9 L. Float and Level Transducer Bracket: Bracket shall be fabricated from 300 series
10 stainless steel with compression style cord grips to maintain float and transducer
11 level positions. It shall be factory installed with at least 0.375 inches in diameter 300
12 series stainless steel fasteners. The wet well wall penetrations shall be sealed with
13 silicone sealer.
- 14 M. Access Covers:
- 15 1. Wet well and integral valvebox covers shall be constructed of 0.250 inches
16 thick mill finish aluminum diamond plate with 300 series stainless steel
17 hardware. The access hatch shall have a recessed handle and locking pin. The
18 hatch shall be held open in the vertical position by means of a hold open arm
19 of corrosion resistant design. Covers shall be mounted to the wet well and
20 integral valvebox with a least six 300 series stainless steel fasteners of at
21 least 0.375 inches in diameter.
 - 22 2. Doors shall be provided with stainless steel hinges with tamper-proof
23 fasteners. Doors shall be provided with an aluminum lifting handle, and
24 stainless steel locking bar, or stainless steel snap-lock with removable key
25 handle.
 - 26 3. Doors furnished with a frame drain shall have drain piping supplied by
27 contractor to a suitable location as indicated by the Engineer.
 - 28 4. When closed the door and all accessories shall provide a smooth surface.
 - 29 5. Access lids for pad lock enclosure shall be secured in the flush position.
 - 30 6. The door shall have a continuous EPDM debris gasket between door and
31 frame.
 - 32 7. Doors shall be single leaf, as required by pump manufacturer.
 - 33 8. Each door shall be provided with fall protection. Secondary grating shall be
34 provided below access cover.
 - 35 a. Grating made from aluminum or fiberglass designed to support a live
36 load of 300 PSF. Grate shall be hinged to frame with stainless steel
37 hinges and a hold arm capable of holding grate in the fully open 90-
38 degree position. Stainless steel lifting assists and padlock-able hasp
39 required.
 - 40 b. Grating shall allow for access of sewer cleaning equipment. This
41 access shall consist of a 4” slot between fall protection grating and
42 the hatch frame or provide a minimum of two 4-inch by 4-inch

1 banded opening within the grating. Maximum allowable opening
2 between hatch frame and grating is 6”

- 3 9. A warning sign shall be attached to each door cover reading the following:
4 “CAUTION - Confined Space: Dangerous/hazardous gases. Do not enter
5 without proper equipment and supervision.”

6 N. Valve Vault Access Ladder:

- 7 1. Fabricate ladder of Aluminum (ASTM B221, alloy 6063-T6) to dimensions
8 coordinated with pre-fabricated vessel manufacturer.
9 2. Ladders shall conform to the requirements of 29 CFR Chapter XVII, Part
10 1926 OSHA 1926.450 and meet the loading and configuration requirements
11 of the “Safety Code for Fixed Ladders”, ANSI A14.3-56.
12 3. Side rails: continuous ½ by 2 ½ inch aluminum flat bars, with eased edges,
13 spaced 18 inches apart.
14 4. Bar rungs: ¾ inch minimum diameter aluminum bars, spaced 12 inches on
15 center. Fit rungs in centerline of side rails; plug-weld and grind smooth on
16 outer rail faces. Each run must support a load of at least 250 lbs. applied in
17 the middle of the rung.
18 5. Support each ladder top and bottom and not more than 60 inches on center
19 with welded or bolted aluminum brackets. Size brackets to support design
20 loads specified in OSHA Standard 1917.118 and ANSI A14.3. The support
21 brackets shall be length such that minim distance between the rung and
22 center line and the nearest permanent object behind the rung is 7 inches.
23 6. Provide corrugated, knurled, or dimpled rungs or provide non-slip surfaces
24 on top of each rung by coating with abrasive material metallically bonded to
25 rung.
26 7. Furnish & install below hatch cover, LadderUP safety post Model LU-4 as
27 manufactured by The Bilco Company or approved equal. Device shall be
28 aluminum with mill finish. It shall be designed with telescoping tubular
29 section that locks automatically when fully extended. Upward and downward
30 movement shall be controlled by a stainless steel spring balancing
31 mechanism. Unit shall be completely assembled with fasteners for securing
32 to the ladder rungs in accordance with the manufacturers instructions.

- 33 O. Vent: Provide 4-inch diameter stainless steel vent with insect screen and
34 weatherhood.

35 2.03 PUMPS

- 36 A. The system shall be designed to permit surface level removal of the pumping unit for
37 inspection or service without dewatering the pump chamber or interrupting operation
38 of the other units in the pumping system. The pumps, when lowered into place, shall
39 automatically connect to the discharge piping with a positive action.
40 B. Submersible pumps shall be manufactured by Xylem-Flygt or Fairbanks-Nijhuis.

1 C. The specifications and physical layout shown on the drawings are based upon Topp
2 Industries Lift Station and Xylem-Flygt pumping system.

3 D. Operating Criteria: Each pump shall meet or exceed design pumping conditions as
4 follows:

5	Pump Application	Municipal Wastewater			
6	Pump Location	Lift Station			
7	Model#:	Flygt Model NP3102 SH			
8		Fairbanks Model 5432MVK			
9	Quantity of Pumps	Two (2)			
10	Discharge Size:	4-inch			
11	Design Points	<u>Condition</u>	<u>Flow (gpm)</u>	<u>TDH (ft.)</u>	<u>Eff. (%)</u>
12		#1	100	29	39
13		#2	140	24	45
14		#3	200	16	53
15	Minimum Shutoff Head	33 feet			
16	Pump Speed	1750 RPM max.			
17	Maximum Motor HP	Five (5)			
18					

19 Each unit shall produce the specified flow at given head, a minimum efficiency, and
20 maximum speed for each operating condition specified above.

21 E. Each pump shall be designed for pumping storm water/raw sewage/septic effluent.

22 F. The pump shall be non-overloading throughout the entire range of operation without
23 employing service factor. The pump shall reserve a minimum service factor of 1.15.
24 The performance curve submitted for approval shall state in addition to head and
25 capacity performance, the pump efficiency, pump speed, solids handling capacity
26 and reflect motor service factor.

27 G. Pump Construction:

28 1. Pump volute shall be single piece, gray iron ASTM A48, Class 30 with
29 smooth internal surfaces free of rough spots, gas holes, or flashing. Scroll
30 type volute design which tends to unbalance from wear resulting in shaft
31 stress shall not be considered equal or acceptable. All exposed nuts or bolts
32 shall be AISI Grade 304 stainless steel or brass construction. All metal
33 surfaces coming into contact with the liquid, other than stainless steel or
34 brass, shall be protected by a factory applied spray coating of alkyd primer
35 with a chlorinated rubber paint finish on the exterior of the pump.

36
37 2. Pump shall be automatically and firmly connected to the discharge. Sealing
38 of the pump to the discharge connection shall be accomplished by a
39 machined metal-to-metal watertight contact. Critical mating surfaces where
40 watertight sealing is required shall be machined and fitted with Nitrile or
41 Viton rubber O-rings. Fittings will be the result of controlled compression of

1 rubber O-rings in two planes and O-ring contact of four sides without the
2 requirement of a specific torque limit. Rectangular cross-sectioned gaskets
3 requiring specific torque limits to achieve compression shall not be
4 considered adequate or equal. No secondary sealing compounds, grease or
5 other devices shall be used. Sealing of the discharge interface with a
6 diaphragm, O-ring or profile gasket will not be acceptable. No portion of the
7 pump shall bear directly on the sump floor.
8

- 9 3. The solid handling type impeller shall be gray iron, ASTM A48, Class 30,
10 dynamically-balanced, double-shrouded non-clogging design having a long
11 through let without acute turns. The impeller shall be one or two vane fully
12 enclosed and the nose of the impeller shall extend into the volute so that the
13 diameter may be trimmed to meet various Special Procedures of head and
14 capacity while still retaining the factory balance. All impellers shall have
15 pump out vanes on the back shroud. Mass moment of inertia calculations
16 shall be provided by the pump manufacturer upon request. All impellers shall
17 be retained with an allen head bolt and shall be capable of passing a 3 inch
18 solid. All impellers shall be coated with alkyd resin primer.
19
- 20 4. A wear ring system shall be used to provide efficient sealing between the
21 volute and suction inlet of the impellers. The wear ring shall be stationary
22 and made of brass, which is drive fitted to the volute inlet.
23
- 24 5. Pump and motor shaft shall be the same unit. The pump shaft shall be an
25 extension of the motor shaft. Couplings shall not be acceptable. The pump
26 shaft shall be AISI Grade 304 stainless steel.

27 H. Motors:

- 28 1. The submersible pump shall be driven by a completely sealed electric
29 submersible motor of 5 horsepower, 1.15 service factor, 1750 rpm, for
30 operation on 208 volts, 3 phase power. The motor nameplate horsepower
31 rating shall not be exceeded by the brake horsepower requirements of the
32 pump for the specified head and GPM conditions.
33
- 34 2. The submersible pump motor shall be designed for a Class 1 Groups C and
35 D, Division 01 hazardous location as defined by the National Electric Code.
36 The motor shall be listed with Underwriters Laboratories as Class 1, Groups
37 C and D, Division 01, explosion-proof, for installation in water or sewage.
38 The motor shall be housed in an air filled, watertight chamber, NEMA B
39 rated. The stator winding and stator leads shall be insulated with moisture
40 resistant Class F insulation rated for 311 degrees F (155 degrees C). The
41 stator shall be dipped and baked with Class F varnish and shall be heat-shrink
42 fitted to the stator housing. The use of bolts, pins or other fastening devices
43 requiring penetration of the stator housing is not acceptable.
44

- 1 3. The motor shall be designed for continuous duty handling liquid media of
2 104 degrees F (40 degrees C) and capable of up to 15 starts per hour. The
3 rotor bars and short circuit rings shall be a made of cast aluminum. Thermal
4 switches set to open at 260 degrees F (125 degrees C) shall be embedded in
5 the stator lead coils to monitor the temperature of each phase winding. These
6 thermal switches shall be used in conjunction with and supplemental to
7 external motor overload protection and shall be connected to the control
8 panel.
9
- 10 4. The combined service factor (combined effect of voltage, frequency and
11 specific gravity) shall be a minimum of 1.15. The motor shall have a voltage
12 tolerance of plus or minus 10 percent. The motor shall be designed for
13 operation up to 104 degrees F (40 degrees C) ambient and with a temperature
14 rise up to 176 degrees F (80 degrees C). A performance chart shall be
15 provided showing curves for torque, current, power factor, input/output kW
16 and efficiency. This chart shall also include data on starting and no-load
17 characteristics. The motor horsepower shall be adequate so that the pump is
18 non-overloading throughout the entire pump performance curve from shut-off
19 through run-out.
20
- 21 5. The motor shaft shall be stainless steel, impervious to the liquid and waste
22 materials being handled. All external hardware including the motor
23 nameplate shall also be made of stainless steel.
24
- 25 6. The pump shall be provided with an oil chamber for the shaft sealing system.
26 The oil chamber shall be designed to prevent overfilling and to provide oil
27 expansion capacity. The drain and inspection plug with positive anti-leak
28 seal shall be easily accessible from the outside. The seal system shall not
29 rely upon the pumped liquid for lubrication. The motor shall be capable of
30 operating dry without damage while pumping under load.
31
- 32 a. Tandem mechanical shaft seal system consisting of two independent
33 seal assemblies, inside an oil chamber that hydrodynamically
34 lubricates the lapped seal faces at a constant rate. The lower, primary
35 seal unit, located between the pump and the oil chamber, shall
36 contain one stationary and one positively driven rotating tungsten
37 carbide ring. The upper secondary seal unit, located between the oil
38 chamber and the motor housing, shall contain one stationary ceramic
39 seal ring and one positively driven rotating carbon seal ring. Each
40 seal interface shall be held in contact by its own ring system. The
41 seals shall require neither maintenance nor adjustment nor depend on
42 the direction of rotation for sealing, and one outside shall provide
43 double protection for the electrical parts. Two moisture-sensing
44 probes shall be used to detect any influx of conductive liquid past the
45 outer seal and provide ample warning of first seal failure.

- 1 b. Shaft seals without positively driven rotating members, or
2 conventional double mechanical seals containing either a common
3 single or double spring acting between the upper and lower seal
4 faces. Cartridge type systems will not be acceptable. No system
5 requiring a pressure differential to offset pressure and to effect
6 sealing shall be used.
7
8 7. Motor bearings shall be permanently pre-lubricated at the factory. The upper
9 bearing shall be a single groove ball bearing. The lower bearing shall be a
10 two row angular contact bearing to compensate for axial thrust and radial
11 forces.
12
13 8. Motor winding shall have a special Class F insulation system providing 1.15
14 service factor and extended life. Automatic reset, normally closed thermal
15 overloads shall be installed in adjacent phases of the motor winding to
16 provide the overheating protection.
17
18 9. The stator shall be securely held in place with a removable end ring and
19 threaded fasteners so that it may be easily removed. Pumps that require the
20 stator to be removed using heat or press fit are not considered acceptable.
21 Air filled motors that require additional external cooling methods are also not
22 considered acceptable. The pumps are to be explosion-proof and meet all
23 requirements for Class I, Group D, Division I hazardous location.

24 I. Power Cord:

- 25 1. Electrical power cord shall be sized per the NEC and ICEA standards and
26 shall have sufficient length to reach the junction box without splices.
27 Electrical power cord shall have an outer jacket which is resistant to oil and
28 other materials normally found in sewage. Power cord is to be sealed, not
29 only by use of a cord grip, but shall have individual conductors sealed into
30 the cord cap assembly with epoxy sealing compound. The epoxy seal shall
31 be repeated where the conductors enter the motor from the connection box
32 which is mounted on top of the motor housing. The cord cap and connection
33 box shall be sealed with an O-ring. Power cord shall run continuously from
34 motor to control panel.
35
36 2. Power cord shall run continuously from motor to control panel.

37 J. Seal Sensor:

- 38 1. A leakage seal sensor shall be provide to sense water in the stator chamber
39 shall be fitted with a float switch. When activated, the Float Leakage Sensor
40 (FLS) shall stop the motor and send an alarm. The use of voltage sensitive
41 solid-state sensors shall not be acceptable. A separate or panel mounted
42 alarm shall be supplied to indicate water in the sealed chamber.

43 K. Heat Sensor:

1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 260 degrees F (125 degrees C) the thermal switches shall open, stop the motor and activate an alarm. The use of voltage sensitive solid-state sensors and trip temperature above 260 degrees F (125 degrees C) shall not be acceptable. A separate or panel mounted alarm shall be supplied to indicate pump overheating.

L. Factory Testing:

1. Commercial testing shall be required and include the following:
 - a. The pump shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase, and hertz.
 - b. The motor seal and housing chambers shall be Megger-ed for infinity to test for moisture content or insulation defects.
 - c. Pump shall be allowed to run dry to check for proper rotation.
 - d. Discharge pipe shall be attached, the pump submerged in water, and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator shall be replaced.
 - e. The pump shall be removed from the water, Megger-ed again, dried and the motor housing filled with dielectric oil.
2. In addition to the above commercial testing, a special megger test shall be performed and include the following:
 - a. The pump shall be submerged in water and allowed to run at maximum load for 30 minutes.
 - b. A written report on the above shall be prepared by the test engineer, certified, and submitted to the Engineer.
3. A hydrostatic test shall also be performed on the pump. The hydrostatic test shall require that the volute and impeller be removed and a fixture installed to hold the spring and lower mechanical seal in place. A double plate, gasket, and through-bolt shall be installed on the pump. A discharge mating flange, gasket and pressure fitting shall be installed. The inlet port, volute, and discharge nozzle shall then be pressurized with water to 150 percent of the maximum pump shut off pressure. This hydrostatic pressure shall be maintained for at least 5 minutes and the housing checked for leaks and/or loss of pressure.
4. A non-witnessed Hydraulic Institute performance test shall be performed. This shall include the following:
 - a. The pump shall be tested at the design point as well as at least four other points to develop a curve. Data shall be collected to plot the head-capacity curve as well as a KW input and amperage curve.
 - b. In making these tests, no minus tolerance or margin shall be allowed with respect to capacity, total head, or efficiency at the specified design condition. Pump shall be held within a tolerance of 10 percent of rated capacity or at rated capacity with a tolerance of 5 percent of rated head. The pump shall be tested at shut-off but not be plotted

1 and only used as a reference point when plotting the performance
2 curve.

3 c. Complete records shall be kept of all information relevant to the test
4 as well as the manufacturer's serial number, type and size of pump as
5 well as any impeller modifications made to meet the design
6 conditions.

7 d. A written test report shall be prepared, signed and dated by the test
8 engineer, incorporating three curves (head-capacity, KW input, and
9 amperage) along with the pump serial number, test number, date,
10 speed, volts, phase, impeller diameter, and certification number. This
11 report shall then be submitted to the Engineer.

12 M. Pump Base and Guide Rails:

13 1. A separate mounting plate shall be furnished for each pump. These shall
14 include guide rail supports and pump discharge elbow to align with hydraulic
15 seal flange and pump discharge. Plates and fittings shall be coated with a tar
16 base epoxy. Sealing face of discharge elbow shall be heavily coated with
17 zinc to provide a smooth corrosion resistant surface. The carrier shall be
18 designed such that lifting is done from the carrier and no strain is placed on
19 the pump or guide rails.

20 2. The guide rails shall be 2 inch Schedule 40 stainless steel pipe. Each pump
21 shall be furnished with 5/32 inch minimum diameter stainless steel cable for
22 lifting out the pumps. The cable shall be of sufficient length and attach to the
23 pump so as to provide a direct pull over the center of weight.

24 2.04 ELECTRICAL POWER AND CONTROL SYSTEM

25 A. The electrical and control system shall be as specified in Division 26.

26 2.05 PIPING

27 A. Exposed Ductile Iron (DI): Pipe shall meet the requirements of ANSI/AWWA
28 C115/A21.15; Class 53. Joint construction shall be flanged type with required bolts
29 and full face gasket, meeting the requirements of ANSI/AWWA C111/ A21.11.
30 Fittings shall be ductile iron, meeting the requirements of ANSI/ AWWA
31 C110/A21.10. Where stainless steel bolts are used, they shall be installed with a
32 heavy coating of anti-seize compound. Standard cement mortar lining shall meet the
33 requirements of ANSI/AWWA C104/A21.04. All exposed ductile iron pipe shall be
34 primed and painted in accordance with manufacturer recommendations and these
35 specifications.

36 B. Buried Ductile Iron (DI). Pipe shall meet the requirements of ANSI AWWA C151/
37 A21.51; Class 52. Fully body fittings shall be ductile iron, meeting the requirements
38 of ANSI/AWWA C110/A21.10. Compact fittings shall be ductile iron, meeting the
39 requirements of ANSI/AWWA C153/A21.53. Standard cement mortar lining shall
40 meet the requirements of ANSI/AWWA C104/A21.04. Joint construction shall be
41 either push-on type or mechanical joint type (meeting the requirements of

1 ANSI/AWWA C111/A21.11). Push-on type shall be rubber gasket type slip joint;
2 “Fastite”, “Bell-Tite”, “Tyton”, or equal. Mechanical joints shall have plain rubber
3 gaskets. Water pipe and other piping as designated shall receive conductivity straps.
4 Metal wedges are not acceptable.

- 5 C. All buried ductile iron pipe and fittings shall receive polyethylene encasement.
6 Polyethylene encasement shall be polyethylene film tube conforming to
7 ANSI/AWWA C105/A21.5. Polyethylene film sheet conforming to ANSI/AWWA
8 C105/A21.5 may be used at odd-shaped appurtenances where the use of tube is not
9 practical. The polyethylene film shall be clearly marked with the information
10 required in ANSI/AWWA C105/A21.5.

11 2.06 VALVES

- 12 A. All buried valves shall be furnished with extension stems which extend to within one
13 foot of the finished grade elevation. The extension stem shall have a 2-inch
14 operating nut and be mechanically connected to the valve operator. Furnish one
15 valve operating key with the same required key length per every ten buried valves.

- 16 B. Buried valves shall have polyethylene encasement conforming to AWWA C105,
17 Type I, 8 mil thickness.

- 18 C. All valves to be tagged with 1-1/2 inch diameter brass valve tags with 1/4 high black
19 enamel filled letters. Each valve number shall consist of an identifying letter prefix
20 with a maximum of five characters followed by a number with a maximum of four
21 characters. Valve numbers to be supplied by Engineer.

- 22 D. Valve ends shall conform to ANSI B16.1, Class 125 flanges or mechanical joints to
23 match the piping system.

- 24 E. Only manufacturers with a local state certified factory representative shall be
25 allowed to supply equipment.

26 F. Plug Valves:

- 27 1. Plug valves shall be of the non-lubricated eccentric type with resilient faced
28 plugs and shall be furnished with end connections as shown on the plans.
29 Port areas for all valves shall be minimum 80 percent full pipe area for
30 rectangular port, and 100 percent of pipe diameter area. Plug valves shall be
31 Val-Matic, or equal.

- 32 2. Valve Bodies shall be of ASTM A126 Class B cast iron compliance with
33 AWWA C504 Section 2.2. Bodies in 3 inch and larger shall be furnished
34 with a welded overlay seat of not less than 90 percent pure nickel, minimum
35 thickness of 1/8 inch and in accordance with AWWA C507 Section 7.2. Seat
36 area shall be raised, with raised surface completely covered with weld to
37 insure that the plug face contacts only nickel. Valves utilizing resilient seats
38 attached to the body shall not be acceptable. As per AWWA C504 Section

1 35.2 and AWWA C507 Section 7.2, sprayed or plated seats are not
2 acceptable, nor shall screwed-in seats be acceptable.

3 3. Plugs shall be of ASTM A126 Class B cast iron in compliance with AWWA
4 C504, Section 2.2. The plug shall be of one-piece construction and shall be
5 capable of withstanding the full pressure rating of the valve without the use
6 of additional structural reinforcing ribs that extend beyond the profile of the
7 plug itself. Plugs shall be resilient faced with neoprene or hycar, suitable for
8 use with sewage. Plugs with cast inlays shall not be acceptable.

9 4. Valves shall have sleeve type metal bearings conforming to AWWA C504,
10 Section 3.6 and AWWA C507, Section 8. Bearings shall be of sintered, oil
11 impregnated and permanently lubricated type 316 ASTM A743 Grade CF-
12 8M or AISI Type 317L stainless steel in 1/2 inch through 36 inch sizes. Grit
13 seals shall be required in the upper and lower journals to protect the bearings.
14 Non-metallic bearings shall not be acceptable.

15 5. Valve shaft seals shall be of the multiple V-ring type or U-cup and shall be
16 externally adjustable or self-adjustable, repackable without removing the
17 bonnet or actuator from the valve, and repackable under pressure. Shaft seals
18 shall conform to AWWA C504, Section 3.7 and AWWA C507, Section 10.2.
19 Valves utilizing O-ring seals shall not be acceptable. All exposed nuts,
20 bolts, springs, washers, etc., shall be stainless steel for buried or submerged
21 valves and zinc plated for all others.

22 6. Valve pressure ratings shall be 175 psi. Each valve shall be given a
23 hydrostatic and seat test with test results being certified when required by the
24 specifications. Valves shall provide driptight shut off with pressure in either
25 direction.

26 7. Manual valves shall have enclosed worm gear actuators with seals and
27 gaskets rated for corrosive, wet duty, stainless steel bolts and fasteners, tee
28 wrenches, extensions stems, and supports. Worm gears shall be designed and
29 certified to withstand input loads of up to 300 ft.lbs. minimum at the stops,
30 without damage. Gear actuators shall be rated for bi-directional shutoff at
31 the design pressure rating of the valve. All gearing shall be enclosed in a
32 semi-steel housing and be suitable for running in a lubricant with seals
33 provided on all shafts to prevent entry of dirt and water into the actuator.
34 The actuator shaft and the quadrant shall be supported on permanently
35 lubricated bronze bearings. Actuators shall clearly indicate valve position
36 and an adjustable stop shall be provided to set closing torque. All exposed
37 nuts, bolts, and washers shall be zinc plated.

38 8. Buried valves shall be furnished with solid cast iron or hot-dipped galvanized
39 steel hollow shaft extension stems for increased corrosion resistance. Stems
40 shall extend to within one foot of the finished grade elevation. The extension
41 stem shall have a 2-inch operating nut and be mechanically connected to the
42 valve operator. Minimum of two (2) wrenches for each plant site area (50 ft
43 x 50 ft area) with buried valves. Valves shall include stainless steel stem
44 guides at 5 ft O.C.

1 G. Check Valves:

- 2 1. Provide Swing-Flex Series 500, ASTM A536 Grade 65-14-12, Class B
3 ductile iron body and cover, molded Buna-N (NBR) ASTM D2000-BG disc,
4 flanges per ANSI B16.1, Class 125, interior and exterior coated with fusion
5 bonded epoxy, manual operator, mechanical disc position indicator and
6 backflow actuator as manufactured by Val-Matic, or equal.
- 7 2. The valve shall have a 150 psi rated body constructed of high-strength cast
8 iron conforming to ASTM A126 Class B with integral flanges, faced and
9 drilled per ANSI B16.1 Class 125 and be suitable for horizontal or vertical
10 installation. Valve materials and construction certified for wastewater and
11 sludge use.
- 12 3. The valve body shall be the full waterway type, designed to provide an open
13 flow area not less than the nominal inlet pipe size when swung open no more
14 than 25 degrees. The valve shall have a replaceable stainless steel body seat.
- 15 4. Valve disc shall be cast iron and faced with a renewable resilient seat ring of
16 rubber or other suitable material, held in place by a follower ring and
17 stainless steel screws.
- 18 5. The disc arm shall be ductile iron or steel, suspended from and keyed to an
19 austenitic stainless steel shaft located completely above the waterway and
20 supported at each end by heavy bronze bushings. The shaft shall rotate freely
21 without the need for external lubrication. The shaft shall be sealed where it
22 passes through the body by means of a stuffing box and adjustable packing.
23 Simple o-ring shaft seals are not acceptable.
- 24 6. The valve shall be supplied with an outside lever and adjustable
25 counterweight to initiate valve closure. Valve closure shall be dampened by
26 means of a single, side-mounted, stationary, bronze air-cushion assembly
27 directly mounted to the valve body on machined pads. The amount of
28 cushioning shall be easily adjustable without the need for pre-charged air
29 chambers.
- 30 7. The valve shall swing open smoothly at pump start and close quickly and
31 quietly upon pump shutdown to prevent flow reversal. When closed, the
32 valve shall seat drop tight.

33 2.07 PIPING IDENTIFICATION

- 34 A. Identify all process piping with its process designation and direction of flow; identify
35 with semi-rigid, snap-on acrylic-plastic identification markers at 15 foot intervals, at
36 each change of direction, and adjacent to each point it passes through a wall, floor or
37 ceiling; comply with ANSI and OSHA pipe mark requirements.
- 38 B. Identify pipes less than 1 inch in diameter with brass tags, 1-1/2 inch in diameter
39 with depressed 1/4 inch high black enamel-filled letters, securely fastened at 5 foot
40 intervals.

1 2.08 PIPE HANGERS & SUPPORTS

- 2 A. Pipe hangers shall consist of ceiling flange threaded rod, and adjustable clevis type
3 hanger constructed of carbon steel.
- 4 B. Vertical piping shall be supported at each floor and at intervals determined by the
5 vertical load involved. Riser clamps shall be supported on spring hangers. Short
6 risers shall include a saddle at the bottom and may require an additional hanger at the
7 top. Longer risers may require over-sized U-bolts or similar devices to prevent
8 lateral motion.
- 9 C. Pipe supports where ceiling mounted to concrete surfaces shall consist of a base
10 flange, support rod with threaded ends for height adjustment, and a saddle type or
11 stanchion type support as required.
- 12 D. Pipe supports shall be wall-mounted brackets where pipelines are located within 3-
13 feet of walls. Maintain minimum of 7-foot clearance under supports.
- 14 1. Provide U-bolt attachment, roller, or pipe saddle above the bracket.
15 2. Where clearance is limited, suspend clevis hanger from wall bracket.
16 3. Provide floor-mounted type support stands with adjustable pipe column,
17 circular cradle, and floor attachment flange where wall or ceiling mount are
18 not feasible and maintenance access will not be interrupted.
- 19 E. Install hangers and supports as required to support piping shown on plans; conform
20 to American Standard Code for Pressure Piping, ANSI B31.1. Provide galvanized or
21 stainless structural steel members required for supporting or anchoring piping and
22 accessories.
- 23 1. Exterior and underwater pipe supports shall be type 316 stainless steel.
24 2. Pipe supports in wet atmosphere or corrosive chemical areas, shall be type
25 316 stainless steel.
26 3. Interior room locations not subject to wet or corrosive conditions shall have
27 pipe supports of hot-dipped galvanized steel construction.
- 28 F. Design and locate supports, anchors, rollers and guides and show on shop drawing
29 submittal subject to acceptance of Engineer.
- 30 1. Absence of pipe support and details on the drawings shall not relieve the
31 Contractor of responsibility for providing supports.
32 2. Maintain equipment maintenance clearance around all equipment and
33 operator and equipment removal egress paths throughout all Rooms.

34 2.09 FIXTURE SUPPORTS

- 35 A. Wall hung fixtures, hanger plates, support arms or mounting lugs shall be fastened to
36 the wall by through bolts where appearance of the bolts is not objectionable. Exposed
37 bolt heads in finished areas shall be hexagonal and painted. Exposed nuts shall be
38 chromium plated hexagonal cap nuts. Washers shall be painted or chromium plated
39 to match bolt heads or nuts.

1 2.10 EXPANSION JOINTS

2 A. Expansion joints shall be of the bellow type with filled arches suitable for
3 temperatures of minus 20 degrees F to plus 180 degrees F equipped with limit bolts
4 to restrict maximum extension.

5 2.11 PIPELINE TAPS

6 A. Pipeline Tapping Saddles: Sizes ½ inch through 3 inch diameter, provide double-
7 strap bronze body saddle with gasket and two stainless steel clamping bands,
8 assembly rated for 150 psig. Provide saddles at all locations, unless indicated
9 otherwise on the drawings.

10 2.12 PAINTING

11 A. All exposed metal piping, exposed fittings, all valves and bollards shall be painted.
12 Stainless steel surfaces, code-required labels or equipment name, identification,
13 performance rating, or nomenclature plates should not be painted.

14 B. Painting of all exposed piping, valves, and fittings shall be completed prior to start-
15 up and performance testing of the lift station.

16 C. Submit product data for paint system. Product data shall include, but not be limited
17 to, manufacturer's information on products intended use, application procedures, and
18 material properties.

19 D. Paint System: the following system is based on Tnemec brand productions.
20 Contractor may use alternate brands only if approved by the Engineer.

- 21 1. Shop surface preparation: Abrasive blast clean in accordance with SSPC-
22 SP10 near-white blast cleaning standards. Apply primer before any rust
23 bloom appears.
- 24 2. Shop prime coat: apply one even coat of Tnemec Series N69-Color at 3.0 to
25 5.0 mils DFT.
- 26 3. Field touch-up: spot blast in accordance with SSPC-SP10 near-white blast
27 cleaning standards. Apply one coat of Tnemec Series N69-Color at 3.0 to 5.0
28 mils DFT.
- 29 4. Intermediate coat: apply one even coat of Tnemec Series N69-Color at 4.0 to
30 6.0 mils DFT.
- 31 5. Finish coat: apply one even coat of Tnemec Series N69-Color at 4.0 to 6.0
32 mils DFT.

1 PART 3 CONSTRUCTION METHODS

2 3.01 INSPECTION AND TESTING

- 3 A. Leakage is not permissible on any exposed line or any line that will be placed under
4 pressure or suction. The Contractor shall at his own expense locate and repair the
5 defective joints.
- 6 B. Inspection and testing requirements shall comply with City of Madison Standard
7 Specifications, Part V – Sewers and Sewer Structures.

8 3.02 PUMP FIELD PERFORMANCE TEST

- 9 A. Each pump shall be tested after installation to check the guaranteed performance.
10 The Contractor shall furnish and install all gauges and accessories required for this
11 test and shall run each pump in the duplex system as directed by the Engineer. The
12 Contractor shall provide field data taken from at least three different operating points
13 for comparison with pump curves. The Contractor shall record the individual shutoff
14 head for each pump for comparison with pump curves. The Contractor shall also
15 record amp readings in each leg for each pump to check for motor imbalance and
16 excessive amp draw by the motor. The Contractor shall be responsible for all
17 adjustments or replacements necessary.
- 18 B. Any defects in the equipment or failure to meet the guarantees or requirements of the
19 specifications shall be promptly corrected by the Contractor by replacements or
20 otherwise. The decision of the Engineer as to whether or not the Contractor has
21 fulfilled his obligations under the contract shall be final. If the Contractor fails or
22 refuses to make these corrections or if the improved equipment, when tested shall
23 again fail to meet the guarantees of the Contractor, the Owner, notwithstanding its
24 ownership of work and materials which have entered into the manufacture of said
25 equipment, shall have the option of rejecting said equipment or of accepting the same
26 at such reduced price as may be agreed upon by the parties hereto.

27 3.03 INSTALLATION

- 28 A. From the time the lift station is delivered to site until final acceptance, the Contractor
29 shall protect the lift station from flooding, freezing, or excessive humidity. If
30 temporary electric power is necessary, that expense shall be borne by this Contractor.
31 The Contractor shall make periodic inspections of the lift station to check for any
32 possible problems including flooding or equipment failure. In the event of damage
33 due to the Contractor failing to maintain the lift station as outlined above, all
34 expenses necessary to restore the lift station in first class working order shall be
35 borne by the Contractor.
- 36 B. After the job installation is completed, a qualified factory representative shall place
37 the station in operation, conduct a complete functional check, and make all necessary
38 adjustments for regular service. The Owner shall be given four complete operating

1 and maintenance manuals. Factory representative shall provide four man-hours of
2 startup service and four hours of operator training. Factory representative shall
3 provide four copies of certified station operation report.

4 3.04 GUARANTEE

- 5 A. The manufacturer of the lift station shall guarantee for one year from the date of start
6 up that the entire station and all equipment therein shall be free from defects in
7 design, materials and workmanship. In the event a component fails or is proven
8 defective during the guarantee period, the manufacturer shall provide replacement
9 parts without cost. The labor required to repair or replace major items including the
10 structure, sewage pumps and/or motors, valves or fittings shall also be furnished
11 without charge. The labor to replace accessory items such as the dehumidifier, sump
12 pump, alternator, etc., that should become defective during this period, shall be
13 provided by the Contractor. Normal use items such as grease, light bulbs,
14 mechanical seals, packing and belts are excluded.

- 15 B. The station manufacturer shall maintain a permanent service station in the State of
16 Wisconsin equipped with the necessary repair parts, shop and field service facilities,
17 and trained personnel to guarantee continuous operation of this installation.

18 PART 4 MEASUREMENT AND PAYMENT

19 4.01 PACKAGE LIFT STATION

- 20 A. Lift Station will be paid for on a lump sum basis at the contract price. Price shall be
21 paid in full for all excavation, bedding, by-pass pumping, back filling, compaction,
22 testing, startup, and furnishing of all materials, fittings, tools, equipment, labor and
23 incidentals necessary to complete the work in accordance with the contract
24 documents. Electrical connection to utility, back-up generator, fencing, and all valves
25 and piping necessary for proper lift station functionality shall be included in the lump
26 sum price.

- 27 B. All Dewatering required for lift station construction shall be included in the trench
28 dewatering bid item.

29
30 END OF SECTION

1 SECTION 33 51 13

2
3 NATURAL-GAS PIPING

4 PART 1 GENERAL

5 1.01 WORK INCLUDED

6 A. Natural gas piping from meter to generator as specified herein, and as needed for a
7 complete and proper installation including, but not necessarily limited to:

- 8 1. Gas service.
9 2. Piping, fittings, valves, regulators, appurtenances, etc.
10 3. Mechanical Identification. Sleeves.
11 4. Caulking of penetrations, openings, and fixtures.

12 B. Coordinate service, with required meter, with local gas utility.

- 13 1. Verify gas service pressure at connection.
14 2. Coordinate installation of concrete pad for gas service.

15 1.02 RELATED SECTIONS

16 A. Documents affecting work of this section include, but are not necessarily limited to,
17 General Conditions, Supplementary Conditions, and Sections in Division 01 of these
18 specifications.

19 B. Division 31 – Earthwork: Requirements for trenching and backfilling.

20 1.03 WORK OF OTHER SECTIONS

21 A. Openings for work in walls, floor, roof, ceiling, etc., required by this section shall be
22 provided under other sections. Locations and size of these openings shall be the
23 responsibility of this Contractor.

24 B. Division 03 - Concrete.

25 C. Division 07 – Joint Sealeants

26 D. Division 09 – High Performance Coatings

27 E. Division 26 - Electrical

28 1.04 GENERAL PROVISIONS

29 A. Everything essential for the completion of the work implied to be covered by these
30 Specifications to make the System ready for normal and proper operation must be
31 furnished and installed by the Contractor. Accordingly, any omission from either the
32 plans or the Specifications, or both, of details necessary for the proper installation

1 and operation of the system shall not relieve the Contractor from furnishing such
2 detail in full and proper manner.

- 3 B. The plans show various details indicating the general arrangement of the gas piping
4 work, sizes and locations of piping, etc. The said plans with figures, lettering, etc.,
5 shall be considered a part of these Specifications and no charge or alternation shall
6 be made in either case unless ordered by the Engineer.

7 1.05 QUALITY ASSURANCE

- 8 A. Perform work in accordance with State of Wisconsin and industry standards.

9 B. Qualification of Installer:

- 10 1. Company specializing in performing the work of this section with minimum
11 three (3) years documented experience.
12 2. In acceptance or rejection of installed work, the Architect or Engineer shall
13 make no allowances for lack of skill on part of the installers.
14 3. Use adequate numbers of skilled workers who are thoroughly trained and
15 experienced in the necessary crafts and who are completely familiar with the
16 specified requirements and the methods needed for proper performance of the
17 work of this Section.
18 4. All work shall be installed in a first class manner by State of Wisconsin
19 licensed plumbers.

20 C. Qualification of Manufacturer:

- 21 1. Company specializing in manufacturing products specified in this section
22 with a minimum of 10 years experience. Manufacturer shall conform to the
23 ratings and certifications indicated.
24 2. Equal products shall be of similar quality, be functionally similar, and have
25 the controls specified. Where more than one type of product is specified in a
26 particular section, the listed acceptable manufacturers may not have an equal
27 product for every type of product specified.

28 D. Codes and regulations:

- 29 1. In addition to complying with the specified requirements, comply with
30 pertinent regulations of governmental agencies having jurisdiction.
31 2. In the event of conflict between or among specified requirements and
32 pertinent regulations, the more stringent requirement will govern when so
33 directed by the Engineer.

- 34 E. The following standards, referred hereafter by basic designation only, are imposed,
35 as applicable to work in each instance, and form a part of this specification to the
36 extent indicated by the reference thereto:

- 37 1. ANSI - American National Standards Institute
38 2. ASME - American Society of Mechanical Engineers
39 3. ASTM - American Society for Testing and Materials

1 1.06 COORDINATION

- 2 A. Cooperate and coordinate with other trades to assure that all systems in the work may
3 be installed in the best arrangement. Coordinate as required with all other trades to
4 share space in common areas and to provide the maximum of access to each system.
- 5 B. Locate equipment properly to provide easy access, and arrange entire work with
6 adequate access for operation and maintenance.
- 7 C. Give right-of-way to piping which must slope for drainage.

8 1.07 DELIVERY, STORAGE, AND HANDLING

- 9 A. Accept valves, regulators, etc., on site in factory packaging. Inspect for damage.

10 1.08 CLOSEOUT SUBMITTALS

- 11 A. Section Project Closeout: Closeout provisions.
- 12 B. Project Record Documents and As-Built: Record actual location of equipment and
13 fixtures including items remotely within walls or above ceilings, etc.
- 14 C. Operation and Maintenance Data and Instructions:
 - 15 1. Submit manufacturer's descriptive literature, operating instructions, service
16 instructions, installation instructions, maintenance and repair data, parts
17 listing, warranties, and wiring diagrams.
 - 18 2. Assemble two (2) complete sets. Prepare in bound copies complete with
19 index tabs.
 - 20 3. Submit bound copies to Engineer for disbursement.

21 1.09 SPECIAL PROJECT CONDITIONS

- 22 A. Allowances:
 - 23 1. Section 01 21 00 – Allowances.
 - 24 2. The allowance amount shown is the invoice amount from the utility.
 - 25 3. The plumbing contract will be adjusted up or down by change order by the
26 amount listed for the allowance, less the actual cost of the utility fee. No
27 additional compensation for mark-ups or handling will be allowed by the
28 contractor. Any such costs shall be included in the bid.
- 29 B. Utility Coordination:
 - 30 1. Be responsible for utility coordination on behalf of the Owner.

1 PART 2 PRODUCTS

2 2.01 PIPES AND TUBES

3 A. Natural Gas Piping:

- 4 1. Piping and tubing shall have a minimum working pressure of 150 psig.
- 5 2. Buried beyond below the building and outside within 5 feet of building:
- 6 a. By gas utility.
- 7 b. Polyethylene Pipe: ASTM D2513, SDR 11.5, with socket type
- 8 fittings and fusion welded joints.
- 9 c. Materials and installation shall conform to AWWA C203
- 10 requirements.
- 11 3. Above ground:
- 12 a. Steel Pipe: ASTM A53, Schedule 40 black, with malleable iron or
- 13 forged steel fittings, screwed or welded. Threaded joints shall
- 14 comply with ASME B1.20.1.
- 15 b. Equipment Connections:
- 16 1) Flexible connector, minimum 12-inch long.
- 17 2) Tested and listed in compliance with the construction,
- 18 installation, and performance requirements of ANSI/AGA LC
- 19 1.
- 20 3) Tubing joints: Shall be made with approved gas tubing
- 21 fittings or brazed with a material having a melting point in
- 22 excess of 1,000° F. Brazing alloys shall not contain more
- 23 than 0.05% phosphorus.

24 2.02 VALVES

25 A. Valves must be trademarked on body with manufacturer's name or trademark and

26 pressure rating.

27 B. Minimum design pressure of 200 psig and certified for water-oil-gas (WOG)

28 operation.

29 C. Gas shut-off valves:

- 30 1. Ball valve: bronze body, threaded ends, stainless steel ball, full or
- 31 conventional port, Teflon seat, blow-proof stem, two-piece construction.
- 32 2. UL listed for use as a gas shut-off.
- 33 3. Acceptable Manufacturers: American Valve, Red-White Valve Corp., or
- 34 equal.

35 D. Gas Cocks:

- 36 1. Sizes 1/2 inch to 4 inches: DeZurik Fig. 425 gas valve, cast iron body,
- 37 screwed or flanged ends, bronze bearings, bronze plug and resilient seal ring
- 38 for bubble-tight shut-off to 175 psig working pressure.
- 39 2. UL approved for natural gas.

- 1 3. Acceptable manufacturers: Crane, DeZurik, Jenkins, Milwaukee, Nibco, and
2 Walworth.

3 2.03 PIPING SPECIALTIES

4 A. Flanges, Unions, and Couplings:

- 5 1. Pipe Size 2 inches and Under: Malleable iron unions for threaded ferrous
6 piping; bronze unions for copper pipe, soldered joints.
7 2. Grooved and Shouldered Pipe End Couplings: Malleable iron housing, C-
8 shape elastomer composition sealing gasket, steel bolts, nuts, and washers.
9 3. Dielectric Connections: Union with galvanized or plated steel threaded end,
10 copper solder end, water impervious isolation barrier.

11 B. Gas Regulators:

- 12 1. Sizes 3/4 inch to 2 inch: Quick reacting with internal relief for overpressure
13 protection, self-operated regulation with cast iron body, relief, spring steel
14 case, and Nitrile diaphragm.
15 2. Regulators shall reduce gas supply line (PSIG) pressure to equipment
16 operating pressure (W.C.). Verify supply line pressure with Gas Utility.
17 Verify equipment operating pressure with manufacturer.
18 3. Gas regulators shall be sized for pressure and flow requirements for all of the
19 equipment it serves.
20 4. Acceptable manufacturers: Fisher, Leslie, Maxitrol, Nibco and Spence.

21 2.04 SLEEVES

22 A. Sleeves: 18 gage thick galvanized steel

23 B. All sleeves shall be of sufficient diameter such that the bare pipe with unbroken pipe
24 covering or wrapping, where specified, can pass through and allow for expansion and
25 contraction in all directions.

- 26 1. Sleeve shall be two pipe sizes larger than the pipe passing through; or
27 provide a minimum of 1/2 inch clearance between inside of sleeve and
28 outside of the pipe.

29 2.05 MECHANICAL IDENTIFICATION

30 A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, UV resistant
31 and stable, preformed to fit around pipe or pipe covering. Larger sizes may have a
32 minimum sheet size with stainless steel spring fastener. Minimum width of 3 inches,
33 to comply with State of Wisconsin Plumbing Code. Color and Lettering: Conform
34 to ASME A13.1 and State of Wisconsin Plumbing Code.

- 35 1. Acceptable Manufacturer: Seton Nameplate Corporation, Kolbi Pipe
36 Markers Co., or equal.

- 1 B. Plastic Underground Pipe Markers: Bright colored continuously printed plastic
2 ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial
3 service.

- 4 C. Valve Tags: minimum 1 1/2 inches diameter, lettering shall be a minimum of 1/2
5 inch in height.
 - 6 1. Material:
 - 7 a. Brass.
 - 8 2. Shape:
 - 9 a. Gas Service: Square/diamond shape.

10 PART 3 EXECUTION

11 3.01 JOB CONDITIONS

- 12 A. Surface Conditions: Examine the areas and conditions under which work will be
13 performed. Correct conditions detrimental to timely and proper completion of the
14 Work. Do not proceed until unsatisfactory conditions are corrected.

- 15 B. Measurements:
 - 16 1. Field measuring existing conditions.
 - 17 2. Lay out work, properly locate all apparatus, pipe, fittings, sleeves, etc.
18 Adjust work, as necessary, to insure that work shall fit into the spaces that
19 have been allotted for such work. Due regard shall be taken for the work of
20 other trades.

21 3.02 SYSTEM LAYOUT

- 22 A. Lay out the system in careful coordination with the Drawings; determine proper
23 elevations for all components of the system and using only the minimum number of
24 bends to produce a satisfactorily functioning system.

- 25 B. Follow the general layout shown on the Drawings in all cases, except where other
26 work may interfere.

27 3.03 TRENCHING AND BACKFILLING

- 28 A. Perform trenching and backfilling associated with the work of this Section in strict
29 accordance with the provisions of Division 31 of these Specifications.

30 3.04 SERVICE CONNECTIONS

- 31 A. Install gas service complete with gas meter and regulators. Verify gas utility pressure
32 at building service connection. Install regulators on each line serving gravity type
33 appliances, sized in accordance with equipment.

1 3.05 INSTALLATION – SLEEVES

2 A. Sleeves shall be fastened securely in place.

3 B. Section 07 92 00: Caulk the space between the sleeve and pipe.

4 3.06 INSTALLATION - PIPE

5 A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

6 B. Remove scale and dirt, on inside and outside piping before assembly.

7 C. Prepare piping connections to equipment with flanges or unions.

8 3.07 INSTALLATION - PIPING SYSTEMS

9 A. Install dielectric connections wherever jointing dissimilar metals.

10 B. Install unions downstream of valves and at equipment connections.

11 C. Route piping parallel to structure and maintain gradient.

12 D. Install piping to allow for expansion and contraction without stressing pipe, joints, or
13 connected equipment.

14 E. Thoroughly clean items before installation.

15 F. Cut pipe accurately, and work into place without springing or forcing. Excessive
16 cutting or other weakening of the building will not be permitted.

17 G. Install piping, valves, and other items to permit access for maintenance. Relocate
18 items as necessary to provide such access, and without additional cost to the Owner.

19 H. Install identification on piping systems, including underground piping.

20 I. Protect piping systems from entry of foreign materials by temporary covers,
21 completing sections of the work, and isolating parts of completed system.

22 J. Make changes in directions with fittings; make changes in main sizes with eccentric
23 reducing fittings.

24 K. Pipe Joints:

25 1. Screwed Piping:

26 a. Deburr cuts.

27 1) Do not ream exceeding internal diameter of the pipe.

28 2) Thread to requirements of ANSI B2.1.

29 b. Use Teflon tape on male thread prior to joining other services.

- 1 c. Use litharge and glycerin on joint prior to cleaning for air and oil
- 2 piping.
- 3 2. Leaky Joints:
- 4 a. Remake with new material.
- 5 b. Remove leaking section and/or fitting as directed.
- 6 c. Do not use thread cement or sealant to tighten joint.

7 3.08 INSTALLATION - VALVES

- 8 A. Install valves with stems upright or horizontal, not inverted.
- 9 B. Install valves for shut-off and to isolate equipment.

10 3.09 INSTALLATION - FUEL PIPING

- 11 A. Install natural gas piping in accordance with NFPA 54.
- 12 B. Provide clearance for installation of and access to valves and fittings.
- 13 C. Establish elevations of buried piping outside building to provide not less than 18-
- 14 inch of cover.
- 15 D. Provide support for utility meters in accordance with requirements of utility
- 16 company.
- 17 E. Terminate vent from gas pressure reducing valves or regulators per manufacturer's
- 18 instructions.

19 3.10 INSTALLATION - MECHANICAL IDENTIFICATION

- 20 A. Install adequate marking of exposed accessible piping, per ANSI A13.1.
- 21 B. Install tags with corrosion resistant metal chain.
- 22 C. Valves:
- 23 1. Tag all valves.
- 24 D. Pipes:
- 25 1. Install pipe markers on all pipes.
- 26 2. Space no more than 25 feet apart, with a minimum of one marker on each
- 27 straight section of pipe.
- 28 3. Color of bands:
- 29 a. Gas Pipe: Red

1 3.11 PAINTING

- 2 A. Section 09 96 00: All exposed piping, fittings, valves, etc., without factory finish or
3 finished cover, shall be painted.
- 4 B. Touch-up all factory finishes damaged during construction.

5 3.12 TESTING AND ADJUSTING

- 6 A. Section 01 77 00 - Closeout Procedures: Testing and adjusting provisions.
- 7 B. Contractor shall notify any inspectors required to observe test, when test is ready to
8 be performed. Contractor shall advise A/E field representative that notification has
9 been given.
- 10 C. All equipment required for testing, including fittings for additional openings, shall be
11 provided by Contractor. Contractor shall provide all personnel required for testing.
12 Contractor shall pay the cost of all required tests and retests and inspections if
13 required.
- 14 D. Tests shall be witnessed and approved by Owner's representatives and A/E field
15 representative. Contractor shall certify in writing the time, date, name, and title of
16 person approving test. This shall also include the description and what portion of the
17 system has been approved. Person approving test shall sign certification.
- 18 E. A complete record shall be maintained of all testing that has been approved, and shall
19 be made available at the job site to all authorities concerned.
- 20 F. Upon completion of the work, all records and certifications approving testing
21 requirements shall be submitted to the A/E Field Representative before final payment
22 is made.
- 23 G. Test natural gas piping in accordance with NFPA 54.
- 24 H. Notify A/E in advance regarding time and date of all tests.
- 25 I. Defective work or material shall be replaced or repaired, as necessary, and the
26 inspection and test repeated. Repairs shall be made with new materials. Caulking of
27 screwed joints or holes will not be acceptable.
- 28 J. Adjust the system to optimum standards of operation.

29 3.13 CLOSEOUT OPERATIONS

- 30 A. Closeout Equipment/System Operations: Sequence operations properly so that work
31 of the project will not be damaged or endangered.
32 1. Adjust and correct operations as required for proper performance.

1 2. Clean each system: After all equipment has been proven operational,
2 carefully clean all accessible parts, thoroughly removing all traces of dirt, oil,
3 grease, and foreign substances.

4 B. Record Drawings.

5 3.14 SCHEDULE OF MECHANICAL IDENTIFICATION

6 A. Piping:

7 1. Natural Gas: “Natural Gas” or “Gas”

8

9

END OF SECTION



Department of Public Works
Engineering Division
Robert F. Phillips, P.E., City Engineer

City-County Building, Room 115
210 Martin Luther King, Jr. Boulevard
Madison, Wisconsin 53703
Phone: (608) 266-4751
Fax: (608) 264-9275
engineering@cityofmadison.com
www.cityofmadison.com/engineering

February 26, 2019

NOTICE OF ADDENDUM
ADDENDUM NO. 2
CONTRACT NO. 8119

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET
RECONSTRUCTION DISTRICT – 2018

Revise and amend the contract document(s) for the above project as stated in this addendum, otherwise, the original document shall remain in effect.

Addendum #1 referenced several plan sheets that were not attached to the addendum. See attached for the revised plan sheets.

Please acknowledge this addendum on page E1 of the contract documents and/or in Section E: Bidder's Acknowledgement on Bid Express.

Electronic version of these documents can be found on the Bid Express web site at:
<http://www.bidexpress.com>

If you are unable to download plan revisions associated with the addendum, please contact the Engineering office at 608-266-4751 receive the material by another route.

Sincerely,

Robert F. Phillips, P.E.
City Engineer

Deputy City Engineer

Gregory T. Fries, P.E.

Deputy Division Manager

Kathleen M. Cryan

Principal Engineer 2

Christopher J. Petykowski, P.E.
John S. Fahrney, P.E.

Principal Engineer 1

Christina M. Bachmann, P.E.
Mark D. Moder, P.E.
Janet Schmidt, P.E.

Facilities & Sustainability

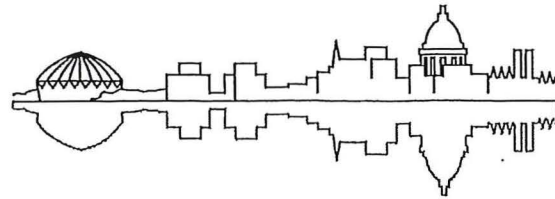
Jeanne E. Hoffman, Manager
Bryan Cooper, Principal Architect

Mapping Section Manager

Eric T. Pederson, P.S.

Financial Manager

Steven B. Danner-Rivers



Madison, Wisconsin

CITY OF MADISON

CITY ENGINEERING DIVISION

DEPARTMENT OF PUBLIC WORKS

PLAN OF PROPOSED IMPROVEMENT

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET RECONSTRUCTION DISTRICT - 2018


CITY PROJECT NO. 11185
CONTRACT NO. 8119

PUBLIC IMPROVEMENT PROJECT APPROVED

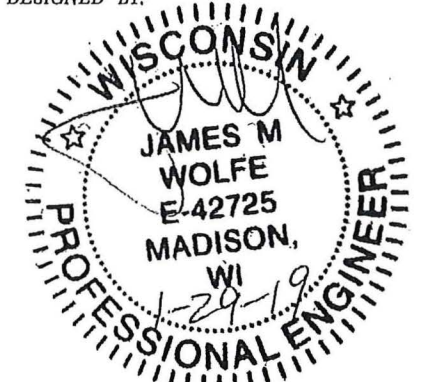
JULY 10, 2018

BY THE COMMON COUNCIL
OF MADISON, WISCONSIN

PUBLIC IMPROVEMENT DESIGN
APPROVED BY:

 2/11/19
City Engineer Date

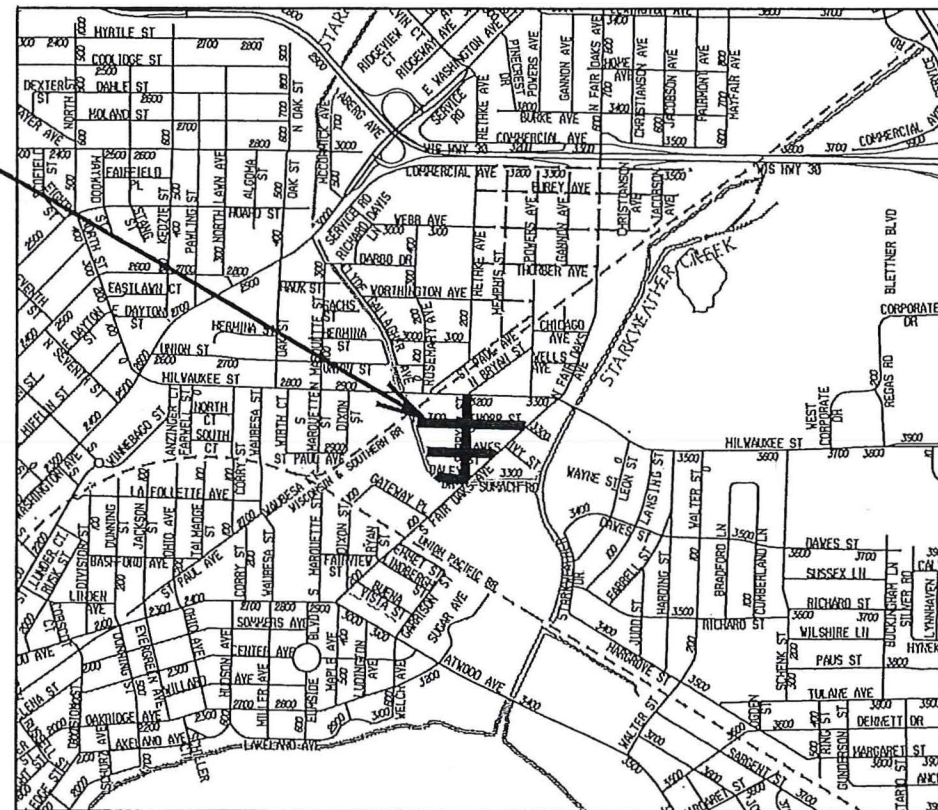
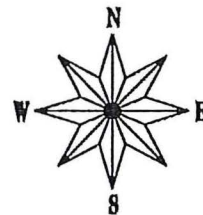
STREET
DESIGNED BY:



INDEX OF SHEETS

SHEET NO.	TITLE
SHEET NO. 1	TITLE
SHEET NO. D1	TYPICAL SECTIONS
SHEET NO. O1	OVERVIEW PLAN
SHEET NO. RGI-RG2	RAIN GARDEN PLANS
SHEET NO. ECI-EC6	EROSION CONTROL PLANS
SHEET NO. P1-P8	STREET PLAN & PROFILES
SHEET NO. U1-U8	SEWERS PLAN & PROFILES
SHEET NO. U9-U11	SEWER SCHEDULES
SHEET NO. LSI-LS22	LIFT STATION PLAN & PROFILES & DETAILS
SHEET NO. W1-W8	WATER PLAN & PROFILES
SHEET NO. W9	WATER IMPACT PLAN
SHEET NO. W10	WATER MATERIALS & DETAILS
SHEET NO. SBI-SB11	STREAMBANK PLANS
SHEET NO. PMI-PM4	PAVEMENT MARKING PLANS
SHEET NO. XI-X24	CROSS SECTIONS

PROJECT
LOCATION



CONVENTIONAL SIGNS

FIELD VERIFY ALL UTILITY LOCATIONS

GAS	— G —
STORM SEWER	— ST —
SANITARY SEWER	— SAN —
WATER	— W —
OVERHEAD ELECTRIC	— OH —
POWER POLE	□

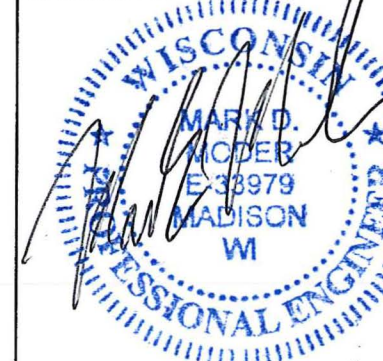
NOTES:

ALL GUTTERS SHALL DRAIN WITH A MINIMUM GRADE OF 0.50% TOWARD STORM SEWER INLETS.

SIDEWALK RAMPS AND CURB THRU SIDEWALK RAMPS SHALL HAVE A MAXIMUM SLOPE OF 1" PER 12". SIDEWALK AND CURB RAMPS SHALL BE CONSTRUCTED WITH A SIDE SLOPE OF 2.00%. SIDEWALK SHALL HAVE A MINIMUM LONGITUDINAL SLOPE OF 0.50% AND A MAXIMUM LONGITUDINAL SLOPE OF 5.00%

EARTH WORK SUMMARY:
EXCAVATION CUT (MEASURED PLAN QUANTITY).....4,105 C.Y.
ESTIMATED UNDISTRIBUTED UNDERCUT.....1,620 C.Y.
TOTAL UNCLASSIFIED EXCAVATION CUT.....5,725 C.Y.

SANITARY SEWER
DESIGNED BY:



GRAVITY SEWER ONLY 2/11/19

PAVEMENT MARKINGS
DESIGNED BY:



STORM SEWER & STREAMBANK
DESIGNED BY:



2-11-19

WATER
DESIGNED BY:



PLOT SCALE:

PLOT NAME:

REV. DATE:

ORIGINATOR: CITY OF MADISON, STREETS DIVISION

RAIN GARDEN PLAN

3238 Thorp St.

CITY OF MADISON

NEW SHEET 2/25/2019 C.W.

NOTE:
ENGINEERED SOIL MIX FOR THE
TERRACE RAIN GARDENS SHALL
BE AS STATED IN STANDARD
SPECIFICATION 211.2(a)

0710-051-1127-5
HAZA, PATRICIA M
3238 Thorp St

STA 10+73.07, LT 23.18'
856.69 @ POINT

STA 10+68.90, LT 19.01'
855.30 @ BOTTOM

STA 10+69.71, LT 16.92'
855.30 @ BOTTOM

STA 10+73.07, LT 13.56'
856.42 @ POINT

STA 10+65.22, LT 14.55'
855.48 @ CENTERLINE OF FLUME

STA 10+58.07, LT 23.18'
856.51 @ POINT

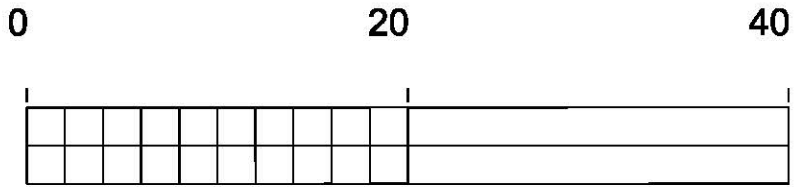
STA 10+61.70, LT 19.55'
855.30 @ BOTTOM

STA 10+61.07, LT 16.56'
855.30 @ BOTTOM

10+00 STA 10+58.07, LT 13.56'
856.30 @ POINT

STA 10+65.24, LT 12.50'
855.66 @ FLUME CENTERLINE

0710-051-1202-5
KINNEY, GRANT M
ROBIN P KINNEY
3237 Thorp St

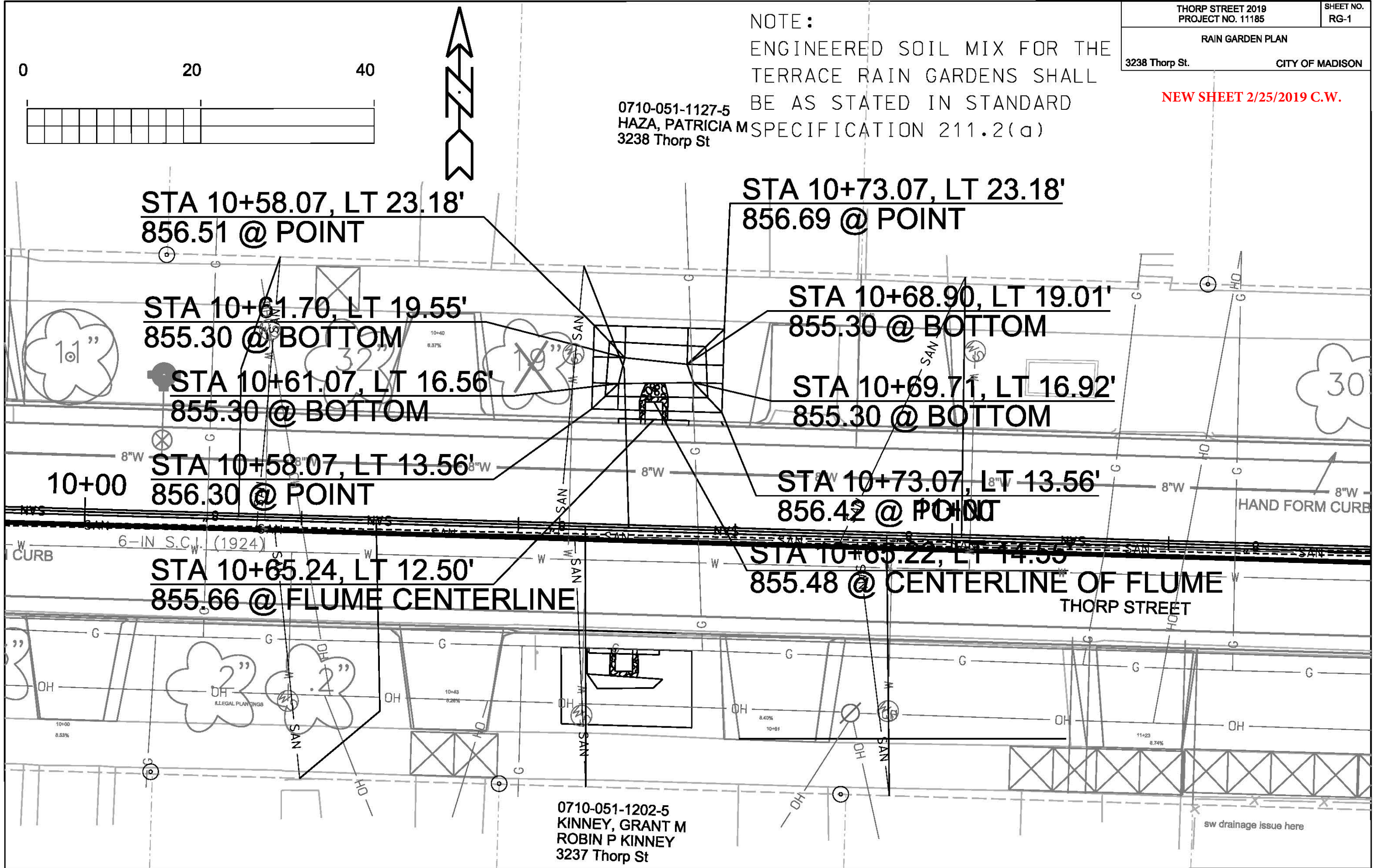


PLOT SCALE: 20

PLOT NAME: RG-1

REV. DATE:

ORIGINATOR: CITY OF MADISON, STREETS DIVISION



sw drainage issue here

REVISED 02/15/2019 TKM
 • REVISED KEY NOTES PER LIFT STATION FOUNDATION PLAN EDITS.
 • REVISED LIFT STATION FOUNDATION PLAN PER CITY COMMENTS.

DESIGN LOADINGS	
LIVE LOADS	
SLAB LIVE LOAD	40

DESIGN STRESSES	
CAST-IN-PLACE CONCRETE	
- SEE SPECS	
STEEL	
REINFORCING	#6 @ 60"
BOLTS	
ANCHOR	F1554, GRADE 36
EXPANSION	WEDGE TYPE
SOIL BEARING PRESSURE CAPACITY	
PER GEOTECHNICAL REPORT	1000

STEEL REINFORCING	
MIN CLEAR COVER, UNO	
FOUNDATION WALLS FORMED	
#5 BARS SMALLER	1 1/2"
#6 BARS LARGER	2"
NON-STRUCTURAL SLABS ON GRADE	
BOTTOM SIDES	1 1/2"
TOP	3/4"
FOOTINGS AND STRUCTURAL SLABS ON GRADE	
BOTTOM SIDES	3"
TOP	2"
NOTES	
1. CLASS 'B' LAP AT SPLICES.	

GENERAL FOUNDATION NOTES

- A. CONTRACTOR TO COORDINATE STRUCTURAL, ARCHITECTURAL, PLUMBING, PROCESS MECHANICAL, HVAC, AND ELECTRICAL PLANS FOR DETAILS, DIMENSIONS, ELEVATIONS, OPENINGS, ETC. NOTIFY ARCHITECT OF ANY VARIANCE BEFORE COMMENCING CONSTRUCTION.
- B. IN NO CASE SHALL STRUCTURAL ALTERATIONS OR WORK AFFECTING A STRUCTURAL MEMBER BE MADE, UNLESS APPROVED BY ENGINEER.
- C. SIMILAR PORTIONS OF THE STRUCTURES SHALL HAVE SIMILAR DETAILING, UNLESS NOTED OTHERWISE.
- D. ALL WALL FORM TIES SHALL BE KNOCKED OFF FLUSH THE FACE OF THE WALL AT INTERIOR AND EXTERIOR FACE OF WALLS. AT TIES BELOW THE FINISHED FLOOR AND/ OR FINISHED GRADE PROVIDE A LAYER OF DAMPPROOFING PRODUCT OVER THE REMOVED TIE AREA, TYP.
- E. BACKFILL AND COMPACT ENGINEERED FILL ON BOTH SIDES OF FOUNDATION AT THE SAME TIME.
- F. FOOTINGS SHALL BE CENTERED ABOUT THE WALLS, UNLESS NOTED OTHERWISE.
- G. PROVIDE 3'-0" X 3'-0" CORNER BARS IN FOUNDATION WALL AT CORNERS. BARS SHALL BE SAME SIZE AND LOCATION OF THE HORIZONTAL REINFORCING.
- H. PROVIDE OPENING REINFORCING FOR ALL MISCELLANEOUS OPENINGS THROUGH FOOTING, FOUNDATION WALL OR FLOOR SLAB.

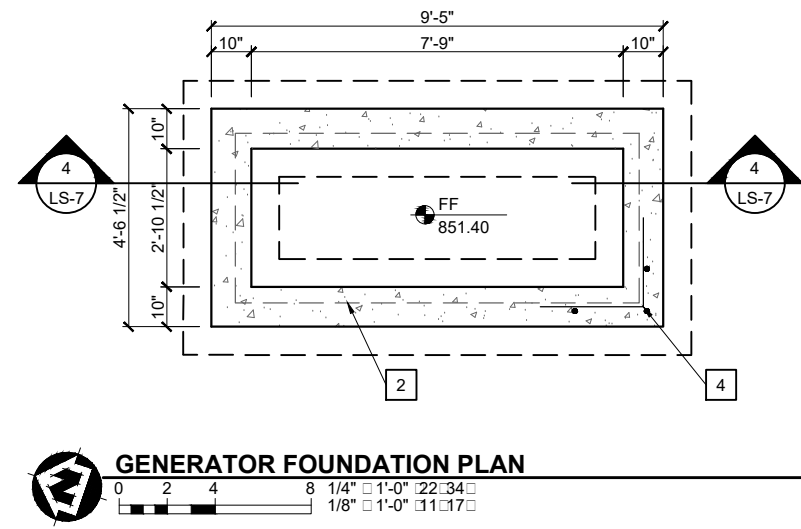
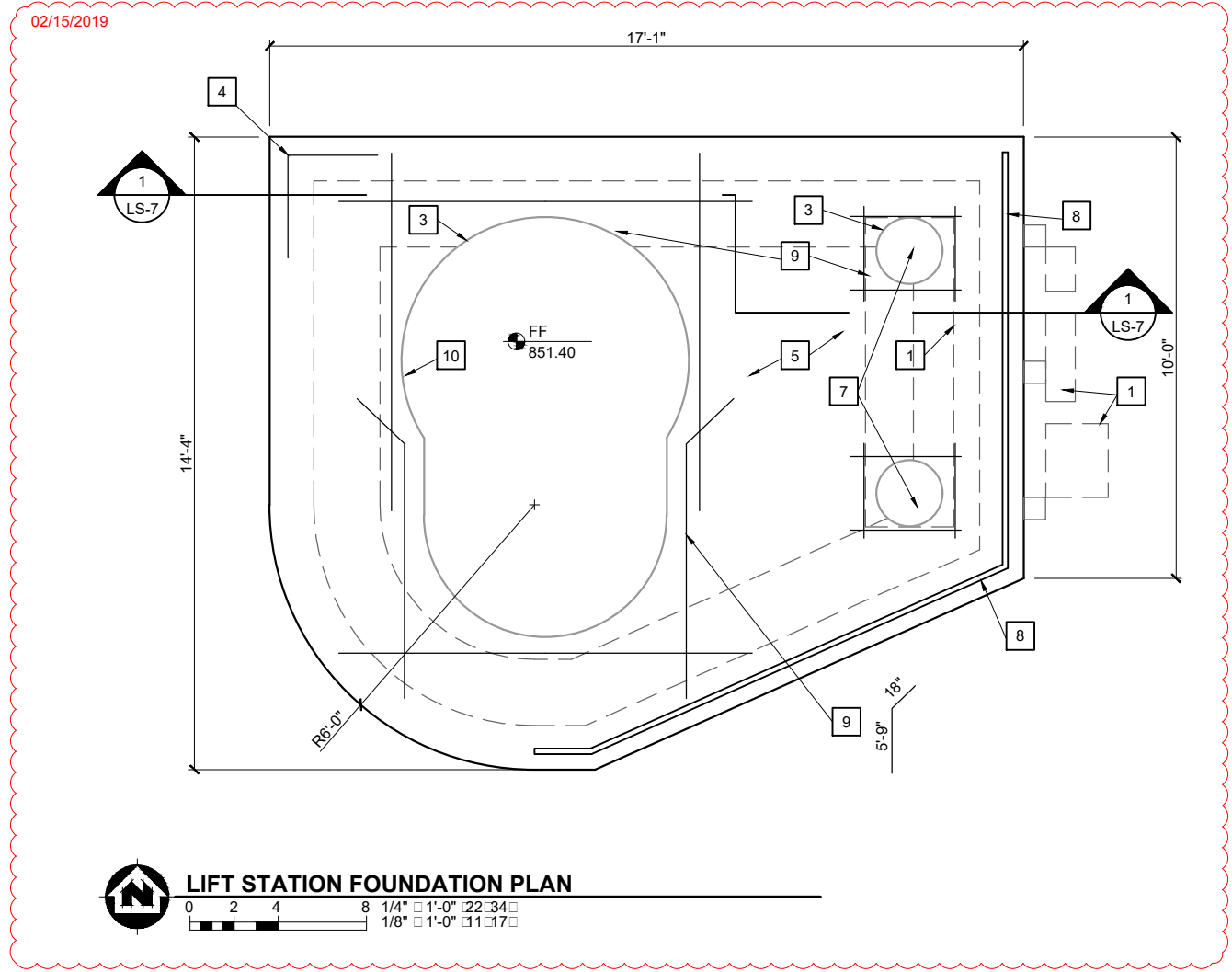
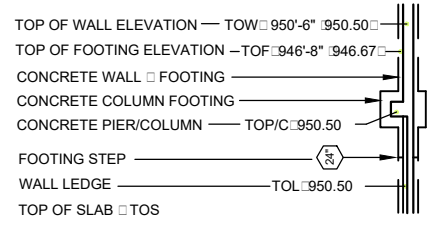
GENERAL REINFORCING/CONCRETE NOTES

- I. ALL LAPS SHALL BE CLASS-'B' PER ACI 318-14, UNLESS NOTED OTHERWISE ON THE DESIGN DRAWINGS. USE TOP BAR LAP LENGTHS FOR ALL HORIZONTAL ALL BARS AND FOR BARS IN SLABS WITH MORE THAN 12" OF CONCRETE BELOW.
- II. BAR PLACEMENT TOLERANCES SHALL BE AS SPECIFIED IN THE CONCRETE REINFORCING STEEL INSTITUTE (CRSI) MANUAL OF STANDARD PRACTICE, CURRENT EDITION.
- III. ALL REINFORCING BAR DIMENSIONS ARE FROM OUT-TO-OUT OF BAR. ALL BEND ANGLES ARE AT 45° AND 90°, UNLESS NOTED OTHERWISE.
- IV. SEE SPECIFICATION FOR CONCRETE CLASS AND FINISH SCHEDULES, UNO.
- V. SEE GENERAL FOUNDATION NOTES FOR ADDITIONAL REINFORCING REQUIREMENTS.

KEY NOTES

1. DASHED LINE INDICATES CONTROL PANELS ABOVE LOCATED ON SLAB-ON-GRADE, TYP - COORDINATE WITH ELECTRICAL
2. DASHED LINE INDICATES GENERATOR ABOVE LOCATED ON SLAB-ON-GRADE, TYP - COORDINATE WITH ELECTRICAL
3. 1/2" EXPANSION JOINT MATERIAL W/ REMOVABLE CAP AND SELF-LEVELING SEALANT, TYP
4. CORNER REINFORCING IN FOUNDATION WALL, AT ALL CORNERS, TYP - SEE GENERAL FOUNDATION NOTES
5. 12" THICK REINFORCED SLAB W/ THICKENED EDGES OVER MIN. 12" COMPACTED GRAVEL FILL AND COMPACTED GRANULAR FILL 02/15/2019
6. **NOTE NOT USED.** 02/15/2019
7. CONTROL PANEL SUPPORTED ON SONOTUBE FOUNDATIONS. SEE TYPICAL DETAIL FOR FREE STANDING CONTROL PANEL MOUNTING ON SHEET LS-22 02/15/2019
8. HOT-DIP GALVANIZED STEEL GUARDRAIL AND POSTS - SEE DETAILS: 2/LS-7 AND 3/LS-7 02/15/2019
9. REBAR AROUND ELECTRICAL OPENING, ADDITIONAL #6 BARS AROUND SLAB OPENINGS AND AROUND SONOTUBE FOUNDATIONS PENETRATING SLAB. MAINTAIN MINIMUM CLEARANCE. BAR LENGTHS EQUAL TO DIAMETER OF OPENING 36" U.N.O. 02/15/2019
10. LIFT STATION VALVE VAULT COORDINATE PLACEMENT WITH MECHANICAL / ELECTRICAL AND SITE CIVIL.

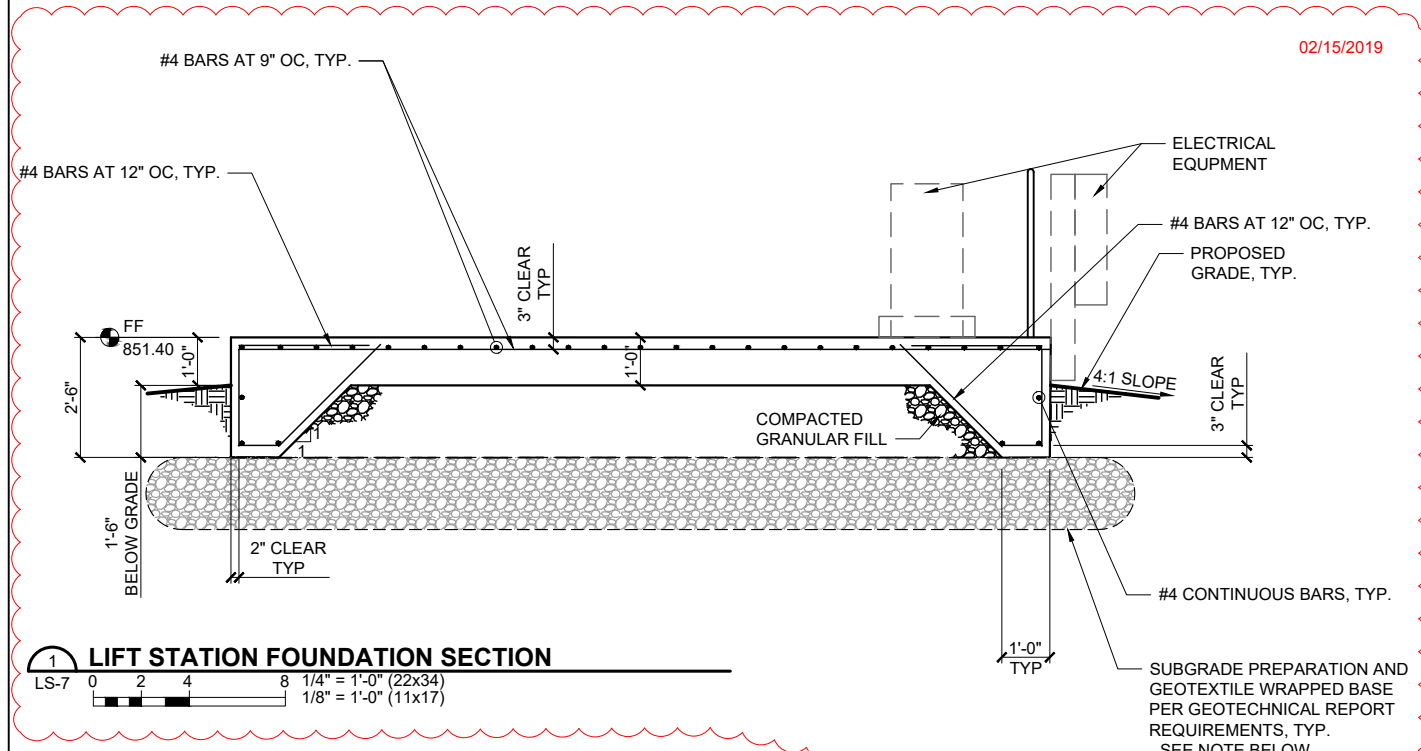
FOUNDATION LEGEND



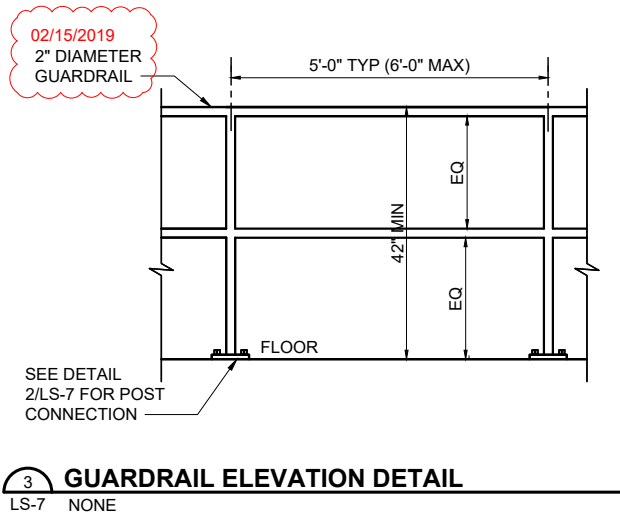
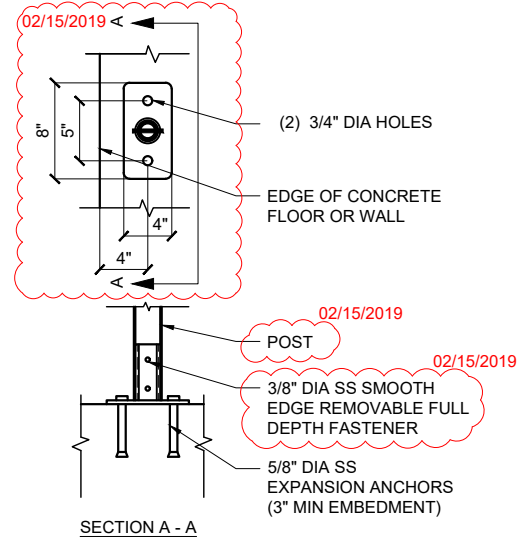
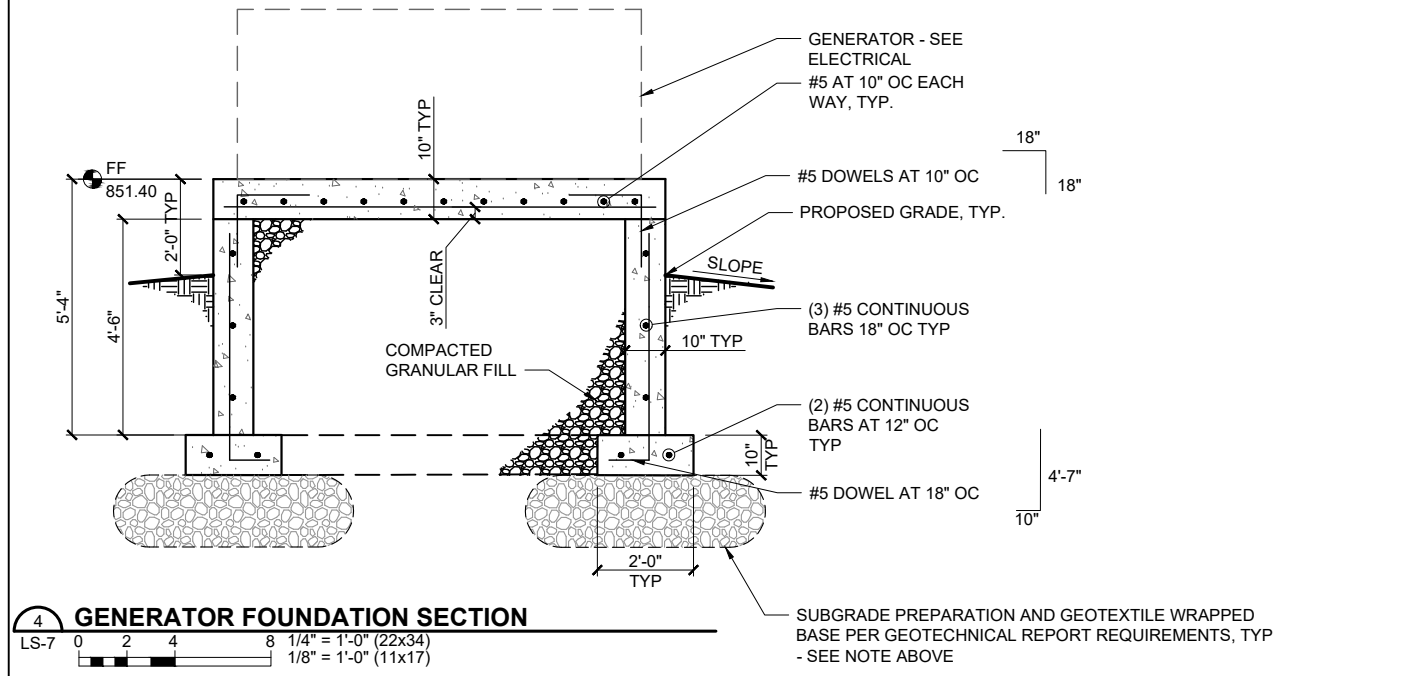
ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

REV. DATE: PLOT NAME: PLOT SCALE:

- REVISED 02/15/2019 TKM
- REVISED LIFT STATION FOUNDATION SECTION 1/LS-7 PER CITY COMMENTS.
 - REVISED TYP REMOVABLE POST MOUNTED DETAIL 2/LS-7. REMOVED TOE-PLATE AND REVISED POST TO GO OVER TOP OF MOUNTING PLATE VERTICAL MEMBER.
 - REVISED GUARDRAIL ELEVATION DETAIL 3/LS-7. CHANGED DIAMETER OF GUARDRAIL.
 - REMOVED TYPICAL SLAB ON GRADE (CJ) DETAIL 5/LS-7.

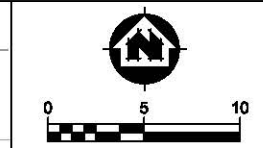


NOTE:
 CONTRACTOR TO PREPARE SUBGRADE AND PROVIDE GEOTEXTILE WRAPPED, COMPACTED STONE BASE PER DIRECTION BY THE GEOTECHNICAL REPORT (GEOTECHNICAL EXPLORATION REPORT, JAMES STREET LIFT STATION BY CGC, INC. DATED JANUARY 25, 2019) - ATTACHED AS APPENDIX A TO PROJECT SPECIFICATIONS.



ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

PLOT SCALE: _____
 PLOT NAME: _____
 REV. DATE: _____



NOTES:
SAN LATERAL AT 3137 JAMES ST NEEDS TO BE RELOCATED IN ORDER TO CONSTRUCT LIFT STATION. COORDINATION BY CONTRACTOR REQUIRED. SEE U-SHEETS FOR SAN SEWER PLANS.

IF THE FLOODWAY IS DISTURBED DURING CONSTRUCTION OPERATIONS CONTRACTOR MUST RETURN GROUND TO ORIGINAL CONDITION/GRADE.

- REVISED 02/15/2019 TKM
- REVISED LIFT STATION FOUNDATION PLAN PER CITY COMMENTS. SEE STRUCTURAL SHEETS.
- REVISED 02/19/2019 KJA
- REVISED LOCATION OF ANTENNA TOWER.

PROPOSED 8" SANITARY COORDINATE INVERT ELEVATIONS WITH SHEET LS-11 AND U-SHEETS. CONTRACTOR TO VERIFY ELEVATIONS WITH CITY PRIOR TO ORDERING LIFT STATION STRUCTURE.

LIFT STATION (TOP OF LIFT STATION ELEV. = 851.40)

PROVIDE CURB & GUTTER EXTENDED TO END OF CUL DE SAC

ELECTRICAL SERVICE (SEE SHEET LS-14 FOR ELECTRICAL SITE DETAILS)

CNC. SIDEWALK PROPOSED CITY SSWR (SEE U-SHEETS)

100-YR FLOOD ELEV. 849.40

JAMES STREET

4-IN C900 PVC FORCE MAIN

CONTROL PANEL

UNDERGROUND NATURAL GAS SERVICE

ELEVATED CONC. PAD (TOP OF CONC. PAD ELEV. = 851.40) (GRND. ELEV. AROUND PAD = 850.40)

RUN GAS PIPE DOWN THROUGH SLAB IN SLEEVE

GAS METER AND 2-PSI REGULATING VALVE LOCATION (BY UTILITY). PROVIDE 4-IN THICK CONC PAD BELOW.

FENCING AROUND GENERATOR SHALL BE PVC VINYL FENCE W/ PERSONNEL GATE OPENING OF 48-IN MIN. FENCE SHALL BE A MINIMUM OF 1' TALLER THAN THE TOP OF THE GENERATOR. FENCE SHALL BE MERCHANT METALS EVERGUARD, CERTAINTED BUFTTECH, OR EQUAL. CONTRACTOR SHALL SUBMIT CATALOG CUTS FOR REVIEW AND SELECTION OF STYLE AND COLOR BY THE ENGINEER.

1-IN DIA GAS LINE BELOW GRADE, BURY 18-IN MIN COVER

CABC (GROUND ELEV.)

RUN GAS PIPE UP THROUGH SLEEVE SLEEVE TO EXTEND 6-IN BELOW GRADE AND TO TOP OF SLAB

PRESSURE REGULATING VALVE (SERVICE PRESSURE 11-IN WC, CONTRACTOR TO COORDINATE WITH GENERATOR MANUFACTURER)

RUN PIPE OVER TOP OF SLAB, INTO GENERATOR. PROVIDE FLEX CONNECTION TO GENERATOR. PROVIDE BALL VALVE FOR SHUT-OFF.

PROPOSED NATURAL GAS GENERATOR KOHLER KG45, 45KW, 805 CFH GAS. CONTRACTOR TO COORDINATE W/ GENERATOR MANUFACTURER. (GENERATOR PAD ELEV. = 851.40)

ELEVATED CONC. PAD (TOP OF CONC. PAD ELEV. = 851.40)

ANTENNA TOWER CONC. BASE

02/19/2019

PLOT SCALE: _____
 PLOT NAME: _____
 REV. DATE: _____
 ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

ELECTRICAL SITE PLAN

JAMES STREET CITY OF MADISON

REVISED 02/19/2019 KJA
 • REVISED ELECTRICAL PLAN NOTES PER MMSD COMMENTS.

REVISED 2/18/19 BY KJA
 -REVISED ANTENNA TOWER LOCATION
 -ADDED NOTE FOR CONDUIT FROM ATS TO CONTROL PANEL FOR STATUS SIGNALS
 -CHANGED ALL CONDUIT TO PVC COATED RIGID STEEL

STARKWEATHER CREEK

JAMES STREET

- LSH-1-1 HIGH LEVEL ALARM
- LSC-1-3 LAG PUMP START
- LSC-1-2 LEAD PUMP START
- LSC-1-1 PUMPS OFF
- LSL-1-1 LOW LEVEL ALARM

CLASS 1 DIV. I HAZARDOUS AREA

WAT

PLAN NOTES:

1. PUMP STATION CONTROL PANEL, VERIFY FINAL DIMENSIONS WITH SYSTEM INTEGRATOR
2. EQUIPMENT RACK
3. 200 AMP RATED, STAINLESS STEEL, 4 POLE, FUSED DISCONNECT. PROVIDE SERVICE ENTRANCE GUTTER PER UTILITY REQUIREMENTS.
4. UTILITY APPROVED METER SOCKET.
5. AUTOMATIC TRANSFER SWITCH
6. SPARE 1-1/2" CONDUIT STUBBED OUT FROM CONTROL PANEL TO PAST CONCRETE FOR FUTURE YARD LIGHT.
7. CONDUITS FROM ATS TO GENERATOR AND CONTROL PANEL
 - 7.1. (1) CONDUIT FOR 3 PHASE POWER CONDUCTORS FROM GENSET TO ATS 02/19/2019
 - 7.2. (1) CONDUIT FOR START/STOP CONDUCTORS FROM ATS TO GENSET
 - 7.3. (1) CONDUIT FOR SPARE
 - 7.4. (1) CONDUIT FOR STATUS FROM ATS TO CONTROL PANEL
8. CONDUITS FROM CONTROL PANEL TO WETWELL
 - 8.1. (1) 2" CONDUIT FOR PUMP NO.1 MOTOR CABLE AND SENSOR CABLES.
 - 8.2. (1) 2" CONDUIT FOR PUMP NO.2 MOTOR CABLE AND SENSOR CABLES.
 - 8.3. (2) 1-1/2" CONDUITS FOR FLOAT SWITCHES
 - 8.4. (1) 1-1/2" CONDUIT FOR SPARE
9. CONDUITS FROM CONTROL PANEL TO GENERATOR
 - 9.1. (1) CONDUIT FOR 120VAC POWER FROM THE CONTROL PANEL TO THE GENERATOR FOR THE BLOCK HEATER.
 - 9.2. (1) CONDUIT FOR 120VAC POWER FROM THE CONTROL PANEL TO THE GENERATOR FOR THE BATTERY CHARGER.
 - 9.3. (1) CONDUIT FOR SIGNAL WIRING FROM THE GENERATOR TO THE CONTROL PANEL FOR GENERATOR STATUS.
 - 9.4. (1) CONDUIT FROM THE CONTROL PANEL TO THE GENERATOR FOR SPARE.
10. UTILITY NATURAL GAS SERVICE MAIN
11. NATURAL GAS METER, INSTALLED PER UTILITY REQUIREMENTS
12. 1" NATURAL GAS LINE SUPPLIED BY CONTRACTOR.
13. UTILITY SUPPLIED 200 AMP UNDERGROUND ELECTRICAL SERVICE. COORDINATE SERVICE WITH UTILITY.
14. ANTENNA TOWER
 - 14.1. PROVIDE CONCRETE BASE PER DETAIL
 - 14.2. ANTENNA TO BE MOUNTED 20' ABOVE FINISH GRADE
 - 14.3. ANTENNA TOWER TO BE INSIDE GENERATOR FENCE.
15. PROVIDE 3" HELIAX RAN INSIDE 2" CONDUIT FROM CONTROL PANEL TO ANTENNA TOWER.
 - 15.1. AIR GAP INSIDE LEGS OF CONTROL PANEL IS A CLASS 1 DIV I SPACE. VERTICAL CONDUIT ENTERING THE AIR GAP OF THE LEGS MUST BE PVC COATED GALVANIZED RIGID STEEL. HORIZONTAL CONDUIT ATTACHED TO THE VERTICAL CAN BE PVC CONDUIT.
16. GENERATOR
 - 16.1. COORDINATE CONDUIT ENTRY WITH GENERATOR SUPPLIER. CONDUIT PLACEMENT IS COORDINATED WITH KOHLER 45 KW NATURAL GAS GENERATOR.
17. WETWELL FLOATS
 - 17.1. SUSPENDED WITH STAINLESS STEEL SUSPENSION KIT
 - 17.2. DON'T MOUNT UNDER INFLUENT
 - 17.3. LEAVE SLACK CABLE COILED UP IN WETWELL

GENERAL NOTES:

1. ALL CONDUIT TO BE PVC COATED GALVANIZED RIGID STEEL

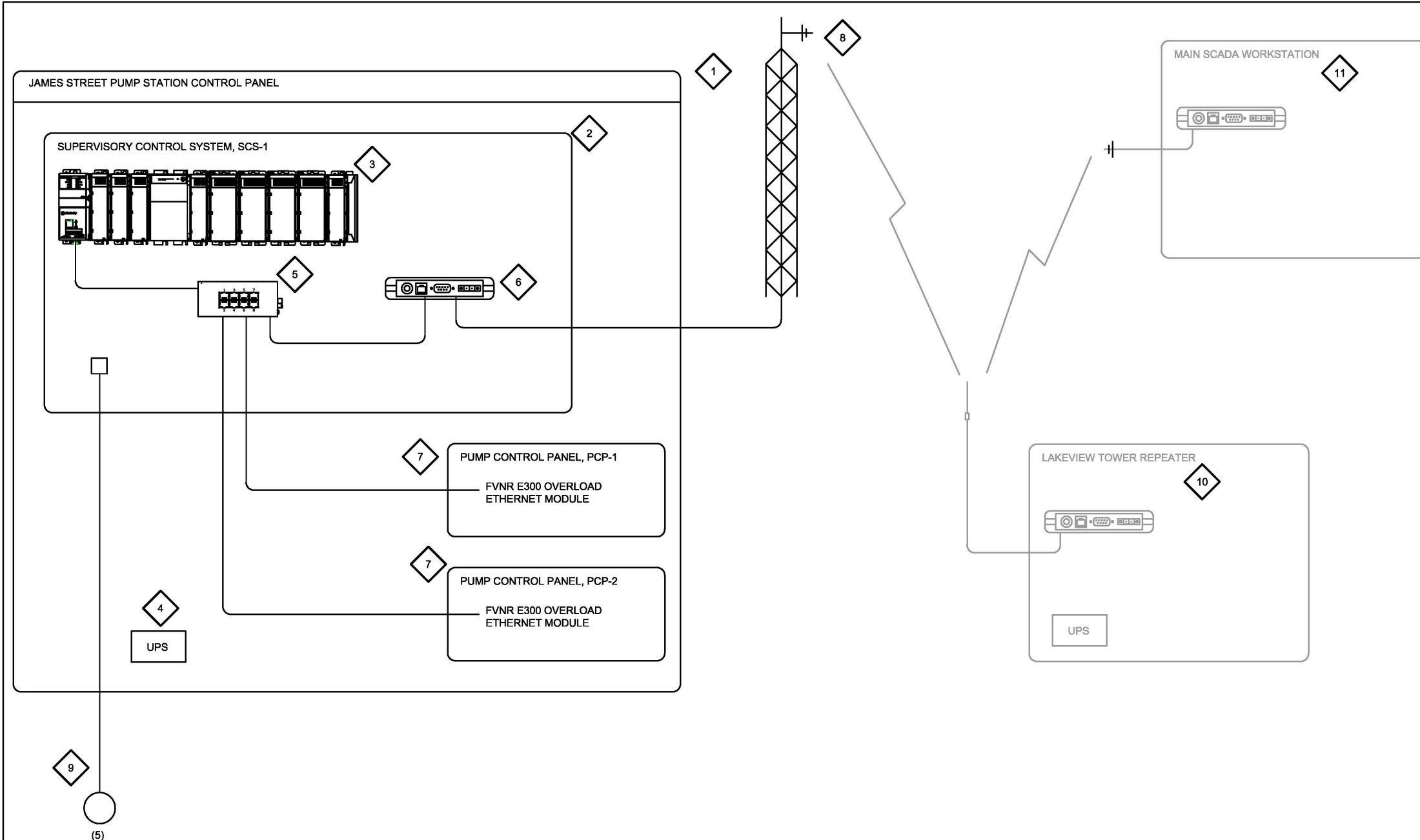
PLOT SCALE: _____ PLOT NAME: _____ REV. DATE: _____

ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

SCADA OVERVIEW
 JAMES STREET CITY OF MADISON

REVISED 02/19/2019 BY KJA
 • REVISED NOTE 8 FOR OWNER FURNISHED ANTENNA EQUIPMENT.
 • DELETED STATION HAND/AUTO AND START/STOP PUSHBUTTON.

02/19/2019



PLC I/O LIST

PANEL	EQUIPMENT NAME	TAG	DI	DO	AI	AO	WIRE
STATION STATUS							
SCS-1	CONTROL POWER AVAILABLE		X				(2) #14
SCS-1	UPS POWER AVAILABLE		X				(2) #14
SCS-1	UPS SERVICE REQUIRED		X				(2) #14
SCS-1	PANEL ENTRY		X				(2) #14
SCS-1	3 PHASE POWER FAIL		X				(2) #14
SCS-1	ALTERNATION 1-2		X				(2) #14
SCS-1	ALTERNATION 2-1		X				(2) #14
SCS-1	E-STOP		X				(2) #14
WETWELL							
SCS-1	HIGH LEVEL ALARM	LSH-1-1	X				(2) #14
SCS-1	LAG PUMP START	LSC-1-3	X				(2) #14
SCS-1	LEAD PUMP START	LSC-1-2	X				(2) #14
SCS-1	COMMON PUMPS OFF	LSC-1-1	X				(2) #14
SCS-1	LOW LEVEL ALARM	LSL-1-1	X				(2) #14
PUMP 1							
SCS-1	IN SERVICE		X				(2) #14
SCS-1	IN AUTO		X				(2) #14
SCS-1	RUNNING		X				(2) #14
SCS-1	FAILED		X				(2) #14
SCS-1	CALL TO RUN			X			(2) #14
SCS-1	AMPS				X		ETHERNET
SCS-1	KW				X		ETHERNET
PUMP 2							
SCS-1	IN SERVICE		X				(2) #14
SCS-1	IN AUTO		X				(2) #14
SCS-1	RUNNING		X				(2) #14
SCS-1	FAILED		X				(2) #14
SCS-1	CALL TO RUN			X			(2) #14
SCS-1	MOTOR HIGH TEMPERATUR		X				(2) #14
SCS-1	SEAL FAIL		X				(2) #14
SCS-1	AMPS				X		ETHERNET
SCS-1	KW				X		ETHERNET
GENERATOR							
SCS-1	IN AUTO		X				(2) #14
SCS-1	RUNNING		X				(2) #14
SCS-1	FAILED		X				(2) #14
ATS							
SCS-1	NORMAL SOURCE AVAILABLE		X				(2) #14
SCS-1	NORMAL SOURCE CONNECTED		X				(2) #14
SCS-1	EMERGENCY SOURCE AVAILABLE		X				(2) #14
SCS-1	EMERGENCY SOURCE CONNECTED		X				(2) #14
SCS-1	IN AUTO		X				(2) #14
SCS-1	FAILED TO TRANSFER		X				(2) #14
SCS-1	INITIATE TEST			X			(2) #14
		TOTALS		32	3	4	0

- PLAN NOTES:**
- JAMES STREET PUMP STATION CONTROL PANEL
 - PROVIDE SUPERVISORY CONTROL SYSTEM, SCS-1, INSIDE PUMP STATION CONTROL PANEL
 - PROVIDE ALLEN BRADLEY PLC 1769-L30ER, PLC PROGRAMMING PROVIDED BY OWNER.
 - PROVIDE UNINTERRUPTIBLE POWER SUPPLY ON SHELF INSIDE PUMP STATION AND OUTSIDE OF SCS-1 ENCLOSURE.
 - PROVIDE 8 PORT UNMANAGED INDUSTRIAL ETHERNET SWITCH.
 - INSTALL OWNER FURNISHED RADIO EQUIPMENT. PROVIDE MINIMUM 12"x12" SPACE ALLOCATED FOR RADIO EQUIPMENT. COORDINATE DIMENSIONS OF EQUIPMENT WITH OWNER. PROVIDE 24 VDC POWER SUPPLY WITH ADDITIONAL 2.5 A DEDICATED TO RADIO EQUIPMENT.
 - PROVIDE PUMP CONTROL PANELS PCP-1 AND PCP-2 INSIDE PUMP STATION CONTROL PANEL. PROVIDE ETHERNET CONNECTION TO E300 OVERLOAD ON STARTER.
 - ANTENNA TO BE MOUNTED AT 20 FT AFG FOR COMMUNICATIONS BACK TO MASTER PLC. 02/19/2019
 - 8.1. PROVIDE ANTENNA TOWER PER SHEET LS-22
 - 8.2. THE CITY WILL PROVIDE THE 1/2" HELIAX ANTENNA CABLE, CONNECTOR, GROUNDING CABLE AND RADIO. COORDINATE ANTENNA INSTALLATION WITH THE CITY.
 - PROVIDE FIBER OPTIC FLOATS WITH TRANSCEIVER RELAY. PROVIDE FLOAT WITH MANUFACTURERS CABLE LONG ENOUGH FOR HOME RUN TO PUMP STATION CONTROL PANEL. PROVIDE STAINLESS STEEL SUSPENSION KIT WITH ANCHOR WEIGHT.
 - EXISTING REPEATER SITE TO REMAIN.
 - EXISTING MAIN SCADA WORKSTATION, ALL PROGRAMMING UPDATES, ALARMS, REPORTS AND SCADA CONFIGURATION PROVIDED BY OWNER.

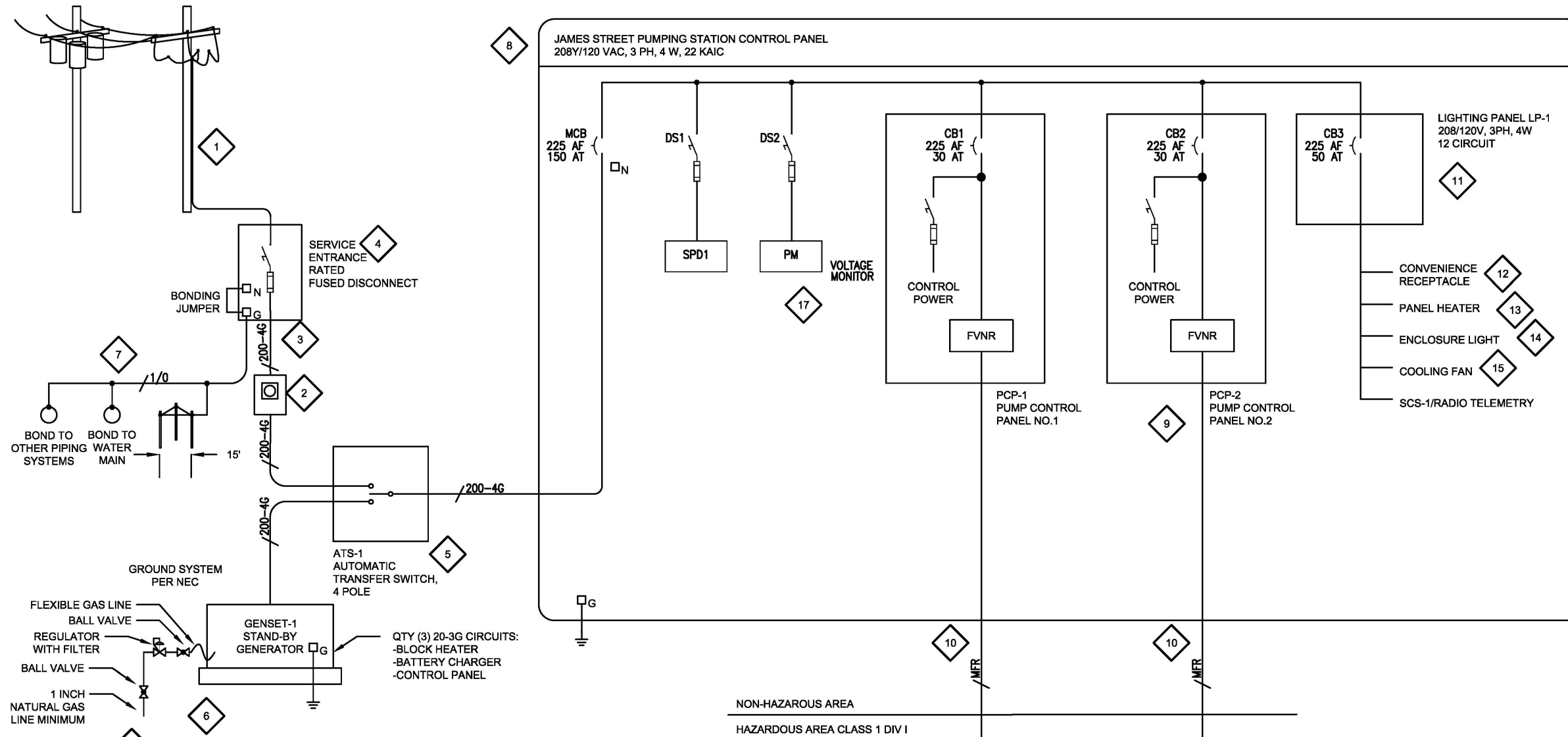
ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

PLOT SCALE: _____
 PLOT NAME: _____
 REV. DATE: _____

ELECTRICAL ONE-LINE

JAMES STREET CITY OF MADISON

REVISED 02/19/2019 BY KJA
 • ADDED NOTE TO GENERATOR TO GROUND PER NEC CODE.



PLAN NOTES:

1. UTILITY TO PROVIDE ELECTRICAL SERVICE FROM POWER POLE TO FUSED DISCONNECT.
 - 1.1. ELECTRICAL UNDERGROUND SERVICE PROVIDED AND INSTALLED BY UTILITY INCLUDES 4/0-ALUMINUM 3 PHASE CONDUCTORS IN 3" CONDUIT FROM THE POWER POLE TO THE FUSED DISCONNECT.
2. PROVIDE UTILITY APPROVED METER SOCKET. MOUNT PER UTILITY REQUIREMENTS.
3. PROVIDE 3 PHASE CONDUCTORS FROM FUSED DISCONNECT TO METER SOCKET
4. PROVIDE NEMA 4X STAINLESS STEEL SERVICE ENTRANCE RATED FUSED DISCONNECT SWITCH WITH ONE SET OF SPARE FUSES.
 - 4.1. INSTALL PER UTILITY REQUIREMENTS.
 - 4.2. PROVIDE 3" CONDUIT STUBBED OUT TO EXPANSION JOINT. UTILITY WILL RUN THEIR CONDUIT TO THAT EXPANSION JOINT.
5. PROVIDE 4-POLE, OPEN TRANSITION, AUTOMATIC TRANSFER SWITCH HOUSED IN A NEMA 4X STAINLESS STEEL ENCLOSURE.
6. PROVIDE PERMANENT GENERATOR
 - 6.1. NATURAL GAS 45 KW, 208Y/120, 3 PHASE, 4 WIRE OUTPUT
 - 6.2. PROVIDE NG LINE SIZED PER MANUFACTURERS RECOMMENDATIONS.
 - 6.3. PROVIDE BALL VALVES, GAS REGULATOR, FILTER AND FLEXIBLE FUEL LINE.
 - 6.4. GROUND PER NEC CODE
7. PROVIDE GROUNDING SYSTEM PER NEC.
8. PUMP STATION CONTROL PANEL
9. PUMP CONTROL PANELS, PCP-1 & PCP-2 SHALL BE MOUNTED IN NEMA 12 ENCLOSURES MOUNTED INSIDE PUMP CONTROL STATION.
10. PUMP MOTOR CABLES SHALL HOMERUN TO PUMP STATION MOTOR STARTER PANELS.
11. PROVIDE NEMA 1 LIGHTING PANEL, 12 CIRCUITS MINIMUM.
12. PROVIDE WEATHERPROOF GROUND FAULT INTERRUPTER CONVENIENCE RECEPTACLE.
13. PROVIDE PANEL HEATER WITH BUILT IN THERMOSTAT.
14. PROVIDE LED ENCLOSURE LIGHTS. PROVIDE (1) 18" LIGHT FOR EVERY 3 FT OF PANEL WIDTH.
15. PROVIDE COOLING FAN, THERMOSTATICALLY CONTROLLED. FAN SHALL PULL FILTERED AIR INTO PANEL. PROVIDE FILTERED LOUVERS. PROVIDE COVERS FOR LOUVERS FOR WINTER MONTHS. PROVIDE SPARE FILTERS.
16. PROVIDE CIRCUIT BREAKER FOR FUTURE YARD LIGHT. PROVIDE CONDUIT STUBBED OUT OF CONCRETE SLAB FOR FUTURE CONNECTION.
17. PROVIDE 3 PHASE VOLTAGE MONITOR, TIMEMARK MODEL 269 HOUSED IN POWER DISTRIBUTION PANEL.

JAMES ST PUMP STATION

NTS

THREE PHASE PANEL SCHEDULE									
LP-1									
TYPE: LIGHTING & APPLIANCE LOAD CENTER		BUS CONSTRUCTION: CU		BUS AMPACITY: 100A		MAIN CIRCUIT BREAKER: NO		SUB-FEED LUGS: NO	
VOLTAGE 208 / 120 - 3P4W		GROUND BUS: YES		ISOLATED GROUND BUS: YES		INTERRUPTING CAPACITY: 10 KAIC			
MOUNT: SURFACE SINGLE TUB									
NO.	DESCRIPTION	LOAD	BKR	A	B	C	BKR	LOAD	DESCRIPTION
1	MAIN CIRCUIT BREAKER		50/3	3.0	3.0	3.0	20/1	3.00	CONTROL/RADIO
2									CONVENIENCE RECEPTACLE
3									ENCLOSURE LIGHT
4									GENSET BATTERY CHARGER
5									GENSET CONTROL PANEL
6									GENSET BLOCK HEATER
7	HEATER/COOLING FAN	1.89	20/1	4.9	3.7	3.7	20/1	3.00	GENSET CONTROL PANEL
8									GENSET CONTROL PANEL
9	YARD LIGHT (FUTURE)		20/1	4.9	12.5	12.5	20/1	12.50	GENSET BLOCK HEATER
10									GENSET BLOCK HEATER
11	SPARE		20/1	4.9	0.0	0.0	20/1		GENSET SPARE
		TOTAL AMPS / PHASE:		7.9	15.5	3.7			
		KVA / PHASE:		0.9	1.9	0.4			TOTAL CONNECTED KVA: 3.3

LIGHTING PANEL

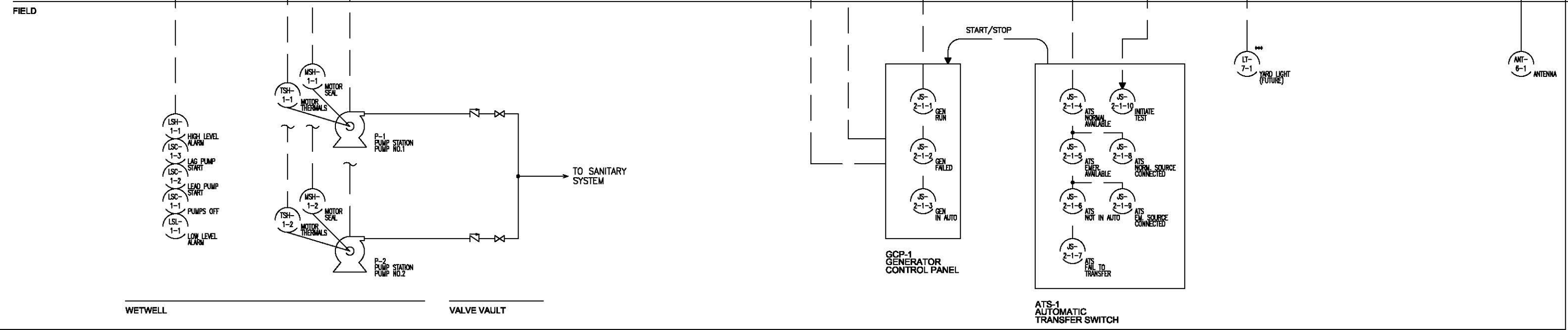
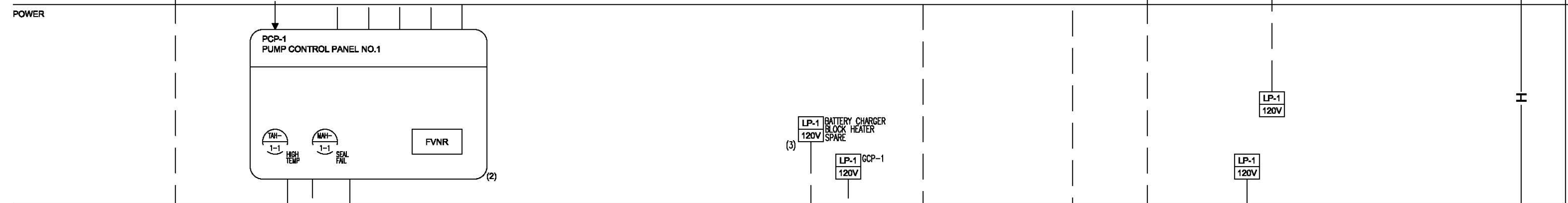
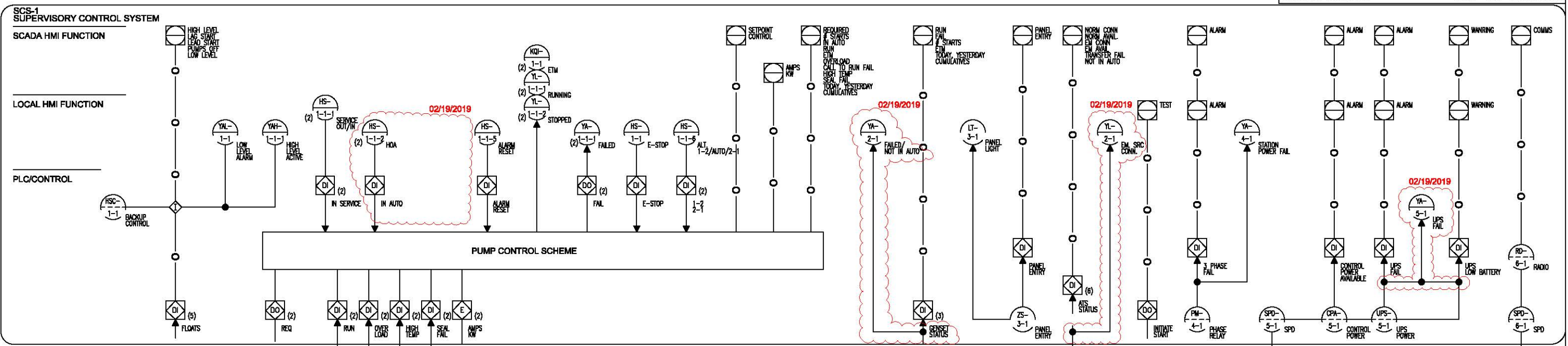
NTS

REVISED 02/19/2019 BY KJA
 • DELETED STATION HAND/AUTO.
 • DELETED START/STOP PUSHBUTTONS.
 • ADDED PILOT LIGHTS.

P&ID

JAMES STREET CITY OF MADISON

PLOT SCALE: _____
 PLOT NAME: _____
 REV. DATE: _____



ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

REVISED 02/19/2019 BY KJA
 • REVISED CONDUIT AND BOX SCHEDULE.

ELECTRICAL SCHEDULE
 JAMES STREET CITY OF MADISON

FIELD INSTRUMENTATION														
TAGNAME	SHEET	DEBC1	DEBC2	LOCATION	ENVIRONMENT	SPEC SECTION	DESTINATION 1	WIRE TYPE 1	DESTINATION 2	WIRE TYPE 2	POWER SOURCE	POWER WIRING	DETAIL	COMMENT
ANT-6-1	E8	ANTENNA		REMOTE	OD	26 90 41	SCS-1	HELIAX					26 90 41	1
ATS-1	E8	AUTOMATIC	TRANSFER SWITCH	REMOTE	OD	26 36 23	SCS-1	D14, D4 SPARE	GCP-1	D2, D2 SPARE				5
GCP-1	E8	GENERATOR	CONTROL PANEL	REMOTE	OD	26 32 13	SCS-1	D6, D4 SPARE	ATS	D2, D2 SPARE	LP-1	(4) 20-3G	26 32 13	5
LSC-1-1	E8	PUMPS OFF		REMOTE		26 90 20-L2	SCS-1	MFR (FIBER)						4
LSC-1-2	E8	LEAD PUMP	START	REMOTE		26 90 20-L2	SCS-1	MFR (FIBER)						4
LSC-1-3	E8	LAG PUMP	START	REMOTE		26 90 20-L2	SCS-1	MFR (FIBER)						4
LSH-1-1	E8	HIGH LEVEL	ALARM	REMOTE		26 90 20-L2	SCS-1	MFR (FIBER)						4
LSL-1-1	E8	LOW LEVEL	ALARM	REMOTE		26 90 20-L2	SCS-1	MFR (FIBER)						4
LT-7-1	E8	YARD LIGHT	(FUTURE)	REMOTE										2
P-1	E8	PUMP STATION	PUMP NO.1	REMOTE	H		PCP-1	MFR			PCP-1	MFR		3
P-2	E8	PUMP STATION	PUMP NO.2	REMOTE	H		PCP-2	MFR			PCP-2	MFR		3

WIRE TYPE

A = ANALOG SIGNAL, # = NUMBER OF TWISTED SHIELDED PAIR
 D = DIGITAL SIGNAL, # = NUMBER OF CONDUCTORS
 H = ANTENNA CABLE
 MFR = MANUFACTURER'S CABLE
 20-2G
 EX. A1 = 1 TWISTED SHIELDED PAIR FOR ANALOG SIGNAL
 D2 = 2 CONDUCTORS FOR DIGITAL SIGNAL
 20-2G = 20 IS THE AMPERE RATING OF THE CONDUCTORS, 2G IS 2 WIRES AND A GROUND.
 SEE SPECIFICATION SECTION 26 05 19 FOR CONDUCTORS AND CABLES

LOCATION/DESTINATION

THE LOCATION IS THE PHYSICAL LOCATION THE TAGNAME CAN BE FOUND. THE DESTINATION IS WHERE THE DEVICE IS BEING WIRED TO

ENVIRONMENT

NH = NON-HAZARDOUS/NOT RATED
 OD = OUTDOOR RATED, NEMA 3R OR NEMA 4X
 C = CORROSIVE
 SUB = SHALL BE RATED FOR FULL CONTACT AND 100% SUBMERSION IN WASTEWATER
 XP = CLASS 1, DIVISION I OR II, INTRINSICALLY SAFE CIRCUITS MAY BE APPLIED
 I.S. = CLASS 1, DIVISION I OR II, WITH INTRINSICALLY SAFE CIRCUIT APPLIED

COMMENTS:

- OWNER FURNISHED EQUIPMENT. 02/19/2019
- PROVIDE SPARE CONDUIT STUBBED OUT PAST CONCRETE FOR FUTURE YARD LIGHT.
- MOTOR CABLE TO HOMERUN TO PUMP CONTROL PANELS.
- EQUIPMENT CABLE TO HOMERUN TO PUMP STATION.
- COORDINATE VOLTAGE REQUIREMENTS WITH EQUIPMENT SUPPLIER.

CONDUIT & BOX SCHEDULE								
AREA CLASSIFICATION	VOLT.	TYPE	INSTALLATION	CONDUIT	USE BOX	SUPPORTS	HARDWARE	LOCATION
NON-HAZARDOUS	ALL	ALL	CONCEALED AFF	PGRS	PCB	SS/GS	SSGS	AS REQUIRED
NON-HAZARDOUS	ALL	ALL	UG/BELOW SLAB	PGRS	PCB	SS	SS	AS REQUIRED
WET/ NON-HAZARDOUS	ALL	ALL	INTERIOR EXPOSED	PGRS	PCB	SS	SS	AS REQUIRED
WET/ NON-HAZARDOUS	ALL	ALL	EXTERIOR EXPOSED	PGRS	PCB	SS	SS	AS REQUIRED
WET/ NON-HAZARDOUS	ALL	ALL	DIRECT BURIED OUTDOOR	PGRS	PCB	SS	SS	AS REQUIRED
HAZARDOUS	ALL	ALL	ALL	PGRS	PCB	SS	SS	AS REQUIRED
HAZARDOUS	ALL	ALL	SLEEVE	PVC 80	PCB	SS	SS	AS REQUIRED

SPACE CLASSIFICATION			
STRUCTURE	ROOM	NAME	CLASSIFICATION
WETWELL			HAZARDOUS
EXTERIOR			WET/NON-HAZARDOUS

02/19/2019

FEEDER SCHEDULE (600 V)				
FEEDER AMPACITY	CONDUCTOR SIZE (KCMIL)		CONDUIT SIZE	
	Ø & N	GRD	3Ø & GRD	3Ø & N & GRD
20	#12	#12	3/4"	3/4"
30	#10	#10	3/4"	1"
40	#8	#10	3/4"	1"
50	#6	#6	1"	1"
70	#4	#6	1-1/4"	1-1/4"
80	#3	#6	1-1/4"	1-1/4"
100	#2	#6	1-1/2"	2"
110	#2	#6	1-1/2"	2"
125	#1	#6	1-1/2"	2"
150	1/0	#6	1-1/2"	2"
175	2/0	#6	2"	2"
200	3/0	#6	2"	2-1/2"
225	4/0	#4	2"	2-1/2"
250	250	#4	2-1/2"	3"
300	350	#4	3"	3"
350	500	#3	3"	3-1/2"
380	500	#3	3"	3-1/2"
400	(2) 3/0	(2) #3	(2) 2"	(2) 2-1/2"
450	(2) 4/0	(2) #2	(2) 2"	(2) 2-1/2"
500	(2) 250	(2) #2	(2) 2-1/2"	(2) 3"
600	(2) 350	(2) #1	(2) 3"	(2) 3"
700	(2) 500	(2) #1/0	(2) 3"	(2) 3-1/2"
800	(2) 600	(2) #1/0	(2) 3-1/2"	(2) 4"
1000	(3) 400	(2) #2/0	(3) 3"	(3) 3-1/2"
1200	(3) 600	(2) #3/0	(3) 3-1/2"	(3) 4"
1600	(4) 600	(2) #4/0	(4) 3-1/2"	(4) 4"
2000	(5) 600	(2) #250	(5) 3-1/2"	(5) 4"

GENERAL NOTES:

- THE ABOVE FEED SCHEDULE IS A SCHEDULE OF TYPICAL FEEDS AND SOME SIZES MAY NOT BE UTILIZED.
- ALL CONDUCTOR AMPACITIES ARE BASED ON TABLE 310-16 OF THE NEC FOR COPPER CONDUCTOR TYPE THW/THWN.
- FEEDER SIZED ON THE RISER DIAGRAM INDICATOR FEEDER AMPACITIES AND DO NOT NECESSARILY CORRESPOND TO CIRCUIT BREAKER AMPACITIES. CERTAIN FEEDERS MAY BE SIZED FOR THE DURATION FACTORS REQUIRED BY CODE AND/OR ARE OVERSIZED FOR VOLTAGE DROP.
- WHERE MULTIPLE CONDUITS ARE INDICATED FOR THE SINGLE FEEDER EACH CONDUIT SHALL CONTAIN AN AØ, BØ, CØ, GROUND CONDUCTOR, AND NEUTRAL CONDUCTOR.

200-4G FEEDER DESIGNATION
 SYSTEM DESCRIPTION
 (2G) 1Ø, 2W + GRD
 (3G) 3Ø, 3W + GRD
 (4G) 3Ø, 4W + GRD
 CONDUCTOR AMPACITY
 (SEE FEEDER SCHEDULE)

NOTES:

- ALL CONDUIT AND RACEWAYS SHALL BE CONCEALED
- NO SUBSTITUTIONS SHALL BE ALLOWED UNLESS WRITTEN PERMISSION TO THE CONTRARY HAS BEEN OBTAINED FROM ENGINEER
- TRANSITION TO EXPOSED CONDUIT SHALL COMPLY WITH SPECIFIED REQUIREMENTS FOR EXPOSED CONDUIT, REGARDLESS OF WHETHER TRANSITION IS RIGID OR FLEXIBLE. EMBEDDED TRANSITIONS SHALL BE RIGID MATERIAL
- ALL JUNCTION BOXES NOT LOCATED IN XP AREAS SHALL BE SS NEMA 4X, OR COST NEMA 7
- EC SHALL FURNISH AND INSTALL WIRE GUTTERS AS REQUIRED
- EX SHALL ONLY USE FLEX CONDUIT IN EQUIPMENT CONNECTIONS, USE ON FIXTURES AND I&C DEVICES SHALL NOT BE PERMITTED
- VFD MOTOR FEEDERS SHALL BE INSTALLED IN GRS CONDUIT AND USE VFD MOTOR CABLES
- EXPOSED CONDUIT SHALL BE PAINTED TO MATCH MOUNTING LOCATION.
- EC MAY SELECT MATERIAL FOR INTERMEDIATE AND TEMPORARY CONNECTION AND CONDUIT, SHALL BE CODE COMPLIANT
- NOTE SCHEDULE 80 PVC SHALL BE USED TO REATED EQUIPMENT CABLE SLEEVES AS DETAILED

ABBREVIATIONS:

CONDUIT:	PVC: POLYVINYL CHLORIDE	SUPPORTS & HARDWARE:	GS: GALVANIZED STEEL	BOXES:	SB: STEEL
	PVC 40: SCHEDULE 40 PVC PIPE		SS: STAINLESS STEEL		CB: CAST BOX
	PVC 80: SCHEDULE 80 PVC PIPE		PVC: POLYVINYL CHLORIDE		PCB: PVC-COATED CAST BOX
	GRS: GALVANIZED RIGID STEEL		ZPS: ZINC PLATED STEEL		
	PBRs: PVC-COATED GRS		PCS: PVC COATED STEEL		
	EMT: ELECTRICAL METALLIC TUBING		S: STEEL		
	HDPE: HIGH DENSITY POLYETHYLENE		AL: ALUMINUM		

ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

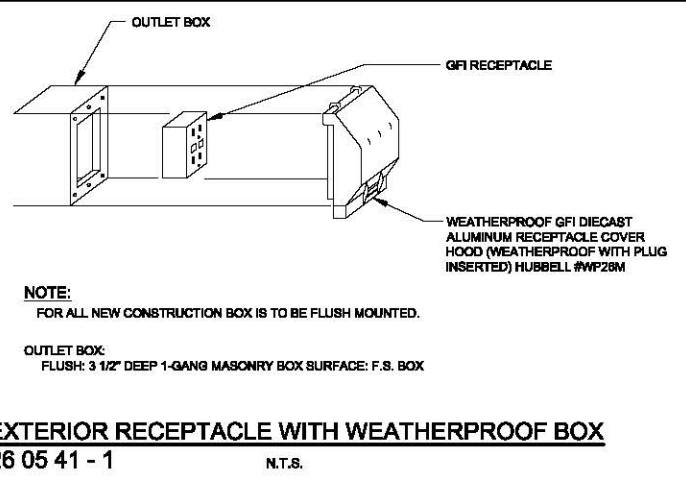
PLOT SCALE: _____ PLOT NAME: _____ REV. DATE: _____

- REVISED 02/19/2019 BY KJA
- REVISED GENERATOR PAD DETAIL.
 - REVISED FREE STANDING CONTROL PANEL DETAIL.

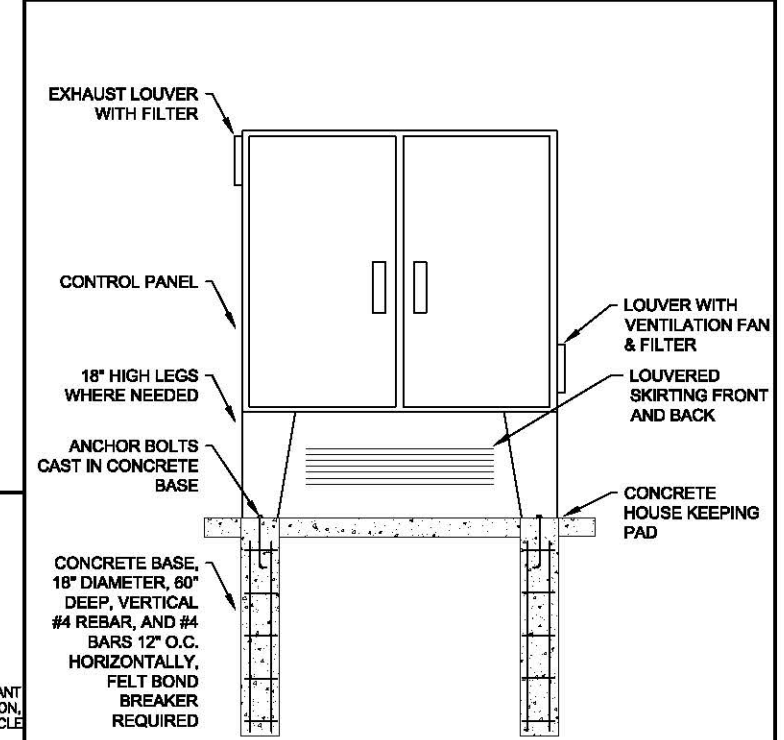
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PLOT NAME: _____

REV. DATE: _____

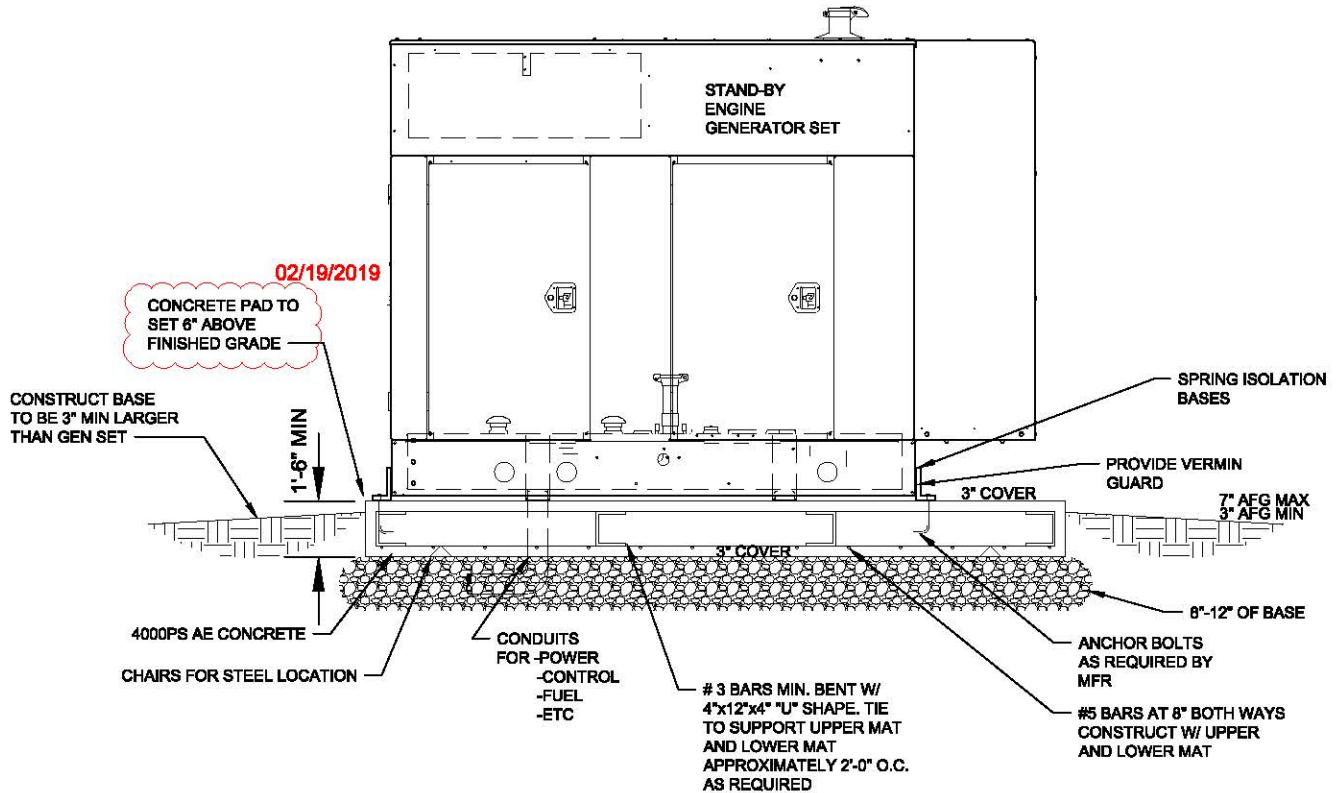


EXTERIOR RECEPTACLE WITH WEATHERPROOF BOX
 26 05 41 - 1 N.T.S.

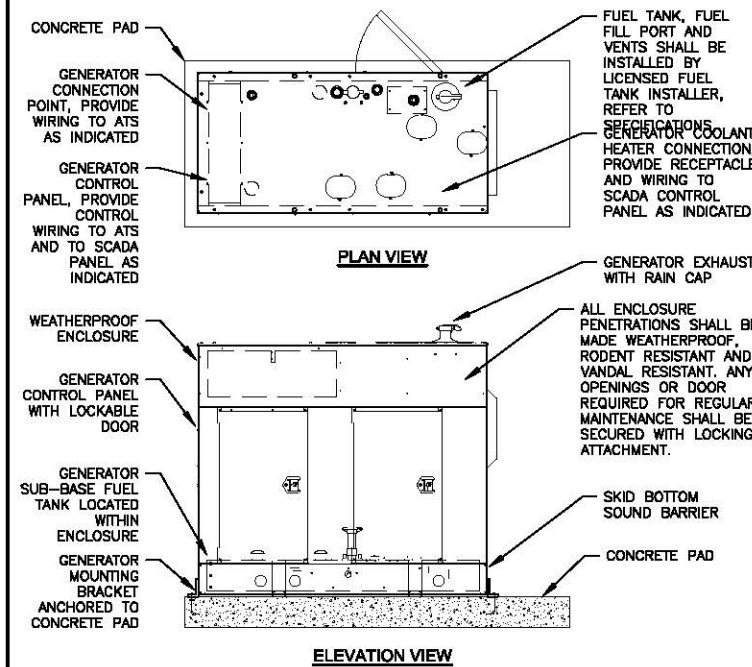


- NOTES:
1. REFER TO SITE PLAN FOR LOCATION AND ORIENTATION.
 2. ALL HARDWARE SHALL BE STAINLESS STEEL.
 3. PROVIDE VENTILATION AND AIR CONDITIONING WHEN REQUIRED FOR PANEL COMPONENT OPERATION.
 4. CONTROL PANEL TO HAVE LOCKABLE THREE POINT LATCH AND DOOR STOPS.
 5. VENTILATION FAN IS TO PUSH COOLER AIR INTO PANEL.

FREE STANDING CONTROL PANEL MOUNTING
 26 90 10 - 2 N.T.S.

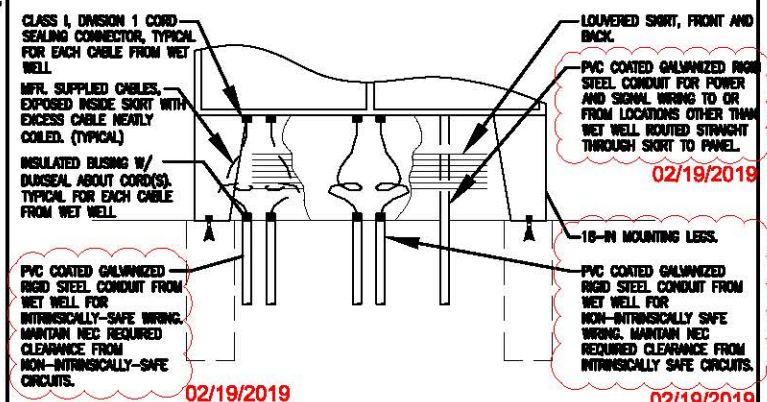


GENERATOR BASE DETAIL
 26 32 13-2 N.T.S.



- NOTES:
1. INSTALL GENERATOR PER MANUFACTURERS RECOMMENDATIONS, IN ACCORDANCE WITH ALL CODES AND ON CONCRETE INSULATION PAD. REFER TO ARCHITECTURAL/STRUCTURAL/CIVIL PLANS.
 2. REFER TO SITE PLAN FOR LOCATION AND ORIENTATION.

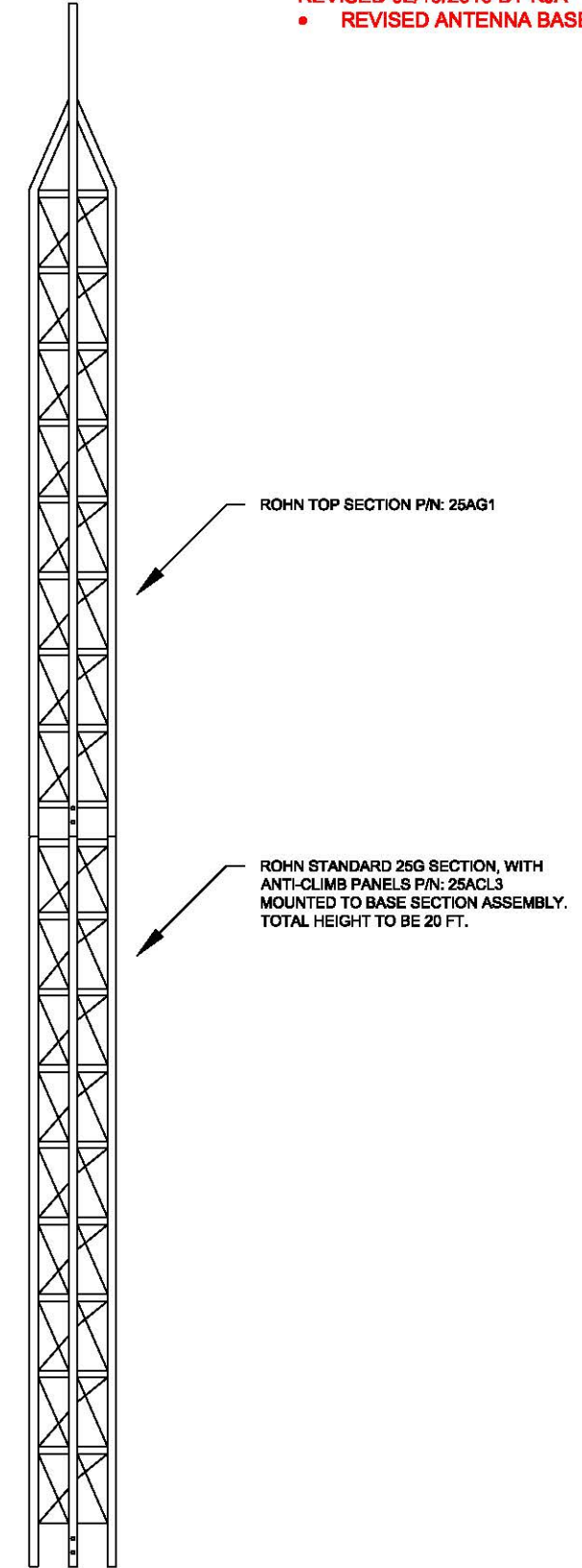
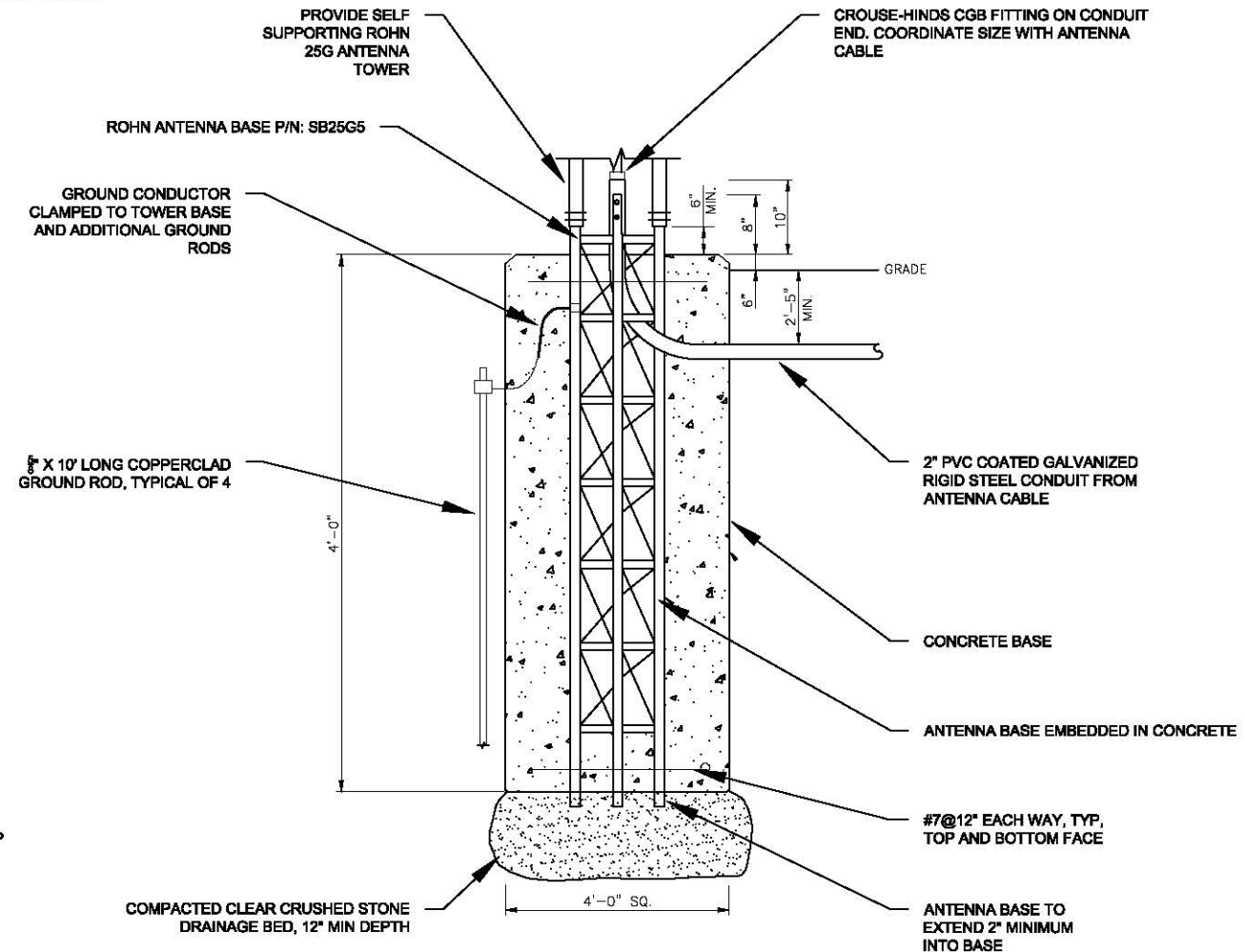
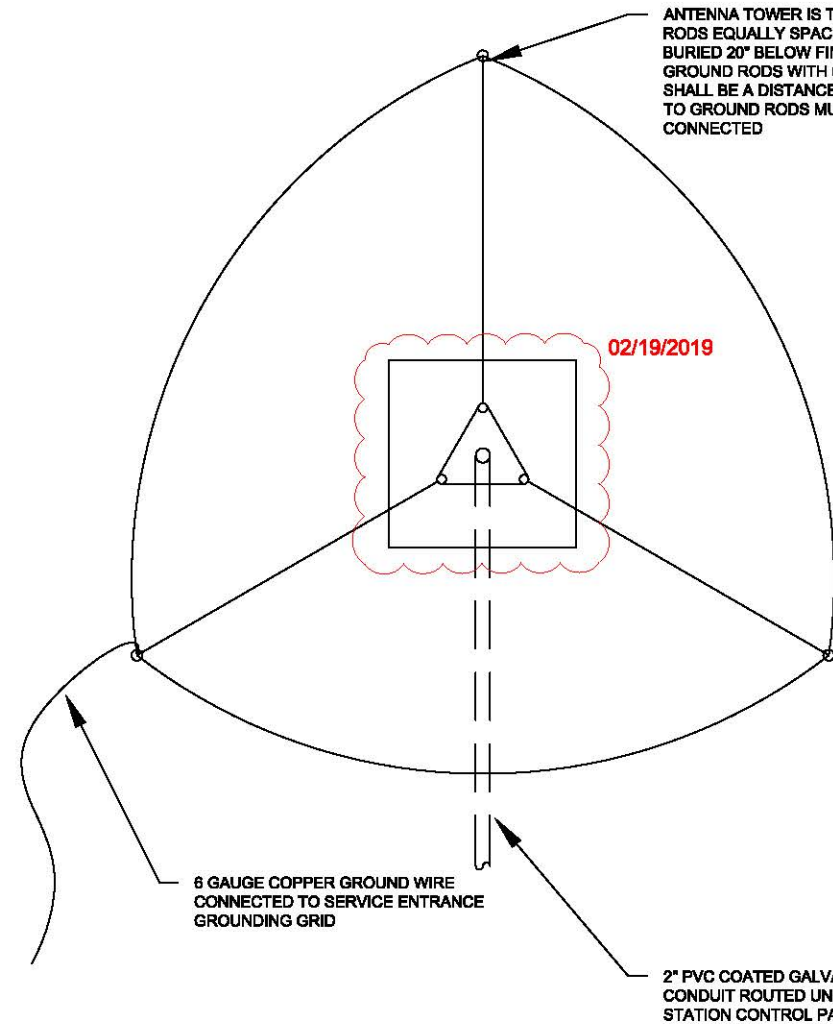
PERMANENT STANDBY EMERGENCY GENERATOR
 26 32 13-1 N.T.S.



CABLE AND CONDUIT INSTALLATION
 26 90 10 - 2-1 N.T.S.

ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

REVISED 02/19/2019 BY KJA
 • REVISED ANTENNA BASE.



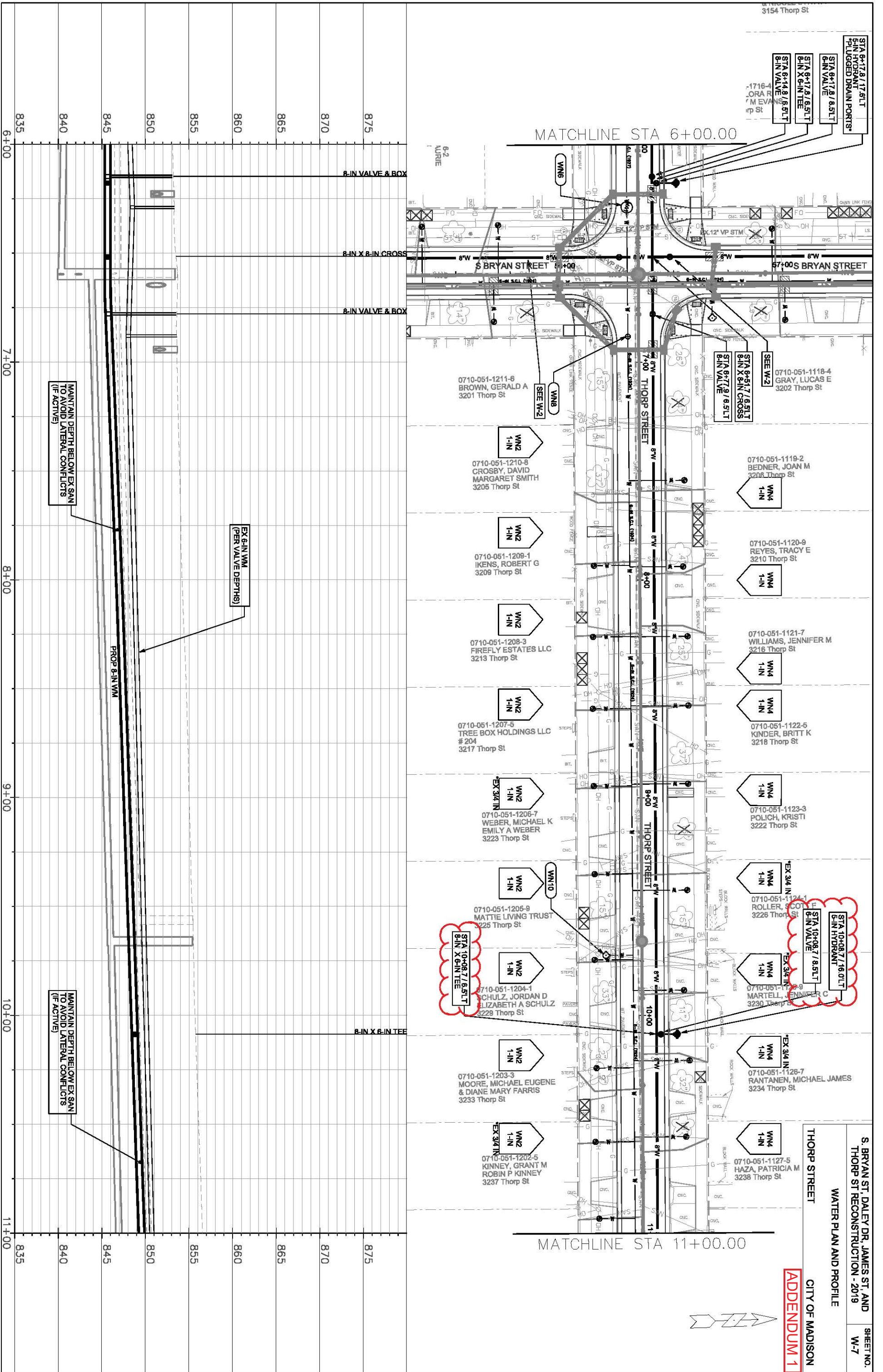
ANTENNA TOWER GROUND GRID - TOP VIEW
 NTS

ANTENNA TOWER CONCRETE BASE - SIDE VIEW
 NTS

ANTENNA TOWER - SIDE VIEW
 NTS

ORIGINATOR: CITY_OF_MADISON_STREETS_DIVISION

REV. DATE: _____ PLOT NAME: _____ PLOT SCALE: _____



S. BRYAN ST DALEY DR, JAMES ST, AND THORP ST RECONSTRUCTION - 2019

WATER PLAN AND PROFILE

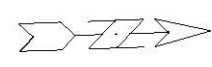
CITY OF MADISON

ADDENDUM 1

THORP STREET

WATER PLAN AND PROFILE

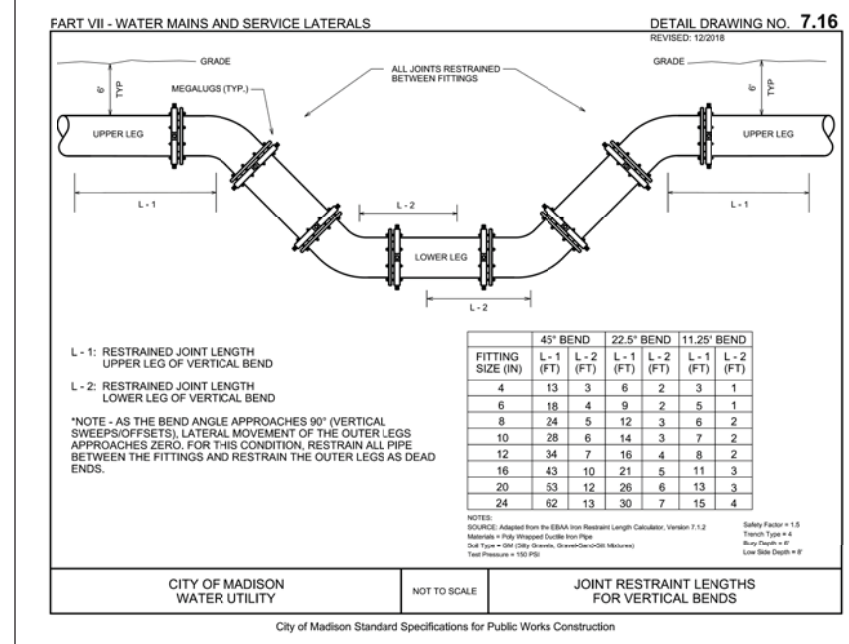
SHEET NO. W-7



ADDENDUM 1

CONSTRUCTION NOTES:

1. CONSTRUCT NEW WATER MAIN 6.0' BELOW FINISHED GRADE, UNLESS OTHERWISE NOTED. INSULATE MAIN WITH POLYSTYRENE BOARD AT STORM SEWER UTILITY CROSSINGS OR OTHER AREAS IDENTIFIED BY ENGINEER AS HAVING INADEQUATE COVER.
 2. VERIFY SIZE OF EXISTING WATER SERVICES AND RECONNECT SERVICES AS INDICATED.
 3. MINIMIZE DISRUPTION OF SERVICE TO EXISTING CUSTOMERS. NOTIFY PER CONTRACT REQUIREMENTS OF ANY PLANNED WATER OUTAGE.
 4. THE EXISTING UTILITIES SHOWN ON THIS PLAN REPRESENT THE BEST INFORMATION AVAILABLE TO THE WATER UTILITY AT THE TIME OF PLAN PREPARATION. CONTRACTOR IS RESPONSIBLE FOR HAVING EACH UTILITY LOCATED PRIOR TO COMMENCING WORK.
- WN1 REPLACE THE EXISTING LEAD SERVICE WITH A NEW COPPER SERVICE.
- WN2 EXTEND AND RECONNECT THE EXISTING COPPER SERVICE FROM THE OLDER WATER MAIN TO THE NEWER WATER MAIN.
- WN3 EXISTING SERVICE TO BE ABANDONED WHEN THE WATER MAIN IS CUT OFF; ABANDON CURB BOX AS REQUIRED.
- WN4 DISCONNECT FROM THE OLDER WATER MAIN AND RECONNECT THE EXISTING COPPER WATER SERVICE LATERAL TO THE NEWER WATER MAIN.
- WN5 RELOCATE THE EXISTING FIRE HYDRANT.
- WN6 ABANDON WATER VALVE ACCESS STRUCTURE.
- WN7 FURNISH AND INSTALL THE NEW TOP SECTION FOR THE WATER ACCESS STRUCTURE.
- WN8 ABANDON THE VALVE BOX.
- WN9 FURNISH THE DITCH, COMPACTION, AND ALL MATERIALS AND LABOR FOR THE INSTALLATION OF NEW SERVICE LATERAL.
- WN10 REMOVE AND SALVAGE EXISTING HYDRANT
- WN11 REPLACE THE EXISTING COPPER SERVICE WITH A COPPER SERVICE



ESTIMATE OF PROJECT WATER MATERIALS - FROM CONTRACTOR:

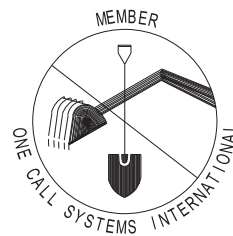
* ESTIMATE OF MATERIALS IS FOR INFORMATION ONLY. ENGINEER DOES NOT GUARANTEE ACCURACY OF MATERIAL TAKE-OFF. ALWAYS REFER TO PLANS.

WATER ASSETS	TOTAL
6-IN PIPE (LF)	100
8-IN PIPE (LF)	2820
POLY WRAP	3230
6-IN VALVE & BOX	6
8-IN VALVE & BOX	14
8-IN - 45° BEND	10
6-IN - 45° BEND	1
6-IN - 90° BEND	1
8-IN X 6-IN TEE	7
8-IN X 8-IN TEE	1
8-IN X 6-IN CROSS	1
8-IN X 8-IN CROSS	2
5-IN HYDRANT	7
6-IN MJ PLUG	1
8-IN MJ PLUG	4
6-IN MJ CAP	2
8-IN X 6-IN REDUCER	2
2-IN STYROFOAM (LF)	168
8-IN X 12-IN OFFSET	1
6-IN X ?-IN OFFSET (AS REQ)	1
1-IN OR 1.5-IN COPPER PIPING	AS REQ

TO OBTAIN LOCATION OF PARTICIPANTS' UNDERGROUND FACILITIES BEFORE YOU DIG IN WISCONSIN

CALL DIGGERS HOTLINE TOLL FREE
 811 OR 1-800-242-8511
 FAX-A-LOCATE 1-800-338-3860
 TDD (FOR HEARING IMPAIRED) 1-800-542-2289

WIS. STATUTE 182.0175 (1974) REQUIRES MIN. OF 3 WORK DAYS NOTICE BEFORE YOU EXCAVATE.



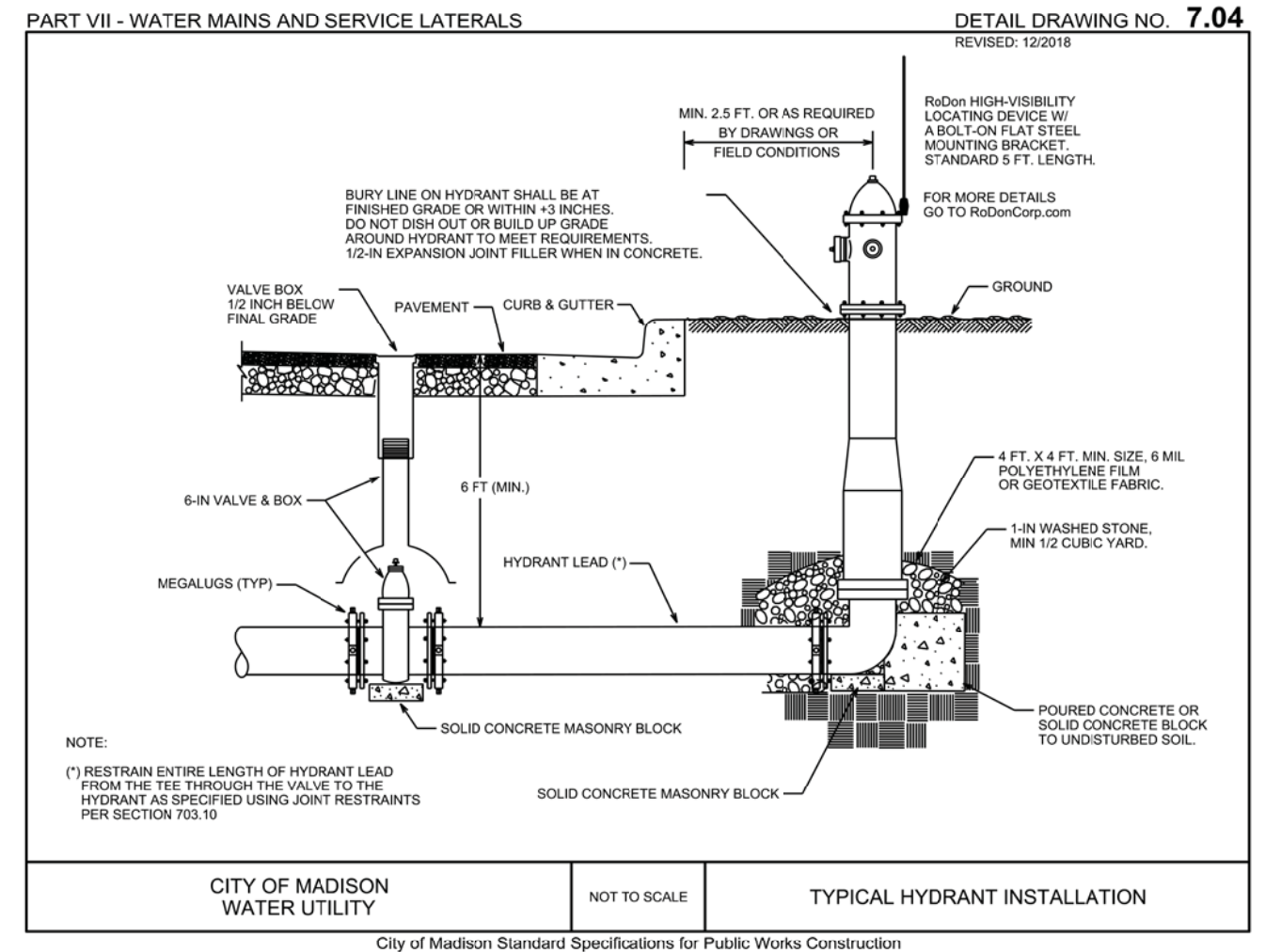
= APPLY STYROFOAM INSULATION OVER THE WATER MAIN AND SERVICES AT STORM SEWER CROSSINGS, PER STANDARD SPECIFICATIONS

ESTIMATE OF PROJECT WATER MATERIALS - FROM CITY:

* ESTIMATE OF MATERIALS IS FOR INFORMATION ONLY. ENGINEER DOES NOT GUARANTEE ACCURACY OF MATERIAL TAKE-OFF. ALWAYS REFER TO PLANS.

WATER ASSETS	TOTAL
6-IN TAPPING VALVE & BOX	1
8-IN TAPPING VALVE & BOX	1
6-IN X 6-IN TAPPING SLEEVE	1
8-IN X 8-IN TAPPING SLEEVE	1

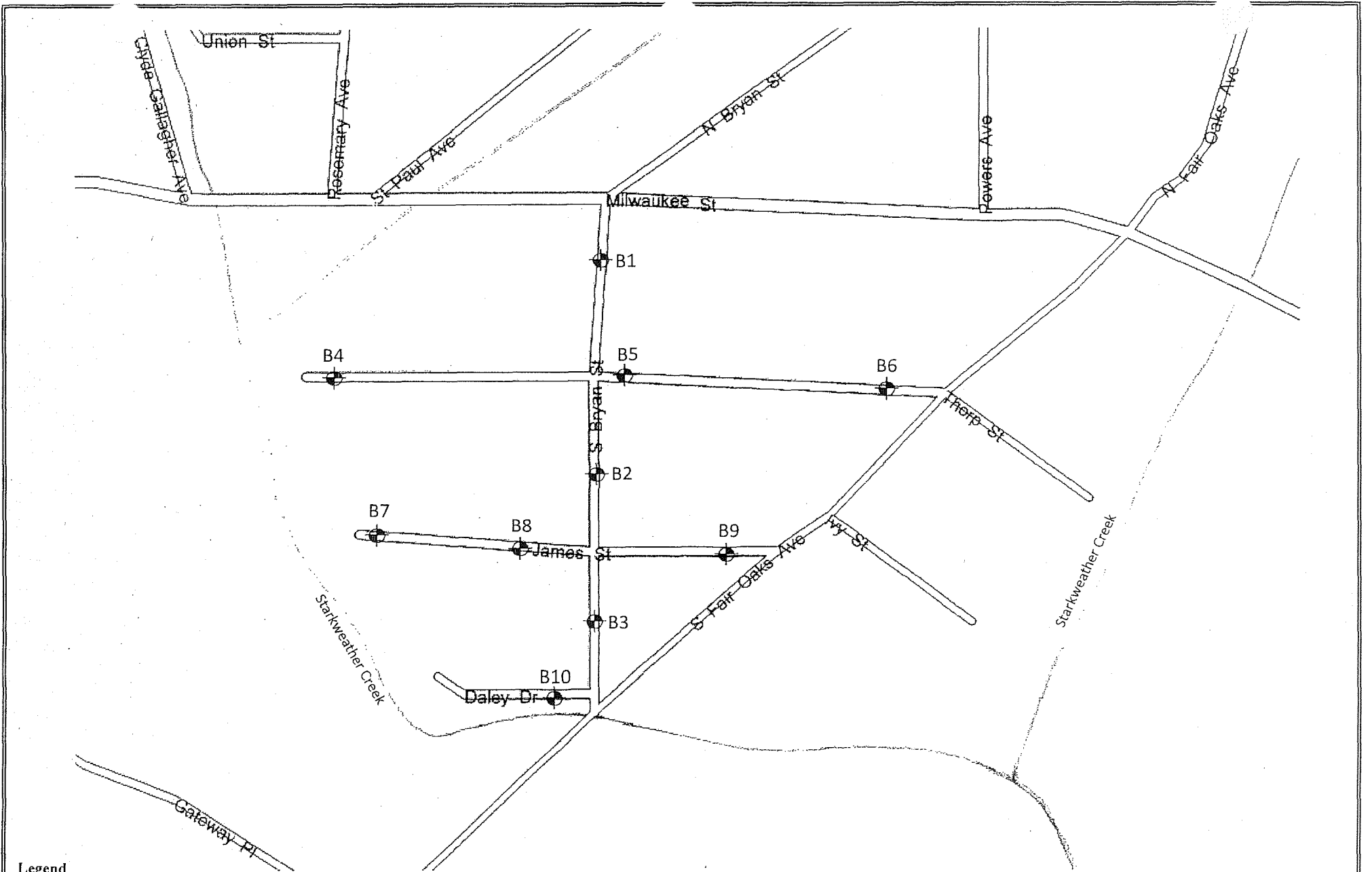
DISCLAIMER NOTE:
 UTILITY LOCATIONS SHOWN ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UNDERGROUND AND OVERHEAD UTILITIES PRIOR TO COMMENCING WORK.



PLOT SCALE: _____

REV. DATE: _____

ORIGINATOR: CITY OF MADISON, STREETS DIVISION

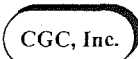


Legend
 Ⓧ Denotes Boring Location



- Notes**
1. Soil borings performed by Badger State Drilling in December 2017
 2. Boring locations are approximate.

Scale: Reduced

Date: 1/2018		Soil Boring Location Plan South Bryan Street Area Madison, WI
Job No. C17051-47		



LOG OF TEST BORING

Project South Bryan Street Area
Bryan: 80'S of Milwaukee, 5'W of CL
 Location Madison, WI

Boring No. 1
 Surface Elevation (ft) 855±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
					2 in. Asphalt Pavement/9 in. Concrete Pavement/4 in. Base Course					
1	14	M	6		FILL: Loose to Very Loose, Brown to Light Brown Sand with Little to Some Silt and Occasional Gravel					
2	12	M	4							
3	16	M/W	5		Loose, Brown Fine to Medium SAND, Little to Some Silt (SP-SM/SM)					
4	12	W	10		Loose to Medium Dense, Brown Fine SAND, Some Silt, Trace Gravel (SM)					
5	14	W	12							
					End Boring at 15 ft					
					Borehole backfilled with bentonite chips and asphalt patch					
					(N 43° 05.974', W 089° 20.157')					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ∇ 8.5' Upon Completion of Drilling _____
 Time After Drilling _____ 20 Min.
 Depth to Water _____ 8.0' ∇
 Depth to Cave in _____ 9.3'

Start 12/20/17 End 12/20/17
 Driller BSD Chief MC Rig CME-55
 Logger MG Editor ESF
 Drill Method 2.25 HSA; Autohammer

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project South Bryan Street Area
Bryan: 115'S of Thorp, 10'E of CL
 Location Madison, WI

Boring No. 2
 Surface Elevation (ft) 853±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE RE	Rec (in.)	Moist	N		Depth (ft)	q _u (qa) (tsf)	W	LL	PL
					0.5 in. Asphalt Pavement/6.5 in. Concrete Pavement/5 in. Base Course					
1	█	10	M	22	FILL: Medium Dense, Brown Sand with Silt, Clay and Trace Gravel to 3 ft					
					Soft to Medium Stiff Gray Clay with Sand to 5.5 ft					
2	█	14	M/W	4		(0.5-0.75)				
					Soft, Gray Lean CLAY, Trace Sand and Plant Fibers (CL)					
3	█	14	M/W	4		(0.3)				
					Medium Dense, Brown Fine SAND, Some Silt (SM)					
4	█	12	M/W	6		(0.4)				
5	█	16	W	23						
6	█	14	W	21						
					End Boring at 15 ft					
					Borehole backfilled with bentonite chips and asphalt patch					
					(N 43° 05.914', W 089° 20.154')					

WATER LEVEL OBSERVATIONS

While Drilling ∇ 10.5' Upon Completion of Drilling _____
 Time After Drilling _____ 20 Min.
 Depth to Water _____ 8.5' ∇
 Depth to Cave in _____ 11.9'

GENERAL NOTES

Start 12/21/17 End 12/21/17
 Driller BSD Chief MC Rig CME-55
 Logger MG Editor ESF
 Drill Method 2.25 HSA; Autohammer

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project South Bryan Street Area
Bryan: 125'S of James, 7'W of CL
 Location Madison, WI

Boring No. 3
 Surface Elevation (ft) 853±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	EPIK Rec (in.)	Moist	N	Depth (ft)		q_u (qa) (tsf)	W	LL	PL	LI
				0	X	3 in. Asphalt Pavement/8.5 in. Concrete Pavement				
1.	14	M	6	1	X	FILL: Loose to Very Loose, Light Brown Fine to Coarse Sand with Little to Some Silt and Gravel				
2	12	M	3	2	X					
3	14	W	14	5	X	Loose to Medium Dense, Light Brown Fine SAND, Trace to Little Silt (SP/SP-SM)				
4	18	W	7	7	X					
5	18	W	10	10	X					
6	14	W	14	15	X	Becoming Fine to Medium Sand and Having Trace Gravel with Depth				
				20	X	End Boring at 20 ft Borehole backfilled with bentonite chips (N 43° 05.865', W 089° 20.153')				
				25	X					

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling ∇ <u>7.0'</u> Upon Completion of Drilling _____ Time After Drilling _____ <u>20 Min.</u> Depth to Water _____ Depth to Cave in _____ <u>6.5'</u>	Start <u>12/21/17</u> End <u>12/21/17</u> Driller <u>BSD</u> Chief <u>MC</u> Rig <u>CME-55</u> Logger <u>MG</u> Editor <u>ESF</u> Drill Method <u>2.25 HSA; Autohammer</u>
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.	



LOG OF TEST BORING

Project South Bryan Street Area
 Thorp: 385'W of Bryan, 7'N of CL
 Location Madison, WI

Boring No. 4
 Surface Elevation (ft) 850±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	q _u (qa) (tsf)	W	LL	PL	LI
1	█	10	M/W	5	5	1 in. Asphalt Pavement/11 in. Concrete Pavement/8 in. Base Course FILL: Very Soft to Medium Stiff, Brown Clay with Occasional Sand and Gravel	(0.25-0.5)				
2	█	12	M/W	5	5	Loose to Very Loose, Black Fibrous PEAT, Trace Sand (PT)		192.5		52.8	
3	█	12	W	3	5	Very Loose, Gray Fine SAND, Some Silt and Plant Fibers (SM)					
4	█	18	W	7	7	Loose, Gray SILT, Trace to Little Fine Sand (ML)					
5	█	14	W	7	7						
6	█	16	W	7	7	Occasional Clay Seams and Lenses Beginning Near 14 ft					
End Boring at 15 ft											
Borehole backfilled with bentonite chips and asphalt patch											
(N 43° 05.942', W 089° 20.237')											

WATER LEVEL OBSERVATIONS

While Drilling ∇ 6.0' Upon Completion of Drilling _____
 Time After Drilling _____ 20 Min.
 Depth to Water _____ 11' ∇
 Depth to Cave in _____ 13'

GENERAL NOTES

Start 12/20/17 End 12/20/17
 Driller BSD Chief MC Rig CME-55
 Logger MG Editor ESF
 Drill Method 2.25 HSA; Autohammer

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project South Bryan Street Area
 Thorp: 80'E of Bryan, 10'N of CL
 Location Madison, WI

Boring No. 5
 Surface Elevation (ft) 854±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
					1.5 in. Asphalt Pavement/7 in. Concrete Pavement/2 in. Base Course					
1	16	M	14		FILL: Stiff, Rust-Brown Clay with Occasional Sand and Gravel	(1.75)				
2	10	M	4		Soft to Medium-Stiff, Dark Gray Lean CLAY (CL - Possible Fill)	(0.5)				
3	12	W	12		Medium Dense, Brown Silty Fine SAND (SM)					
4	10	W	20		Medium Dense, Brown Sandy SILT to Silty Fine SAND (ML/SM)					
5	14	W	28		Medium Dense, Light Brown Fine SAND, Trace to Little Silt (SP/SP-SM)					
End Boring at 15 ft					Borehole backfilled with bentonite chips and asphalt patch (N 43° 05.941', W 089° 20.130')					
Borehole backfilled with bentonite chips and asphalt patch										

WATER LEVEL OBSERVATIONS					GENERAL NOTES				
While Drilling	∇ 6.0'	Upon Completion of Drilling			Start	12/20/17	End	12/20/17	
Time After Drilling				20 Min.	Driller	BSD	Chief	MC	Rig CME-55
Depth to Water				9' ∇	Logger	MG	Editor	ESF	
Depth to Cave in				9.3'	Drill Method	2.25 HSA; Autohammer			
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.									



LOG OF TEST BORING

Project South Bryan Street Area
 Location Thorp: 165'W of Fair Oaks, 6'N of CL
Madison, WI

Boring No. 6
 Surface Elevation (ft) 857±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					0	2 in. Asphalt Pavement/8.5 in. Concrete Pavement/3 in. Base Course				
1		12	M	8	8	Medium-Stiff to Stiff, Brown to Rust-Brown Lean CLAY (CL)				
2		12	M	6	6	Loose, Brown Fine SAND, Some Silt (SM)				
3		16	M	6	5	Loose, Brown Fine to Medium SAND, Little to Some Silt (SP-SM/SM)				
4		14	M	10	10	Loose to Medium Dense, Light Brown Fine SAND, Trace to Little Silt (SP/SP-SM)				
5		16	W	16	15	End Boring at 15 ft				
Borehole backfilled with bentonite chips and asphalt patch										
(N 43° 05.938', W 089° 20.048')										
					20					
					25					

WATER LEVEL OBSERVATIONS

While Drilling ∇ 12.0' Upon Completion of Drilling _____
 Time After Drilling _____ 20 Min.
 Depth to Water _____ ∇
 Depth to Cave in _____ 10'

GENERAL NOTES

Start 12/20/17 End 12/20/17
 Driller BSD Chief MC Rig CME-55
 Logger MG Editor ESF
 Drill Method 2.25 HSA; Autohammer

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project South Bryan Street Area
James: 345'W of Bryan, 8'N of CL
 Location Madison, WI

Boring No. 7
 Surface Elevation (ft) 849±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	q_u (qa) (tsf)	W	LL	PL	LI
					0	X	1 in. Asphalt Pavement/9 in. Concrete Pavement/6 in. Base Course				
1	F	12	M	8	1		FILL: Loose, Brown to Light Brown Sand with Little to Some Silt				
2	F	10	M	5	5		Loose, Black to Dark Brown Fibrous PEAT, Trace Sand (PT)		200.6		55.3
3	F	16	W	2	10		Very Loose, Gray Fine to Medium Sand, Some Silt and Shells (SM)				
4	F	18	M/W	0	12		Very Soft, Gray to Dark Gray Lean CLAY, Trace Sand and Plant Fibers(CL)	(<0.2)			
5	F	18	M/W	0	14			(<0.2)			
6	F	18	M/W	0	16			(<0.2)			
7	F	16	W	13	20		Medium Dense, Gray Fine to Medium SAND, Little to Some Silt (SP-SM/SM)				
End Boring at 20 ft											
Borehole backfilled with bentonite chips and asphalt patch											
(N 43° 05.892', W 089° 20.233')											

WATER LEVEL OBSERVATIONS					GENERAL NOTES				
While Drilling	∇	6.0'	Upon Completion of Drilling		Start	12/20/17	End	12/20/17	
Time After Drilling				20 Min.	Driller	BSD	Chief	MC	Rig
Depth to Water				13.3'	Logger	MG	Editor	ESF	
Depth to Cave in				17'	Drill Method	2.25 HSA; Autohammer			
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.									



LOG OF TEST BORING

Project South Bryan Street Area
James: 80'W of Bryan, 10'S of CL
 Location Madison, WI

Boring No. 8
 Surface Elevation (ft) 851±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	DEPTH (ft)	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					2 in. Asphalt Pavement/7.5 in. Concrete Pavement/4 in. Base Course					
1		12	M	5	FILL: Medium Stiff to Stiff, Brown Clay with Occasional Sand and Gravel	(1.0)				
2		8	M	5	Soft, Gray Lean CLAY, Trace Sand and Plant Fibers(CL)	(0.4)				
3		12	W	11	Medium Dense, Fine SAND, Little to Some Silt (SP-SM/SM)					
4		12	W	15						
5		18	W	22	Medium Dense, Light Brown Fine SAND; Trace to Little Silt (SP/SP-SM)					
6		16	W	26	Occasional Seams and Layers with Fine to Medium Sand					
					End Boring at 20 ft					
					Borehole backfilled with bentonite chips and asphalt patch					
					(N 43° 05.889', W 089° 20.168')					

WATER LEVEL OBSERVATIONS

While Drilling ∇ 6.0' Upon Completion of Drilling _____
 Time After Drilling _____ 20 Min.
 Depth to Water _____ 6.25' ∇
 Depth to Cave in _____ 6.9'

GENERAL NOTES

Start 12/21/17 End 12/21/17
 Driller BSD Chief MC Rig CME-55
 Logger MG Editor ESF
 Drill Method 2.25 HSA; Autohammer

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project South Bryan Street Area
James: 115'W of Fair Oaks, 10'S of CL
 Location Madison, WI

Boring No. 9
 Surface Elevation (ft) 855±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE E	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					0.5 in. Asphalt Pavement/9 in. Concrete Pavement					
1		14	M	5	FILL: Loose, Brown to Light Brown Sand with Little to Some Silt					
2		14	M	6	Loose, Brown Fine to Medium SAND, Little to Some Silt (SP-SM/SM)					
3		16	M	4	Very Loose to Loose, Light Brown Fine SAND, Trace to Little Silt (SP/SP-SM)					
4		14	W	6	Medium Dense, Light Brown Fine to Medium SAND, Trace to Little Silt and Gravel (SP/SP-SM)					
5		14	W	13						
6		14	W	18						
					End Boring at 20 ft					
					Borehole backfilled with bentonite chips and asphalt patch					
					(N 043° 05.883', W 089° 20.111')					

WATER LEVEL OBSERVATIONS					GENERAL NOTES					
While Drilling	∇ 9.7'	Upon Completion of Drilling			Start	12/21/17	End	12/21/17		
Time After Drilling				20 Min.	Driller	BSD	Chief	MC	Rig	CME-55
Depth to Water					Logger	MG	Editor	ESF		
Depth to Cave in				8.7'	Drill Method	2.25 HSA; Autohammer				
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.										



LOG OF TEST BORING

Project South Bryan Street Area
 Daley: 120'W of Bryan, 5'S of CL
 Location Madison, WI

Boring No. 10
 Surface Elevation (ft) 852±
 Job No. C17051-47
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					6 in. Concrete Pavement/4 in. Base Course					
1		6	M	10	FILL: Loose to Medium Dense, Brown to Light Brown Sand with Little to Some Silt					
2		10	M	5	Medium Stiff to Stiff, Brown and Gray (Mottled) Lean CLAY, Trace Sand and Plant Fibers(CL)	(1.0)				
3		14	W	9	Loose to Medium Dense, Light Brown Fine to Medium SAND, Trace to Little Silt and Gravel (SP/SP-SM)					
4		18	W	11						
5		18	W	17						
					End Boring at 15 ft					
					Borehole backfilled with bentonite chips and asphalt patch					
					(N 43° 05.845', W 089° 20.173')					

WATER LEVEL OBSERVATIONS

While Drilling ∇ 6.0' Upon Completion of Drilling _____
 Time After Drilling _____ 20 Min.
 Depth to Water _____ 6' ∇
 Depth to Cave in _____ 7'

GENERAL NOTES

Start 12/21/17 End 12/21/17
 Driller BSD Chief MC Rig CME-55
 Logger MG Editor ESF
 Drill Method 2.25 HSA; Autohammer

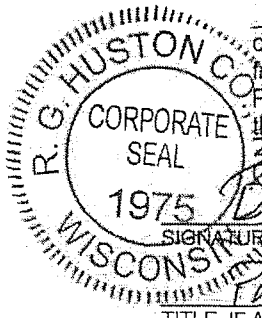
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

SECTION E: BIDDERS ACKNOWLEDGEMENT

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET
RECONSTRUCTION DISTRICT 2018
CONTRACT NO. 8119

Bidder must state a Unit Price and Total Bid for each item. The Total Bid for each item must be the product of quantity, by Unit Price. The Grand Total must be the sum of the Total Bids for the various items. In case of multiplication errors or addition errors, the Grand Total with corrected multiplication and/or addition shall determine the Grand Total bid for each contract. The Unit Price and Total Bid must be entered numerically in the spaces provided. All words and numbers shall be written in ink.

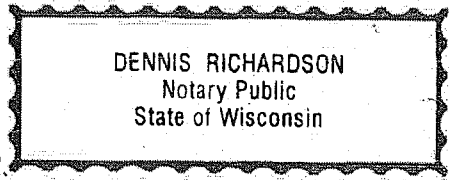
- The undersigned having familiarized himself/herself with the Contract documents, including Advertisement for Bids, Instructions to Bidders, Form of Proposal, City of Madison Standard Specifications for Public Works Construction - 2019 Edition thereto, Form of Agreement, Form of Bond, and Addenda issued and attached to the plans and specifications on file in the office of the City Engineer, hereby proposes to provide and furnish all the labor, materials, tools, and expendable equipment necessary to perform and complete in a workmanlike manner the specified construction on this project for the City of Madison; all in accordance with the plans and specifications as prepared by the City Engineer, including Addenda Nos. 1 through 2 to the Contract, at the prices for said work as contained in this proposal. (Electronic bids submittals shall acknowledge addendum under Section E and shall not acknowledge here)
- If awarded the Contract, we will initiate action within seven (7) days after notification or in accordance with the date specified in the contract to begin work and will proceed with diligence to bring the project to full completion within the number of work days allowed in the Contract or by the calendar date stated in the Contract.
- The undersigned Bidder or Contractor certifies that he/she is not a party to any contract, combination in form of trust or otherwise, or conspiracy in restraint of trade or commerce or any other violation of the anti-trust laws of the State of Wisconsin or of the United States, with respect to this bid or contract or otherwise.
- I hereby certify that I have met the Bid Bond Requirements as specified in Section 102.5. (IF BID BOND IS USED, IT SHALL BE SUBMITTED ON THE FORMS PROVIDED BY THE CITY. FAILURE TO DO SO MAY RESULT IN REJECTION OF THE BID).
- I hereby certify that all statements herein are made on behalf of R.G. HUSTON Co. Inc. (name of corporation, partnership, or person submitting bid) a corporation organized and existing under the laws of the State of WISCONSIN a partnership consisting of _____; an individual trading as _____; of the City of _____ State of _____; that I have examined and carefully prepared this Proposal, from the plans and specifications and have checked the same in detail before submitting this Proposal; that I have fully authority to make such statements and submit this Proposal in (its, their) behalf; and that the said statements are true and correct.



BRAD HUSTON - BRAD HUSTON
SIGNATURE
PRESIDENT
TITLE, IF ANY

Sworn and subscribed to before me this 28TH day of FEBRUARY, 2019.

Diana [Signature]
(Notary Public or other officer authorized to administer oaths)
My Commission Expires 1-10-20
Bidders shall not add any conditions or qualifying statements to this Proposal.



Contract 8119 – R. G. Huston Co., Inc.

Section F: Best Value Contracting (BVC)

This section is a required document for the bid to be considered complete. There are two methods for completing the Best Value Contracting (BVC) form. Method one: The form can be filled out online and submitted to this site to be included with your electronic bid. Method two: The form can be downloaded from the site and submitted by hand to the City of Madison.

Method of Submittal for BVC (click in box below to choose) *

I will submit Bid Express fillable online form (BVC).

Best Value Contracting

1. The Contractor shall indicate the non-apprenticeable trades used on this contract.

2. Madison General Ordinance (M.G.O.), 33.07(7), does provide for some exemptions from the active apprentice requirement. Apprenticeable trades are those trades considered apprenticeable by the State of Wisconsin. Please check applicable box if you are seeking an exemption.

- Contractor has a total skilled workforce of four or less individuals in all apprenticeable trades combined.
- No available trade training program; The Contractor has been rejected by the only available trade training program, or there is no trade training program within 90 miles.
- Contractor is not using an apprentice due to having a journey worker on layoff status, provided the journey worker was employed by the contractor in the past six months.
- First time contractor on City of Madison Public Works contract requests a onetime exemption but intends to comply on all future contracts and is taking steps typical of a "good faith" effort.
- Contractor has been in business less than one year.
- Contractor doesn't have enough journeyman trade workers to qualify for a trade training program in that respective trade.
- An exemption is granted in accordance with a time period of a "Documented Depression" as defined by the State of Wisconsin.

3. The Contractor shall indicate on the following section which apprenticeable trades are to be used on this contract. Compliance with active apprenticeship, to the extent required by M.G.O. 33.07(7), shall be satisfied by documentation from an applicable trade training body; an apprenticeship contract with the Wisconsin Department of Workforce Development or a similar agency in another state; or the U.S Department of Labor. This documentation is required prior to the Contractor beginning work on the project site.

The Contractor has reviewed the list and shall not use any apprenticeable trades on this project.

LIST APPRENTICABLE TRADES (check all that apply to your work to be performed on this contract)

- BRICKLAYER
- CARPENTER
- CEMENT MASON / CONCRETE FINISHER
- CEMENT MASON (HEAVY HIGHWAY)
- CONSTRUCTION CRAFT LABORER
- DATA COMMUNICATION INSTALLER
- ELECTRICIAN
- ENVIRONMENTAL SYSTEMS TECHNICIAN / HVAC SERVICE TECH/HVAC INSTALL / SERVICE
- GLAZIER
- HEAVY EQUIPMENT OPERATOR / OPERATING ENGINEER
- INSULATION WORKER (HEAT and FROST)
- IRON WORKER
- IRON WORKER (ASSEMBLER, METAL BLDGS)
- PAINTER and DECORATOR
- PLASTERER
- PLUMBER
- RESIDENTIAL ELECTRICIAN
- ROOFER and WATER PROOFER
- SHEET METAL WORKER
- SPRINKLER FITTER
- STEAMFITTER
- STEAMFITTER (REFRIGERATION)
- STEAMFITTER (SERVICE)
- TAPER and FINISHER
- TELECOMMUNICATIONS (VOICE, DATA and VIDEO) INSTALLER-TECHNICIAN
- TILE SETTER

S. Bryan Street, Daley Drive, James Street and Thorp
Street Reconstruction District 2018
CONTRACT No. 8119

Small Business Enterprise Compliance Report

Cover Sheet

This information **MUST** be submitted in a separate sealed envelope marked
"ENVELOPE NO. 2 - SBE COMPLIANCE REPORT".

Prime Bidder Information:

Company: R.G. Huston Company, Inc.

Address: 2561 Coffeytown Road
Cottage Grove, WI 53527

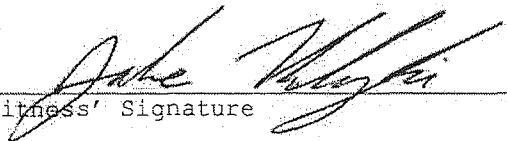
Telephone Number: (608) 255-9223

Fax Number: (608) 839-5936

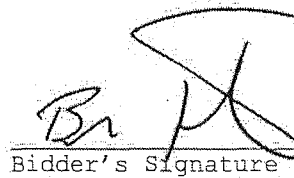
Contact Person/Title: Brad Huston, President

Prime Bidder Certification:

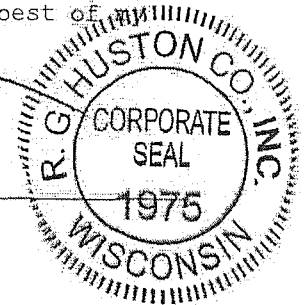
I, Brad Huston, President of R.G. Huston Company, Inc. certify that the information
contained in this SBE Compliance Report is true and correct to the best of my
knowledge and belief.



Witness' Signature



Bidder's Signature



2-28-19

Date

S. Bryan Street, Daley Drive, James Street and Thorp
Street Reconstruction District 2018
CONTRACT No. 8119

Small Business Enterprise Compliance Report

Summary Sheet

This information MUST be submitted in a separate sealed envelope marked
"ENVELOPE NO. 2 - SBE COMPLIANCE REPORT".

SBE SUBCONTRACTORS WHO ARE NOT SUPPLIERS

<u>Name(S) of SBEs Utilized</u>	<u>Type of Work</u>	<u>% of Total Bid Amount</u>
Bullet	Trucking	4.00%
JR's Construction	Landscaper	1.31%

Subtotal SBE who are not suppliers: 5.31 %

SBE SUBCONTRACTORS WHO ARE SUPPLIERS

<u>Name(S) of SBEs Utilized</u>	<u>Type of Work</u>	<u>% of Total Bid Amount</u>
USSI	Railing	0.18%

Subtotal SBE who are suppliers: 0.18 % X 0.6 = 0.11 % (discounted to 60%)

Total Percentage of SBE Utilization: 5.42 %

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET RECONSTRUCTION DISTRICT 2018
 CONTRACT NO. 8119
 DATE: 2/28/19

R. G. Huston Co., Inc.

Item	Quantity	Price	Extension
Section B: Proposal Page			
10701.0 - TRAFFIC CONTROL - LUMP SUM	1.00	\$8,100.00	\$8,100.00
10720.0 - TRAFFIC CONTROL SIGN - PORTABLE ARROW BOARD - DAYS	15.00	\$20.00	\$300.00
10721.0 - TRAFFIC CONTROL SIGN - PORTABLE CHANGEABLE MESSAGE - DAYS	21.00	\$70.00	\$1,470.00
10801.0 - ROOT CUTTING - CURB & GUTTER - L.F.	80.00	\$18.00	\$1,440.00
10802.0 - ROOT CUTTING - SIDEWALK - L.F.	40.00	\$18.00	\$720.00
10911.0 - MOBILIZATION - LUMP SUM	1.00	\$397,500.55	\$397,500.55
20101.0 - EXCAVATION CUT C.Y.	5725.00	\$33.00	\$188,925.00
20130.0 - UNDERDRAIN - L.F.	1000.00	\$18.00	\$18,000.00
20140.0 - GEOTEXTILE FABRIC TYPE SAS (NON-WOVEN) - S.Y.	2000.00	\$1.30	\$2,600.00
20219.0 - BREAKER RUN - TON	3200.00	\$10.20	\$32,640.00
20301.0 - SAWCUT CONCRETE PAVEMENT, FULL DEPTH - L.F.	40.00	\$1.95	\$78.00
20303.0 - SAWCUT ASPHALT PAVEMENT - L.F.	220.00	\$1.95	\$429.00
20321.0 - REMOVE CONCRETE PAVEMENT - S.Y.	6300.00	\$3.00	\$18,900.00
20322.0 - REMOVE CONCRETE CURB & GUTTER - L.F.	5050.00	\$5.80	\$29,290.00
20323.0 - REMOVE CONCRETE SIDEWALK & DRIVE - S.F.	23000.00	\$3.75	\$86,250.00
20325.0 - REMOVE GUARD RAIL - L.F.	35.00	\$10.00	\$350.00
20326.0 - REMOVE FENCE - L.F.	15.00	\$18.00	\$270.00
20401.0 - CLEARING - I.D.	743.00	\$29.17	\$21,673.31
20402.0 - GRUBBING - I.D.	474.00	\$6.65	\$3,152.10
20701.0 - TERRACE SEEDING - S.Y.	6800.00	\$1.25	\$8,500.00
21063.0 - EROSION MATTING, CLASS I, TYPE A - ORGANIC - S.Y.	6800.00	\$2.85	\$19,380.00
30201.0 - TYPE 'A' CONCRETE CURB & GUTTER - L.F.	5200.00	\$14.89	\$77,428.00
30203.0 - TYPE 'X' CONCRETE CURB & GUTTER - L.F.	300.00	\$19.39	\$5,817.00
30208.0 - HAND FORMED CONCRETE CURB & GUTTER (TREE LOCATIONS) - L.F.	40.00	\$40.40	\$1,616.00
30301.0 - 5" CONCRETE SIDEWALK - S.F.	13500.00	\$5.41	\$73,035.00
30302.0 - 7" CONCRETE SIDEWALK AND DRIVE - S.F.	12400.00	\$6.12	\$75,888.00
30340.0 - CURB RAMP DETECTABLE WARNING FIELD - S.F.	160.00	\$30.30	\$4,848.00
40101.0 - CRUSHED AGGREGATE BASE COURSE GRADATION NO. 1 - TON	2900.00	\$21.50	\$62,350.00
40102.0 - CRUSHED AGGREGATE BASE COURSE GRADATION NO. 2 - TON	4100.00	\$21.50	\$88,150.00
40202.0 - HMA PAVEMENT 4 LT 58-28 S - TON	1400.00	\$70.50	\$98,700.00
40231.0 - ASPHALT DRIVE & TERRACE - S.Y.	35.00	\$57.00	\$1,995.00
40301.0 - FULL WIDTH GRINDING - S.Y.	400.00	\$9.90	\$3,960.00
40410.0 - CONCRETE SPEED HUMP - S.Y.	150.00	\$83.54	\$12,531.00
60802.0 - PAVEMENT MARKING EPOXY, LINE, 6-INCH - L.F.	2950.00	\$0.65	\$1,917.50
60812.0 - PAVEMENT MARKING EPOXY, CROSSWALK, 6-INCH - L.F.	1300.00	\$7.75	\$10,075.00
60816.0 - PAVEMENT MARKING EPOXY, CONTINENTAL CROSSWALK, 18-INCH - L.F.	280.00	\$12.75	\$3,570.00
60818.0 - PAVEMENT MARKING EPOXY, STOP LINE, 24-INCH - L.F.	180.00	\$14.50	\$2,610.00
60823.0 - PAVEMENT MARKING EPOXY, SYMBOL, BIKE LANE - EACH	5.00	\$185.00	\$925.00
60883.0 - PAVEMENT MARKING REMOVAL, 12-INCH - L.F.	100.00	\$4.50	\$450.00

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET RECONSTRUCTION DISTRICT 2018
 CONTRACT NO. 8119
 DATE: 2/28/19

R. G. Huston Co., Inc.

Item	Quantity	Price	Extension
60941.0 - TEMPORARY PAVEMENT MARKING TAPE, REMOVABLE, REFLECTIVE, DOUBLE LINE, 4-INCH - L.F.	300.00	\$2.00	\$600.00
90001.0 - TRAFFIC CONTROL FLEXIBLE TUBULAR MARKER POSTS - EACH	30.00	\$20.00	\$600.00
90002.0 - TRAFFIC CONTROL FLEXIBLE TUBULAR MARKER BASES - EACH	30.00	\$6.00	\$180.00
20217.0 - CLEAR STONE - TON	350.00	\$25.00	\$8,750.00
21001.0 - EROSION CONTROL PLAN & IMPLEMENTATION - LUMP SUM	1.00	\$1,500.00	\$1,500.00
21002.0 - EROSION CONTROL INSPECTION - EACH	3.00	\$500.00	\$1,500.00
21011.0 - CONSTRUCTION ENTRANCE - EACH	1.00	\$550.00	\$550.00
21012.0 - STREET CONSTRUCTION ENTRANCE BERM - EACH	3.00	\$330.00	\$990.00
21013.0 - STREET SWEEPING - LUMP SUM	8.00	\$650.00	\$5,200.00
21014.0 - CLEAR STONE BERM (DITCH CHECK) - EACH	460.00	\$5.50	\$2,530.00
21032.0 - INLET PROTECTION TYPE C - PROVIDE & INSTALL - EACH	14.00	\$100.00	\$1,400.00
21033.0 - INLET PROTECTION TYPE C - MAINTAIN - EACH	14.00	\$60.00	\$840.00
21034.0 - INLET PROTECTION TYPE C - REMOVE - EACH	14.00	\$40.00	\$560.00
21056.0 - INLET PROTECTION TYPE D HYBRID - PROVIDE & INSTALL - EACH	36.00	\$170.00	\$6,120.00
21057.0 - INLET PROTECTION TYPE D HYBRID - MAINTAIN - EACH	36.00	\$65.00	\$2,340.00
21058.0 - INLET PROTECTION TYPE D HYBRID - REMOVE - EACH	36.00	\$40.00	\$1,440.00
50401.0 - 12 INCH TYPE I RCP STORM SEWER PIPE - L.F.	566.00	\$120.00	\$67,920.00
50741.0 - TYPE H INLET - EACH	27.00	\$2,880.00	\$77,760.00
20311.0 - REMOVE SEWER ACCESS STRUCTURE - EACH	14.00	\$680.00	\$9,520.00
20312.0 - REMOVE CATCHBASIN - EACH	1.00	\$1,025.00	\$1,025.00
20313.0 - REMOVE INLET - EACH	15.00	\$500.00	\$7,500.00
20314.0 - REMOVE PIPE - L.F.	534.00	\$15.00	\$8,010.00
20336.0 - PIPE PLUG - EACH	6.00	\$380.00	\$2,280.00
21110.0 - TERRACE RAIN GARDEN - S.F.	300.00	\$16.00	\$4,800.00
40362.0 - ADJUST ACCESS STRUCTURE CASTING - EACH	1.00	\$1,080.00	\$1,080.00
50211.0 - SELECT BACKFILL FOR STORM SEWER - T.F.	1505.00	\$0.01	\$15.05
50402.0 - 15 INCH TYPE I RCP STORM SEWER PIPE - L.F.	48.00	\$140.00	\$6,720.00
50403.0 - 18 INCH TYPE I RCP STORM SEWER PIPE - L.F.	246.00	\$110.00	\$27,060.00
50404.0 - 21 INCH TYPE I RCP STORM SEWER PIPE - L.F.	371.00	\$115.00	\$42,665.00
50405.0 - 24 INCH TYPE I RCP STORM SEWER PIPE - L.F.	274.00	\$119.00	\$32,606.00
50461.0 - 12 INCH RCP AE - EACH	3.00	\$1,480.00	\$4,440.00
50499.0 - CONCRETE COLLAR - EACH	2.00	\$615.00	\$1,230.00
50723.0 - 3'X3' STORM SAS - EACH	7.00	\$3,450.00	\$24,150.00
50761.0 - SADDLED INLET TYE 1 - EACH	1.00	\$2,875.00	\$2,875.00
50792.0 - STORM SEWER TAP - EACH	1.00	\$1,090.00	\$1,090.00
50801.0 - UTILITY LINE OPENING (ULO) - EACH	12.00	\$730.00	\$8,760.00
90039.0 - STORM BOX TAP - EACH	1.00	\$3,035.00	\$3,035.00
50103.0 - RECONSTRUCT BENCH AND FLOWLINE(S) - EACH	1.00	\$1,590.00	\$1,590.00
50202.0 - TYPE II DEWATERING - LUMP SUM	2.00	\$8,750.00	\$17,500.00
50212.0 - SELECT BACKFILL SANITARY SEWER - T.F.	5469.00	\$0.01	\$54.69
50301.0 - 8" PVC SEWER PIPE (SDR-35, SDR 26) - L.F.	2859.00	\$188.75	\$539,636.25
50353.0 - SANITARY SEWER LATERAL (SDR-35, SDR 26) - L.F.	1875.00	\$34.75	\$65,156.25
50356.0 - RECONNECT SANITARY SEWER LATERAL - EACH	75.00	\$5,950.00	\$446,250.00
50361.0 - WASTEWATER CONTROL - LUMP SUM	1.00	\$24,000.00	\$24,000.00

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET RECONSTRUCTION DISTRICT 2018
 CONTRACT NO. 8119
 DATE: 2/28/19

R. G. Huston Co., Inc.

Item	Quantity	Price	Extension
50390.0 - SEWER ELECTRONIC MARKERS - EACH	224.00	\$55.00	\$12,320.00
50701.0 - 4' DIA SANITARY SAS - EACH	9.00	\$3,800.00	\$34,200.00
50702.0 - 5' DIA SANITARY SAS - EACH	3.00	\$5,780.00	\$17,340.00
50771.0 - INTERNAL CHIMNEY SEAL - EACH	4.00	\$335.00	\$1,340.00
50783.0 - INSIDE DROP - V.F.	16.00	\$350.00	\$5,600.00
50797.0 - EXTERNAL SEWER ACCESS STRUCTURE JOINT SEAL - EACH	12.00	\$330.00	\$3,960.00
50791.0 - SANITARY SEWER TAP - EACH	7.00	\$2,765.00	\$19,355.00
70110.0 - TEMPORARY WATER SUPPLY SYSTEM - LUMP SUM	1.00	\$80,100.00	\$80,100.00
50225.0 - UTILITY TRENCH PATCH TYPE III - T.F.	80.00	\$71.00	\$5,680.00
70002.0 - FURNISH AND INSTALL 6-INCH PIPE & FITTINGS - L.F.	100.00	\$156.00	\$15,600.00
70003.0 - FURNISH AND INSTALL 8-INCH PIPE & FITTINGS - L.F.	2820.00	\$146.00	\$411,720.00
70031.0 - FURNISH AND INSTALL 6-INCH WATER VALVE - EACH	6.00	\$1,450.00	\$8,700.00
70032.0 - FURNISH AND INSTALL 8-INCH WATER VALVE - EACH	14.00	\$1,850.00	\$25,900.00
70040.0 - FURNISH, INSTALL AND SALVAGE HYDRANT - EACH	7.00	\$4,080.00	\$28,560.00
70053.0 - REPLACE 1-INCH COPPER SERVICE LATERAL - EACH	5.00	\$3,650.00	\$18,250.00
70056.0 - RECONNECT 1-INCH SERVICE LATERAL - EACH	70.00	\$2,280.00	\$159,600.00
70057.0 - RECONNECT 1½-INCH SERVICE LATERAL - EACH	1.00	\$4,200.00	\$4,200.00
70080.0 - CUT-IN OR CONNECT TO EXISTING WATER SYSTEM - EACH	2.00	\$2,200.00	\$4,400.00
70081.0 - FURNISH EXCAVATION AND DITCH FOR LIVE TAP - EACH	2.00	\$1,400.00	\$2,800.00
70082.0 - CUT OFF EXISTING WATER MAIN - EACH	2.00	\$1,450.00	\$2,900.00
70090.0 - ABANDON WATER VALVE BOX - EACH	4.00	\$170.00	\$680.00
70091.0 - ABANDON WATER VALVE ACCESS STRUCTURE - EACH	7.00	\$565.00	\$3,955.00
70101.0 - FURNISH AND INSTALL STYROFOAM - L.F.	168.00	\$14.00	\$2,352.00
20109.0 - FINISH GRADING - LUMP SUM	1.00	\$21,500.00	\$21,500.00
20221.0 - TOPSOIL - S.Y.	8443.00	\$7.40	\$62,478.20
20228.0 - MEDIUM RIPRAP - GLACIAL FIELD STONE - TON	1155.00	\$81.50	\$94,132.50
20970.0 - TREES, SHRUBS, PERENNIALS AND GRASSES DROUGHT WATERING - EACH	1.00	\$4,800.00	\$4,800.00
21017.0 - SILT SOCK (8 INCH) - COMPLETE - L.F.	151.00	\$10.00	\$1,510.00
21061.0 - EROSION MATTING, CLASS I, URBAN TYPE A - S.Y.	1643.00	\$3.00	\$4,929.00
21093.0 - TURBIDITY BARRIER - COMPLETE - L.F.	800.00	\$24.00	\$19,200.00
90030.0 - CANOE/KAYAK LAUNCH DEWATERING - LUMP SUM	1.00	\$1,800.00	\$1,800.00
90031.0 - CONSTRUCTION FENCING - L.F.	832.00	\$5.40	\$4,492.80
90032.0 - CANOE/KAYAK LAUNCH DOUBLE RAILING SLIDE - LUMP SUM	1.00	\$9,600.00	\$9,600.00
90033.0 - CANOE/KAYAK LAUNCH AT JAMES STREET - LUMP SUM	1.00	\$24,500.00	\$24,500.00
90034.0 - REMOVE STEEL BULKHEAD - L.F.	780.00	\$27.50	\$21,450.00
90035.0 - SEEDING - WOODY UNDERSTORY AGGRESSIVE SPECIES MIX - S.Y.	1643.00	\$3.60	\$5,914.80
90036.0 - STUMP MANAGEMENT - I.D.	279.00	\$9.75	\$2,720.25
90037.0 - BRUSHING - LUMP SUM	1.00	\$3,428.75	\$3,428.75
90038.0 - REMOVE EXISTING CANOE LAUNCH - LUMP SUM	1.00	\$3,000.00	\$3,000.00
50703.0 - 6' DIA SANITARY SAS - EACH	1.00	\$7,150.00	\$7,150.00
90070.0 - SANITARY SEWER LIFT STATION - LUMP SUM	1.00	\$444,500.00	\$444,500.00
90071.0 - SANITARY SEWER FORCE MAIN - 4 INCH - L.F.	735.00	\$53.00	\$38,955.00
125 Items	Totals		\$4,475,235.00



Department of Public Works
Engineering Division
Robert F. Phillips, P.E., City Engineer
City-County Building, Room 115
210 Martin Luther King, Jr. Boulevard
Madison, Wisconsin 53703
Phone: (608) 266-4751
Fax: (608) 264-9275
engineering@cityofmadison.com
www.cityofmadison.com/engineering

Assistant City Engineer
Gregory T. Fries, P.E.
Kathleen M. Cryan
Principal Engineer 2
Christopher J. Petykowski, P.E.
John S. Fahrney, P.E.
Principal Engineer 1
Christina M. Bachmann, P.E.
Eric L. Dundee, P.E.
Facilities & Sustainability
Jeanne E. Hoffman, Manager
Mapping Section Manager
Eric T. Pederson, P.S.
Financial Manager
Steven B. Danner-Rivers

BIENNIAL BID BOND

R.G. Huston Co., Inc.

(a corporation of the State of Wisconsin)
(individual), (partnership), (hereinafter referred to as the "Principal") and
Travelers Casualty and Surety Company of America

a corporation of the State of Connecticut (hereinafter referred to as the "Surety") and licensed to do business in the State of Wisconsin, are held and firmly bound unto the City of Madison, Wisconsin (hereinafter referred to as the "City"), in the sum equal to the individual proposal guaranty amounts of the total bid or bids of the Principal herein accepted by the City, for the payment of which the Principal and the Surety hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of this obligation is that the Principal has submitted to the City certain bids for projects from the time period of February 1, 2018 through January 31, 2020.

If the Principal is awarded the contract(s) by the City and, within the time and manner required by law after the prescribed forms are presented for its signature, the Principal enters into (a) written contract(s) in accordance with the bid(s), and files with the City its bond(s) guaranteeing faithful performance and payment for all labor and materials, as required by law, or if the City rejects all bids for the work described, then this obligation shall be null and void; otherwise, it shall remain in full force and effect.

In the event the Principal shall fail to execute and deliver the contract(s) or the performance and payment bond(s), all within the time specified or any extension thereof, the Principal and Surety agree jointly and severally to pay to the City within ten (10) calendar days of written demand a total equal to the sum of the individual proposal guaranty amounts of the total bid(s) as liquidated damages.

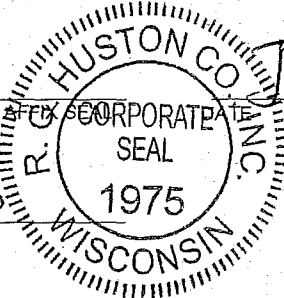
The Surety, for value received, hereby agrees that the obligations of it and its bond shall be in no way impaired or affected by any extension of time within which the City may accept a bid, and the Surety does hereby waive notice of any such extension.

This bond may be terminated by the Surety upon giving thirty (30) days written notice to the City of its intent to terminate this bond and to be released and discharged therefrom, but such termination shall not operate to relieve or discharge the Surety from any liability already accrued or which shall accrue before the expiration of such thirty (30) day period.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, on the day and year set forth below.

PRINCIPAL

R.G. Huston Co., Inc.
COMPANY NAME

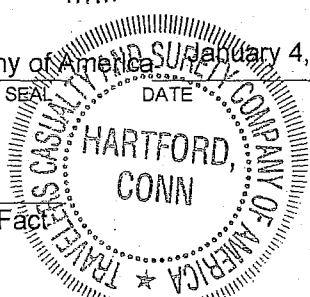


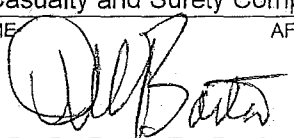
January 8, 2018

By: 
SIGNATURE AND TITLE

SURETY

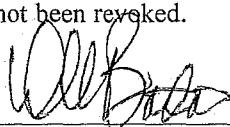
Travelers Casualty and Surety Company of America
COMPANY NAME AFFIX SEAL DATE January 4, 2018



By: 
SIGNATURE AND TITLE Attorney-in-Fact

This certifies that I have been duly licensed as an agent for the Surety in Wisconsin under National Provider No. 283633 for the year 2018 and appointed as attorney in fact with authority to execute this bid bond, which power of attorney has not been revoked.

January 4, 2018
DATE


AGENT SIGNATURE

20975 Swenson Drive - Suite 175
ADDRESS

Waukesha, Wisconsin 53186
CITY, STATE AND ZIP CODE

262-317-8044
TELEPHONE NUMBER

Note to Surety and Principal: Any bid submitted which this bond guarantees may be rejected if the Power of Attorney form showing that the Agent of Surety is currently authorized to execute bonds on behalf of Surety is not attached to this bond.



POWER OF ATTORNEY

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company

St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

Attorney-In Fact No. 232082

Certificate No. 007269866

KNOW ALL MEN BY THESE PRESENTS: That Farmington Casualty Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company are corporations duly organized under the laws of the State of Connecticut, that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc., is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

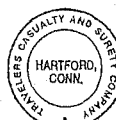
Anthony S. Von Rueden, Todd Looker, Robert E Flath, Dennis M Barton, Joseph L Vigna, and Elizabeth M Fedyn

of the City of Milwaukee/Waukesha, State of Wisconsin, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed and their corporate seals to be hereto affixed, this 19th day of June, 2017.

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company

St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company



State of Connecticut
City of Hartford ss.

By: Robert L. Raney, Senior Vice President

On this the 19th day of June, 2017, before me personally appeared Robert L. Raney, who acknowledged himself to be the Senior Vice President of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

In Witness Whereof, I hereunto set my hand and official seal. My Commission expires the 30th day of June, 2021.



Marie C. Tetreault
Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

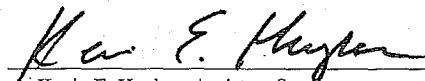
FURTHER RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

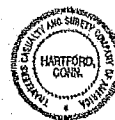
FURTHER RESOLVED, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

FURTHER RESOLVED, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, Kevin E. Hughes, the undersigned, Assistant Secretary, of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 4th day of January, 20 18.


Kevin E. Hughes, Assistant Secretary



To verify the authenticity of this Power of Attorney, call 1-800-421-3880 or contact us at www.travelersbond.com. Please refer to the Attorney-In-Fact number, the above-named individuals and the details of the bond to which the power is attached.

SECTION H: AGREEMENT

THIS AGREEMENT made this 20 day of March in the year Two Thousand and Nineteen between R. G. HUSTON CO., INC. hereinafter called the Contractor, and the City of Madison, Wisconsin, hereinafter called the City.

WHEREAS, the Common Council of the said City of Madison under the provisions of a resolution adopted MARCH 19, 2019, and by virtue of authority vested in the said Council, has awarded to the Contractor the work of performing certain construction.

NOW, THEREFORE, the Contractor and the City, for the consideration hereinafter named, agree as follows:

1. **Scope of Work.** The Contractor shall, perform the construction, execution and completion of the following listed complete work or improvement in full compliance with the Plans, Specifications, Standard Specifications, Supplemental Specifications, Special Provisions and contract; perform all items of work covered or stipulated in the proposal; perform all altered or extra work; and shall furnish, unless otherwise provided in the contract, all materials, implements, machinery, equipment, tools, supplies, transportation, and labor necessary to the prosecution and completion of the work or improvements:

S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET RECONSTRUCTION DISTRICT 2018 CONTRACT NO. 8119

2. **Completion Date/Contract Time.** Construction work must begin within seven (7) calendar days after the date appearing on mailed written notice to do so shall have been sent to the Contractor and shall be carried on at a rate so as to secure full completion SEE SPECIAL PROVISIONS, the rate of progress and the time of completion being essential conditions of this Agreement.
3. **Contract Price.** The City shall pay to the Contractor at the times, in the manner and on the conditions set forth in said specifications, the sum of FOUR MILLION FOUR HUNDRED SEVENTY-FIVE THOUSAND TWO HUNDRED THIRTY-FIVE AND NO/100 (\$4,475,235.00) Dollars being the amount bid by such Contractor and which was awarded to him/her as provided by law.
4. **Affirmative Action.** In the performance of the services under this Agreement the Contractor agrees not to discriminate against any employee or applicant because of race, religion, marital status, age, color, sex, disability, national origin or ancestry, income level or source of income, arrest record or conviction record, less than honorable discharge, physical appearance, sexual orientation, gender identity, political beliefs, or student status. The Contractor further agrees not to discriminate against any subcontractor or person who offers to subcontract on this contract because of race, religion, color, age, disability, sex, sexual orientation, gender identity or national origin.

The Contractor agrees that within thirty (30) days after the effective date of this agreement, the Contractor will provide to the City Affirmative Action Division certain workforce utilization statistics, using a form to be furnished by the City.

If the contract is still in effect, or if the City enters into a new agreement with the Contractor, within one year after the date on which the form was required to be provided, the Contractor will provide updated workforce information using a second form, also to be furnished by the City. The second form will be submitted to the City Affirmative Action Division no later than one year after the date on which the first form was required to be provided.

The Contractor further agrees that, for at least twelve (12) months after the effective date of this contract, it will notify the City Affirmative Action Division of each of its job openings at facilities in

Dane County for which applicants not already employees of the Contractor are to be considered. The notice will include a job description, classification, qualifications and application procedures and deadlines. The Contractor agrees to interview and consider candidates referred by the Affirmative Action Division if the candidate meets the minimum qualification standards established by the Contractor, and if the referral is timely. A referral is timely if it is received by the Contractor on or before the date started in the notice.

Articles of Agreement Article I

The Contractor shall take affirmative action in accordance with the provisions of this contract to insure that applicants are employed, and that employees are treated during employment without regard to race, religion, color, age, marital status, disability, sex, sexual orientation, gender identity or national origin and that the employer shall provide harassment free work environment for the realization of the potential of each employee. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation and selection for training including apprenticeship insofar as it is within the control of the Contractor. The Contractor agrees to post in conspicuous places available to employees and applicants notices to be provided by the City setting out the provisions of the nondiscrimination clauses in this contract.

Article II

The Contractor shall in all solicitations or advertisements for employees placed by or on behalf of the Contractors state that all qualified or qualifiable applicants will be employed without regard to race, religion, color, age, marital status, disability, sex, sexual orientation, gender identity or national origin.

Article III

The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice to be provided by the City advising the labor union or worker's representative of the Contractor's equal employment opportunity and affirmative action commitments. Such notices shall be posted in conspicuous places available to employees and applicants for employment.

Article V

The Contractor agrees that it will comply with all provisions of the Affirmative Action Ordinance of the City of Madison, including the contract compliance requirements. The Contractor agrees to submit the model affirmative action plan for public works contractors in a form approved by the Affirmative Action Division Manager.

Article VI

The Contractor will maintain records as required by Section 39.02(9)(f) of the Madison General Ordinances and will provide the City Affirmative Action Division with access to such records and to persons who have relevant and necessary information, as provided in Section 39.02(9)(f). The City agrees to keep all such records confidential, except to the extent that public inspection is required by law.

Article VII

In the event of the Contractor's or subcontractor's failure to comply with the Equal Employment Opportunity and Affirmative Action Provisions of this contract or Section 39.03 and 39.02 of the Madison General Ordinances, it is agreed that the City at its option may do any or all of the following:

1. Cancel, terminate or suspend this Contract in whole or in part.
2. Declare the Contractor ineligible for further City contracts until the Affirmative Action requirements are met.
3. Recover on behalf of the City from the prime Contractor 0.5 percent of the contract award price for each week that such party fails or refuses to comply, in the nature of liquidated damages, but not to exceed a total of five percent (5%) of the contract price, or ten thousand dollars (\$10,000), whichever is less. Under public works contracts, if a subcontractor is in noncompliance, the City may recover liquidated damages from the prime Contractor in the manner described above. The preceding sentence shall not be construed to prohibit a prime Contractor from recovering the amount of such damage from the non-complying subcontractor.

Article VIII

The Contractor shall include the above provisions of this contract in every subcontract so that such provisions will be binding upon each subcontractor. The Contractor shall take such action with respect to any subcontractor as necessary to enforce such provisions, including sanctions provided for noncompliance.

Article IX

The Contractor shall allow the maximum feasible opportunity to small business enterprises to compete for any subcontracts entered into pursuant to this contract. (In federally funded contracts the terms "DBE, MBE and WBE" shall be substituted for the term "small business" in this Article.)

5. Substance Abuse Prevention Program Required. Prior to commencing work on the Contract, the Contractor, and any Subcontractor, shall have in place a written program for the prevention of substance abuse among its employees as required under Wis. Stat. Sec. 103.503.
6. **Contractor Hiring Practices.**

Ban the Box - Arrest and Criminal Background Checks. (Sec. 39.08, MGO)

This provision applies to all prime contractors on contracts entered into on or after January 1, 2016, and all subcontractors who are required to meet prequalification requirements under MGO 33.07(7)(1), MGO as of the first time they seek or renew pre-qualification status on or after January 1, 2016. The City will monitor compliance of subcontractors through the pre-qualification process.

- a. **Definitions.** For purposes of this section, "Arrest and Conviction Record" includes, but is not limited to, information indicating that a person has been questioned, apprehended, taken into custody or detention, held for investigation, arrested, charged with, indicted or tried for any felony, misdemeanor or other offense pursuant to any law enforcement or military authority.

"Conviction record" includes, but is not limited to, information indicating that a person has been convicted of a felony, misdemeanor or other offense, placed on probation, fined, imprisoned or paroled pursuant to any law enforcement or military authority.

"Background Check" means the process of checking an applicant's arrest and conviction record, through any means.

- b. **Requirements.** For the duration of this Contract, the Contractor shall:

1. Remove from all job application forms any questions, check boxes, or other inquiries regarding an applicant's arrest and conviction record, as defined herein.
2. Refrain from asking an applicant in any manner about their arrest or conviction record until after conditional offer of employment is made to the applicant in question.
3. Refrain from conducting a formal or informal background check or making any other inquiry using any privately or publicly available means of obtaining the arrest or conviction record of an applicant until after a conditional offer of employment is made to the applicant in question.
4. Make information about this ordinance available to applicants and existing employees, and post notices in prominent locations at the workplace with information about the ordinance and complaint procedure using language provided by the City.
5. Comply with all other provisions of Sec. 39.08, MGO.

c. Exemptions: This section shall not apply when:

1. Hiring for a position where certain convictions or violations are a bar to employment in that position under applicable law, or
2. Hiring a position for which information about criminal or arrest record, or a background check is required by law to be performed at a time or in a manner that would otherwise be prohibited by this ordinance, including a licensed trade or profession where the licensing authority explicitly authorizes or requires the inquiry in question.

To be exempt, Contractor has the burden of demonstrating that there is an applicable law or regulation that requires the hiring practice in question, if so, the contractor is exempt from all of the requirements of this ordinance for the position(s) in question.

SECTION I: PAYMENT AND PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we R. G. HUSTON CO., INC. as principal, and Travelers Casualty and Surety Company of America Company of Hartford, Connecticut as surety, are held and firmly bound unto the City of Madison, Wisconsin, in the sum of **FOUR MILLION FOUR HUNDRED SEVENTY-FIVE THOUSAND TWO HUNDRED THIRTY-FIVE AND NO/100 (\$4,475,235.00)** Dollars, lawful money of the United States, for the payment of which sum to the City of Madison, we hereby bind ourselves and our respective executors and administrators firmly by these presents.

The condition of this Bond is such that if the above bounden shall on his/her part fully and faithfully perform all of the terms of the Contract entered into between him/herself and the City of Madison for the construction of:

**S. BRYAN STREET, DALEY DRIVE, JAMES STREET AND THORP STREET
RECONSTRUCTION DISTRICT 2018
CONTRACT NO. 8119**

in Madison, Wisconsin, and shall pay all claims for labor performed and material furnished in the prosecution of said work, and save the City harmless from all claims for damages because of negligence in the prosecution of said work, and shall save harmless the said City from all claims for compensation (under Chapter 102, Wisconsin Statutes) of employees and employees of subcontractor, then this Bond is to be void, otherwise of full force, virtue and effect.

Signed and sealed this 20th day of March, 2019

Countersigned:

[Signature]
Witness

[Signature]
Secretary

Approved as to form:

[Signature]
City Attorney

R. G. HUSTON CO., INC.
Company Name (Principal)
[Signature]
President

Travelers Casualty and Surety
Company of America

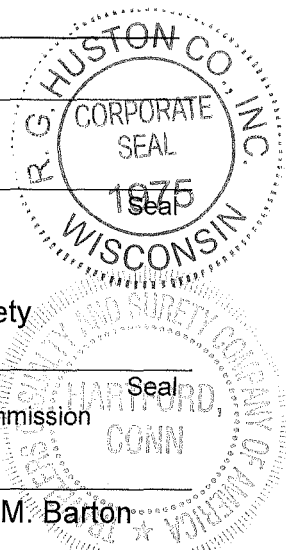
Surety
 Salary Employee Commission Seal

By [Signature]
Attorney-in-Fact Dennis M. Barton

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under National Producer Number 283633 for the year 2019, and appointed as attorney-in-fact with authority to execute this payment and performance bond which power of attorney has not been revoked.

March 20, 2019
Date

[Signature]
Agent Signature Dennis M. Barton





**Travelers Casualty and Surety Company of America
Travelers Casualty and Surety Company
St. Paul Fire and Marine Insurance Company**

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **DENNIS M BARTON** of **MILWAUKEE Wisconsin**, their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this **3rd** day of **February**, 2017.



State of Connecticut

City of Hartford ss.

By:
Robert L. Raney, Senior Vice President

On this the **3rd** day of **February**, 2017, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

In Witness Whereof, I hereunto set my hand and official seal.

My Commission expires the **30th** day of **June**, 2021



Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

FURTHER RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

FURTHER RESOLVED, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

FURTHER RESOLVED, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this **20th** day of **March**, 2019



Kevin E. Hughes, Assistant Secretary

**To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.
Please refer to the above-named Attorney-in-Fact and the details of the bond to which the power is attached.**