Contract Routing Form

ROUTING: Routine

printed on: 08/09/2013

Contract between: Staab Construction Corporation
and Dept. or Division: Engineering Division
Name/Phone Number:

Project: Booster Pumping Station 106 Reconsstruction

Contract No.: 7101
Enactment No.: RES-13-00570
Dollar Amount: 2,317,000.00

File No.: 30717
Enactment Date: 07/22/2013

(Please DATE before routing)

Signatures Required	Date Received	Date Signed
City Clerk	8/9/13	8/9/13
Director of Civil Rights	8/12/13	8/14/13
Risk Manager	8-14-13	8/22/13
Finance Director	8-23-13	
City Attorney	8-23-13	8-26-13
Mayor	8/26/13	8-26-13

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

Original + 2 Copies

Po# 81537101

08/09/2013 08:13:58 enjls - Adam Wiederhoeft, 266-9121

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

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File #:	30717 Version: 1	Name:	Awarding Public Works Contract No. 7101, Booster Pumping Station 106 Reconstruction, to Staab Construction Corporation, in the amount of $2,317,000.00, and amending the Capital Budget by $1,007,000.00.
Type:	Resolution	Status:	Passed
File created:	6/25/2013	In control:	BOARD OF ESTIMATES
On agenda:	7/16/2013	Final action:	7/16/2013
Enactment date:	7/22/2013	Enactment #:	RES-13-00570
Title:	Awarding Public Works Contract No. 7101, Booster Pumping Station 106 Reconstruction, to Staab Construction Corporation, in the amount of $2,317,000.00, and amending the Capital Budget by $1,007,000.00.		
Sponsors:	BOARD OF PUBLIC WORKS		
Attachments:	1. 30717 Registration Forms for Common Council Mtg 7/16/13.pdf		

History (4) | Text

4 records | Group | Export

Date	Ver.	Action By	Action	Result	Action Details	Watch
7/16/2013	1	COMMON COUNCIL	Adopt Under Suspension of Rules 2.04, 2.05, 2.24, and 2.25	Pass	Action details	Not available
7/8/2013	1	BOARD OF ESTIMATES	RECOMMEND TO COUNCIL TO ADOPT UNDER SUSPENSION OF RULES 2.04, 2.24, & 2.25 - (15 VOTES REQUIRED) - REPORT OF OFFICER	Pass	Action details	Not available

Date	Ver.	Action By	Action	Result	Action Details	Watch
7/3/2013	1	BOARD OF PUBLIC WORKS	RECOMMEND TO COUNCIL WITH THE FOLLOWING RECOMMENDATIONS - REPORT OF OFFICER	Pass	Action details	Not available
6/25/2013	1	Engineering Division	Refer		Action details	Not available

City of Madison

City of Madison
Madison, WI 53703
www.cityofmadison.com

Master

File Number: 30717

File ID:	30717	**File Type:**	Resolution	**Status:**	Passed
Version:	1	**Reference:**		**Controlling Body:**	BOARD OF ESTIMATES
Lead Referral:	BOARD OF PUBLIC WORKS	**Cost:**		**File Created Date :**	06/25/2013
File Name:	Awarding Public Works Contract No. 7101, Booster Pumping Station 106 Reconstruction, to Staab Construction Corporation, in the amount of $2,317,000.00, and amending the Capital Budget by $1,007,000.00.			**Final Action:**	07/16/2013

Title: Awarding Public Works Contract No. 7101, Booster Pumping Station 106 Reconstruction, to Staab Construction Corporation, in the amount of $2,317,000.00, and amending the Capital Budget by $1,007,000.00.

Notes: Adam W.

Code Sections:		**CC Agenda Date:**	07/16/2013
Indexes:		**Agenda Number:**	44.
Sponsors:	BOARD OF PUBLIC WORKS	**Effective Date:**	07/22/2013
Attachments:		**Enactment Number:**	RES-13-00570
Author:	Rob Phillips, City Engineer	**Hearing Date:**	
Entered by:	mhacker@cityofmadison.com	**Published Date:**	

Approval History

Version	Date	Approver	Action
1	07/03/2013	Elizabeth York	Approve

History of Legislative File

Ver-sion:	Acting Body:	Date:	Action:	Sent To:	Due Date:	Return Date:	Result:
1	Engineering Division	06/25/2013	Refer	BOARD OF PUBLIC WORKS	07/03/2013	07/03/2013	

Action Text: This Resolution was Refer to the BOARD OF PUBLIC WORKS due back on 7/3/2013
Notes:

1	BOARD OF PUBLIC WORKS	07/03/2013	RECOMMEND TO COUNCIL WITH THE FOLLOWING RECOMMENDATIONS - REPORT OF OFFICER	Pass

Action Text: A motion was made by Skidmore, seconded by Fix, to RECOMMEND TO COUNCIL WITH THE FOLLOWING RECOMMENDATIONS - REFER TO BOE FOR APPROVAL - REPORT OF OFFICER. The motion passed by voice vote/other.

Notes: A motion was made by Skidmore, seconded by Fix, to RECOMMEND TO COUNCIL WITH THE FOLLOWING RECOMMENDATIONS - REFER TO BOE FOR APPROVAL - REPORT OF OFFICER. The motion passed by voice vote/other.

1	BOARD OF ESTIMATES	07/08/2013	RECOMMEND TO COUNCIL TO ADOPT UNDER SUSPENSION OF RULES 2.04, 2.24, & 2.25 - (15 VOTES REQUIRED) - REPORT OF OFFICER	Pass

Action Text: A motion was made by Schmidt, seconded by Clausius, to RECOMMEND TO COUNCIL TO ADOPT UNDER SUSPENSION OF RULES 2.04, 2.24, & 2.25 - (15 VOTES REQUIRED) - REPORT OF OFFICER. The motion passed by voice vote/other.

Notes:

1	COMMON COUNCIL	07/16/2013	Adopt Under Suspension of Rules 2.04, 2.05, 2.24, and 2.25	Pass

Action Text: A motion was made by Resnick, seconded by Phair, to Adopt Under Suspension of Rules 2.04, 2.05, 2.24, and 2.25. The motion passed by voice vote/other.

Notes:

Text of Legislative File 30717

Title

Awarding Public Works Contract No. 7101, Booster Pumping Station 106 Reconstruction, to Staab Construction Corporation, in the amount of $2,317,000.00, and amending the Capital Budget by $1,007,000.00.

Body

BE IT RESOLVED, that Staab Construction Corporation be accepted and that the Mayor and City Clerk be and are hereby authorized and directed to enter into a contract 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 2013 Water Utility Capital Budget is hereby amended to reallocate $800,000 from the Unit Wells project (810459) and increase Revenue Bonds by $207,000 for the Booster Station 106 Rebuild project (810516);

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

Fiscal Note

This resolution amends the budget for project #21, Booster Station 106 Rebuild (810516), by $1,007,000. Budget authority of $1,493,000 is available in the Water Utility 2013 capital budget. Bids came in higher than expected and the total amount needed is $2,500,000. $800,000 of the additional funding will be transferred from the 2013 East Side Well projects #7, 8, and 9 (810459). The remaining $207,000 will be funded by Revenue Bonds.

The budget entry necessary is as follows:

$1,007,000	EW01 58401 810516
(1,007,000)	EW01 79130 810516
(696,000)	EW01 54950 810459
(4,000)	EW01 58015 810459
(100,000)	EW01 58401 810459
800,000	EW01 79130 810459

Wisconsin Office of the Commissioner of Insurance
Licensed Producer Search*

Tuesday, July 23, 2013

WEIDNER, KATHRYN A
HORICON WI

Year of Birth: 1959
Status: Active
License Number: 2163632
NPN**: 6497333
Effective Date: 04-04-1990
Expiration Date: 11-30-2013
License Type: Resident Intermediary Indv
CE Compliance: 11-30-2013

Lines of Authority

Line of Authority	Residency	Effective Date	Status
Casualty	Resident	07-29-1999	Active
Property	Resident	07-29-1999	Active
Accident & Health	Resident	04-16-1992	Inactive
	Resident	04-04-1990	Active
Life	Resident	04-16-1992	Inactive
	Resident	04-04-1990	Active

Appointments and Terminations

Company Name	Qualification Type/Status	Effective Date	Termination Date	Termination Reason
ACUITY, A Mutual Insurance Company	CAS/Active	10-24-2000		
	PROP/Active	10-24-2000		
Allegheny Casualty Company	CAS/Active	08-22-2008		
American Casualty Company of Reading, Pennsylvania	CAS/Active	05-03-2000		
	PROP/Active	05-03-2000		
American Contractors Indemnity Company	CAS/Active	07-17-2007		
American Fire and Casualty Company	CAS/Active	04-06-2011		
	PROP/Active	04-06-2011		
American States Insurance Company	CAS/Active	09-27-2008		
	PROP/Active	09-27-2008		
Berkley Regional Insurance Company	CAS/Active	11-13-2006		
	PROP/Active	11-13-2006		
Capitol Indemnity Corporation	CAS/Inactive	04-11-2000	10-11-2005	Inadequate Production
	PROP/Inactive	04-11-2000	10-11-2005	Inadequate Production

Colonial American Casualty and Surety Company	CAS/Active	02-07-2000		
	PROP/Active	02-07-2000		
Consolidated Insurance Company	CAS/Active	03-10-2006		
	CAS/Inactive	04-27-2000	05-01-2003	Canceled
	PROP/Active	03-10-2006		
	PROP/Inactive	04-27-2000	05-01-2003	Canceled
Continental Casualty Company	CAS/Active	05-03-2000		
	PROP/Active	05-03-2000		
Continental Insurance Company, The	CAS/Active	02-24-2006		
	PROP/Active	02-24-2006		
Developers Surety and Indemnity Company	CAS/Active	03-07-2008		
	PROP/Active	03-07-2008		
Emcasco Insurance Company	CAS/Inactive	04-04-2001	11-19-2009	Vol. Surrender per Agent Rqst
	PROP/Inactive	04-04-2001	11-19-2009	Vol. Surrender per Agent Rqst
Employers Assurance Company	CAS/Inactive	08-25-2000	04-27-2002	Canceled
	PROP/Inactive	08-25-2000	09-17-2012	Canceled
Employers Mutual Casualty Company	CAS/Inactive	04-04-2001	11-19-2009	Vol. Surrender per Agent Rqst
	PROP/Inactive	04-04-2001	11-19-2009	Vol. Surrender per Agent Rqst
Fidelity and Deposit Company of Maryland	CAS/Active	12-02-2008		
	PROP/Active	12-02-2008		
First National Insurance Company of America	CAS/Active	09-27-2008		
	PROP/Active	09-27-2008		
General Casualty Company of Wisconsin	CAS/Inactive	05-18-2001	06-07-2002	Canceled
	PROP/Inactive	05-18-2001	06-07-2002	Canceled
General Insurance Company of America	CAS/Active	09-27-2008		
	PROP/Active	09-27-2008		
Great American Insurance Company	CAS/Active	04-03-2008		
	PROP/Active	04-03-2008		
Hawkeye-Security Insurance Company	CAS/Active	03-10-2006		
	CAS/Inactive	01-16-2003	05-01-2003	Canceled
	PROP/Active	03-10-2006		
	PROP/Inactive	01-16-2003	05-01-2003	Canceled

Hudson Insurance Company	CAS/Active	11-30-2012		
	PROP/Active	11-30-2012		
Indiana Insurance Company	CAS/Active	03-10-2006		
	CAS/Inactive	04-27-2000	05-01-2003	Canceled
	PROP/Active	03-10-2006		
	PROP/Inactive	04-27-2000	05-01-2003	Canceled
Liberty Mutual Fire Insurance Company	CAS/Active	08-03-2006		
	PROP/Active	08-03-2006		
Liberty Mutual Insurance Company	CAS/Active	08-03-2006		
	PROP/Active	08-03-2006		
LM Insurance Corporation	CAS/Active	08-03-2006		
	PROP/Active	08-03-2006		
Merchants Bonding Company (Mutual)	CAS/Active	06-19-2007		
Merchants National Bonding, Inc.	CAS/Active	02-06-2013		
Middlesex Mutual Assurance Company	CAS/Active	03-28-2006		
	PROP/Active	03-28-2006		
Midwestern Indemnity Company, The	CAS/Active	03-10-2006		
	PROP/Active	03-10-2006		
Milwaukee Casualty Insurance Co.	CAS/Inactive	08-24-2000	02-04-2009	Vol. Surrender per Agent Rqst
	PROP/Inactive	08-24-2000	02-04-2009	Vol. Surrender per Agent Rqst
Milwaukee Insurance Company	CAS/Inactive	08-24-2000	12-31-2008	Canceled
	PROP/Inactive	08-24-2000	12-31-2008	Canceled
National Fire Insurance Company of Hartford	CAS/Active	05-03-2000		
	PROP/Active	05-03-2000		
Netherlands Insurance Company, The	CAS/Active	03-10-2006		
	CAS/Inactive	04-27-2000	05-01-2003	Canceled
	PROP/Active	03-10-2006		
	PROP/Inactive	04-27-2000	05-01-2003	Canceled
Ohio Casualty Insurance Company, The	CAS/Active	04-06-2011		
	PROP/Active	04-06-2011		
Ohio Security Insurance Company	CAS/Active	04-06-2011		
	PROP/Active	04-06-2011		
Old Republic	CAS/Active	04-08-2004		

Insurance Company	PROP/Active	04-08-2004		
Old Republic Surety Company	CAS/Active	04-08-2004		
	PROP/Active	04-08-2004		
Peerless Indemnity Insurance Company	CAS/Active	03-10-2006		
	PROP/Active	03-10-2006		
Peerless Insurance Company	CAS/Active	03-10-2006		
	CAS/Inactive	04-27-2000	05-01-2003	Canceled
	PROP/Active	03-10-2006		
	PROP/Inactive	04-27-2000	05-01-2003	Canceled
Plaza Insurance Company	CAS/Inactive	02-22-2008	02-10-2010	Vol. Surrender per Agent Rqst
Regent Insurance Company	CAS/Inactive	05-18-2001	06-07-2002	Canceled
	PROP/Inactive	05-18-2001	06-07-2002	Canceled
RLI Insurance Company	CAS/Active	09-30-2008		
	PROP/Active	09-30-2008		
SAFECO Insurance Company of America	CAS/Active	09-27-2008		
	PROP/Active	09-27-2008		
SAFECO Insurance Company of Illinois	CAS/Active	09-27-2008		
	PROP/Active	09-27-2008		
SECURA INSURANCE, A Mutual Company	CAS/Active	10-18-2012		
	CAS/Inactive	11-11-1999	10-01-2012	Canceled
	PROP/Active	10-18-2012		
	PROP/Inactive	11-11-1999	10-01-2012	Canceled
SECURA Supreme Insurance Company	CAS/Active	10-18-2012		
	CAS/Inactive	11-11-1999	10-01-2012	Canceled
	PROP/Active	10-18-2012		
	PROP/Inactive	11-11-1999	10-01-2012	Canceled
Selective Insurance Company of America	CAS/Active	12-08-2010		
	PROP/Active	12-08-2010		
Selective Insurance Company of South Carolina	CAS/Active	12-08-2010		
	PROP/Active	12-08-2010		
Selective Insurance Company of the Southeast	CAS/Active	12-08-2010		
	PROP/Active	12-08-2010		
SOCIETY INSURANCE, a mutual company	CAS/Active	03-16-2006		
	PROP/Active	03-16-2006		
Transcontinental	CAS/Inactive	05-03-2000	01-14-2008	Canceled

Insurance Company	PROP/Inactive	05-03-2000	01-14-2008	Canceled
Transportation Insurance Company	CAS/Active	05-04-2000		
	PROP/Active	05-04-2000		
Travelers Casualty and Surety Company of America	CAS/Active	10-13-2006		
	PROP/Active	10-13-2006		
United Fire & Casualty Company	CAS/Active	12-28-2009		
	PROP/Active	12-28-2009		
Unitrin Safeguard Insurance Company	CAS/Inactive	08-24-2000	03-03-2010	Vol. Surrender per Agent Rqst
	PROP/Inactive	08-24-2000	03-03-2010	Vol. Surrender per Agent Rqst
Valley Forge Insurance Company	CAS/Active	05-03-2000		
	PROP/Active	05-03-2000		
West American Insurance Company	CAS/Active	04-06-2011		
	PROP/Active	04-06-2011		
Western Surety Company	CAS/Active	10-27-2005		

* Photocopies of this report provided to an insurer should be confirmed on-line for accuracy.

** NPN = National Producer Number assigned by the National Insurance Producer Registry to assist with nonresident licensing in the future.

Bond No. 929561718

SECTION I: PAYMENT AND PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we STAAB CONSTRUCTION CORPORATION as principal, and Western Surety Company Company of Sioux Falls, SD as surety, are held and firmly bound unto the City of Madison, Wisconsin, in the sum of TWO MILLION THREE HUNDRED SEVENTEEN THOUSAND ($2,317,000) 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:

CONTRACT NO. 7101

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 17th day of July, 2013

Countersigned:

Witness

Secretary Jeffrey A. Graves

STAAB CONSTRUCTION CORPORATION
Company Name (Principal)

President Aaron E. Staab Seal

Approved as to form:

City Attorney

Western Surety Company
Surety Seal

☒ Salary Employee ☐ Commission

By Kathryn A. Weicher
Attorney-in-Fact

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under License No. 2163632 for the year 2013, and appointed as attorney-in-fact with authority to execute this payment and performance bond which power of attorney has not been revoked.

7/17/2013
Date

Kathryn A. Weicher
Agent

$2,317,000.00
FILE

BID OF STAAB CONSTRUCTION CORPORATION

PROPOSAL, CONTRACT, BOND AND SPECIFICATIONS

FOR

BOOSTER PUMPING STATION 106 RECONSTRUCTION

CONTRACT NO. 7101

IN

MADISON, DANE COUNTY, WISCONSIN

AWARDED BY THE COMMON COUNCIL
MADISON, WISCONSIN ON **JULY 16, 2013**

MADISON WATER UTILITY
119 E. OLIN AVENUE
MADISON, WISCONSIN 53713

www.cityofmadison.com/business/pw

https://bidexpress.com/login

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

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SECTION I: PAYMENT AND PERFORMANCE BOND I-1

SECTION J: PREVAILING WAGE RATES J-1

This Proposal, and Agreement have
been prepared by:

MADISON WATER UTILITY
CITY OF MADISON
MADISON, DANE COUNTY, WISCONSIN

Alan L. Larson, P.E., Principal Engineer

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:	Booster Pumping Station 106 Reconstruction
CONTRACT NO.:	7101
SBE GOAL	12%
BID BOND	5%
PRE BID MEETING (1:00 P.M.)	June 14, 2013 *(revised – Addendum 01 5/20/13)*
PREQUALIFICATION APPLICATION DUE (1:00 P.M.)	June 14, 2013 *(revised – Addendum 01 5/20/13)*
BID SUBMISSION (1:00 P.M.)	June 21, 2013 *(revised – Addendum 01 5/20/13)*
BID OPEN (1:30 P.M.)	June 21, 2013 *(revised – Addendum 01 5/20/13)*
PUBLISHED IN WSJ	May 10, 2013 & May 17, 2013

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.

Plans and Specifications are also available at 1600 Emil St., Madison, WI, 53713; (608) 267-1197.

STANDARD SPECIFICATIONS

The City of Madison's Standard Specifications for Public Works Construction - 2013 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)I. 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.

The Bidder shall execute the Disclosure of Ownership form. REFER TO SECTION F.

SECTION 102.5: BID DEPOSIT (PROPOSAL GUARANTY)

All bids, sealed or electronic, must be accompanied with a Bid Bond 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.

PREVAILING WAGE RATES

Prevailing Wage Rates may be required and are attached in Section J of the contract. See Special Provisions to determine applicability.

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
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
250 ☐ Landscaping, Site and Street
251 ☐ Parking Ramp Maintenance
255 ☐ Pavement Sealcoating and Crack Sealing
260 ☐ Petroleum Above/Below Ground Storank Tank Removal/Install
265 ☐ Retaining Walls, Precast Modular Units
270 ☐ Retaining Walls, Reinforced Concrete
275 ☐ Sanitary, Storm Sewer and Water Main Construction
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
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 ☐ Other_____
9 ☐ Other_____

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/aaTBDir.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/aaTBDir.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.

2.4.2 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 shall be deemed non-responsible and the bidder ineligible for award of this contract.

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-7; and
2.4.2.1.2 **Summary Sheet,** C-8.

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-7;
2.4.2.2.2 **Summary Sheet,** C-8; and
2.4.2.2.3 **SBE Contact Report,** C-9 and C-10. (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 deemed non-responsible for failure to demonstrate a good faith effort to achieve such goal and subsequently denied eligibility for award of contract may, within 72 hours of receiving such notification, appeal that decision to a special appeals committee composed of three (3) members of the Affirmative Action Commission, three (3) members of the Board of Public Works and a seventh member appointed by the Mayor. All appeals must be made in writing to the City Engineer and received within 72 hours of City of Madison's notice. Postmark not applicable.

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.

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

Small Business Enterprise Compliance Report

This information may be submitted electronically through Bid Express or submitted with bid in sealed envelope.

Cover Sheet

Prime Bidder Information

Company:_____

Address:_____

Telephone Number:_____ Fax Number:_____

Contact Person/Title:_____

Prime Bidder Certification

I, _____, _____ of
Name Title

_____ certify that the information
Company

contained in this SBE Compliance Report is true and correct to the best of my knowledge and belief.

_____ _____
Witness' Signature Bidder's Signature

_____
Date

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

Small Business Enterprise Compliance Report

Summary Sheet

SBE Subcontractors Who Are NOT Suppliers

Name(s) of SBEs Utilized	Type of Work	% of Total Bid Amount
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%

Subtotal SBE who are NOT suppliers: _____ %

SBE Subcontractors Who Are Suppliers

Name(s) of SBEs Utilized	Type of Work	% of Total Bid Amount
		%
		%
		%
		%
		%
		%

Subtotal Contractors who are suppliers: _____ % x 0.6 = _____ % (discounted to 60%)

Total Percentage of SBE Utilization: _____%.

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

Small Business Enterprise Compliance Report

SBE Contact Report

Submit separate copy of this form for each SBE which you are not able to utilize towards meeting the SBE goal for this project. Attach separate sheets if necessary.

SBE Information

Company:_____

Address:_____

Telephone Number:_____

Contact Person/Title:_____

1. Outline below all efforts to solicit a bid from the above SBE. Include date, means of contact, who from your company made this contact and the result.

   _____

   _____

   _____

2. Describe the information provided to the aforementioned SBE regarding the scope of work for which he/she was to provide a bid.

   _____

   _____

   _____

   Is this the same scope of work on which the subcontractor you intend to utilize based his/her bid?

   ☐ Yes ☐ No

3. Did this SBE submit a bid? ☐ Yes ☐ No

4. Is the General Contractor pre-qualified to self-perform this category of work?

   ☐ Yes ☐ No

5. If you responded "Yes" to Question 3, please check the items below which apply and provide the requested detail. If you responded "No" to Question 3, please skip ahead to item 6 below.

☐ The SBE listed above is unavailable for work on this project for the following reasons. Provide specific detail for this conclusion.

_____

_____

☐ The SBE listed above is unqualified for work on this project. Provide specific details for this conclusion.

_____

_____

☐ The SBE listed above provided a price that was unreasonable (i.e. more than 5% above the lowest bidder). Provide specific detail for this conclusion including the SBE's price and the price of the subcontractor you intend to utilize.

_____

_____

☐ A contract with the SBE listed above may constitute a breach of the bidder's collective bargaining agreements. Provide specific detail for this conclusion including, but not limited to, correspondence from the SBE indicating it will not sign a project labor agreement and/or correspondence from the applicable trade union indicating a project labor agreement will not be allowed at the time of project bidding.

_____

_____

☐ Other; please specify reason(s) other than listed above which made it impossible for you to utilize this SBE on this project.

_____

_____

6. Describe any other good faith efforts:

_____

_____

SECTION D: SPECIAL PROVISIONS

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

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 101: DEFINITIONS AND TERMS

Relationship Between the City and Strand Associates, Inc.® Strand Associates, Inc.® has been engaged by the City to prepare drawings and specifications for this project. Additionally, Strand will assist the City with resident engineering and shop drawing review during construction. The City will provide contract administration and is referred to as the City and/or ENGINEER in the Contract Documents.

Strand Associates, Inc.® will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or safety precautions and programs incidental thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. Strand Associates, Inc.® will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents. Strand Associates, Inc.® will not be responsible for the acts or omissions of CONTRACTOR or of any subcontractor, any supplier, or of any person or organization performing or furnishing any of the Work.

Relationship Between the City and Strand Associates, Inc.® The duties and responsibilities of the resident project representative include the following:

1. Review schedules as required.

2. Attend conferences and meetings with CONTRACTOR.

3. Serve as liaison between ENGINEER and CONTRACTOR and help ENGINEER serve as liaison between OWNER and CONTRACTOR.

4. Conduct on-site observation of the work.

5. Observe tests, equipment, and system startups.

6. Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed. Consider, evaluate, and report to ENGINEER, CONTRACTOR's requests for modification.

7. Maintain orderly records, keep a daily log (when on a part-time basis, keep log for days visiting site), and furnish periodic reports to ENGINEER of the progress of the Work.

8. Before project completion, prepare final list of items to be completed or corrected and make recommendations to ENGINEER concerning acceptance of the Work.

The resident project representatives shall not:

1. Authorize any deviation from the Contract Documents or substitutions of materials or equipment.

2. Exceed limitations of ENGINEER's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of CONTRACTOR, Subcontractor, Suppliers or Contractor's superintendent.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of construction.

5. Advise on, issue directions regarding, or assume control over safety precautions and programs in connection with the Work.

6. Accept shop drawing or sample submittals from anyone other than CONTRACTOR.

7. Authorize OWNER to occupy the Project in whole or in part.

8. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by ENGINEER.

SPECIAL PROVISIONS. Add the following to the end of the definitions of **SPECIAL PROVISIONS**:

SPECIAL PROVISIONS include Divisions 1 through 16 bound at the end of this document.

SECTION 102.4: PROPOSAL

ADD the following to the end of Section 102.4:

For cash allowances the Contract Price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances. These costs shall not be included in the cash allowance. The final Contract Price will be adjusted to reflect actual costs on account of cash allowances.

The following cash allowances shall be included in the Bid for the Contract(s).

Remove and Replace Unsuitable Foundation Materials for Structures and Roads	Section 02222–Excavation, Fill, Backfill, and Grading
Remove and Replace Unsuitable Foundation Material for Utility Trenches	Section 02222–Excavation, Fill, Backfill, and Grading
Concrete Repair Mortar–Underside of Reservoir Roof Slab Repairs	Section 03560–Concrete Surface Repair
Concrete Repair Mortar–Reservoir Wall Vertical Surface Repairs	Section 03560–Concrete Surface Repair
Underground Electrical Service	Section 16420–Electrical Service System
Telephone Company Allowance	Section 16420–Electrical Service System
SCADA Software Improvements at Master Station	Section 16940–Controls and Instrumentation
Card Access System	Section 16940–Controls and Instrumentation

SECTION 102.9: BIDDER'S UNDERSTANDING

Section 102.9 is amended as follows:

In the preparation of Drawings and Specifications, Strand Associates, Inc.® relied upon the following reports of explorations and tests of subsurface conditions at the Site which are attached at the end of the **SPECIAL PROVISIONS**: **GEOTECHNICAL EXPLORATION, BOOSTER PUMP STATION 106, dated February 11, 2013 by CGC, Inc.**

The technical data in the above report(s), upon which CONTRACTOR may rely, consists of boring methods, level of subsurface water, boring logs, laboratory test methods and results, and boring locations all as of the date made.

ENGINEER accepts no responsibility for accuracy of the soil data or water level information. Soil borings and report, included with these Contract Documents, were not obtained for the purposes of designing excavations and trenches. Soils information was used by Strand Associates, Inc.® for analysis purposes of existing bridge abutments only. CONTRACTOR shall assure itself by personal examination as to subsurface conditions and shall provide its own investigations and make its own assumptions to comply with OSHA and any other applicable laws and regulations regarding excavation and trenching requirements.

The following drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) are known to OWNER:

1. Drawings dated April 1925, prepared by City of Madison Water Department, titled: Plans for a Reinforced Concrete Reservoir, consisting of 8 sheets numbered 1 to 8, inclusive.

None of the contents of such drawings include technical data on which CONTRACTOR may rely.

The drawings identified above are not part of the Contract Documents, but the "technical data" contained therein upon which CONTRACTOR may rely, as expressly identified and established above, are incorporated into the Contract Documents by reference. CONTRACTOR is not entitled to rely upon any other information and data known to or identified by OWNER or ENGINEER.

Copies of reports and drawings identified that are not included with the Bidding Documents may be examined at Strand Associates, Inc.®, 910 West Wingra Drive, Madison, WI 53715 during regular business hours.

SECTION 102.10: MINIMUM RATE OF WAGE SCALE

For this project, payment of prevailing wages (white sheet) is not required if either: a single trade accounts for 85% or more of the total labor costs of the project and the bid is less than $48,000; or no single trade accounts for 85% or more of the total labor costs of the project and the bid is less than $100,000. For bids not meeting either of these conditions, prevailing wages shall be required.

If required, the wages and benefits paid on the contract shall not be less than those specified in the Prevailing Wage Determination included with these contract documents for the following types of work:

☒ Building and Heavy Construction
☐ Sewer, Water, and Tunnel Construction
☐ Local Street and Miscellaneous Paving Operations
☐ Residential and Agricultural Construction

All bidders are notified that all labor employed on City contracts must be paid in accordance with the minimum rate of wage scale included in the Contract Documents.

For the information of the employees working on the project, a copy of the wage scale included in the contract documents and the provisions of Section 66.0903(8) of the Wisconsin Statutes shall be kept

posted by the employer and in at least one conspicuous and easily accessible place at the site of the project.

The Contractor shall keep weekly payroll records setting forth the name, address, telephone number, classification, wage rate and fringe benefit package of each employee who worked on such City project and all other projects the employee worked in the same period, and the Contractor must keep records of the individual time each employee worked on the project and for each day of the project. Records shall include employee demographics or contractor can submit a one-time report of all employee demographics that can be matched up with weekly payrolls. Reports shall only include last four social security digits. Such records shall also set forth the total number of hours of overtime credited to each such employee for each day and week and the amount of overtime pay received in that week. Such records shall, in addition, set forth the full weekly wages earned by each such employee and the actual hourly wage paid to that employee. The Contractor shall submit payroll records to the Engineer every week for those periods when work is being done on the project. Said submittal shall be within twenty-one (21) calendar days of the end of the Contractor's weekly pay period.

The Contractor shall ensure that employees shall be paid unconditionally and shall receive the full amounts accrued at the time of payment, computed at rates not less than those stated in the City of Madison "Minimum Rate of Wage Scale" and that each employee's rate shall be determined by the work that is done within the trade or occupation classification which should be properly assigned to such employee. Questions regarding an employee's classification or rate of pay within that classification, shall be resolved by the practice that predominates in the industry and on which the trade or occupation rate/classification is based. Therefore, rate of pay, classification and work jurisdiction disputes shall be resolved by relying upon practices established by collective bargaining agreements and guidelines used in such determinations by appropriate recognized trade unions operating within the City of Madison.

The Contractor shall agree that the normal rate of wage paid to the Contractor's employees on other projects shall not be reduced or otherwise diminished as a result of the requirement to pay no less than the minimum rate of wage scale on a City project. Mulcting of employees on City projects by contractors, such as by kickbacks or other such devices, is prohibited.

These contract provisions shall apply to all work performed on the contract by the Contractor with its own organization and with assistance of laborers under its immediate superintendency and to all work performed by piecework or by subcontract. No laborer, worker, or mechanic shall be employed directly upon the site of the work except on a wage basis, but this shall not be construed to prohibit the rental of equipment from individuals.

In the event of a refusal by the Contractor to submit payroll records as required by the contract, the City of Madison shall have the option to cancel this contract and request the Surety to perform or to re-let the balance of the work for bids, and in that event, to charge the Contractor for any loss which the City may incur thereby.

SECTION 102.12: BEST VALUE CONTRACTING

This Contract shall be considered a Best Value Contract if the Contractor's bid is equal to or greater than $53,000 for a single trade contract; or equal to or greater than $257,500 for a multi-trade contract pursuant to MGO 33.07(7).

SECTION 105.1: AUTHORITY OF THE ENGINEER

The Engineer shall resolve all questions which arise as to the quality and acceptability of materials furnished, work performed, manner of performance, rate of progress of the work, interpretation of the plans and Specifications, acceptable fulfillment of the contract, compensation, and disputes and mutual rights between Contractors under the Specifications. The Engineer shall determine the amount and quantity of work performed and materials furnished.

All decisions of the Engineer shall, when so requested, be rendered in writing. They shall be final and conclusive in all matters unless within ten (10) days after such decision the Contractor applies in writing to the Board of Public Works for a review of such decision.

Any change proposed by a Contractor in SBE subcontractors, vendors or suppliers from those SBEs indicated on the SBE Compliance Report must be approved by the Engineer and the City's Manager of the Affirmative Action Division (hereafter, AAD). When requested, such decision shall be rendered in writing. Such decisions shall be final and conclusive in all matters unless within ten (10) days after such decision the Contractor or the affected SBE applies in writing to the Board of Public Works for a review of such decision.

In the event the Engineer and the AAD disagree over the proper decision to be made regarding an SBE, the Mayor shall appoint a third person to resolve the disagreement, within 30 days of appointment. The decision thus rendered may be reviewed by the Board of Public Works upon request of the Contractor or the affected SBE as set forth in Sections 105.1 and 105.2 of the City's standard specifications.

SECTION 105.6: CONTRACTOR'S RESPONSIBILITY FOR WORK

Add the following paragraph to the end of Section 105.6:

CONTRACTOR shall keep at the Site at all times during the progress of the Work a competent person to comply with OSHA trenching and excavation requirements. The competent person shall be one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

CONTRACTOR shall provide a photographic record of construction and construction progress. Provide a minimum of 10 photos per week. All utilities that are buried or hidden within the construction shall be photographed prior to covering. CONTRACTOR shall submit photographs in the format described below with each payment application.

Photographs shall be color digital photographs. Photographs shall be date-stamped. Photographs shall be provided in a digital format only on compact disc media. Photographs shall be submitted in the .jpg format. Alternate formats may be approved by the OWNER. Photos shall be taken with a minimum 5.0 megapixel camera at highest quality resolution.

CONTRACTOR shall provide a photo log in a Word document stored on compact disk. The photo log shall include photo identification, file name, location information, brief description, and date of photo. Photo log shall contain a minimum of ten photographs per week.

CONTRACTOR shall provide and maintain an e-mail address for electronic communication.

SECTION 105.7: CONTRACT DRAWINGS

Add the following paragraph to the end of Section 105.7:

CONTRACTOR shall keep one record copy of all specifications, drawings, addenda, modifications, and shop drawings at the site in good order and shall record on the drawings all changes made during the construction process. CONTRACTOR providing buried or concealed piping, conduit, or similar items shall locate all such items by dimensions and elevations. The daily record of changes shall be the responsibility of CONTRACTOR's field superintendent. No arbitrary mark-ups shall be permitted. CONTRACTOR shall submit his marked up record documents to ENGINEER **prior** to final payment. CONTRACTOR shall include in the payment application a line item of $5,000 for record documents. This cash allowance shall be paid to CONTRACTOR after delivery of final record documents.

SECTION 105.15: SUBSTANTIAL COMPLETION

Add the following to the end of Section 105.15:

Outage of the reservoir shall be minimized during construction. Demolition work and removal from service shall not occur without written authorization from the Madison Water Utility. Request shall be made to the Utility in writing 14 calendar days before the planned outage. The reservoir and booster station may not be removed from service prior to September 1, 2013. The reservoir shall be returned to service by December 15, 2013.

The Project shall be substantially complete and ready for final payment no later than May 9, 2014.

SECTION 105.17: PROGRESS SCHEDULE

Section 105.17 is added as follows:

Within 10 days after delivery of the Notice to Proceed, CONTRACTOR shall submit to OWNER, for approval, an estimated progress schedule indicating the starting and completion dates of the various stages of work, and a preliminary schedule of shop drawing submissions.

Progress schedule shall be updated prior to each construction meeting and an updated schedule submitted with each payment application.

SECTION 105.18: PRECONSTRUCTION CONFERENCE

Section 105.18 is added as follows:

Before starting the work at the project sites, a conference will be held to review schedules, to establish procedures for handling shop drawings and other submissions and for processing Applications for Payment, to review list of proposed subcontractors, to establish a working understanding between the parties as to the project, and to discuss project details. Present at the conference will be representatives of the City of Madison, Strand Associates, Inc.®, and CONTRACTOR.

SECTION 105.19: SCHEDULE OF VALUES OF THE WORK

Section 105.19 is added as follows:

At least ten days following the issuance of the Notice to Proceed, CONTRACTOR shall submit to ENGINEER a schedule of values of the work. This schedule shall include quantities and unit prices aggregating the Contract price and shall subdivide the work into component parts according to Specification sections in sufficient detail to serve as the basis for progress payments during construction. This schedule, when approved by ENGINEER, shall be used as a basis for CONTRACTOR's Application for Payment.

Include lump sum items in the following amounts in the Schedule of Values:

1. Training $5,000
2. Operation and Maintenance Manuals $5,000
3. Record Drawing $5,000

Payment of these items will only be made upon completion of these items.

SECTION 106.6: SUBSTITUTE MATERIALS OR EQUIPMENT

Section 106.6 is added as follows:

Whenever in any of the Contract Documents an article, material, or equipment is defined by describing a proprietary product, or by using the name of a manufacturer or vendor, the term "or equal," if not inserted, shall be implied. The specific article, material, or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency, and quality desired, and shall not be construed in such a manner as to exclude manufacturer's products of comparable quality, design and efficiency. If CONTRACTOR wishes to furnish or use a proposed substitute, he shall, prior to the preconstruction conference, make written application to Strand Associates, Inc.®, for approval of such a substitute certifying, in writing, that the proposed substitute will perform adequately the functions called for by the general design, be similar and of equal substance to that specified and be suited to the same use and capable of performing the same function as that specified; stating whether or not its incorporation in or use in connection with the project is subject to the payment of any license fee or royalty; and identifying all variations of the proposed substitute from that specified and indicating available maintenance service. No substitute shall be ordered or installed without the written approval of Strand Associates, Inc.®, who will be the judge of equality and may require CONTRACTOR to furnish such other data about the proposed substitute as he considers pertinent. No substitute shall be ordered or installed without such performance guarantee and bonds as the City may require which shall be furnished at CONTRACTOR's expense.

SECTION 107.1: PROTECTION OF PUBLIC AND UTILITY INTERESTS

Section 107.1 is amended as follows:

In order to abate objectionable noise to the extent feasible, motorized construction equipment shall not be operated between the hours of 7:00 P.M. and 7:00 A.M. without the prior written approval of ENGINEER.

SECTION 107.3: INDEMNIFICATION

Consultant, as included under Section 107.3 of the General Conditions shall include Strand Associates, Inc.®

SECTION 107.4: CONTRACTOR'S LIABILITY INSURANCE

Section 107.4(j) is added as follows:

On all insurance policies required to be provided by CONTRACTOR, the policies shall include the City of Madison and Strand Associates, Inc.®, as their interests may appear and their employees and agents as additional insured.

SECTION 107.4(i): Insurance for the Construction of Buildings

The City will effect and maintain, Builder's Risk Insurance on a replacement cost basis in an amount equal to the estimated project cost. Coverage includes the building as well as materials stored on the site to be incorporated in the building, including form work in place, form lumber on site, temporary structures, equipment and supplies incidental to the construction of the building. The City's Builders Risk coverage is written on a per building basis and contains a $25,000 per occurrence deductible. If a loss under the City's Builders Risk policy is caused by the negligence of the Contractor or its Subcontractor(s), the Contractor will be responsible for paying the City's $25,000 deductible. The City Engineer has the authority to withhold such deductible from payments due to Contractor. In addition, City Engineer, in his/her sole authority, will determine whether the Contractor was negligent in causing the loss and therefore is responsible for the City's deductible.

The insured loss, if any, is to be adjusted with and payable to the City.

SECTION 107.7: MAINTENANCE OF TRAFFIC

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.

Contractor shall submit an acceptable traffic control plan to the Traffic Engineer Division 5 days prior to the preconstruction meeting.

Traffic Control shall be included in the Lump Sum Bid. 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. Contractor shall supply all necessary mounting hardware and supports for signing. This shall also include covering and uncovering any conflicting 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 insure 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.

The Contractor shall supply temporary stop signs at any location where a permanent stop sign needs to be removed or is no longer affective.

Maintain Access to all properties along Owen Parkway at all times.

Contractor may close Glenway Street between Ridge Road and Zwerg Drive. Contractor shall occupy not occupy any other portions of the Street Right of Way at any time. All sidewalks shall remain open and clean for the duration of the project

Contractor shall install temporary no parking signs on Glenway between Ridge Road and Zwerg Drive. Signs shall be installed and verified by police department in accordance with the Madison Police Departments Guidelines for temporary no parking restrictions for construction or special events. Contact John Villareal (267-8756) of the Madison Parking utility at least 2 business days prior to needing the temporary signs.

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.

SECTION 108.2: PERMITS AND LICENSING

Add the following to the end of Section 108.2:

CONTRACTOR shall secure all required building permits.

Madison Water Utility will pay any required building permit fees.

CONTRACTOR shall obtain erosion control permit and shall meet all requirements for installation, maintenance, and reporting requirements.

SECTION 109.9: LIQUIDATED DAMAGES

Add the following paragraphs to the end of Section 109.9:

The following milestone dates and liquidated damages shall apply:

Milestone 1; Facility back in service-December 15, 2013. Liquidated damages, as defined in Section 109.9, shall apply for each calendar day that this milestone is not met.

Milestone 2; Facility back in-service and ready for the commissioning period-April 10, 2014. Liquidated damages, as defined in Section 109.9, shall apply for each calendar day that these milestones are not met, or, the second facility outage period exceeds 28 calendar days.

Substantial Completion-May 9, 2014. Liquidated damages, as defined in Section 109.9, shall apply for each calendar day that this completion date is not met.

Liquidated damages shall be cumulative with several applying simultaneously.

SECTION 110.2: PARTIAL PAYMENTS

Add the following to the end of Section 110.2:

No advanced payment for shop drawing preparation will be made. Shop drawing costs will be paid when equipment and materials are delivered and suitably stored and protected on the site.

All stored equipment and materials for which payment is requested shall have two copies of invoices included with the pay request. Equipment shall be identified thoroughly on the invoices, including serial numbers.
Payment for the stored equipment and material which are on the site shall not exceed the invoiced amount for each item, less the contract retainage. The overhead and profit for the stored items shall not be invoiced until the item is installed.

Payment for off-site storage is normally reserved for sensitive or very large pieces of equipment that in ENGINEER's opinion would not be practical to have stored on the site. Payment for off-site stored items shall be limited to 75% of the invoiced value of the item, less contract retainage. CONTRACTOR shall reimburse OWNER the cost of inspecting off-site stored items. When off-site storage is approved CONTRACTOR shall provide Insurance Certificates and Document of Ownership to OWNER.

No partial payments shall be permitted for line items for training, operation and maintenance manuals, or record drawing called for under Section 105.19.

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MADISON, WISCONSIN

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SPECIFICATIONS

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SUMMARY OF WORK

PART 1–GENERAL

1.01 DIVISION ONE

A. The requirements of Division 1 apply to all sections of the Contract(s).

1.02 PROJECT SCOPE

A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes, and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

1.03 CONTRACT DOCUMENTS–INTENT AND USE

A. Intent of Documents:
   1. Singular notations and specifications shall be considered plural where application is reasonably inferred.
   2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
   3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications not referenced in individual sections shall apply as required for proper performance of the Work.
   4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
   5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from ENGINEER.

B. Use of Documents:
   1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
   2. CONTRACTOR shall use all of the Project Drawings and Specifications:
      a. For a complete understanding of the Project.
      b. To determine the type of construction and systems required.
      c. For coordination with other contractors.
      d. To determine what other work may be involved in various parts or phases.
      e. To anticipate and notify others when work by others will be required.
      f. And all other relevant matters related to the project.
   3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work as may be shown or inferred by the entire set of Project Drawings and Specifications.

1.04 CONSTRUCTION REQUIREMENTS

A. Construction Sequence:
   1. The following construction sequence is provided as a general guideline for the information and for the benefit of CONTRACTOR. This construction sequence is not intended to dictate means, method of construction, or direct construction activities. This construction sequence is a conceptual general construction sequence with minimum recommended outages and shutdowns. The general construction sequence is projected to allow the Work to be completed while maximizing operation of the reservoir. It is not intended to be all inclusive and does not list all work elements or details that are required to complete the Work. CONTRACTOR shall be responsible for implementing any additional details required, including temporary piping, bypass pumping, or temporary construction at no additional cost to OWNER.
   2. CONTRACTOR may propose alternate sequence or modifications to this sequence. OWNER will review the proposed modification and determine if such modification of the sequence interferes with the proper operation of the reservoir. Any modifications to this general construction sequence shall be proposed in writing and shall be approved by OWNER prior to their implementations.
   3. CONTRACTOR shall not begin demolition of the existing station or removal of the reservoir from service prior to September 1, 2013. Pump station demolition shall not begin until reservoir interior has been cleaned and inspected. The reservoir shall be returned to service on December 15, 2013 (Milestone 1). CONTRACTOR shall have new connections to the distribution system, cleaning and repair of reservoir, hatch modifications, and valve modifications completed by this time. CONTRACTOR shall provide any temporary fittings, piping, and appurtenances to return the reservoir to service.
   4. During the time the reservoir is in operation between Milestone 1 and Milestone 2, CONTRACTOR shall provide temporary heat and insulation for freeze protection for the fill and draw lines.
   5. A second shut down period shall be permitted to remove any temporary connections and complete any final connections prior to start-up and commissioning. This shutdown shall not exceed 28 days and shall be completed by April 10, 2013 (Milestone 2).

1.05 CONTRACTOR USE OF SITE

A. General:
   1. The "area of the site" referred to in these specifications shall be as shown on the Drawings as "construction limits." If the "area of the site" is not shown, OWNER's property lines, the project right-of-way, or the easements obtained for the project shall be considered the "area of the site."
   2. Construction activities shall be confined within the "area of the site" limits, unless otherwise noted.
   3. From the start of work to completion, CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
   4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work to the conditions which previously existed.
   5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

6. CONTRACTOR shall minimize vehicle access to the access path, base of existing mature trees identified on the plans, and roof of the existing reservoir. The access path on the north side of the reservoir is an unimproved dirt track and is not suitable for regular traffic or heavy construction equipment. CONTRACTOR shall only use the access path for delivery of equipment used in construction activities on the roof. Daily vehicular access to the reservoir roof shall not be permitted. Access to the reservoir roof, delivery of construction materials, and removal of spoil or demolition debris shall be by other means. Trucking material such as forms, concrete, spoil, and stone on the access path will not be permitted.
7. Vehicles/construction equipment used on the reservoir roof shall not exceed a gross operating weight of 4,000 pounds. If multiple pieces of equipment are used on the reservoir roof, a distance of 30 feet shall be maintained between the pieces of equipment. Throughout construction, contractor shall maintain a four foot tall plastic safety fence around the reservoir perimeter. Provide signs indicating weight limits and operating restrictions at the fence line.
8. Prior to starting construction, CONTRACTOR shall erect and maintain a portable chain link fence a radius of 10 feet around the based of the trees identified for protection. In addition, a 4 foot plastic "safety" fence shall be provided at a 45 foot radius from the same trees. The fence limits shall be truncated at the limits of the existing tree line and at the limits of the existing reservoir. The four foot fence may be temporarily removed to permit access to the reservoir roof for delivery of equipment to the roof, and shall be immediately replaced following delivery. No construction activities, including storage of materials, shall be performed within these boundaries. CONTRACTOR shall make other necessary steps to protect the identified trees.
9. Where construction traffic must cross the 45 foot radius of the identified trees, CONTRACTOR shall provide a root buffer over the area that must be driven across to control soil compaction. Root buffer shall consist of a minimum depth of 6-inches of wood chips, overlaid by quarried gravel as necessary to stabilize the surface. Gravel shall be covered with plywood or construction mats. Root buffer shall be maintained until access to the reservoir roof for vehicles is no longer required and shall be removed as soon as possible following construction.
10. All trees on the site which are damaged during construction shall be repaired. CONTRACTOR shall retain the services of a professional nurseryman who is a member of the National Arborist Association to direct them on the proper repair of damaged trees. Damaged limbs and roots shall be pruned or dressed according to recommendations of the nurseryman. Backfill shall be replaced as soon as possible to reduce exposure of roots to air. Scarfed areas on trees shall be suitably dressed. Compaction of root areas under the drip line of the tree is to be avoided whenever possible.
11. The fencing requirements are not intended to protect public safety or provide for site security. They are intended to keep CONTRACTOR's operations off of sensitive areas. CONTRACTOR shall provide all additional necessary protections as required by Standard Specifications, Special Provisions, and Technical Specifications to meet site security and public protection needs.

B. Parking and Deliveries:
1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER.
3. Access to the site for delivery of construction material or equipment shall be at locations shown on the Drawings.

1.06 EXISTING SERVICES, STRUCTURES, AND UNDERGROUND FACILITIES

A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security systems, and similar work shall be kept to an absolute minimum and shall be limited to times approved by OWNER.

B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.

C. Work shall not commence until all labor, materials, and equipment are available so Work can continue without interruption or delay.

D. Should uncharted or incorrectly charted piping or other utilities be encountered during installation, notify OWNER and consult with utility owner immediately for directions.

E. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation, and repair any damaged utilities to satisfaction of utility owner.

F. CONTRACTOR shall not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.

G. Any accidental interruption of services shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.

H. Wisconsin Statute 182.0175(2) requires, among other provisions, that before excavation or demolition begins, reasonable advance notice not less than three working days prior to the start of the excavation or demolition of the intent to excavate or demolish and the commencement date be provided to the owners of the Underground Facilities in and near the construction area whose facilities may be affected by the excavation or demolition. As part of this notification requirement, CONTRACTOR shall contact Digger's Hotline (811 or 1-800-242-8511). CONTRACTOR shall be aware that not all owners participate in the Digger's Hotline program. A call to this agency shall not absolve CONTRACTOR of the requirements of this statute. CONTRACTOR shall comply with all other provisions of the statute though not enumerated herein.

I. CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of structures and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such structures and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.

J. CONTRACTOR shall keep an accurate and complete record of all such structures and Underground Facilities encountered and shall provide OWNER a copy of this record. The record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.

K. CONTRACTOR shall inspect all structures and Underground Facilities for condition and soundness. Unsound conditions shall be reported to the structure or facility owner immediately after exposing. CONTRACTOR shall not proceed with the work until the structure or facility owner has been notified. OWNER shall then be given time to inspect and correct, if required, the structure or Underground Facility. CONTRACTOR may make

claim under the General Conditions of the City of Madison Standard Specifications should CONTRACTOR feel a price or time adjustment is justified.

L. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing structure or Underground Facility encountered shall be paid for by CONTRACTOR.

M. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing structures and Underground Facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is required to perform additional work in making the explorations and excavations, extra compensation will be allowed as provided for in the Standard Specifications.

1.07 PROTECTION OF WORK AND IMPROVEMENTS

A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.

B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.

C. CONTRACTOR shall keep property, existing improvements, and the Work including structures, mains, fittings, and accessories free from dirt and foreign matter at all times.

D. CONTRACTOR shall provide temporary plugging of openings, holes, and pipe ends that are existing or that CONTRACTOR has installed.

E. Property, improvements, and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.

1.08 AVAILABILITY OF LANDS

A. Easements were not obtained for this project. CONTRACTOR shall contain its operation to within the rights-of-way or lands upon which the work is to be performed.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01019

CONTRACT CONSIDERATIONS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Cash allowances.
   2. Inspection and Testing Allowances.
   3. Measurement and Payment–Unit Prices.
   4. Measurement and Payment–Lump Sum.

1.02 CASH ALLOWANCES

A. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to OWNER and ENGINEER.

B. Cash Allowances: CONTRACTOR agrees that:
   1. The cash allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes.
   2. CONTRACTOR's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance: CONTRACTOR agrees that a contingency allowance, if any, is for the sole use of OWNER to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

E. See individual Specification sections for allowances to be included in the Bid.

1.03 INSPECTION AND TESTING ALLOWANCES

A. Costs Included in Inspection and Testing Allowances: Cost of engaging an inspection or testing firm; execution of inspection and tests; and reporting results.

B. Costs not to be included in Inspection and Testing Allowances but to be included in the Contract Price:
   1. Costs of incidental labor and facilities required to assist inspection or testing firm.
   2. Costs of testing laboratory services used by CONTRACTOR separate from Contract Document requirements.
   3. Costs of retesting upon failure of previous tests.
   4. Costs of tests specified to be provided by CONTRACTOR.

C. Payment Procedures: Submit one copy of the inspection or testing firm's invoice with next application for payment.

D. Refer to technical sections of specifications for required testing and any associated allowances.

E. Difference in final cost and allowances will be adjusted by Change Order.

1.04 MEASUREMENT AND PAYMENT–UNIT PRICES

A. Measurement methods are delineated in the individual Specification sections.

B. CONTRACTOR shall take measurements and compute quantities. ENGINEER will check measurements and quantities.

C. Incidental Items of Work: Any items of Work shown on the Drawings or called for in the Specifications, but not included in the Bid Form, shall be considered incidental items of Work. The cost of incidental items of Work shall be included in the prices bid for adjacent Work.

1.05 MEASUREMENT AND PAYMENT–LUMP SUM

A. No separate measurement for payment will be performed for Lump Sum Work.

B. CONTRACTOR shall estimate percentage of Work completed. ENGINEER will review CONTRACTOR's estimate of quantity of Work completed.

C. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.

D. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings shall be included in the Lump Sum Bid.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01039

COORDINATION, FIELD ENGINEERING, AND MEETINGS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Coordination.
   2. Field engineering.
   3. Progress meetings.
   4. Preinstallation meetings.

1.02 COORDINATION

A. CONTRACTOR shall coordinate scheduling, submittals, and work of the various sections of the work to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. CONTRACTOR shall verify utility requirements and characteristics of operating equipment are compatible with building utilities and coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.

C. CONTRACTOR shall coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings and shall follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas, except as otherwise indicated, CONTRACTOR shall conceal pipes, ducts, and wiring within the construction and coordinate locations of fixtures and outlets with finish elements.

E. CONTRACTOR shall coordinate completion and clean up of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's occupancy.

F. After OWNER occupancy of premises, CONTRACTOR shall coordinate access to Site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of OWNER's activities.

1.03 FIELD ENGINEERING

A. CONTRACTOR shall locate and protect property stakes, legal survey monuments, benchmarks, and survey control and reference points. CONTRACTOR shall pay for replacement of disturbed property stakes and legal survey monuments by a Registered Land Surveyor acceptable to OWNER and for replacement of benchmarks and survey control and reference points provided by ENGINEER.

B. CONTRACTOR shall provide field engineering services as required to establish elevations, lines, and levels utilizing recognized engineering survey practices.

C. CONTRACTOR shall furnish all required plummets and graduated poles to check all Work.

D. If stakes and boards have to be reset because of negligence of CONTRACTOR, CONTRACTOR shall bear the cost of such work.

E. If laser beam is used, CONTRACTOR shall check its Work against intermediate grade stakes provided between manholes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.

F. If existing property stakes not within the limits of the trench are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.

G. CONTRACTOR shall be responsible for all lines, elevations, and measurements of buildings, structures, piping, utilities, and other work executed by CONTRACTOR under the Contract. CONTRACTOR must exercise proper precaution to verify figures before laying out the Work and will be held responsible for any error resulting from its failure to exercise such precaution.

1.04 PROGRESS MEETINGS

A. Progress meetings will be held throughout progress of the Work at intervals agreed to by OWNER, ENGINEER, and CONTRACTOR. Interval will generally be monthly.

B. CONTRACTOR's project manager, job superintendent, major subcontractors, and suppliers shall attend as appropriate to address agenda topics for each meeting. CONTRACTOR's representatives shall have authority to bind CONTRACTOR to decisions at the meetings.

C. The project schedule shall be updated monthly and shall be reviewed at each progress meeting. CONTRACTOR shall provide the following information in written form at each meeting.
   1. Construction progress, including:
      a. Activities completed this reporting period.
      b. Activities in progress this reporting period.
      c. Activities scheduled to commence this reporting period.
   2. Description of problem areas.
   3. Current and anticipated delays.
      a. Cause of the delay.
      b. Corrective action and schedule adjustments to correct the delay.
      c. Impact of the delay on other activities, on milestones, and on completion dates.
   4. Changes in construction sequence.

D. ENGINEER will prepare and distribute minutes to all attending parties.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01045

CUTTING, PATCHING, AND ALTERATIONS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: CONTRACTOR shall be responsible for all cutting, fitting, patching, and other alterations required to complete the Work as specified herein or to:
   1. Make its several parts fit together properly.
   2. Uncover portions of the Work to install improperly sequenced Work.
   3. Remove and replace defective Work.
   4. Remove and replace Work not conforming to requirements of the Contract Documents.
   5. Remove samples of installed Work as specified for testing.
   6. Provide penetrations of surfaces for installation of piping and electrical conduit.

1.02 REFERENCES

A. ANSI A10 Safety Requirements for Construction and Demolition.

1.03 QUALITY ASSURANCE

A. CONTRACTOR shall perform all cutting, patching, and alterations in strict accordance with pertinent requirements of these Specifications.

B. Except as modified by governing codes, CONTRACTOR shall comply with the applicable provision and recommendations of ANSI A10.

1.04 SUBMITTALS

A. CONTRACTOR shall submit a written request to OWNER well in advance of executing any cutting or alteration which affects the following:
   1. Work of OWNER or any separate contractor.
   2. Structural value or integrity of any element of the Project.
   3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
   4. Efficiency, operational life, maintenance, or safety of operational elements.
   5. Visual qualities of sight-exposed elements.

B. The request shall include:
   1. Description of affected work.
   2. The necessity for cutting, patching, or alteration.
   3. Effect on work of OWNER, any separate contractor, or on the structural or weather-proof integrity of the Project.
   4. Description of proposed work to include:
      a. Scope of cutting, patching, or alteration.
      b. Trades who will execute the work.
      c. Products proposed to be used.
      d. Extent of refinishing to be done.
   5. Alternatives to cutting and patching.

6. Written permission of any separate contractor whose work will be affected.

C. Submit written notice to OWNER designating the date and the time the Work will be uncovered or executed.

1.05 SCHEDULING AND COORDINATION

A. All work under this section shall be coordinated with OWNER's work forces and those of other contractors and shall be accomplished at times acceptable to OWNER.

B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service to the existing building, notify ENGINEER and OWNER 72 hours in advance and obtain OWNER's approval before proceeding with this phase of the work. Temporary facilities, if required, shall be in place prior to disruption of service.

PART 2–PRODUCTS

2.01 NEW MATERIALS

A. For replacement of work removed, CONTRACTOR shall use materials which comply with the pertinent sections of these Specifications.

B. All new materials for patching and extending work shall match existing products and work.

C. CONTRACTOR shall determine type and quality of existing products by inspection and any necessary testing and workmanship by use of existing as the standard.

2.02 SALVAGEABLE MATERIAL

A. Materials or items designated to become the property of OWNER shall be as specified or as shown on the Drawings.

B. Items which are to become the property of OWNER shall be removed by CONTRACTOR with care.

C. Materials or items damaged in its removal shall be replaced by CONTRACTOR.

2.03 UNSALVAGEABLE MATERIALS

A. Materials or items demolished and not designated to become the property of OWNER or not designated to be reinstalled shall become the property of CONTRACTOR and shall be removed from the site and legally and properly disposed of by CONTRACTOR.

B. Materials shall be removed by CONTRACTOR in a manner that will avoid damage to materials or equipment to remain.

PART 3–EXECUTION

3.01 INSPECTION

A. CONTRACTOR shall inspect existing conditions including elements subject to movement or damage during cutting, patching, and other alterations.

B. After uncovering the work, CONTRACTOR shall inspect conditions affecting installation of new products or performance of new work.

C. CONTRACTOR shall report unsatisfactory or questionable conditions to ENGINEER in writing.

D. CONTRACTOR shall not proceed with work until unsatisfactory or questionable conditions are resolved.

E. Beginning of cutting, patching, and alterations work means acceptance of existing conditions by CONTRACTOR.

3.02 PREPARATION AND PROTECTION

A. CONTRACTOR shall provide temporary bracing, shoring, needling, and support of the structure during alterations work as necessary to prevent collapse, settling, or deflection and to protect persons and property from injury or damage.

B. Temporary supports must adequately carry all existing and imposed load.

C. CONTRACTOR shall provide and maintain temporary protection of surface finishes, equipment, and adjacent work designated to remain where demolition, removal, and new work is being done, connections are being made, materials are being handled, or equipment is being removed.

D. CONTRACTOR shall provide temporary partitions or barriers to contain all dust, dirt, and debris from entering into finished areas.

E. CONTRACTOR shall provide adequate fire protection in accordance with local Fire Department requirements.

F. CONTRACTOR shall provide waterproofing, weather protection, heat, and other facilities for that portion of the work which may be exposed by cutting and patching, demolition, or other alterations.

G. CONTRACTOR shall cut, move, or remove items as necessary for access to alterations and renovations work and replace and restore at completion of work.

H. CONTRACTOR shall prepare surfaces and remove surface finishes to provide for proper installation of new work and new finishes.

I. CONTRACTOR shall be responsible for any damage to the existing structure or its contents directly or indirectly by its crews or those of its subcontractors.

3.03 PERFORMANCE

A. CONTRACTOR shall accomplish all work of cutting, removal, demolition, patching, or other alterations using only persons skilled in the appropriate trade.

B. CONTRACTOR shall execute the work in a careful and orderly manner.

C. CONTRACTOR shall execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.

D. CONTRACTOR shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

E. CONTRACTOR shall fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

F. CONTRACTOR shall thoroughly clean and prepare all surfaces to receive new finish or covering to completely remove all dirt, dust, grease, oil, paint, loose materials, and soil.

G. CONTRACTOR shall refinish entire surface as necessary to provide an even finish to match adjacent finishes:
   1. For continuous surfaces, refinish to nearest intersection.
   2. For an assembly, refinish entire unit.

3.04 DEMOLITION, CUTTING, AND REMOVAL

A. Cutting and removal of construction shall be performed by CONTRACTOR so as not to cut or remove more than is necessary and so as not to damage adjacent work.

B. CONTRACTOR shall cut out embedded anchorages and attachment items as required to properly provide for patching and repair of the respective finishes.

C. CONTRACTOR shall not cut structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.

D. CONTRACTOR shall not cut operational elements and safety components in a manner resulting in decreased performance, shortened useful life, or increased maintenance.

E. CONTRACTOR shall not cut work exposed to view (exterior or interior) in a manner resulting in noticeable reduction of visual qualities as determined by OWNER.

F. Construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of careless cutting or demolition and is unsuitable for use intended shall be removed and replaced at no additional cost to OWNER.

G. CONTRACTOR shall clean demolished areas and remove debris, waste, and rubbish from the building at the conclusion of each day's work.

H. CONTRACTOR shall not let piled waste material endanger the structure.

3.05 PATCHING, EXTENDING, AND MATCHING

A. Patching work shall conform to the standards of the Specifications where applicable, and where not specified, work shall conform to the highest standards of the applicable trade.

B. CONTRACTOR shall patch construction to match adjacent work unless noted otherwise.

C. Patching or restoration shall be carried to natural breaks (e.g., corners) wherever possible.

D. CONTRACTOR shall provide adequate support to substrate for patching finishes.

E. Transitions:
   1. Where new work abuts or finishes flush with existing work, CONTRACTOR shall make the transition as smooth as possible.
   2. Patched work shall match adjacent work in texture and appearance so as to make the patch or transition invisible to the eye at a distance of 3 feet.
   3. Where masonry, tile, plaster, metal, or other finished surface is cut in such a way that a smooth transition is not possible, CONTRACTOR shall terminate the existing surface in a neat fashion along a straight line at a natural line of division and provide trim appropriate to the finished surface.
   4. CONTRACTOR shall restore existing work that is damaged during patching operations to a condition equal to its construction at the time of the start of work.

END OF SECTION

SECTION 01060

REGULATORY REQUIREMENTS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. OSHA Requirements.
   2. Roadway Limits.
   3. Permits.
   4. Wage Rates.

1.02 OSHA REQUIREMENTS

A. All work including site safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the "Occupational Safety and Health Act."

1.03 ROADWAY LIMITS

A. CONTRACTOR shall comply with roadway weight restrictions including seasonal weight restrictions.

1.04 PERMITS

A. City of Madison Planning Approval has been obtained. The following permits were applied for by OWNER:
   1. WDNR Water Supply Approval.
   2. PSC Authorization to Construct.

B. CONTRACTOR shall comply with all provisions of these permits and shall be responsible for notifications as required by these permits. CONTRACTOR shall obtain all other permits required for the Work. Where the requirements of any permit is more restrictive than the Drawings or the Specifications, the permit requirements shall govern.

C. A building permit will be required from OWNER. However, OWNER will waive fees associated with the permit.

D. Any permits required for dewatering operations shall be obtained and paid for by CONTRACTOR.

E. CONTRACTOR shall comply with the provisions of Chapter 283, Wisconsin Statutes, regulating the discharge of effluent from construction pit trench dewatering. These provisions provide for the removal of suspended solids from dewatering effluent prior to the direct discharge to surface waters or wetlands. CONTRACTOR shall apply as necessary to the Department of Natural Resources for a permit to discharge effluent from construction pit or trench dewatering. This discharge may be covered by an existing state general permit for discharging contaminated stormwater runoff/or construction pit dewatering. Information about and application forms for this permit(s) may be obtained at the address shown below.

South Central Region:
Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711
(608) 275-3266

1.05 WAGE RATES

A. CONTRACTOR shall also comply with the wage rates established by OWNER and applicable provisions of Section 66.0903 of the State of Wisconsin Statutes.

B. Not less than the prevailing wage rates for this area shall be paid to the workers employed to do the Work under this Contract.

C. CONTRACTOR shall comply with all provisions of Section 66.0903 and Section 103.49 of the Wisconsin Statutes, and Wisconsin Administrative Code Chapter DWD 290. Unless exempted by Statute, CONTRACTOR shall comply with the following:
   1. Subsection 66.0903(10)(a) requires that records be kept of employee's names, trades or occupation, hours worked, and wages paid.
   2. Subsection 66.0903(8) requires that a copy of the wage rate determination, if issued for this project, be posted in at least one conspicuous and easily accessible place at the site of the project.
   3. Subsection 66.0903(9)(b) requires that each agent or Subcontractor furnish evidence to CONTRACTOR of compliance with Subsection 66.0903(10).
   4. Subsection 66.0903(9)(c) requires that upon completion of the Project and prior to final payment, CONTRACTOR must file with the municipality an affidavit stating that it has complied fully with the provisions and requirements of the wage rate determination and that CONTRACTOR has received evidence of compliance from each of its agents and Subcontractors. A municipality may not authorize final payment until such an affidavit is filed in proper form and order. See attached form.

D. See Wage Rate Forms bound at the end of Section I: Payment and Performance Bond. The forms bound at the end of Division 1 may not include all forms that may be applicable to your project. CONTRACTOR shall check the DWD Website for other applicable or updated forms.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01090

REFERENCE STANDARDS AND DEFINITIONS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Reference Standards:
      a. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
      b. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is CONTRACTOR's responsibility to provide materials and workmanship which meet or exceed that specifically named code or standard.
      c. It is also CONTRACTOR's responsibility, when so required by the Contract Documents, to deliver to ENGINEER all required proof that the material or workmanship, or both, meet or exceed the requirements of the specifically named code or standard.
   2. Definitions:
      a. A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.
      b. Certain terms used in the Contract Documents are defined generally in this section to supplement definitions of the Agreement, General Conditions, Supplementary Conditions, and other general contract documents.
      c. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the Work.

B. Related Work Described Elsewhere: The specific naming of codes or standards occurs on the Drawings and in other sections of these Specifications.

1.02 QUALITY ASSURANCE

A. Familiarity with Pertinent Codes and Standards:
   1. It is CONTRACTOR's responsibility to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.
   2. When required by individual sections of these specifications, CONTRACTOR shall obtain a copy of each pertinent code or standard and maintain the copies at the job site during submittals, planning, and progress of the Work until Substantial Completion of the Work is attained.

B. Overlapping or Conflicting Requirements:
   1. Where compliance with two or more industry standards or sets of requirements are specified, and the overlapping of those standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement (which is

generally recognized to be also most costly) is intended and will be enforced, unless more detailed language written directly into Contract Documents clearly indicates that a less stringent requirement is acceptable.

2. Refer all uncertainties to ENGINEER for decision before proceeding.

1.03 REFERENCE STANDARDS

A. Applicable standards of the construction industry are made a part of the Contract Documents by reference as if copied directly into the Contract Documents, or as if published copies were bound herewith. See the Standard Specifications for additional provisions regarding references.

B. Standards referenced directly in the Contract Documents or by governing regulation, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.

C. Nonreference standards are hereby defined to have no particular applicability to the work except as a general measurement of whether the Work complies with standards recognized in the construction industry.

D. Reference standards and codes listed in these specifications may include, but are not necessarily limited to, standards or codes published by the following agencies and organizations:

1. AA — Aluminum Association
   1525 Wilson Boulevard, Arlington, VA 22209

2. AAMA — American Architectural Manufacturer's Association
   1827 Walden Office Square Suite 550, Schaumberg, IL 60173-4268

3. AASHTO — American Association of State Highway & Transportation Officials
   444 North Capitol Street NW Suite 249, Washington, DC 20001

4. ACI — American Concrete Institute
   38800 Country Club Drive, Farmington Hills, MI 48331-3439

5. AI — Asphalt Institute
   2696 Research Park Drive, Lexington, KY 40511-8480

6. AISC — American Institute of Steel Construction
   One East Wacker Drive Suite 700, Chicago, IL 60601-1802

7. AISI — American Iron and Steel Institute
   25 Massachusetts Avenue NW Suite 800, Washington, DC 20001

8. ANSI — American National Standards Institute
   25 West 43rd Street, New York, NY 10036

9. APA — American Plywood Association
   7011 South 19th, Tacoma, WA 98466-5333

10. API	American Petroleum Institute 1220 L Street NW, Washington, DC 20005-4070
11. ARI	Air-Conditioning & Refrigeration Institute 4100 North Fairfax Drive Suite 200, Arlington, VA 22203
12. ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers 1791 Tullie Circle NE, Atlanta, GA 30329
13. ASME	American Society of Mechanical Engineers Two Park Avenue, New York, NY 10016-5990
14. ASSE	American Society of Sanitary Engineering 901 Canterbury Suite A, Westlake, OH 44145
15. ASTM	ASTM International 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959
16. AWI	Architectural Woodwork Institute 46179 Westlake Drive Suite 120, Potomac Falls, VA 20165-5874
17. AWPA	American Wood Protection Association P.O. Box 361784, Birmingham, AL 35236-1784
18. AWS	American Welding Society 8669 Doral Boulevard Suite 130, Doral, FL 33166
19. AWWA	American Water Works Association 6666 West Quincy Avenue, Denver, CO 80235
20. BHMA	Builder's Hardware Manufacturers Association 355 Lexington Avenue 15th floor, New York, NY 10017
21. BIA	Brick Industry Association 1850 Centennial Park Drive Suite 301, Reston, VA 20191
22. CRSI	Concrete Reinforcing Steel Institute 9333 North Plum Grove Road, Schaumburg, IL 60173
23. EJMA	Expansion Joint Manufacturers Association 25 North Broadway, Tarrytown, NY 10591
24. FM	FM Global FM Global Corporate Offices, 270 Central Avenue, Johnston, RI 02919
25. FTI	Facing Tile Institute Box 8880, Canton, OH 44711

26. GA	Gypsum Association 6525 Belcrest Road Suite 480, Hyattsville, MD 20782
27. GANA	Glass Association of North America 800 SW Jackson Street Suite 1500, Topeka, KS 66612-1200
28. ICC	International Code Council 500 New Jersey Avenue NW 6th Floor, Washington, DC 20001
29. IES	Illuminating Engineering Society 120 Wall Street, Floor 17, New York, NY 10005-4001
30. MIL	Military Specifications Naval Publications and Forms Center 5801 Tabor Avenue, Philadelphia, PA 19120
31. NAAMM	National Association of Architectural Metal Manufacturers 800 Roosevelt Road Building C Suite 312, Glen Ellyn, IL 60137
32. NCMA	National Concrete Masonry Association 13750 Sunrise Valley Drive, Herndon, VA 20171-4662
33. NECA	NECA National Electrical Contractors Association 3 Bethesda Metro Center Suite 1100, Bethesda, MD 20814
34. NEMA	National Electrical Manufacturers Association 1300 North 17th Street Suite 1752, Rosslyn, VA 22209
35. NFPA	National Fire Protection Association 1 Batterymarch Park, Quincy, MA 02169-7471
36. NIST	National Institute of Standards and Technology (U.S. Department of Commerce), 100 Bureau Drive, Stop 1070 Gaithersburg, MD 20899-1070
37. NRCA	National Roofing Contractors Association 10255 West Higgins Road Suite 600, Rosemont, IL 60018-5607
38. NSF	National Sanitation Foundation International P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, MI 48113-0140
39. OSHA	Occupational Safety & Health Administration 200 Constitution Avenue NW, Washington, DC 20210
40. PCA	Portland Cement Association 5420 Old Orchard Road, Skokie, IL 60077
41. PCI	Prestressed Concrete Institute 200 West Adams Street Suite 2100, Chicago, IL 60606

42. SAE — Society of Automotive Engineers
SAE World Headquarters
400 Commonwealth Drive, Warrendale, PA 15096-0001

43. SDI — Steel Deck Institute
P.O. Box 25, Fox River Grove, IL 60021

44. SDI — Steel Door Institute
30200 Detroit Road, Westlake, OH 44145-1987

45. SIGMA — Sealed Insulating Glass Manufacturers Assoc.
401 North Michigan Avenue Suite 2400, Chicago, IL 60611

46. SJI — Steel Joist Institute
234 Cheves Street, Florence, SC 29501

47. SMACNA — Sheet Metal and Air Conditioning
Contractor's National Association
4201 Lafayette Center Drive, Chantilly, VA 20151-1219

48. SSPC — Society for Protective Coatings
40 24th Street 6th Floor, Pittsburgh, PA 15222-4656

49. TCA — Tile Council of America
100 Clemson Research Boulevard, Anderson, SC 29625

50. ICC — International Code Council
500 New Jersey Avenue NW 6th Floor, Washington, DC 20001

51. UL — Underwriters Laboratories
333 Pfingston Road; Northbrook, IL 60062

1.04 SUBMITTALS

A. For OWNER's records, CONTRACTOR shall submit copies of permits, licenses, certifications, inspection reports, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

1.05 DEFINITIONS

A. Indicated:
   1. The term "indicated" is a cross-reference to details, notes, or schedules on the drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in the Contract Documents.
   2. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated", it is for the purpose of helping the reader locate cross-reference, and no limitation is intended except as specifically noted.

B. Approve (or Words of Similar Nature):
   1. Where used in conjunction with ENGINEER's response to submittals, requests, applications, inquiries, reports, and claims by CONTRACTOR, the meaning of the term "approve" will be held to the limitation of ENGINEER's responsibilities and duties as specified in the Standard Specifications.
   2. In no case will "approval" by ENGINEER be interpreted as a release of CONTRACTOR from responsibility to fulfill requirements of the Contract Documents.

C. Minimum Requirements:
   1. Indicated requirements are for a specific minimum acceptable level of quality or quantity, as recognized in the industry.
   2. Actual work must comply with (or within specified tolerances) or exceed minimums.
   3. CONTRACTOR shall refer uncertainties to ENGINEER before proceeding.

D. Abbreviations: Abbreviations, where not defined in the Contract Documents, will be interpreted to mean the normal construction industry terminology.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
   2. To facilitate CONTRACTOR's understanding of the design intent, procedures have been established for advance submittal of design data and for its review or rejection by ENGINEER.
   3. The type of submittal requirements specified in this section include progress schedule, shop drawings, product data, samples, and other miscellaneous work related submittals.

B. Related work described elsewhere: More detailed requirements for submittals are described in other sections of these specifications for some materials and equipment. They are to be considered additional requirements to supplement the requirements specified in this section. Submittals shall conform to Article 6 of the General Conditions.

C. Definitions: "Electronic Submittal" is defined as any submittal transmitted electronically to ENGINEER for review.

1.02 IDENTIFICATION OF SUBMITTALS

A. CONTRACTOR shall completely identify each submittal and resubmittal by showing at least the following information:
   1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
   2. Name and location of project and identification number.
   3. Drawing number and specifications section number to which the submittal applies.
   4. Include the date of each submittal or resubmittal.

1.03 GROUPING OF SUBMITTALS

A. Unless otherwise specifically permitted by ENGINEER, CONTRACTOR shall make all submittals in groups containing all associated items so that information is available for checking each item when it is received.

B. Partial submittals may be rejected as not complying with the provisions of the Contract Documents.

1.04 TIMING OF SUBMITTALS

A. CONTRACTOR shall make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary approval, for possible revision and resubmittal, and for placing orders and securing delivery.

B. The review period for submittals that are received after 3 P.M. shall commence on the following business day.

1.05 CONSTRUCTION PROGRESS SCHEDULE

A. Submit initial schedule in duplicate within 10 days after date of OWNER-CONTRACTOR Agreement.

B. Revise and resubmit as required.

C. Submit revised schedules with each Application for Payment, identifying changes since previous version.

D. Submit a horizontal bar chart with separate line for each major portion of Work or operation, identifying first workday of each week.

E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

F. Indicate estimated percentage of completion for each item of Work at each submission.

G. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

1.06 SHOP DRAWINGS

A. Shop drawings shall include specially prepared technical data for this project including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements, and similar information not in standard printed form for general application to a range of similar projects. Shop drawings shall be submitted for all manufactured or fabricated items. See individual technical sections for special requirements.

B. CONTRACTOR shall make all shop drawings accurately to scale and sufficiently large to show all pertinent aspects of the item and its method of connection to the work.

C. Shop drawings shall be checked, approved, and stamped by CONTRACTOR in accordance with the General Conditions before transmittal to ENGINEER for review and approval.

D. Complete shop drawings and descriptive data shall be submitted on all manufactured or fabricated items prior to 25% completion of the Work. Applications for payment beyond 25% of the Contract amount will not be recommended for payment until all shop drawings are submitted or a revised schedule for any remaining submittals is agreed to by OWNER and ENGINEER.

E. CONTRACTOR shall submit shop drawings following the electronic submittal procedure described below. If electronic submittal is impossible, CONTRACTOR may request ENGINEER to review hard copy submittals on a limited basis. ENGINEER may request to review hard copy submittals on a limited basis for submittals that are over 100 pages in length. If ENGINEER agrees to or requests hard copy submittal review, CONTRACTOR shall submit six color copies of shop drawings and descriptive data to ENGINEER for

approval. Three copies of these will be returned to CONTRACTOR if approved. If shop drawings are not approved or if they are stamped "Approved as Noted-Resubmit," two corrected copies will be returned to CONTRACTOR for use in resubmittal. If CONTRACTOR desires more than three approved copies, submitted quantity shall be increased accordingly.

F. Hard copy shop drawings shall be submitted in 3-tab report covers, binder clips, or large envelopes.

G. Shop drawings submitted to ENGINEER will be reviewed and stamped "Approved," "Approved as Noted," "Approved as Noted-Resubmit," or "Not Approved." CONTRACTOR shall resubmit the above number of corrected shop drawings for all shop drawings stamped "Approved as Noted-Resubmit" and "Not Approved" and will continue this process until shop drawings are stamped "Approved" or "Approved as Noted." If drawings are stamped "Approved as Noted-Resubmit," fabrication may proceed in accordance with the marked-up shop drawings. Installation shall not proceed until shop drawings have been resubmitted and stamped "Approved" or "Approved as Noted."

H. If shop drawings are stamped "Approved as Noted" or "Approved as Noted-Resubmit" and CONTRACTOR does not agree with revisions or cannot conform with revisions, fabrication shall not proceed and shop drawings shall be resubmitted with explanation of CONTRACTOR's position.

I. All shop drawings used for construction site activities shall bear the "Approved" or "Approved as Noted" stamp of ENGINEER.

J. Arrangements may be made between CONTRACTOR and ENGINEER to provide additional copies of "Approved" shop drawings for field activity purposes.

K. Electronic Submittal Procedures:
   1. Summary:
      a. Shop drawing and product data submittals shall be transmitted to ENGINEER in electronic (PDF) format using Submittal Exchange, or equal, a website service designed specifically for transmitting submittals between construction team members, or equal.
      b. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
      c. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
   2. Procedures:
      a. Submittal Preparation–CONTRACTOR may use any or all of the following options:
         (1) Subcontractors and Suppliers provide electronic (PDF) submittals to CONTRACTOR via the Submittal Exchange website, or equal.
         (2) Subcontractors and Suppliers provide paper submittals to CONTRACTOR who electronically scans and converts to PDF format.
         (3) Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
      b. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.

c. CONTRACTOR shall transmit each submittal to ENGINEER using the Submittal Exchange website, www.submittalexchange.com, or equal.
d. ENGINEER review comments will be made available on the Submittal Exchange website for downloading. CONTRACTOR will receive email notice of completed review.
e. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of CONTRACTOR.
f. Electronically submitted shop drawings shall follow the following format:
   (1) Filenames for the shop drawing submittals shall follow a XXXXX.YYY-Z. Description convention where XXXXX is the specification section number, YYY is the submittal number, .Z is the resubmittal number, and description is a short description of what the submittal includes. Submittals shall be consecutively numbered in direct sequence of submittal. Resubmittals shall be consecutively numbered with the first submittal numbered with an -0 and the first resubmittal numbered with a -1.
      (a) Example file name: 03200.016-1. Structure 10 Concrete Reinforcement. This would be the first revision of the sixteenth submittal and contain information on concrete reinforcement.
   (2) All files shall be delivered in PDF format with a minimum resolution of 300 dpi unless otherwise requested by ENGINEER. Scanned in material shall be scanned in color and any markings by CONTRACTOR shall be made in red. Pages shall be rotated to the appropriate position for easy reading on a computer monitor such that the majority of text is vertical.
   (3) Files shall be delivered without security features activated.
   (4) Shop Drawings shall be uploaded as individual files. Files combined into a zip drive are not acceptable. All pages of one submittal should be contained in one file.
   (5) The file shall open to a cover page containing, at a minimum, the following information:
      (a) CONTRACTOR's stamp.
      (b) Name, e-mail, and telephone number of the individual who may be contacted for further information.
      (c) Project number.
      (d) Submittal number.
      (e) Submission date, if resubmittal, all previous submission dates.
      (f) Index detailing contents and the total number of pages in the submittal.
g. Once a shop drawing has been "Approved" or "Approved as Noted," CONTRACTOR shall provide three hard color copies of the "Approved" or "Approved as Noted," shop drawings to ENGINEER. CONTRACTOR is responsible for the hard copy color replication of ENGINEER's "Approved" or "Approved as Noted," shop drawings for use by CONTRACTOR. Hard copy shop drawings shall be submitted in 3-ring binders or 3-tab report covers.

3. Costs:
   a. CONTRACTOR shall include the full cost of Submittal Exchange, or equal, project subscription in their proposal. This cost shall be included in the Contract amount. Contact Submittal Exchange at 1-800-714-0024 to verify cost prior to Bid.
   b. At CONTRACTOR's option, training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 1-800-714-0024.
   c. Internet Service and Equipment Requirements:
      (1) Email address and Internet access at CONTRACTOR's main office.

(2) Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

L. CONTRACTOR is fully responsible for obtaining any and all copyright permission associated with conversion of shop drawing information to electronic format.

1.07 COLORS AND PATTERNS

A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product, CONTRACTOR shall submit accurate color charts and pattern charts to ENGINEER for OWNER's review and selection.

B. Unless all available colors and patterns have identical wearing capabilities and are identically suited for the installation, CONTRACTOR shall completely describe the relative capabilities of each.

1.08 SAMPLES AND FIELD MOCK-UPS

A. CONTRACTOR shall provide samples and field mock-ups where noted or specified.

B. Samples are physical examples which illustrate materials, equipment, or workmanship and establish standards by which the work will be judged.

C. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product and full range of color, texture, and pattern.

D. Samples shall have labels firmly attached, bearing the following information:
1. Name of project.
2. Description of product and finish.
3. Name of CONTRACTOR.
4. Trade name and number of product.
5. Standards met by the product.

E. Approval of samples must be obtained prior to proceeding with any work affected by material requiring sample approval.

F. Samples, unless otherwise noted, become the property of OWNER.

G. In situations specifically approved by ENGINEER, the retained sample may be used in the construction as one of the installed items.

H. Field mock-ups:
1. CONTRACTOR shall erect field mock-ups at the project site in a location acceptable to ENGINEER and OWNER.
2. When accepted by ENGINEER, the mock-up will become the basis for comparison of the actual work.
3. Remove mock-up at conclusion of the work if it was not incorporated into the work.

1.09 PRODUCT DATA

A. CONTRACTOR shall provide product data as required to supplement shop drawings.

B. Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by CONTRACTOR to illustrate a material, product, or system for some portion of the work.

C. CONTRACTOR shall collect required product data into one submittal for each unit of work or system.

D. CONTRACTOR shall include manufacturer's standard printed recommendations for application and use, compliance with standards, performance characteristics, wiring and piping diagrams and controls, component parts, finishes, dimensions, required clearances, and other special coordination requirements.

E. CONTRACTOR shall mark each copy of standard printed data to identify pertinent products, models, options, and other data.

F. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

1.10 RESUBMISSION REQUIREMENTS

A. Make any corrections or changes in the submittals required by ENGINEER.

B. Shop Drawings and Product Data:
   1. Revise initial drawings or data and resubmit as specified for initial submittal.
   2. Itemize in a cover letter any changes which have been made other than those requested by ENGINEER.

C. Electronic shop drawing resubmissions shall follow the nomenclature described in Section 1.06.J.2.f.

1.11 MANUFACTURER'S DIRECTIONS

A. Manufactured articles, materials, and equipment shall be stored, commissioned, operated, applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer, unless specified to the contrary.

B. Wherever specifications call for work to be performed or materials to be installed in accordance with the manufacturer's printed instructions or directions, CONTRACTOR shall furnish copies as required for shop drawings of those instructions or directions to ENGINEER before installing the material or performing the work.

1.12 MAINTENANCE MANUAL

A. Prior to 50% completion of the Contract or at a minimum of 45 days prior to the scheduled start-up date of any individual item of equipment, whichever is earlier, CONTRACTOR shall furnish to ENGINEER four complete copies of a maintenance manual for all equipment furnished and an electronic format compact disk of the maintenance manual in the most recent version of Adobe (.pdf) format identical to the hard copy. Applications for payment beyond 50% of the contract amount will not be recommended for payment until all maintenance manuals are submitted or a revised schedule for remaining maintenance manuals is agreed to by OWNER and ENGINEER.

B. CONTRACTOR is responsible for producing an electronic version of the Equipment Operations and Maintenance (O&M) Manuals Manual. The Electronic Equipment O&M Manual shall be delivered in Portable Document Format (PDF). The entire manual may be converted to PDF via scanning or other method of conversion. Drawings or other graphics must be converted to PDF format and made part of the PDF document. The CONTRACTOR shall provide all Equipment O&M Manuals in the electronic format as defined below.

C. The filename for the Equipment O&M Manual submittal will be provided with the request for final Equipment O&M Manuals. Filenames use the "eight dot three" convention (XXXXX_YY.PDF) where XXXXX is the specification section number and YY is an ID number. No one file shall be larger than 10 MB. If technical problems require that the submittal be divided into more than one file, a letter extension shall be added to the end of each filename.

D. (Example: 19876_01a.pdf). The number of files shall be kept to a minimum. Equipment O&M Manuals that span more than one file shall have the final Bookmark "Return to Table of Contents" which shall take the User to the first file on the Equipment O&M Manual.

E. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document format (*.PDF). The resolution of all scanned images shall be a minimum of 300 dpi unless otherwise requested by ENGINEER. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 6 or higher). This results in a clear image and provides for optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. All submittals must be indexed with the Adobe Catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems when transferring files. Successful searches for words or strings in the PDF document shall demonstrate proof of OCR.

F. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.

G. Bookmarks shall be created in the navigation frame for each entry in the Table of Contents. Three levels deep is usually enough (i.e., "Chapter", "Section", "Subsection"); however, complex submittals like instrumentation and electrical may be required at the discretion of ENGINEER. When setting bookmarks for Chapter level heading, the page shall be displayed at Full Page. Section and Subsection level heading pages shall be displayed as a magnified view. Bookmarks shall be displayed as subordinate (to other bookmarks in their hierarchy set so that only the Chapter level headings are displayed.

H. Thumbnails shall be generated and embedded in each PDF file.

I. Files shall be delivered without Security features activated. Password protected files will be unacceptable.

J. The opening view for PDF files shall be set as follows:
   1. Initial View: Bookmarks and Page
   2. Magnification: Fit In Window
   3. Page Layout: Single Page

K. The file shall open to the cover page of the Equipment O&M Manual with bookmarks to the left. The first bookmark shall be the name of Equipment O&M Manual.

L. The submittal shall be delivered on CD after all Equipment O&M Manuals have been received and approved. Each CD shall be labeled, at a minimum, as follows, including: 1) CD-ROM disks, 2) jewel cases, and 3) hard copies.

M. Manufacturer name, point of contact, telephone number, facsimile number, and e-mail address as appropriate.

N. Equipment name and/or O&M title spelled out in complete words.

Example "Operations and Maintenance Manual"
"Horizontal Centrifugal Nonclog Pump"

O. Specifications section number.

P. Project name.

Q. Date and File Name: Example "12-20-07", "19876_01.pdf"

R. CONTRACTOR shall reprocess any portion of the document that does not view or print to OWNER's satisfaction.

S. CONTRACTOR is fully responsible for obtaining any and all copyright permissions associated with conversion of this information to electronic format.

T. The manuals shall include manufacturer's instructions for maintenance and operation for each item of mechanical and electrical equipment. Manuals shall be specific for the equipment as installed; provide project specific inserts as required. Manuals shall contain: operation instructions, lubrication schedules, types and quantities, preventive maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and start-up procedures and, where applicable, test data and curves. All sheets shall have reduced dimensions as described for shop drawings.

U. Two copies shall be submitted in a 3-ring binder or 3-tab report cover, and the remaining copies shall be furnished in 3-tab report covers, binder clips, or large envelopes.

V. Each maintenance manual shall include a completed equipment maintenance summary form for each type and size of equipment being furnished that requires power, lubrication, or maintenance. Equipment Summary forms are located at the end of this section.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

EQUIPMENT MAINTENANCE SUMMARY FORM[1]

Equipment No.: _____

_____

_____

_____

Specification Section: _____

Equipment Name: _____

Building Name: _____ Room No.: _____

Plant Location: _____

Manufacturer: _____

Address: _____

Phone: _____

Service Representative: _____

Address: _____

Phone: _____ Fax: _____

Make: _____ Model: _____

Serial No.: _____ Type: _____

Size: _____ _____

Equipment Speed: _____

Capacity: _____

Operating Range: _____

Material: _____

Alarms: _____

_____

_____

Drive Ratio: _____

Motor Speed: _____ Service Factor: _____

Volts: _____ Phase: _____ hp: _____ Efficiency: _____

Motor Type: _____

Motor Sensors: _____

Motor Manufacturer: _____

Model: _____ Motor Frame: _____

Insulation Class: _____ FLA: _____ LRA: _____

(1) Complete as applicable; attach supplementary pages as necessary.

Maintenance Requirements
(Use additional sheets if more space is needed.)

LUBRICATION

Item	Generic Type of Lubricant	Supplier	Estimated Frequency	Annual Quantity

PREVENTIVE MAINTENANCE

Item	Action	Frequency	Reference

SUGGESTED MINIMUM SPARE PARTS LIST

Manufacturer	Part No.	Quantity Unit	Description

The following information is included in O&M Manual:

Check or mark N/A

1. Recommended installation, adjustment, calibration, and troubleshooting. _____
2. Complete internal and connection wiring diagrams. _____
3. Complete parts lists, by generic title and identification number, with exploded views of each assembly. _____
4. Disassembly, overhaul, and reassembly instructions. _____
5. Recommended prestart checks. _____
6. Recommended start procedure. _____
7. Recommended shutdown procedure for both short and long term. _____
8. Recommended operating precautions that include safety for personnel and equipment. _____
9. Recommended standing maintenance procedure. _____

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1–GENERAL

1.01 SUMMARY

A. Work Includes:
   1. Quality Assurance–Control of Installation.
   2. Tolerances.
   3. Manufacturers' Field Services and Reports.

1.02 QUALITY ASSURANCE–CONTROL OF INSTALLATION

A. CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.

B. CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.

D. CONTRACTOR shall 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. Work shall be performed by persons qualified to produce workmanship of specified quality.

F. CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

A. CONTRACTOR shall monitor tolerance control of installed products to produce acceptable work and shall not permit tolerances to accumulate.

B. CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.

C. CONTRACTOR shall adjust products to appropriate dimensions; position before securing products in place.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual specification sections or when requested by ENGINEER, CONTRACTOR shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship.

B. CONTRACTOR shall submit qualifications of observer to ENGINEER 30 days in advance of required observations.

C. CONTRACTOR shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. CONTRACTOR shall submit report in duplicate within 30 days of observation to ENGINEER for information.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Temporary utilities.
   2. Temporary stairs and access.
   3. Temporary support facilities.
   4. Construction sign.
   5. Removal of temporary facilities.

B. CONTRACTOR shall arrange for and provide temporary facilities as required for proper and expeditious prosecution of the Work.

C. CONTRACTOR shall pay all costs, except as otherwise specified, until final acceptance of the Work unless OWNER makes arrangements for use of completed portions of the Work after substantial completion in accordance with the provisions of the General Conditions.

D. CONTRACTOR shall make all temporary connections to utilities and services in locations acceptable to OWNER and local authorities having appropriate jurisdiction.
   1. Furnish all necessary labor and materials.
   2. Make all installations in a manner subject to the acceptance of such authorities and OWNER.
   3. Maintain such connections.
   4. Remove temporary installation and connection when no longer required.
   5. Restore services and sources of supply to proper operating conditions.

1.02 TEMPORARY UTILITIES

A. Temporary Toilets: CONTRACTOR shall provide and maintain sanitary temporary chemical toilets located where approved by OWNER and in sufficient number required for the work force employed by CONTRACTOR.

B. Temporary Electrical Services:
   1. CONTRACTOR shall make all necessary arrangements, furnish, install, and maintain necessary temporary electrical services at the Site. CONTRACTOR shall remove all temporary services when Project is complete.
   2. All utility charges for installation of the temporary services shall be paid for by CONTRACTOR. All metering installation charges and all energy charges for electric current used for temporary lighting and power are to be paid by CONTRACTOR.
   3. No permanent electrical equipment or wiring shall be used without express written permission of OWNER. Such approval, if given, shall not affect guarantee period. If OWNER authorizes use of permanent service facilities, CONTRACTOR shall pay all metering costs until acceptance or occupancy (whichever occurs first) of building by OWNER.

C. Weather Protection and Temporary Heat:
   1. CONTRACTOR shall provide weather protection to protect the Work from damage because of freezing, rain, snow, and other inclement weather.
   2. No permanent heating equipment shall be used on a temporary basis without express written permission by OWNER. Such approval, if given, shall not affect the guarantee period. If OWNER authorizes use of permanent heating equipment, CONTRACTOR shall pay all related energy costs until acceptance or occupancy (whichever occurs first) of the building by OWNER.

D. Temporary Telephone Service: CONTRACTOR shall provide, without extra cost to OWNER, telephone services at the Site for phones and computer modems specified in Section 01590–Field Offices and Sheds for the duration of the Work at the Site. Also provide service as required for CONTRACTOR's use. Party making toll calls shall pay for same.

E. Temporary Water: CONTRACTOR shall supply its own water during construction. CONTRACTOR shall also provide its own piping, valves, and appurtenances for its requirements. Connection to the existing water system shall be coordinated with OWNER and shall meet all code requirements including disinfection and backflow prevention.

F. Temporary Fire Protection: CONTRACTOR and Subcontractor(s) who maintain or provide an enclosed shed or trailer shall provide and maintain in operating order in each shed or trailer a minimum of one fire extinguisher. More extinguishers shall be provided as necessary. Fire extinguishers shall be minimum dry chemical, nonfreezing-type, UL rating 2A-30BC, with 10-pound capacity for Class A, B, and C fires.

1.03 TEMPORARY STAIRS AND ACCESS

A. CONTRACTOR shall provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, chutes, and so on as required for proper execution of the Work. CONTRACTOR shall be responsible for providing its own scaffolds, hoists, etc.

B. All such apparatus, equipment, and construction shall meet all requirements of OSHA, the labor laws, and other applicable State and local laws. Provide stairs with handrails. As soon as possible and where applicable, permanent stairs shall be installed.

C. As soon as permanent stairs are created, provide temporary protective treads, handrails, and shaft protection.

D. Provide barricades at hazardous locations, complete with signs, temporary general lighting, warning lights, and similar devices as required.

1.04 TEMPORARY SUPPORT FACILITIES

A. CONTRACTOR shall provide whatever facilities and services which may be needed to properly support primary construction process and meet compliance requirements and governing regulations.

B. CONTRACTOR shall not use permanent facilities except as otherwise indicated, unless authorized by OWNER.

1.05 CONSTRUCTION SIGN

A. Furnish and erect a construction sign to be maintained and kept in place until completion of the Contract.

B. The sign shall be minimum 4 feet high by 8 feet wide, constructed by a professional sign painter, and shall show the name of the Project, OWNER, all prime contractors and ENGINEER. ENGINEER will furnish a sketch showing the printing. OWNER will select colors of paint required. General sign layout shall be as shown on Drawing 01-975-158A attached at the end of these Specifications. General sign layout shall be as approved by OWNER.

1.06 REMOVAL OF TEMPORARY FACILITIES

A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to substantial completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities and restore existing facilities used during construction to specified, or to original, condition.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01560

TEMPORARY CONTROLS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Dust Control.
   2. Water, Erosion, and Sediment Control.
   3. Noise Control.
   4. Traffic Control.
   5. Site Security.
   6. Daily Cleanup.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 DUST CONTROL

A. CONTRACTOR shall execute the Work by methods to minimize raising dust from construction operations.

B. CONTRACTOR shall provide positive means to prevent airborne dust from dispersing into atmosphere.

C. CONTRACTOR shall provide partitions, enclosures, etc., within buildings as necessary to confine dust and protect adjacent areas.

3.02 WATER, EROSION, AND SEDIMENT CONTROL

A. CONTRACTOR shall grade site to drain and shall maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. CONTRACTOR shall protect Site from puddling or running water.

C. CONTRACTOR shall provide erosion control measures as necessary to control discharge of sediment laden water to surface waters and wetlands.

D. Except as provided for in the document, overland discharge of water from dewatering operations shall not be allowed. Depending on water quality, such water shall either be piped directly to the surface water or shall be directed to sedimentation basins or other such structures or features prior to discharge to surface waters so as not to cause damage to existing ground and improvements, erosion, or deposition in the discharge area.

E. CONTRACTOR shall use jute or synthetic netting, silt fences, straw bales, dikes, channels, and other applicable measures to prevent erosion of soils disturbed by its construction operation.

F. Restoration of the Site shall proceed concurrently with the construction operation. See Drawings and Specifications for erosion control measures in addition to that which may be required above.

G. Erosion control measures shall comply with DNR Conservation Practice Standards-Construction Site Erosion and Sediment Controls.

3.03 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

3.04 TRAFFIC CONTROL

A. Refer to Section 107.7 of the Special Provisions.

3.05 SITE SECURITY

A. CONTRACTOR shall have the sole responsibility of safeguarding the Site perimeter to prevent unauthorized entry to the Site throughout the duration of the Project. CONTRACTOR shall at all times provide such permanent and temporary fencing or barricades or other measures as may be necessary to restrict unauthorized entry to its construction area including construction in public rights-of-way or easements. Site security measures shall include safeguards against attractive nuisance hazards as a result of construction activity.

B. CONTRACTOR shall at all times be responsible for the security of the Work including materials and equipment. OWNER will not take any responsibility for missing or damaged equipment, tools, or personal belongings. CONTRACTOR shall have the sole responsibility of safeguarding the Work and the Site throughout the duration of the Project.

3.06 DAILY CLEANUP

A. CONTRACTOR shall clean up the Site and remove all rubbish on a daily basis.

B. CONTRACTOR shall clean up public streets and highways and remove any dirt, mud, or other materials due to project traffic on daily basis and shall comply with all local and state ordinances and permit requirements.

END OF SECTION

SECTION 01590

FIELD OFFICES AND SHEDS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Materials, equipment, and furnishings.
   2. Construction.
   3. Environmental control.
   4. CONTRACTOR office and facilities.
   5. Storage areas and sheds.
   6. Preparation.
   7. Maintenance and cleaning.
   8. Removal.

PART 2–PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FURNISHINGS

A. Materials, equipment, and furnishings shall be serviceable, new or used, and adequate for required purpose.

2.02 CONSTRUCTION

A. Portable or mobile buildings or buildings shall be constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.

B. CONTRACTOR shall provide structurally sound, secure, weathertight enclosures for office and storage spaces.

C. Exterior materials shall be weather resistant.

D. Provide appropriate type fire extinguisher at each office and each storage area.

2.03 ENVIRONMENTAL CONTROL

A. Heating, cooling, and ventilating for offices shall consist of automatic equipment to maintain comfort conditions.

2.04 CONTRACTOR OFFICE AND FACILITIES

A. CONTRACTOR shall provide facilities to meet CONTRACTOR's needs and to provide space for Project meetings.

B. Provide telephone as required for CONTRACTOR's needs.

2.05 STORAGE AREAS AND SHEDS

A. Provide storage areas and sheds of size to meet storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for observation of products to meet requirements of Section 01600–Materials and Equipment.

PART 3–EXECUTION

3.01 PREPARATION

A. CONTRACTOR shall fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 MAINTENANCE AND CLEANING

A. CONTRACTOR shall maintain approach walks free of mud, water, and snow.

3.03 REMOVAL

A. Upon final acceptance and completion of the Work, CONTRACTOR shall remove field offices, foundations, utility services, and debris and shall restore areas.

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: CONTRACTOR shall be responsible for the delivery, handling, storage and protection of all material and equipment required to complete the Work as specified herein.

B. Related Sections and Divisions: Specific requirements for the handling and storage of material and equipment are described in other sections of these Specifications.

1.02 PRODUCTS

A. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.

B. CONTRACTOR shall not use materials and equipment removed from existing construction, except as specifically required, or allowed, by the Contract Documents.

C. When any construction deviations from the Drawings and/or Specifications necessary to accommodate equipment supplied by CONTRACTOR, result in additional costs to CONTRACTOR or other contractors, such additional costs shall be borne by CONTRACTOR. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

D. Each major component of equipment shall bear a nameplate giving the name and address of the manufacturer and the catalogue number or designation.

1.03 TRANSPORTATION AND HANDLING

A. Materials, products and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.

B. CONTRACTOR shall not overload any portion of the structure in the transporting or storage of materials.

C. CONTRACTOR shall not damage other construction by careless transportation, handling, spillage, staining or impact of materials.

D. CONTRACTOR shall provide equipment and personnel to handle products, including those provided by OWNER, by methods to prevent soiling and damage.

E. CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

F. CONTRACTOR shall handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

1.04 DELIVERY AND RECEIVING

A. CONTRACTOR shall arrange deliveries of products in accordance with the Progress Schedule, allowing time for observation prior to installation.

B. CONTRACTOR shall coordinate deliveries to avoid conflict with the Work and conditions at the Site; work activities of other contractors or OWNER; limitations on storage space; availability of personnel and handling equipment and OWNER's use of premises.

C. CONTRACTOR shall deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.

D. CONTRACTOR shall clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.

E. Immediately on delivery, CONTRACTOR shall inspect shipment to assure:
   1. Product complies with requirements of Contract Documents and reviewed submittals.
   2. Quantities are correct.
   3. Accessories and installation hardware are correct.
   4. Containers and packages are intact and labels legible.
   5. Products are protected and undamaged.

1.05 STORAGE AND PROTECTION

A. General:
   1. CONTRACTOR shall store products, immediately on delivery, in accordance with manufacturer's instructions, with all seals and labels intact and legible.
   2. Available storage space at the Site is limited. Any additional off-site space required shall be arranged by CONTRACTOR.
   3. CONTRACTOR shall allocate the available storage areas and coordinate their use by the trades on the job.
   4. CONTRACTOR shall arrange storage in a manner to provide access for maintenance of stored items and for observation.

B. In enclosed storage, CONTRACTOR shall:
   1. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.
   2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
   3. Provide ventilation for sensitive products as required by manufacturer's instructions.
   4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
   5. Store solid materials such as insulation, tile, mechanical and electrical equipment, fittings, and fixtures under shelter, in original packages, away from dampness and other hazards.
   6. Store liquid materials away from fire or intense heat and protect from freezing.

C. At exterior storage, CONTRACTOR shall:
   1. Store unit materials such as concrete block, brick, steel, pipe, conduit, door frames, and lumber off ground, out of reach of dirt, water, mud and splashing.
   2. Store tools or equipment that carry dirt outside.
   3. Store large equipment so as not to damage the Work or present a fire hazard.

4. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet material and provide ventilation to avoid condensation.
5. Completely cover and protect any equipment or material which is prime coated or finish painted with secured plastic or cloth tarps. Store out of reach of dirt, water, mud and splashing.
6. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
7. Provide surface drainage to prevent erosion and ponding of water.
8. Prevent mixing of refuse or chemically injurious materials or liquids.
9. Cover aggregates such as sand and gravel in cold wet weather.
10. Remove all traces of piled bulk materials at completion of work and return site to original or indicated condition.

1.06 MAINTENANCE OF STORAGE

A. CONTRACTOR shall periodically inspect stored products on a scheduled basis.

B. CONTRACTOR shall verify that storage facilities comply with manufacturer's product storage requirements, and verify that manufacturer required environmental conditions are maintained continually.

C. CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.

D. CONTRACTOR shall perform scheduled maintenance of equipment in storage as recommended by the manufacturer. A record of the maintenance shall be kept and turned over to ENGINEER when the equipment is installed.

1.07 INSTALLATION REQUIREMENTS

A. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respective manufacturers, unless otherwise specified.

B. After installation, CONTRACTOR shall protect all materials and equipment against weather, dust, moisture, and mechanical damage.

C. CONTRACTOR shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until completion and final acceptance of the Work by OWNER. Damaged material and equipment shall be immediately removed from the Site.

1.08 CONCRETE EQUIPMENT BASE

A. Cast-in-place concrete equipment bases shall be provided for all new and relocated equipment including electrical control panels, motor control centers, etc. Concrete equipment bases shall be provided by CONTRACTOR except where specifically noted to be provided by others. Bases shall be 3-1/2 inch minimum height and shall be a minimum of 3 inches larger than equipment being supported. Grouting of equipment bases shall be as recommended by equipment manufacturer.

B. Concrete and grout shall meet applicable sections of the specifications.

C. Provide all anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete for support of equipment.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Starting equipment and systems.
   2. Demonstration and instructions.
   3. Start-up and testing.
   4. Commissioning period.

B. CONTRACTOR shall perform the Work described in the following subsections.

1.02 STARTING EQUIPMENT AND SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify ENGINEER and OWNER a minimum of seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.

G. Require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up and to supervise placing equipment or system in operation.

H. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.

I. Provide lubricants as recommended by manufacturer appropriate for start-up conditions.

1.03 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to OWNER's personnel.

B. For all mechanical equipment or systems, demonstrate project equipment and instruct in a classroom environment at a location acceptable to OWNER and instructed by qualified manufacturers' representative who is knowledgeable about the Project.

C. For equipment or systems requiring seasonal operation, perform demonstration for noncurrent season at start of noncurrent season.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time at equipment location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

G. Supervision and Start-up: Installation of all equipment furnished under this Contract shall be supervised as required by a qualified representative of equipment manufacturer. All equipment shall be placed in operation by a qualified representative of the equipment manufacturer and the staff shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to OWNER's satisfaction.

H. Where items of equipment are placed into service at different times or sequence, manufacturer's services for start-up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.

1.04 START-UP AND TESTING

A. Prior to acceptance of any portion of the Work, start-up and testing of all equipment and testing of all materials furnished on the Project by CONTRACTOR shall have been conducted in the presence of representatives of CONTRACTOR, OWNER, and ENGINEER and also manufacturer if requested by OWNER or ENGINEER.

B. CONTRACTOR shall provide whatever temporary installations and conditions are necessary in order to perform start-up and testing operations on all equipment and materials furnished under the Contract. Temporary connections and equipment necessary during start-up and testing operations shall include, but not be limited to, temporary piping and electrical equipment and devices, temporary connection from various parts of the systems and any other labor, materials, fuel, devices, or items that may be required for start-up and testing operations. Temporary conditions shall include filling with water, if necessary, to check equipment and materials.

C. All temporary installations and conditions shall be removed by CONTRACTOR upon completion of start-up and testing.

1.05 COMMISSIONING PERIOD

A. Prior to final acceptance and following successful start-up, the Station shall undergo a 7-day commissioning period. During the commissioning period, CONTRACTOR and subcontractors shall be available to provide service no later than the following business

day when notified by OWNER that an operational problem exists. If service is required during the commissioning period, the period shall be extended 7 days. The commissioning period shall be complete once 7 days of satisfactory operation without need for service have been completed.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Closeout procedures.
   2. Final cleaning.
   3. Adjusting.
   4. Project record documents.
   5. Warranties.
   6. Spare parts and maintenance materials.

1.02 CLOSEOUT PROCEDURES

A. CONTRACTOR shall provide submittals to ENGINEER that are required by governing or other authorities.

B. CONTRACTOR shall comply with General Conditions and Supplementary Conditions and complete the following before requesting ENGINEER's observation of the Work or designated portion thereof for substantial completion.
   1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of Work, enabling OWNER's unrestricted occupancy and use.
   2. Submit record documentation, maintenance manuals, tools, spare parts, keys, and similar operational items.
   3. Submit consent of surety (if surety required in Contract).
   4. Complete final cleaning, touch-up work of marred surfaces, and remove temporary facilities and tools.

1.03 FINAL CLEANING

A. It is CONTRACTOR's responsibility to completely clean up the inside and outside of all buildings and the construction site at the completion of the Work.

B. CONTRACTOR shall clean areas of the building in which painting and finishing work is to be performed just prior to the start of this work and maintain these areas in satisfactory condition for painting and finishing. This cleaning includes:
   1. Removal of trash and rubbish from these areas.
   2. Broom cleaning of floors.
   3. Removal of any plaster, mortar, dust, and other extraneous materials from finish surfaces, including but not limited to exposed structural steel, miscellaneous metal, masonry, concrete, mechanical equipment, piping, and electrical equipment.

C. In addition to the cleaning specified above and the more specific cleaning that may be required in various technical sections of the Specifications, CONTRACTOR shall prepare the Project for occupancy by a thorough cleaning throughout, which shall include the following:
   1. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
   2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
   3. Replace filters of operating equipment.
   4. Clean debris from roofs, gutters, downspouts, and drainage systems.
   5. Clean site; sweep paved areas, rake clean landscaped surfaces.
   6. Remove waste and surplus materials, rubbish, and construction facilities from the Site.

1.04 ADJUSTING

A. CONTRACTOR shall adjust operating products and equipment to ensure smooth and unhindered operation.

1.05 PROJECT RECORD DOCUMENTS

A. CONTRACTOR shall maintain on Site one set of the following record documents to record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. CONTRACTOR shall ensure entries are complete and accurate, enabling future reference by OWNER.

C. CONTRACTOR shall store record documents separate from documents used for construction.

D. CONTRACTOR shall record information concurrent with construction progress.

E. Specifications: CONTRACTOR shall legibly mark and record at each Product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by addenda and modifications.

F. Record Documents and Shop Drawings: CONTRACTOR shall legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of the work.
   4. Field changes of dimension and detail.

5. Details not on original Contract drawings.

1.06 WARRANTIES

A. CONTRACTOR shall provide warranties beyond project one-year warranty as required by technical sections and as follows.

B. Submit warranty information as follows:
   1. Provide notarized copies.
   2. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers, and provide Table of Contents and assemble in three-ring binder with durable cover.
   3. Submit with request for certificate of Substantial Completion.
   4. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance listing date of acceptance as start of warranty period.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

A. CONTRACTOR shall provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 02050

DEMOLITION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: All demolition, removal, and salvage work as shown on the drawings or specified herein.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. CONTRACTOR shall submit permits and notices, if required, authorizing building demolition.

1.03 QUALITY ASSURANCE

A. CONTRACTOR shall perform demolition, removal, and salvage in conformity with applicable federal, state, and local safety practices and code requirements.

B. CONTRACTOR shall contact all public utilities and shall shut off, cut and cap all utility services in accordance with utility requirements, codes, rules and regulations.

C. Obtain and pay for all necessary permits, licenses and certificates required.

1.04 SEQUENCE

A. No demolition, removal, or salvage work shall commence until approval to proceed has been granted by OWNER. Such work shall be completed in accordance with the construction sequence included in Division 1 of these specifications and in accordance with the construction phases of this project and work to be done by other contractors.

PART 2–PRODUCTS

2.01 GENERAL

A. Compacted fill shall meet the requirements of Section 02222–Excavation, Fill, Backfill and Grading.

B. Pipe fittings and materials shall meet the requirements of Section 02600–Buried Piping and Appurtenances and Section 15040–Piping and Appurtenances.

PART 3–EXECUTION

3.01 BREAKING DOWN AND REMOVING STRUCTURES

A. General:
   1. All existing structures, with all attached parts and connections, shown on the drawings or specified to be removed or that interfere with the new construction, shall be entirely removed within the limits shown or specified, unless otherwise provided.
   2. When a portion of any existing structure is to be retained, CONTRACTOR shall take care during construction operations so as not to impair the value of the retained portion.
      a. Complete all operations necessary for the removal of any existing structure which might endanger the new construction prior to the construction of the new work.
      b. Do not use any equipment or devices which might damage structures, facilities, or property which are to be preserved and retained.
   3. When existing reinforcing is exposed at the surface of removal areas, CONTRACTOR shall burn back the reinforcing bars 2 inches and patch with nonshrink grout, unless noted otherwise.

B. Pavement, Curb, Gutter, Sidewalk, Driveways, Crosswalk, and Similar Structures:
   1. Where portions of the existing structure are to be left in the surface of the finished work, CONTRACTOR shall remove the structure to an existing joint, or saw and chip the structure to a true line.
   2. Sufficient removal shall be made to provide for proper grades and connections in the new work.

3.02 ABANDONING AND REMOVING UTILITIES AND UNDERGROUND PROCESS PIPING

A. CONTRACTOR shall be responsible for the turning off or unhooking of all utilities and process piping before starting the demolition work. Remove all utility lines, including electrical services and process piping that are shown or specified to be removed. Remove utility lines that are to be abandoned as needed to clear new construction.

B. The ends of utility lines and process piping shown or specified to be abandoned that are exposed by excavation shall be plugged with concrete to prevent soil infiltration into the pipes.

3.03 EQUIPMENT

A. CONTRACTOR shall remove all equipment specified herein or indicated.

3.04 INTERIOR PIPING, DUCTWORK, AND APPURTENANCES

A. CONTRACTOR shall remove all piping, ductwork, and appurtenances as indicated. The location and elevations of existing piping are approximate.

B. CONTRACTOR shall remove all supports for piping, ductwork, and appurtenances indicated to be removed. Repiping and connections to new piping shall be as specified for new piping. Remaining piping and tubing, not reconnected for new piping, shall be fitted with an appropriate blind flange or plugged and insulated as required.

C. CONTRACTOR shall patch all holes resulting from removal of piping, ductwork, appurtenances, and their supports. Patching of concrete shall be with nonshrink grout and as indicated. Patching of masonry shall be with matching material toothed in. Patch other material as indicated.

3.05 SALVAGE

A. OWNER has first right of refusal to all material, piping, and equipment removed.

B. All equipment, material, and piping, except as specified hereinafter, within the buildings and structures to be demolished and additional items as noted shall be removed by CONTRACTOR. CONTRACTOR shall inspect each structure and determine the type and amount of equipment, materials, and piping to be removed.

C. All equipment, material, and piping, except as specified hereinafter, within the limits of the demolition and additional items noted to be removed, will become the property of CONTRACTOR if OWNER does not claim under first right of refusal and shall be removed from the project site. Comply with State and local ordinances and regulations for disposing of materials.

D. The following equipment and materials shall be removed and turned over to OWNER:
1. Emergency siren.
2. SCADA antenna and control panel.
3. Chlorine analyzer.
4. Pressure transducers.
5. Door controller.
6. Gage panel.
7. Dehumidifier.
8. Sump pump.
9. Telephone.
10. Supervisory control panel.
11. Video controller.
12. Power panel.
13. Video camera.

3.06 BACKFILL

A. CONTRACTOR shall fill all abandoned structures and excavations resulting from removal of structures and utilities with compacted fill. See Section 02222–Excavation, Fill, Backfill, and Grading for required degree of compaction.

END OF SECTION

SECTION 02110

SITE CLEARING AND STRIPPING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Removal of surface debris.
   2. Removal of paving, curbs, and sidewalks.
   3. Removal of trees, shrubs, and other plant life.
   4. Strip and stockpile topsoil.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 PREPARATION

A. CONTRACTOR shall identify existing plant life to remain and shall tag accordingly.

3.02 PROTECTION

A. CONTRACTOR shall protect from damage utilities and structures that are to remain.

B. CONTRACTOR shall protect trees, plant growth, and features designated to remain as final landscaping.

C. See Division 1 for protection of survey monumentation.

3.03 CLEARING AND GRUBBING

A. Clearing and grubbing shall consist of cutting and disposing of trees, brush, windfalls, logs, and other vegetation, and the removing and disposing of roots, stumps, stubs, grubs, logs, and other timber from within the clearing limits as defined on the drawings, designated to be removed on the drawings or in the specifications, or fall within the excavation, embankment, or improved areas of the site.

B. All roots and stumps shall be removed to a depth of not less than 12 inches below the original ground surface in embankment areas. In cut areas, such material shall be removed to a depth of not less than 12 inches below the subgrade.

3.04 REMOVALS

A. CONTRACTOR shall remove from the site all trees, brush, and other vegetation, debris, and rocks that fall within the excavation and grading limits, as well as any paving, curb and gutter, and sidewalks shown on the drawings to be removed.

3.05 STRIPPING

A. Excavate topsoil from areas to be built upon, cut or filled, or to have surface improvements, including roadways and walks.

B. Excavated topsoil shall be removed from the site and stored at the CONTRACTOR's expense. CONTRACTOR shall provide additional topsoil as required.

C. Excess topsoil, if any, shall be removed from the site and disposed of at CONTRACTOR's expense.

END OF SECTION

SECTION 02140

DEWATERING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Removal of groundwater to allow belowgrade construction.
   2. Site grading to prevent surface water from entering the excavation.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Payment:
   1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
   2. The cost for removal of groundwater and surface water shall be included in the prices bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.

1.02 REFERENCES

A. Wisconsin Administrative Code Chapter NR 141 and NR 811.

B. See Division 1, Regulatory Requirements for permit requirements and water, erosion, and sediment control.

1.03 SYSTEM REQUIREMENTS

A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. No water shall flow over the work until the joints are complete or the concrete has set.

B. Dewatering shall be sufficient to lower the piezometric level to at least 2 feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.

C. In areas where rock is encountered, the water level shall be kept at or below top of rock, but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.

D. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented.

E. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

1.04 QUALITY ASSURANCE

A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 DEWATERING

A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.

B. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages, and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.

C. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.

3.02 PROTECTION

A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.

B. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences to the greatest extent possible by using electric-driven pumps, or intake and exhaust silencers or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

SECTION 02222

EXCAVATION, FILL, BACKFILL, AND GRADING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
   1. Excavating for footings, foundations, roads, and utilities.
   2. Placing and compacting all fill and backfill.
   3. Placement of granular mat vapor barrier and granular cushion below interior slabs on grade.
   4. Placement of crushed stone mat below manhole/vault slabs, basement floors, or other structures where required.
   5. Rough and finish grading prior to paving, seeding, etc.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Allowances:
   1. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 50 cubic yards of unsuitable foundation material for structures and roads as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for structures and roads will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 50 cubic yards) and the unit price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting and filling or gravel bedding material required for placing concrete above water level as required under the concrete specifications. The Bid shall include any removal and replacement of excavated material so indicated on the drawings or specified herein.
   2. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 25 cubic yards of unsuitable foundation material for utility trenches as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for utility trenches will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 25 cubic yards) and the unit price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting, filling, or bedding. The Bid shall include any removal and replacement of excavated material so indicated on the drawings or specified herein.

D. Payment: General excavation shall include all excavation specified, undercutting, fill, backfill and grading, including rock excavation but not including unsuitable foundation material, as hereinafter described.

1.02 REFERENCES

A. ASTM D1557–Test Methods for Moisture Density Relations of Soils and Soil–Aggregate Mixtures using 10-pound Rammer and 18-inch drop.

B. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.

1.03 SUBMITTALS

A. CONTRACTOR shall submit samples of materials proposed for use as fill to soils testing laboratory for analysis of their suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.

B. CONTRACTOR shall submit sufficient samples of each different type or classification of soil to obtain representative values.

1.04 JOB CONDITIONS

A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.

B. Soil borings were made and the soils information is included in an appendix to these Specifications. The information contained is not guaranteed to be indicative of conditions to be encountered during construction. It is CONTRACTOR's responsibility to make its own investigations to determine physical conditions at the site, which may affect the work.

PART 2–PRODUCTS

2.01 COMPACTED FILL

A. All fill and backfill material designated to be compacted fill shall be granular with no stones larger than 4 inches and shall be reasonably well-graded throughout the particle size range. Of that portion of the material passing the No. 4 sieve, not more than 25% shall pass the No. 200 sieve, and material shall have less than 5% clay content. When placing fill during wet weather or in wet areas, this requirement shall be modified to not more than 5% passing the No. 200 sieve. Adequately dewatered areas are not defined as wet areas.

B. Native material may be used as compacted fill if it meets the above specification. CONTRACTOR shall determine whether native material meets the above specification. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

2.02 CRUSHED STONE MAT

A. Crushed stone mat below tank slabs, manholes, vault slabs and basement floors shall be 3/4-inch clear crushed stone and shall meet all requirements of ASTM C33 size No. 67.

2.03 GRANULAR CUSHION

A. Granular cushion beneath floor slabs-on-grade shall meet requirements of Section 305 of Standard Specifications for WisDOT Base Aggregate Dense, 3/4 inch.

2.04 EMBANKMENT FILL

A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

2.05 CLAY FILL

A. Clay fill shall contain at least 25% clay minerals (material finer than 0.002 mm).

PART 3–EXECUTION

3.01 GENERAL

A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

3.02 PROTECTION

A. CONTRACTOR shall provide all necessary sheeting, shoring, or other soil retention systems including all labor, material, equipment, and tools required, or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheeting, shoring, and other soil retainage systems shall be withdrawn or removed in a manner so as to prevent subsequent settlement of structures, utilities, and other improvements.

B. Design of sheet piling and other soil retaining systems shall be the sole responsibility of CONTRACTOR. Where such systems are shown on the drawings, no parameters such as embedment depth, section profile, presence or lack of whalers, etc., nor system type or suitability shall be inferred. CONTRACTOR is responsible for designing and providing a fully functional system compatible with construction and site requirements.

C. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

3.03 UTILITIES

A. Before starting excavations, CONTRACTOR shall locate existing underground utilities in all areas of the work.

B. If utilities are to remain in place, CONTRACTOR shall provide adequate means of protection during earthwork operations.

C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions.

D. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation, and repair any damaged utilities to satisfaction of utility owner.

E. CONTRACTOR shall not interrupt existing utilities serving facilities occupied and used by OWNER or others except when permitted in writing by OWNER.

F. CONTRACTOR shall demolish and completely remove from the site existing underground utilities indicated to be removed after utility has been capped and sealed.

G. CONTRACTOR shall accurately locate and record abandoned and active utility lines rerouted or extended on project record drawings.

3.04 FINISH ELEVATIONS AND LINES

A. CONTRACTOR is responsible for setting and establishing finish elevations and lines.

3.05 EXCAVATION

A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.

B. All excavated material that does not meet the specification for compacted fill or embankment fill or meets the specification but is not required for backfill or fill shall be classified as excess material and shall be removed from the site and disposed of at CONTRACTOR's expense.

C. All material other than suitable bearing soil or bedrock, as determined by the Project Soils Engineer, shall be removed from under concrete to be poured on ground.

D. Excavation for all footings, foundation walls, pits, etc., shall be large enough to provide adequate clearance for the proper execution for the work within them.

E. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 02140–Dewatering.

F. A smooth-edged backhoe shall be used for foundation excavations. Moist to dry silt subgrade soils shall be recompacted with a vibratory plate compactor or hoe-pak (backhoe mounted compactor), and clay soils should be hand-trimmed or recompacted with a jumping jack to density soils loosened/disturbed during excavation.

G. No footings or slabs shall bear on the top 2 feet of existing soil. Where planned subgrade is within 2 feet of existing grade, remove soils to 2 feet below existing grade and backfill with compacted fill up to subgrade elevation.

H. When excavations reach subgrade elevations as shown on the drawings or as specified herein, the Project Soils Engineer will observe the bottom material. Where, in the opinion of the Project Soils Engineer, unsuitable foundation material is found at the level of the subgrade, original material below the excavation necessary for construction according to grades shown or specified, shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.

I. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation 1 foot plus a distance at least equal to the depth of undercut below footing grade.

J. CONTRACTOR shall backfill and compact all overexcavated areas.

3.06 PREPARATION OF SUBGRADE

A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Project Soils Engineer.

B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.

C. All slab-on-grade and road subgrades shall be proofrolled with a heavy rubber-tired construction vehicle (such as a fully loaded tandem-axle dump truck) in the presence of the Project Soils Engineer.

3.07 COMPACTED FILL AND BACKFILL

A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.

B. Unless otherwise noted, structures with a top slab shall not be backfilled until the slab is in place and has reached its specified 28-day strength.

C. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.

D. No fill shall be placed under water or over unsuitable subgrade conditions.

E. All fill and backfill, except embankment fill and clay fill, shall be compacted as follows:
   1. Class 1 Compaction: This class of compaction shall apply to all fill areas under buildings, structures, piping, bituminous roadway and parking areas, curb and gutter, and backfill within 10 feet of structure walls. All compacted material shall be placed in uniform layers not exceeding 8 inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557). Compaction shall be obtained by compaction equipment appropriate for the conditions.
   2. Class 2 Compaction: This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer of the fill shall be compacted to at least 90% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.

F. No frozen material shall be placed nor shall any material be placed on frozen ground.

G. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

3.08 EMBANKMENT FILL

A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.

B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment, and in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

3.09 GRADING

A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the drawings.

B. Grading Tolerances:
   1. Rough Grade: Buildings, parking areas, and sidewalks–±0.1 feet.
   2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs-±0.03 feet.
   3. Lawn areas away from buildings, parking areas, and sidewalks–±0.25 feet.

3.10 PLACING GRANULAR CUSHION AND VAPOR BARRIER

A. When subgrade is prepared for slab-on-grade areas, CONTRACTOR shall place, compact, and finish grade a 6-inch layer of granular cushion.

B. The vapor barrier shall then be placed.

3.11 PLACING CRUSHED STONE AND GEOTEXTILE FABRIC

A. The same day that the subgrade is exposed, place geotextile fabric on subgrade, and place 12 inches of crushed stone mat below manholes, vault slabs, and basement floors. Compact in place.

3.12 COMPACTION TESTING

A. Compaction tests shall be done by the Project Soils Engineer. Location and frequency of the tests shall be as recommended by the Project Soils Engineer and paid for by OWNER.

END OF SECTION

SECTION 02231

AGGREGATE BASE COURSE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Aggregate base course for roads.

B. Related Sections and Divisions: Applicable provisions of Division 1 and the City of Madison Standard Specifications shall govern work in this section.

C. Repair or replacement of aggregate base course shall be considered incidental and included in the price bid.

D. CONTRACTOR is cautioned that existing public roads may not hold up to typical construction traffic or activities. CONTRACTOR shall replace all roads indicated on the drawings in accordance with this section. All paved areas shall also be repaired in accordance with Section 02510–Asphaltic Concrete Paving.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the City of Madison Standard Specifications, current edition, including all issued supplemental specifications.

1.03 DEFINITIONS

A. Street or road shall include streets, roads, driveways, and parking lots.

1.04 SUBMITTALS

A. Submit sieve analysis for proposed materials in accordance with Section 01300-Submittals.

1.05 DRAINAGE DURING CONSTRUCTION

A. CONTRACTOR shall comply with the provisions of Article 201 of the Standard Specifications.

PART 2–PRODUCTS

2.01 AGGREGATES

A. Aggregate for base course shall meet the requirements of Article 401 of the Standard Specifications.

B. Base course shall be uniformly graded and shall conform to the requirements of Gradation No. 2 of the Standard Specifications.

PART 3–EXECUTION

3.01 PREPARATION

A. The subgrade shall be graded and rolled to provide uniform density and shall comply with the profile and cross sections contained in the drawings. All street subgrade in cut areas and all areas to receive fill shall be proof-rolled in the presence of OWNER or ENGINEER with a heavily loaded triaxle dump truck or similar equipment prior to the placement of any fill materials or base course. The subgrade shall be prepared in accordance with Article 401 of the Standard Specifications.

3.02 CONSTRUCTION

A. Base course grade shall be set to allow placement of thickness of asphaltic pavement shown or specified.

B. Depth of base course shall be the existing depth or 10 inches, whichever is greater.

C. Each layer of base course shall be wetted and rolled to provide maximum compaction in accordance with Article 401 of the Standard Specifications.

D. The finished base course shall be fine graded in preparation for paving.

E. After final grading, CONTRACTOR shall maintain the base course until asphaltic paving work has been completed.

END OF SECTION

SECTION 02240

GEOTEXTILES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Geotextiles at perforated drain pipe trenches and drain tile and below riprap.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS

A. Geotextile for use at perforated drain pipe trenches and drain tile, and as specified elsewhere, shall be Mirafi 140N, or equal.

B. Geotextiles below riprap shall be Mirafi 180N, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Geotextile shall be installed in accordance with manufacturer's recommendations.

B. Geotextile shall be lapped a minimum of 24 inches or as otherwise indicated.

C. CONTRACTOR shall protect the construction fabric from exposure to the sun until installation. Construction fabric shall be covered with stone or soil immediately upon placement.

END OF SECTION

SECTION 02270

SLOPE PROTECTION AND EROSION CONTROL

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Erosion control devices.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 PAYMENT

A. All costs associated with slope protection and erosion control shall be included in CONTRACTOR's Bid. This work shall include, but is not limited to, erecting fence, excavation, placing posts, backfilling, attaching woven wire and geotextile fabric; placing ditch checks; installing sediment traps; removing the fence at completion of project; cleaning and repairing; removing or spreading accumulated sediment to form a surface suitable for seeding; replacing silt fence and damages caused by overloading of sediment material or ponding of water adjacent to silt fence; and furnishing labor, tools, equipment, and incidentals necessary to complete the work in accordance with the Contract.

1.03 REFERENCES

A. Wisconsin Department of Natural Resources Conservation Practice Standards-Construction Site Erosion and Sediment Control (Conservation Practice Standards).

B. Erosion Control Product Applicability List for Multi-Modal Applications (PAL) Wisconsin Department of Transportation.

C. Dane County Erosion Control and Stormwater Management Manual (www.co.dane.wi.us/landconservation/ecswpg.htm).

1.04 REGULATORY REQUIREMENTS

A. Land disturbance less than one acre. Where land disturbance activities do not exceed one acre, CONTRACTOR shall maintain site conditions where erosion and pollution are controlled.

B. CONTRACTOR and its subcontractors shall execute and sign the following certification:

> "I certify under penalty of law that I understand the terms and conditions of the General Pollutant Discharge Elimination System Permit that authorizes the storm water discharges associated with industrial activities from the construction site and as may be detailed in the Contract Documents. I agree to indemnify and hold OWNER harmless from any claims, demands, suits, causes of action, settlements, fines, or judgments and the costs of litigation, including, but not limited to, reasonable attorneys fees and costs of investigation and arising from a condition,

obligation or requirement assumed or to be performed by CONTRACTOR for storm water pollution and erosion control."

C. CONTRACTOR shall pay any fines or other fees resulting from failure of CONTRACTOR to comply with the permit requirements.

1.05 QUALITY CONTROL

A. Construct and maintain erosion sediment control measures in accordance with the Conservation Practice Standards.

B. Check facilities weekly and after any rainfall event, and make needed repairs within 24 hours.

PART 2–PRODUCTS

2.01 EROSION CONTROL PRODUCTS

A. Erosion control products, except for stone bags, shall be as listed in the *Erosion Control Product Acceptability List for Multi-Modal Applications (PAL)* of the Wisconsin Department of Transportation. Contractors may obtain copies of the PAL and PAL qualification procedures from the WisDOT Bureau of Highway Construction.

2.02 STONE BAGS

A. Where shown on the Drawings, CONTRACTOR shall provide stone bags in the gutter to minimize transport of sediment. See detail for more information.

2.03 EROSION CONTROL LOGS

A. Erosion control logs shall conform to Conservation Practice Standard 1071–Interim Manufactured Perimeter Control and Slope Interruption Products.

2.04 EROSION MATS

A. Erosion mat products shall be selected from the PAL in conformance with criteria specified in Conservation Practice Standard 1052 (Nonchannel Erosion Mat) and 1053 (Channel Erosion Mat).

B. Unless designated on the drawings, CONTRACTOR may furnish any prequalified erosion mat product of the class and type listed in the PAL.

C. A 300 mm by 300 mm sample of a product proposed for erosion mat may be required to verify that it is prequalified. When a sample is required, it shall be accompanied by the manufacturer's literature for the proposed product.

2.05 SILT FENCE

A. Silt fence shall conform to Conservation Practice Standard 1056-Silt Fence. Silt fence shall conform to Table 2 of Conservation Practice Standard 1056.

B. Furnish wrapping on each roll of fabric to protect the fabric from ultraviolet radiation and from abrasion during shipping and handling. Keep geotextile dry until installed.

2.06 SOIL STABILIZER

A. Soil stabilizer shall be Type A or Type B. Type A is either a cementitous soil binder added to wood cellulose fiber mulch or a bonded fiber matrix. Type B is a water soluble anionic polyacrylamide meeting requirements specified in Conservation Practice Standard 1050-Land Application of Anionic Polyacrylamide. CONTRACTOR shall provide soil stabilizer products from the PAL.

2.07 INLET PROTECTION

A. Inlet protection shall conform to Conservation Practice Standard 1060-Storm Drain Inlet Protection for Construction Sites. Manufactured bags shall conform to Table 1 of Conservation Practice Standard 1060.

2.08 STONE TRACKING PADS AND TIRE WASHING STATION

A. Stone tracking pads and tire washing stations shall conform to Conservation Practice Standard 1057-Stone Tracking Pad and Tire Washing.

2.09 MULCHING

A. Mulching for construction sites shall conform to Conservation Standard Practice 1058-Mulching for Construction Sites.

2.10 TEMPORARY SEEDING

A. Temporary seeding for construction site erosion control shall conform to Conservation Standard Practice 1059-Seeding for Construction Site Erosion Control.

2.11 GEOTEXTILE FABRIC

A. See Section 02240–Geotextiles for fabric.

PART 3–EXECUTION

3.01 GENERAL

A. Install devices before construction activities begin.

B. Proceed carefully with construction adjacent to stream channels to avoid washing, sloughing, or deposition of materials into the stream. If possible, the work area should be diked off and the volume and velocity of water that crosses disturbed areas be reduced by means of planned engineering works (diversion, detention basins, berms).

C. Unless noted on drawings, do not remove trees and surface vegetation.

D. Expose the smallest practical area of soil at any given time through construction scheduling. Make the duration of such exposure before application of temporary erosion control measures or final revegetation as short as practicable.

E. CONTRACTOR shall provide a "qualified" inspector to inspect erosion control and sediment controls once in place. Inspector shall have prior experience with and knowledge of installation and maintenance of erosion and pollution controls. Unless stricter requirements are mandated by DNR or by any local permits, project site erosion control inspection shall be conducted every seven days and after each one-half-inch rainfall or greater. CONTRACTOR shall maintain hard copies of the inspection reports for the duration of the Project.

F. Any necessary repairs to erosion and sediment control facilities shall be provided within 24 hours to all corrective measures noted on the inspection reports to address pollution issues. CONTRACTOR shall submit to OWNER a written notice stating the times, dates and actions taken to rectify the defective erosion and sediment controls.

G. CONTRACTOR shall also make any necessary additions for erosion and sediment control as may result from on-site conditions or the progress of the Work or as may be required by DNR or OWNER.

H. Disturbed areas shall be stabilized with temporary or permanent measures within 14 calendar days of the soil disturbance or redisturbance.

I. All temporary erosion and sediment control measures shall be removed within 30 days after final stabilization is achieved or after the temporary measures are no longer needed. All sediment accumulated in temporary and permanent facilities shall be removed and properly disposed of and the area restored.

3.02 STONE BAGS

A. Stone bags shall be replaced at such time as the bag material has degraded to a point that the bag is no longer sound.

B. Sediment shall be removed from behind the stone bags when the accumulated sedinment reaches approximately 1/3 to 1/2 the height of the stone bags.

3.03 EROSION CONTROL LOGS

A. Erosion control logs shall be installed in conformance with the criteria specified in Conservation Practice Standard 1071–Interim Manufactured Perimeter Control and Slope Interruption Products.

3.04 EROSION MAT

A. Erosion mats shall be installed in accordance with manufacturer's requirements and with Conservation Practices Standards 1052 and 1053.

B. Place erosion mats immediately after seeding operations have been completed. Before mat placement, remove all material or clods over 1 1/2 inches in diameter and all organic material or other foreign material which may interfere with the mat bearing completely on the soil.

C. Any small stones or clods which prevent contact of the mat with the soil shall be pressed in the soil with a small lawn–type roller or by other means. The mat shall have its lateral edge so impressed in the soil so as to permit runoff water to flow over it.

D. The matting strips shall be rolled on or laid in direction of flow. Spread mat evenly and smoothly in a natural position without stretching and with all parts bearing on soil. Place blanket with netting on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. Make overlaps with upgrade section on top.

E. Bury upgrade end of each strip of fabric or blanket at least 6 inches in a vertical slot cut in the soil and press soil firmly against the imbedded fabric or blanket.

F. Anchor mats in place with vertically driven staples, driven until their tops are flush with the soil. Space staples on 3-foot centers along mat edges and stagger space at 3-foot centers through the center. Place staples at 10-inch centers at end or junction slots.

G. Reseed areas damaged or destroyed during erosion mat placing operations as specified for original seeding.

H. Dispose of surplus excavated materials during erosion mat placing operation as specified for original seeding.

I. Following mat placement, uniformly apply water to the area to moisten seed bed to 2-inch depth and in a manner to avoid erosion.

J. Maintain erosion mat and make satisfactory repairs of damage from erosion, traffic, fires, or other causes until Work is accepted.

3.05 SILT FENCE

A. Silt fence shall be constructed in conformance with the criteria specified in Conservation Practice Standard 1056–Silt Fence.

3.06 SOIL STABILIZER

A. Soil Stabilizer Type A shall be applied with conventional hydraulic seeding equipment. CONTRACTOR shall take care to ensure that surrounding surfaces, structures, trees, and shrubs are not over-sprayed. Before Work is accepted any over-spray must be satisfactorily cleaned from surfaces. The finished application shall be 3/16 inches to 1/4 inch thick. For permanent slope applications, CONTRACTOR shall sow seed separately before applying the soil stabilizer to ensure that the seed has direct contact with the soil.

B. Soil Stabilizer Type B shall be applied with conventional hydraulic seeding equipment or by dry spreading. CONTRACTOR shall apply material at the manufacturer's recommended rate. For permanent slope applications, CONTRACTOR shall apply an approved mulch when the soil stabilizer is applied or after it is applied to protect the seed.

3.07 INLET PROTECTION

A. All storm drains that are or will be functioning during construction shall be provided with inlet protection. Inlet protection shall be provided in conformance with the criteria specified

in Conservation Practice Standard 1060–Storm Drain Inlet Protection for Construction Sites.

3.08 STONE TRACKING PADS AND TIRE WASHING

A. Tracking pads (tire washing stations as required) shall be installed in accordance with the criteria in Conservation Practice Standard 1057–Stone Tracking Pad and Tire Washing.

B. Surface water must be prevented from passing through tracking pads. Flows shall be diverted away from tracking pads and conveyed under and around them such as with culverts.

C. Any sediment tracked onto a road shall be removed before the end of each day. Flushing sediment shall not be allowed.

3.09 MULCHING

A. Mulching shall be provided in conformance with the criteria specified in Conservation Practice Standard 1060–Mulching for Construction Sites.

3.10 SEEDING FOR EROSION CONTROL

A. Temporary seeding for erosion control shall be provided in conformance with the criteria specified in Conservation Practice Standard 1059–Seeding for Construction Site Erosion Control.

END OF SECTION

SECTION 02275

RIPRAP

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Furnishing and placing riprap.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.

PART 2–PRODUCTS

2.01 MATERIALS

A. Stone for riprap shall be durable quarry stone of approved quality. It shall be sound, hard, dense, resistant to the action of air and water, and free from seams, cracks, or other structural defects.

B. Stone for riprap shall be in accordance with Standard Specifications, Section 606 Riprap. Size of riprap is as designated on the Drawings.

PART 3–EXECUTION

3.01 PREPARATION

A. The bed for the riprap shall be properly trimmed and shaped before geotextile and stone is placed. Bed shall be minimum 6 inches thick.

B. Geotextile shall be placed below riprap. See Section 02240–Geotextile.

3.02 INSTALLATION

A. Riprap shall be provided in areas as designated on the drawings.

B. Stone placed above the water line shall be placed by hand. It shall be laid with close, broken joints and shall be firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with ends in contact.

C. The riprap shall be thoroughly compacted as construction progresses, and the finished surface shall present an even, tight surface.

D. The large stone shall be placed in the lower courses. Interstices between stones shall be chinked with spalls firmly rammed into place.

E. Unless otherwise shown or specified, riprap shall be at least 12 inches in thickness, measured perpendicular to the slope.

END OF SECTION

SECTION 02510

HOT MIX ASPHALT PAVING

PART 1–GENERAL

1.01 SUMMARY

A. Work includes Hot Mix Asphalt (HMA) paving, tack coat, and casting adjustments.

B. Related Sections and Divisions: Applicable provisions of Division 1 and the City of Madison Standard Specifications shall govern work in this section.

C. CONTRACTOR is cautioned that existing public roads may not hold up to typical construction traffic or activities. CONTRACTOR shall replace all roads indicated on the Drawings during the project in accordance with this section.

D. Payment: Payment for HMA paving shall be considered incidental to the project and included in the Lump Sum Bid.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the City of Madison Standard Specifications, current edition, including all issued supplemental specifications.

1.03 DEFINITIONS

A. Street or road shall include streets, roads, driveways, and parking lots.

1.04 SUBMITTALS

A. Prior to the commencement of paving, mix designs and aggregate sieve analysis shall be submitted to ENGINEER for approval in accordance with Section 01300–Submittals.

PART 2–PRODUCTS

2.01 HMA PAVEMENT

A. Asphaltic pavement shall be HMA Pavement Type E-0.3. Asphaltic material for lower layer and upper layer shall be asphaltic material PG58-28.

B. Aggregate shall conform to the requirements of Article 402 of the Standard Specifications. Aggregate for the lower layer shall be nominal size of 19.0 mm. Aggregate for the upper layer shall be nominal size of 12.5 mm.

C. Where existing pavement is replaced, pavement thickness shall match existing thickness. Lower layer shall be 1 3/4 inches minimum. Upper layer shall be 1 3/4 inches minimum.

D. Materials for tack coat shall conform to the requirements of Article 402 and shall be MS-2, SS-1, SS-1h, or CSS-1.

E. Pavement markings shall conform to Article 608 for white markings, except without the reflective additive.

PART 3–EXECUTION

3.01 ALLOWABLE REMOVAL OF PAVEMENT

A. CONTRACTOR shall remove asphalt pavement and road surface as a part of the general excavation. The width of pavement removed shall be the minimum possible and acceptable for convenient and safe installation of structures, utilities, and appurtenances.

B. All asphalt pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the excavation. Should the cut edge be damaged, a new cut shall be made in neat, straight lines parallel to the original cut encompassing all damaged areas. Pavement removal shall be extended to a seam or joint if seam or joint is within 3 feet of damaged pavement.

3.02 CASTING ADJUSTMENTS

A. All new and existing manhole castings and valve boxes within the paving limits of the street, which require adjustment, shall be adjusted to match the finished asphaltic surface. Adjustments shall not be made greater than 48 hours prior to the anticipated time of paving. Adjustments shall be performed as called for in Section 02600–Buried Piping and Appurtenances. CONTRACTOR shall furnish Class 1 barricades with flashers on all adjusted castings until paving has been completed. Tops of castings and valve boxes shall be oiled or protected by other methods to prevent sealing of lids and filling of lift holes during paving. Upon completion of paving operations, CONTRACTOR shall check all castings and valve boxes to ensure that the lids are clean and operational. Manhole casting adjustment shall be included in the cost of other items of work, and no further compensation will be made. Valve box adjustment shall be considered an incidental item of work.

3.03 TACK COAT

A. All work shall be in accordance with the Standard Specifications.

B. If asphaltic upper layer is applied to an existing street or is not applied the same day as lower layer, the existing street or lower layer shall be tack coated prior to surface paving. Prior to placement of tack coat, the streets shall be thoroughly cleaned and broomed. Tack coat shall be applied at a rate of 0.10 gallons per square yard immediately prior to placement of asphaltic upper layer.

C. In situations where traffic must be maintained, tack coat shall not be placed on the traveled half of the street until traffic can be switched to the new pavement.

3.04 JOINTS

A. Joints between old and new pavements or between successive day's work shall be constructed and treated as to ensure thorough and continuous bond between the old and new mixtures. Transverse construction joints shall be constructed by cutting the material back for its full depth so as to expose the full depth of the course. Where a header is used, the cutting may be omitted provided the joint conforms to the specified thickness. These joints shall be treated with tack coat material applied with a hose and spray nozzle attachment to fully coat the joint surface.

B. The longitudinal joint shall be made by overlapping the screed on the previously laid material for a width of not more than 2 inches and depositing a sufficient amount of asphaltic mixture so that the finished joint will be smooth and tight. Longitudinal joints in the upper layer shall at no time be placed immediately over similar joints in the lower layer beneath. A minimum distance of 12 inches shall be permitted between the location of the joints in the lower layer and the location of similar joints in the upper layer above.

C. All costs for furnishing and applying tack coat to butt joints as specified above shall be considered incidental.

3.05 FINISHING ROADWAY

A. The finished base course shall be fine-graded in preparation for HMA paving. Base course ramps at all existing pavement shall be removed to provide a full depth butt joint. Base course around manhole castings and valve boxes shall be hand-trimmed and compacted with a vibratory plate compactor.

B. This item shall include all of the following preparatory and finishing items and any other incidental items of work required for construction. Asphaltic ramps around manholes on existing lower layer to receive upper layer shall be removed. Asphaltic ramps shall be installed on all manholes and at all butt joints in areas to receive lower layer only.

C. Finishing roadway shall be considered incidental to HMA paving.

D. Paint all markings as shown on drawings with lines not less than 4 inches wide.

3.06 TESTING HOT MIX ASPHALT

A. ENGINEER may require samples of HMA pavement for testing. CONTRACTOR shall cut samples from the finished pavement where marked by ENGINEER and patch the sample area. Samples for sieve analysis and asphalt content will be taken by ENGINEER prior to placement.

3.07 HOT MIX ASPHALT PAVING

A. HMA paving work shall include the construction of plant-mixed hot mix asphalt pavement in the areas shown on the drawings. All work shall be performed in accordance with Article 402 of the Standard Specifications.

B. Prior to commencement of paving operations, CONTRACTOR shall examine the finished road bed. CONTRACTOR shall notify ENGINEER of any areas of suspected instability.

C. The pavement structure for new roads shall be determined from the standard cross sections provided on the drawings.

END OF SECTION

SECTION 02521

CONCRETE CURB AND GUTTER AND SIDEWALKS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes concrete curb and gutter and sidewalks as shown on the drawings.

B. Related Sections and Divisions: Applicable provisions of Division 1 and the City of Madison Standard Specifications shall govern work in this section.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the City of Madison Standard Specifications, current edition, including all issued supplemental specifications.

B. AASHTO M148 Standard Specifications for Liquid Membrane–Forming Compounds for Curing Concrete.

1.03 QUALITY ASSURANCE

A. Unless otherwise specified, all curb and gutter and sidewalk construction shall meet the requirements of the Standard Specifications.

PART 2–PRODUCTS

2.01 CONCRETE

A. All concrete shall conform to Article 301 of the Standard Specifications.

2.02 CURING COMPOUND

A. Liquid curing compounds shall conform to the requirements of the Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete, AASHTO Designation M148, Type 2, White Pigmented.

PART 3–EXECUTION

3.01 BASE PREPARATION–CURB AND GUTTER

A. The base course beneath the curb and gutter shall be trimmed or filled as necessary to provide a full depth of curb and gutter as detailed in the Standard Specifications. Prior to placement of concrete, the base shall be thoroughly compacted and moistened.

3.02 BASE PREPARATION–SIDEWALKS

A. The subgrade shall be thoroughly compacted and finished to a trim, firm surface. All soft or unsuitable material shall be removed and replaced with suitable material.

B. A minimum 2-inch-thick layer of sand, sand and gravel, or base course shall be placed under all sidewalks. This material shall be thoroughly moistened and compacted before the concrete is placed.

3.03 FORMS

A. Forms shall be of steel and of sufficient strength to resist distortion or displacement. Metal forms shall be used to construct a curb and gutter cross section as shown in the Standard Specifications. Forms shall be full depth of the required work. Facing boards, if used, shall be built so as to obtain the cross section called for on the drawings. Forms shall be securely staked and held firmly to line and grade. Forms shall be cleaned thoroughly and oiled before reuse.

3.04 PLACING AND FINISHING CONCRETE

A. Unless otherwise specified, concrete shall be placed in accordance with Article 302 and 303 of the Standard Specifications.

B. Concrete shall be thoroughly tamped to remove all voids. The exposed surfaces of the curb and gutter shall be thoroughly troweled and finished with a brush at right angles to the line of the curb and gutter. The back edge of the curb, the edge of the gutter adjacent to the pavements, and edges adjacent to expansion joints shall be rounded with a 1/4-inch radius edger. Honeycombed areas along the back of the curb shall be pointed with mortar.

C. Before final finishing of curb and gutter, a 10-foot straight edge shall be used to check the surface. Any areas showing a variation of more than 1/4 inch from the straight edge shall be corrected. Final finishing shall be delayed a sufficient time so that excess water and grout will not be brought to the surface.

D. Concrete for sidewalk shall be placed to a minimum thickness of 5 inches. The concrete shall be thoroughly spaded and tamped to remove all voids. The surface of the sidewalk shall be thoroughly troweled and finished with a brush at right angles to the sidewalk line.

3.05 MACHINE FORMED CURB AND GUTTER

A. CONTRACTOR may elect to use a machine for placing, forming, and consolidating concrete curb and gutter. If a machine is used, the resulting curb and gutter shall be of such a quality as to equal or exceed that produced by the method described above.

3.06 JOINTING–CURB AND GUTTER

A. A 3/4-inch expansion joint filler shall be placed through the curb and gutter at the radius points of all intersection curbs. This expansion joint filler shall extend through the entire thickness of concrete and shall be perpendicular to the surface and at right angles to the line of the curb and gutter.

B. At intervals of not more than 10 feet, a contraction joint shall be tooled to a minimum depth of 3 inches with a 1/4-inch radius jointer. The contraction joint shall be at right angles to the line of the curb and gutter.

C. If machine-formed curb and gutter is provided by CONTRACTOR, CONTRACTOR shall create a plane of weakness at all joints that is sufficient to cause contraction cracking at the joints.

D. CONTRACTOR may saw contraction joints. The depth of cut shall be a minimum of 3 inches. Sawing shall be done as soon as practicable after the concrete has set sufficiently to preclude raveling during the sawing and before any shrinkage cracking takes place in the concrete. If this method results in random cracking, CONTRACTOR will be required to tool the contraction joints as specified above.

E. The use of steel separator plates will not be allowed.

F. Jointing shall be included in the price bid for curb and gutter.

3.07 JOINTING–SIDEWALKS

A. Concrete sidewalk shall be cut into rectangular blocks approximately 5 feet long. The cut must extend at least one-fifth of the total thickness of concrete. The edges of the sidewalk along forms and joints shall be rounded with an edging tool of 1/4-inch radius. All joints shall be at right angles to the centerline of the sidewalk.

3.08 EXPANSION JOINTS

A. A 1-inch-thick expansion joint filler shall be placed between curb ramps and back of curb.

B. A 3/4-inch-thick expansion joint shall be placed at all sidewalk corners, between sidewalks and buildings, and between back of curb and sidewalk.

3.09 SLOPE

A. Sidewalk cross slope shall be 1/4 inch per foot unless otherwise noted in the drawings or requested by ENGINEER.

3.10 CURB RAMP

A. Curb ramps shall be constructed in accordance with the Standard Specifications.

3.11 UTILITY MARKINGS

A. The ends of utility service lines (sewer, water, and electrical conduits) shall be marked during installation. The curb top shall be marked immediately adjacent to these utility markers. Curb markers shall be 2 inches in height and shall consist of a "W" for water, "S" for sewer, and "E" for electric and blank conduits. Markings shall be embossed a minimum of 1/4 inch deep and be 3/8 inches thick. Utility markings shall be considered incidental work to curb and gutter.

3.12 CURING

A. As soon after finishing operations as the free water has disappeared, the concrete surface shall be sealed by spraying on it a uniform coating of curing material in such a manner as to provide a continuous water impermeable film on the entire concrete surface.

B. The material shall be applied to form a uniform coverage at the rate of not less than one-half gallon per 100 square feet of surface area.

C. Within 30 minutes after the forms have been removed, the edges of the concrete shall be coated with the curing compound applied at the same rate as on the finished surface.

3.13 PROTECTION OF CONCRETE

A. CONTRACTOR shall erect and maintain suitable barricades to protect the new concrete. Where it is necessary to provide for pedestrian traffic, CONTRACTOR shall, at his own cost, construct adequate crossings. Crossing construction shall be such that no load is transmitted to the new concrete.

B. Any part of the work damaged or vandalized prior to final acceptance shall be repaired or replaced at the expense of CONTRACTOR in a manner satisfactory to ENGINEER.

C. Pedestrian traffic shall not be permitted over new concrete prior to 72 hours after application of curing material. Vehicular traffic shall not be permitted over newly placed concrete within 7 days after completion when temperatures are 70°F or higher, 10 days when temperatures are not lower than 60°F and up to a maximum of 21 days when the temperatures are generally lower than 60°F.

END OF SECTION

SECTION 02600

BURIED PIPING AND APPURTENANCES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All underground piping and valves of every description.
   2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
   3. Concrete reaction blocking, gaskets, and all miscellaneous equipment furnished under this section.
   4. Underground piping connections to all equipment, whether furnished under this section or not.

B. Related Sections and Divisions: Applicable provisions of Division 1 and the City of Madison Standard Specifications shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials shall be National Sanitation Foundation (NSF)-approved.

B. Size and Type:
   1. All materials shall conform to the size and type shown on the drawings or called for in the specifications.
   2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be standard selected by CONTRACTOR and submitted for review by ENGINEER.

C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be selected by CONTRACTOR and submitted for review by ENGINEER.

2.02 BURIED PIPING

A. Ductile Iron Piping and Fittings:
   1. Unless otherwise specified, all exterior piping shall conform to AWWA C151 with wall thickness provided in accordance with AWWA C150 for the depth of cover shown on the drawings using a minimum rated working pressure of 350 psi and Laying Condition 4; minimum Special Class 52, unless otherwise shown or specified. The words "ductile iron," weight and class of pipe shall be plainly marked on each piece of exterior pipe.

2. Except where shown, exterior pipe joints shall be mechanical joint or push-on joint. All mechanical and push-on joints shall be bonded with cable bond conductors or electrobond conductivity strips.
3. Exterior joints and gaskets shall conform to AWWA C110 and C111.
4. Bolts on exterior joints shall be high-strength low-alloy steel (Corten, or equal) conforming to AWWA C111. Certificate to that effect shall be provided.
5. Except where shown otherwise, exterior fittings shall be mechanical joint or push-on joint. Exterior fittings and gaskets shall comply with AWWA C110, Ductile Iron Fittings, or C153, Ductile Iron Compact Fittings, and C111, as applicable, with a minimum rated working pressure of 150 psi.
6. Exterior and/or buried pipe and fittings shall be cement-mortar lined and asphaltic coated inside and asphaltic coated outside. Cement-mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.

B. Copper Piping: All buried copper piping shall be provided as specified in Section 15040-Piping and Accessories.

C. Perforated Piping and Drain Tile:
1. Perforated pipe, drain tile, and fittings shall be heavy-duty corrugated polyethylene conforming to ASTM F405 and ASTM F667. Pipe and fittings shall be provided as shown on the drawings and in accordance with ASTM F449.
2. Adapters with band seals shall be provided when joining with pipe of different materials.
3. Pipe shall be as manufactured by Advance Drainage Systems, Inc., Hancor, Inc., or equal.
4. See detail on drawings for laying conditions.
5. Fabric shall be provided in accordance with manufacturer's instructions. Minimum lap shall be 12 inches. All laps shall be tacked or pinned to prevent separation during installation.

D. PVC Piping:
1. Sanitary and storm sewers shall be PVC pipe meeting requirements of ASTM D3034 (SDR 35) or ASTM F679 (F/DY = 46) with elastomeric gasketed joints meeting ASTM D3212 requirements.
2. Provide tracer wire for underground PVC piping as specified herein, unless otherwise noted.

E. Drainage Piping: All buried drainage piping including waste, soil, and vent piping shall be provided as specified in Section 15040–Piping and Accessories.

F. Tracer Wire:
1. Install 10 gauge solid tracer wire with buried pipe where specified. Wire shall be continuous and terminate at valve boxes, manholes, or PVC test stations. Wire shall be taped to pipe at 5-foot intervals for all piping except piping carrying combustible material. For pipe carrying combustible material, the tracer wire shall be placed in the trench directly above the pipe, maintaining 6 inches separation between the tracer wire and the PVC pipe. Any splices in copper wire shall be soldered and fitted with a Raco, or equal, insulated watertight boot.
2. Tracer wire test stations shall be a 7-foot section of 2-inch schedule 80 PVC pipe with threaded end cap. Cap shall not be glued onto pipe. The PVC pipe shall be white and the cap shall be green. Pipe shall be installed with 3 feet of pipe aboveground. The

tracer wire shall be accessible at a minimum of every 500 feet along the pipeline. The tracer wire shall run into and up the sides of all manholes and be secured near the casting. PVC test stations shall be placed as required between manholes to comply with the minimum 500-foot tracer wire accessibility requirement.

2.03 VALVES

A. Valves: Valves and accessories for underground service are specified in the City of Madison Standard Specifications.

2.04 MANHOLES

A. Manholes and accessories are specified in the City of Madison Standard Specifications.

2.05 FIRE HYDRANT

A. Fire Hydrant:
   1. Fire hydrant and accessories are specified in the City of Madison Standard Specifications.
   2. Provide restrained joint system from auxiliary valve in road box back to tee.
   3. Connect hydrant to auxiliary valve with 2-foot length of pipe. Auxiliary valve shall be gate valve with cast iron road box as specified in the City of Madison Standard Specifications.

PART 3–EXECUTION

3.01 INSTALLATION

A. All buried ductile iron piping and appurtenances shall be polyethylene encased in accordance with AWWA C105. Polyethylene encasement shall be minimum 8 mil thickness. Repair any rips or punctures prior to backfilling pipe.

B. Installation Standards:
   1. Except where noted or specified, all underground water main piping shall be laid in accordance with AWWA C600 with all sewer clearances and separations from water main in accordance with Wisconsin Department of Natural Resources requirements.
   2. Plumbing system shall be installed in accordance with applicable portions of the Plumbing Code. Where requirements conflict, the stricter standard shall apply.
   3. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided as required.

C. General Excavation:
   1. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this Contract, unless otherwise noted.
   2. Work shall conform to other sections of Division 2 except where modified by this section.
   3. The width of trench below the top of the pipe shall not exceed the nominal diameter of the pipe plus 2 feet for all pipelines.
   4. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used as necessary.

5. If the maximum trench width is exceeded for any reason other than by request of ENGINEER, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense.
6. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill, and rock excavation, the removal of pavement, and all incidental work thereto. All above work shall be included in the Lump Sum Bid.
7. CONTRACTOR shall excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown.
8. The bottom of the excavation shall be leveled off, all loose and disturbed soil shall be removed, and it shall be hand-tamped prior to pipe, manhole, etc., installation. Where requested by ENGINEER, original material below the excavation necessary for construction according to grades shown or specified shall be removed and replaced with material and placing methods as specified in Section 02222–Excavating, Backfilling and Compaction.
9. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable.
10. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work.
11. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service.
12. The present underground services shown on the drawings are located in accordance with available data.
13. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
14. Any service connections encountered which are to be removed shall be cut off at the limits of the excavation and capped in accordance with the requirements of owners of such connections.
15. Excavated material that is unsuitable or not required for filling shall be wasted.
16. Materials to be used for fill and suitable for this purpose shall be deposited where required, except that no fill shall be placed where trenches for sewers, water lines or other services will be located until after the trench work is completed.
17. CONTRACTOR shall provide adequate shoring, sheet piling, and bracing to prevent earth from caving or washing into the excavation and shall do all shoring and underpinning necessary to properly support adjacent or adjoining structures. All shoring, sheet piling, and underpinning must be maintained until permanent support is provided.

D. Laying Pipe:
1. CONTRACTOR shall excavate and lay all pipe to the line and grade shown on the drawings with bell ends uphill.
2. Grade stakes will be required for all lines.
3. Water lines shall have a minimum of 6 1/2 feet of cover, unless noted otherwise.
4. Unless shown otherwise, under floor piping shall clear floor slabs or footings by a minimum of 6 inches.
5. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used.
6. Pipe must be kept clean of mortar, cement, clay, sand or other material.
7. Trenches shall be kept water-free and dry during bedding, laying, and jointing.
8. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.

9. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.

E. Restraint Based on Concrete Thrust Blocking:
1. Except where noted or indicated, all bends, caps, plugs, tees, and other fittings shall be anchored with poured concrete to resist thrust as shown on Figure 01-975-92A included at the end of this section. The thrust block sizes are based on assumed minimum soil bearing pressures of 4,000 lbs/ft^2.
2. If CONTRACTOR determines soil bearing pressure is under 4,000 lb/ft^2 or if adequate support against undisturbed soil cannot be obtained, CONTRACTOR shall provide proportionally larger thrust blocks or shall provide tie rods or restraining joints.
3. Where indicated as a "restrained" joint or where use of concrete thrust block is not possible, mechanical joints on ductile iron pipe shall be restrained by MEGALUG® 1100 Series by EBAA Iron Sales, Inc. or equal restraining system.
4. Where indicated as a "restrained" joint or where use of concrete thrust block is not possible, ductile iron push-on joint pipe shall be restrained by Lok-Ring Joint by American Ductile Iron Pipe, TRFLEX by U.S. Pipe, MEGALUG® 1700 Series by EBAA Iron Sales, Inc., or equal.
5. Push-on joints for PVC piping shall be restrained with MEGALUG® Series 1500 (AWWA C900) or Series 2800 (AWWA C905) by EBAA Iron Sales, Inc., Uni-Flange® Series 1350 by Ford Meter Box Co., Inc., or equal. PVC piping with ductile iron mechanical joint fittings shall be restrained with MEGALUG® Series 2000 PV by EBBA Iron Sales Inc., Uni-Flange® Series 1500 by Ford Meter Box Co., Inc., or equal.
6. If flexible restraint system used in lieu of concrete reaction blocking, submit to ENGINEER calculations determining the minimum number of restrained joints on both sides of fitting required to restrain pipe.

F. Bedding:
1. All underground pipe, except copper, perforated pipe, and polyethylene encased pipe, shall be bedded in compacted granular material.
2. Copper and polyethylene encased pipe piping shall be bedded in compacted sand.
3. Perforated piping shall be bedded with washed stone material as shown on the drawings.
4. Ductile iron piping shall be placed using Class "C" Bedding Details as shown on Drawing No. 01-975-43A.
5. All other piping, except perforated piping and ductile iron piping, shall be placed using Class "B" Bedding Details as shown on Drawing No. 01-975-43A.
6. CONTRACTOR shall perform all necessary excavation and shall furnish all required materials to provide bedding material. Bedding material shall conform to the gradation requirements of ASTM C-33.
7. Bedding material shall be hard, tough, and durable and shall meet the following gradation requirements:

PERCENTAGE BY WEIGHT PASSING

	Crushed Stone Aggregate	Crushed Stone Chips	Crushed Gravel Aggregate	Bedding Sand
1-inch	100	--	100	--
3/4-inch	90 to 100	--	90 to 100	--
1/2-inch	--	100	--	--

	Crushed Stone Aggregate	Crushed Stone Chips	Crushed Gravel Aggregate	Bedding Sand
3/8-inch	20 to 55	90 to 100	20 to 55	100
No. 4	0 to 10	--	0 to 10	95 to 100
No. 8	0 to 5	0 to 15	0 to 5	80 to 100
No. 30	--	0 to 5	--	25 to 60
No. 100	--	--	--	5 to 20
Passing No. 200	--	--	--	2 to 10

8. CONTRACTOR shall furnish ENGINEER with a sieve analysis of the bedding material for approval prior to construction.
9. No materials native to the trench shall be used as bedding material unless they meet the above specifications.
10. Native material may be used for ductile iron piping if it consists mostly of sand and contains no stones larger than 3/4 inch.
11. Immediately prior to placing the pipe, bedding shall be shaped by hand to fit the entire bottom quadrant of the pipe between bell holes.
12. Bell holes shall be large enough to permit proper making of the joint but not larger than necessary to make the joint.
13. All adjustments to line and grade must be done by scraping away or filling in bedding under the body of the pipe. Bedding must be tamped into place.
14. If necessary to obtain uniform contact of the pipe with the bedding, a template shall be used.

G. Cover Material:
1. Material which is to be placed from the bedding material around and to 1 foot above the top of all pipe shall be termed cover material.
2. Except for copper piping, cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination.
3. Unwashed bank run sand and crushed bank run gravel will be considered generally acceptable for cover material.
4. No stones larger than 3/4 inches in their greatest dimension shall be allowed in the cover material.
5. Native materials may be used if they conform to the above specifications.
6. Cover material for copper piping shall be sand.
7. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously.
8. Granular cover material shall be placed over the top of the pipe to the height as shown on Drawing 01-975-43A for Class "B" (12 inches) or Class "C" (6 inches) Bedding.
9. This cover material shall be placed by hand in 6-inch layers and shall be compacted using hand-tamping bars and/or mechanical tampers.
10. If bedding material, except sand, conforming to any of the above three gradations under "Bedding" is used as cover material, it need not be tamped.
11. Sand cover material must be tamped.
12. Unless sand backfill is required, the remaining 6 inches to make up the required 1 foot of cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4 inch.
13. Compaction shall be equivalent to that described under "Filling and Backfilling" in these specifications.

H. Backfill: Except as otherwise specified, all backfill above 1 foot above the pipe shall be granular material specified in Section 02222–Excavation, Fill, Backfill and Grading. Compaction shall be as specified herein.

3.02 REPAIR/RESTORATION

A. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced, including all site improvements, landscaping, and/or paving material as existed prior to construction.

3.03 FIELD QUALITY CONTROL

A. Site Tests:
1. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price bid.
2. All piping shall be subject to test before being covered with base course or pavement. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
3. All piping and appurtenances shall be flushed or cleaned after installation prior to testing.
4. When test medium for piping is water, all air shall be removed from piping by flushing and/or installation of corporations at high points in system. Presence or absence of air will be determined during pressurization of the piping system.
5. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge, and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing. Note, when pressure testing against existing valves or piping, CONTRACTOR shall assume these items will fail and provide temporary plugging or valving as required.
6. Pressure Tests: The test pressure in all nongravity lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests.
7. Leakage allowance shall be not more than 0.002 gallon per hour per inch diameter per 100 feet of buried pipe for compression or solder joint pipe. Buried mechanical and push-on joint pipe shall meet the leakage specifications of AWWA C600.
8. Tests for all gravity sewers shall be as follows: Pipe will be plugged at its downstream end and water will be placed inside the pipe to a minimum head of 10 feet. Water shall be held for 15 minutes without dropping. No leakage is allowed.

3.04 CLEANING AND DISINFECTION

A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the system before it is put on line. Water main, including buried and exposed piping, shall be disinfected according to AWWA C651.

B. In accordance with the requirements of AWWA C651-05, at least one set of samples shall be collected from every 1,200 feet of new water main, plus one set from the end of the line and at least one set from each branch.

C. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Bid. Copies of test results shall be submitted to OWNER and ENGINEER.

D. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.

E. All waste disposal areas and all areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off, cleaned up, and returned to condition that existed prior to construction.

F. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.

END OF SECTION

SECTION 02832

ORNAMENTAL ALUMINUM FENCE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Prefinished ornamental aluminum fence.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM B117–Practice for Operating Salt-Spray (Fog) Apparatus.

B. ASTM B221–Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. ASTM D523–Test Method for Specular Gloss.

D. ASTM D822–Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.

E. ASTM D1654–Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

F. ASTM D2244–Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

G. ASTM D2794–Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

H. ASTM D3359–Test Method for Measuring Adhesion by Tape Test.

PART 2–PRODUCTS

2.01 MANUFACTURER

A. Acceptable manufacturers include the following, or equal: Ameristar Fence Products.

2.02 MATERIALS

A. Aluminum material for fence framework (i.e., tubular pickets, rails, and posts) shall conform to the requirements of ASTM B221. The aluminum extrusions for posts and rails shall be Alloy and Temper Designation 6005-T52. The aluminum extrusions for pickets shall be Alloy and Temper Designation 6063-T52.

B. Fence posts shall be 2 1/2-inch-square x 0.080-inch-thick aluminum tubing with reinforced web.

C. Fence pickets shall be 1-inch-square x 0.062-inch-thick extruded tubing. Pickets shall have predrilled holes to accept 0.125-inch-diameter galvanized retaining rods within rails.

D. Rails shall be Ameristar Forerunner design, or equal, minimum thickness of 0.070 inches gauge.

E. Rails shall be prepunched to receive pickets. Provide rubber grommets to seal all picket-to-rail intersections.

F. Base plates shall be 6-inch by 6-inch by 0.5-inch thick and shall be provided at the base of the fence posts for attachment of posts to cast-in-place concrete.

G. Fencing system shall be Ameristar Echelon II, Majestic 3-rail flush bottom style, 4-feet high.

2.03 FINISH

A. Fence shall be coated by electrostatic spray application of polyester powder; coating shall withstand 1,000 hours of salt spray testing per ASTM B117 without creep.

B. Color shall be selected by OWNER from manufacturer's standard available options.

2.04 ACCESSORIES

A. Ground Rods: Provide a 1/2-inch-diameter 6-foot-long copper clad rod to provide a ground. Provide one for each 1,000 feet of fence and one for each separated fence section.

PART 3–EXECUTION

3.01 INSTALLATION

A. Fence posts shall be maximum 6 feet on center or as indicated on the drawings.

B. Fence panels shall be attached to posts using panel brackets and fasteners supplied by fence manufacturer.

C. Connect at least three fence wires to the ground rod by clamping, bolting, or brazing. Ground rod shall be installed on line with fence.

D. Where required, install ground rods as specified for each run of fence, and install additional rods for each 1,000 feet on long runs of fence.

END OF SECTION

SECTION 02936

SEEDING AND SODDING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Preparation of subsoil.
   2. Placing topsoil.
   3. Seeding, mulching, and fertilizing.
   4. Maintenance.

B. Except for paved, riprapped, or built-up areas, all areas of the site which are disturbed and areas noted on the drawings shall be seeded.

C. Related Sections and Divisions: Applicable provisions of Division 1 and the City of Madison Standard Specifications shall govern work in this section.

1.02 REFERENCES

A. FS O-F-241–Fertilizers, Mixed, Commercial.

B. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the City of Madison, Standard Specifications, current edition, including all issued supplemental specifications.

1.03 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Sod: Minimum age of 18 months, with root development that will support its own weight without tearing when suspended vertically by holding the upper two corners. Submit sod certification for grass species and location of sod source.

1.04 DELIVERY, STORAGE, AND PROTECTION

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

B. Deliver sod on pallets or in rolls. Protect exposed roots from dehydration. Do not deliver more sod than can be laid within 24 hours.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2–PRODUCTS

2.01 SEED MIXTURE

A. Sun Terrace Mix, No Mow Turf, and No Mow Turf with annual rye per Article 207 of the Standard Specifications. Each seed lot will be subject to sampling and testing by the State seed laboratory.

2.02 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay, or impurities, plants, weeds, roots and rocks; pH value of minimum 5.4 and maximum 7.0.

B. Topsoil from the site may be used if it meets the above requirements. Additional topsoil shall be provided as required by drawings and specifications.

2.03 ACCESSORIES

A. Mulching material shall be oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Fertilizer shall be FS O-F-241, Type I, Grade A; recommended for grass, with 50% of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil to the following proportions: Nitrogen 10%, phosphoric acid 10%, soluble potash 10%. Submit composition deviations to suit site conditions for ENGINEER's approval.

C. Water shall be clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

PART 3–EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated subsoil in accordance with local, state, and federal regulations.

C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.03 PLACING TOPSOIL

A. Spread topsoil to a minimum depth of 4 inches over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign nonorganic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

E. Manually spread topsoil around trees, plants, and buildings to prevent damage.

F. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.04 FERTILIZING

A. Apply fertilizer at a rate of 17 pounds per 1,000 square feet.

B. Apply after smooth raking of topsoil and prior to installation of seed or sod, no more than 18 hours before seeding or 48 hours before sodding.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.05 SEEDING

A. Apply seed at a total rate of 3 1/2 pounds per 1,000 square feet. Apply evenly in two intersecting directions. Rake in lightly or roll the seeded area after seeding.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Planting season shall be between April 15 and June 15, or between August 15 and October 15.

D. Do not sow immediately following rain, when ground is too dry or during windy periods.

E. Immediately following seeding, apply mulch:
   1. Spread Rate: 70 to 90 pounds per 1,000 square foot.
   2. Maximum Depth: 1 1/2 inches to 2 inches.

F. Apply water with a fine spray immediately after each area has been mulched and on a daily basis to keep straw in place.

G. Seeding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.

H. Place erosion control mats per Section 02270–Slope Protection and Erosion Control.

3.06 MAINTENANCE

A. Mow grass at regular intervals to maintain at a maximum height of 2 1/2 inches. Do not cut more than one-third of grass blade at any one mowing.

B. Immediately remove clippings after mowing.

C. Water to prevent grass and soil from drying out.

D. Roll surface to remove minor depressions or irregularities.

E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

F. Immediately reseed areas which fail to show adequate catch. Bare spots shall not exceed 5 square feet in area and not exceed 3% of the total seeded areas. Immediately replace sod in areas which show bare spots or deterioration.

G. Protect seeded areas with warning signs during maintenance period.

H. Immediately reseed areas which do not show a satisfactory stand of established grass, and resod areas that do not show satisfactory establishment.

I. Correct damage resulting from erosion, gullies, rills, or other causes by filling with topsoil, tamping, refertilizing, and reseeding if damage occurs prior to acceptance of work.

J. Maintain seeded lawns for not less than 60 days after substantial completion.

K. If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.

L. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth acceptable lawn free of eroded or bare areas.

END OF SECTION

SECTION 02950

TREES, PLANTS, STONE MULCH, AND EDGING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Trees and plants.
   2. Hardwood mulch.
   3. Stone mulch.
   4. Plastic and aluminum edging.
   5. Maintenance.
   6. Tree pruning.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. Nursery Qualifications: Company specializing in growing and cultivating the plants with 3 years experience. Plant materials shall be free of disease and hazardous insects.

B. Installer Qualifications: Company specializing in installing and planting the plants with 3 years experience.

C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.

1.03 WARRANTY

A. All woody plant material is to be fully guaranteed through September 15, 2015. Only those plants that are alive and normally healthy will be accepted. Unaccepted material shall be removed and replaced by CONTRACTOR at no cost to OWNER during the next suitable growing season.

B. Replacement plants shall be the same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

C. Plant Plugs: Greater than 75% of the plants installed shall have minimum of two months growth and be guaranteed to be in healthy and flourishing condition through September 15, 2015. The guarantee shall not cover damage from vandalism, animals, freezing rains, high winds or hail.

D. At any time during the guarantee period, CONTRACTOR shall remove or replace, without cost to OWNER, and within a specified planting period, all plants not in a healthy and flourishing condition as determined by ENGINEER or OWNER.

E. Replacement plants shall be subject to the same specified requirements of the Contract. The guarantee of replacement plants shall extend for two years. In the event that a

replacement plant is not acceptable during, or at the end, of the said guarantee extension period, OWNER may choose between subsequent replacement of credit for plant materials.

PART 2–PRODUCTS

2.01 PLANT MATERIALS

A. All plant materials shall conform to American Standard for Nursery Stock (current edition). Plants shall be true to species and variety specified and nursery grown in accordance with good horticultural practices.

B. Woody Plant Materials: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the project for at least 2 years.

C. Plant Plugs: Root plugs or up to 3 1/2-inch by 3 1/2-inch potted plants of specified grasses and forbs. Plants shall be grown in the same climatic conditions/zone of the project site and shall be free of disease, mold or other limitation to establishment.

D. Woodland Edge Prairie Plant Plugs: Species shall be selected from the plant schedule located on the Drawings.

E. Ground Cover Plantings: Species include Columbine (Aquilegia Canadensis) and Wild Geranium (Geranium maculatum) to be provided as plant plugs.

F. Trees with multiple leaders, unless specified, will be rejected. Trees with a damaged, cut, or crooked leader, included bark, abrasion of bark, sunscald, disfiguring knots, insect damage, mold, or prematurely opened buds are cause for rejection.

2.02 MULCH MATERIALS

A. Hardwood Mulch: Organic hardwood mulch, free from deleterious materials, weeds, stones, sticks and growth or germination-inhibiting ingredients.

PART 3–EXECUTION

3.01 PLANTING–WOODY PLANTS

A. Plant pits shall be excavated with vertical sides. These holes shall be no deeper than the depth of the ball, container, or root system when the plant is at its proper grade. Set plants vertical.

B. Place topsoil in holes around roots or balls, mixed with fertilizer and peat moss or compost. Topsoil around roots shall be compacted and watered. After plant pit is backfilled, shallow basin shall be formed with ridge of soil to facilitate watering.

C. Place plants where indicated on the drawings. Position plants for best appearance.

D. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

E. Remove nonbiodegradable root containers and twine.

3.02 PLANTING–PLANT PLUGS

A. Woodland Edge plants shall be installed in the areas as described on the Drawings. Install plants on 30-inch centers, grouped by species with 6 to 8 plants per group.

B. Ground cover plants shall be installed in the areas as described on the Drawings. Install plants on 24-inch centers, grouped by species with 6 to 8 plants per group.

3.03 TREE REMOVAL AND PROTECTION

A. See City of Madison Standard Specifications.

B. Trees marked for removal shall be removed by CONTRACTOR and properly disposed. CONTRACTOR shall replace all other damaged trees and shrubs with new stock at its expense. New trees shall be located as requested by OWNER.

C. It is intended that as many trees as possible be saved during construction. No trees, except those so designated, shall be removed without prior approval. CONTRACTOR shall conduct the work to protect all trees to remain. CONTRACTOR shall provide fencing as designated on the Drawings to protect trees from damage and soil compaction by its equipment.

D. When removing trees, special care shall be taken so as not to damage surrounding property. Tree removal method shall be reviewed and approved by OWNER. Costs for tree removal or replacement and construction around trees shall be included in the price bid for the work.

3.04 TREE PRUNING

A. Each tree and shrub shall be pruned in accordance with good horticulture practice to preserve natural character of plant and to facilitate growth.

3.05 MULCH

A. Place organic hardwood mulch rings to a depth of 3 inches around all trees and shrubs.

3.06 MAINTENANCE

A. Maintain plant life until September 15, 2015.

B. Neatly trim plants where necessary.

C. Immediately remove clippings after trimming.

D. Water to prevent soil from drying out.

E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.

F. Apply pesticides in accordance with manufacturer's instructions.

3.07 SCHEDULE–PLANT LIST

A. See Drawings for schedules.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Forms for cast-in-place concrete.
   2. Form accessories.
   3. Openings for other work.
   4. Form stripping.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ACI 301–Structural Concrete for Buildings.

B. ACI 318–Building Code Requirements for Reinforced Concrete.

C. ACI 347–Recommended Practice for Concrete Formwork.

D. PS1–Construction and Industrial Plywood.

1.03 DESIGN

A. All formwork shall comply with ACI 347 and ACI 301.

B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300–Submittals for form ties, form coatings, form liners (if any), and any other form accessories.

PART 2–PRODUCTS

2.01 FORMS

A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of ENGINEER.

B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

2.02 FORM TIES–NONREMOVABLE

A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall have cones on the water side of water-containing structures. Ties shall also have cones on the exterior side of all structures which have PVC water-stopped construction joints. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.

B. All wall ties used in the placement of structures which have PVC or hydrophilic water-stopped construction joints shall contain integral waterstops. All such ties shall be crimped or deformed in such a manner that the bond between concrete and tie cannot be broken in removal of the outer units. This portion of the tie shall not be removed prior to 24 hours after completion of the concrete placement.

C. The use of wood spacers and wire ties will not be approved.

2.03 FORM COATINGS

A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

2.04 CHAMFER STRIPS

A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

2.05 KEYWAYS

A. Keyways shall be formed with wood inserts.

PART 3–EXECUTION

3.01 CONSTRUCTION

A. Forms shall conform to the shape, line, grade, and dimensions as shown on the drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape and insure safety to workmen and passersby. Spacing of ties shall be recommended by the tie manufacturer.

B. Formwork shall be constructed to meet the tolerances and intentions specified below for the indicated applications:
   1. Flat surfaces shall be formed in accordance with tolerances indicated in ACI 347 for buildings.

2. Curved surfaces shall also meet ACI 347 for buildings. All exposed curved surfaces shall be formed to the continuous surface of the radius specified. Where segmented forms are proposed, a form system which deviates more than 3/8 inches from a circle through pan edges will not be allowed.
3. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
4. Variation from plumb shall not exceed 1/4 inch in 10 feet, and variation in linear lines shall not exceed 1/2 inch in 20 feet. These and other tolerance specified in ACI-347 shall be considered a part of this specification.

C. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.

D. At the request of ENGINEER, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.

E. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.

F. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.

G. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to assure ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.

H. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.

I. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to review of ENGINEER.

3.02 FORM REMOVAL

A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.

B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete and will ensure complete safety of the structure.

C. Forms shall not be removed before the expiration of the minimum times as stated below unless specifically authorized by ENGINEER. These times may be increased by ENGINEER.
1. Wall and vertical faces: 24 hours.

2. Columns: 24 hours.
3. Beams and slabs: 14 days.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1–GENERAL

1.01 SUMMARY

A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the drawings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. Applicable standards listed in this section include, but are not necessarily limited to the following:
   1. ACI 315–Manual of Standard Practice for Detailing Reinforced Concrete Structures.
   2. ACI 318–Building Code Requirements for Reinforced Concrete.
   3. ASTM A82–Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement.
   4. ASTM A185–Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.
   5. ASTM A615–Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   6. CRSI–Manual of Standard Practice.
   7. ASTM C1116-Standard Specification for Fiber-Reinforced Concrete.

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300–Submittals.

B. Provide complete shop drawings of all material to be furnished and installed under this section:
   1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of ENGINEER on reinforcing bar lists and placing drawings.
   2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
   3. Shop drawings shall be in accordance with ACI 315.

1.04 PRODUCT HANDLING

A. Delivery:
   1. Deliver reinforcement to the job site bundled, tagged, and marked.
   2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2–PRODUCTS

2.01 MATERIALS

A. Reinforcing bars shall comply with ASTM A615, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.

B. Steel wire shall comply with ASTM A82.

C. Welded wire fabric shall comply with ASTM A185. Fabric shall be provided in flat sheets. Rolled fabric shall not be used.

D. Reinforcement supports including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
   1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
   2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
   3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
   4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.

E. Fibrous Reinforcing:
   1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Propex Concrete Systems, or equal.
   2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.
   3. Physical Characteristics:
      a. Specific Gravity: 0.91.
      b. Fiber Length: Multidesign gradation.

2.02 FABRICATION

A. General:
   1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
   2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
   3. Unless otherwise shown on the drawings, all end hook dimensions shall conform with "ACI Standard Hooks."

B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:
   1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
   2. Bend or kinks not indicated on drawings or final shop drawings.
   3. Bar with reduced cross section because of excessive rusting or other cause.

PART 3–EXECUTION

3.01 INSPECTION

A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.

B. Correct conditions detrimental to the proper and timely completion of the work.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:
   1. Comply with the specified standards for details and methods of placing reinforcement and supports.
   2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials which reduce or destroy bond with concrete.

B. Placing Reinforcement:
   1. All reinforcing shall be placed in accordance with Contract drawings and with shop drawings stamped and approved by ENGINEER.
   2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
   3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
   4. Unless otherwise shown on the drawings, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
      a. Three inches of cover where the concrete is placed directly against ground.
      b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
      c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
      d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.
   5. Reinforcement shall be positioned within ±3/8-inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be ±1/2 inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.
   6. Bars shall be securely tied at all intersections except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly as approved by ENGINEER. Tack welding of reinforcing will not be permitted.

7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at ±4 feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3-foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4-foot 0-inch centers.
10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the drawings and specifications.

C. Reinforcement Supports:
1. Strength and number of supports shall be sufficient to carry reinforcement.
2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.

D. Welded Wire Fabric:
1. Install welded wire fabric in as long of lengths as practicable.
2. Lap adjoining pieces at least one full mesh.
3. Fabric shall be supported with bar supports.

E. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
2. Lap splices in reinforcing shall be provided as shown on the drawings. Where lap splice lengths are not shown on the drawings, provide Class B, Category 1 lap splices in accordance with ACI 318.
3. Adjacent splices of tangential bars in circular slabs and horizontal bars in circular walls shall be staggered a minimum of one full lap splice length or 3 feet, whichever is greater, unless otherwise shown. Stagger dimension shall be measured from center to center of lap splices.
4. For circular walls, horizontal bar lap splices shall not coincide in vertical arrays more frequently than every third bar.
5. Mechanical splices and threaded dowel bar inserts may be used where approved by ENGINEER. Splices shall be capable of developing at least 125% of the yield strength of the reinforcing bar.

F. Embedded Items:
1. Allow other trades to install embedded items as necessary.
2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.

G. Minimum Reinforcing: Where reinforcing is not shown, provide a minimum of No. 4 at 8-inch centers each way in members 10 inches or less in thickness and No. 5 at 12-inch centers each way in each face in members greater than 10 inches thick.

H. Fibrous Reinforcing:
   1. Fibrous concrete reinforcing shall be used in all slab-on-grade concrete and all precast concrete topping.
   2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
   3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All cast-in-place concrete as shown except as noted otherwise.
   2. PVC and hydrophilic waterstops, bonding agents, patching mortars, curing compounds, nonshrink grout, floor sealer, and other related items and accessories.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ACI 211.1–Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

B. ACI 301–Specifications for Structural Concrete.

C. ACI 304–Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment.

D. ACI 305R–Guide to Hot Weather Concreting.

E. ACI 306R–Guide to Cold Weather Concreting.

F. ACI 308–Specification for Curing Concrete.

G. ACI 309–Guide for Consolidation of Concrete.

H. ACI 318–Building Code Requirements for Structural Concrete and Commentary.

I. ASTM C31–Standard Practice for Making and Curing Concrete Test Specimens in the Field.

J. ASTM C33–Standard Specification for Concrete Aggregates.

K. ASTM C39–Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

L. ASTM C40–Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

M. ASTM C88-Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

N. ASTM C94–Standard Specification for Ready-Mixed Concrete.

O. ASTM C143–Standard Test Method for Slump of Hydraulic-Cement Concrete.

P. ASTM C150–Standard Specification for Portland Cement.

Q. ASTM C156–Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.

R. ASTM C172–Standard Practice for Sampling Freshly Mixed Concrete.

S. ASTM C231–Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

T. ASTM C260–Standard Specification for Air-Entraining Admixtures for Concrete.

U. ASTM C309–Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

V. ASTM C494–Standard Specification for Chemical Admixtures for Concrete.

W. ASTM C618–Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

X. ASTM D994–Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

Y. ASTM D1752–Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300–Submittals.

B. Submit the following information:
1. Gradation of fine and coarse aggregate–ASTM C33.
2. Specific gravity and dry rodded density of each aggregate.
3. Test of deleterious substances in fine and coarse aggregate–ASTM C33.
4. Design mix of each individual concrete mix to be used.
5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
7. Brand, type, principal ingredient, and amount of each admixture to be used.

C. It is important that the above data be submitted to ENGINEER well in advance of anticipated concreting operations to avoid any delay in construction.

PART 2–PRODUCTS

2.01 CEMENT

A. All cement used shall be Portland cement and shall conform to ASTM C150 and shall be Type I or Type III. Type III shall be used only when permitted by ENGINEER. All cement shall be the product of one reputable manufacturer and mill.

B. Cement shall be stored in a dry, weathertight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

2.02 FLY ASH

A. All fly ash used as an admixture in Portland cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

2.03 AGGREGATE

A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

	Aggregate	
Deleterious Substance	Fine	Coarse
Clay Lumps and Friable Particles	3.0	3.0
Coal and Lignite	0.5	0.5
Mineral finer than No. 200 sieve	3.0	
Soft Fragments	3.0	3.0
Chert*	---	5.0
Sum of Chert and Clay Lumps		5.0

* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

B. The combined amount of all deleterious substances in an aggregate shall not exceed 5% of the weight of the aggregate.

C. If required by ENGINEER, sodium sulfate soundness tests (ASTM C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM C33. Certified test results shall be submitted to ENGINEER confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.

D. Fine aggregate shall be well-graded from coarse to fine and shall conform to the following requirements:

Percentage by Weight	
Passing 3/8-inch sieve	100
Passing No. 4 sieve	95-100
Passing No. 8 sieve	80-100
Passing No. 16 sieve	50-85
Passing No. 30 sieve	25-60
Passing No. 50 sieve	5-30
Passing No. 100 sieve	0-10

E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20

from the fineness modulus of the representative sample used in proportioning the concrete.

F. If required by ENGINEER, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.

G. Coarse aggregate shall be well-graded from coarse to fine, and when tested by laboratory sieves having square openings, shall conform to the following requirements:

	Percentage by Weight Aggregate	
	3/4-inch Stone	1 1/2-inch Stone
Passing 2-inch sieve	---	100
Passing 1 1/2-inch sieve	---	90-100
Passing 1-inch sieve	100	20-55
Passing 3/4-inch sieve	90-100	0-15
Passing 3/8-inch sieve	20-55	0-5
Passing No. 4 sieve	0-10	---
Passing No. 8 sieve	0-5	---

H. The 3/4-inch aggregate shall be used in concrete members no thinner than 4 inches and less than 10 inches thick. A blend of 3/4-inch and 1 1/2-inch aggregate shall be used in members 10 inches thick and thicker with the 3/4-inch aggregate comprising between 35% and 65% of the total course aggregate. When members thinner than 10 inches are placed monolithically with members thicker than 10 inches, the aggregate requirements for the thinner member shall apply.

I. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained, and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

2.04 WATER

A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

2.05 ADMIXTURES

A. Water Reducing Admixture shall be Pozzolith 200N by BASF Admixtures, Inc., Daracem 19 by Grace, or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.

B. Air-Entraining Admixture shall be equal to MB AE90 Standard by BASF Admixtures, Inc., Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.

C. No other admixture will be allowed without written approval of ENGINEER. All admixture shall be compatible with cement, aggregate, and water used.

2.06 PROPORTIONING

A. The proportions of aggregate to cement shall be such as to produce a workable mixture that can be thoroughly compacted and that will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.

B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

Class	Maximum Water/ Cement or Water/ (Cement+Fly Ash)	Minimum 28 Day Strength-Pounds per Square Inch	Cement Content-Pounds per Cubic Yard	Fly Ash-Pounds per Cubic Yard	
				Type C	Type F
A	0.45	4,000	564	---	---
A-FA	0.45	4,000	480	110	125
X	---	2,000	376	---	---

C. Except as otherwise indicated on the drawings or specified, all concrete shall be Class A or Class A-FA concrete.

D. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a competent concrete engineer or competent laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by ENGINEER. Mix computations shall be submitted if requested by ENGINEER.

E. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable unless otherwise stated.

F. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.

G. An air-entraining admixture shall be used in all concrete except at patches. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between 4 to 7% by volume.

H. CONTRACTOR shall submit to ENGINEER compressive strength of concrete cylinder test results for the same concrete mixes proposed on a previous project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained. All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.

I. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device that can be adjusted to deliver the desired amount of water. All measuring, mixing, and proportioning equipment is subject to the approval of ENGINEER.

2.07 WATERSTOPS

A. PVC waterstops shall be as manufactured by Greenstreak, Inc., W.R. Meadows, Grace Construction Products, or equal. Provide serrated center bulb-type, nontapered 3/8-inch minimum thickness waterstops manufactured from virgin polyvinyl chloride with no reclaimed/scrapped material or pigment whatsoever conforming to Corps of Engineers CRD-C-572. The waterstop shall have an integral fastening system consisting of hogrings or grommets. For 6-inch PVC waterstops in construction joints, use Greenstreak, Inc. Profile No. 732, or equal. For expansion joints, use Greenstreak, Inc. Profile No. 735, or equal. Where 4-inch PVC waterstops are called for in the drawings, use Greenstreak, Inc. Profile No. 702, or equal.

B. Hydrophilic waterstop shall be a flexible hydrophilic natural rubber strip composed of nonvulcanized rubber and urethane polymer hydrophilic agent creating a moisture-activated, self-healing waterproofing compound.

C. Hydrophilic waterstop shall be Adeka Ultraseal, or equal, products as follows:
   1. Construction Joints: Wall/slab thickness between 4 inches and 9 inches with 1-inch minimum cover and single or double mat of reinforcing: KBA-1510FP (all 6 inch by 3/8 inch). Expansion amount shall not exceed 30 percent.
   2. Pipe Penetrations:
      a. Wall/slab thickness between 4 inches and 9 inches and pipe diameter greater than 4 inches and less than or equal to 24 inches: KBA-1510FP (9/16 inches by 3/8 inches).
      b. Wall/slab thickness greater than 9 inches and pipe diameter greater than 4 inches and less than or equal to 24 inches: MC-2005T (3/4 inches by 3/16 inches).
      c. Wall/slab thickness greater than 9 inches and pipe diameter greater than 24 inches: MC-2010MN (3/4 inches by 3/8 inches) with embedded stainless steel wire mesh for expansion control.

2.08 JOINT FILLER

A. Expansion joints in exterior concrete walks and between concrete walks and other structures shall be asphalt expansion joint filler, 1/2 inch thick, Grace, W.R. Meadows, or equal, meeting ASTM D994.

2.09 BONDING AGENT

A. Acceptable manufacturers include Thorobond by BASF, Emaco P24 by BASF, or equal.

2.10 PATCHING ADDITIVE

A. Acceptable manufacturers include ACRYL 60 by Harris Specialty Chemicals, Inc., Sonocrete by Sonneborn Contech Co., or equal.

2.11 NONSHRINK GROUT

A. Acceptable manufacturers include Dayton Superior, Master Builders, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

2.12 CURE-SEAL-HARDENER

A. Penetrating sealer for interior building doors shall be Ashford Formula by Curecrete Chemical Company, Inc., or equal. See finish schedule for locations to be used.

PART 3–EXECUTION

3.01 MIXING

A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304 from an approved batching plant. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.

B. A representative of ENGINEER may be at the batching plant periodically to observe the batching and mixing.

C. No water shall be added on the job unless required by CONTRACTOR and with the knowledge of ENGINEER; the amount of water, if added, shall be recorded on all copies of the delivery tickets. If water is added, CONTRACTOR shall verify that the required water-cement ratio is not exceeded.

D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the jobsite.

E. With each load of concrete CONTRACTOR shall obtain delivery tickets and shall make these tickets available for review by ENGINEER. Delivery tickets shall provide the following information:
   1. Date.
   2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
   3. Type of cement and admixtures, if any.
   4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.
   5. Amount of concrete in load, in cubic yards.
   6. Water-cement ratio.
   7. Water added at job, if any.
   8. Truck number and time dispatched.
   9. Number of mixing drum revolutions.

F. For job-mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. The mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive timing device that will positively prevent discharging the mixture until the specified mixing time has elapsed.

3.02 JOINTS

A. CONTRACTOR shall place all joints as shown on the drawings or specified herein. If approved by ENGINEER, CONTRACTOR may, at his own expense, place construction joints in addition to and at places other than those shown on the drawings. Unless otherwise shown, all joints shall be straight, truly vertical or horizontal, and proper methods shall be employed to obtain this result.

B. Where joints are not shown on the drawings or specified elsewhere, CONTRACTOR shall provide joints as follows:
   1. Walls shall have vertical joints at 30 feet on center maximum but not more than 15 feet from corners or intersections and shall have horizontal joints at 15 feet on center maximum.
   2. Slabs shall have joints at 20 feet on center maximum in each direction.

C. Immediately after completion of the first pour at a joint, the concrete surface, reinforcement, and waterstop projecting beyond the joint shall be thoroughly cleaned and laitance removed. The waterstops shall not be disturbed after the concrete in the first pour at a joint has set. Concrete around waterstops shall be thoroughly compacted by hand spading and vibrating. Immediately before the second pour, all extraneous matter shall be removed from the joint, the waterstop and steel cleaned, and the surface thoroughly wetted.

D. Concrete at all joints shall have been in place at least 48 hours before abutting concrete is placed. At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slab supported thereon. Beams, girders, brackets, column capital, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

3.03 WATERSTOPS

A. Unless noted otherwise, PVC waterstops shall be provided at all construction joints in floors and walls of structures exposed to ground or liquid on one side and occupied by personnel or nonsubmerged equipment on the other side.

B. PVC waterstops shall be made continuous by splicing. Waterstops shall be spliced using a corner, tee, or cross splice, as applicable, at intersections. Waterstops shall be mitered to maintain the continuity of the ribs and center bulb. Splices shall be made using a hot metal plate or an electric splicer and full butt weld. Direct flame will not be allowed. Sample field-splices shall be submitted to ENGINEER for approval prior to construction.

C. PVC waterstops placed in all joints shall be securely held in place by an approved method or as shown on the drawings. PVC waterstops shall be installed and secured prior to concrete placement. PVC waterstops shall not be inserted into wet concrete. No nails will be permitted through the waterstop. Great care shall be taken when concrete is placed to insure that the waterstop remains erect and is not bent over.

D. Hydrophilic waterstop shall be placed as shown on the drawings and in accordance with the manufacturer's recommendations.

3.04 BONDING TO EXISTING CONCRETE

A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of

new pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

B. When patching existing concrete, remove poor concrete until firm hard concrete is exposed; roughen and clean surface of the existing concrete, clean any exposed reinforcing bars, and pour new concrete. Concrete finish shall match existing concrete. New concrete shall be 4,000 psi 28-day strength mixed with patching additive, mixed according to manufacturer's instructions. Concrete shall not be air-entrained.

3.05 EMBEDDED ITEMS IN CONCRETE

A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

3.06 PLACING CONCRETE

A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.

B. After reinforcement is placed and before concrete is placed over it, ENGINEER shall be allowed sufficient time to observe the reinforcing.

C. Unless otherwise authorized by ENGINEER, all concrete shall be placed in the presence of ENGINEER.

D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the segregation or loss of materials. Chuting for conveying purposes must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.

E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.

F. Concrete in wall and beam pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.

G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation from rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. When concreting is once started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.

H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas, vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.

I. A sufficient number of spare vibrators shall be kept in ready reserve to assure adequate vibration in case of breakdown of those in use.

J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.

K. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.

L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

3.07 MOIST CURING

A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:
   1. Wood forms left in place and kept wet at all times. If the forms are not going to be kept wet, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
   2. Use of a curing compound conforming to ASTM C309, Type I as approved by ENGINEER. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces that are to be painted, receive ceramic tile or resilient flooring, or be waterproofed. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
   3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.
   4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
   5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.

6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."

B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

3.08 HOT WEATHER CONCRETING

A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.

B. The temperature of the delivered concrete shall not exceed 85°F.

C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the job site.

D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.

E. If approved by ENGINEER, an admixture for retarding the setting of the concrete may be used.

F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

3.09 COLD WEATHER CONCRETING

A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than 3 successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, except as modified by the requirements of these specifications.

B. Detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to ENGINEER. Cold weather concreting shall not begin until these procedures have been accepted.

C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.

D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.

E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.

F. If heating is used, the housing shall be constructed weathertight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within 2 hours after concrete placement.

G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.

H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to ensure compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for ENGINEER's use.

I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.

J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

3.10 FINISHING

A. Flat Work:
   1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
   2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.
   3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
   4. Tolerance for concrete floors shall be 1/4 inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.
   5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.
   6. The above finishes shall be used in the following locations:
      a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.

b. Light Troweled Finish: Submerged tank slabs.
c. Hard Troweled Finish: Building floors.
d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.

B. Formed Surfaces:

1. Within 2 days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots that appear shall be repaired. No extra compensation will be allowed CONTRACTOR for such work.
2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner as to insure complete filling of the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.
4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.
5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by ENGINEER. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
   a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all painted surfaces, interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel-faced forms are used to form walls, the portion of wall to receive the sack finish shall first be roughened by brush blasting or other approved method to achieve a texture similar to 40 to 60 grit sandpaper.
   b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof- and moistureproof-coated surfaces.
   c. Finish C shall be referred to as a finish that has surface imperfections less than 3/8 inches in any dimension. Surface imperfections greater than 3/8 inches shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels

from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.

d. Finish D shall be the finish for surfaces that may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.

C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

3.11 LOADING OF CONCRETE STRUCTURES

A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.

B. Extreme care shall be taken to ensure that construction loads do not exceed design loading of the structure.

3.12 NONSHRINK GROUT

A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by ENGINEER. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

3.13 TESTING AND SAMPLING

A. The following tests of fresh concrete shall be performed by CONTRACTOR. CONTRACTOR shall prepare, protect, transport, and have tested all cylinders at his expense.

1. Sampling of concrete for slump tests, air tests, temperature tests, and for making concrete test cylinders shall be performed in accordance with ASTM C172.
2. Cylinders:
   a. Three test cylinders shall be made for each pour less than 25 cubic yards, four test cylinders shall be made for each pour between 25 and 100 cubic yards, and eight test cylinders shall be made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least four cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by ENGINEER.
   b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F and 80°F and shall remain undisturbed and stored in a location free from vibration. In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the job site.
   c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.

d. Cylinders shall be broken at 7 and 28 days or as requested by ENGINEER. Test results shall be mailed immediately and directly to ENGINEER. Test data shall include date and location of pour and concrete mix used.

3. Slump Test: CONTRACTOR shall make one slump test near the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by ENGINEER. Slump tests shall conform to ASTM C143.
4. Air Test:
   a. When air-entrained concrete is used, the air content shall be checked by CONTRACTOR near the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards, or as requested by ENGINEER.
   b. The air contents shall be checked using the pressure method in accordance with ASTM C231. The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.

B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

3.14 RECORDS

A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The project representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

3.15 CONCRETE REMOVAL AND PATCHING

A. All areas disturbed as a result of concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

3.16 RESERVOIR TESTING AND DISINFECTION

A. Water for testing and disinfection of the reservoir (existing) may be obtained from OWNER. Prior to chlorination, the reservoir shall be thoroughly cleaned and washed down. Testing shall be done before placing reservoir back in service after all work is completed.

B. If water from chlorination is of acceptable quality as defined below for chlorination, it may be discharged into the distribution system. If the water is found to be unacceptable, it shall be disposed of through the drain and waste equipment.

C. CONTRACTOR may disinfect the reservoir using one of the AWWA C652 methods which include the following methods:
1. AWWA Method 2:
   a. A solution of 200 mg/L available chlorine shall be applied directly to the surfaces of all parts of the reservoir that would be in contact with water when the reservoir is full to the overflow elevation.
   b. The chlorine solution may be applied with suitable brushes or spray equipment. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping so that it will have available chlorine of not less than 10 mg/L when filled with water. The inside of the overflow piping need not be disinfected.
   c. The surfaces disinfected shall remain in contact with the strong chlorine solution for at least 30 minutes, after which potable water shall be admitted, any drain

piping shall be purged of the 10 mg/L chlorinated water, and the storage facility shall then be filled to its overflow level.

2. AWWA Method 3:
   a. Water and chlorine shall be added to the storage facility in amounts so that initially the solution will contain 50 mg/L available chlorine and will fill approximately 5% of the total storage volume. Chlorine shall be added to the storage facility by hand pouring chlorine granules onto the floor of the reservoir and allowing the incoming water to provide mixing. This solution shall be held in the storage facility for a period of not less than 6 hours. The actual volume of the 50 mg/L chlorine solution shall be such that after the solution is mixed with filling water and the storage facility is held full for 24 hours, there will be free chlorine residual of not less than 2 mg/L. The storage facility shall then be filled to the overflow level by flowing potable water into the highly chlorinated water and shall be held full for a period of not less than 24 hours. All highly chlorinated water shall then be purged from any drain piping.
   b. Then, subject to satisfactory bacteriological testing by OWNER, leakage test, and acceptable aesthetic quality, including a 2 mg/L or less chlorine residual, such water may be served to the distribution system.
   c. If satisfactory chlorination is not achieved, CONTRACTOR shall repeat procedures or prepare other methods satisfactory to ENGINEER. Care should be taken in handling chlorine. Chlorine granules should be poured on dry surfaces, unless adequate precautions are taken to provide ventilation or protective breathing equipment. The same protective procedures shall apply to the application of liquid chlorine solutions. Should the chlorinated reservoir water be acceptable in all aspects except chlorine residual, water shall not be pumped to the distribution system. Highly chlorinated water shall be disposed of using a chlorine-reducing agent as provided for in AWWA C652 Appendix B. Additional water may be applied to reduce by dilution the chlorine residual to acceptable levels as determined by OWNER.

END OF SECTION

SECTION 03560

CONCRETE SURFACE REPAIR

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Miscellaneous concrete surface repairs.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Repair Locations: Interior surfaces of existing below-grade reservoir.

D. Allowances: CONTRACTOR shall INCLUDE in the Bid the following quantities of concrete repairs.
   1. Underside of roof slab repairs: 300 cubic feet.
   2. Wall vertical surface repairs: 100 cubic feet.

E. Payment to CONTRACTOR for repairs will be adjusted, add or deduct, based upon the actual repairs performed (more or less than allowance quantities) and the unit price(s) bid for these repairs. Unit price(s) shall include all materials, labor, and incidental items associated with completing repairs as noted on drawings and in these specifications. Unit price for wall and underside of roof slab surface repairs shall include cost for scaffolding. Before any work included in this allowance begins, CONTRACTOR and ENGINEER shall agree on the extent of work. All other concrete repair work noted on the drawings and in the specifications shall be included in the Lump Sum Bid and is not included in these allowances.

1.02 SUBMITTALS

A. Comply with Section 01300–Submittals.

B. Product Data: Submit manufacturer's technical data sheets for each product.

C. Submit list of project references as documented in this specification under 1.03 Quality Assurance. Include contact name and phone number of person charged with oversight of each project.

1.03 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications: Company with minimum 15 years of experience in manufacturing of specified products and systems.
   2. Applicator Qualifications:
      a. Company with minimum of 5 years experience in application of specified products and systems on projects of similar size and scope, and is acceptable to product manufacturer.
      b. Successful completion of a minimum of five projects of similar size and complexity to specified Work.

1.04 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Application range of repair mortar is from 20°F (minimum 7°C) to 85°F (29°C). Follow ACI-recommended concreting practices for hot or cold weather.
   2. Ensure that frost or frozen surfaces are thawed and dry.
   3. Allow surfaces to attain temperature and conditions specified before proceeding with application.

PART 2–PRODUCTS

2.01 MANUFACTURER

A. Repair materials shall be by BASF Building Systems, or equal.

2.02 MATERIALS

A. Vertical Wall Surface and Underside of Slab Repairs: Repair mortar shall be one component, rheoplastic, shrinkage-compensated, fiber-reinforced, cementitious repair mortar, EMACO S88-CI by BASF Building Systems, or equal. Repair mortar must be NSF-approved for use in contact with potable water.

B. Reinforcing Primer: Primer for reinforcing shall be a 2-component, polymer-modified, cementitious bonding agent, and anticorrosion coating, EMACO P24 by BASF Building Systems, or equal.

PART 3–EXECUTION

3.01 IDENTIFICATION

A. When reservoir is removed from service and is available for inspection, CONTRACTOR and ENGINEER shall observe conditions and identify areas to be repaired. Where practicable, approximate quantities of repair material shall be agreed upon prior to commencement of repairs. Where quantities may be affected by subsurface conditions not visible prior to repairs, quantities shall be determined and agreed upon as soon as practicable after removal of unsound concrete.

B. Upon removal of reservoir from service, CONTRACTOR shall pressure wash the interior walls and columns. CONTRACTOR shall document interior condition of reservoir. Provide temporary access such as scaffolding or other means for observation of reservoir walls and ceiling by Utility or ENGINEER. CONTRACTOR shall provide temporary lighting to complete reservoir observations. The current reservoir has no working ladders.

3.02 SURFACE PREPARATION

A. Protect adjacent Work areas and finish surfaces from damage during repair work.

B. Concrete:

1. Remove unsound or delaminated concrete, providing minimum of 1/4-inch (6 mm) substrate profile and 3/4-inch (19 mm) clearance behind corroded reinforcing steel.
2. After removal of concrete, but before placement, mechanically abrade concrete surface to remove bond-inhibiting materials and to provide additional mechanical bond. Do not use method of surface preparation that will fracture concrete. Verify absence of microcracking or bruising according to ICRI Guideline No. 310.2.
3. Sawcut straight edges along repair area perimeters minimum of 1 inch (25 mm) deep to eliminate feather edges. Do not cut reinforcement.
4. Report cracks that appear in interface area of patch or overlay to ENGINEER, and repair.
5. Continue expansion and control joints through repair or as required, review with ENGINEER.
6. Dampen base concrete interface to be repaired to saturated surface dry (SSD) conditions by wetting, fogging, or ponding with clean water for 24 hours.

C. Reinforcing Steel:
1. Expose full circumference of corroded steel in areas to be repaired.
2. Remove oxidation and scale from exposed reinforcing steel according to ICRI Technical Guideline No. 310.1R *Guide to Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion*.
3. To prevent future steel corrosion, coat prepared reinforcing steel with reinforcing primer as specified.
4. Any existing reinforcement displaced by prior demolition operations shall be bent back into place.

3.03 INSTALLATION

A. Substrate shall be SSD with no standing water during application.

B. Mix components and apply concrete according to manufacturer's instructions.

C. Repair areas shall be water-cured for 7 days or use a NSF-approved curing compound.

END OF SECTION

SECTION 04100

MORTAR AND MASONRY GROUT

PART 1–GENERAL

1.01 SUMMARY

A. The work includes mortar and grout for masonry.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. Wisconsin Commercial Building Code.

B. ASTM C144–Aggregate for Masonry Mortar.

C. ASTM C150–Portland Cement.

D. ASTM C207–Hydrated Lime for Masonry Purposes.

E. ASTM C404–Aggregates for Masonry Grout.

F. ASTM C476–Grout for Masonry

G. ASTM C979–Pigments for Integrally Colored Mortar/Concrete.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Submit information on Portland cement, integral waterproofing compound, and hydrated lime for mortar. Include design mix with proportions of materials being used. Submit gradation on aggregates.

C. Submit design mix for grout including gradation of aggregates.

D. Manufacturer's certificate: Certify that products meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

A. All cement shall be stored in a dry, weatherproof, properly ventilated structure which will protect it from dampness and freezing.

1.05 ENVIRONMENTAL REQUIREMENTS

A. See Section 04300–Unit Masonry System, for cold weather requirements.

PART 2–PRODUCTS

2.01 MORTAR

A. Mortar shall be Type S Portland cement-lime mortar with proportion restrictions as stated in the Wisconsin Commercial Building Code. Mortar and masonry cements will not be permitted. Provide integral waterproofing compound in mortar for all exterior masonry mortar.

B. Portland cement shall conform to ASTM C150, Type I or III.

C. Hydrated lime shall conform to ASTM C207, Type S.

D. Integral waterproofing compound shall be Dry-Block by W.R. Grace Company, or equal.

E. Mortar aggregate for ordinary tile, brick, stone, and block shall consist of clean, sharp sand, conforming to ASTM C144. The sand shall be graded within the following limits:

Sieve Number	Percent by Weight Passing
4	100
8	95 to 100
16	70 to 100
30	40 to 75
50	10 to 35
100	2 to 15
200	---

F. Sand from any one source shall not vary over the extreme limits shown above. For unusually thin joints, such as occur with a unit having cut or ground edges, the aggregate used shall conform to these specifications except that 95% shall pass a No. 16 sieve.

G. Water used in mixing water shall be clean and free of injurious materials.

H. Mortar shall be thoroughly mixed until of uniform color and consistency. Only sufficient mortar to meet the immediate requirements of the work shall be mixed at one time. No mortar shall be retempered after it has begun to set, and no partially set mortar shall be used. No antifreeze material shall be used in the mortar to lower the freezing point.

I. Colored mortar shall be provided. Colored mortar shall be Western Colored Masons Blend, premixed and colored as manufactured by Western Lime and Cement Company or equal. Color shall be selected by OWNER. White cement and sand may be required.

2.02 GROUT

A. Grout shall conform to ASTM C476–Mortar and Grout for Reinforced Masonry.

B. Aggregates shall conform to ASTM C404–Aggregates for Masonry Grout.

C. Grout shall have a minimum 28-day compressive strength of 2,500 psi with the following proportions:
   1. Fine Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate.
   2. Coarse Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate: 1 to 2 coarse aggregate.

D. Fine grout shall be used in spaces with least horizontal dimension greater than 3/4 inches and less than 2 1/2 inches. Coarse grout shall be used in all spaces with least dimensions 2 1/2 inches or greater.

PART 3–EXECUTION

3.01 INSTALLATION

A. Brace masonry for wet grout pressure.

B. Work grout into masonry cores and cavities.

C. Where joints occur in grout, they shall be made 2 inches below the block joint so that a key is provided.

D. Grout full masonry walls from top of floor to underside of all lintels at openings for a distance of 16 inches adjacent to each side of opening, unless shown otherwise on the drawings.

END OF SECTION

SECTION 04300

UNIT MASONRY SYSTEM

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Concrete block.
   2. Glass block.
   3. Glazed concrete masonry units.
   4. Reinforcement, anchorage, control joints, and accessories.
   5. Cold weather requirements.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. Wisconsin Commercial Building Code.

B. ASTM C67–Sampling and Testing Brick and Structural Clay Tile.

C. ASTM C90–Load Bearing Concrete Masonry Units.

D. ASTM C216–Facing Brick.

E. ASTM C744–Pre-Faced Concrete and Calcium Silicate Masonry Units.

F. UL–Fire Resistance Directory.

1.03 QUALITY ASSURANCE

A. Variation from the plumb in the lines and surfaces of columns and walls shall not exceed 1/4 inch in 10 feet, 3/8 inches in a story height or 20 feet maximum, nor 1/2 inch in 40 feet or more. Variation from plumb for external corners, expansion joints, and other conspicuous lines shall not exceed 1/4 inch in any story or 20 feet maximum nor 1/2 inch in 40 feet or more.

B. Variation from the level of the grades indicated on the drawing for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines shall not exceed 1/4 inch in any bay or 20 feet nor 1/2 inch in 40 feet or more.

C. Variation of the linear building line from an established position in plan and related portion of columns, walls, and partitions shall not exceed 1/2 inch in any bar or 20 feet maximum nor 3/4 inches in 40 feet or more.

D. Variation in cross-sectional dimensions of columns and thickness of walls shall not exceed minus 1/4 inch nor plus 1/2 inch from the dimensions indicated on the drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Masonry units, when delivered to the site, shall be thoroughly cured and shall be dry. When stored on the site, they shall not be in contact with the ground, shall be kept clean, and shall be covered with waterproof cover.

1.05 COLD WEATHER REQUIREMENTS

A. All masonry units delivered to use in freezing weather shall be fully protected by a weather-tight covering to prevent accumulation of ice on the units. Loose board covering will not be permitted.

B. Cold Weather Protection:
   1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
   2. Remove all masonry determined to be frozen or damaged by freezing conditions.
   3. Perform the following construction procedure while the work is progressing. When air temperature is from 40°F (4°C) to 32°F (0°C), heat sand or mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C):
      a. When air temperature is from 32°F (0°C) to 25°F (-4°C) heat sand or water to produce mortar temperature between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
      b. When air temperature is from 25°F (-4°C) to 20°F (-7°C) heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.
      c. When air temperature is from 20°F (-7°C) and below, heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); provide enclosures and auxiliary heat to maintain air temperature above 32°F (0°C); do not lay units which have a surface temperature of 20°F (-7°C).
   4. Perform the following protections for completed masonry and masonry not being worked on:
      a. When the mean daily air temperature is from 40°F (4°C) to 32°F (0°C), protect masonry from rain or snow for at least 24 hours by covering with weather-restrictive membrane.
      b. When the mean daily air temperature is from 32°F (0°C) to 25°F (-4°C), completely cover masonry with weather-restrictive membrane for at least 24 hours.
      c. When the mean daily air temperature is from 25°F (-4°C) to 20°F (-7°C), completely cover masonry with insulating blankets or similar protection for at least 24 hours.
      d. When mean daily temperature is 20°F (-7°C) and below, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures, blankets, and supplementary heat.

PART 2–PRODUCTS

2.01 CONCRETE BLOCK

A. Concrete block shall be load bearing and shall conform to the requirements of ASTM Designation C90 and the Wisconsin Commercial Building Code. Bond shall be running bond. Concrete block shall be the two-cell type and shall be made with normal weight aggregate.

B. Unless otherwise indicated, interior concrete block at window sills and lintels, pilasters, and the top course of walls at roof lines shall be constructed of solid concrete block, lintel block filled with grout, or the cores of the block filled with grout. Interior block at window sills shall be solid concrete block unless otherwise noted. Bullnose block shall be used at all door, window, and wall corners that remain exposed.

C. All interior concrete block walls shall extend to the underside of roof deck or floor above unless noted otherwise.

2.02 DECORATIVE CONCRETE BLOCK

A. Glazed Concrete Masonry Units:
   1. Glazed concrete masonry units shall be used where indicated on the Finish Schedule bound at the back of these specifications.
   2. All glazed concrete masonry units shall be made with lightweight aggregate and shall be autoclaved units conforming to ASTM C90 as applicable. The glazed surface shall have a smooth satin-gloss finish and externally heat-polymerized cast-on facing conforming to ASTM C744, Federal Specification SS-C-621b, and ASTM C67, paragraph 8 (50 cycles of Freezing and Thawing).
   3. Glazed masonry units shall be used with colors selected by OWNER from manufacturer's standard colors.
   4. The glazed facing shall be free from chips, cracks, crazes, or any other imperfections that would detract from the overall appearance of the wall when viewed from a distance of 5 feet at right angles to the wall. Only quality units shall be installed; all defective units shall be rejected.
   5. Glazed units shall be ASTRA-GLAZE-SW as manufactured by Trenwyth Industries, Inc., or equal. All units shall include W.R. Grace DRY-Block water repellent block admixture, or equal.

2.03 GLASS BLOCK

A. Glass block shall be 7 5/8 inches by 7 5/8 inches by 3 5/8 inches Argus brand by Pittsburgh Glass, or equal.

B. All mortar and bearing surfaces of the block shall be precoated or prepared to ensure adhesion between mortar and glass.

2.04 REINFORCEMENT AND ANCHORAGE

A. For concrete block walls, masonry wall joint reinforcement shall be 120 Truss Mesh manufactured by Hohmann and Barnard, or equal. Side and cross rods shall be 9 gauge wire.

B. Stone ties to CMU Backing: For tying stone masonry to CMU backup walls, use adjustable anchor system for stone, Tie-HVR-195V Truss Type Anchor System by Hohmann and Barnard, or equal. Side and cross rods shall be 9 gauge wire. Rectangular box with restraint bar shall be 3/16-inch diameter. Vertical J-hook shall be minimum 1/2-inch diameter. Masonry tie shall be minimum 3/16-inch diameter. Rectangular boxes and masonry ties shall be spaced 16 inches o.c. horizontally and vertically.

C. Wall reinforcement and ties shall be hot-dipped galvanized having a minimum 1.50 ounce/square foot zinc coating in accordance with ASTM A153 Class B2.

D. Prefabricated corner and tee sections shall be used to form continuous reinforcement around corners and for anchoring abutting walls and partitions.

E. Stone Ties To Concrete Backing: For tying stone masonry to concrete, use adjustable anchor system for stone, Tie-HVR-195VB Clip Style Anchor System by Hohmann and Barnard, or equal. Backplate shall be minimum 12 gauge by 2 5/8-inch-wide. Masonry tie shall be minimum 3/16-inch diameter. Vertical J-hook shall be minimum 1/2-inch diameter. Backplates shall be spaced 24 inches o.c. vertically and 16 inches o.c. horizontally. Masonry ties shall be spaced 16 inches o.c. horizontally and vertically.

F. Reinforcing Bar Positioners: Where vertical reinforcing bars are required, provide bar positioners D/A 815 or D/A 816 by Durowall, or equal.

2.05 ACCESSORIES

A. Cellular or honeycomb cell vents, 2 1/2 inches high, shall be provided at weep holes. Cell vents shall be U.V.-resistant polypropylene, Durowall D/A 1006, or equal.

B. See Section 07620–Flashing and Sheet Metal for masonry flashing specifications.

PART 3–EXECUTION

3.01 MASONRY WORKMANSHIP

A. All masonry shall be laid plumb and true to lines. Mortar beds shall be spread smooth or only slightly furrowed.

B. All masonry shall be laid in running bond, unless specified otherwise.

C. In building cavity walls, the cavity shall be kept clean by slightly beveling the mortar bed to incline toward the cavity or by placing wood strips with attached wire pulls on the metal ties. The strips shall be withdrawn and cleaned before placing the next row of metal ties. Any mortar fins which protrude into the cavity space as the wall is built shall be troweled flat onto the inner face of the wythe.

D. Where cutting of exposed masonry is necessary, the cuts shall be made with a motor-driven masonry saw or by other methods which provide cuts that are straight and true.

E. Glazed concrete masonry units shall be cut using either an abrasive or diamond blade and cut units shall be cut neatly and located for best appearance.

F. Where flashing is to be laid on or against masonry, the surface of the masonry shall be smooth and free from projections which might puncture the flashing material. Through-wall flashing shall be placed on a bed of mortar, and mortar shall be placed above the flashing.

G. Weep holes spaced 32 inches on center 2 1/2 inches high shall be provided in the first course immediately above all flashing. Weep holes shall be kept free of mortar droppings.

H. Outside joints around the perimeter of exterior door and window frames or other wall openings shall be not less than 1/4 inch nor more than 1/2 inches wide and shall be cleaned out to a uniform depth of at least 3/4 inches ready for placement of caulk.

I. All walls shall be adequately braced until they are completed and anchored to the roof construction.

3.02 MORTAR JOINTS

A. All joints shall be laid plumb to lines. Unless specified otherwise, mortar beds shall be full 3/8 inches thick and shall be spread smooth or only slightly furrowed. Vertical joints shall be shoved not over 3/8 inches thick, unless otherwise shown. All joints shall be completely filled.

B. Interior and exterior joints shall be tooled concave. All joints shall be tooled to uniform depth and shall be straight and true. Mortar joints shall be cut flush with masonry where rigid thermal insulation will be applied to interior masonry surfaces.

C. The laying of glazed concrete masonry units shall be consistent with the best concrete masonry practices. Units shall be aligned level, plumb, and true with uniform carefully tooled 1/4-inch-wide joints on the glazed face side of the wall.

3.03 REINFORCEMENT AND ANCHORAGE

A. Reinforcement shall be installed in the first and second bed joint 8 inches apart immediately above lintels and below sills at openings. Elsewhere, spacing shall be at 16-inch vertical intervals or as shown on the drawings. Reinforcement in the second joint above and below openings shall extend 2 feet beyond the jambs. All other reinforcing shall be continuous.

B. Side rods shall be lapped 6 inches minimum at splices. Reinforcement units shall be of widths required for wall thicknesses as shown. Reinforcement shall be placed to assure a 5/8-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces.

C. Vertical reinforcing bars shall be installed using prefabricated bar positioners. Provide one positioner at the top of the first course of block and one additional positioner at a maximum spacing of 200 bar diameters.

3.04 BUILT-IN WORK

A. As work progresses, install all built-in work (such as: window and door frames, anchor bolts, plates, lintels, etc.) to be provided by other sections.

B. Install built-in items plumb and level.

C. Bed anchors of metal door frames in adjacent mortar joints. Grout all steel door frames full with mortar except those called for to be "removable."

D. Do not build-in organic materials subject to deterioration.

E. Steel members embedded in exterior masonry shall be "buttered" with not less than 1/2 inch of setting mortar on all surfaces.

3.05 JOINING OF WORK

A. Where fresh masonry joins masonry that is partially set or totally set, the exposed surface of the set masonry shall be cleaned and lightly wetted so as to obtain the best possible bond with the new work. All loose brick and mortar shall be removed. If it becomes necessary to "stop-off" a horizontal run of masonry, this shall be done only by racking back brick in each course, and if grout is used, stopping grout four inches back of the rack. Toothing will not be permitted.

3.06 PROTECTION OF WORK

A. During erection, all walls shall be kept dry by covering at the end of each day or shutdown period with a canvas or waterproof covering. Partially completed walls not being worked on shall be similarly protected at all times. All covering shall overhang at least two feet on each side of the wall and shall be securely anchored.

3.07 CLEANING NEW WORK

A. Masonry faces to remain exposed shall be wiped with a damp cloth as the work progresses and thoroughly cleaned and pointed upon completion. If stiff brushes and water will not suffice, the surface shall be thoroughly wetted with plain water and then scrubbed with a 5% or 10% solution of hydrochloric acid. Alternatively, a commercial cleaner such as Sure Klean, or equal, may be used. Immediately after, the surface shall be washed to remove all traces of acid. All surfaces not being cleaned shall be protected from the acid. All mortar shall be removed from surfaces other than masonry.

B. Glazed masonry walls shall be cleaned with a detergent masonry cleaner containing no muriatic acid strictly following the cleaner manufacturer's instructions, including thorough rinsing.

3.08 MASONRY CONTROL JOINTS

A. Provide masonry control joints in masonry as detailed on the Drawings.

B. Where control joints are not shown on the Drawings, they shall be provided as follows:

	Stone Veneer
Distance from wall corner (maximum)	12 feet
Spacing between joints (minimum)	20 feet

C. Where possible, joints shall be located at edges of door, window, and louver openings, and at changes in wall height.

END OF SECTION

SECTION 04853

STONE VENEER ASSEMBLIES

PART 1–GENERAL

1.01 SUMMARY

A. Work includes:
   1. Solid masonry construction of base supported natural full stone veneer, set in cement mortar, and tied to a structural backup wall.
   2. Special decorative cut stone shapes for trim.
   3. Installation of built-in accessories.
   4. Installation of water repellant and anti-graffiti coating.

1.02 REFERENCES

A. ASTM C 97–Standard Specification for Absorption and Bulk Specific Gravity of Dimension Stone.

B. ASTM C 99–Standard Specification for Modulus of Rupture of Dimension Stone.

C. ASTM C 170–Standard Specification for Compressive Strength of Dimension Stone.

D. ASTM C 568–Standard Specification for Limestone Dimension Stone.

E. ASTM C 880–Standard Specification for Flexural Strength of Dimension Stone.

F. ACI 530/ASCE 5/TMS 402–Building Code Requirements for Masonry Structures.

G. ACI 530.1/ASCE 6/TMS 602–Specifications for Masonry Structures.

H. National Concrete Masonry Association TEK 8-2A for masonry cleaning.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Perform Work in accordance with ACI 530/ASCE 5/TMS 402 Building Code Requirements for Masonry Structures, ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures and the Wisconsin Commercial Building Code.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Cleaning methods.

C. Selection Samples: For each stone product specified, submit two samples, minimum size 6 inches long, representing actual product, color, and texture.

D. Quarrier's Certificate: Certify stone properties and mortar mix will conform to specified requirements.

1.05 QUALIFICATIONS

A. Stone Quarrier: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Stone Masonry Company: Company specializing in performing Work of this section with minimum five years documented experience.

1.06 QUALITY ASSURANCE

A. Stone Materials: Stone shall be standard grade, free of crack or seam which may impair its structural integrity or function and shall comply with industry standards and practices specified.

B. Mock-Up: Provide a sample panel for evaluation of construction techniques, finishes and workmanship.
   1. Provide is location designated by ENGINEER.
   2. Size: 4 feet by 4 feet.
   3. Include stone types and sizes to be used and include a typical corner condition with special shapes and joint treatment.
   4. Clean the sample panel using the same materials and tools as planned for the final stone masonry construction.
   5. Do not proceed with remaining work until workmanship and color is approved by OWNER.
   6. Sample panel will be used as a standard for the balance of the work.
   7. Remove sample panel at the completion of the work.

C. Preconstruction Meetings: Conduct preconstruction meetings including ENGINEER, CONTRACTOR, stone masonry subcontractor, and the flashing subcontractor to verify project requirements, substrate conditions, manufacturer's installation instructions and other requirements. Comply with Division 1 requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products on pallets, under cover and in manufacturer's unopened packaging until ready for installation.

B. All stone shall be received and unloaded at the site with necessary care in handling to avoid damaging or soiling.

C. Store stone materials on pallets on a dry level surface. Pallets shall not be stacked and shall be covered with tarps.

1.08 PROJECT CONDITIONS

A. Hot and Cold Weather Requirements: In accordance with ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.

B. Ambient temperature shall be 40 degrees F or above during erection of stone masonry. When ambient temperature falls below 50 degrees F, mortar mixing water shall be heated.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Eden Stone Co. Inc., which is located at: W4520 Lime Rd. ; Eden, WI 53019-1108; Tel: 920-477-2521; www.edenstone.net.

B. Requests for substitutions will be considered by ENGINEER in accordance with provisions of Division 1. ENGINEER reserves the right to reject substitution requests based on natural stone color and texture, even though size, slopes, and properties are equivalent.

2.02 VENEER STONE

A. Chilton Weathered Edge–No Red, Jumbled Brown, light brown, buff, orange with some gold.
   1. Lengths: 8 to 24 inches.
   2. Heights: 2 to 9 inches.
   3. Thickness: 3 1/2 to 4 1/2 inches with some up to 5 inches maximum.
   4. Material shall conform to ASTM C 568 with the following properties:
      a. Maximum absorption rate of 0.20 percent when tested in accordance with ASTM C 97.
      b. Minimum density of 170 pounds per cubic feet when tested in accordance with ASTM C 97.
      c. Minimum compressive strength of 35,000 average psi when tested in accordance with ASTM C 170.

2.03 CUT STONE

A. Provide special shapes as indicated on the Drawings and as follows:
   1. Cut stone coping.
   2. Cut stone window/HVAC opening sill.
   3. Cut stone window/HVAC opening header.
   4. Cut stone sill Type 1.
   5. Cut stone sill Type 2.
   6. Cut stone sill veneer.
   7. Cut stone arched door header.

B. Stone shall be furnished in sizes indicated plus or minus 1/2 inch. Materials shall conform to the properties specified for the materials specified.

C. Color shall match the veneer stone.

2.04 ACCESSORIES

A. Joint Reinforcement: As specified in Section 04300.

2.05 SEALANTS

A. Provide sealants and backing material for perimeter and control joints as recommended by stone manufacturer and as required to provide a weathertight stone veneer installation. Sealant shall contain anti-graffiti coating.

2.06 MORTAR

A. As specified in Section 04100.

2.07 COATINGS

A. Provide water-repellant anti-graffiti coating as recommend by stone manufacturer.

PART 3–EXECUTION

3.01 EXAMINATION

A. Do not begin installation until backing structure is plumb, bearing surfaces are level and substrates are clean and properly prepared.

B. Verify that built-in items are in proper location, and ready for roughing into stone masonry.

3.02 PREPARATION

A. Stone must be water saturated, surface-dry when placed. Water down the stone 24 hours prior to placement until saturated. Reapply water to keep stone saturated as required by weather conditions.

B. Coordinate placement of reinforcement, anchors and accessories, flashings and other moisture control products supplied by other sections.

C. Clean all built-in items of loose rust, ice, mud, or other foreign matter before incorporating into the wall. All ferrous metal built into the wall shall be primed or galvanized.

D. If required, provide temporary bracing during installation of masonry work. Maintain bracing in place until building structure provides permanent support.

3.03 INSTALLATION

A. Install veneer stone and mortar in accordance with ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.

B. Maintain masonry courses to uniform dimension(s). Form vertical and horizontal joints of uniform thickness.

C. Pattern Bond:
   1. Lay stone with the bedface, splitface or weather edge exposed. Take care to avoid a concentration of any one color to any one wall surface.
   2. Maintain an approximate 1/2-inch joint, as stone allows.
   3. Do not use stacked vertical joints.
   4. Lay out work in advance and distribute color range of stone uniformly over total work area.

D. Anchoring: Tie stone to backing as required by the applicable Building Code. As a minimum tie stone to backing with metal ties as follows:
   1. Maximum spacing between adjacent ties shall be 16 inches vertically and 16 inches o.c. horizontally.
   2. Ties shall be imbedded in horizontal joints to a 2-inch minimum depth.
   3. Provide additional ties at openings within 12 inches of opening.

E. Joining Work: Where fresh masonry joints partially set masonry.
   1. Remove loose stone and mortar.
   2. Clean and lightly wet surface of set masonry.
   3. To avoid a horizontal run of masonry rack back 1/2 the length of stone in each course.
   4. Toothing is not permitted.

F. Joints:
   1. Lay stone with an approximate 1/2-inch mortar joint, as stone allows.
   2. Tool joints when "thumb-print" hard with a round jointer slightly larger than the width of the joint.
   3. Trowel-point or concave tool exterior joints below grade.
   4. Flush cut joints to be finished with a soft brush only.
   5. Retempering or mortar is not permitted.
   6. Use non-corrosive stone shims as required to maintain uniform joint thickness.

G. Flashing:
   1. Clean surface of masonry smooth and remove any projections, which could damage flashings.
   2. Place flashing on a bed of mortar.
   3. Cover flashing with mortar.
   4. Provide weep vents at head joints placed every 16 inches along the first course immediately above flashing or as recommended by weep vent manufacturer.
   5. Use a non-corrosive, fluid conducting polymer mesh such as "Mortar Net", "Control Cavity", "CavClear" or equal to keep the air space behind the installed veneer stone, clear of mortar and mortar droppings.

H. Control and Expansion Joints: Keep joints open and free of debris. Coordinate control joint in accordance with Section 07900 for sealant performance.

I. Sealant Recesses: Provide open joint 3/4 inch deep and 1/2 inch wide, where masonry meets doors, windows and other exterior openings. Coordinate sealant joints in accordance with Section 07900 for sealant performance.

J. Cutting And Fitting: Cut and fit for chases, pipes, conduit, sleeves, grounds, and other penetrations and adjacent materials.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Cover the top of unfinished stone masonry work to protect it from the weather.

C. Extend cover a minimum of 24 inches down both sides and hold securely in place.

D. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials from stone without damage to the stonework.

E. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

F. Protect sills, ledges and projections from droppings of mortar and sealants.

G. Touch-up, repair or replace damaged products before Substantial Completion.

3.05 CLEANING

A. Clean exposed faces to remove dirt and stains which may be on units after erection and completion of joint treatments.

B. Wash and rinse in accordance with stone panel manufacturer's instruction.

C. Do not use cleaning materials or processes which could change the character of the exposed finishes.

3.06 SEALING

A. Treat exposed stone surfaces and mortar joints with clear water repellant and anti-graffiti coating as recommended by stone manufacturer.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Shop-fabricated carbon steel, stainless steel, and aluminum items, including monorails, lintels, prefabricated alternating tread stairs, and ladders.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A36–Structural Steel.

B. ASTM A53–Pipe, Steel, Black, and Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.

C. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A143–Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

E. ASTM A153–Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A176–Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.

G. ASTM A307–Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

H. ASTM A384–Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

I. ASTM A385–Practice for Providing High Quality Zinc Coatings (Hot-Dipped).

J. ASTM A570–Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.

K. ASTM A611–Steel Sheet, Carbon, Cold-Rolled, Structural Quality.

L. ASTM B209–Aluminum and Aluminum-Alloy Sheet and Plate.

M. ASTM B211–Aluminum-Alloy Bar, Rod, and Wire.

N. ASTM B221–Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.

O. AWS A2.0–Standard Welding Symbols.

P. AWS D1.1–Structural Welding Code.

1.03 DESIGN REQUIREMENTS

A. All fabrications shall meet applicable code requirements including OSHA.

1.04 SUBMITTALS FOR REVIEW

A. Comply with pertinent provisions of Section 01300–Submittals.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

A. Fabricate steel members in accordance with AISC Code of Standard Practice.

B. Mill Test Reports: Submit indicating structural strength and composition.

C. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

1.06 QUALIFICATIONS

A. Qualify welding processes and welding operators in accordance with AWS "Standard Qualifications Procedures."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

B. Store all members off the ground using pallets, platforms, or other supports.

C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.

D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

PART 2–PRODUCTS

2.01 MATERIALS–CARBON STEEL

A. Steel Sections:
   1. ASTM A36 (channels, angles, plates).
   2. ASTM A992-50 (wide flange sections).

3. Pipe: ASTM A53, Grade B.
4. Tubes: ASTM 500, Grade B.

B. Sheet Steel: ASTM A570 or A611.

C. Plain Washers: Round carbon steel complying with FS FF-W-92.

D. Bolts and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.

E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.

F. Welding Materials: AWS D1.1; E70XX electrodes.

G. Select fasteners for the type, grade, and class required.

2.02 MATERIALS–STAINLESS STEEL

A. Unless otherwise noted, all stainless steel shall meet the requirements of ASTM A240 and shall be Type 316L.

B. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.

2.03 MATERIALS–ALUMINUM

A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.

B. Sheet Aluminum: ASTM B209, Alloy 3005.

C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.

D. Bolts, Nuts, and Washers: Stainless steel galvanized to ASTM A153.

E. Welding Materials: AWS D1.1; type required for materials being welded.

2.04 PREFABRICATED ALTERNATING TREAD STAIRS

A. Alternating tread stairs shall be hot-dipped galvanized steel 68 degree model by Lapeyre Stairs, Harahan, LA, (800) 535-7631.

B. Stair unit shall be factory manufactured and delivered to site.

C. Handrail at top shall be optional parapet type. See drawings for height and layout. CONTRACTOR to provide mounting hardware as recommended by manufacturer.

D. Landings, treads, and mounting feet shall be stamped and formed from single-piece material. All risers shall be equally spaced. Handrails on each side shall be provided. Provide molded rubber foot divider.

2.05 FABRICATION

A. Fabrication and Assembly:
   1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
   2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
   3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
   4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
   5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

B. Connections:
   1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
   2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
   3. Assemble and weld built-up sections to produce true alignment of axes without warp.
   4. Welding shall be done by the shielded arc process.
   5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.

C. Workmanship:
   1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.
   2. Work to dimensions shown or accepted on the Shop drawings using proven details of fabrication and support.
   3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
   4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
   5. Cap all open ends of pipe and structural tubing.
   6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
   7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
   8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

2.06 MISCELLANEOUS METAL FABRICATION

A. Stainless Steel Ladder and Cage: Provide fixed stainless steel ladder and cage as shown on the drawings. Stainless steel ladder shall have serrated surface on rungs.

2.07 FINISHES

A. Carbon steel surfaces shall be prepared by abrasive blasting to SSPC-SP10 as specified in Section 09900–Painting.

B. Do not prime surfaces where galvanizing or field welding is required.

C. Immediately after surface preparation, prime paint carbon steel items with one coat in accordance with manufacturer's instructions and Section 09900–Painting.

D. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.

E. Surfaces which will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.

F. Galvanizing:
   1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
   2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in "Recommended Details for Galvanized Structures" as published by the American Hot Dip Galvanizer's Association, Inc.
   3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
   4. Steel shall conform to ASTM A36 except that the silicone content shall be in the range of 0 to 0.04%.
   5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
   6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, "Welding Zinc Coated Steel." All uncoated weld areas shall be touched up.

G. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3–EXECUTION

3.01 EXAMINATION

A. Correct conditions detrimental to the proper and timely completion of the work.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.

B. Coordinate delivery of such items to project.

C. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

B. Cutting, Fitting and Placement:
   1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.
   2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
   3. Fit exposed connections accurately together to form tight hairline joints.
   4. Weld connections which are not to be left as exposed joints, grind joints smooth, and touch-up shop paint coat or galvanizing repair.

3.04 FIELD WELDING

A. Comply with AWS Code for procedures of manual shielded metal arc welding, appearance and quality of weld made, and methods in correcting welding work.

3.05 TOUCH-UP PAINTING

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting in accordance with Section 09900–Painting.

3.06 GALVANIZING REPAIR

A. Areas damaged by welding, flame-cutting or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16 inches in width.
   1. Cold Galvanizing Compound:
      a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
      b. Areas to be repaired shall be power disc-sanded to bright metal. To ensure that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
      c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
      d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
      e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
   2. Zinc-Based Solder:
      a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
      b. Areas to be repaired shall be wire brushed.
      c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until

the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.

d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

3.07 SCHEDULE

A. The following schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.

B. Lintels: Shop prime paint finish for interior wall lintels; galvanized and field finish paint per Division 9 for exterior wall lintels. Lintels approved by ENGINEER shall be placed over all masonry openings, even though not shown on the drawings. See lintel schedule on the drawings.

C. Galvanized alternating tread stairs.

D. Stainless steel ladder and cage.

E. Monorail beams and hardware: Primed painted.

F. Reservoir access hatch: Aluminum mill finish.

G. Grating supports: Aluminum mill finish.

END OF SECTION

SECTION 05520

HANDRAILS AND RAILINGS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes aluminum handrails, railings, and fittings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM B241–Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

1.03 DESIGN REQUIREMENTS

A. Handrail shall be designed in accordance with and meet the applicable requirements of the Occupational Safety and Health Act and the Wisconsin Commercial Building Code.

PART 2–PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

A. Provide a mechanically joined pipe railing system, Tabco 2500 Railing System as manufactured by Tuttle Aluminum and Bronze Co. or equal.

B. Rails shall be ASTM B241, Aluminum Alloy 6063-T6, Schedule 40, 1 1/2-inch-diameter pipe extrusion.

C. Posts shall be ASTM B241, Aluminum Alloy 6063-T6, Schedule 40, 1 1/2-inch-diameter pipe.

D. Furnish and install 4-inch by 1/4-inch toeboards where shown or noted on the drawings, or where required by OSHA 1910.23(c).

E. Provide expansion joints in railing and toeboards at expansion joints in structures and as necessary to prevent buckling or buildup of stresses. Expansion joints shall occur within 1 foot of posts.

F. Finished joints shall be smooth.

G. All rails, posts, toeboards, and connectors shall have a M12C22A41 clear anodized finish.

H. Posts shall be anchored to the top of walls and decks with a flange base plate. Base plate shall reinforce the bottom end of the post as required to meet OSHA design criteria.

I. Stainless steel expansion bolt anchoring system, in accordance with manufacturer's recommendations, shall be used.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.

B. Install components plumb and level, accurately fitted, and free from distortion or defects.

C. Clean all components as recommended by railing manufacturer.

END OF SECTION

SECTION 05531

GRATINGS AND FLOOR PLATES

PART 1–GENERAL

1.01 SUMMARY

A. Work includes floor grating.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 PERFORMANCE REQUIREMENTS

A. Floor grating shall be designed for a maximum deflection of 1/4 inch when supporting a 100 psf uniform load.

1.03 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2–PRODUCTS

2.01 ALUMINUM FLOOR GRATING

A. All grating, unless otherwise specified, shall be rectangular bar style, swage-locked aluminum floor grating with serrated surface.

B. Acceptable manufacturers include the following or equal: IKG Industries, Type BS.

C. All edges of the grating and all openings in the grating for pipe and miscellaneous equipment shall be banded by welding on minimum 1/8-inch-thick bars. The band shall have less depth than the bearing bars to permit drainage.

D. Individual sections shall be of a size to permit ease in handling with a maximum length not in excess of 8 feet.

E. All aluminum grating support angles shall be aluminum. Support angles shall be provided at the bearing ends of all grating. This includes locations such as wall openings and corners. Support angles shall also be provided at the nonbearing ends of grating where shown on the drawings.

2.02 FINISHES

A. Any aluminum in contact with concrete shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3–EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes and dimensional tolerances are acceptable.

B. Verify that supports are correctly positioned.

3.02 INSTALLATION

A. Place frames and supports in correct position, plumb and level.

B. All aluminum floor grating shall be secured to supporting members with aluminum or stainless steel saddle clips supplied by the grating manufacturers. Stud bolts and other hardware shall be supplied by CONTRACTOR.

END OF SECTION

SECTION 05560

ANCHOR BOLTS, EXPANSION BOLTS, AND ADHESIVE ANCHORS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Anchor bolts, expansion bolts, and adhesive anchors.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A36/A36M–Structural Steel.

B. ASTM F1554-Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.

C. ICC-ES International Code Council-Evaluation Service.

D. AC 193-Acceptance Criteria for Mechanical Anchors in Concrete Elements.

E. AC 308-Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete.

PART 2–PRODUCTS

2.01 ANCHOR BOLTS

A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.

B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

2.02 EXPANSION BOLTS

A. Expansion bolts shall be Power-Stud + SD2 by Powers Fastening Systems, Strong-Bolt, by Simpson Strong-Tie Anchor Systems, or equal.

B. Unless waived by ENGINEER for certain applications, all expansion bolts shall comply with the Wisconsin Commercial Building Code and AC 193. They shall be ICC-ES approved for use in cracked and uncracked concrete.

C. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of ENGINEER or where otherwise specifically called for.

D. Unless indicated otherwise on the drawings or specified, use the following bolt material for the various installation situations:
   1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
   2. Steel: In other locations in contact with items to be painted or encased in concrete.

2.03 ADHESIVE ANCHORS

A. Adhesive anchors shall be PE 1000+ by Powers Fastening Systems, Set-XP by Simpson Strong-Tie Anchor Systems, or equal.

B. Unless waived by ENGINEER for certain applications, all adhesive anchors shall comply with the Wisconsin Commercial Building Code and AC 308. They shall be ICC-ES approved for use in cracked and uncracked concrete.

PART 3–EXECUTION

3.01 ANCHOR BOLTS

A. Anchor bolts for structural members shall be located as shown and specified.

B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.

C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

3.02 EXPANSION BOLTS

A. Unless otherwise noted on the drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's recommendations.

B. Bolt embedment shall at least equal six bolt diameters.

C. All procedures shall be in accordance with the manufacturer's recommendations.

D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and bolts and shall be located to clear reinforcing steel.

3.03 ADHESIVE ANCHORS

A. At locations shown on the drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.

B. All existing surfaces to receive adhesive anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.

C. All procedures shall be in accordance with the manufacturer's recommendations.

D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and bolts and shall be located to clear reinforcing steel.

END OF SECTION

SECTION 07112

BELOW-GRADE WATERPROOFING MEMBRANE SYSTEM

PART 1–GENERAL

1.01 SUMMARY

A. Work includes self-adhesive rubberized, asphalt/polyethylene sheet membrane waterproofing system.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submittals shall be in accordance with provisions of Section 01300–Submittals.

B. Shop drawings shall include product data, layout plan, joint and termination details, details of interface with other materials, and copy of manufacturer's warranty.

1.03 QUALITY ASSURANCE

A. The manufacturer of the waterproofing membrane system shall have 10 years experience producing self-adhesive sheet membrane waterproofing.

B. Waterproofing system shall be installed by an applicator who is thoroughly familiar with the system and has experience in performing the work of this section.

C. Manufacturer's representative shall be on-site periodically during membrane waterproofing work to review installation procedures.

1.04 WARRANTY

A. Provide manufacturer's written 5-year material warranty to OWNER at successful completion of the project.

PART 2–PRODUCTS

2.01 MANUFACTURER

A. Acceptable manufacturers include the following, or equal: W.R. Grace & Co., Connecticut.

2.02 MATERIALS

A. Sheet Membrane Waterproofing: Bituthene 3000/Low Temperature Membrane; a self-adhesive, cold-applied composite sheet consisting of a thickness of 0.056 inches of rubberized asphalt and 0.004 inches of cross-laminated, high density polyethylene film. Provide rubberized asphalt membrane covered with a release sheet, which is removed during installation. No special adhesive or heat shall be required to form laps.

B. Prefabricated Drainage Composite: Hydroduct 220 for vertical surfaces and Hydroduct 660 for horizontal surfaces. Drainage composite shall be designed to promote positive drainage while serving as a protection course.

C. Miscellaneous Materials: Primer, mastic, liquid membrane, tape, and accessories shall be provided by or acceptable to the membrane manufacturer.

PART 3–EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive waterproofing membrane for conditions that may be detrimental to the proper completion of the work. Do not commence work until all defects are remedied.

3.02 PREPARATION

A. Substrates shall be prepared as recommended by manufacturer. Surfaces shall be structurally sound and free of voids, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil, and wax from exposed surfaces. Remove dust, dirt, loose stone, and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

B. Treat joints and install flashings as recommended by waterproofing manufacturer.

3.03 INSTALLATION

A. Membrane shall be installed in accordance with manufacturer's recommendations, including but not limited to, the following:
   1. Apply primer at the rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of primer.
   2. Delay application of membrane until primer is completely dry. Dry time will vary with weather conditions.
   3. Seal daily terminations with troweled bread of mastic.

3.04 CLEANING AND PROTECTION

A. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.

B. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION

SECTION 07212

BOARD INSULATION

PART 1–GENERAL

1.01 SUMMARY

A. Work includes board insulation for cavity wall construction, for perimeter foundation walls, and under floor-slabs on-grade.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 CAVITY WALL INSULATION

A. Cavity wall insulation shall be 1 1/2-inch-thick polyisocyanurate foam board with foil facing on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 10.0.

B. Acceptable products include the following, or equal. DOW Thermax by DOW Corporation.

C. Adhesive for adhering insulation to backup wall shall be as recommended by the insulation manufacturer.

2.02 FOUNDATION AND UNDER-SLAB INSULATION

A. Foundation and under-slab insulation shall be 2-inch-thick extruded polystyrene closed cell rigid foam board with continuous skins on both sides. Aged thermal resistance (R-value) at 75°F shall be a minimum of 10.0.

B. Acceptable products include the following, or equal:
   1. Styrofoam Square Edge by Dow Chemical Company.
   2. Foamular 250 by UC Industries, Inc.

PART 3–EXECUTION

3.01 INSTALLATION–CAVITY WALLS

A. Insulation shall be installed horizontally within the cavity space between masonry wythes.

B. Take care during installation to ensure all insulation boards are butted and installed between ties and fit flush against inner wythe or backup wall.

C. Cut insulation neatly to fit around obstructions across the cavity such as vents, louvers, pipes, and conduits.

D. Secure insulation in place against backup wall with mastic adhesive and observe label directions.

3.02 INSTALLATION–FOUNDATION WALLS AND UNDER FLOORS

A. Rigid insulation shall be laid dry against the foundation walls as backfill is placed. Insulation shall be located at all perimeter frost walls and below-grade walls of buildings and structures containing areas that may be occupied by personnel.

B. At perimeter frost wall foundations, insulation shall be 48 inches high and located on the inside of foundation walls.

C. Insulation under edges of slab-on-grade floors shall be 24 inches wide.

END OF SECTION

SECTION 07270

FIRESTOPPING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Silicone firestopping foam for sealing annular spaces around ductwork penetrations through fire-rated assemblies.
   2. Silicone firestopping sealant for sealing annular spaces around piping and conduit penetrations through fire-rated assemblies and to seal gaps at intersections of walls and floors/ceilings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. UL 1479–Fire Tests of Through-Penetration Fire Stops.

B. UL–Fire Hazard Classifications.

1.03 REGULATORY REQUIREMENTS

A. Firestopping materials and installation shall conform to the Wisconsin Commercial Building Codes requirements, including fire-resistance ratings and surface-burning characteristics.

B. Provide certificate of compliance from local building inspector indicating approval of firestopping materials and installation.

1.04 ENVIRONMENTAL REQUIREMENTS

A. A small amount of hydrogen gas is released as the firestopping foam cures. Use forced-air ventilation when installing if areas of installation have less than 2 cubic feet of free air for each pound of liquid mixture being formed.

PART 2–PRODUCTS

2.01 FIRESTOPPING FOAM

A. Firestopping foam for duct penetrations through fire-rated assemblies shall be a foamed-in-place silicone elastomer produced from two liquid components.

B. Acceptable products include the following, or equal: Fire Barrier 2001 Silicone RTV Foam by 3 M Corporation.

2.02 FIRESTOPPING SEALANT

A. Firestopping sealant for piping and conduit penetrations through fire-rated assemblies shall be a single-component silicone elastomer.

B. Acceptable products include the following, or equal: Fire Barrier Silicone Sealant 2000 by 3 M Corporation.

2.03 DAMMING MATERIAL

A. Damming material shall be fire-resistant mineral fiber (if left in place) or other combustible material (if removed), as directed by the appropriate fire-tested designs.

2.04 PRIMER AND WRAP STRIP

A. Primer for firestopping sealant shall be 3 M Corporation, or equal.

B. Wrap strip for firestopping sealant shall be 3 M Fire Barrier FS-195 Wrap/Strip, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Firestopping foam and sealant shall be applied according to manufacturer's written instructions and shall achieve a fire rating equal to rating of construction which is penetrated. Substrate shall be free of all combustible materials (except damming material for later removal), loose impediment, oil, and other free liquids.

B. Install damming material to establish the thickness and hold the firestopping foam/sealant in place. Follow the manufacturer's installation instructions. All gaps or cracks left after damming materials are in place must be sealed.

C. Firestopping Foam: Immediately after mixing, dispense liquid foam into the penetration opening in accordance with manufacturer's installation instructions. Do not overfill penetration openings with liquid foam. Foam expands approximately three times its original volume during cure. Follow manufacturer's guidelines. If the opening is not filled when the cured foam has completed its expansion, repeat the installation and cure procedure until the opening is filled to the desired level. Allow 15 minutes between application of each shot.

D. Firestopping Sealant: Apply primer and wrap strip in accordance with manufacturer's instructions prior to installing sealant. Apply sealant to a minimum depth of 1 1/2 inches and with uniform density and texture.

E. Remove combustible damming material after foam/sealant has cured. Noncombustible damming material may be left in place.

3.02 QUALITY CONTROL

A. Firestopping Foam:
   1. Perform manufacturer's four-step in-line quality control check at least once daily and upon changing to a new lot of material in order to ensure performance of both dispensing equipment and foam product prior to installing penetration seals. The four-step quality check includes evaluation for: snap time (cure rate); foam color and uniformity; foam cell structure; and foam density (weight).
   2. Check cured penetration seal after 24-hour cure by removing damming materials to examine seal.
   3. Cured foam should completely fill penetration. Fill all remaining gaps with freshly mixed foam or firestopping sealant.
   4. Recheck after added material has cured 24 hours.
   5. Damming materials required to achieve a fire rating must be returned to the penetration.
   6. Clean up spills of liquid components with high-flash mineral spirit solvent, following manufacturer's instructions.
   7. If necessary, trim excess cured foam with a sharp knife or blade.

B. Firestopping Sealant:
   1. Check completed work for complete adhesion and seal 48 hours after sealant application.
   2. Clean adjacent surfaces of excess sealant using a compatible solvent in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 07620

FLASHING AND SHEET METAL

PART 1–GENERAL

1.01 SUMMARY

A. Work includes masonry wall flashing.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM D4586–Asphalt Roof Cement, Asbestos-Free.

1.03 SUBMITTALS

A. See Section 01300–Submittals for general submittal requirements.

B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.

PART 2–PRODUCTS

2.01 MATERIALS

A. Masonry wall flashing and flashing around windows, doors, and other openings shall be 32 mil of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane. Flashing shall be PERM-A-BARRIER wall flashing as manufactured by Grace Construction Products, or equal. Provide primer or surface conditioner as recommended by manufacturer.

PART 3–EXECUTION

3.01 INSTALLATION

A. Through-wall flashing shall be installed 1/2 inch back of the outside face of the wall, carried through the outside wythe, turned up in the collar, and adhered to back-up wall as shown on the drawings. At no time should any portion of the flashing be allowed to hang or drape beyond the width of the wall. All laps shall be sealed and shall not be less than 3 inches in width. Flashing around openings shall extend at least 3 inches beyond each side of opening.

END OF SECTION

SECTION 07710

MANUFACTURED ROOF SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Metal, soffit, and accessories.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. SMACNA–Architectural Sheet Metal Manual.

1.03 SUBMITTALS

A. Submittals shall comply with requirements of Section 01300–Submittals.

B. Submit sample panels for selection of anodized or Kynar 500 finish colors.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA standard details.

1.05 WARRANTY

A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

PART 2–PRODUCTS

2.01 SOFFIT

A. Metal soffit system shall be constructed of 0.032-inch-thick aluminum sheet and shall include all necessary channels, angles, clips, flashing, fasteners, and other accessories of the same material as the soffit panels. Soffit panels shall be unperforated and shall have stiffener grooves spaced at 6 inches on center.

B. Acceptable products include the following, or equal: Fabral, PAC 750 by Peterson Aluminum Corporation.

2.02 FINISHES

A. Finish on all products shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500 fluoropolymer coating over an epoxy prime coat. Colors shall be selected by OWNER. All exposed fasteners shall be provided with the same finish as the sheet metal products.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install components in accordance with the drawings and the manufacturer's instructions.

B. Installation details shall be such as to allow for thermal expansion and contraction of the components and to provide for a complete weatherproof installation.

END OF SECTION

SECTION 07900

CAULKING AND SEALANTS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Caulking and sealants on the project, including primers and backer rod material.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM C920–Elastomeric Joint Sealants.

1.03 SUBMITTALS

A. Submittals shall comply with provisions of Section 01300–Submittals.

B. Submit color chart for each sealant used on project. Colors will be selected by ENGINEER.

C. Submit copies of warranty.

1.04 WARRANTY

A. Caulked joints shall be weathertight and guaranteed watertight by installer for 2 years from date of final payment. Deliver original guarantee to OWNER with copies to ENGINEER.

B. Provide manufacturer's standard 5-year product warranty.

PART 2–PRODUCTS

2.01 CAULK–NONSUBMERGED APPLICATIONS–GENERAL

A. Caulk for nonsubmerged applications in all locations except floor joints shall be a one-part polyurethane sealant.

B. Acceptable products include the following, or equal:
1. NP1 BASF Construction Chemicals, LLC.
2. Vulkem 116 by Tremco, Inc.

2.02 CAULK–NONSUBMERGED APPLICATIONS–FLOOR JOINTS

A. Caulk for floor joints in nonsubmerged applications shall be a one-part, self-leveling, polyurethane sealant.

B. Acceptable products include the following, or equal:
   1. SL1 by BASF Construction Chemicals, LLC.
   2. Vulkem 45 SSL by Tremco, Inc.

2.03 CAULK-SUBMERGED APPLICATIONS-POTABLE WATER CONTACT

A. Caulk in all submerged potable water contact applications shall be an NSF-approved, two-part polysulfide base synthetic rubber sealant, or an NSF-approved, one-part polyurethane sealant recommended by the sealant manufacturer for potable water contact.

B. Acceptable products include the following, or equal: Sika Duoflex NS, or Thiokol 2235M by PolySpec.

2.04 ACCESSORIES

A. Backer rod shall be flexible, closed-cell polyethylene rod stock sized to be under at least 25% compression when positioned in the joint. In shallow joints and where backer rod is not used, polyethylene bond breaker tape shall be used. It is essential that the caulk bond to the side of the joint but not to the base of the joint.

B. Primer(s) shall be used where required by the manufacturer for the specific product(s) used and the specific application(s) intended. Specific product(s) shall be as recommended by the manufacturer.

C. Cleaning fluid shall be methyl ethyl ketone (MEK), methyl isopropyl ketone (MIK), or similar solvent material which will not etch or mar metal finishes and shall be the product of a nationally recognized manufacturer, of type expressly recommended for use with the caulking or sealant compound used.

PART 3–EXECUTION

3.01 INSTALLATION

A. Seal completely all joints around entire perimeter of all openings in all exterior walls (inside and outside faces), including joints at all exterior doors, windows, louvers, sills, and elsewhere as noted on the drawings and as necessary to seal all open joints in the building in a complete manner. Joints in exterior walls shall be caulked in a completely weathertight manner. Joints between interior walls and concrete ceilings and other interior joints shall be caulked as indicated on the drawings. Caulking not specified in other sections shall be performed under this heading.

B. All caulking shall be done in accordance with manufacturer's specifications. Allow minimum 28-day curing period for concrete, grout, or mortar prior to caulking unless requested otherwise. Caulking work shall be done before the final coat of paint is applied except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting. All caulking shall occur only when the temperature is above 40°F.

C. Joints shall be thoroughly cleaned and primed before caulking in accordance with manufacturer's instructions. Unless otherwise shown, joints shall be square in cross

section 1/2 inch by 1/2-inch and shall comply with manufacturer's joint width/depth ratio limitations.

D. Backer rod shall be used in all openings 3/4 inches or more in depth and shall be tightly packed to completely fill the space to 1/2 inch back of face. The 1/2 inch shall then be filled with caulking compound.

E. Caulking shall be done by hand gun. Compound shall be driven into joint grooves with sufficient pressure to force out all air and fill joint grooves solidly. Caulking where exposed shall be free of wrinkles and shall be uniformly smooth.

F. At completion of caulking, clean off all excess material from adjoining surfaces and material. Entire installation shall be left in a perfect appearing weathertight condition.

END OF SECTION

SECTION 08220

FIBERGLASS DOORS AND ALUMINUM FRAMES

PART 1–GENERAL

1.01 SUMMARY

A. Work includes thermally-insulated fiberglass doors and aluminum frames.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 WARRANTY

A. Provide 10-year warranty on doors and frames signed by manufacturer, installer, and CONTRACTOR.

PART 2–PRODUCTS

2.01 FIBERGLASS DOORS

A. Thermally-insulated fiberglass doors shall be 1 3/4 inches total thickness with a 1 1/2-inch rigid polyurethane core.

B. Acceptable products include the following, or equal: Special-Lite, Inc., SL-17.

2.02 DOOR FRAMES

A. Frames shall have 4-inch head member at 7 feet 0-inch doors in masonry walls.

B. Aluminum frames shall be tube-type, minimum 0.125 inches thick.

C. Double door shall have a removable 4-inch wide mullion.

2.03 FABRICATION

A. Face sheets shall be laminated to the polyurethane core. Face sheets shall be 0.120-inch-thick reinforced polyester. Face sheets shall be Spec Lite 3, Inc., as manufactured by Special-Lite, Inc.

B. Stiles and rails shall be minimum 2 5/16 inches depth by 0.125-inch-thick aluminum, 6063-T5 aluminum alloy.

C. All doors shall be mortised and reinforced to receive hardware.

D. Frames shall be prepared for all door hardware including door position switches and electric strikes.

2.04 FINISH

A. Color of fiberglass door face sheets shall be chosen by OWNER from manufacturer's standard colors. Aluminum frames and door extrusions shall have a Kynar® two-coat finish chosen from manufacturer's standard, 20 color. Color as chosen by OWNER.

PART 3–EXECUTION

3.01 INSTALLATION

A. Set all doors and frames as supplied by manufacturer. Use masonry anchors to support frame.

B. Hang all doors allowing for expansion and contraction at time of setting.

C. Set all hardware in accordance with templates as supplied by hardware supplier.

D. Cover all exposed hardware until completion of painting and finishing.

E. Examine hardware at completion; test, oil, grease, and adjust for perfect operation.

3.02 SCHEDULE

A. See Door Schedule on the drawings.

END OF SECTION

SECTION 08305

ACCESS DOORS AND FRAMES

PART 1–GENERAL

1.01 SUMMARY

A. Work included: Aluminum floor doors and frame units.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 ALUMINUM FLOOR DOORS AND FRAMES

A. Acceptable products include the following, or equal: The Bilco Company, Type J as scheduled.

B. Type J doors shall be designed for a minimum live load of 300 psf with a maximum deflection of 1/150 of span.

C. Doors shall be constructed of stiffened 1/4-inch aluminum diamond-pattern plate.

D. Channel frame for Type J doors shall be 1/4-inch extruded aluminum with bend-down anchor tabs. Depth of frame shall be 6 inches. A continuous EPDM gasket shall be mechanically attached to the frame around the entire perimeter.

E. Hinges shall be through bolted to the door and frame with tamper-proof Type 316 stainless steel lock bolts.

F. Provide 1 1/2-inch drain coupling located in corner of channel frame for Type J doors.

G. Type J doors shall be equipped with required number and size of compression spring operators for door to operate easily and smoothly. Provide heavy-forged cam-action hinges to open door so edge of door does not open into channel. Doors shall have smooth controlled operation and not be affected by temperature.

H. Provide hold-open arm that automatically locks in open position. Provide snap lock with fixed handle mounted to underside of cover. Provide removable exterior turn/lift handle with spring-loaded ball detent to open cover. All hardware shall be Type 316 stainless steel for corrosive environment.

2.02 FINISH

A. Aluminum floor doors and frames shall have mill finish. Apply bituminous coating to portions of frames in contact with concrete.

PART 3–EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions.

B. Provide piping from channel frames for Type J floor doors from outlet to base of wall.

3.02 SCHEDULE

A. See Door Schedule on the drawings.

END OF SECTION

SECTION 08505

STEEL WINDOWS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes fire-rated steel window assemblies.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A569	(1991a; R 1993) Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A653	(1994) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B633	(1985; R 1994) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM B766	(1986; R 1993) Electrodeposited Coatings of Cadmium
ASTM E163	Fire Tests of Window Assemblies

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts
ASME B18.6.4	(1981; R 1991) Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1992) Fire Doors and Windows

UNDERWRITERS LABORATORIES INC.

UL9	Fire Tests of Window Assemblies
File No. R13157	D.V. Fyre-Tec Classification

1.03 PERFORMANCE REQUIREMENTS

A. Steel windows shall be designed to meet the following performance requirements, and shall be of the type and size indicated. Fire-rated windows shall bear the Underwriters Laboratories, Inc. label, including the manufacturer's file number for the indicated rating.

B. Fire Resistance:
   1. Fire resistance shall meet requirements established by ASTM E163 and as tested and classified by Underwriters Laboratories, Inc, in accordance with UL-9. Products shall meet the requirements of Underwriters Laboratories, Inc. The Listing Mark of UL on the product will be accepted as evidence of compliance.
   2. Rated protected openings specified as 3/4 hour shall be glazed with rated wire glass

1.04 SUBMITTALS

A. Manufacturer's descriptive data and catalog cut sheets.

B. Drawings indicating elevations of windows, rough-opening dimensions for each type and size of windows, full-size sections, thickness of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details and window schedules showing locations of each window type, and indicating compliance with fire safety code where required.

C. Manufacturer's preprinted installation instructions and cleaning instructions.

D. Certificates stating that the steel windows conform to requirements of this section.

E. Manufacturer's standard color samples of painted finishes.

1.05 DELIVERY AND STORAGE

A. Steel windows shall be delivered to project site and stored in accordance with manufacturer's recommendations.

PART 2–PRODUCTS

2.01 GENERAL

A. Manufacturer: Series 950 Fixed Lite Window as manufactured by D.V. Fyre-Tec, Wayne, NE 68787 (800-377-3261), or equal.

2.02 MATERIALS

A. Steel Frames: Steel frames shall be fabricated from roll-formed galvanized lock-forming quality steel per ASTM A527. Frame corners shall mitered and welded. Integral munton shall be galvanized roll-formed material fitted and welded.

B. Formed Component Parts: Formed component parts shall be hot-rolled sheet steel conforming to ASTM A569, commercial quality with a minimum of 0.15% carbon. Sheet

steel shall be zinc coated (galvanized) by the hot-dip process in accordance with ASTM A653 or ASTM A924.

C. Screws and Bolts: Screws and bolts shall conform to ASTM B766, ASME B18.6.3 and ASME B18.6.4.

2.03 STEEL WINDOW TYPES

A. Units shall be complete with glass and glazing provisions to meet requirements of Paragraph 1.03. Glazing material shall be compatible with steel and shall not require painting.

B. Fire-Rated Windows: Fire-rated windows shall conform to UL-9 and shall be labeled with a 3/4-hour fire-test rating as specified herein. Units shall be designed and fabricated to meet glass sizes, window sizes, and opening dimensions established by NFPA 80. Hardware shall conform to NFPA 80 requirements.

2.04 ACCESSORIES

A. Fasteners: Fastening devices shall be window manufacturer's design made from nonmagnetic stainless steel, cadmium-plated steel, zinc-plated steel, nickel/chrome-plated steel, or magnetic stainless steel.

B. Window Anchors: Anchors for installing windows shall be stainless steel or hot-dip zinc-coated steel conforming to ASTM A 123.

2.05 FINISHES

A. Prime Coat: Steel windows, fins, mullions, cover plates and associated parts shall be cleaned, pretreated with iron phosphate and factory-painted manufacturer's standard primer coat in a dry film thickness of not less than 0.025 mm (1.0 mil).

B. Finish Coat: Steel windows, fins, mullions, cover plates and associated parts shall be cleaned, pretreated with iron phosphate and factory coated with baked alkyd enamel with a manufacturer's standard color in a dry film thickness of not less than 0.050 mm (2.0 mil).

PART 3–EXECUTION

3.01 INSTALLATION

A. Steel windows shall be installed in accordance with approved shop drawings and manufacturer's recommendations. Fire-rated windows shall be installed in compliance with NFPA 80. Steel surfaces in close proximity with masonry, concrete, wood, and dissimilar metals other than stainless steel, zinc, cadmium, or small areas of white bronze shall be protected from direct contact. The completed window installation shall be watertight. Fire-rated windows shall be glazed in accordance with NFPA 80.

3.02 CLEANING

A. Steel window finish and glass shall be cleaned on interior and exterior sides in accordance with window manufacturer's recommendation. Alkaline or abrasive agents shall not be used.

3.03 SCHEDULE

A. See Window Schedule on the drawings.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Hardware to fully equip all doors.
   2. Thresholds and weatherstripping.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REGULATORY REQUIREMENTS

A. Hardware shall conform to the Wisconsin Commercial Building Code for requirements applicable to fire-rated doors and frames. Hardware shall comply with NFPA 80 and shall be properly stamped or labeled for easy identification.

B. Hardware shall comply with barrier-free requirements.

PART 2–PRODUCTS

2.01 LOCKSETS AND LATCHSETS

A. Locksets, latchsets, and dead locks shall be Sargent cylindrical-type Series 10L, or equal, with 2 3/4-inch backset. Strikes shall be curved lip. Lockset and latchset numbers specified in paragraph 3.02 are Sargent. Provide removable core brass 6-pin cylinders.

2.02 EXIT DEVICES

A. Exit devices shall be Von DuPrin 9925 Series, or equal, and shall be equipped with reinforced cross bars and functions as indicated on the hardware sets. The exit device shall be operated by a lockable lever from the exterior side.

2.03 HINGES

A. Butt hinges shall be Stanley FBB 191, Hager BB 1191, or equal, full mortise, ball bearing, nonferrous, nonrising, loose pin, and flat bottom tip, unless otherwise specified. Provide three 4 1/2-inch by 4 1/2-inch hinges per door for doors 7 feet or less in height with one additional hinge for each additional 30 inches or fraction thereof, unless otherwise specified. Provide additional hinges or heavyweight hinges for all doors that are over 36 inches wide, unless specified otherwise.

2.04 DOOR CLOSERS

A. Door closers shall be LCN Series 1460 for exterior doors and 1461 for interior doors, or equal. Provide aluminum finish on closers. Provide full covers. Door closers for locations

noted as (ss) shall have the SRI primer for corrosion resistance. Door closers specified in paragraph 3.02 are LCN. (H-Hold Open)

2.05 OVERHEAD DOOR HOLDERS

A. Overhead door holders shall be Glynn Johnson GJ 81H Series, or equal, unless otherwise specified. Holders for locations noted as (ss) shall be fabricated with stainless steel components. Numbers specified in paragraph 3.02 are Glynn Johnson.

2.06 SURFACE BOLTS

A. Surface bolts shall be 8-inch Ives 1630 series, or equal. At doors with (ss) hardware, bolts shall be 8-inch Ives 1640 Series, or equal.

2.07 KICKPLATES

A. Kickplates shall be Rockwood, or equal, 6 inches high. Kickplate width shall be 2 inches less than door width.

2.08 DOOR STOPS

A. Provide wall- or floor-mounted door stops at all interior doors. Stops shall be Glynn Johnson GJFB-13, GJ60C, or GJ60W for locations noted as (ss), or equal.

2.09 THRESHOLD AND WEATHERSTRIPPING

A. All exterior doors shall be weatherstripped with Reese DS106, National Guard Products, Inc. 190, or equal, weatherstripping. Provide Reese 323C, Pemko 315AN, or equal, sweeps; and Reese S425A, Pemko 171A.

2.10 KEYING

A. Door keys shall be keyed to match Madison Water Utility standards that have Sargent key systems. Provide two keys per lock. Doors shall have temporary construction cylinders. Provide permanent cylinders at project completion.

2.11 LATCH PROTECTION PLATE

A. Latch protection plate shall be 3 inches by 11 inches for use with cylindrical locksets with a 2 3/4-inch backset. Protection plate shall be steel with finish to match door hardware, Hager 341D, DonJo MLP211, or equal.

2.12 ELECTRIC STRIKE

A. Electric strike shall be Von Duprin Model 6211 for standard cylindrical locks, and Model 6112 for exit devices, or equal. Strike shall be stainless steel, nonhanded, fail secure, adjustable and have plug connections. Division 16 will provide corresponding controls and power transformer to be installed by CONTRACTOR. Coordinate with equipment provided.

2.13 FINISH

A. Finish for all hardware, except as noted below, shall be US 26D or US 32D where stainless steel (ss) hardware is specified in paragraph 2.

B. Finish for surface bolts shall be US 26D; finish for kickplates shall be 32D.

C. Where stainless steel (ss) is specified, all hardware, including threshold and weatherstripping, shall be installed with stainless steel fasteners.

PART 3–EXECUTION

3.01 INSTALLATION

A. Provide finish hardware to fully equip all doors.

B. Install hardware in accordance with manufacturer's instructions.

3.02 SCHEDULE

A. Provide the following hardware groups in the amounts indicated on the door schedule or required for a complete and proper installation:

Group 1

Lockset–10G05
Door Closer–1460H
(Parallel Arm)
Hinges and Kickplate
Electric Strike
Latch Protection

Group 2

Exit Device–8813 x PRK (ss)
Door Closer–1460 (ss)
(Parallel Arm)
Hinges and Kickplate (ss)
Electric Strike
Latch Protection

Group 3

Surface bolts–One top and bottom
Overhead Door Holder GJ 81 H–HD
Hinges and Kickplate

Group 4

Lockset 10U65
Hinges

END OF SECTION

SECTION 09111

METAL STUD FRAMING SYSTEM

PART 1–GENERAL

1.01 SUMMARY

A. Work includes metal studs, furring channels, and accessories.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM C754–Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products.

B. ASTM C840–Standard Specification for Application and Finishing of Gypsum Board.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include the following, or equal:
   1. Dietrich Industries, Inc.
   2. Clark Western.
   3. UNIMAST Incorporated.
   4. Marino/WARE.

2.02 MATERIALS

A. Metal studs shall be 25 gauge, galvanized, except as otherwise shown or specified; channel shaped and punched for utility access. Depth as shown on drawings; 3 1/2 inches minimum if size not shown.

B. Top and bottom runners shall be of same material and thickness as studs with 1 1/4-inch leg.

C. Provide fasteners, 20 gauge sheet metal backing, and other accessories for a complete installation.

D. Furring channels shall be 25 gauge, galvanized, except as otherwise shown or specified. Depth and configuration shall be as shown on drawings.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install metal framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation.

B. Framing shall be with studs and runners of depth shown or required.

C. Provide continuous runner tracks sized to match stud depth. Align runner tracks accurately to the partition layout at both sill and head. Secure runner tracks as recommended by the stud manufacturer for the sill and head construction involved, except do not exceed 24 inches on center spacing for nail- or power-driven fasteners or 16 inches on center for other types of attachment. Provide fasteners at all corners and ends of runner tracks.

D. Friction fit studs to runner tracks by positioning and rotating into place. Provide positive attachment to runner tracks for studs located at partition corners and intersections and adjacent to openings using 3/8-inch self-tapping screws or stud-clinching tool on both flanges of studs. Do not weld.

E. Brace stud framing system rigid.

F. Frame and/or furr out to receive miscellaneous gypsum wallboard surfaces. Use applicable framing members and accessories for use intended.

END OF SECTION

SECTION 09250

CEMENT BOARD

PART 1–GENERAL

1.01 SUMMARY

A. Work includes cementitious wallboard and accessories.

B. Related Sections: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM C 954: Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.110 inch in Thickness.

B. ASTM C 1002: Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

C. ASTM C 1280: Standard Specification for Application of Gypsum Sheathing.

D. ASTM C 1325: Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Interior Substrate Sheets.

E. ASTM D 226: Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

F. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.

G. ASTM E119: Test Method for Fire Tests of Building Construction and Materials.

1.03 REGULATORY REQUIREMENTS

A. Conform to the Wisconsin Commercial Building Code for fire-rated assemblies.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include the following, or equal: United States Gypsum Company (USG).

2.02 MATERIALS

A. Cementitious Fiber-Mat Reinforcing Sheathing (Cement Board):
   1. Provide cement board conforming to ASTM C1325, in maximum lengths available to minimize end-to-end joints.

2. Gypsum shall be 5/8-inch-thick by 48-inch-wide USG Durock Brand Cement Board, or equal.

B. Accessories: Provide corrosion-resistant screws complying with recommendations of manufacturer of cement board.

PART 3–EXECUTION

3.01 EXAMINATION

A. Examine substrate to receive cement board for alignment, support, bracing, etc., prior to installation. Shim, block as required to comply with tolerances.

B. Verify that the installation of all blocking work is completed.

3.02 INSTALLATION

A. Install cement board to comply with ASTM C1280 and manufacturer's written instructions.

END OF SECTION

SECTION 09670

RESINOUS FLOORING

PART 1–GENERAL

1.01 WORK

A. Work included: Provide decorative quartz epoxy flooring.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Standard Division 1

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM).

1.04 SUBMITTALS

A. Prior to commencing work, submit manufacture's technical information and installation details to describe material to be used.

B. Submit manufacturer certificate of compliance that materials meet specification requirements.

C. Before beginning work, provide samples for the flooring system for approval.

1.05 QUALITY ASSURANCE

A. Contractor shall be an established firm regularly engaged in satisfactory installation of similar material for the past 5 years. Provide a letter of certification my manufacturer that Contractor is a current qualified installer.

B. Single source responsibility: Provide fillers, primers, body coats, and topcoats produced by the same manufacturer and supply of principal material or work in this section.

1.06 DELIVERY AND STORAGE

A. Deliver material to project site in manufacturer's original unopened containers bearing manufacturer's name, product and color.

B. Store material indoors, room temperature 77°F. Protect from damp, moisture and direct sunlight.

1.07 PRODUCT CONDITIONS

A. Evaluate the substrate condition, including moisture content and extend of substrate leveling and repairs required, if any.

B. Coordinate flooring work with other trade to ensure adequate illumination, ventilation, and dust free environment during application and curing of flooring.

C. Comply with material manufacturers recommended temperature limitations for flooring application.

PART 2–PRODUCTS

2.01 APPROVED MANUFACTURERS

A. MICOR Company Inc., Milwaukee, WI 53216 Phone (414-872-2071) Fax (414-873-3904), or equal.

B. Primer: MICOROX® 103 epoxy primer.

C. Decorative Resinous liquids shall be blended silica aggregated in an epoxy resin binder broadcast with colored quartz aggregate and top coated with 100% solids, cycloaliphatic amine cured sealer. Nominal application to be 1/4 inch thick.

D. Ceramic-coated aggregate shall be used to achieve color. Color to be chosen by OWNER.

E. Epoxy Sealer: Clear, two component 100% solids epoxy seal coat(s) MICOROX® 1882

PART 3–EXECUTION

3.01 SURFACE CONDITIONS

A. Surface shall be clean and dry, physically sound, and free of contamination, hole voids, or defects. Correct racks and abrupt changes in surface profile. Remove fins, projections, curing compounds, and sealers.

B. Verify the moisture content is within range acceptable to flooring manufacturer, using calcium chloride test kit or plastic sheet method per ASTM 4263.

C. Report, in writing, surfaces left in improper condition by other trades. Application will constitute acceptance of surfaces.

3.02 PREPARATION

A. No curing agents or sealers may be used that interfere with the adhesion of the coating applied. If such materials are applied, cement contractor shall bear all costs incurred for removal.

B. New concrete shall have a minimum of 28 days cure prior to coating application.

C. Clean floor surface to remove all dirt, dust, grease, oil, old coatings, and loose concrete by abrasive blasting in accordance with SSPC-SP13/NACE No. 6. Final surface must allow proper bonding of the primer coat to the substrate.

D. Cracks and voids shall be repaired or filled only with materials approved by MICOR Company, Inc.

E. CONTRACTOR and OWNER shall determine if present floor slopes adequately to insure proper drainage in the areas to receive decorative quartz flooring. Should existing floor require repitching, consult manufacturer's representative for recommendations.

3.03 INSTALLATION

A. Install specified materials in strict conformance to manufacturer's written instructions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider stripes, control joints, or other types of joints (if any), indicated or required.

3.04 CLEANUP

A. Remove waste materials, rubbish and debris and dispose of them at OWNER's direction. Leave work areas in a clean condition.

B. CONTRACTOR, Project Manager, or OWNER will be responsible for protection of floors from damage by other trades and for final cleanup upon completion of project.

3.05 PROTECTION

A. Protect completed work from water, airborne particles, or other surface contaminates until cured and tack free, approximately 12 hours after application.

B. Protect completed system from immersion and chemical exposure until thoroughly cured, approximately 24 hours.

END OF SECTION

SECTION 09900

PAINTING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Surface preparation and application of paints and coatings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM B117–Test Method of Salt Spray (Fog) Testing.

B. ASTM D2247–Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.

C. ASTM D3363–Test Method for Film Hardness by Pencil Test.

D. ASTM D4060–Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

E. ASTM D4541–Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

F. ASTM D4585–Practice for Testing Water Resistance of Coatings Using Controlled Condensation.

G. SSPC–The Society for Protective Coatings–Steel Structures Painting Manual.

H. NACE–National Association of Corrosion Engineers.

I. ICRI–International Concrete Repair Institute.

J. Federal Register–Code of Federal Regulations (CFR).

K. Federal Register–Resource Conservation and Recovery Act (RCRA).

L. Federal Register–Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.03 SUBMITTALS

A. Submittals shall be in accordance with provisions of Section 01300–Submittals.

B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.

C. Submit two copies of manufacturer's Material Safety Data Sheets (MSDS) for each type of paint with each shop drawing submittal. MSDS sheets shall be posted at the construction site at all times painting is in progress.

D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in paragraph 2.01.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
   2. All paints shall be NSF Standard 61-approved when they are in contact with potable water or within potable water reservoirs.

B. Prepainting Meeting:
   1. A prepainting meeting shall be held immediately following the project preconstruction conference. The prepainting meeting is to be held prior to any material and equipment that requires painting is delivered to the site.
   2. CONTRACTOR, the paint subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
   3. The paint manufacturer's representative shall review progress at the site as requested by ENGINEER. These are generally expected to be prior to monthly progress meetings.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.

B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.

C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

1.06 ENVIRONMENTAL REQUIREMENTS

A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.

B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open-flame heaters shall not be used.

C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

1.07 COLOR SELECTIONS

A. Provide color charts for all coatings being used on the project. After initial selection of colors by OWNER, provide draw down samples of selected colors for OWNER's final

approval. For stained wood, provide specified wood species sample with selected color for final approval.

B. CONTRACTOR shall provide a summary sheet at the completion of the project listing the finish paint products used and the manufacturer's color identification for each item painted. This summary sheet should be submitted to ENGINEER and OWNER for review.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin Williams Company, or equal, unless noted otherwise in the schedule.

B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.

C. Paint and paint products of Tnemec Company and Sherwin Williams, listed in the following specifications, are set up as standard of quality. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM Specifications shall be the latest revision:
   1. Abrasion–ASTM D4060, CS-17 Wheel, 1,000 grams load.
   2. Adhesion–ASTM D4541.
   3. Hardness–ASTM D3363.
   4. Humidity–ASTM D2247 and D4585.
   5. Salt (Fog) Spray–ASTM B117.

PART 3–EXECUTION

3.01 SURFACE PREPARATION

A. General:
   1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
   2. No field painting shall be done before the prepared surfaces are observed by ENGINEER. Surfaces painted without such observation shall be abrasive-blast-cleaned and repainted.
   3. Prior to field-blasting, a sample of the blast abrasive shall be provided to ENGINEER for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to ENGINEER for pH testing.
   4. For on-site abrasive-blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Staurolite abrasive shall be used on concrete and concrete block.

5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.

B. Ferrous Metal:
   1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
   2. All ferrous metals not primed in the shop shall be abrasive-blasted in the field prior to application of the primer, pretreatment, or paint.
   3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
   4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive-blasting operations.
   5. Ductile iron pipe shall be prepared by abrasive blasting per National Association of Pipe Fabricators NAPF 500-03.
   6. Prior to finish coating, all primed areas that are damaged shall be cleaned and spot-primed.

C. Concrete:
   1. All concrete surfaces, including precast concrete to be painted, shall be cleaned of all form oil, curing compound, and other foreign matter. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues.
   2. All new concrete and precast concrete walls, floors, and ceilings shall be abrasive-blast cleaned in accordance with SSPC-SP13/NACE No. 6 in order to prepare the surfaces for adherence of the painting systems as specified. Abrasive blasting of concrete shall result in a surface profile in accordance with ICRI No. 03732 at CSP-3 to CSP-5. Bug holes that are opened up shall be filled with an appropriate filler.
   3. Bug holes shall be filled as specified in Section 03300, Cast-in-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
   4. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
   5. After cleaning, the surface shall be washed and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.

D. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with nonhydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC SP 1 and shall be abrasive-blasted in accordance with SSPC-SP7.

E. Copper: Where copper piping is not submerged or buried, it shall be solvent-cleaned in accordance with SSPC SP 1 and shall be lightly sanded.

F. PVC and CPVC: All PVC and CPVC to be painted shall be solvent-cleaned in accordance with SSPC SP 1 and shall be lightly sanded.

G. Aluminum: Where listed in the Schedule to be painted, it shall be solvent-cleaned in accordance with SSPC SP 1 and shall be lightly sanded.

3.02 APPLICATION

A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.

B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.

C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.

D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.

E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.

F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.

G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.

H. Walls and ceiling surfaces shall receive a minimum of one coat of paint before surface-mounted items such as conduits, boxes, piping, etc., are installed on these surfaces.

I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to, between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.

J. No paint shall be applied to new or existing surfaces until joints have been caulked according to Section 07900 requirements, except at moving joints which shall be finish-painted before caulking or caulking shall be protected during painting.

K. For PVC and CPVC piping, unions and valves shall not be painted.

3.03 FIELD QUALITY CONTROL

A. Examination of work on the site by the manufacturer's representative shall be performed when requested by ENGINEER.

3.04 CLEANING

A. All stains and marks shall be removed from other surfaces upon completion of the work.

3.05 SCHEDULE

A. General:
1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched-up.
2. See Finish Schedule on the drawings for an additional reference for areas to be painted.
3. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze, machined surfaces, moving parts where painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask ENGINEER.
4. Products listed first are Tnemec and second are Sherwin Williams.

B. New Work:
1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all ferrous metal items scheduled for painting be shop-primed. If items are not shop-coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from ENGINEER, and the items shall be painted as part of this Contract without additional cost.
2. Interior Concrete Floors: Sealed: Section 03300. Resinous Flooring: Section 09670.
3. Interior Concrete Walls, Including Equipment Bases: Two coats of Enviro-Crete 157, Pro Industrial Zero VOC Waterbased Epoxy.

   Note: Interior face of concrete tank walls and floors channels and pipe trenches are not to be painted.

4. All Exposed Concrete Ceilings (Ceilings of water-containing tanks are not considered exposed): Two coats of Enviro-Crete 157, Pro Industrial Zero VOC Waterbased Epoxy.
5. Cast or Ductile Iron; Not Submerged or Buried:
   a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
   b. Touch-up prime coat prior to finish coating; and apply either:
      (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
      (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
6. Cast or Ductile Iron, Tar Coated; Buried: Not painted.
7. Cast or Ductile Iron; Submerged:
   a. One shop coat N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
   b. Touch-up prime coat prior to finish coating; and two coats of N69 Hi-Build Epoxoline II, Macropoxy 646.
   c. For areas in contact with potable water:
      (1) One shop coat of N140-1255 Beige Pota-Pox Plus, Macropoxy 646 NSF Beige as primer;
      (2) Touch-up prime coat prior to finish coating; and one coat of N140-11WH White Pota-Pox Plus, Macropoxy 646 NSF White; and one coat of N140 Pota-Pox Plus, Macropoxy 646 NSF.
8. Steel, Machinery, and Equipment; not Submerged:
   a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
   b. Touch-up primer prior to finish coat; and either:

(1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
(2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

FIRST FIELD COAT SHALL BE APPLIED PRIOR TO INSTALLATION TO SURFACES INACCESSIBLE AFTER INSTALLATION INCLUDING BACK SIDES OF DOOR FRAMES. SEE DIVISION 8 FOR FACTORY-APPLIED DOOR PRIMERS.

9. Motors, gear drives, and doors delivered with nonepoxy primers:
   a. Degrease per SSPC-SP1.
   b. Lightly hand-sand per SSPC-SP2.
   c. Apply one coat 135-1255 Chembuild Beige, Macropoxy 646 Beige.
   d. Apply two finish coats as follows:
      (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
      (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
10. Steel, Machinery, and Equipment; Submerged:
   a. One shop coat N69-1255 High-Build Epoxoline, Macropoxy 646 Beige as primer; and two field coats N69 High Build Epoxoline II, Macropoxy 646.
   b. For areas in contact with potable water: One shop coat of N140-1255 Beige Pota-Pox Plus, Macropoxy 646 NSF Beige as primer; and touch-up prime coat prior to finish coating; and one coat of N140-11WH White Pota-Pox Plus, Macropoxy 646 NSF White; and one coat of N140 Pota-Pox Plus, Macropoxy 646 NSF.
11. Galvanized, Copper, Brass, CPVC, and PVC; not Submerged or Buried:
   a. One coat of N69-1255 Hi-Build Epoxoline II, Macropoxy 646; and either:
   b. Two coats of N69 Hi-Build Epoxoline, Macropoxy 646 for interior surfaces; or
   c. One coat of N69 Hi-Build Epoxoline, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
12. Insulation of Equipment, Pipes, and Ductwork: Two coats of Series 6 Tnemec-Cryl, DTM Acrylic B66100.
13. Galvanized, Copper, CPVC, and PVC; Submerged or Buried: Not painted.
14. Aluminum Items:
   a. Exposed areas of structural items such as railings and grating shall not be painted.
   b. For structural items in contact with concrete, See Division 5.
15. Stainless Steel: Not painted.
16. Brick: Not painted.

C. Existing Areas: Existing areas damaged by removal of existing work and/or installation of new work shall be repainted to match existing and in accordance with the schedule for new work.

D. Coverage:
   1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
   2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of ENGINEER, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.

3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the painter, one additional coat, minimum, will be required to achieve total DFT thickness as specified and recommended by the manufacturer.

	Sq. Ft.** Coverage	Dry Mil Thickness Per Coat
Products		
6 Tnemec-Cryl, DTM Acrylic B66100	200	
N69 Hi-Build Epoxoline II, Macropoxy 646		
Concrete Block Primer Coat	90	---
Concrete Block Intermediate Coat(s)	130	---
Concrete Block Finish Coat	140	---
Concrete Primer Coat	100	---
Concrete Intermediate Coat(s)	140	---
Concrete Finish Coat	160	---
Steel or Impervious Substrate Primer Coat	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish coat	---	5.0
135-1255 Chembuild, Macropoxy 646	335	4.0
Steel Doors	---	3.0
140 Pota-Pox Plus, Macropoxy 646 NSF		
Steel or Impervious Substrate Primer	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish Coat	---	5.0
Enviro-Crete 157, Pro Industrial Zero VOC	160	
1074 Endura-Shield II, Acrolon 218HS	---	2.5

** Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or application. Final total dry film thickness (DFT) shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to assure coverage.

E. Pipe Colors: Colors are to be selected by OWNER, with the following piping colors used where applicable. Pipe color shall be in accordance with the requirements of the Wisconsin/Illinois Administrative Code.

	WATER PIPING COLORS		
Pipe Type	WI DNR NR 811	IEPA IL35(f)II Part 653[1]	10 States Standards (2007 Water)
Water Lines			
Finished or Potable	Dark blue	-	Dark blue
Waste Lines			
Sewer (sanitary or other)	Dark grey	-	Dark grey

Pipe Type	WATER PIPING COLORS		
	WI DNR NR 811	IEPA IL35(f)II Part 653[1]	10 States Standards (2007 Water)
Other Lines			
Compressed air/Vacuum	Dark green	-	Dark green
Gas	Red	-	Red
Other lines	Light gray	-	Light gray

END OF SECTION

SECTION 10050

MISCELLANEOUS SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Lockout/tagout centers.
   2. Neoprene gaskets.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 LOCKOUT/TAGOUT CENTERS

A. CONTRACTOR shall provide one lockout/tagout kit. One shall be located at the MCC. Kit shall include one carrying case, five colored padlocks, five safety locks, and five lockout tags.

B. Lockout/tagout kits shall be Seton Model No. 42469.

2.02 NEOPRENE GASKETS

A. Furnish and install neoprene gaskets at weir plates and as called for on the drawings.

B. Neoprene shall be of the size and thickness shown on the drawings. Minimum thickness shall be 1/8 inch. The material shall be 40-50 durometer premium-grade neoprene. Only virgin polymers shall be used to manufacture the neoprene. A certificate of material quality shall be furnished.

C. Where splices are necessary, they shall be butt splices made with a two-part neoprene base-bonding cement. The vulcanizing cement shall be Black Cement by CPR Industries of Carteret, New Jersey, or equal.

D. At splices in weir plates, provide an additional thickness of neoprene to match the plate material. Bond the additional neoprene to the continuous gasket using the cement specified for splices.

E. All gaskets shall be watertight.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10520

FIRST AID KIT

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: First aid kit.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MANUFACTURER

A. First aid kit shall be Johnson and Johnson Model No. 8162 wall-mounted (50-person 227-item kit), Lab Safety Supply Co. (800-356-0783), or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. First aid kit shall be wall-mounted.

B. Mount in the Building where requested by OWNER.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Fire extinguishers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/NFPA 10–Portable Fire Extinguishers.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Product Data: Provide extinguisher operational features, color and finish, anchorage details, and cabinet dimensions.

1.04 QUALITY ASSURANCE

A. Provide units conforming to NFPA 10 requirements for portable fire extinguishers.

B. Provide fire extinguisher, cabinets, and accessories by single manufacturer.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Larsen's Manufacturing Company, Product MP Series.

B. Substitutions: Under provisions of Section 01600–Materials and Equipment.

2.02 EXTINGUISHERS

A. Provide two dry-chemical-type, Larsen's MP Series, 10-pound-capacity fire extinguishers. Fire extinguishers shall be UL-approved for Class A, Class B, and Class C fires.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place extinguishers in brackets where shown on the drawings.

C. Mount fire extinguisher so the handle is at 48 inches above the finished floor.

END OF SECTION

SECTION 10800

TOILET AND BATH ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Toilet, bath, shower, and washroom accessories.
   2. Grab bars.
   3. Attachment hardware.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI A117.1–Safety Standards for the Handicapped.

B. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A167–Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A269–Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

E. ASTM A366–Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.

F. ASTM B456–Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.03 REGULATORY REQUIREMENTS

A. Conform to ANSI A117.1 and Federal ADA-AG code and the Wisconsin Commercial Building Code for access for the handicapped.

PART 2–PRODUCTS

2.01 TOILET TISSUE DISPENSERS

A. Multiroll dispensers shall be surface-mounted. Bobrick B-288, Bradley 5402, or equal. Provide total of one.

B. Unit shall be Type 304 stainless steel with satin finish.

2.02 HOOKS

A. Heavy-duty hooks shall be Bobrick B-2116, Bradley Model 911, or equal. Provide total of three.

B. Hook and flange shall be brass castings with satin nickel-plated finish.

2.03 SOAP DISPENSER

A. Surface-mounted liquid soap dispensers shall be Bobrick B-86, Bradley 657, Bradley 5050, or equal. Provide total of one.

B. Unit shall be chrome-plated brass with plastic container.

C. Install one above each toilet room sink.

2.04 TOWEL DISPENSERS

A. Surface-mounted, 400 single-fold towel dispensers shall be Bobrick B-263, Bradley 251-15, or equal. Provide total of one.

B. Unit shall be Type 304 stainless steel with satin finish.

C. Locate near toilet room sink.

2.05 GRAB BARS

A. Provide stainless steel, peen grip with satin finish, 1 1/4-inch-diameter grab bars. Bars shall be concealed mounted-type, Bobrick B-550.99X18, B-550.99X36 and B-550.99X42; Bradley 832-00118, 832-00136 and 832-00142, or equal.

B. Provide stainless steel, peen grip with satin finish 1 1/4-inch-diameter grab bar. Bar shall be concealed mounted-type, Bobrick B-58616, Bradley 832-059, or equal.

C. See drawings for configuration of grab bars.

2.06 UNDERSINK PROTECTIVE PIPE COVERS

A. ADA-conforming, wheelchair-accessible lavatory P-trap and angle valve assemblies shall be covered with molded, antimicrobial undersink protective pipe covers, TRUE BRO, INC. LAV GUARD No. 103 and No. 403, 1-800-340-5969, or equal.

B. Cover shall be secured with reusable fasteners and access covers.

C. Coordinate protective pipe covers for tailpiece and extensions to fit lavatories.

D. Standard color to be selected by OWNER.

2.07 KEYING

A. Supply two keys for each accessory to OWNER.

B. Key all accessories alike.

PART 3–EXECUTION

3.01 INSTALLATIONS

A. Install accessories in accordance with manufacturers' instructions, ANSI A117.1, Federal ADA-AG, and the Wisconsin Commercial Building Code.

B. Install plumb and level securely and rigidly anchored to substrate.

END OF SECTION

SECTION 11211

CENTRIFUGAL PUMPS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: This section includes furnishing, installing, and placing into successful operation two horizontal centrifugal booster pumping units as indicated on the drawings. The pumps and appurtenances shall be furnished by the same supplier.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Project Data/Bid Requirements:
   1. Bidder shall furnish with its Bid, performance data and head discharge curves showing pump field delivery when driven by the field motor only.
   2. Each Bidder shall furnish the following information.
      a. Name of pump manufacturer and type of model designation of pump.
      b. Field-operating speed of unit. All performance data and tests shall be at this speed.
      c. NPSH required.
      d. Impeller diameter as percent of maximum possible.
      e. Name of motor manufacturer and type of model designation of motor with full information on frame size, insulation, temperature rating.
      f. Motor-rated horsepower without service factor.
      g. Motor service factor.
      h. Full-load and locked rotor current.
      i. Motor efficiency at one-half, three-quarters, and full load.
      j. Power consumption in kwh per 1,000 gallons for each pump at performance point.
      k. Complete performance curves for the equipment being offered (not a page from a catalog) showing capacity, head (not including velocity head), NPSH required, wire-to-water efficiency, and brake horsepower from shutoff to cutoff head where driven by the field electric motor.
      l. Descriptive data showing pump construction.
   3. The above specifications and data as approved by ENGINEER shall become a part of the Contract and the equipment shall be constructed and installed in accordance with them.
   4. Guaranteed Power Consumption/Annual Cost:
      a. Each Bidder shall enter in the proposal the guaranteed power consumption per 1,000 gallons of water pumped at the performance point specified.
      b. The award will be made on the considerations of performance curve characteristics, equipment construction, and total annual cost of the equipment.
      c. Annual cost will be the sum of power cost at $0.10 per kwh for pumping 220 million gallons per year from station plus fixed costs of 10% of the amount Bid.

B. Shop Drawings:
   1. CONTRACTOR shall furnish detailed drawings and description showing the size, dimensions of pumps, dimensions of motors, dimensions of bases, and necessary foundation drawings, giving exact position of all bolts.
   2. All information required in this paragraph is to be submitted in duplicate.
   3. Certified pump dimensional drawings shall be submitted to ENGINEER within 30 days after award of Contract.
   4. The drawings will be used by CONTRACTOR to order piping and construct pump bases.
   5. Submittals for motors shall include data sheets from the motor manufacturer. Data sheets from the pump manufacturer or supplier are not acceptable.
   6. Additional shop drawing requirements are discussed in Division 1.

C. Factory Test Submittals:
   1. All equipment shall be factory tested, using the job motors to drive the pumps.
   2. Test points shall include shutoff head performance point, cutoff head, plus at least three other points as required for accurate curve plotting. Head shall not include velocity head. Three certified copies of test data, notation of presence or absence of cavitation, computations for performance curve construction, computations for kWh per 1,000 gallons power consumption, field head-discharge curves, field wire-to-water efficiency curves, and field-motor load, all from shutoff to cutoff head, shall be submitted to ENGINEER for approval. Total head shall be as defined herein.
   3. Shipment shall not be made until ENGINEER approves the factory test results.

1.03 QUALITY ASSURANCE

A. Equipment shall conform to the standards of the AIEE, NEC, and NEMA, and to the state regulatory requirements.

1.04 WARRANTY

A. Standard 1-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of 1 year from the earlier of either the date established for partial utilization in accordance with GC14.04 and 14.05, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 MANUFACTURER

A. Type of pump, efficiency, and head discharge curve shall be similar to Fairbanks Morse Model 2823C, Crane Deming Model 10x8x17A, or equal.

B. The drawings were prepared based on Fairbanks Morse Model 2823C. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including, but not limited to, structural, mechanical, and electrical work.

C. CONTRACTOR is requested to include Alternative Bids for equipment manufactured by Crane Demming. CONTRACTOR shall include in the Alternative Bid and be responsible for the cost of any changes, including engineering changes, to accommodate the equipment including, but not limited to, structural, mechanical, and electrical work.

D. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

2.02 EQUIPMENT

A. Design Requirements:
1. Pumps shall be horizontal centrifugal single-stage double-suction, nominal 1800 rpm.
2. Pump shall each have a performance point capacity of 2100 gpm against a total head exterior to the pump of 142 feet.
3. The head on the pumps may vary between 127 and 153 feet.
4. A steep head discharge curve, maintaining high efficiency to each side of the performance point is desired, and these characteristics will be considered in awarding the Contract.
5. NPSH required for the pump will be considered in according the Contract. The pumps will be required to generate suction static lift of up to 125 feet, not including suction friction losses. Calculated NPSH available is anticipated to be on the order of 16 feet.
6. Total head as specified is the sum of suction and discharge pressure heads measured through piezometer connections on the horizontal centerline of the suction and discharge nozzles with no credit for difference in velocity heads at these points.
7. The pump design shall be such that the units operate satisfactorily without cavitation, excessive noise, or vibration in excess of limits set forth in the Hydraulic Institute Standards on the pumping units installed as shown on the drawings and operating within the range of heads and suction conditions specified.

2.03 COMPONENTS

A. Casings:
1. The casings shall be cast iron, horizontally split with ASA 125 psi flanged suction and discharge connections in lower half of casing.
2. The pump may be started and stopped against a closed valve in the discharge piping, and pump construction shall be proper for pressures developed under this condition.
3. Provide 1/4-inch tapped piezometer connections on horizontal centerline of suction and discharge nozzles, and 1-inch tapped priming connection at high point of casing.

B. Impellers:
1. Impellers shall be cast bronze or other material as recommended by manufacturer for the water being pumped, double-suction type, mechanically- and hydraulically-balanced.
2. Provide renewable bronze wearing rings on impellers, and bronze or cast iron rings on casings.
3. Impellers shall be compatible with chlorinated water.

C. Shaft: Shafts shall be equipped with renewable stainless steel or bronze sleeves. External piping complete with snubber valves shall be installed from the casing to each sealing box to circulate water to the seals.

D. Bearings and Couplings:
   1. Bearings shall be cartridge-type ball bearings, grease-lubricated, designed to resist radial and thrust loads.
   2. Grease seals and water slingers shall be provided for protection of the bearings.
   3. Bearings to provide average AFBMA B-10 rated life of 50,000 hours or more at duty point.
   4. Shaft deflection shall not exceed .003 inches at greatest loads to prolong mechanical and bearing life.
   5. Each pump is to be furnished with mechanical seal boxes, placed on both sides of the pump centerline to seal pump shaft. Seals shall have all metal parts, 303 stainless steel with Buna-N elastomers, Ni-Resist seal and carbon washers.
   6. A bypass line shall be provided for the upper seal between the seal faces and the discharge flange to assure adequate venting of the seal chamber and to provide lubrication.
   7. The mechanical seal boxes shall be equipped with heavy cast one-piece O-ring sealed glands made from bronze or cast iron.
   8. A flexible coupling, Wood, Dodge, or equal shall be provided. A base-mounted coupling guard shall be provided.

E. Base:
   1. A one-piece cast iron or fabricated steel base shall be provided upon which both the pump and motor are mounted.
   2. The base shall have a raised edge or trough for collecting drainage, and this trough shall be provided with 1-inch-diameter tapped outlets for pumps with packing glands.
   3. Anchor bolts and foundation drawings are to be provided.
   4. The space under the base will be filled with grout, and proper and separate openings shall be provided for placing grout and venting air. Vents shall be at each corner of the base.

2.04 MOTORS

A. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL-Listed for the service specified.

B. Motors provided shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition:
   1. Physical Construction:
      a. Copper leads and windings with ball- or roller-bearings in end brackets of steel or cast iron or aluminum brackets with steel-bearing sleeves.
      b. Rotor bars shall be copper.
      c. Motor shaft shall be high-strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft runout shall be 0.002 inches.
      d. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
   2. Mounting: Horizontal.
   3. Enclosure: TEFC.

4. Efficiency: Premium efficiency as noted in schedule below.
5. Service Factor: 1.15.
6. Power requirements: 60 Hz, three phase, 230/460 volt, factory-wired for 460 volt connection, ±10% voltage variation.
7. Load type: Variable torque.
8. NEMA Design: B.
9. Insulation: Class F and rated for a Class B temperature rise.
10. Nominal operating speed: Single speed, 1,800 rpm.
11. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
12. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and bar, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
13. Accessories:
    a. Oversized motor junction box.
    b. Lifting eyes.
    c. Thermostats applied to motor windings, capable of shut down and manual reset by external controls (by Division 16).
14. VFD requirements: Motor operating on VFDs shall be inverter duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown of 10:1.

C. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Pump Blower	Horsepower	Nominal Speed	Efficiency
BP 106-1	100	1800	95.4%
BP 106-2	100	1800	95.4%

2.05 CONTROLS

A. Electrical controls and instrumentation for this equipment are specified under Section 16480–Motor Control and Section 16940–Controls and Instrumentation of these specifications.

2.06 VARIABLE SPEED PUMP CONTROLS

A. Variable speed drives are specified in Division 16 of these specifications. Care shall be taken in sizing the drive to ensure adequate starting torque is available for the pump. This information shall be provided to the variable speed supplier specified in Division 16.

2.07 FINISHES

A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials.

Surface preparation shall be done at such time during the assembly process to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. (For equipment surfaces in contact with potable water, primer shall be 140-1255 Beige Pota-Pox Primer and shall be NSF approved.) Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. Motors shall be factory shop-primed and finished-painted using the manufacturer's standard paint system for the specified application.

2.08 ANCHOR BOLTS

A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 5.

PART 3–EXECUTION

3.01 GENERAL

A. Refer to requirements specified in Division 1 for equipment installation, quality control, testing, supervision, start-up, and operator training.

3.02 VARIABLE SPEED CONTROL COORDINATION

A. The equipment manufacturer shall coordinate with the variable speed drive supplier at the time of equipment startup to address minimum speed requirements to protect both motor and equipment and to meet specified design and performance requirements. Minimum speed settings (in hertz) shall be provided to OWNER. Equipment operation over the entire control range shall be completed to demonstrate successful operation and to meet specified design and performance requirements.

3.03 FIELD QUALITY CONTROL

A. Site Tests: Vibration:
   1. Vibration at any point on the equipment and shafting as operated in the field in excess of limits set forth in the current edition of the Hydraulic Institute Standards shall be the cause for rejection. All surfaces intended for bearing shall be in full contact, and insertion of washers or spacers to minimize vibration will not be permitted.
   2. OWNER will make field tests to check compliance with the specifications.

B. Penalties:
   1. If the unit does not meet the power consumption guarantee submitted with the Bid at the head specified, OWNER reserves the right to assess a 5-year power consumption penalty based on the Bid data and power cost per kWh stated in these specifications.
   2. If the unit does not substantially meet the performance curves submitted with the Bid, OWNER reserves the right to reject the equipment, and no payment will be made. If the actual field-measured power consumption figure is greater than that bid, OWNER reserves the right to reject the equipment or apply a 5-year power-cost penalty calculated by OWNER at the operating head specified.
   3. If the unit, after installation, does not operate smoothly, does not meet the vibration limitations, or does not operate in accordance with the factory characteristics curve, it

shall be removed by CONTRACTOR. OWNER retains the right to assess a 5-year power consumption penalty if the pump does not operate according to the factory test power-consumption curve once the pump is installed in the field.

END OF SECTION

SECTION 11730

SUBMERSIBLE RESERVOIR MIXING SYSTEM

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: This section includes furnishing, installing, and placing into successful operation a complete submersible tank mixing system for continuous use while submersed in potable water storage tanks. This system shall include two mixers, one for each side of the reservoir. Each mixer shall have the ability to function continuously on a year-round basis, regardless of drain and fill cycles. Each mixer shall consist of a low-voltage, water-filled submersible motor, an impeller and a non-submersible control center that houses all control electronics. The tank mixer and appurtenances shall be furnished by the same supplier.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Based on models validated and/or calibrated with experimental data from laboratory-scale and real scale representative systems for similarly-sized reservoirs, manufacturer shall show that mixing system has an output flow-rate that is equal to, or larger than, the following:
      a. For tanks larger than 500,000 gallons in volume, mixer shall output at least 10,000 GPM.
      b. In addition, mixing system shall completely mix reservoir according to the following minimum performance requirements. These requirements can be measured and validated after installation by operators with readily-available tools such as temperature probes and total chlorine grab samplers.
      c. Temperature Uniformity: All temperatures shall converge to within 0.2°C within 72 hours after mixer is installed and activated. During continuous operation of the mixer, all temperatures shall converge to within 0.2°C at least once every 24 hours.
      d. Disinfectant Residual Uniformity: Disinfectant residual within top five feet of tank and bottom five feet of tank shall converge to within 0.20 ppm within 7 days after mixer is installed and activated. During continuous operation of the mixer, disinfectant residual shall converge to within 0.20 ppm at least once every 72 hours.

1.03 SUBMITTALS

A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

B. Design Calculations:
   1. Based on models validated and/or calibrated with experimental data from laboratory-scale and real scale representative systems for similarly-sized reservoirs, manufacturer shall show completely mixed conditions for equipment configuration. The manufacturer shall provide documentation of the Computational Fluid Dynamics (CFD) model parameters and assumptions, tank geometry and dimensions considered, mesh information, and CPU time required.
   2. Analysis should include the following sections:
      a. Velocity vectors and contour plot at different cross-sections.
      b. The average flow induced throughout the tank.
      c. The corresponding average turnover for the tank (in hours).
      d. The corresponding average power consumption of the mixer.

C. Copies of the NSF-61 certified listing for all material being placed inside the tank and headspace, including the motor power cable.

D. Installation, Operations, and Maintenance Manuals shall be obtained from the equipment manufacturer and submitted. The following sections shall be included:
   1. General equipment specifications and data sheets.
   2. Installation, start-up, operation, and maintenance instructions.
   3. Factory-recommended maintenance schedule and list of recommended spare parts.
   4. Wiring diagrams specifying what electrical wiring needs to be done onsite during and prior to the installation, and by which responsible party.
   5. List of equipment or tooling necessary for diagnostics, trouble-shooting, repair or general maintenance.

1.04 QUALITY ASSURANCE

A. Each mixing system shall be tested prior to deployment according to standard engineering practices at the factory testing facilities. Certification of this completed testing shall accompany mixer installation documentation.

1.05 WARRANTY

A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC14.04 and 14.05, as modified in the Supplementary Conditions, or Substantial Completion of the project.

B. Extended Warranty: Manufacturer shall warrant equipment and appurtenances for a period of five years from the earlier of either the date established for partial utilization in accordance with GC14.04 and 14.05, as modified in the Supplementary Conditions, or Substantial Completion of the project. Warranty shall be nonprorated, include all parts and labor, and be in written form. Warranty shall specifically exclude buyer's indemnification language. Warranty language shall not eliminate manufacturer's responsibility for sizing of the equipment. During warranty period, manufacturer shall be responsible for any travel expenses, outside contractor fees, and rental equipment fees associated with providing warranty service. Warranty shall not exclude normal wear items. Manufacturer shall pay expenses incurred for repairs and parts replacement not made by manufacturer if manufacturer's response is not within 7 days of notification by OWNER. Warranty language shall be provided with the shop drawings.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. The reservoir mixing system shall be as provided by PAX Water Technologies of San Rafael, CA, PWM-400 model mixers, or equal.

2.02 GENERAL

A. Products Description:
   1. Mixing system shall consist of an impeller mounted on a submersible motor and supported approximately three feet in height from the tank floor in order for it to launch a jet of water from the bottom of the tank up toward the surface of the water.
   2. Floating devices shall not be acceptable.
   3. Mixer duty cycle shall be variable with the size and volume of the tank.
   4. Mixer control and operation shall be independent of tank drain and fill cycles to ensure constant mixing.
   5. Mixing system active components shall be elevated at a minimum of 18 inches above tank floor to avoid disturbing accumulated tank sediment or entraining particles and causing accelerated wear of moving parts.

B. Components:
   1. Impeller:
      a. AISI Type 316 Stainless Steel.
      b. Balanced to within 0.5 gram-inches.
      c. Passivated to minimize corrosion.
      d. Shall not create cavitation at any rotational speed up to 2500 RPM.
   2. Motor:
      a. AISI Type 316 Stainless Steel body.
      b. Chlorine/Chloramine resistant rubber seals.
      c. Fully submersible.
      d. Low Voltage (10-45V).
      e. Low power (0.5 HP maximum).
      f. Water-filled motor.
      g. Water-lubricated motor.
      h. Variable RPM.
   3. Mounting Tripod:
      a. AISI Type 316 Stainless Steel.
      b. Three-foot long detachable legs, or pedestal mount.
      c. NSF/ANSI Standard 61 certified EPDM rubber, non-skid, non-scratch feet or insulating pad.
      d. Attachments to secure motor cable away from impeller.
   4. Control Center–Each 110VAC control center shall consist of the following components:
      a. Enclosure:
         (1) Lockable.
         (2) Over-hanging lip as moisture seal.
         (3) Vandal-resistant, 14 gauge, AISI Stainless Steel 304 construction.
      b. Power supply:
         (1) 110V AC to 48V DC power supply.
         (2) Operating temperature range -40°C to +70°C.

(3) Automatic Thermal shut-off protection built-in.
(4) Power Factor meets EN61000-3-2.
(5) RoHS-compliant design.

c. Motor Controller:
(1) Conformal-coated PC Board to control motor speed.
(2) Green and Red LED Indicator lights showing motor status (running and failed).
(3) Operating temperature range -40°C up to 85°C.
(4) Manual speed control located on board (potentiometer).
(5) Thermal shut-off protection built-in.
(6) Current overload protection built-in.

d. SCADA Control Board:
(1) Conformal-coated.
(2) Digital Output signal indicating motor running.
(3) Digital Output signal indicating fault.
(4) Digital Input/output signal allowing remote control of motor on/off.
(5) Green and Red LED status indicator lights on enclosure.

5. Cable and wiring between all system components: 120V AC, 60 Hz, single phase power to the Control Center and a disconnect switch shall be provided by Division 16. Provide terminal blocks in control panel factory prewired for SCADA system signal wire.

2.03 CONTROLS

A. Each unit shall be equipped with all necessary controls, interwired, to provide the following minimum functions:
1. On/Off switch to control power to mixer.
2. Automatically-activated motor shut-off if water level drops below motor height in tank.
3. Any other controls shown on electrical and instrumentation drawings.
4. Each unit shall have a dedicated 15-Amp, 5mA trip level, GFCI circuit breaker for 120-volt, 60-Hz, single-phase grid power. Connection from circuit breaker to control center shall terminate in a disconnect switch located within 10 feet (3m) of mixer control center.

2.04 FINISHES

A. It is the intent of these specifications that equipment be provided with Standard Factory finishes.

PART 3–EXECUTION

3.01 GENERAL

A. Refer to requirements specified in Division 1 for equipment installation, quality control, testing, supervision, start-up, and operator training.

3.02 EQUIPMENT INSTALLATION AND COORDINATION

A. The CONTRACTOR shall furnish services of a factory-trained installation contractor or crew having experience with installation procedures and operation and maintenance requirements for the type of equipment installed under these specifications.

B. The mixer and control center shall be installed in accordance with approved procedures submitted and as shown, unless otherwise approved in writing from the Manufacturer.

3.03 START-UP AND TESTING

A. Manufacturers representatives shall instruct OWNER in the proper operation of the mixing system. This training will reference the operations manual provided with equipment, and show how to check for proper functioning of the equipment.

END OF SECTION

SECTION 12692

FLOOR MATS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Motor control center mats.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 DIAMOND PLATE MOTOR CONTROL CENTER MATS

A. Motor control center mats shall be diamond-plate, high-performance, nonconductive, switchboard matting. Matting shall conform to ANSI/ASTM D-178-01, Type II, Class 2.

B. Acceptable manufacturers shall include the following, or equal: Wearwell Carpet, No. 701. Mats shall be 3 feet wide and extend the full length of the motor control center. Do not cover floor door.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install mats after cleaning of finish flooring.

B. Provide mats for all motor control centers and any other free-standing or pad-mounted electrical equipment.

END OF SECTION

SECTION 15000

GENERAL REQUIREMENTS FOR MECHANICAL WORK

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All material, piping and installation for piping and appurtenances, mechanical insulation, plumbing, heating, ventilating, and air conditioning.
   2. Concrete foundations and anchor bolts for all equipment furnished under this division.
   3. Connections to all equipment whether furnished under this division or not.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Work of Other Divisions: CONTRACTOR for this work shall coordinate its work with that of any other contractors working in the same construction area. The contractors shall make a mutual agreement as to when piping and appurtenances shall be installed so as to minimize interference with each other's work.

D. Finishes: Unless otherwise specified, valves, piping, and mechanical equipment items shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC, and underground piping) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.

E. Electrical Controls: All electrical controls shall be furnished and installed under Division 16, except for those items specified to be furnished with the equipment. Where electrical controls are specified to be furnished with the equipment, electrical controls shall be in accordance with Division 16 unless otherwise specified.

F. Equipment Foundations: CONTRACTOR shall construct concrete foundations for all equipment and control panels under this Contract unless noted otherwise. Foundations shall generally be at least 4 inches high, shall consist of six-bag mix concrete, anchor bolts, reinforcing rod dowels into building concrete, and grouting with nonshrink element (containing no iron filings) where required. More specifically, concrete and grout shall meet the requirements found in Division 3.

G. Concrete: All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 3.

1.02 CONTRACT DOCUMENTS

A. The drawings are generally diagrammatic, and CONTRACTOR shall coordinate the work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.

1.03 CODES AND ORDINANCES

A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

B. In preparing Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the drawings and specifications. All cases of serious conflict or omission between the drawings, specifications, and codes shall be brought to ENGINEER's attention as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.

1.04 SUBMITTALS

A. See Section 01300–Submittals for shop drawing submittal procedures.

B. Applicable provisions of Section 01300–Submittals cover requirements for Operation and Maintenance Manuals.

C. Applicable provisions of Section 01700–Contract Closeout govern requirements for record drawings, operation and maintenance data, and warranty information.

1.05 DELIVERY STORAGE AND HANDLING

A. Applicable provisions of Section 01600–Materials and Equipment govern the handling, storage, and protection of materials and equipment.

1.06 MAINTENANCE MANUAL

A. Prior to 50% completion of the Contract, CONTRACTOR shall furnish to ENGINEER four complete copies of a maintenance manual for all equipment furnished.

1.07 SEQUENCING

A. Applicable provisions of Section 01010–Summary of Work govern construction sequencing.

1.08 WARRANTY

A. Applicable provisions of Section 01700–Contract Closeout govern product warranties.

1.09 SYSTEM START-UP

A. Applicable provisions of Section 01650–Starting of Systems govern start-up and testing.

B. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

C. All costs of supervision, operator training, and start-up shall be included in the Bid.

1.10 MAINTENANCE

A. CONTRACTOR shall furnish a 1-year supply of grease and oils for all items of equipment requiring lubrication. Lubricants for all items of equipment shall be the same brand, when available, as recommended by the manufacturer to meet both warm and cold weather requirements.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 15040

PIPING AND ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Aboveground and exposed piping and valves of every description.
   2. Wall pipes and fittings.
   3. Concrete foundations and anchor bolts for all equipment furnished under this section.
   4. Piping connections to all aboveground or exposed equipment whether furnished under this section or not.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Shop Drawings: General arrangement drawings of all interior cast or ductile iron or steel piping with all equipment attached shall be submitted to ENGINEER for approval prior to installation. Additional shop drawing requirements are found in the General Conditions and Division 1. Drawings shall include proposed length, location and elevation of pipe, fittings, valves, and other appurtenances.

PART 2–PRODUCTS

2.01 MATERIALS–GENERAL

A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials shall be National Sanitation Foundation (NSF) approved.

B. Size, Type, and Joining:
   1. All materials shall conform to the size and type shown on the drawings or called for in the specifications.
   2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted to ENGINEER for review.

C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER.

2.02 PIPE MATERIALS

A. Steel Piping and Fittings:
   1. Unless otherwise shown or specified, all interior piping 4 inches in diameter or larger shall be steel conforming to AWWA C200.
   2. Interior piping shall conform to ASTM A139 Grade B with a minimum rated working pressure of 250 psi. Wall thickness shall be minimum 0.375 inches.
   3. Steel fittings shall be fabricated in accordance with AWWA C208.
   4. Flanges, where required, shall be per AWWA C207 or as shown on the drawings. Flanges shall conform to applicable portions of AWWA C115 and ANSI B16.1, Class 125 standard.
   5. Flanged gaskets shall be minimum 1/8-inch-thick, full-face, rubber-ring gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerances.
   6. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressures and installation conditions specified or shown.
   7. All welds shall be made in the shop prior to painting. Shop welds shall be made in accordance with AWWA C206 and shall be of the butt-joint design.
   8. All couplings shall be tied with a joint harness. Harness design shall be as shown in the AWWA M11 Steel Pipe Manual and as shown on the drawings.
   9. All taps as shown shall be made at the factory.
   10. All steel piping shall be shop-primed and completely shop-painted inside and outside in accordance with the painting requirements of Division 9 prior to shipment to the jobsite.
   11. Shop drawings with bills of materials of all steel piping shall be submitted to ENGINEER for approval. Drawing shall show supports and shall be approved before shipping pipe to the jobsite. The pipe manufacturer shall also submit an Affidavit of Compliance to ENGINEER before the materials are shipped.

B. Ductile Iron Piping and Fittings:
   1. Unless otherwise shown or specified, all interior piping 4 inches in diameter or larger shall be ductile iron conforming to AWWA C151.
   2. Interior piping shall be minimum Special Class 53 with a minimum rated working pressure of 250 psi.
   3. Except where shown, interior pipe joints shall be flanged. Flanged joints shall conform to applicable flanged joint sections of AWWA C110 and C115 and shall be compatible with ANSI B16.1 Class 125. Flanges shall be cast or ductile iron. Manufacturers of flanged pipe and fittings shall be certified to NSF 61 by an ANSI-accredited third-party certification organization.
   4. Flanged gaskets shall be minimum 1/8-inch-thick rubber "ring" gaskets, not full-faced gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerances.
   5. Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked prior to finish painting with Sonneborn NP-1 by Sonneborn-Chem Rex, Inc., Sika FLEX 1-A, or equal.
   6. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressures and installation conditions specified or shown.
   7. Interior fittings shall be flanged and of ductile or cast iron. Flange fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.

8. All flanged sections of pipe shall be made up in accordance with AWWA C115 specifications. No field makeup flanges will be allowed unless strictly conforming to AWWA C115, with facing done after turning pipe through flange.
9. Interior and submerged pipe and fittings shall be cement-mortar lined and asphaltic-coated inside and shall be shop-primed outside. Cement mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Shop priming with products equal to, and compatible with, those listed under painting in Division 9 of these specifications shall be provided.

C. Copper Piping:
1. Copper piping shall conform to the requirements of the *Specifications for Seamless Copper Water Tube*, ASTM B88.
2. Unless otherwise shown or specified, all interior or aboveground potable and nonpotable water supply piping 3 inches in diameter or smaller shall be Type K hard copper.
3. Fittings shall be soldered or sweated on and shall be of cast bronze or forged brass containing 85% copper.
4. All underground water supply piping 3 inches or smaller shall be Type K soft copper with compression fittings. Joints shall not be used under floor slabs.
5. Shutoff valves shall be placed on each branch for all underground, aboveground, or interior piping.
6. Pump vent and drain lines, manometer lines, and lines to pressure gauges above the floor shall be rigid Type K hard copper. An ample number of unions shall be provided for disassembling. Pump vents shall be valved.

D. PVC Piping:
1. All chemical feed lines shall be constructed of PVC.
2. PVC shall conform to ASTM D1784, Class 12454-B.
3. PVC piping and fittings shall be PVC 1120, Schedule 80 high-impact conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent-weld fittings shall conform to ASTM D2467 and for threaded ASTM D2464.
4. All piping shall be approved for use by the National Sanitation Foundation.
5. All pipe delivered to the jobsite shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent-weld, except where flanges are shown on the drawings, or where transition to another pipe material is required. Pipe shall be installed in compliance with ASTM D2321, except as otherwise specified herein.
6. Schedule 40 PVC pipe may be used for plumbing vents where allowed by code. Above grade PVC vent pipes shall be Schedule 80.

E. Drain, Waste and Vent (DWV) Piping:
1. All building drain, waste and vent (DWV) piping and aboveground conductor, and Clearwater piping located in or within 2 feet of buildings or buried under slabs, may be PVC pipe as specified herein.
2. Sanitary and storm drain, waste and vent piping shall be Schedule 40 PVC conforming to Class 12454-B, ASTM D1785, and ASTM D2665. Fitting patterns shall conform to ASTM D3311; primers shall conform to ASTM F656, and solvent cement shall conform to ASTM D2564.
3. Sanitary and storm building sewers that penetrate exterior foundation walls shall be ductile iron from 2 feet beyond the exterior wall.

4. Aboveground PVC shall not be used where smoke generation, noise transmission, or physical abuse/durability are an issue. Schedule 80 PVC pipe shall be above grade.

2.03 VALVE MATERIALS

A. Gate Valves:
   1. Where shown or specified, gate valves in lines 4 inches through 12 inches in diameter or larger, shall be AWWA C509 iron body, resilient-wedge, nonrising stem, 150 psi working pressure, with O-ring above and below the thrust collar.
   2. All interior valves shall be flanged and have handwheels. Right-angle operators shall be provided, if required, because of valve position.
   3. Underground valves shall have either mechanical joints or push-on joints, extended stem for maximum depth of 5 feet from operating nut to surface, valve box, and key. Valve boxes shall be cast iron telescopic-adjustable. Gate valves for buried service shall conform to the City of Madison Standard Specifications.
   4. Gate valves on reservoir connection pipes shall be provided with steel extension stems from the top of the valve to the valve access on reservoir roof. Provide couplings and stem guider at spacing recommended by manufacturer. Stem guide spacing shall not exceed 10 feet.
   5. Shutoff valves in water lines 3 inches to 1 inch in diameter shall be gate valves, Class 150-pound bronze, or iron body bronze-mounted, solid-wedge disc, threaded, rising stem, Nibco T-131, Milwaukee Valve 1150, or equal. Provide unions for ease of valve removal.

B. Swing Check Valves:
   1. The check valves in the booster pump discharge lines and in the pipe trench lines shall be a swing check valve with outside lever and weight equipped with an air-cushion chamber to cushion the closing of the valve disc. The valve shall be manufactured in accordance with AWWA C508.
   2. The swing check valves shall be constructed with a heavy cast iron or cast steel body, a bronze or stainless steel seat ring, an extra-heavy noncorrosive shaft for attachment of lever and necessary weights to close valve, and a complete noncorrosive air-cushion chamber.
   3. The valve shall be tight-seating and shockless in operation.
   4. The seal ring shall be renewable and shall be securely held in place by a threaded joint.
   5. The air-cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any hammering action.
   6. Shock absorption shall be by air, and the chamber shall be so arranged that the closing speed can be adjusted to meet the service requirements.
   7. The valve disc shall be of cast iron or cast steel and shall be suspended from a noncorrosive shaft which shall pass through a stuffing box to be connected to the chamber on the outside of the valve.
   8. Provide a NEMA 4 limit switch to indicate when valve is closed. Limit switch activation shall be field adjustable. Coordinate voltage requirements with Division 16.
   9. The GA Industries, Inc., Fig. 250-D is representative of the installation desired. Valves that require external hydraulic connections or power will not be approved.

C. Flap Valves
   1. Flap valves shall be of the circular port design with offet single pivoted hinge. Value shall be iron body with a flanged end.

2. The valve shall be Clow Valve, Model F-3012-T, or equal.

D. Small Check Valves: Check valves in other than cast iron lines shall be Milwaukee Valve 510, Nibco T-433, screwed-end bronze swing-check for water, air, and gas. Provide unions to allow for ease of removal.

E. Butterfly Valves:
   1. General:
      a. Except as otherwise specified or shown on the drawings, shutoff valves in lines 4 inches in diameter or larger shall be butterfly valves.
      b. Butterfly valves shall be AWWA C504, short body, Class 150B. Provide certified drawings by manufacturer and Affidavit of Compliance.
      c. Valve bodies shall be cast iron (ASTM A126, Class B), or ductile iron ASTM A536. Valves shall be flanged interior exposed and mechanical joint underground and conform to ANSI B16.1, Class 125.
      d. Valve shaft shall be stainless steel.
      e. Valve disc shall be cast iron.
      f. Valve seat shall be constructed of synthetic rubber compound and shall be recess-mounted and bonded in the valve body or attached to the disc. Seat shall be mechanically-attached to the valve body or seat with screws, bolts, clamping-rings, or similar devices.
      g. Valve shaft bearing shall be self-lubricating Teflon, nylon, or bronze.
      h. Shaft seals shall have split V-type packings that are replaceable without removing the valve from the line.
   2. Standard Operators:
      a. Except as noted below, butterfly valves shall be equipped with top-mounted handwheel operators with totally-enclosed, sealed and lubricated gear boxes.
      b. The rated torque capability of each operator shall be sufficient to seat, unseat, and hold any valve disc position with the maximum pressure differential across the valve without creep or fluttering.
      c. Exposed valves shall be equipped with handwheels and valve disc position indicators, and shall be equipped with field-adjustable mechanical stop limiting devices.
      d. Valves for buried service shall be furnished with 2-inch-square wrench nuts, extended stem, valve box, and key. Valve boxes shall be cast iron telescopic-adjustable as specified in the City of Madison Standard Specifications.

F. Air Release Valve:
   1. The air release valve shall be 1-inch APCO Model No. 200A, Val-Matic No. 25S, or equal.
   2. The valve assembly shall be installed as shown on drawings.
   3. CONTRACTOR shall run 1/2-inch pipe from the top of the valve as shown. Screen end of pipe with 24-inch mesh. Terminate 24 inches above floor and center over drain.

G. Solenoid Valves: Except where otherwise shown or specified, solenoid valves for water services shall be normally closed, two-way pilot-operated, slow-closing solenoid valves, ASCO Red-Hat II 8221 Series, or equal. Valve shall be brass body with Buna-N disc. Enclosure shall be rated for NEMA 4X. Valve shall be operated on 120 V AC, 60 Hz power supply. Valve shall be rated for a maximum operating pressure differential of 150 psi. Unit shall be CSA certified and UL listed.

H. Miscellaneous Valves:
   1. Y-strainer in water lines shall be bronze, Watts, or equal. Provide 20 mesh 304 stainless steel screens.
   2. Provide unions for ease of valve removal. For transition from PVC to metal, use Chemtrol transition unions.
   3. For pressures less than 80 psi, provide 1/2-inch chrome-plated smooth-end sampling cock, Zurn Z-80401, or equal. For pressures greater than 80 psi, provide 1/2-inch satin brass smooth-end sample cock, Conbraco 26-314, or equal.
   4. Shutoff valves in potable water lines smaller than 1 inch shall be Milwaukee 1131 (threaded), or Milwaukee 1169 (solder joint), Nibco T-134 (threaded), or Nibco S-134 (solder joint), or equal, bronze 300 psi gate valves.
   5. Corporations in potable water lines (3/4 inches or 1 inch) shall be Mueller H 15008 compression-type fittings, or equal.
   6. Exterior hose valves shall be Woodford Model 65, Ken-Ray Model 120, or equal, freezeless wall hydrants with integral Nidel 34HA vacuum breaker, permanent valve seat, and brushed-chrome exterior face with 3/4-inch garden hose threads. Provide separate interior shutoff valves as specified herein.
   7. Interior hose valves shall be Woodford Model 24, Jenkins 112, or equal, 3/4-inch garden hose thread. Interior hose valves on the potable water system shall be equipped with approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal.

I. Pressure Reducing/Pressure Sustaining and Pressure Relief Valve: The pressure reducing/pressure sustaining and pressure relief valve shall be installed as shown on the drawings. Valve shall be provided with a solenoid valve to provide the following functions:
   1. The valve shall function as a pressure relief valve no matter the state of the solenoid. The valve shall open at a preset high pressure and relieve pressure from the pump discharge back to the pump suction. Normal pressure in the pump discharge header will vary from 50 to 70 psi. Head downstream of the valve may vary from 0 to 15 psi. Valve shall be designed to release all surges above 100 psi.
   2. When solenoid valve is energized, the valve shall function as a pressure reducing/pressure sustaining valve. Valve shall open and maintain a manually adjustable preset pressure on the downstream side of the valve. Downstream pressure shall be manually adjustable between 2 and 30 psi. Valve shall monitor upstream pressure and perform a pressure-sustaining function. Valve shall maintain an upstream pressure that shall be manually adjustable between 20 and 200 psi.
   3. In case of pressure reversal, valve shall permit flow from the low zone to enter the high zone.
   4. Auxiliary contacts shall be provided on the valve to provide for valve closed indication. Electrical connections shall be done by Division 16 Contractor. Auxiliary contacts to be equal to Cla-val limit switch X105LCW.
   5. The valve shall consist of a diaphragm-actuated "main" control valve and shall consist of all necessary mechanical and electrical accessories to adjust the "main" valve to achieve the previously described functions. The main valve shall be a hydraulically-operated, diaphragm-actuated, globe pattern valve manufactured in ductile iron per ASTM A536. Valve shall be provided with stainless steel anticavitation trim.
   6. The main valve shall contain a resilient, synthetic rubber disk forming a tight seal against a single removable seat insert. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with

synthetic rubber and shall not be used as a seating surface. All necessary repairs shall be possible without removing valve from the line.

7. The pressure reducing/pressure sustaining and pressure relief valve shall be equal to 8-inch Hytrol globe valve, with stainless steel trim epoxy coating inside and out, flanged, 125 class with standard pressure adjust ratings. Valve model shall be 58-09KO combination pressure reducing, sustaining, and solenoid control with pressure relief override and return flow function as manufactured by Cla-Val Company, Newport Beach, CA, or equal.
8. Manufacturer of surge relief/surge anticipator valve shall confirm model number to written description above and shall submit letter with shop drawings stating the valve will function as intended under the conditions shown on the drawings specified herein.

J. Altitude Valve: The altitude valve shall be installed as shown on the drawings. The valve shall be designed for the following function:
   1. The altitude valve shall control the high water level in the reservoir without the need for floats or other devices. The valve shall be non-throttling type and remain fully open until the "shut-off" point in the reservoir is reached. The valve shall be designed for one-way flow.
   2. The valve shall consist of a diaphragm-actuated "main" control valve and shall consist of all necessary mechanical and electrical accessories to adjust the "main" valve to achieve the previously described functions. The main valve shall be a hydraulically-operated, diaphragm-actuated, globe-pattern valve manufactured in ductile iron per ASTM A536. The pilot control shall operate on the differential of forces between a spring load and the water level in the reservoir.
   3. The main valve shall contain a resilient synthetic rubber disc forming a tight seal against a single removable seat insert. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with synthetic rubber, and shall not be used as a seating surface. All necessary repairs shall be possible without removing valve from the line.
   4. Valve shall be equipped with y-strainers, isolation cocks, opening and closing speed controls, and X105LCW single limit switch to monitor valve position.
   5. Valve closing set point shall be adjustable from 5 to 40 feet.
   6. The valve shall be equal to 16-inch Hytrol globe-pattern valve with stainless steel trim, epoxy coating inside and out, flanged, 125 Class, Model 610-01, as manufactured by Cla-Val Co., Newport Beach, CA, or equal, with standard pressure adjust ratings.

2.04 VALVE BOXES

A. See the City of Madison Standard Specifications.

2.05 COUPLINGS AND RESTRAINT MATERIALS

A. Pipe Coupling: Pipe couplings identified on the drawings shall be equal to Dresser Type 38, Rockwell 411, or equal coupling. CONTRACTOR shall provide tension ties and tie ears as shown on the drawings, and specified herein.

B. Restrained Flanged Adapter: Restrained flanged adapter, as shown on the Drawings, shall be EBAA Iron Series 2100, or equal.

C. Rubber Expansion Joints:
   1. Rubber expansion joints shall be furnished and installed as shown.
   2. Expansion joints shall be the single, nonfilled arch-type as manufactured by Mercer Rubber Company, General Rubber Co., or equal.
   3. Each expansion joint shall be furnished complete with control rods and rubber washers to resist excessive deflection at rated working pressures.
   4. Expansion joints shall have integral duct and rubber flanges with split backup rings, and have a rated working pressure of 150 psi and 15 psi vacuum.
   5. Expansion joints shall meet or exceed the chemical resistance characteristics of chlorobutyl elastomers suitable for potable water usage.

D. Tension Ties:
   1. All tension ties, rod ties and control rods shall be provided to resist a minimum 150 psi (250 psi surge allowance) pressure in the pipe line.
   2. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary with dimensions as shown on the drawings.
   3. Rods shall be provided with nuts and washers on both sides of tie ears.
   4. All nuts shall be carbon alloy steel conforming to A563, and washers shall be hardened steel conforming to ASTM F436.
   5. Rods shall be ASTM A36 steel at a minimum.
   6. Tie rods shall be equally spaced around pipe.
   7. The following tables lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

	250 psi Pressure	
Pipe Size (Inches)	Minimum Number	Minimum Size (Inches)
4-10	4	5/8
12	4	3/4
14	4	7/8
16	4	1
18	4	1 1/8
20	4	1 1/4
24	4	1 1/2
30	7	1 3/8
36	8	1 1/2
42	12	1 1/2
48	22	1 1/4
54	22	1 3/8

2.06 MATERIALS–NONSHRINK MORTAR

A. Nonshrink mortar shall be All-Crete as manufactured by Concrete Products, Inc., Woodland, California; Speed Crete as manufactured by Tamms Industries Co., Itasco, Illinois; or equal. Nonshrink mortar shall be placed in accordance with manufacturer's recommendations.

2.07 EQUIPMENT–PRESSURE GAUGES

A. Gauges are to be aluminum 6-inch ANSI B40.1, Grade 2A bourdon gauges and be equipped with properly-sized Ray pressure snubbers and brass shutoff valves.

B. Gauges shall be accurate to ±1/2% of scale range.

C. Gauges shall be Trerice No. 500-X Series, Ashcroft Duragauge, or equal.

D. Gauges shall be as follows:
   1. Two booster pump discharge gauges graduated in psi, range 0 to 160 psi.
   2. Two booster pump suction gauges graduated in psi and inches HG, range 30 inches HG to 15 psi.
   3. Low zone pressure gauge graduated in psi, range 0 to 100 psi.
   4. Station high zone discharge pressure gauge graduated in psi, range 0 to 160 psi.
   5. Two reservoir level sensing gauges graduated in water, range 0 to 35 feet water.

2.08 EQUIPMENT–BOOSTER PUMP PRIMING SYSTEM-VACUUM PRIMING SYSTEM

A. Furnish one duplex automatic vacuum priming system consisting of two vacuum pumps, control panel, and accessories all mounted on a horizontal receiver. Single point design shall require only one electrical and one mechanical connection for installation. The entire vacuum priming system, including vacuum pumps and all valves and appurtenances described herein, are to be provided by a single vendor. All component valves and gauges shall be provided in brass or bronze construction unless indicated otherwise. All interconnecting pipe and fittings shall be schedule 40, class 150, T304/304L SS.

B. Operating Conditions and Performance Requirements:
   1. Number of Vacuum Pumps: 2.
   2. System Volume to be evacuated: 40 cubic feet.
   3. Design Lift: 13 feet.
   4. Required Evacuation Time: 5 minutes or less.
   5. Pump Cycle Time: 10 minutes (a maximum of 3 start/stop/starts per hour per pump under actual load conditions).
   6. Priming system manufacturer to provide appropriately sized vacuum priming system in accordance with project plans and specifications, and guarantee the system to meet above operating condition requirements.

C. Vacuum Pumps:
   1. The vacuum pumps shall be mounted on the air receiver. Vacuum pumps shall be oil lubricated rotary vane type and shall have an open flow (@ 0 inch HgV) of no less than 7.1 SCFM, and an ultimate vacuum of 7.5 Torr (29.63 inches Hg gage). Each pump shall be direct coupled to a 0.6 HP, TEFC motor wired for operation on a 460 V three phase power supply.
   2. Vacuum pumps shall be constructed primarily of cast iron with ductile iron rotor and shaft. Each pump shall be equipped with three cast aluminum alloy vanes for maximum life. Multiple stages of liquid and aerosol oil separation shall be integral to the pump to ensure clean discharge air. An oil drain valve shall be piped to the edge of priming system for ease of maintenance. Maximum noise level of each pump shall be 59 dB(A) or less measured at a distance of 3 feet. Each pump assembly shall be supplied with the following equipment connected to the inlet: a 5-micron inlet filter; an inlet check valve; and a full port isolation ball valve. Vacuum pumps shall have

vibration isolating mounts and a stainless steel flexible hose connector between the vacuum pumps and receiver tank for a vibration free attachment.

D. Receiver:
   1. The receiver shall have a capacity of 60-US gallons and be designed to meet ASME Section VIII, Division 1 code for unfired pressure vessels and CRN registration. The receiver shall be horizontal and have a support base for mounting of the two vacuum pumps on top and have supports for permanently anchoring.
   2. The receiver exterior is to be finished with a powder coated enamel.
   3. The receiver shall include the following equipment pre-piped and mounted: a glass sight gauge with upper and lower isolation cocks for visual inspection of water level accumulation within the receiver; a protective high water level switch in 316SS wetted parts construction to shut down the system and provide an alarm during a high water condition; a liquid filled vacuum gauge with gauge valve to monitor system vacuum level; a vent valve to facilitate draining; a manual drain valve for draining accumulated water and condensation; an inlet ball valve to isolate the priming system from the process vacuum line; and field adjustable vacuum switches for automatic operation of system between preset vacuum levels.

E. Controls:
   1. Automatic controls shall be housed in a NEMA 4/12 enclosure and shall include: two NEMA size 1 motor starters with solid state overloads and door mounted resets; Panel disconnect switch, 120V control transformer; separate H-O-A control switches for manual or automatic pump operation; alternator and pump selector switch for alternating lead-lag operation or specified lead-lag pump operation; minimum run timers; individual pump run lights; low vacuum alarm; high-water alarm light with automatic shutdown.
   2. All switches & pilot devices shall be heavy-duty 30 mm oil-tight.
   3. System control panel shall be UL-Listed.
   4. Automatic controls shall be utilized for maintaining operating vacuum levels between the low vacuum and high vacuum set points.
   5. Form C dry contacts shall be provided for high water level and low vacuum level to the supervisory control panel.
   6. Provide automatic purge control to prevent buildup of moisture in the priming system.

F. Priming Valve Assembly:
   1. A priming valve assembly shall be provided at each pump connected to the vacuum priming system. Priming valve assemblies shall be a model LES-200AP-1102 as provided by Lynn Engineered Systems (or approved equal).
   2. Assembly shall include an APCO model 200AP priming valve (or equal) constructed of cast iron with stainless steel internals and fusion bonded epoxy coating in and out with a 2-inch inlet and 1/2-inch vacuum connection.
   3. Priming valves shall be furnished with a mounted water level control switch with DPDT switch contacts in a NEMA-4 weatherproof enclosure for proof of prime interlock with centrifugal pump start-up and remote alarm annunciation; 2-inch NPT 316 SS suction isolation ball valve; and 1/2-inch NPT 316 SS vacuum isolation ball valve for a complete assembly.

Receiver tank exterior shall be primed and finished with manufacturer's standard powder enamel coating. Vacuum pump and component equipment shall be furnished with manufacturer's standard finish.

G. Vacuum priming system shall be model APD-10RV-60H Duplex Automatic Vacuum Priming system as manufactured by Lynn Engineered Systems, or equal. System is to be appropriately sized for the project design conditions and requirements. Provide a factory trained and certified field representative to inspect the installation, test the system and make any necessary adjustments to verify and insure proper system operation. Submit a written report certifying satisfactory installation and operation.

2.09 FINISHES

A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10, removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. (For equipment surfaces in contact with potable water, primer shall be 140-1255 Beige Pota-Pox Primer and shall be NSF-approved.) Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify.

B. Factory standard prime finish for meters is acceptable if material is compatible with epoxy finish coat specified in Division 9. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify.

PART 3–EXECUTION

3.01 INSTALLATION

A. Unless shown otherwise, underfloor piping shall clear floor slabs and footings by a minimum of 6 inches.

B. Support:
1. All interior or exposed pipelines, except in chemical feed rooms, shall be securely supported by adjustable metal saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile.
2. Exposed piping in chemical feed rooms shall be supported with a plastic support system, Aickinstrut Series V, or equal.
3. Strap hangers, tin clips, or U-hooks will not be acceptable.
4. Piping shall be supported, even though not shown on the drawings, with base fittings and concrete pads when bottom of pipe is less than 6 inches above the floor, with Anvil 264, B-line, or equal, adjustable pipe saddle stand with floor flange to 6 feet above the floor, and with Grinnell, or equal, adjustable iron or heavy steel pipe hangers with supporting clamps or inserts more than 6 feet above the floor.
5. In general, the maximum spacing of supports shall not exceed 10 feet on centers.
6. Plumbing system shall be installed with hangers and supports in accordance with the Plumbing Code.
7. Stainless steel supports shall be used in submerged locations.

8. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the drawings.
9. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties.
10. The weight of the piping shall be supported independently of connected equipment.
11. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Where vertical movement up to 1/8 inch is anticipated, a precompressed variable spring support shall be used. Rigid hangers shall be provided with a means of vertical adjustment after erection. Where horizontal piping movements are greater than 1/2 inch, or where the hanger rod angularity from vertical is greater than 4 degrees from hot to cold position of the pipe, the hanger pipe and structural attachments shall be offset in a manner that the rod is vertical in the hot position. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so stress will not be transferred to them.
12. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
13. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel), prepared in accordance with near white grade SSPC Specification No. 10, removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop-primed. Shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.
14. The following maximum spacings shall be provided for supports:

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

	Copper Tubing			
Nominal Pipe or Tube Size	Water Service ft	Vapor or Air Service ft	Ductile Iron (See Note 1) ft	PVC Pipe (See Note 2) ft
1/4	5	5		
3/8	5	6		Continuous
1/2	5	6		Continuous
3/4	5	7		Continuous
1	6	8		4
1 1/4	7	9		4
1 1/2	8	10		4

	Copper Tubing			
Nominal Pipe or Tube Size	Water Service ft	Vapor or Air Service ft	Ductile Iron (See Note 1) ft	PVC Pipe (See Note 2) ft
2	8	10		4
2 1/2	9	10		4
3	10	10		4
4	10	10	10	4
5	10	10	10	4
6	10	10	10	9
8	10	10	10	9
10	10	10	10	10
12	10	10	10	10
14			10	10
16			10	10
18			10	10
20			10	
24			10	
30			10	
36			10	
42			10	

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

Note 2: Spacing is based on Schedule 80 at 100°F. For Schedule 40 or higher temperatures, provide shorter span. Consult manufacturer's recommendations.

15. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
16. Provide saddles or shields under piping hanger and supports for all insulated piping to prevent crushing of insulation. Provide stainless steel pipe shields under stainless steel piping to prevent indentation of piping from the support or clamp.

C. Penetrations:
1. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping.
2. The sleeve diameter shall not exceed the pipe o.d. (or flange o.d. where applicable) plus 2 inches, unless otherwise shown on drawings.
3. If the concrete members are to be watertight, the annular space around the pipe shall be caulked with lead wool or sealed with an approved mechanical seal.
4. For copper pipe provide an elastomeric sleeve on pipe where it passes through walls or slabs.
5. Where pipes pass through a roof, they shall be run through an approved roof penetration with flashing and counter-flashing.
6. Where pipes pass through nonwatertight walls, the annular space shall be grouted full.

7. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation, and the annular space shall remain open.
8. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the wall and provide a wall sleeve or wall pipe.
9. Space between wall sleeve or wall pipe and concrete shall be filled with nonshrinking mortar.
10. The annular space between the wall sleeve and pipe shall be sealed with an approved mechanical seal.
11. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and grouted full (walls), remain open (floors).
12. Plug abandoned pipes and wall pipes, after pipe and fitting removal, flush to the concrete surface with nonshrinking mortar, or as otherwise approved, to achieve a watertight seal.
13. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the drawings or specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case, where such cutting or core drilling is necessary, shall reinforcing rods be cut or disturbed without prior consultation with ENGINEER.
14. All openings for pipe work shall be neatly patched in a workmanlike manner.

D. Layout:
1. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings and floors, to permit access for covering of pipe and painting work.
2. Care shall be taken in laying out piping that there is no interference with the proper location of piping for other purposes or other equipment, and shall be run with regard to the requirements of each service.
3. Piping shall not interfere with headroom or clear floor space.
4. Do not install gas pipe in a ventilation air plenum.
5. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside. Terminate with a screened vent cap and locate according to gas utility regulations.
6. Unless otherwise shown, small water piping shall be concealed in (except reinforced concrete walls) walls placed in piping pits, above suspended ceilings, or under floors where possible, or as shown on the drawings.
7. Pipes under floors shall have a minimum of 6 inches of sand cover.
8. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings, constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
9. An ample number of unions shall be provided in all threaded, soldered, and glued pipelines and at all equipment to facilitate removal and replacement. Install a shutoff valve at each appliance.
10. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
11. The appropriate number, size, and lengths of spool pieces and flange fillers needed for plumbing and leveling any existing piping shall be included in the price bid.
12. Valves shall be located on all branches of water supply lines where shown on the drawings. Position valves to facilitate access and operation.

3.02 FIELD QUALITY CONTROL

A. Site Tests:
   1. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price bid.
   2. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
   3. All piping shall be flushed or blown out after installation prior to testing.
   4. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge, and other equipment, materials and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents as required for testing.
   5. Pressure Tests: The test pressure in all lines shall be held for 1 hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests.
   6. Test Requirements:

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
Chilled Water	150	Water	"A"
Potable Water	150	Water	"A"
Vacuum Piping	15 inches Hg	Vacuum	Zero

   7. Leakage allowance Designation "A" shall mean zero leakage for unburied pipe and shall be not more than 0.002 gallons per hour per inch diameter per 100 feet of buried pipe for compression or solder joint pipe.
   8. Tests for all gravity sewers shall be as follows: Pipe will be plugged at its downstream end and water will be placed inside the pipe to a minimum head of 10 feet. Water shall be held for 15 minutes without dropping. No leakage is allowed.

3.03 CLEANING AND DISINFECTION

A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the system before it is put on line.

B. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Lump Sum Bid. Copies of test results shall be submitted to OWNER and ENGINEER.

C. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.

D. All surplus material, tools, and equipment shall be removed and the premises shall be left free of everything of the kind.

END OF SECTION

SECTION 15195

PIPING AND EQUIPMENT IDENTIFICATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Perform all work required to furnish and install equipment, valve, pipe, and wire identification with supplementary items necessary for proper installation as specified herein, or shown on the drawings. CONTRACTOR shall identify all equipment, valves, piping, ductwork, and wires.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

B. Schedule:
1. Submit valve schedule complete with building number, room number, valve tag numbering system, valve function, valve type, area served, year installed, manufacturer, model number, size, rated pressure, temperature rating and normal position.
2. Valve schedule shall be developed utilizing OWNER's valve naming convention; refer to Attachment A. Provide OWNER with electronic version (Microsoft Excel) of the final approved valve schedule, at or before Project Closeout.

1.03 REFERENCES

A. All material, installation and workmanship shall comply with the applicable requirement and standards addressed within the following references:
1. ASME A13.1-Scheme for the Identification of Piping Systems
2. NFPA 13-Installation of Sprinkler Systems
3. NFPA 14-Installation of standpipe and hose systems.
4. Wisconsin Plumbing Code.

PART 2–PRODUCTS

2.01 NAMEPLATES

A. Type "A" Nameplates:

Use: Fans, fan coil units, unit heaters, water heaters, etc.
Size: 4 inch by 4 inch.
Material: 3-layer laminated Micarta.
Background Color: Black.
Character Color: White.
Character Size: 2 1/4 inches.

Engraving: Equipment label.
Mounting Location: Equipment–Top wireway.

B. Type "B" Nameplates:

Use: Identify control stations, thermostats, etc.
Size: 3/8 inch by 2 inch.
Material: 3-layer laminated Micarta.
Background Color: Black.
Character Color: White.
Character Size: 1/8 inch.
Engraving: Control station number or equipment controlled.
Mounting Location: Device front at top.

2.02 LABELING TAGS

A. Valve Tags:
1. All new valves on lines designated shall be tagged. All stop plates, slide gates, and sluice gates shall also be tagged. CONTRACTOR shall furnish and install on valves, engraved 2 1/2-inch by 2 1/2-inch plastic laminated tags, Seton "Setonply Series M4550-H," or equal. Nomenclature for tagging (letters and numbers) will be provided by ENGINEER. Colors will be selected by OWNER. CONTRACTOR shall affix tags to valves with Brady 3809, or equal, stainless steel wire and Brady 38090, or equal, zinc wire clamps.
2. Valve tags shall be fastened next to valve box cover on valve manholes with stainless steel fasteners. Each stop plate and slide gate and each stop plate and slide gate grooves shall both be labeled with tags using stainless steel fasteners.

2.03 WIRE MARKERS

A. Wire markers shall be permanently attached wraparound adhesive, sleeve- or heat-shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable.

B. Wire markers shall be specifically printed for this project using a wire marker printer. Handwritten markers are not acceptable.

2.04 PIPE MARKERS

A. Manufacturers: Marking Systems, Inc., Seton Name Plate Company, W.H. Brady Company, or equal.

B. Pipe markers shall conform to ANSI A13.1-2007 "Scheme for the Identification of Piping Systems." Arrow markers must have same ANSI background colors as their companion pipe markers, or be incorporated into the pipe identification marker.

C. Plastic Pipe Markers: Factory-fabricated, flexible, semirigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Pipe markers and arrow markers also shall be provided for all piping systems.

E. Use Seton Setmark type SNA, or Brady Snap-on type identification for all piping systems, up through 6 inches. For piping systems larger than 6 inches, use Seton or Brady strap-on markers, or similar, by Marking Services, Inc. Self-adhesive labels are not acceptable. Provide lettering in accordance with table below.

PIPE MARK SIZE CHART

Outside Pipe Diameter (Including Covering)	Minimum Length of Label Field Color (Inch)	Minimum Height of Letters (Inch)
3/4 inch to 1 1/4 inch	8	1/2
1 1/2 inch to 2 inch	8	3/4
2 1/2 inch to 6 inch	12	1 1/4
8 inch to 10 inch	24	2 1/2
Over 10 inch	32	3 1/2

PART 3–EXECUTION

3.01 INSTALLATION

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Affix nameplates with stainless steel screws or sticky-back adhesive.

D. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8-inch hole to accommodate wire tie.

E. Prepare and install neatly-typed directions in all panels, including existing panels, where work is done under this Contract.

F. Four-inch-round, 4-inch-square, and 4 11/16-inch junction boxes concealed above ceilings may be identified with neat lettering on the cover with a permanent-type black marking pen.

3.02 WIRE IDENTIFICATION

A. Provide wire markers on each conductor in pull boxes, control panels, thermostats, junction boxes, and at load connection. Identify with control wire number as indicated on schematic and interconnection diagrams for control wiring. Wire markers shall be permanently attached wraparound adhesive or heat-shrink-type markers. Wire numbering preprinted on the conductor, individual wraparound numbers, and flag-type labels are not acceptable.

3.03 PIPE MARKERS

A. Install pipe markers in accordance with manufacturer's instructions.

B. Install in clear view and align with axis of piping.

C. All pipes shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Locate identification at maximum 20-foot centers on straight runs, including

risers and drops adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Labels shall be abbreviated as noted under fluid abbreviations on drawings.

D. All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10 feet and with at least two labels in each room, closet, or pipe chase.

E. Labels shall identify fluid being conveyed and include flow direction arrow. Provide a double-ended arrow marker when flow can be in either or both directions.

F. Indicate delivered water temperature on domestic hot water supply and return lines.

G. CONTRACTOR shall include a schedule in their submittal identifying the various pipe designations, abbreviations, and labeling scheme. Colors, text, and piping abbreviations are to be selected by OWNER, with the following piping marker scheme used where applicable.

Pipe Contents	Label Colors (Background/Text)
Wastewater Lines	
Sewage (sanitary or other)	Green/White
Water Lines	
Finished or Potable	Green/White
Other Lines	
Vacuum	Blue/White
Condensate	Blue/White
Fire Protection	Red/White
Plumbing drains and vents	Green/White
Chilled Water	Green/White

END OF SECTION

SECTION 15250

MECHANICAL INSULATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: All new cold and hot potable water, water supply piping and rigid chemical feed piping 3-inch diameter and smaller; located aboveground, exposed to view or above suspended ceilings, shall be insulated with preformed pipe insulation. All insulation damaged during construction shall be replaced in accordance with these specifications.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. See Section 01300–Submittals for shop drawing submittal procedures.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Except as otherwise specified, insulation shall be manufactured by the following, or equal:
1. Schuller International, Inc.
2. Owens Corning.
3. Knauf.
4. Armstrong.
5. Johns Mansville.

2.02 PIPE INSULATION

A. All pipe covering, jackets, duct insulation, vapor barriers, adhesive and mastics shall have a flame spread rating of 25 or less, and a smoke-developed rating of 50 or less in active return or supply air plenums. Insulation in all other areas within the building shall have a flame spread of 25 or less, and a smoke-developed rating of 150 or less. Test method shall be ASTM E84.

B. Water Piping: All new hot and cold water piping (including PW), fittings, valve bodies, and flanges shall be covered with 1-inch glass fiber (K-factor of 0.25 at 75°F mean), 1-inch molded phenolic (K-factor of 0.23 at 75°F mean), or 3/4-inch rigid urethane (K-factor of 0.16 at 75°F mean) with all service jacket. Provide a PVC jacket for all exposed water piping. Color shall be selected by OWNER. CONTRACTOR may provide PVC jacketing in place of painting. See Division 9 for details.

C. Piping in Slabs and Walls: All new cold and hot water piping and nonpotable water inside concrete slabs or inside walls shall be insulated with Armstrong Armaflex II, or equal, 1/2-inch thick.

PART 3–EXECUTION

3.01 INSTALLATION

A. All insulation shall be applied in strict accordance with the manufacturer's written recommendations.

B. All pipe insulation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation or with "Zeston"-type, premolded PVC fittings installed in accordance with the manufacturer's instructions. Fittings are to be finished with 8-ounce glass mesh and mastic (use breather mastic on systems operating above 50°F; a vapor barrier mastic on systems operating from 50°F down). Jackets on pipe insulation may be stapled using outward clinch staples spaced 3 inches apart at least 1/4 inch in from the lap edge on systems operating at 50°F and above; below 50°F and on roof drain lines, the laps are to be vapor-sealed using self-sealing lap, lap-seal tape gun, or adhesive. All insulation ends are to be tapered and sealed regardless of service.

C. Vapor barrier jackets shall be applied with a continuous unbroken vapor seal. Pipe hangers are to be sized large enough to be installed over the outer surface of the insulation. Load distributing corrosion-resistant metal shields shall be installed around the lower one-third circumference of the insulation. For each pipe hanger, provide a half-round, 12-inch-long hanger block at the bottom half of the pipe in place of the fiberglass insulation. The blocks shall be molded foam glass insulation. Shields shall be 16 gauge. Shields shall be 12 inches long.

END OF SECTION

SECTION 15290

HEATING, VENTILATION, AND AIR CONDITIONING INSULATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Pipe insulation.
   2. Ductwork insulation.
   3. Equipment insulation.
   4. Jackets.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM E84–Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM C533–Specification for Calcium Silicate Block and Pipe Thermal Insulation.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers are Owens-Corning, Knauf, or Johns Manville.

2.02 PIPE INSULATION

A. Rigid molded glass fiber pipe insulation shall be 3 pcf with a K-factor of 0.25 at 75°F mean temperature. Insulation shall cover piping fittings, valves, and flanges completely with thicknesses as specified.

2.03 DUCT INSULATION

A. Rigid-type duct insulation shall be 3-pound density, rigid insulating board. Thermal conductivity shall be not more than 0.23 at 75°F mean.

2.04 JACKETS

A. PVC jackets (PVJ) shall be 0.02-inch-thick ultraviolet-inhibited white glass PVC film.

B. Self-adhering jackets (SAJ) shall be VentureTape VentureClad 1577CW, or equal. Jacket shall be 5-ply, self-adhering laminated waterproofing with reflective aluminum foil providing

zero permeability. Jackets located in corrosive locations shall be Venture Tape Venture Clad 1574CW-H, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. All insulation shall be applied in accordance with manufacturer's recommendations. Destructive methods such as sheet metal screws are not acceptable.

B. Pipe Insulation:
   1. All pipe insulation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation, or with "Zeston"-type, premolded PVC fittings installed in accordance with the manufacturer's instructions. Fittings are to be finished with 8-ounce glass mesh and mastic (use breather mastic on systems operating above 50°F; a vapor barrier mastic on systems operating from 50°F down). Jackets on pipe insulation may be stapled using outward clinch staples spaced 3 inches apart at least 1/4 inch in from the lap edge on systems operating at 50°F and above; below 50°F and on roof drain lines the laps are to be vapor-sealed using self-sealing lap, lap-seal tape gun, or adhesive. All insulation ends are to be tapered and sealed regardless of service.
   2. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers are to be sized large enough to be installed over the outer surface of the insulation. Load-distributing corrosion-resistant metal shields shall be installed around the lower one-third circumference of the insulation. For each pipe hanger, provide a half-round, 12-inch-long hanger block at the bottom half of the pipe in place of the fiberglass insulation. The blocks shall be fiberglass insulation. Shields shall be 16 gauge. Shields shall be 12 inches long.

C. Ductwork Insulation:
   1. Rigid Type:
      a. Provide finished edges at all access doors and ends of insulation.
      b. Provide additional insulation trim pieces over flanged ductwork joints to completely insulate and seal to the thickness specified.
      c. Flexible connections from ducts to HVAC equipment shall not be insulated.
   2. Wrap Type: Wrap-type duct insulation shall be fiberglass 1.5-pound density duct insulation with FSK aluminum foil for reinforced vapor barrier. Thermal conductivity shall be not more than 0.25 at 75°F mean.

3.02 PIPE INSULATION SCHEDULE

Type of System	Jacket	Type	*Runouts Up to 2-IN (inch)	1 1/2-IN and Less (inch)	Greater than 1 1/2-IN (inch)
Chilled Water Supply and Return	PVJ	Fiberglass	1.5	1.5	1.5

* Runouts are extensions to individual terminal units not exceeding 12 feet in length.

3.03 DUCT INSULATION SCHEDULE

Service	Insulation Type	Jacket	Thickness (Inch)
Outside Air Ducts	Rigid Fiberglass	SAJ	2.0
Exhaust Ducts	Wrap-Type	SAJ	2.0
Intake and Exhaust Damper Frames	Rigid Fiberglass	SAJ	2.0

3.04 JACKET SCHEDULE

Service	Jacket Type
Exposed piping within 8 feet of floor	PVJ

END OF SECTION

SECTION 15300

WATER-BASED FIRE PROTECTION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: There is one automatic fire sprinkler zone scheduled and outlined on the drawings. The zone is a wet sprinkler system and connects to the incoming water service. The zone begins with a backflow preventer with tamper switches, flow switch, 1-inch inspector's test valve, auxiliary drain valve, fire department connection, and full flow backflow preventer bypass with shut-off valve and tamper switch.

B. Provide complete fire protection systems that are compatible with the fire alarm system in accordance with the Factory Mutual Research Approval Guide. The fire protection system shall include all necessary piping, valves, controls, fittings, and hardware and the corresponding system types:

Building	Automatic Fire Sprinkler Zone
Booster Station	Wet Pipe System

C. Work under this section shall commence with a connection to the potable water service and all interior fire protection systems.

D. CONTRACTOR may install additional piping and fittings and valves not shown on the drawings for testing purposes or for the convenience of the installation. Where such materials are installed, they shall comply with the specifications and shall be sized to be compatible with the system design. Remove such installed materials when they interfere with the design conditions.

E. Information given herein and on drawings is as exact as could be secured, but is not guaranteed. Do not scale drawings for exact dimensions. Where architectural features govern location of work, refer to architectural drawings. Check, verify, and coordinate work with drawings and specifications prepared for other trades. Include all modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.

F. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 CODES AND STANDARDS

A. Comply with requirements of Wisconsin Commercial Building Code, local fire chief or fire marshal, insurance underwriter, and applicable National Fire Protection Association (NFPA) Standards (latest editions):
   1. ASSE 1015: Double Check Valve Backflow Preventers.
   2. NFPA 13: Installation of Sprinkler Systems.
   3. NFPA 25: Inspection, Testing & Maintenance of Water-Based Fire Protection Systems.
   4. NFPA 72: National Fire Alarm Code.

5. NFPA 231: General Storage.
6. Underwriters Laboratories Fire Protection Equipment Directory.
7. Current Factory Mutual Approval Guide.
8. Local and State Building, Mechanical and Fire Codes.

1.03 QUALITY ASSURANCE

A. All plans and hydraulic calculations shall be signed and sealed by a registered architect, Professional Engineer, fire protection systems designer, or signed and dated by the contractor responsible for the design and installation of the system; in accordance with the Wisconsin Administrative Code.

B. CONTRACTOR shall be licensed by the State of Wisconsin for installation of sprinkler fire protection systems.

C. CONTRACTOR(s) shall submit prequalification evidence of at least five projects of comparable size and scope successfully completed with their Bid. Distortion or misrepresentation of qualification evidence may result in Contract cessation.

D. UL and FM Compliance: Unless otherwise indicated, all products shall be listed in the latest publication of Approval Guides for Underwriters Laboratory and Factory Mutual for the service intended. All system components shall be in conformance with applicable NFPA Standards.

E. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.

1.04 DESIGN CRITERIA

A. Available water supply data (preliminary) is as follows:

Location	Date	Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)
Booster 106	4/8/13	1130	50	40

B. Water test data is preliminary for Bidding purposes. CONTRACTOR shall perform flow tests prior to preparation of design calculations. Test shall be representative of high water-use periods.

C. Design fire protection systems in accordance with codes, standards, and regulations noted above. Design sprinkler systems for the most hydraulically-remote area based on the following:

Zone Description	Area (sf)	Sprinkler System Type	Area of Sprinkler Operation (sf)	Sprinkler Density (gpm/sf)	Occupancy Classification	Sprinkler Rating (°F)	Total Combined Inside/Outside Hose (gpm)
Zone 1	1224	Wet	1500	.20	O.H. GRII	165	250

D. Maximum head spacing per NFPA 13, for each occupancy hazard indicated.

E. Hydraulic Calculations: Sprinkler systems which shall be hydraulically designed must be designed a minimum of 10% or 10 psi, whichever is greater, below the available water curve.

F. Hose Streams: Add indicated hose streams to all sprinkler zone hydraulic calculations at the base of the riser.

G. Water velocity throughout the entire system shall not exceed 20 feet per second.

H. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows.

I. Fire protection system components shall be rated for minimum operating pressure of 175 psig.

J. Corrosive Atmosphere(s): Corrosive atmospheres include the following: Future chemical room 103.

1.05 SUBMITTALS

A. Submittals shall be in accordance with provisions of Section 01300–Submittals. The provisions outlined in this section shall expand and supplement the requirements specified in Division 1. Where additional or differing requirements are indicated, the more stringent provision applies.

B. Submittals are to be sent to and approved by the insurance underwriter, local fire chief, or fire marshal prior to submitting to ENGINEER. Include copy of approval letters in submission to ENGINEER.

C. Submit fire protection system drawings at minimum scale of 1/8 inch equals 1 foot 0 inches for floor plans, and 1/2 inch equals 1 foot 0 inch for details. Drawings shall include water supply locations and size, piping layout and size, sprinkler locations and type, piping and fire protection specialty locations and type, valve stem movement, hanger locations and type, lighting, ductwork, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference points, design areas, hose locations, and discharge densities. Include incidental details not usually shown or specified but necessary for proper installation and operation. Submittal drawings shall be stamped by the designer.

D. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all fire protection installations. Indicate locations where space is limited and where sequencing and coordination of installations are of importance to other trades.

E. Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet and detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations. Include graph illustration of water supply, hose demand, and sprinkler demand.

F. Furnish product submittals for all equipment and systems. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number as indicated in the Contract Documents. Where more than one item appears on a manufacturer's catalog sheet, the item(s) to be used shall be

indicated by a red marking or an arrow. Include wiring diagrams of electrically-powered equipment.

G. Material submittals shall include all items listed in the product section and all additional items necessary to provide a complete installation.

1.06 OPERATING AND MAINTENANCE MANUALS

A. Assemble material in three-ring or post binders using an index at the front of each volume, and tabs for each system or type of equipment. In addition to the Division 1 requirements, include the following information:
   1. Copies of all approved submittals along with approval letters.
   2. Manufacturer's wiring diagrams for electrically-powered equipment.
   3. Records of tests performed to certify compliance with system requirements.
   4. Certificates of inspection by regulatory agencies.
   5. Parts lists for equipment and specialties.
   6. Manufacturer's installation, operation, and maintenance recommendations for equipment and specialties.
   7. Valve types and locations.
   8. Warranties.
   9. Additional information as required for records and maintenance of system.
   10. Lubrication instructions including list/frequency of lubrication.
   11. Provide two copies of NFPA 25 current for the year the system is installed.

1.07 AS-BUILT DRAWINGS

A. Maintain at the site an up-to-date marked set of "as-built" drawings which shall be corrected and delivered to ENGINEER upon completion.

B. Upon completion of the Work and final acceptance by the local authority, CONTRACTOR shall submit record drawings to OWNER and ENGINEER under the provisions of Division 1.

1.08 TRAINING

A. Instruct OWNER's personnel in the proper operation, maintenance, and testing of systems and equipment provided as part of this project. Include not less than 4 hours of instruction using the Operating and Maintenance Manuals and Record Drawings during this instruction. Demonstrate testing, start-up and shutdown procedures for all equipment. All training to be during normal working hours. Videotape all instructions and provide OWNER with copy.

PART 2–PRODUCTS

2.01 FIRE PROTECTION PIPING

A. Piping Below Ground: Ductile iron pressure pipe, mechanical joint, Class 53, 150 psi working pressure, ANSI Standard A21.51. Ductile iron fittings, ANSI Standard A21.11. Include cement mortar lining, ANSI Standard A21.4.

B. Piping Above Ground:
   1. Steel Pipe: Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135. Threaded light wall pipe and plastic pipe are not acceptable.
   2. Pipe Wall Thickness: Schedule 40 for welded, rolled groove, cut groove and threaded. Schedule 30 for welded, rolled groove, 8 inches and larger cut groove, and 8 inches and larger threaded piping. Schedule 10 up to and including 6 inches for rolled groove and welded. Zero.188 inches for 8 inches and 10 inches rolled groove and welded.
   3. Fittings (2 inches and Under): Cast iron threaded fittings, Class 125/250, ASTM A126/ANSI B16.4. Malleable iron threaded fittings, Class 150/300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI B16.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable iron, or ASTM A53 fabricated steel. Fittings on galvanized pipe systems shall be galvanized.
   4. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
   5. Finish: Hot-dipped zinc-coated (galvanized) finish piping exposed to future corrosive environments where indicated in design criteria. Thread or cut groove hot-dipped zinc-coated pipe ends for fitting connections.

C. Unions and Flanges:
   1. Unions, flanges, and gasket materials to have a pressure rating of not less than 175 psig.
   2. Two-inch and Smaller Steel: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
   3. Two and one-half-inch (2 1/2-inch) and Larger Steel: ASTM A181 or A105, Class 150, Grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast-iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full-face gaskets. Use ANSI B16.1 flat face flanges with full-face gaskets for mating with other flat face flanges on equipment. Provide galvanized flanges on galvanized piping.
   4. Rigid or zero flex-type couplings will be used when operating pressures may cause piping to move out of place or sway on hangers. Flexible couplings may be used where piping is properly braced or clamped into a grid position.

D. Mechanical Grooved Pipe Connections:
   1. Mechanical grooved pipe couplings and fittings, as manufactured by Victaulic, Anvil, or equal, may be used with cut steel pipe. Couplings and fittings to be malleable iron ASTM A47, or ductile iron A536 with painted finish. Fittings used on galvanized steel pipe to have galvanized finish, ASTM A153.
   2. All mechanical grooved pipe material including gaskets, couplings, fittings, and flange adapters to be from the same manufacturer.
   3. Gaskets shall be EPDM, ASTM D2000. Heat-treated carbon steel oval-neck track bolts and nuts, ASTM A183 with zinc electroplated finish. Gaskets for dry systems to be flush seal or flush gap design.
   4. "Pipeolets" or similar mechanically-attached fittings will not be permitted as fittings. "Weldolets" welded to cross mains in fabrication shops will be permitted as a fitting to supply branch piping only, unless specifically approved for other applications.

5. Fittings and couplings must be suitable for the temperature and pressure involved. In no case is the final system to have a pressure rating of less than 175 psig.
6. Acceptable fittings and couplings are listed below, based on Victaulic figure numbers:
   a. Couplings: Standard flexible couplings, Style 77; or lightweight couplings, Style 75. Reducing couplings are not acceptable.
   b. Flanges: Flange adaptor, Style 741, except at lug-type butterfly valves where standard threaded flanges shall be used.
   c. Fittings: Malleable or ductile iron elbows and tees of the manufacturer's standard line may be used in all sizes, except bullhead tees will not be accepted. Mechanical-T Style 920 fittings with malleable iron housings may be used for up to 2-inch outlet size.

2.02 HANGERS, SUPPORTS AND ANCHORS

A. Comply with the requirements of applicable NFPA Standards. Hangers shall be UL-listed and FM-approved, unless otherwise specified.

B. Riser clamps shall not protrude more than 2 inches beyond the edge of the hole. The riser clamps need to be only UL-listed, Grinnell figure 261, or approved equal.

C. Below concrete construction, inserts, expansion cases, or Phillips-type shells shall be installed to support piping smaller than 6 inches. Concrete expansion anchors are to be Hilti Drop-in Anchor, Phillips concrete fasteners, or approved equal. "Kwik" bolts or similar concrete anchors are not permitted. Below concrete construction inserts shall be installed for all piping 6 inches and larger. In lieu of inserts, expansion shields spaced no more than 10 feet apart may be installed in accordance with NFPA 13, Sections 2-6 and A-2-6.3.

D. Corrosive Atmosphere Coatings: Factory coat supports and anchors used in future corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.

E. Equipment Stands: Use structural steel members welded to and supported by pipe supports. Clean, prime, and coat with three coats rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

2.03 SPRINKLERS

A. Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following manufacturers, determined to be equal by ENGINEER, will be accepted: Central Sprinkler Corporation, Reliable Automatic Sprinkler Co., Star Sprinkler Corporation, Viking Corporation, Victaulic, and TYCO.

B. All sprinkler heads shall be UL-listed and FM-approved, fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2-inch discharge orifice except where greater than normal density requires large orifice.

C. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location and as indicated. Provide ordinary temperature fusible link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to

diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where otherwise indicated.

D. Listed corrosion-resistant sprinkler heads shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist. Sprinkler heads located in areas listed in design requirements shall be listed corrosion-resistant heads.

E. Sprinkler Cabinets: Provide cabinets complete with required number of spare heads of each type and temperature rating and special wrenches in accordance with NFPA 13. Provide multiple cabinets as required. Cabinet shall be finished steel suitable for wall mounting with hinged cover and adequate space for required spare heads and wrenches. Coordinate cabinet location with OWNER's representative. Coordinate quantities with the authority having jurisdiction over the project.

2.04 VALVES

A. Manufacturers: Kennedy, Milwaukee, Nibco, Stockham, Victaulic, Viking, and Watts.

B. Line Control Valves 2 inches and Smaller:
1. Ball Valves: Bronze 2-piece, threaded or sweat ends, standard port, blowout proof stem, chrome plated ball, glass reinforced seats, UL-approved, 250 psi rating.
2. Butterfly Valve: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem. Equal to Milwaukee Model BB-SC01.

C. Line Control Valves 2 1/2 inches and Larger:
1. Gate Valve: UL-listed/FM-approved, outside screw and yoke (OS&Y) gate valves, 175 psig, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads. Valves shall be capable of being repacked under pressure with valve wide open. Equal to Nibco F-607-O.
2. Butterfly Valve: Cast or ductile iron body butterfly valve, lug style or grooved, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, EPDM resilient seat, EPDM seals, nickel-plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use cap screws for removal of downstream piping while using the valve for system shutoff. Equal to Nibco LD3510-8.

D. Test and Drain Valves:
1. Threaded bronze globe-type with composition disc, 175 psi WOG. Valves shall be equal to Nibco KT-65 for piping assemblies built on site. Victaulic style 718 or 719 or equal may be installed to save space and assembly time.
2. Drain Valves: UL listed, 3/4-inch minimum, two- or three-piece bronze body ball valve; threaded ends, chrome-plated bronze ball; glass-filled Teflon seat; Teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG. Low point drain valves shall have, in addition, a 1-inch brass nipple with 3/4-inch male hose threads and cap.

E. Check Valves: Cast or ductile iron body, flanged or grooved ends, bolted cap, renewable bronze seat and disc, stainless steel clapper with a replaceable rubber seal (a rubber seal integral with the seat is not acceptable), and 175 psig suitable for installation in a horizontal or vertical line with flow upward. Valve equal to Viking Model D, Central Model 90. Provide 1/2-inch automatic drip drain on inlet to fire department connection check valve. Provide

full-sized check valve bypass with shutoff valve and tamper switch to facilitate annual testing of backflow preventer.

2.05 BACKFLOW PREVENTER

A. Manufacturers: Ames, Conbraco, Febco, Watts, Beeco, Cla-Val, Wilkinson

B. ASSE 1015 double check backflow preventer with two independent spring loaded check valves, two isolation ball or gate valves with normally open tamper switches, double wire leads, 4-valved test ports, and lockable valves. Constructed of bronze or epoxy-coated cast iron or stainless steel body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats, rated for 175 psig.

2.06 SPECIALTIES

A. Supervisory/Tamper Switches:
   1. Manufacturer Potter, System Sensor, or equal.
   2. For OS&Y valve or butterfly valve installations, UL/FM listed/approved, to monitor position of valve, tamper-resistant cover screws, single or double SPDT switch contacts, corrosion-resistant, for indoor or outdoor use, NEMA 4 and 6P enclosures.

B. Flow Switches:
   1. Manufacturer: Potter, System Sensor, or equal.
   2. Flow switches shall be UL listed and FM-approved capable of transmitting a signal when the flow of water equals or exceeds the discharge of a single head. Unit shall be vane-type, with retard chamber and electrical characteristics compatible with fire alarm system.

C. Local Alarm Bell:
   1. Manufacturer Potter, System Sensor, or equal.
   2. Weatherproof electric alarm bell with red painted metal housing, mounting base and gong; solenoid operator; weatherproofing O-ring seal and electrical characteristics compatible with alarm system.

2.07 ACCESSORIES

A. Fire Department Connection:
   1. Manufacturers: All equipment shall be UL listed and FM-approved by Elkhart Brass, Potter-Roemer, Badger-Powhatan, Croker Corp., J.W. Moon, and W.D. Allen.
   2. Fire Department Pumper Connection: Pumper connection shall be flush type, cast brass body with drop clappers, polished chrome cover plate with lettering reading "AUTO SPRINKLER." Unit shall include chrome-plated brass snoot with rigid end threading to match local fire department standards by pin-lug hose thread swivels, pin-lug plugs and chains. Pumper connection shall be Potter-Roemer series 5018-D, or equal.
   3. Ball Drip: Provide a bronze ball drip for the fire department connection inside of the building and pipe to the nearest floor drain.

B. Pressure Gauges:
   1. Manufacturer: Ametek/U.S. Gauge Division, Ashcroft, Marsh, Taylor, H.O. Trerice, Weiss, Weksler.

2. Cast aluminum, stainless steel or brass case of not less than 3.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale. Include bronze three-way globe valve with plugged outlet for fire inspector's test gauge.

PART 3–EXECUTION

3.01 GENERAL INSTALLATION

A. Install pipe, fittings, equipment, and components in accordance with referenced standards, manufacturer's recommendations, recognized industry practices, and the authority having jurisdiction.

B. General Coordination: Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures, and grilles before installing piping.

C. Where piping must be embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

D. Maintain piping, fittings, and fire protection system components in clean condition internally during construction. All material shall be kept at proper temperature to assure proper jointing. Pipe and fittings shall be corresponding materials when assembled.

E. Provide clearance for access to valve and piping specialties to facilitate maintenance and repair or replacement.

F. Pipe shall be hung from building members using concrete inserts or beam clamps. Provide anchors, expansion joints, swing joints, and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

G. Install sprinkler piping so that the system can be drained in accordance with NFPA 13. Where possible, slope to main drain valve. Slope dry pipe, deluge, and pre-action systems subject to freezing at minimum 1 inch per 10 feet on mains and 1 inch per 10 feet on branches. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve, inspector's tests, and auxiliary drains to grade or to air gap sewer receptor.

H. Provide 3/32 inches minimum thickness steel nailing plates behind or on either side of piping where the possibility of penetration from nails or drywall screws exists.

I. Piping between preaction or deluge valves and sprinkler heads and test/auxiliary drain piping shall be galvanized steel to retard or eliminate corrosion because of oxidation in

these subsystems. Fittings shall match piping installed such as galvanized fittings on galvanized pipe. Provide dielectric fittings between dissimilar pipe materials.

J. Mitered ells, notched tees, and orange peel reducers are not acceptable. Bushings and reducing couplings are not acceptable.

K. Install auxiliary drains at all low points in the system and as required by the referenced standards. The drain shall consist of, as a minimum, a 1-inch ball valve, 1-inch brass nipple with 3/4-inch male hose threads and cap.

L. Fire Barrier Penetrations: Where pipes pass through fire-rated wall assemblies, partitions, ceilings, or floors, the fire rating integrity shall be maintained.

M. Do not install piping within exterior walls.

N. Do not route piping above transformers, panelboards, or switchboards included the required service space for this equipment, unless the piping is serving this equipment.

O. Floor and Roof Protection:
   1. CONTRACTOR shall take extra precautions to protect the floors and roofs from oil spillage and dripping. Any operation, such as cutting and threading of pipe that can result in dripping of oil and thread cuttings, shall be done over a drain pan that will collect all drippings. Tarpaulins, plywood, or drop cloths shall be used around such piping to prevent workers from tracking oil over the area. Workers shall be cautioned about cleaning their feet. Any liquids, such as oil, that will be used in this work shall be kept in tightly stoppered containers; extreme care shall be used when charging equipment with these materials to avoid any spills.
   2. All residual matter deposited on floors, roofs, walls, and other surfaces because of the system installation shall be completely removed.

3.02 WELDED PIPE JOINTS

A. Welded joints shall be made in a fabrication shop. No welding is allowed at the project site.

B. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and the Wisconsin Commercial Building Code where applicable. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

C. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half the diameter of the main.

3.03 THREADED PIPE JOINTS

A. Joints of threaded pipe shall be made by cutting pipe square and reaming inside. Ream ends of pipe to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly. Threads shall be cut so that exposed threads shall not exceed three. Exposed threads shall be coated with asphaltum. Use joint compound sparingly.

B. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.04 MECHANICAL GROOVED PIPE CONNECTIONS

A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools available for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

3.05 UNIONS AND FLANGES

A. Install a union, flange, or grooved coupling combination at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union or grooved coupling combination connections on the equipment side of the valve. Concealed unions, flanges, or couplings are not acceptable.

3.06 HANGERS

A. Support piping in accordance with NFPA 13, other sections of this specification, and in accordance with all state and local requirements.

B. Provide hangers to support all piping in perfect alignment without sagging or interference, to permit free expansion and contraction, and to meet the requirements of NFPA 13. Strap hangers, wire hangers, or trapeze hangers will not be acceptable.

3.07 SPRINKLER HEADS

A. Install sprinkler heads as recommended by manufacturer. Locate sprinkler heads as indicated on fire protection plan and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings, and walls. Install sprinkler heads level in locations not subject to spray pattern interference. When ducts, lights, or other objects are obstructions to sprinkler distribution, additional heads shall be provided beneath the obstruction.

B. All sprinkler heads installed in finished ceilings shall be fed by a swing joint or return bend arrangement for final positioning in ceiling grid pattern during construction phases.

C. All sprinkler heads shall be centered on ceiling tile.

3.08 GAUGES

A. Provide a valved pressure gauge in main fire protection riser, at or near each test connection, and at the top of each piping riser. Provide gauge with a connection having a soft metal seated globe valve arranged for draining pipe between gauge and valve. Install gauges to permit removal and where they will not be subject to freezing.

3.09 VALVES

A. Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing, and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a

capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.

B. Install supervised-open gate valves located to control all sources of water supply except fire department connections.

C. Provide independent locked open control valves for shutoff of accidental sprinkler discharge in each room without removing the sprinkler protection in the remainder of the building.

D. Provide permanently marked identification signs indicating the portion of the system controlled by each valve.

E. Provide tamper switch on each shutoff valve.

F. Install locking device with each shutoff valve to prevent inadvertent closing of the valve. Keys shall be indexed to identify valve location.

3.10 SPECIALTY VALVES

A. Install in vertical position fire protection riser. Install trim recommended by manufacturer including drain and test valves. Pipe drains to hub or floor drains. Test and adjust operation of valves, alarms, pressure maintenance devices, and deluge/preaction controls.

3.11 FIRE DEPARTMENT CONNECTIONS

A. Fire department connections will be installed in the same location as the double check valve assembly. Mount on wall where indicated and/or as required. Support from structure independent of piping. Locate between 2 feet to 3 feet above grade. Fill wall penetration with insulation and caulk exterior and interior face of wall opening weather-tight.

B. Provide 1/2-inch automatic drip drain on inlet of fire department connection check valve and where indicated.

3.12 TEST CONNECTIONS

A. Install test connections sized and located in accordance with NFPA Standards, complete with shutoff valve. Test connections may also serve as drain pipes.

B. Provide test connections for each flow switch. Test connections shall discharge to appropriate receptacles.

C. When test valves are located remote from the flow switch, the valve shall be identified with a brass tag denoting which flow switch is being tested.

3.13 FIRE ALARM SYSTEMS

A. CONTRACTOR shall coordinate his work with the Fire Alarm System Contractor. The system (Fire Alarm and Fire Protection) must be compatible as listed in the Factory Mutual Research Approval Guide.

3.14 FINISHES

A. See Section 09900 for methods and material required for work under this section.

3.15 TESTING

A. Flush, test, and inspect sprinkler piping systems in accordance with NFPA 13.

B. The sprinkler system shall be tested as an entire system or partial system. The system shall be hydrostatically-tested at 200 psi for 2 hours. No leakage allowed. All defective joints shall be replaced with new materials. No caulking of defective joints shall be allowed. After defective joints are replaced, the system shall be retested until satisfactory results are obtained. Pipe shall not be concealed until satisfactorily pressure-tested.

C. ENGINEER and OWNER shall be notified 24 hours prior to any pressure test. This test shall be performed in the presence of appropriate representatives for OWNER and ENGINEER. A log of tests shall be kept stating who performed test, time and date of test, what section of system was tested, and results of test with properly executed Contractor's Material and Test Certification forms from NFPA 13, Chapter 8. This log shall be kept at the jobsite and submitted to ENGINEER for review.

D. Flow switches shall be operated to test that proper signals are transmitted to the Fire Alarm System.

E. Include tests for tamper switches.

3.16 IDENTIFICATION

A. Identify equipment with engraved nameplates.

B. Identify interior piping mains not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Place flow directional arrows at each identification location. Provide one piece, preformed construction, snap-around pipe markers fastened by nylon ties at each end of the marker.

C. Identify valves with signs per NFPA rulings.

D. Provide a hydraulic design information sign of permanently marked weather proof metal or engraved nameplate material. Secure to alarm valve with brass chain or nylon wire ties. Information to include location of the design areas. Discharge densities, required flow and residual pressure at base of the riser, hose stream demand and fire sprinkler head demand.

END OF SECTION

SECTION 15400

PLUMBING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All material and piping for plumbing.
   2. Concrete foundations and anchor bolts for all equipment furnished under this section.
   3. Piping connections to all plumbing equipment, whether furnished under this section or not.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials shall be National Sanitation Foundation (NSF) approved.

2.02 PLUMBING PIPING AND APPURTENANCES

A. Unless otherwise specified, piping shall be in accordance with Section 15040–Piping and Accessories.

B. Thermostatic Mixing Valve: Provide Watts Model L111, or equal. Valve shall be capable of operating pressure of 0 to 60 psi, hot water temperatures 120° to 180°F, cold water temperatures of 33°F to 85°F, minimum temperature differential of 10°F, and a field-adjustable outlet temperature of 60°F to 120°F. Valve shall meet ASSE 1016 or ASSE 1017.

2.03 PLUMBING SPECIALTIES

A. Unless otherwise specified, valves shall be provided in accordance with Section 15040–Piping and Accessories.

B. Floor Drains:
   1. All floor drains shall be furnished and installed with all options and accessories required for a leak-free installation within the particular construction in which they are to be mounted.
   2. Each floor drain shall be provided with a deep-seal P-trap unless otherwise noted.
   3. Each drain shall be provided with a trap. A minimum of one cleanout shall be provided for each single or common leader.

4. (FD-1) Floor drains in finished areas or tiled areas shall be Zurn ZN-415, Type H, Wade Model AX6, or equal, with 6-inch round adjustable strainer top with integral clamping frame and secured heelproof grade. Provide polished nickel bronze top. Provide square grate for tiled floors.
5. (FD-2) Floor drains for piping 4 inches and under shall be Zurn ZN-550, Wade W-1300, or equal, and for piping larger than 4 inches Zurn ZN-505, Wade W-1240, or equal. Drains receiving pump drainage piping shall be provided with Zurn Z-329, Wade EG-8, funnel converter assembly, or equal. Finish to match floor drain finish. Provide nickel bronze grate.
6. Drains located above the lower level shall be provided with membrane flashing flange to prevent dripping to lower level.

C. Hub Drain (HD-1): Provide Kusel Equipment, or equal, 304 stainless steel hub drain.

D. Cleanouts:
1. Manufacturers shall be Zurn, Wade, Smith, Josam, or equal.
2. Each cleanout shall be gas and watertight.
3. Cleanouts that are elevated shall include a membrane flashing flange to prevent leakage to the lower floor.
4. Interior concrete floor areas: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
5. Interior exposed vertical stacks: Line-type cleanout tee with tapered threaded ABS closure plug; Zurn Z-1445.

E. Water Hammer Arrestors: Sized in accordance with ANSI A112.26.1, ASSE 1010, precharged piston-type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with O-ring seals, FDA-approved silicone lubricant, suitable for operation in temperature range 35 to 150°F, maximum 150 psig working pressure, 1,500 psig surge pressure. Water hammer arrestor shall be Watts series 15, or equal.

2.04 PLUMBING FIXTURES

A. All exposed metal fixture parts, piping, and valves are to be chromium plated.

B. The following fixtures shall be Kohler (K), American Standard (A), or equal.

C. Water Closet (WC): (WC-1) K-4302 High Crest, A-2305.100, floor mount, vitreous china, 1.6 gpf, ADA-compliant, 1 1/2-inch top spud, and elongated bowl. Provide white open front seat and Sloan Uppercut Model WES-111 flush valve.

D. Lavatories: (L-1): K-2030 (20×18), A 0356.015, wall hung, supplies and cast iron hanger. Provide ADA-approved faucets. Faucet:
1. Provide ADA-approved paddle-handled faucet; Chicago Faucet 2200-4E2805ABCP with E2805JKABCP removable strainer, or equal.
2. Provide insulation wrap on hot water line and drain line as required by ADA. Faucet shall be NSF61-certified.

E. Service Sinks (SS): Mop Basin (MSB): Furnish and install 24-inch by 24-inch by 10-inch mop service basin as manufactured by E.L. Mustee & Sons, Inc., Zurn, or equal. Faucet shall be Chicago Faucet 911-ISCP in polished chrome plate with integral stops and teardrop escutcheons. Provide the following accessories: Hose and hose holder, mop

hanger, bumper guards, and wall guards. Faucet shall include cross connection prevention device.

F. Drinking Fountains:
   1. Manufacturers: Elkay (E), Halsey Taylor (HT), Haws (H), or equal.
   2. (DF-1): Wall-mounted barrier-free stainless steel drinking fountain with self-closing front-mounted push bar valve, wall hanger, 1/2-inch supply and 1 1/2 inch tailpiece. Mount at 36-inch spout height. Provide Model No. (H) 1025.

2.05 PLUMBING EQUIPMENT

A. Water Heaters: Electric Instantaneous Water Heater (WH-106-01):
   1. Manufacturers: Eemax (E), Keltech (K), or equal.
   2. Type: Wall-mounted, tankless, UL listed, instantaneous electric water heater with digital microprocessing temperature control capable of maintaining outlet temperature of one degree accuracy, LED temperature display, 150 psig pressure rating, and capable of supplying multiple lavatories. Model E PA018208T2T.
   3. Performance:
      a. Storage: None.
      b. Input: 208-volt, 50-amp, three-phase, 18 kW.
      c. Minimum recovery rate: 49-degree temperature rise at 2.5 gpm.
   4. Element shall be replaceable cartridge insert nickel chrome material.
   5. CONTRACTOR shall provide a pressure relief valve at the hot water outlet with no shutoff valve between the heater and the relief valve. Provide Watts LFTWH, or equal. Tankless water heater valves on cold and hot water lines to water heater. Provide unions or compression fittings at the water heater to facilitate removal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Unless otherwise specified, installation of piping shall be in accordance with Section 15040–Piping and Accessories.

B. Plumbing system shall be installed with hangers and supports in accordance with the Plumbing Code. Insulation saddles shall be used at supports of insulated piping.

C. Plumbing system shall be installed in accordance with local plumbing requirements and applicable portions of the Wisconsin Plumbing Code. Where requirements conflict, the stricter standard shall apply.

D. CONTRACTOR shall identify piping, valves, and outlets in accordance with Division 9 and SPS 382.

E. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.

F. Pipe temperature and pressure relief valves to floor drain or floor as indicated.

G. Start-up and test equipment adjusting operating and safety controls for proper operation.

H. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters, floors, and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07900; color to match fixture. CONTRACTOR shall coordinate fixture hanger support with wall construction details.

I. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.

J. Provide unions at water connections to drinking fountains.

K. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy-duty type with brass stems and screwed or sweat inlet connections. Compression-type inlets are not acceptable.

L. Provide isolation valves at plumbing equipment.

3.02 TESTING AND CLEANING

A. General:
1. All new piping shall be tested. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
2. All piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests, flushing, sterilization, and inspection. CONTRACTOR shall also provide all temporary sectionalizing devices and vents as required.
3. All new and parts of existing altered, extended, or repaired plumbing system piping shall be tested and inspected for leaks and defects. Piping being tested shall not leak nor show any loss in test pressure for duration specified.
4. In cases of minor installation and repairs where specified water and/or air test procedures are deemed impractical, CONTRACTOR shall obtain written approval from ENGINEER to perform alternate testing and inspection procedures. Alternate testing and inspection procedures for minor installation and repairs shall include visual evaluation of installed components by ENGINEER during a simulation of use.
5. The water utilized for tests shall be obtained from a potable source of supply.
6. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After inspection has been approved or portions thereof, certify in writing the time, date, name and title of the persons reviewing the test. This shall also include the description of what portion of the system has been approved. A complete record shall be maintained of all testing that has been approved, and shall be made available at the jobsite. Upon completion of the work, all records and certifications approving testing requirements shall be submitted to ENGINEER before final payment is made.
7. Verify systems are complete, flushed and clean prior to testing. Isolate or remove components subject to damage or not rated for test pressure. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or

repaired. Leave piping uninsulated, uncovered and unconcealed until it has been tested and approved. Where any portion of piping system must be concealed before completion of entire system, the portion shall be tested separately as specified for the entire system prior to concealment. CONTRACTOR shall expose all untested covered or concealed piping.

8. Gauges used for testing shall have increments as follows:
   a. Tests requiring a pressure of 10 psi or less shall utilize a testing gauge having increments of 0.10 psi or less.
   b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall utilize a testing gauge having increments of 1 psi or less.
   c. Tests requiring a pressure of greater than 100 psi shall utilize a testing gauge having increments of 2 psi or less.
9. Separately test above- and belowground piping.
10. Do not introduce test water into piping systems when exposure to freezing temperatures is possible.
11. Do not introduce test water into sections of piping located above existing sensitive areas and/or equipment that may be damaged or contaminated by water leakage. Coordinate with OWNER to determine areas and/or equipment considered as being sensitive.
12. Defective work or material shall be reworked and replaced, and inspection and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.
13. CONTRACTOR shall be responsible for cleaning up any leakage during flushing, testing, repairing and disinfecting to the original condition any building parts subjected to spills or leakage.
14. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground pressure mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.
15. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
16. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

B. Drainage and Vent System:
   1. Subject gravity drainage and vent piping and joints to a vertical water column pressure of at least 10 feet. If after 2 hours the level of the water has been lowered by leakage, the leaks must be found and stopped and the water level shall again be raised to the level described and the test repeated until, after a 2-hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
   2. Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with air. Air test may also be performed when allowed by ENGINEER. Isolate the test section from all other sections and slowly fill pipe with oil-free air until there is a uniform gauge pressure of 5 pounds per square inch. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of

changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.

3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of ENGINEER.
4. Test plugs must extend outside the end of pipe to provide a visible indication for removal after the test has been completed.
5. Each floor drain P-trap that has successfully passed pressure testing shall be proven clean and free of debris as follows:
   a. An inspection request shall be submitted to OWNER, identifying the quantity and location of drain(s) to be inspected.
   b. Vacuum out each floor drain P-trap. A visual inspection of the trap shall be performed to verify that the trap is debris free.
   c. Perform a free-flowing test by pouring two 5-gallon buckets of water down the floor drain.
   d. After confirming that the floor drain trap is clean and free of debris, ensure that the trap is filled with water.
   e. At the discretion of ENGINEER, a visual inspection of the trap utilizing a sewer scope may be required in addition to, or in lieu of, a vacuum procedure.
6. OWNER may require that any portion of the drainage, waste and vent systems installed be proven undamaged, clean and free of debris. Verification of the interior condition of piping shall be accomplished utilizing a sewer scope or other method as determined by ENGINEER.

C. Domestic Water System:
   1. Subject piping system to a hydrostatic pressure of at least 100 pounds per-square-inch gauge, but not less than the operating pressure under which it is to be used, for a period of no less than 2 hours. During test period, all pipe, fittings and accessories in the particular piping system that is being tested shall be carefully inspected. If leaks are detected, such leaks shall be stopped and the hydrostatic test shall again be applied. This procedure shall be repeated until no leaks are detected for an entire 2-hour period. EXCEPTION: Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with oil-free air in lieu of water.
   2. After completion of the testing, all new and/or altered water piping systems shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. Do not exceed 150 parts per million at any time. Introduce chlorine into the supply stream at a rate sufficient to provide a uniform concentration throughout the system. All outlets shall be opened and closed several times. When the specified level of chlorine is detected at every outlet in the system, close all valves to prevent release of water from the system for 24 hours. At the completion of the 24-hour disinfection period, test every outlet for a minimum chlorine residual of 50 parts per million. This minimum residual must be present to proceed with flushing. Flush the system with clean water at a sufficient velocity until the residual chlorine detected at every outlet is within 0.2 parts per million of the normal water supply's level.
   3. Sufficient samples must be taken no sooner than 24 hours after sterilization and flushing to represent the extent and complexity of the affected water system, along with a control sample to indicate municipal water quality at the time of testing. Send water samples to an accredited and/or certified laboratory to perform qualitative and quantitative bacteriological analysis in accordance with AWWA C651 or in accordance

with Plumbing Code. CONTRACTOR shall obtain written certification from the independent testing agency stating that the water samples meet Federal and State guidelines for safe drinking water. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to OWNER.

4. Isolate or bypass equipment that would be detrimentally affected by disinfecting solution. Isolate all other sections of the domestic water system not being disinfected to prevent migration of chlorine.
5. Prior to injection of chlorine into the piping system, strategically place signs stating "Heavily Chlorinated Water-Do Not Drink," and protect all outlets to prevent use during disinfection and flushing procedures.
6. A bacteria test may not be necessary for small scale work. However, disinfection is required. Examples of small scale work are less than 20 feet of pipe, replacement and/or installation of a sink, drinking fountain, eyewash, backflow preventer, isolation valve, etc. Disinfect individual parts, fixtures, isolation valves, pipes, etc. by swabbing with full strength bleach (5.25%) or soaking for at least 30 minutes in a 500 ppm chlorine solution. Materials should then be thoroughly rinsed before putting into service.

System	Test Medium	Initial Test Pressure	Duration	Pressure	Final Test Duration
Sanitary Waste and Vent	Water	N/A		10 feet water	2 hours
*Belowground Domestic Water	Water	N/A		200 psig	2 hours
Aboveground Domestic Water	Water	N/A		150 psig	8 hours

* Leakage on exterior mains 3 inch and larger may not exceed leakage calculated as follows:

$$\text{GPH Allowable Leakage} = \frac{(\text{Feet of Pipe})(\text{Inches Diameter of Pipe})(\text{Test Pressure})^5}{133{,}200}$$

END OF SECTION

SECTION 15510

HYDRONIC PIPING AND SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Hydronic piping.
   2. Valves.
   3. Temperature and pressure indicators.
   4. Air control fittings.
   5. Strainers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A47-Specification for Ferritic Malleable Iron Castings.

B. ASTM A53-Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

C. ASTM A183-83-Specification for Carbon Steel Track Bolts and Nuts.

D. ASTM A234/A234M-Specification for Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

E. ASTM D2000-Classification System for Rubber Products in Automotive Applications.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300-Submittals.

PART 2–PRODUCTS

2.01 HYDRONIC PIPING AND CHILLED WATER

A. Hydronic piping 2 inches in diameter and less and drain and air vent piping shall be Type L hard copper piping with wrought copper sweat fittings with 50/50 solder joints. Piping shall conform to ASTM AB88 and fittings shall conform to ASTM B88, Class 125.

B. Pro-Press fittings shall be an acceptable alternative to sweat fittings on piping 2 inches and smaller.

2.02 VALVES

A. Acceptable valve manufacturers are DeZurik, Apollo, Bell and Gossett, or equal.

B. Balancing Valves:
   1. Balancing valves 2 inches and smaller shall be Bell and Gossett Model CB, or equal, with bronze body, brass ball orifice with O-ring stem seal, and glass- and carbon-filled seat rings. Ball orifice shall be bidirectional calibrated and provide positive shutoff. Valve shall have a position indicator with memory stop, pressure taps, and a drain tap. Valve shall be rated for 300 psi at 250°F.
   2. Provide Bell and Gossett Model RO-2, or equal, portable balancing readout meter for differential pressure measurement.

C. Ball Valves:
   1. Shutoff valves 2 inches and smaller shall be Nibco S-585, or equal, ball valves with two-piece bronze body, 316 stainless steel ball and stem, and TFE seat. Valve shall be rated for 600 psig WOG.
   2. Provide stem extensions where necessary for access.
   3. Provide a lever operator for each valve.

D. Drain Valves and Gauge Valves:
   1. Provide valve with threaded or sweat ends rated for 125 psig at 200°F. Valve shall have bronze body and Teflon seat.
   2. Drain valves shall be full size of piping runouts.

2.03 CONTROL VALVES

A. Provide all control valves as required to perform the functions listed in Section 16940–Controls and Instrumentation. Refer to drawings for two-way and three-way valve configuration and requirements. Valve types shall be as indicated in the table below.

Valve Serving	Type	Input Signal	Fail Position	Spring Return Required?
AHU Cooling Coil	Ball	2-position	Last position	No

B. Ball valves 2-inches and smaller:
   1. Ball valves shall be Belimo model B2 or B3, TAC VBS series, or Honeywell model VBN.
   2. Valves shall have forged brass or bronze body, stainless steel shaft and ball, PTFE seats and Tefzel operating disc.
   3. Valves shall be line size.

C. Valve actuators:
   1. Modulating valve actuators shall be sized for a pressure drop between 2 and 4 psig at design water flow.
   2. Two position valve actuators shall be sized for a maximum pressure drop of 2 psig at design water flow.
   3. Valve actuators shall receive power from fan coil unit controller and input signal from thermostat.
   4. Modulating non-spring return actuators shall be Belimo _RB24-SR, or equal, proportional actuators with 4-20 mA input signal and 2-10 VDC feedback signal. Actuator shall operate at 24 VAC/DC.
   5. Two position non-spring return actuators shall be Belimo _R24, or equal. Actuator shall operate at 24 VAC/DC.

2.04 TEMPERATURE AND PRESSURE INDICATORS

A. Acceptable manufacturers are Trerice, or equal. All gauges and thermometers shall be mounted so that they can be read from the floor.

B. Temperature Indicators (TI):
   1. Temperature indicators shall have chrome-plated brass fittings, adjustable 9-inch cast aluminum case, and glass-enclosed spirit-filled column.
   2. Temperature range shall be from 30°F to 240°.
   3. Furnish and install where shown on drawings.
   4. Furnish and install a brass well with a length suitable to extend past pipe insulation.

C. Pressure Indicators (PI):
   1. Pressure indicators shall have a cast aluminum case with a 4 1/2-inch dial.
   2. Pressure range shall be from 0 to 100 psig.
   3. Furnish and install gauges where shown on drawings.
   4. Furnish and install pressure snubber.

2.05 STRAINERS

A. Provide cast iron Y-type strainers with a 304 stainless steel strainer, 1/8-inch perforations, dirt leg, blowoff valve, and 125 psig rating. Strainer sizes and locations shall be as shown on the drawings.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install all hydronic piping and specialties in accordance with manufacturer's recommendations and Section 15040-Piping and Accessories in locations as shown on drawings.

B. Piping shall be run level and free of depressions or pockets. High points shall have manual air vents, and low points shall have drain plugs.

C. Valves and strainers serving pumps shall be line size.

D. Provide unions in supply and return connections to all equipment. Piping shall be arranged so that coils and equipment may be removed without dismantling piping beyond unions. Provide double swing joints at equipment connections.

E. Connect piping to equipment served without strain as shown on the drawings. Install pipe loops in piping to allow for expansion and contraction.

F. In joining two dissimilar types of pipe, standard fittings shall be used when available. The proposed joint shall be submitted by CONTRACTOR to ENGINEER for review prior to installation.

END OF SECTION

SECTION 15835

TERMINAL HEAT TRANSFER UNITS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Electric heaters.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NFPA 70–National Electric Code.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 ELECTRIC HEATERS

A. CONTRACTOR shall provide electric heaters of the type, size, capacity, and accessories as listed on the equipment schedule. All units shall be UL listed.

B. All electric unit heaters shall be factory-assembled and tested.

C. Electric Unit Heaters (Standard):
1. Acceptable manufacturers are Chromalox, QMark, or equal.
2. The cabinet shall be constructed of heavy gauge, die-formed steel. Manufacturer shall provide mounting bracket.
3. Provide a propeller fan with direct-drive totally-enclosed motor.
4. Provide an aluminum-finned copper-clad steel sheath heating element.
5. Provide an automatic reset thermal cutout to protect the element.
6. Equipment disconnect and line voltage thermostat shall be provided by Division 16 contractor.
7. Mount units to provide 8 feet 0-inch clearance below, unless otherwise shown on the drawings.
8. Unit shall include an automatic reset thermal cutout to protect the element, and a thermal fan delay.

D. Electric Unit Heaters (Corrosion-Resistant):
1. Acceptable manufacturers are Chromalox, QMark, or equal.
2. The cabinet shall be constructed of heavy gauge stainless steel with a corrosion-resistant grille and stainless steel wall-mounting bracket. Heating elements shall be 316 stainless steel sheathed with 316 stainless steel fins.

3. Unit shall include a direct-drive totally-enclosed motor, designed to resist moisture and corrosion, wired to a NEMA 4X enclosure.
4. Unit shall include an automatic reset thermal cutout to protect the element and a thermal fan delay.
5. Line voltage thermostat shall be provided by Division 16 contractor.
6. Unit mounted equipment disconnect shall be provided by manufacturer suitable for corrosive locations.
7. Mount units to provide 8 feet 0-inch clearance below, unless otherwise shown on drawings.

E. Electric Wall Heaters (EWH):
1. Acceptable manufacturer is QMark, or equal.
2. Furnish and install a steel cabinet for surface mounting. Provide a cabinet with 16 gauge steel grille bars and finished in baked enamel.
3. Provide a direct-drive propeller fan and permanently-lubricated totally-enclosed motor.
4. Provide steel-finned metal sheath electric heating elements.
5. Provide automatic reset thermal overheat protection to disconnect power in the event of overheating. Provide an integral, tamper-resistant thermostat. Provide integral contactors and disconnects.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations and local codes, including minimum mounting heights above floor.

B. CONTRACTOR shall provide all mounting hardware and accessories necessary to complete installation.

C. Drawings are based on the scheduled make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.

END OF SECTION

SECTION 15855

AIR HANDLING UNITS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Fan coil units (FCU).

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ARI 430–Central Station Air Handling Units.

B. NFPA 70–National Electric Code.

C. NFPA 90A–Standard for the Installation of Air Conditioning and Ventilating Systems.

D. UL900–Test Performance of Air Filter Units.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals. Included in submittals shall be detailed control wiring diagrams specific to the project that show logic circuits for the unit, as well as all external connections (e.g., thermostats, valves, etc.).

1.04 QUALITY ASSURANCE

A. Unit performance shall be certified in accordance with ARI Standard 430 for Central Station Air Handling Units.

B. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored and handled in accordance with the unit manufacturer's instructions.

PART 2–PRODUCTS

2.01 FAN COIL UNITS (FCU)

A. Acceptable manufacturers are EnviroTec, McQuay, or equal.

B. General:
   1. Furnish and install Belt Drive Fan Coil Units where indicated on the plans and specifications. Units shall be completely factory assembled and tested and shipped as one piece.
   2. All units shall be capable of meeting or exceeding the scheduled capacities for cooling, heating and air delivery. All unit dimensions for each model and size shall be considered maximums.
   3. All units shall be of "draw-thru" design with coils, fans, motor/ drive and drain pan completely contained within the unit cabinet.
   4. Units shall be cETL listed in compliance with UL/ANSI Std. 1995.
   5. All unit coils shall meet or exceed the scheduled cooling capacity, selected and rated in accordance with ARI 410.

C. Construction:
   1. All units shall be fabricated of minimum 18 gauge galvanized steel, able to withstand a 125 hour salt spray test per ASTM B-117. All exterior panels shall be single wall insulated with 1 inch thick fiberglass insulation, rated for a maximum air velocity of 5000 f.p.m. Adhesives shall complying with NFPA 90A. Adhesive as the only method of fastening the insulation to the casing is not acceptable. Maximum thermal conductivity shall be 0.24. Insulation must meet all requirements of UL 181 and NFPA 90A. All units shall have minimum 1-inch duct collars on discharge and return.
   2. All access panels shall be fully insulated and attached with standard fasteners on at least two opposite sides. No single access panel shall be larger than 30 inches by 36 inches for safety and ease of handling. No coil or drain piping or electrical connections shall pass through any access panel.
   3. Each unit shall be furnished with a one-piece heavy gauge G90 steel drain pan with welded corner construction. All units shall be provided with 9/16-inch diameter hanger rod holes in the top and bottom panels for "through-bolt" type suspension installation.

D. Fan Assembly: All units shall be furnished with standard selection double inlet forward curved centrifugal blowers statically and dynamically balanced for smooth operation. All blower wheels shall have two set screws and shall be mounted on solid steel shafting rotating in ball bearings with a minimum design average life (L50) of 100,000 hours. All standard blower assemblies shall have resilient mounted cartridge type permanently lubricated ball bearings.

E. Fan Motor and Drive Assembly:
   1. All fan motors shall be standard NEMA design motors of the horsepower listed in the equipment schedule. All motors shall be 1750 RPM, 60 hertz ODP single speed motors rated for continuous duty. All motors shall be reversible rotation type.
   2. Three phase motors shall be "across-the-line" start type.
   3. All motors shall be mounted on an adjustable base.
   4. All motor wiring is to be terminated in a junction box, external to the unit casing.
   5. All fan drive assemblies shall include an adjustable pitch motor pulley, a fixed pitch blower pulley and a standard cross section "V-belt". All fan drives shall be selected at a minimum service factor of 1.2.

F. Coils:
   1. All unit coils shall be rated in accordance with ARI 410.
   2. All coils shall be 1/2-inch O.D. seamless copper tubes with collared aluminum fins. All tubes shall be mechanically expanded to provide an efficient bond between tube and

fin. All water coils shall be provided with a manual air vent fitting to allow for coil venting. Valve core type vent fittings shall not be accepted.

3. All chilled water coils shall have aluminum fins and 0.016-inch tube wall thickness.
4. All coils shall be hydrostatically tested with air under water at 450 PSIG minimum pressure and rated for a maximum of 300 PSIG working pressure at 200°F.

G. Filter Rack Assembly: All units shall be furnished with a flat filter rack with hinged access on both sides designed to accept a 2-inch nominal standard sized filters. All units shall be provided with nominal 2-inch throwaway filters factory installed.

H. Electrical Control: The unit fan motor shall be completely factory wired to an external electrical enclosure. Each unit shall include fan control package with 24 volt control voltage. Each unit shall include motor circuit fusing, starter, control circuit transformer and terminal strip for connection of field wiring. Manufacturer shall provide a low voltage remote mounted thermostat to be wired by Division 16 Contractor. Thermostat shall be Honeywell TH5110D, or equal. Thermostat and control valve shall receive 24 V power from fan coil unit. Control sequence shall be as follows:

1. When fan is in Auto: Thermostat shall call for cooling, fan coil shall start, and control valve shall open.
2. When fan is in On mode: Fan coil shall run continuously and control valve shall modulate open on call for cooling from thermostat.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with drawings and manufacturer's recommendations.

B. Pipe and trap condensate to nearest floor drain in accordance with Section 15400-Plumbing.

C. Furnish and install neoprene vibration isolators sized by the manufacturer.

D. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

E. Provide flexible duct connections on outlet of unit in accordance with Section 15910-Ductwork Accessories.

F. Installation of all equipment furnished under this contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

3.02 CLEANING

A. Unit shall be cleaned and new filters shall be furnished and installed prior to final acceptance by OWNER.

END OF SECTION

SECTION 15860

HVAC FANS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Ceiling or cabinet fans.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. AMCA 99–Standards Handbook.

B. AMCA 210–Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300–Test Code for Sound Rating Air Moving Devices.

D. AMCA 301–Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. NFPA 70–National Electrical Code.

F. NEMA MG I–Motors and Generators.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Submittal shall include fan-specific performance curves showing airflow, head, and motor horsepower.

1.04 QUALITY ASSURANCE

A. Fans shall bear AMCA certified rating seals.

1.05 DELIVERY, STORAGE AND HANDLING

A. All fans shall be stored and handled in accordance with manufacturer's instructions.

B. Motors, shafts, and bearings shall be protected from weather and dust.

PART 2–PRODUCTS

2.01 CEILING FANS OR CABINET FANS

A. Acceptable manufacturers are Greenheck, Cook, or Carnes.

B. Fans shall have acoustically insulated housings and shall have maximum sound level rating not to exceed 4.0 sones in accordance with AMCA Bulletin 300-74. Fans shall bear the AMCA-certified ratings and seal for air capacity, sound, and UL label.

C. Unit shall be equipped with integral chatter-proof backdraft damper.

D. Fans shall have centrifugal wheel with inlet perpendicular to grille. Ceiling grille shall be aerodynamically designed and shall provide 80% free area.

E. Terminal box shall be furnished with cord, plug, and receptacle inside housing. Entire fan, motor, and wheel assembly shall be removable without disturbing the housing. Motor speed shall not exceed 1,100 rpm.

F. Fan shall be mounted on vibration isolators furnished by fan manufacturer.

G. Manufacturer shall furnish line voltage variable speed controller for fan. Controller shall be used for balancing only and shall be inaccessible to room occupants unless otherwise indicated on the drawings.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and drawings.

B. CONTRACTOR to provide all mounting hardware and accessories necessary to complete installation.

C. Provide flexible duct connections on inlet and outlet of all fans.

D. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 15890

DUCTWORK

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Metal ductwork.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A36–Structural Steel.

B. ASTM A90–Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

C. ASTM A480–General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

D. ASTM A653–Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

E. ASTM A527–Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

F. NBS PS 15–Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.

G. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.

H. NFPA 90B–Installation of Warm Air Heating and Air Conditioning Systems.

I. SMACNA–HVAC Air Duct Leakage Test Manual.

J. SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

K. UL 181–Factory-Made Air Ducts and Connectors.

L. SMACNA-Thermoplastic Duct (PVC) Construction Manual.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Provide layout drawing for review prior to ductwork fabrication. Layout drawings shall be coordinated between all other trades prior to review.

1.04 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700–Contract Closeout.

B. Record actual locations and sizes of ducts and duct fittings. Record changes in fitting location sizes and types. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

1.06 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain recommended minimum temperatures during and after installation of duct sealants.

PART 2–PRODUCTS

2.01 MATERIALS

A. All sheet metal used for construction of duct shall be 24 gauge, or heavier.

B. Galvanized steel ducts shall be ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating in conformance with ASTM A90, A653.

C. All fasteners shall be 316 stainless steel unless otherwise indicated.

D. Duct sealant shall be United McGill United Duct Sealer, or equal, for indoor applications and United McGill Uni-Weather, or equal, for outdoor applications. Sealant shall be UL classified for flame and smoke development and shall be suitable for mating materials.

E. Hanger rod shall be ASTM A36 galvanized steel for galvanized ducts, or 316 stainless steel for ducts other than galvanized; threaded both ends, threaded one end, or continuously threaded.

2.02 DUCTWORK FABRICATION

A. Field and Shop Fabricated Ductwork (Rectangular):
   1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible. Provide duct material, gages, reinforcing, and sealing in accordance with SMACNA Standards for 2-inch static rating, 2,500 fpm velocity, and duct seal Class A.

2. Construct Ts, bends, and elbows with radius of not less than 1 1/2 times width of duct on centerline. Where not possible, rectangular elbows may be used with turning vanes in accordance with Section 15910-Ductwork Accessories.
3. Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible; maximum 30 degree divergence upstream of equipment and 45 degree convergence downstream.
4. Provide 45 degree expanded entry takeoffs unless otherwise indicated. Flange ductwork for attachment to grille registers and outlets unless otherwise detailed.

B. Manufactured Ductwork and Fittings (Round):
1. Manufacture in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
2. Ductwork shall be United McGill Uni-Seal, or equal, fabricated spiral seam round where shown on drawings. Material and sizes shall be as indicated on the drawings.
3. Ductwork shall be constructed with locktight spiral grooved seams, gored elbows with centerline radius of 1 1/2 times the duct diameter, and male/female fittings. Conical tees, conical 45 degree laterals, conical bellmouth taps, and fittings shall be used. Seal all joints airtight with gaskets and sealants per SMACNA.
4. Where grilles and registers are shown to be tapped into ductwork sides, the entire assembly including the round duct section and the rectangular tap shall be fully welded and provided by the manufacturer.
5. Ductwork construction, sheet metal gauges, sealant, reinforcing, joints, accessories, spiral seams, hangers, and bracing shall be in accordance with SMACNA Standards for 2-inch to 10-inch static pressure rating, 4,000 fpm velocity, and duct seal Class A.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards-Metal and Flexible.

C. Duct sizes are inside clear dimensions.

D. Provide openings in ductwork to accommodate testing equipment and controllers. Where openings are provided in insulated ductwork, install a metal insulation sleeve of same material as ductwork.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. Make all necessary incidental changes in cross section, offsets, etc., to avoid interference with other equipment and supports.

F. Use double nuts and lock washers on threaded rod supports.

G. Exposed ductwork shall be painted per Division 9–Finishes.

H. Connect air diffusers, registers, and grilles to supply and return ducts directly, unless flexible ductwork is specifically indicated on the drawings. Where registers and grilles are to be mounted on exposed ductwork, provide flanged opening for finished appearance.

I. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

J. Provide an experienced installer to go through the air distribution system with the balancer.

K. Any modifications to the ductwork shown on the drawings must be reviewed by ENGINEER prior to installation.

END OF SECTION

SECTION 15910

DUCTWORK ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Air turning devices.
   2. Duct access doors.
   3. Duct test holes.
   4. Flexible duct connections.
   5. Duct screens.
   6. Dampers and actuators.
   7. Balancing dampers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.

B. SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

C. UL 33–Heat Responsive Links for Fire-Protection Service.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

1.04 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700–Contract Closeout.

B. Record actual locations of access doors, fire dampers, flexible duct connections, dampers, and screens.

PART 2–PRODUCTS

2.01 AIR TURNING DEVICES

A. Provide factory-fabricated metal air turning vanes in all square elbows and bends per SMACNA Standards. Turning vanes shall be constructed of the same material specified for the ductwork.

2.02 DUCT ACCESS DOORS

A. Provide Ductmate Model FD&H, or equal, access doors for ductwork. Access door hinge and cover shall be constructed of material similar to that specified for ductwork. Provide insulated access doors where ductwork is insulated. All access doors shall be gasketed.

2.03 DUCT TEST HOLES

A. Provide Ventfabrics, Inc. No. 699 Instrument Test Holes, or equal, complete with gaskets and screw caps.

2.04 FLEXIBLE DUCT CONNECTIONS

A. All ductwork shall be isolated from fans, fan enclosures, etc., with flexible connections. Provide connections to air handling equipment (except as noted), with Ventfabrics, Inc., "Ventglass," or equal, neoprene-coated glass fabric with a metal-to-metal fabric length of approximately 6 inches.

2.05 DUCT SCREENS

A. Provide screens equal to Ryerson Ryex Standard, 3/4 inches, 12 gauge sheet metal with border frame for protection on open duct inlets and outlets, and as indicated on the drawings. Frame and screen shall be of similar material to ductwork.

2.06 DAMPERS AND ACTUATORS

A. Outside Air Intake:
   1. Dampers shall be TAMCO Series 9000 BF, Alumavent Series 3900SS, or Arrow AFDTI-25LT, thermally insulated control damper with aluminum construction. Dampers for corrosive environments shall be TAMCO Series 9000SW provided with an anodized coating and stainless steel linkage.
   2. Dampers shall be parallel blade.
   3. Extruded aluminum (6063T5) damper frame shall be thermally broken, minimum 0.080-inch thickness. Damper frame to be 4 inches deep and shall be insulated with polystyrene on four sides. Damper shall be rated at a leakage of less than 4.0 cfm per square foot at 4.0 inches of water column pressure differential at 20°F.
   4. Blades to be extruded aluminum (6063T5), internally insulated with nonCFC, expanded polyurethane foam, and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
   5. Blade gaskets shall be extruded EPDM; blade seals shall be silicone.
   6. Shaft to actuator shall be hex-type, material to match damper construction.
   7. Side seals shall be silicone.

B. Actuators:
   1. Actuators shall be Belimo NFBUP, Honeywell MS4110, or equal, maintenance-free actuator rated for at minimum 88 inches/lb. of torque. Dampers shall be power-to-open, spring-closed unless otherwise specified. Provide auxiliary switch where noted on drawings. Actuator shall be capable of accepting 120 volt power for operation and control.
   2. Actuators shall include electronic overload protection and visual position indication throughout range of motion.

3. Actuators shall include a manual override via a manufacturer-supplied hex crank.
4. Where actuators are in areas requiring NEMA 4X equipment, provide Belimo ZS300, or equal, NEMA 4X housing for actuators.
5. All actuators shall be direct-coupled to damper and mounted outside the air stream.
6. If auxiliary switch is not used, terminate cord in nearest junction box.
7. All actuators shall be of the same manufacturer. Manufacturer shall be responsible for furnishing quantity of actuators required to meet minimum damper torque rating, plus an additional 10% torque.

2.07 BALANCING DAMPERS

A. Dampers for metal ductwork shall be single blade, manual balancing damper of same construction as specified for ductwork. Damper shall conform to SMACNA standards for single blade-type volume dampers.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards–Metal and Flexible. Refer to Section 15890–Ductwork for duct construction and pressure class.

B. Provide duct access doors for inspection and cleaning before and after intake louver screens, filters, coils, fans, automatic dampers, at fire dampers, underneath duct smoke detectors, and elsewhere as indicated. Provide minimum 8-inch by 8-inch size for hand access, 18-inch by 18-inch size for shoulder access, and as indicated.

C. Provide duct test holes as necessary for testing and balancing purposes.

D. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Metal-to-metal gap shall be approximately 4 inches.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts for air balancing and where indicated on the drawings. Install minimum two duct widths from duct takeoff.

F. Provide balancing dampers on duct takeoff to diffusers, grilles, and registers regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 15940

AIR OUTLETS AND INLETS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Diffusers and grilles.
   2. Louvers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ADC 1062–Certification Rating and Test Manual.

B. AMCA 500–Test Method for Louvers, Dampers, and Shutters.

C. ARI 650–Air Outlets and Inlets.

D. ASHRAE 70–Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Submittal shall include a louver schedule that includes louver model, screen type, louver size, finish type, free area, face velocity, and pressure drop for each louver.

1.04 QUALITY ASSURANCE

A. Performance of air terminals shall be in accordance with ADC 1062.

B. Louvers shall be tested and certified in accordance with AMCA 500 and shall bear the AMCA seal.

PART 2–PRODUCTS

2.01 DIFFUSERS AND GRILLES

A. Acceptable manufacturers are Carnes, Price, or Metalaire. Submit standard color chart with shop drawings for selection by OWNER.

B. SG-1: Supply grilles for sidewall and surface mounting shall be Carnes model RSDB, or equal. Grilles shall be steel construction with double deflection blades.

2.02 LOUVERS (EXTRUDED ALUMINUM)

A. Acceptable louvers are Greenheck ESD 635, or equal. See drawings for sizes and locations.

B. Blades and frame shall be extruded aluminum 6063-T5 alloy and 0.08 inch thickness. Blades shall be 35-degree drainable-type spaced at 4 inches on center. Louver shall be capable of a velocity of 1,077 fpm with no water penetration. Performance shall include AMCA-certified air and moisture penetration data and louver shall bear the AMCA seal. Vertical and horizontal mullions and connections between panels shall not be exposed.

C. Provide channel frame unless noted otherwise on the drawings.

D. Provide aluminum screen on louver in accordance with louver schedule on drawings. All fastenings shall be stainless steel or aluminum in accordance with louver schedule on drawings.

E. Louvers shall be furnished with 70% Kynar 500 finish with custom color selected by OWNER. Submit manufacturer's standard color chart with shop drawings.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install diffusers, grilles, and registers in locations shown on drawings and in accordance with manufacturer's recommendations.

B. Clean surface of diffusers, grilles, and registers after installation.

C. Install louvers in accordance with manufacturer's recommendations and drawing details.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1–GENERAL

1.01 GENERAL

A. Work Included:
   1. Balancing air systems.
   2. Balancing water systems.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Prior to final balancing, submit a final report which includes the following information.
   1. For each supply, return and exhaust register, and ceiling outlet:
      a. Room number.
      b. Type of register and outlet and catalog size.
      c. Air flow factor.
      d. Design CFM and velocity.
      e. Actual CFM and velocity.
      f. Percent of design CFM.
      g. Room pressure relationship.
   2. For each fan:
      a. Unit number.
      b. Fan size and wheel type.
      c. Motor horsepower.
      d. Motor nameplate voltage and amps.
      e. Design CFM and static pressure (total pressure).
      f. Actual CFM and static pressure (total pressure).
      g. Actual fan RPM.
      h. Actual motor voltage and amps (each phase).
   3. For piping: For piping system, record water flow through all equipment and inlet and outlet water pressure at each pump together with motor nameplate and actual current.

C. Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting, and balancing. Provide recommendations for correcting unsatisfactory performances, and indicate whether modifications required are within the scope of the Contract, are design-related, or installation-related. List instrumentation used during testing, adjusting, and balancing procedures.

1.03 QUALITY ASSURANCE

A. Obtain services of an independent testing organization to perform testing and balancing work. The criteria for determining qualifications shall be membership in the Associated Air

Balance Council (AABC), or certification by the National Environmental Balancing Bureau (NEBB).

B. Balancing procedures shall be observed by Division 15 contractor, temperature controls contractor, OWNER, or ENGINEER. Balancing report must include verification of observation by any of the parties listed above.

PART 2–PRODUCTS

2.01 BALANCING EQUIPMENT

A. CONTRACTOR shall have the following minimum equipment for balancing systems:
1. Duct air velocities below 1,000 fpm: Pitot tube and Micro-Manometer or Alnor velometer and duct-jet using zero to 1,000 fpm range.
2. Water Flows: Ultrasonic Dopler Flow Meter for water systems.
3. Supply Register Velocities: Alnor velometer and applicable jet or Anemotherm.
4. Fan Rotative Speed: Timec tachometer or RPM counter and stop watch (1-minute reading, minimum).
5. Contact pyrometer 0 to 300°F range.
6. Amprobe model RS-3, or equal.
7. Calibrated pressure gauge (0 to 100 feet water head).
8. Inclined manometer 0 to 30 inches of water.
9. Instruments used for measurements shall be accurate, and calibration shall be calibrated by the manufacturer or an AABC-approved method.
10. Instruments shall be applied in accordance with manufacturer's instructions.

B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards.

PART 3–EXECUTION

3.01 PRELIMINARY REPORT

A. Provide an experienced installer to check the air distribution system for completion to be sure that the test openings and volume dampers indicated on the drawings or called for in the specifications are installed, that dampers are in the open position, that the fans operate properly, and that the system is ready for balancing. Add test openings, volume dampers, air scoops, deflectrols, turning vanes, etc., as required. Adjust and change fan drives and belts, remove and reinstall ceilings, air terminals, access doors, and air devices as required to balance the system. Maintain the air handling equipment in good operating condition during the testing and balancing procedures.

3.02 ROOM AIR PRESSURE RELATIONSHIPS

A. The balancing contractor shall pay special attention to specific room pressure relationships specified. Rooms indicated to be positive or negative shall be balanced such. Rooms indicated to be positive shall have 10% more supply air than return/exhaust air quantities. Rooms indicated to be negative shall have 10% more exhaust than supply air quantities.

The balancing contractor shall adjust and change fan drives to provide this feature regardless of plan air quantities noted on drawings.

3.03 THERMAL PERFORMANCE TESTING

A. Measure and record system measurements for each system described below. Measurements shall be taken with coils at 100 percent capacity. Contractor shall make provisions for seasonal testing.

B. CHILLED WATER COILS
1. Coil location.
2. Design and actual water flows.
3. Actual airflow during testing.
4. Design and actual entering air temperature (dry bulb and wet bulb).
5. Design and actual leaving air temperature (dry bulb and wet bulb).
6. Actual pressure drop across the coil (both water and air).
7. Design and actual entering water temperature.
8. Design and actual leaving water temperature.
9. Designation of wet or dry coil.

3.04 METHOD OF AIR BALANCE (CONSTANT VOLUME SYSTEMS)

A. Prepare balancing sheets tabulating air quantities, unit areas, correction factors, and calculated air velocities required for each terminal system. For procedures not specified, follow AABC. Balancing shall be completed with all doors closed.

B. Adjust total air quantity to 110% of design, as measured by duct traverse, by adjusting fan speeds or branch duct volume dampers.

C. Read and record on the balance sheets the air velocities and volumes obtained. (Do not change any volume dampers while reading and recording.)

D. If air quantities are not within 10% of design values, readjust the duct terminal dampers to proportion the air.

E. Adjust the fan speed or the branch duct damper to adjust the air volume and then reread and record.

F. Immediately after completion of the final round, measure the total pressure in the duct and record on the balance sheet.

G. Adjust register, dampers, etc., to equalize the air volume between outlets and adjust air pattern on supply outlets to produce the correct air pattern.

H. Repeat the above for each branch duct system.

I. Proportion the air flow for each branch duct system by adjusting the branch duct volume dampers using a pitot tube traverse or the total pressure reading recorded above.

J. Adjust the fan speed to deliver or exhaust the required air volume when the automatic dampers are placed in the 100% outside air position (and 100% exhaust air position when so equipped). Balance modulating dampers at extreme conditions, and record both sets of

data. Balance variable air volume systems at maximum air flow rate, full cooling, minimum flow rate, and full heating; record all data.

K. Measure static pressure ahead of filters and heating coil. Measure static pressure at fan inlets and fan outlets. Correct any problems. Measure fan speed and motor inputs and compare with manufacturer's fan data to determine the point of operation. Adjust fan speeds to produce the correct air volumes. (Do not overload the motors.) Reread and record the pressure (positive and negative), RPM, and motor input readings.

L. Final air volumes shall be within 10% of design values except that specified room air pressure relationships must be provided. Provide reports on pressure relationships.

3.05 METHOD OF WATER BALANCE

A. The balancer shall provide a mechanic to check the water distribution systems for completion, properly installed control valves, and flow measuring devices. The mechanic shall also assist the balancing contractor in locating all control and flow measuring devices and remove any piping restrictions found by the balancing contractor.

B. The balancer shall report any discrepancies or omissions immediately.

C. Adjust the water flow through equipment not having automatic control valves by use of Ultrasonic Doppler Meter or flow reading balancing valves. Set all balancing valves, and permanently mark position on valves.

D. All automatic control valves shall be opened wide to the coils.

E. Check the water flow by measuring the pump pressures and motor input, and compare to the pump manufacturer's performance curves.

F. For equipment specified with balancing valves or flow meters, measure flow and pressure drops. Set all balancing valves, and permanently mark position on valves.

G. Proportion the water flow to all equipment.

H. Record the water flow through all coils and equipment. Flows through three-way bypass valves shall be adjusted to balance through the coil and in bypass position.

I. Final water flows shall be within 5% for cooling flow rates.

J. Balance water flow with both booster pumps off. Record booster pump status for balancing report.

3.06 GENERAL REQUIREMENTS

A. Contact the temperature control contractor for assistance in operation and adjustment of controls during testing, adjusting, and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.

B. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.

C. Division 15 contractor to correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work including sheave and pulley replacement. Test and balance agency will notify the project representative of these items and instructions will be issued to the Division 15 contractor for correction of the deficient work.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes general requirements for all electrical work.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/NFPA 70–National Electrical Code.

B. ANSI/IEEE C2.

1.03 CONTRACT DOCUMENTS

A. Any device or fixture roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.

B. The drawings are generally diagrammatic, and CONTRACTOR shall coordinate the work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.

1.04 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 70.

B. Conform to ANSI/IEEE C2.

C. The rules and regulations of the federal, state, local, civil authorities, and utility companies in force at the time of execution of the Contract shall become a part of this specification.

D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be by CONTRACTOR.

1.05 CODES AND ORDINANCES

A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

B. In preparing Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the drawings and specifications. All cases of serious conflict or omission between the drawings, specifications, and codes shall be brought to ENGINEER's attention, as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.

C. When requested by ENGINEER, CONTRACTOR shall provide written calculations to show compliance with applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, conductor derating, and voltage drop. CONTRACTOR shall indicate calculation method used, as well as compliance with applicable code, drawing, or specification.

1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

1.07 ELECTRICAL DISTRIBUTION SYSTEM

A. Provide a complete electrical distribution system consisting of components indicated on the drawings or specified herein, including but not limited to:
   1. All miscellaneous equipment coordination and related appurtenances required by power company.
   2. 480-volt, 3-phase, 4-wire service entrance conductors.
   3. Feeders, branch wiring, and electrical distribution equipment.
   4. All control wiring.
   5. Access panels and access doors for access to equipment installed by Division 16.
   6. Wiring between system components if equipment is not prewired.
   7. Lighting fixtures, lighting controls, and associated wiring.
   8. Telephone raceway system.
   9. Support system design and supports for electrical raceways.
   10. Code-required disconnects.

B. CONTRACTOR shall connect the following equipment furnished by Divisions 11 and 15 consisting of components indicated on the drawings or specified herein, including, but not limited to:
   1. Unit heater fans.
   2. HVAC unit starters.
   3. Pumps, starters, and control panels.
   4. Air exhaust fans.

C. Provide balancing and adjusting of electrical loads.

D. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.

E. Provide miscellaneous items for a complete and functioning system as indicated on the drawings and specified herein.

F. A partial list of work not included in Division 16 is as follows: Painting (except as otherwise specified herein).

1.08 NOISE

A. Eliminate any abnormal noises which are not considered by ENGINEER to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

1.09 DRAWINGS

A. The drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.

B. Prior to locating light fixtures, confer with ENGINEER as to desired location in the various areas. In no case should fixture locations be determined by scaling drawings. Relocate fixtures and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.

C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.

D. The drawings are schematic in nature and are not intended to show exact locations of conduit, but rather to indicate distribution, circuitry, and control.

1.10 EXISTING UNDERGROUND UTILITIES

A. The drawings show approximate location of existing underground electrical based on OWNER-provided record drawings. CONTRACTOR shall excavate and verify the location of all underground electrical prior to installing new electrical equipment and prior to making modifications to existing electrical. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground electrical to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

1.11 SUBMITTALS

A. CONTRACTOR shall submit to ENGINEER for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01300–Submittals for requirements.

B. CONTRACTOR shall, in addition, submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by ENGINEER for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall

also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project:

1. Electrical interconnection wiring diagrams; see Section 16480–Motor Control and Section 16940–Controls and Instrumentation.
2. Equipment room layouts showing exact locations and arrangements of equipment, feeders, wiring, etc., and clearances.

C. These drawings and diagrams shall show all electrical switch and breaker sizes, as well as the manufacturer's name and catalog number for each piece of equipment used.

D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:

1. Proper sizes and capacities.
2. That the item will fit in the available space in the manner that will allow proper service.
3. Construction materials and finishes.

E. When the manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. The shop drawings shall be clearly marked and noted accordingly.

F. When fixtures, equipment, and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.

G. See additional requirements of shop drawings under Division 1–General Requirements.

PART 2–PRODUCTS

2.01 STANDARD PRODUCTS

A. All equipment shall be UL and NEMA approved.

B. Unless specified otherwise, major distribution equipment such as panelboards, motor control centers, motor starters, SPD, transformers, etc., shall each be by the same manufacturer.

C. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, raintight, explosionproof, dusttight, or any other special type).

2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of substitute material or equipment, sufficient data to show conclusively that it is equivalent to that specified in the following respects:

1. Performance:
   a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
   b. Energy consumption at the point of rating shall not exceed that of the specified equipment.
   c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
2. Materials of construction.
3. Gauges, weights, and sizes of all portions and component parts.
4. Design arrangements, methods of construction, and workmanship.
5. Coatings, finishes, and durability of wearing parts.
6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.

B. Requests for substitution shall include CONTRACTOR's reason for the request.

C. If ENGINEER does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.

D. See General Conditions for additional requirements.

PART 3–EXECUTION

3.01 UTILITY SERVICES

A. Utility connection requirements shall be determined. All costs for coordinating utility service shall be included in the price bid as described in Section 16420–Electrical Service System of these specifications.

B. All costs for temporary service, temporary routing of piping, or any other requirements of a temporary nature associated with the utility service shall be included in the Base Bid.

C. It is the intent that in the latter stages of construction, the permanent electrical service will be used and the temporary construction service discontinued. The following requirements shall govern the use of the permanent services:
   1. No permanent service shall be available until building is enclosed, watertight, and heated.
   2. Only permanently connected and protected circuits and outlets shall be available.
   3. Temporary wiring shall not be connected to permanent distribution equipment.
   4. Under the above conditions, the use of permanent service equipment shall in no way affect the Contract conditions of the guarantee.

D. It shall be CONTRACTOR's responsibility to police this situation and protect their equipment.

3.02 CLEANING UP AND REMOVAL OF RUBBISH

A. All lighting and appliance panelboards, MCCs, motor starter and disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cut off prior to installation of covers.

B. Where louvers are provided in MCCs or transformer enclosures, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in equipment such as control panels, motor control centers and transformers, CONTRACTOR shall replace all filters with new at the time of final completion.

C. All lighting fixture lenses and lamps (interior and exterior fixtures) shall be cleaned at time of installation, and all lens exteriors shall be cleaned just prior to final inspection.

D. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

3.03 CONCRETE WORK

A. All cast-in-place concrete for new electrical equipment bases shown on the drawings shall be provided by CONTRACTOR, except where specifically noted to be provided by others. All new equipment shall be set on 3 1/2-inch minimum leveling slabs including MCCs, free-standing enclosures, etc. Pads shall be 3 inches larger than equipment being supported.

B. Concrete shall comply with Section 03300–Cast-In-Place Concrete.

C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

3.04 PAINTING

A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.

B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.

C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR.

D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

3.05 CAULKING

A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.

B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.

C. Caulking sealant shall contain no acid or ingredients which will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

D. Caulking shall be performed by craftsman skilled at such work.

3.06 BUILDING ACCESS

A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.

B. When the installation requires openings and access through existing construction and the openings are not provided, CONTRACTOR shall provide the necessary openings.

3.07 COORDINATION

A. Provide wiring for all motors and all electrically-powered or electrically-controlled equipment.

B. All starters, disconnects, relays, wire, conduit, pushbuttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the drawings.

C. Where starters or other devices are provided by others, they shall be connected and wired by CONTRACTOR.

D. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size, horsepower rating, or means of control be made to any motor or other electrical equipment after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.

E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters as specified herein, or under the various trades' sections of these specifications.

F. CONTRACTOR shall provide all line voltage power and control wiring (100 volts and above), including temperature control wiring for operation, control, and supervision of all motorized equipment, including wiring between motor starters and control devices as specified herein and as shown on the drawings. Low-voltage control wiring (below 100 volts) shall be provided by CONTRACTOR supplying the equipment which has low-voltage wiring, unless otherwise noted. CONTRACTOR shall provide raceways for ALL low-voltage wiring.

G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.

H. Motors 1/2 hp and larger shall be NEMA rated 460-volts, 3-phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115-volt, single-phase, 60 Hz, unless otherwise shown.

3.08 EXCAVATION AND BACKFILL

A. Backfilling of all trenches beneath concrete floor slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 02222–Excavation, Fill, Backfill, and Grading. Refer to Section 16110-Conduit for additional requirements associated with PVC conduit installed in earth.

B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.

C. Care shall be taken to ensure no disturbance of bearing soil under foundations.

D. CONTRACTOR shall follow underground pipe runs where possible to avoid additional rock excavation. See Division 2 for rock excavation requirements.

3.09 EQUIPMENT ACCESS AND LOCATION

A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems which are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.

B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials which will fit properly the types of finishes actually installed.

C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.

D. Electrical equipment, devices, instruments, hardware, etc. shall be installed with ample space allowed for removal, repair, calibration or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment which is to be installed or which is already in place.

E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. ENGINEER shall reserve the right to make minor position changes of the outlets before the work has been installed. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.

3.10 WORKMANSHIP

A. Install work using procedures defined in NECA Standard of Installation.

B. Location of process equipment as shown on the drawings is approximate.

C. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.

D. Locations of utilization equipment and control devices as shown on drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance will be performed at no additional cost to OWNER.

E. Unless otherwise noted, equipment shall be fastened to building structure or equipment framework and not placed on the floor.

F. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the Bid.

G. Materials and equipment of the types for which there are National Board of Fire Underwriters Laboratories (UL) listing, and label service shall be so labeled and shall be used by CONTRACTOR.

3.11 AREA CLASSIFICATION

A. As noted on the drawings.

3.12 MODIFICATIONS TO EXISTING CONSTRUCTION

A. CONTRACTOR shall remove all conduit and wiring associated with items specified herein and/or shown on the drawings to be removed.

B. Include in Bid removal of existing electrical material and equipment as specified hereinafter, as noted on the drawings, or as needed by field conditions.

END OF SECTION

SECTION 16110

CONDUIT

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Rigid metal conduit and fittings.
   2. PVC externally and internally coated galvanized rigid metal conduit.
   3. Polyvinyl chloride conduit and fittings.
   4. Liquidtight flexible metal conduit and fittings.
   5. Conduit seals and special fittings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI C80.1–Rigid Steel Conduit, Zinc-Coated.

B. ANSI C80.5–Rigid Aluminum Conduit.

C. ANSI/NEMA FB 1–Fittings and Supports for Conduit and Cable Assemblies.

D. NEMA RN 1–PVC Externally and Internally Coated Galvanized Rigid Steel Conduit.

1.03 QUALITY ASSURANCE

A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. Prior to shipment to the site, all conduit provided shall be new, unused material, and may not have been stored outdoors or exposed to weather.

F. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.

B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.

C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well abovegrade and enclose with durable, waterproof wrapping.

PART 2–PRODUCTS

2.01 RIGID METAL CONDUIT AND FITTINGS

A. Rigid Steel Conduit: ANSI C80.1. Heavy wall seamless tubing with hot-dipped galvanized coating.

B. Conduit bodies for rigid steel conduit shall be as manufactured by Appleton, Form 35, or equal, and be constructed of stamped steel for sizes 2 inches and under, and cast malleable iron for sizes over 2 inches. Conduit bodies shall have built-in pulling rollers, domed gasketed covers, and stainless steel screws. CONTRACTOR shall select body style and size per application.

C. PVC coated conduit and fittings shall be internally and externally hot dipped galvanized rigid metal conduit with hot dipped galvanized threads and PVC coating. PVC coating shall be UL listed with rigid metal conduit as the primary means of corrosion protection for the conduit, and PVC coating shall have an external 40 mil thickness with an internal 2 mil urethane coating. Acceptable manufacturers shall be Plasti-bond RedH_2OT by Robroy Industries, Ocal-Blue by Thomas & Betts, or equal. PVC coated conduit and fittings shall meet the following listings and manufacturing standards, without exception. All installers shall be field-certified from the factory for installation and shall provide proof of certification:
   1. Federal Specification WW-C-581 E.
   2. ANSI C80.1.
   3. UL6.
   4. NEMA RN-1.

D. Conduit bodies for PVC coated rigid conduit shall be as manufactured by Plasti-bond RedH_2OT by Robroy Industries, Ocal Blue by Thomas & Betts, or equal, and have a 40 mil PVC exterior coating and 2 mil red urethane interior coating. Conduit bodies shall be Form 7 style or pulling elbow and include pulling rollers, domed, gasketed covers and stainless steel screws. CONTRACTOR shall select body style and size per application.

E. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded-type, material to match conduit.

F. Supports: One-hole or two-hole pipe straps may be used for surface-mounted conduit. Where one-hole straps are used, provide conduit clamp and back spacer. Where standoffs

are required, provide pipe straps and supporting devices as specified in Section 16190-Supporting Devices. Support material shall match that of the conduit type provided.

2.02 POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and aboveground applications. PVC conduit installed in exterior locations shall be UV resistant.

B. Conduit bodies for PVC conduit shall be as manufactured by Carlon, or equal, and be suitable for use with Schedule 40 or Schedule 80 PVC conduit. Conduit bodies shall have smooth hubs, textured lids, and foam-in-place gaskets. CONTRACTOR shall select body style and size per application.

C. Supports: Two hole nonmetallic clamps or conduit support straps may be used for surface-mounted conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 16190-Supporting Devices. Support material shall match that of the conduit type being provided.

2.03 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: Electro galvanized single-strip steel with PVC coating and integral grounding conductor. Liquidtight conduit installed in exterior locations shall be sunlight resistant. Liquidtight conduit shall be UL listed.

B. Fittings: ANSI/NEMA FB 1.

2.04 CONDUIT SEALS AND SPECIAL FITTINGS

A. Conduit Seals: OZ Gedney Type DUX, or equal.

B. Expansion Fittings: Crouse Hinds or Robroy type XJG, or equal, for rigid, IMC, or PVC-coated rigid conduit. Crouse Hinds, type XD, or equal for PVC conduit.

C. Expansion-deflection Fittings: O-Z type "DX", Crouse Hinds, type XD (PVC conduit only), or Appleton.

D. Ground Bushings: Appleton, model GIB, or equal.

E. Mechanical Seals: 316 stainless steel, Link Seal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners.

F. Watertight Hubs: Die-cast, insulated, and gasketed, rated for wet or dry locations, indoors or outdoors. Water tight hubs shall be Appleton HUB, Crouse-Hinds Myers Hubs, or equal.

G. Conduit Plugs: Kwik N Sure pipe plug as manufactured by Cherne Industries, or equal. Plug shall include natural rubber O-ring with galvanized wing nut and hex nut.

PART 3–EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4 inch minimum size. Minimum size for liquidtight flexible metal conduit is 1/2 inch.

B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2 inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).

C. All conduit shall be supported in accordance with the NEC and as specified herein. This shall apply to all conduit types, including flexible conduit.

D. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.

E. Run conduits concealed to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid all materials and equipment of other trades. Maintain a minimum clearance of 6 inches from all hot water pipes, flues, or any high-temperature piping or duct work.

F. Conduits shall be attached to building surfaces and not suspended unless installed in a Unistrut type conduit rack as specified herein. Individual conduits shall not be suspended. Clevis hangers are not allowed.

G. Center conduit in structural slabs (other than topping), clear of reinforcing steel and spaced on centers equal or exceeding three times the conduit diameter. Outside diameter of conduit shall not exceed one-third the slab thickness for each run of conduit 1 1/4 inches or larger. Provide shop drawings when it will be installed in structural slabs. Conduits shall not be run in slabs-on-grade or structural topping slabs.

H. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice.

I. Conduit attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion using fittings approved for the use. Use back-straps on all conduit in damp or wet locations or mount conduit with Unistrut straps, or equal. Watertight hubs shall be used in all damp locations. Damp locations shall include, but not be limited to, all exterior locations, and all areas below grade.

J. Conduits shall be securely fastened to building structure at intervals not exceeding 8 feet or closer, if necessary. Where hangers are necessary, 3/8-inch rod/eyelets/rings/or trapeze-type in Unistrut channel and pipe clamps shall be used. Wire or perforated strap iron is not acceptable. PVC conduit shall be securely fastened to building structure at intervals not exceeding 3 feet.

3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

A. Interior conduit shall be run concealed in walls, building cavities, chases, and buried below floor slabs. Exterior conduit shall be buried below grade and concealed in structure walls. Exposed conduit runs shall be avoided. Conduit may be run exposed only where it is impossible to conceal.

B. Conduit may be run exposed on the underside of precast or poured concrete floor slabs. Run exposed conduit grouped and parallel or perpendicular to construction. Do not route exposed conduits over high-temperature machinery nor in contact with such equipment. All conduit shall be run exposed in structures below grade.

C. All conduit installed below grade shall be buried a minimum of 2 feet 0 inches. All conduit installed below floor slabs shall be buried a minimum of 1 foot below slab.

D. PVC conduit installed in earth (interior and exterior) shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.

E. Ream conduit smooth at ends, cap upon installation, rigidly attach to structural parts of the building, and securely fasten to all outlet boxes, panel cabinets, junction boxes, pull boxes, splicing chambers, safety switches, and all other components of the raceway system.

F. Conduits installed for future equipment shall be capped and have threaded fittings to accommodate future conduit installation. Provide labeling tags indicating origin.

G. Provide all empty raceways 2 1/2 inches and over with No. 10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2 inches. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty conduits shall be threaded, capped and flush with finished floor. Exposed conduits shall be threaded and capped.

H. Provide conduit raceway for exposed cables that are not UV resistant. This shall include, but not be limited to, instrument wiring, float cables, etc.

I. Conduit seals shall be provided where conduits pass from the interior to exterior of the building, and any conduit entering a NEMA 4X area.

J. Liquidtight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.

K. All runs of flexible conduit to equipment and devices shall be as short as practicable, of the same size as the conduit it extends, and with enough slack to reduce the effects of vibration to a minimum. A minimum of 18 inches of flexible conduit shall be installed for each motor.

L. Provide conduit expansion-deflection fittings as specified herein, in all conduit runs where movement perpendicular to axis of conduit may be encountered.

M. Conduits shall be pitched so that drainage is away from all structures.

N. Conduit bends for PVC conduit shall be made using a hot box, heat blanket, or glycol bender. Open flame or point heat sources of any type are not allowed.

O. The PVC-coated rigid conduit manufacturer's touch-up compound shall be used on all conduit interior and exterior bare steel exposed because of nicks, cuts, abrasions, thread cutting, and reaming; minimum six coats.

3.03 CONDUIT PENETRATIONS AND TERMINATIONS

A. Where fittings are brought into an enclosure with a knockout, a gasket assembly consisting of an O-ring and retainer shall be installed on the outside. Fittings shall be insulated throat-type.

B. Conduit penetrations for control panels or enclosures containing electronic equipment shall be made on the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.

C. Provide conduit expansion fittings as specified herein, in all conduit runs that cross a structural expansion joint, and for conduits protruding from earth where the conduit is terminated within 5 feet of finished grade.

D. All conduits that protrude from poured concrete shall be PVC-coated rigid conduit. Conduit shall extend a minimum of 4 feet beyond the poured concrete (both sides).

E. Conduits passing through masonry, concrete, or similar construction shall be cast-in-place using PVC-coated rigid conduit extending completely through the construction.

F. Where abovegrade conduits pass through cores in existing structures or through masonry walls, grout openings between conduit and walls or floors with sand-cement mortar.

G. All spare conduits that terminate in a building or structure below grade shall be plugged with conduit plugs as specified herein.

3.04 CONDUIT INSTALLATION SCHEDULE

A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed:
   1. Rigid steel:
      a. Structural slabs.
      b. Interior locations requiring mechanical protection.
      c. All exposed interior locations.
      d. All concealed interior locations.
      e. Exterior locations (except in earth) and locations exposed to weather.
   2. PVC coated rigid steel:
      a. Conduits protruding from concrete.
      b. Exterior locations requiring mechanical protection.
      c. Within 6 feet of building or structure footing or wall.
   3. PVC:
      a. Earth, except within 6 feet of a building or structure footing or wall. PVC conduit under pavement or roadways shall be Schedule 80.
      b. NEMA 4X areas (indoors only).
      c. Service entrance ground conductors.
      d. Buried below slabs on grade.
   4. Liquidtight flexible metal conduit not over 3 feet in length for final connections to:
      a. Equipment in wet locations.

b. Equipment with sliding bases or flexible positioning.
c. Equipment with vibration isolation mounting.
d. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including transformers and motors.
e. All pumps and associated equipment.

END OF SECTION

SECTION 16120

WIRE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Wire.
   2. Terminal blocks and accessories.
   3. Wiring connections and terminations.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.03 SUBMITTALS

A. Submit shop drawings and product data under the provisions of Section 01300–Submittals.

B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.

C. Submit manufacturer's instructions.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Provide factory-wrapped, waterproof, flexible-barrier material for covering wire on wood reels, where applicable, and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

PART 2–PRODUCTS

2.01 WIRE

A. All wire for permanent installation shall be new stranded copper 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 multiconductor cable is NOT ALLOWED.

B. Motor circuit branch wiring and associated control wiring:
   1. Insulation type shall be THHN (indoors, nonVFD application).
   2. Minimum size for motor control wiring shall be 14 AWG.
   3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on drawings.

C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be type XHHW-2.

D. All wiring within control panels and supervisory control centers shall be insulation type MTW, minimum size 16 AWG.

E. Wiring in dry locations shall be THHN. Wiring in damp and wet locations shall be XHHW-2. Damp and wet locations shall include, but not be limited to, exterior locations, unconditioned spaces, and exterior buried conduits.

F. All available colors shall be used; however, green shall be used only for equipment grounds. Where color-coded wire in larger sizes is not available, one wrap of 1-inch-wide colored self-adhesive tape at each terminal end shall be used for identification. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.

G. Color Coding:

	120/208 V	277/480 V
A Phase	Black	Brown
B Phase	Red	Orange
C Phase	Blue	Yellow
Neutral	White	Gray
Travelers	Yellow	Orange
Equipment Ground	Green	Green

2.02 WIRING CONNECTIONS AND TERMINATIONS

A. Provide crimp type UL or ETL listed terminations for 6 AWG and smaller stranded conductor connections to electrical devices and equipment such as receptacles, switches, and terminal strips. Crimp devices shall be Sta-con, or equal.

B. Provide insulated, **silicone-filled** spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes. Spring wire connectors are not allowed for terminating of motor conductors.

C. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of one-hole copper compression lugs for 6 AWG and larger, split-bolt connector for 8 AWG and smaller, and motor-lead pigtail splice kit. Individual components shall be as follows:
   1. Split-bolt connectors shall be for use with copper conductors only.
   2. One-hole copper compression lugs shall be as manufactured by 3M, or equal, 30000 series. Lug size shall be selected based on motor and feeder wire sizes installed.
   3. Pigtail splice kit shall consist of one-hole lug cover, locking pin, silicone grease and mastic sealing strip. Kit shall be as manufactured by 3M, or equal, 5300 series, and be selected based on motor, feeder, and lug sizes installed.

D. No splices will be allowed unless reviewed by ENGINEER. Where allowed, provide in-line splices for all conductor connections, 6 AWG and larger. Splice crimp component shall be Burndy copper compression splice long barrel, beveled entry, type YS, or equal. Splice shall be made with crimp tool by manufacturer that allows expanded conductor ranges. Splice insulation component shall be Raychem heavy-wall, low-voltage tubing, type WCSM, or equal.

2.03 TERMINAL BLOCKS AND ACCESSORIES

A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed.

B. Power Terminals: Unit construction-type, closed-back-type, with tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction-type, channel-mounted; tubular pressure screw connectors, rated 300 volts.

D. Manufacturer and Model Number: Phoenix Contact UK 5 N, or equal.

PART 3–EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which the work is to be installed and notify CONTRACTOR of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 GENERAL WIRING METHODS

A. Install electrical wire and connectors in accordance with the manufacturer's written instructions; applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation"; and in accordance with recognized industry practices to ensure that products serve the intended functions. Use appropriate wiring methods and materials for the equipment or environment.

B. Stranded conductors shall be terminated using crimp-type devices specified herein. Conductors may not be wrapped around a terminal screw.

C. Place an equal number of conductors for each phase of a circuit in same raceway.

D. Torque conductor connections and terminations with calibrated torque wrench to manufacturer's recommended values. Provide permanent marking on lug, bolt, nut, or connection for conductors larger than 4 AWG.

E. Splice only in junction or outlet boxes. Splicing is not allowed in disconnects, motor control centers, etc. Avoid splices between terminals of interconnecting power and control wiring.

F. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways (e.g., motor control centers, panelboards, disconnects, etc.) and control panels shall not have any spring-wire connectors installed; all terminations shall be on terminal strips.

G. Neatly train, lace, and tie-wrap all wiring inside boxes, equipment, MCCs, and panelboards.

H. Make conductor lengths for parallel circuits equal.

I. The same color shall be used for each numbered wire throughout its entire length.

J. Terminate all wiring on terminal blocks in control panels, starter cubicles, and similar equipment. This shall include all spare or unused wires.

K. Provide preprinted adhesive or heat shrink-type wire numbering labels at all terminations and splices. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (e.g., Brady labels) are not acceptable.

L. Provide a dedicated neutral for each branch circuit or feeder requiring a neutral. Ampacity of neutral conductor shall match that of the branch circuit or feeder.

M. Do not use a pulling means which can damage the raceway.

N. Signal wiring (below 100 volts) must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop powered devices, voice and data communications, and communication wiring (i.e., DeviceNet, RS-232, etc.).

O. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.

P. Provide junction or pull boxes to facilitate the "pulling in" of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.

Q. Thoroughly clean wires before installing lugs and connectors.

R. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.

S. Terminate spare conductors within equipment, MCCs, control panels, etc., on terminal strips and label as "SPARE." Spare wiring in pull or junction boxes may be terminated with electrical tape and labeled as "SPARE." All spare conductor labels shall indicate where the conductors terminate. Refer to Section 16195-Electrical Identification, for additional requirements.

T. Feeder connections to motors shall be installed within the motor junction box utilizing factory engineered kits as specified herein. Spring wire connectors are not allowed for connections to motors.

3.03 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Wax-based pulling lubricant is not allowed unless it includes a Teflon additive.

B. Install wire in raceway after interior of building is enclosed, watertight, dry, and all mechanical work likely to injure conductors has been completed.

C. Completely and thoroughly swab raceway system before installing conductors.

D. Conductors No. 6 AWG and larger shall be pulled into conduits utilizing a tugger with built-in tension meter. CONTRACTOR shall provide a report to ENGINEER for each pull indicating maximum tension reached during the pull along with manufacturer's maximum pulling tension. Motorized machines of any type are NOT ALLOWED for any wire pulling.

E. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.

F. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation, or provide larger boxes approved for additional capacity.

G. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.

H. Circuiting is indicated diagrammatically on the drawings.

3.04 FIELD QUALITY CONTROL

A. Inspect wire for physical damage and proper connection.

B. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.

C. Subsequent to wire hook-ups, energize circuitry and demonstrate functioning in accordance with these specifications.

D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

E. Perform field inspection and testing according to provisions of this section.

3.05 ACCEPTANCE TESTS

A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.

B. CONTRACTOR shall be responsible for powered tests of each field-installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.

C. Operation Test: By operational testing, OWNER will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.

D. At the request of OWNER's representative, demonstrate by test the compliance of the installation with these specifications and drawings, the National Electrical Code, and the accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.

E. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.

F. The transformer, feeder, and subfeeds to the lighting panels shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C as follows:
   1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.
   2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

3.06 WIRE INSTALLATION SCHEDULE

A. Install all wiring in raceways except as otherwise noted. This includes all low-voltage wiring such as instruments, phone, network, etc.

END OF SECTION

SECTION 16130

BOXES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Wall and ceiling outlet boxes.
   2. Pull and junction boxes.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/NEMA OS 1–Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

B. ANSI/NEMA OS 2–Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.

C. NEMA 250–Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 QUALITY ASSURANCE

A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

PART 2–PRODUCTS

2.01 SWITCH, OUTLET, AND SMALL JUNCTION BOXES

A. Masonry and Partition Boxes: Galvanized steel, nongangable. Thomas & Betts, GW Series, or equal. Provide number of gangs for devices shown on the drawings.

B. Cast Boxes: Aluminum or cast feraloy, deep-type, gasketed cover, threaded hubs, Crouse-Hinds FD Series, or equal.

C. NEMA 4X Boxes: PVC or FRP, Carlon HS Series, or equal, with proper cover and gasket.

2.02 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1: Code gauge steel with galvanized or sheradized finish, secured by galvanized machine screws. Hoffman ASG Series without knockouts, or equal.

B. Cast Boxes: NEMA 250; Type 4, flat-flanged, surface-mounted junction box, UL-listed as watertight. Cast aluminum or feraloy box and cover with ground flange, neoprene gasket, and stainless steel cover screws, Crouse-Hinds WCB Series, or equal.

C. NEMA 4X Boxes: PVC or FRP, Carlon NS Series, or equal with proper cover and gasket.

D. Boxes Larger Than 12 inches in Any Dimension: Hinged enclosure in accordance with Section 16160–Cabinets and Enclosures.

E. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

PART 3–EXECUTION

3.01 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.

B. Electrical box locations shown on drawings are approximate. Verify location and size of outlet boxes in all work areas prior to rough-in.

C. Where dedicated raceways are provided for different voltage systems or wiring, (e.g., motor power wiring and motor space heaters), separate boxes shall also be provided unless approved by ENGINEER. Where approved by ENGINEER, combined boxes shall be physically divided to separate the wiring.

D. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.

E. Locate and install to maintain headroom and to present a neat appearance.

F. All boxes attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion. All boxes in damp locations shall be on 1-inch standoffs. Damp locations shall include, but not be limited to, all exterior locations, and all areas below grade.

3.02 SWITCH AND OUTLET BOX INSTALLATION

A. Locate boxes in masonry walls for cutting of masonry unit corners only. Coordinate masonry cutting to achieve neat openings for boxes.

B. Provide knockout closures for unused openings.

C. Support boxes independently of conduit.

D. Use multiple gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

E. Install boxes in walls without damaging wall insulation.

F. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

G. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring shall have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g., 24 V, 120 V, 480 V) shall have dedicated pull and junction boxes for each voltage.

H. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

I. In plaster or concrete walls, single receptacle, single- or double-switch outlets, use 4-inch-square masonry boxes fitted with raised plaster covers. In poured concrete walls below grade, use cast boxes.

J. In unplastered brick or block walls use masonry boxes.

K. In metal door frames use partition boxes.

L. For weatherproof switches, devices, and exterior fixtures use cast boxes with proper cover and gasket.

M. All exterior outlet boxes shall be NEMA 4X.

N. <u>All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted</u>.

O. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.

P. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so they will support the weight of the fixture. Conduit will not be considered as adequate supports.

Q. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.

3.03 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pull and junction boxes independent of conduit.

C. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.

D. All junction boxes shall be labeled with permanent labels (not adhesive type). Permanent labels shall include painted stencil-type labels or engraved laminated nameplates. Labels shall indicate circuit or load served, as well as power source.

E. All interior exposed junction and pull boxes shall be cast-type with cover, unless noted otherwise.

F. All exterior junction and pull boxes shall be NEMA 4X. Boxes in areas subject to damage shall be stainless steel.

END OF SECTION

SECTION 16141

WIRING DEVICES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Wall switches.
   2. Receptacles.
   3. Cover plates.
   4. Wall-mounted occupancy sensors.
   5. Thermostats.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NEMA WD 1–General-Purpose Wiring Devices.

B. NEMA WD 5–Specific-Purpose Wiring Devices.

C. Drawings–Bill of Materials.

1.03 QUALITY ASSURANCE

A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2–PRODUCTS

2.01 WALL SWITCHES

A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Cooper 222*, Leviton 122*, or Pass and Seymour PS20AC*.

B. Provide ivory-colored handles.

C. Manual motor switches or manual motor controllers for 120 V or 240 V motors on circuits 20 amps or less shall be specification grade snap switch as specified above. Manual motor switches or manual motor controllers for 120 V or 240 V motors on circuits 30 amps or less shall be Cooper 303*, Leviton 303*, or Pass and Seymour PS30AC*.

*Complete catalog number for pole arrangement necessary.

2.02 RECEPTACLES

A. Twenty ampere, 125 volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Cooper 5362, Leviton 5362, Pass and Seymour 5362-A. 208-volt receptacles shall be grounded type, rated same as circuit indicated on the drawings. Receptacles shall be mounted vertically. Provide ivory coloring.

B. GFCI Receptacle: Pass and Seymour 2095, Cooper TRVGF20 receptacle with integral ground fault current interrupter. Receptacles shall be mounted vertically. GFCI receptacles shall not be series wired. Provide ivory coloring.

2.03 COVER PLATES

A. Each and every flush box shall be provided with standard 302 series stainless steel plates, blank, receptacle, switch or cord as designated by outlet symbol. Surface boxes shall have plates to match Crouse-Hinds, Appleton, or equal cast boxes.

B. NEMA 4X and weatherproof switch covers shall be Thomas and Betts, Industrial Gray, toggle switch cover, Model E98TSCN-CAR, or equal.

C. While in use receptacle covers for exterior use shall be Leviton M5979, or equal. Receptacle covers for NEMA 4X locations shall be Leviton 5976, or equal.

D. Cover plates for manual motor switches or manual motor controllers shall have provisions for locking the switch in the On or Off position.

2.04 WALL-MOUNTED OCCUPANCY SENSORS (DOUBLE POLE [TYPE 2])

A. The sensor shall use both passive infrared and ultrasonic detection methods for detecting room occupancy. The unit shall fit on/in a standard single-gang switchbox and shall require two wires and a grounded box for proper operation.

B. The sensor shall utilize a temperature compensated, dual element sensor and a multielement Fresnel lens. The lens shall be Poly IR4 material to filter short wavelength IR, such as those emitted by the sun and other visible light sources.

C. Sensor shall have selectable DIP switches to adjust automatic time delay to fit occupant usage patterns.

D. The sensor shall operate at universal voltages of 100-300 Vac. Sensor shall be capable of switching line voltage loads without the use of relay power packs.

E. Sensor shall have no minimum load requirement and shall be capable of switching from 0-800 watt incandescent, 0–800 watt fluorescent or 1/6 hp @ 120 Vac, 60 Hz.

F. Double pole sensors shall have the capability of switching two independent line voltage circuits. Each pole shall have no minimum load requirement and shall be capable of switching from 0-800 watts incandescent, 0-800 watts fluorescent or 1/6 hp @ 120 Vac, 60 Hz.

G. Sensor shall not protrude more than 3/8 inches from the wall.

H. Sensor shall have a 28-segment, two-level, Fresnel injection molded lens.

I. Sensor shall cover up to 1,000 square feet for walking motion, with a field view of 180°.

J. In automatic mode, sensor shall be able to automatically return to Automatic-on after lights are turned off manually.

K. Sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.

L. Sensor shall have a service switch to allow end-users to operate the sensor in the event of a failure, set by a DIP switch.

M. Sensor shall be able to control incandescent, magnetic low voltage, electronic low voltage, and fluorescent loads.

N. Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have ground wire and grounded strap.

O. The PIR wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch.

P. Single-pole wall-mounted passive infrared occupancy sensor shall be Model DW-100 as manufactured by Wattstopper or equal.

Q. Double-pole wall-mounted passive infrared occupancy sensor shall be Model DW-200 as manufactured by Wattstopper, or equal.

2.05 CEILING-MOUNTED OCCUPANCY SENSORS (TYPE 3)

A. The sensor shall use both passive infrared and ultrasonic detection methods for detecting room occupancy. The unit shall fit on/in a standard octagon box and shall require two wires and a grounded box for proper operation.

B. Sensors shall have selectable DIP switches to adjust sensitivity settings to fit occupants usage patterns.

C. Sensors shall be mounted to the ceiling with a flat, unobtrusive appearance and provide 360 degrees of coverage.

D. Sensor shall utilize a temperature compensated dual element sensor and a multielement Fresnel lens. Fresnel lens shall be a Poly IR 4-based material to filter short wavelength infrared, such as those emitted by the sun and other visible light sources.

E. The sensors shall feature terminal-style wiring.

F. The sensor shall have a 34-element Extended Range lens.

G. Sensor shall cover 360 degrees, up to 2,000 square feet of walking motion with the Standard Lens mounted at 8 feet AFF.

H. Sensors shall operate at 24 Vdc/Vac and half-wave rectified and utilize a power pack.

I. Power pack shall be a self-contained transformer and relay module and shall meet the following requirements:
   1. Power and auxiliary relay pack shall have 1/2-inch snap-in nipple for 1/2-inch knockouts. Power and auxiliary relay packs shall be mounted on the outside of junction boxes above suspended ceilings. If the occupancy sensor is installed in an unfinished exposed location sensor shall be installed within a junction box. The junction box cover shall be permanently labeled "OS Control."
   2. Power and auxiliary relay packs shall have dry contacts capable of switching 20 amp ballast load, 13 amp incandescent, 1 hp @ 120 Vac, 60 Hz.
   3. Power packs shall provide a 24 Vdc, 150 mA output.
   4. Power packs shall be capable of parallel wiring without regard to AC phases on primary.
   5. Auxiliary relay packs shall be identical in physical size of power packs and contain no transformer power supply and shall switch 120 Vac.
   6. Power pack and auxiliary relay packs shall be UL 2043 rated, use UL 94 V-O plenum rated plastic, and have low voltage Teflon coated leads, rated for 300 volts.
   7. Power and auxiliary relay packs shall be UL and CUL listed.
   8. Power and auxiliary relay pack shall be Model OSP20 as manufactured by Leviton, or equal.

J. The sensor shall have an additional single-pole, double-throw isolated relay with normally open, normally closed, and common outputs.

K. Sensors shall have a time delay that is adjusted automatically or shall have a fixed time delay of 5 to 30 minutes set by DIP switches.

L. The sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED shall be able to be disabled for applications that require less visibility.

M. Ceiling-mounted motion sensor shall be Model OSC20-M0 as manufactured by Leviton, or equal.

2.06 THERMOSTATS

A. Line voltage thermostats for single-stage heating or single-stage cooling shall be Honeywell T6051A. Line voltage thermostats for high- and low-temperature alarms shall be Johnson Controls Model A19BAC-1. Line voltage thermostats for single-stage heating, single-stage cooling, or high- and low-temperature alarms in NEMA 4X areas shall be Honeywell T631F.

B. Thermostats shown on the drawings shall be single-stage unless otherwise noted.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install wall switches 42 inches above floor (top of box), "Off" position down, except as otherwise noted.

B. Install convenience receptacles 15 inches above floor (bottom of box), grounding pole on bottom except as otherwise noted.

C. Install thermostats 48 inches above floor (top of box).

D. Convenience Receptacles: Specification grade self-grounding.

E. Install devices and cover plates flush and level.

F. Back-wiring is not allowed for switches and receptacles. Wires shall be terminated with the device screw terminal.

G. Individual labels shall be placed on the back of all switch faceplates and receptacle faceplates indicating the lighting panel and circuit from which the switch or receptacle is fed. Labels shall be White background with Black lettering no smaller than 12-point font. Provide Pan Net permanently attached self-adhesive type, machine fed, and self-laminating labels, or equal. All labels must be by the same manufacturer, same size, and same font. Handwritten labels are not acceptable.

END OF SECTION

SECTION 16160

CABINETS AND ENCLOSURES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Hinged cover enclosures.
   2. Cabinets.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NEMA 250–Enclosures for Electrical Equipment (1000 Volts Maximum).

B. ANSI/NEMA ICS 1–Industrial Control and Systems.

C. ANSI/NEMA ICS 6–Enclosures for Industrial Control Equipment and Systems.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

B. Show Drawings for Equipment Panels: Include wiring schematic diagram, connection diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1.

PART 2–PRODUCTS

2.01 HINGED COVER ENCLOSURES

A. Construction: NEMA 250, larger than 12 inches in any dimension. Acceptable manufacturers: Hoffman, B-Line, or equal.

B. Covers: Continuous hinge, applicable NEMA rating with hasp and staple for padlock.

C. Back Panel for Mounting Terminal Blocks or Electrical Components: 14 gauge steel, white enamel finish.

D. All cabinets with double doors or that are free-standing shall have 3-point latch.

2.02 CABINETS

A. Construction: NEMA 250. Acceptable manufacturers: Hoffman, Saginaw, Lehman, or equal.

B. Cabinet Fronts: Steel, surface-type with screw cover front, concealed hinge and flush lock. Finish in white baked-enamel.

2.03 FABRICATION

A. Shop-assembled enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.

B. Provide conduit hubs on all enclosures.

C. Provide protective pockets inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

D. Provide gasketed surfaces for all enclosure and cabinet doors and covers.

2.04 ENCLOSURE RATING

A. Cabinets and enclosures shall be rated as listed below, unless noted otherwise on the drawings:
   1. Indoor: NEMA 12, steel.
   2. Outdoor, corrosive or wet location: NEMA 4X, stainless steel.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install cabinets and enclosures plumb. Anchor securely to wall and structural supports at each corner minimum.

B. All cabinets and enclosures shall be labeled with permanent labels (not adhesive-type). Permanent labels shall include painted, stencil-type labels or engraved laminated nameplates (4 inches by 4 inches minimum size).

C. Provide accessory feet for free-standing equipment enclosures.

D. All cabinets and enclosures attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion. All boxes in damp locations shall be on 1-inch standoffs. Damp locations shall include, but not be limited to, all exterior locations, and all areas below grade.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Conduit and equipment support members.
   2. Fastening hardware.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

PART 2–PRODUCTS

2.01 MATERIAL

A. Support Members:
   1. 316 stainless steel, fiberglass, or PVC in exterior locations and NEMA 4X areas. PVC-coated steel where used with PVC-coated conduit.
   2. Galvanized steel in all other areas.

B. Hardware:
   1. Stainless steel in exterior locations and NEMA 4X areas.
   2. Galvanized steel in all other areas.

C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or support members. Do not use spring steel clips and clamps. Provide standoffs as specified in other technical sections.

B. Use toggle bolts or hollow wall fasteners in hollow masonry walls; expansion anchors or preset inserts in solid masonry walls; and self-drilling anchors or expansion anchors on concrete surfaces.

C. Where support members are used for conduit, cutoff ends shall be ground smooth. Cutoff PVC-coated support members shall be ground smooth and touched-up with PVC coating material from the manufacturer.

D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

E. Do not use powder-actuated anchors.

F. Do not drill structural steel members.

G. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring-lock washers under all nuts.

H. In wet locations install free-standing electrical equipment on concrete pads. Anchor all equipment to adjacent walls with standoffs and caulk.

I. Install surface-mounted cabinets with minimum of four anchors.

J. Do not use chain hangers.

K. All welds shall be continuous and ground smooth.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Nameplates.
   2. Labeling tags.
   3. Wire markers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

B. Provide schedule for nameplates and labeling tags with shop drawings. Reference drawings for type used.

PART 2–PRODUCTS

2.01 NAMEPLATES

A. Type "A":
   1. Use:
      a. Motor starters.
      b. Each separately mounted circuit breaker or disconnect switch.
      c. Each device in Motor Control Centers.
      d. SPD.
      e. Cabinets, enclosures, pull, and junction boxes.
      f. Field devices (flowmeter transmitters, etc.).
   2. Size: 2 inch by 3 inch.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 1/4 inch.
   7. Engraving: See MCC schedule, one-line, and I/O list for labels, or as requested by ENGINEER. Label shall include equipment number and description (i.e., SCAL-60-01, Fluoride Scale).
   8. Mounting Location: Front exterior.

B. Type "B":
   1. Use: Standby power systems as in "A" above.
   2. Size: 2 inch by 3 5/8 inch.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Red.
   5. Character Color: White.
   6. Character Size: 1/4 inch.
   7. Engraving: See MCC schedule and one-line for labels, or as requested by ENGINEER.
   8. Mounting Location: As requested by ENGINEER.

C. Type "C":
   1. Use:
      a. Motor Control Centers.
      b. Supervisory Control Centers.
   2. Size: 4 inch by 4 inch.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 2 1/4 inch.
   7. Engraving: Equipment label. Label shall include equipment number and description (i.e., LP-10-01, First Floor Power).
   8. Mounting Location: Equipment: Top wireway.

D. Type "D":
   1. Use: Control stations, thermostats, etc.
   2. Size: 3/8 inch by 2 inch.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 1/8 inch.
   7. Engraving: Control station number and equipment description (e.g., T-15-01, Chlorine Room).
   8. Mounting Location: Device front at top.

E. Type "E":
   1. Use: Operator instructions.
   2. Size: As necessary.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Yellow.
   5. Character Color: Black.
   6. Character Size: 3/16 inch.
   7. Engraving and Mounting Location: As requested by ENGINEER.

2.02 LABELING TAGS

A. Use: Field-mounted Devices (Valves, Limit Switches, etc.) and spare conduits.
   1. Size: 1 inch by 3 inch.
   2. Material: 1/32-inch-thick stainless steel.
   3. Character Size: 1/4 inch.
   4. Engraving: As requested by ENGINEER.

2.03 WIRE MARKERS

A. Wire markers shall be permanently attached sleeve or heat shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

B. Wire markers shall be specifically printed for this project using permanently attached computerized adhesive tags, such as Brady IDXPERT labeling printer with self-laminating vinyl, permasleeve heat-shrink polyolefin, or equal. Handwritten markers are not acceptable.

PART 3–EXECUTION

3.01 INSTALLATION

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Affix nameplates with stickyback adhesive.

D. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8-inch hole to accommodate wire tie.

E. Prepare and install neatly-typed directions in all panels, including existing panels where work is done under this Contract.

3.02 WIRE IDENTIFICATION

A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.

B. Conductors in pull boxes, motor control centers, supervisory control panels, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

END OF SECTION

SECTION 16250

AUTOMATIC TRANSFER SWITCHES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Provide an automatic transfer switch control system where shown on the drawings.
   2. The system shall be a completely integrated assembly for automatic, unattended operation and control of the standby power system. System operation shall be as described in the following sections.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

B. Shop drawings shall include the following:
   1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
   2. Detailed layouts of all cubicles and equipment.
   3. The manufacturer shall furnish schematic and wiring diagrams for the automatic transfer switch and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

1.03 QUALITY ASSURANCE

A. The transfer switch shall be listed by Underwriters Laboratories, Inc. (Std. 1008) and be approved by the Canadian Standards Association.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The automatic transfer switch shall be as manufactured by Cummins Power Generation OTPC, Kohler, KSP, 400 amp, 3 pole, or equal.

B. The drawings and specifications were prepared based on Cummins Power Generation. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 AUTOMATIC TRANSFER SWITCHES

A. One complete automatic transfer switch shall be provided. Interlocked molded case circuit breakers or contactors are not acceptable.

B. The transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a nonventilated enclosure constructed in accordance with Underwriters Laboratories, Inc., Standard UL-1008. The transfer switch shall be open type, installed in MCC.

2.03 CONSTRUCTION AND PERFORMANCE

A. The transfer switch shall be double-throw, actuated by a single electrical operator momentarily energized and connected to the transfer mechanism by a simple overcenter linkage, with a minimum transfer time of 400 milliseconds.

B. The time delay between the opening of the closed contacts and the closing of the open contacts shall allow for voltage decay before transfer.

C. The transfer switch shall allow the motor and transformer loads to be reenergized after transfer with normal inrush current. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.

D. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and standby positions without the use of hooks, latches, magnets, or springs and shall be silver tungsten alloy. All contacts shall be 100% rated. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches.

E. The transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. The manual operator shall provide the same transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

2.04 SEQUENCE OF OPERATION

A. Engine starting contacts shall be provided to start the generating plant should the voltage of the normal source drop below 80% on any phase after an adjustable time delay to allow for momentary dips. The transfer switch shall transfer to standby when 90% of rated voltage and frequency has been reached. After restoration of normal power on all phases to 90% of rated voltage, an adjustable time delay period of zero to 31 minutes shall delay retransfer to allow stabilization of normal power. If the standby power source should fail during this time delay period, the switch shall automatically return to the normal source. After retransfer to normal, the engine-generator shall be allowed to operate at no-load for a period of 5 minutes. Two auxiliary contacts rated 25 amps, 120 volts shall be mounted on the main shaft; one closed on normal, the other closed on standby. All relays, timers, control wiring, and accessories shall be front accessible. In addition, one set of relay contacts shall be provided to open upon loss of the normal power supply. All control wire terminations are to be identified by tubular sleeve-type markers.

B. The automatic transfer switch shall include the following functions. Adjustable time delays and features described below shall be operator-adjustable from the front of the transfer switch, and shall not require the use of a laptop, software, or external programming device.
   1. Time delay to override momentary normal source power outages to delay engine start signal and transfer switch operation. Adjustable 0.5 to 90 seconds.
   2. Time delay relays to control contact transition time on transfer to either source, adjustable 1 to 300 seconds (Programmed Transition).
   3. Time delay on retransfer to normal. Adjustable 0-31 minutes, with engine overrun to provide fixed 5-minute unloaded engine operation after retransfer to normal.
   4. Test with load-Auto-Test without load selector switch to simulate normal power failure. (Maintained Type).*
   5. Contact to close on failure of normal source to initiate engine starting or other customer functions.
   6. Contact to open on failure of normal source to initiate engine starting or other customer functions.
   7. Green pilot light to indicate switch in normal position.*
   8. Red pilot light to indicate switch in standby position.*
   9. Auxiliary contact closed in normal position.
   10. Auxiliary contact closed in standby position.
   11. Adjustable relay to prevent transfer to standby until voltage and frequency of generating plant have reached acceptable limits.
   12. Plant exerciser with 7-day time clock, multiple test schedules, and programmable exceptions for holidays, weekends, etc.

   * Front cabinet door mounted.

C. When coordinated with circuit breakers, the automatic transfer switch shall have the following short circuit withstand capability:

Withstand Capability (RMS Amps, Symmetrical) Testing at 480 Vac	
Switch Ampere Rating	ATS Coordinated with Molded Case Circuit Breakers
400	42,000

D. During the withstand tests, there shall be no contact welding or damage. The tests shall be performed on identical samples without the use of current limiting fuses. Oscillograph traces across the main contact shall verify that contact separation has not occurred. These procedures shall be in accordance with UL 1008 and testing shall be certified by Underwriters Laboratories or any nationally recognized independent testing laboratory.

E. When conducting temperature rise tests to UL 1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full-rated current after completing the overload and endurance tests.

F. As a precondition for approval, the manufacturer of the automatic transfer switch shall verify that his switches are listed by Underwriters Laboratories, Inc., Std. UL 1008 with withstand and close-in values at least equal to the interrupting rating of the circuit breaker, and/or fuse that is specified to protect the circuit.

PART 3–EXECUTION

3.01 INSTALLATION

A. The installation of this system shall comply with the directions and recommendations of authorized factory representatives. These representatives shall offer the supervision necessary for proper installation.

B. A final inspection and an initial start-up of the system shall be provided by the factory representatives.

C. A letter of certification written by the authorized factory representatives which states that the system is properly installed and does properly function as recommended by the factory and as described herein shall be submitted to ENGINEER.

D. A test run shall be performed by the authorized factory representatives in the presence of CONTRACTOR and ENGINEER or his representatives; the time of this test run shall be mutually agreed upon by all persons concerned.

3.02 START-UP AND TRAINING

A. CONTRACTOR shall include 4 hours of start-up by a certified, factory-trained engineer. Start-up services shall include, but not be limited to, inspection of CONTRACTOR installation and functional testing of the ATS assembly. On-site time shall be over and above the cost of travel and travel time to the site.

B. CONTRACTOR shall provide a training session for up to three OWNER's representatives for 1 normal workday (not including start-up) at a job site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly, simulated outages, and review of major components within the assembly.

3.03 WARRANTY

A. The manufacturer shall warrant that all equipment shall be free from defects in material and workmanship under normal and proper use and service for a period of 1 year after final completion.

END OF SECTION

SECTION 16412

SURGE PROTECTIVE DEVICES (SPD)

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Service entrance devices.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/IEEE C62.41 and C62.45.

B. NFPA 70, and 75.

C. UL 1449, most recent issue.

1.03 QUALITY ASSURANCE

A. Manufacturers of surge protective devices. Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide surge protective devices which have been listed and labeled by Underwriters Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports certified by the manufacturer shall be provided to ENGINEER upon request for each model submitted.

1.05 WARRANTIES

A. Manufacturer shall provide a minimum 20-year warranty from the date of substantial completion to cover repair or replacement of the device. This warranty shall include the field replaceable plug-in modules and coordinated fuses.

PART 2–PRODUCTS

2.01 GENERAL

A. These specifications describe the electrical and mechanical requirements for high energy transient voltage (service entrance) surge suppressors. The specified surge protective device shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category C3 (service entrance). Testing shall be per ANSI/IEEE C62.45–2002 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes.

B. The system individual units shall be UL listed under UL1449, latest edition, Standard for Surge Protective Devices (SPD). Surge ratings shall be permanently affixed to the SPD.

C. Operating Temperature: Operating temperature range shall be -40 to +55°C (-40 to 131°F).

D. Storage Temperature: Storage temperature range shall be -40 to +85°C.

E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.

F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.

G. Design Life: >15 years.

H. Operating Voltage: Maximum continuous operating voltage shall be no less than 115% of the nominal rated line voltage.

I. Power Frequency: SPD power frequency shall be rated for use on 50 and 60 Hertz power systems.

J. All SPDs shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.

K. SPD shall be suitable for use in Type 2 locations.

L. Unit shall provide maximum ANSI/UL 1449 VPRs for 480Y/277-volt systems.
   1. L-N = 1500 V.
   2. L-G = 1500 V.
   3. N-G = 1200 V.
   4. L-L = 2500 V.

2.02 SERVICE ENTRANCE DEVICES

A. The maximum surge current capacity of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 160 kA per phase. The surge life (8/20) shall be at least 6 kA for 10,000 occurrences or 10 kA at 20 kV for 16,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating (I_n) of 10 kA.

B. The SPD shall have a minimum Short Circuit Rating (SCCR) of 100 KAIC. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.

C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.

D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple fuse protected metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with multiple surge rated fuses per module or one fuse per MOV.

E. Red and green solid-state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.

F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.

G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.

H. A 14 gauge, NEMA Type 4, steel enclosure, with corrosion-resistant hardware shall be provided for the unit.

I. Service entrance devices shall be as manufactured by MCG, 160M Series, Liebert LM, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.

B. Each installed device shall be fed by an appropriately sized circuit breaker, per the manufacturer's installation notes, in the protected panel. No SPD shall be installed without an upstream overcurrent device.

C. Units shall be installed as close as practical to the electrical panel. Low impedance cabling furnished by the manufacturer shall be utilized for installations with lead lengths greater than, or equal to, 5 feet. Low impedance cabling furnished by the manufacturer or appropriately-sized standard cable, as approved by ENGINEER may be utilized for installations with lead lengths less than 5 feet. SPD leads shall be as short as possible for best performance.

D. Manufacturer shall provide protection modules and coordinated fuses under a no-cost lifetime replacement warranty.

END OF SECTION

SECTION 16420

ELECTRICAL SERVICE SYSTEM

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Utility company.
   2. Secondary service characteristics.
   3. Definitions.
   4. Sequencing, scheduling.
   5. Underground electrical service.
   6. Telephone service.

B. Allowances: CONTRACTOR shall INCLUDE in the Bid the cost of the following items specified in this Section. Refer to the individual sections listed below for a complete description of the Work required.
   1. Electric Utility Service Entrance, Section 1.06–Underground Electrical Service.
   2. Telephone Utility Service Entrance, Section 1.07–Telephone Service.

C. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 UTILITY COMPANY

A. The Utility Company is Madison Gas and Electric.

1.03 SECONDARY SERVICE CHARACTERISTICS

A. The secondary service will be 277/480-volt, 4-wire, three-phase for combined lighting and power.

1.04 DEFINITIONS

A. Service–As defined in the NEC, Article 100.

B. Primary Voltage–Above 600 volts.

C. Secondary Voltage–600 volts and below.

1.05 SEQUENCING, SCHEDULING

A. Provide electrical service system, except the Utility Company will provide:
   1. Transformer (pad by CONTRACTOR).
   2. Cable from transformer to main circuit breaker in the MCC.
   3. Window-type current transformers to be installed by CONTRACTOR in CT compartment in the MCC.
   4. Meter.
   5. Primary conduit and wiring.

1.06 UNDERGROUND ELECTRICAL SERVICE

A. Provide complete underground electrical service except for items furnished and installed by the Utility Company.

B. Coordinate the new electrical service with the Utility, and all Utility costs shall be included in the Lump Sum Bid. All costs associated with temporary service of any type shall be included in CONTRACTOR's Bid and will not be paid for as a part of the allowance. An allowance of $5,000 shall be included in the Lump Sum Bid to be adjusted at final payment in accordance with actual Utility charges.

1.07 TELEPHONE SERVICE

A. Coordinate the telephone service with Verizon. Three independent telephone lines (one for general service and two for fire alarm system) will be required. An allowance of $2,000 shall be included in the Lump Sum Bid to be adjusted at final payment in accordance with actual Utility charges.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 16440

DISCONNECT SWITCHES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Disconnect switches.
   2. Fractional hp motor switches.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NEMA KS 1–Enclosed Switches.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Disconnect Switches: Square D Class 3110, or Cutler Hammer Type DH.

B. Substitutions: Under provisions of the General Conditions.

2.02 DISCONNECT SWITCHES

A. Nonfusible Disconnect Switches: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in "On" position. A defeater shall be provided to bypass this interlock. Handle lockable in "Off" position. Provide auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.

2.03 SINGLE PHASE MOTOR SWITCHES (2 HP OR LESS)

A. Where noted on the drawings, motors rated 2 hp or less, for operation on 120 V or 240 V, single-phase, shall be provided with a specification-grade wall switch as disconnecting means. See Section 16141-Wiring Devices for additional information.

2.04 ENCLOSURES

A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the drawings:
   1. Indoor: NEMA 12, steel.
   2. Outdoor, corrosive or wet location: NEMA 4X, stainless steel.

PART 3–EXECUTION

3.01 INSTALLATION

A. Provide disconnect switches where indicated on the drawings. Maximum mounting height shall be 42 inches above finished floor unless noted otherwise, or approved by ENGINEER based on field conditions.

B. Provide wall switch for each single phase fractional horsepower motor where indicated on the drawings.

C. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the "Off" position.

D. Wiring within disconnects shall only be for loads or equipment served by that disconnect. Foreign wiring within disconnect enclosures is not allowed. All wiring within disconnect enclosures shall be landed on lugs or terminals provided by the disconnect manufacturer, or on dedicated terminal strips for instrumentation equipment or field devices. Splices and spring wire connectors are not allowed within disconnect enclosures.

END OF SECTION

SECTION 16450

SECONDARY GROUNDING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Power system grounding.
   2. Electrical equipment and raceway grounding and bonding.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.

B. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

PART 2–PRODUCTS

2.01 MATERIALS

A. Ground Rods: Copper bonded, 5/8-inch diameter; minimum length 10 feet.

B. Ground Connections Below Grade: Exothermic-type Cadweld, Thomas & Betts compression-type, or equal. Compression connectors shall be prefilled with an oxide inhibitor.

C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, KG, GBL, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Compression-type connectors shall be installed with the manufacturer recommended tools. Compression dies shall emboss index on the connector when installed correctly. An indenter crimp shall be made on ground rods prior to connection of grounding conductor.

B. Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Provide a dedicated neutral conductor sized to match the circuit or feeder conductors for each feeder, or branch circuit requiring a neutral. Terminate each end on a grounding lug, bus, or bushing.

C. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold water plumbing systems.

D. Connect grounding electrode conductors to metal water piping, metal frame of building or structure, and structural reinforcing bars using suitable ground clamps. Make connections to flanged piping at a point ahead of meter or service shutoff valve. Provide jumper connection across meter or service shutoff valve.

E. Ground system, transformer neutrals and equipment as required by code and local ordinances.

F. All feeder neutrals shall be connected to neutral at only one point in the MCC.

G. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.

H. Water system grounds and a minimum of three ground rods at 15-foot separations near service entrance of each building shall be provided and ground wires must attach to point ahead of meter or service shutoff valve. These shall be connected to ground bus by conductors sized to code requirements. The above are minimum requirements.

I. All service entrance grounding electrode conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90-degree bends are not allowed.

J. Include ground for grounded receptacles, light fixtures, motors, and equipment items shown on drawings.

K. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, lighting fixture, or equipment frame to conduit system.

L. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each fixture or device.

M. All equipment in NEMA 4X areas that are fed from circuits in PVC conduit shall be provided with a separate green ground wire that is terminated at the metallic conduit system and the equipment.

N. Separately derived systems as defined by the National Electrical Code shall be grounded as such. This shall include, but not be limited to, 4-wire transformers.

O. Refer to Specification Section 16930-Instrument Wire and Cable for Additional Grounding Requirements.

3.02 TESTING

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three-point "fall of potential" test. The test results shall include a graph of the results plus a diagram of the testing layout. The remote current probe (C2) shall be placed a minimum of 100 feet from the ground system potential/current probe (P1/C1), or as required to provide sufficient spacing to demonstrate a resistance plateau on the graph. The ground resistance shall be tested with the potential probe (P2) between the P1/C1 probe and the C2 probe at 10% intervals starting at 0% and ending at 100% of the distance between P1/C1 and C2, 11 points total. A single point of measurement is not acceptable, and the two-point method of ground system testing shall only be used where there is no or insufficient "open earth" area to use the three-point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by ENGINEER.

C. The test meter shall be Associated Research Vibroground test set with null balance, James A. Biddle Megger Earth-Tester-Null Balance, or equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test report.

D. In lieu of testing the ground grid as a system, CONTRACTOR may choose to test individual ground rods separately. Individual ground rods when tested separately shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.

E. Multiple ground rod grids shall be isolated from all metallic connections such as from grid under test to other grounded structures and electrical system neutrals.

F. Provide test report using the attached Form 16450. Each ground grid, including service entrance transformers, switchgear, etc., shall have a form submitted.

END OF SECTION

FORM 16450

GROUND ROD RESISTANCE TO EARTH TEST RECORD

1. DATE _____

2. PROJECT NAME _____

3. LOCATION OF TEST _____

4. DRAWING NO. _____

5. GROUND ROD TYPE _____

   DIAMETER _____

   LENGTH _____

6. TEST METHOD _____

   INSTRUMENT TYPE _____

   SERIAL NO. _____

7. REQUIRED MAXIMUM RESISTANCE TO EARTH _____

8. MEASURED RESISTANCE TO EARTH ROD 1 _____

   ROD 2 _____

   ROD 3 _____

   GROUND ROD SYSTEM _____

TEST PERFORMED BY: _____
Signature

TEST WITNESSED BY: _____
Signature

SECTION 16480

MOTOR CONTROL

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Motor control devices, accessories, and general requirements.
   2. Manual motor starters.
   3. Magnetic motor starters.
   4. Variable frequency drives.
   5. Motor control centers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

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1.02 REFERENCES

A. ANSI/NEMA ICS 6–Enclosures for Industrial Controls and Systems.

B. NEMA AB 1–Molded Case Circuit Breakers.

C. NEMA ICS 2–Industrial Control Devices, Controllers, and Assemblies.

D. NEMA ICS-18-Motor Control Centers.

E. NEMA KS 1–Enclosed Switches.

F. NEMA PB 1–Panelboards.

G. NEMA PB 1.1–Instruction for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01300–Submittals.

B. Include spare parts data listing; source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

1.05 DELIVERY, STORAGE, AND HOLDING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.06 SPARE PARTS

A. Furnish spare parts for equipment specified herein as listed in Section 16951–Spare Parts.

1.07 COORDINATION

A. To assure proper coordination between Section 16940-Controls and Instrumentation, and equipment specified herein, all equipment specified in this section shall be supplied as part of the Controls and Instrumentation package described in Section 16940. This shall include, but not be limited to, equipment such as MCCs, standalone motor controllers, combination starters, and control stations. Drawings for MCCs, combination starters, motor controllers, and motor control equipment shall be provided by the Section 16940 system supplier. Drawings from equipment manufacturers will not be accepted as shop drawings or O&M documents.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Motor control devices, motor starters, variable frequency drives, and motor control centers shall be as manufactured by Allen-Bradley, or equal, as approved by ENGINEER and in accordance with substitutions under provisions of the General Conditions. All equipment

specified in this section and provided by CONTRACTOR shall be by the same manufacturer.

B. The drawings and specifications were prepared based on Allen-Bradley. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.

B. Pushbuttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as shown on the drawings.

C. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as shown on the drawings.

D. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as shown on the drawings.

E. Timing Relays: UL listed with On and Timing-Out LEDs.

F. Contactors: NEMA ICS 2. All contactors for starters specified herein, including VFD and bypass starters, shall be NEMA rated. IEC contactors are not allowed. Contactors shall be Allen-Bradley, Bulletin 509, or equal.

G. Control Power Transformers: 240/120-volt secondary. Each motor starter shall have a dedicated control power transformer.

H. Elapsed Time Meters: Redington/Engler 722 series, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.

I. Relays for motor control circuits, hardwired control logic, and for loads less than 10 amps shall be general purpose, industrial, square base relays. Relays for lighting circuits and small motor loads shall be industrial, electrically-held power relays. Relays shall meet the following requirements:
   1. General purpose relays:
      a. Configuration: DPDT or 3 PDT as required by system supplier.
      b. Mounting: DIN rail with screw terminal base socket.
      c. Voltage: 120 Vac.
      d. Contact rating: 15 A, minimum; 3/4 hp.
      e. Operating life: 10 million cycles.
      f. Status: On-Off flag type or LED indicator.
      g. UL listed.
      h. Manufacturer: Allen-Bradley, 700-HB, or equal.
   2. Power relays:
      a. Configuration: Electrically-held, 2-12 poles.
      b. Mounting: DIN rail, square base.
      c. Voltage: 120 Vac.
      d. Contact rating: 20 A continuous; 1 hp.
      e. Operating life: 10 million cycles.

f. UL listed.
g. NEMA rated.
h. Manufacturer: Allen-Bradley, 700-PK, or equal.

J. All starters shall be equipped with the auxiliary devices to meet the requirements of the plans and specifications. Each starter operating at other than 120-volt, single-phase shall be equipped with a control transformer providing 120-volt secondary for control power. Transformer shall have fused primary and secondary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all starters shall be 120 volts.

K. Enclosures for Stand-Alone Controllers, Starters, and Control Devices:
1. Enclosures in indoor dry locations shall be NEMA 12 gasketed.
2. Enclosures in indoor damp or wet locations, outdoor locations, or locations below grade shall be NEMA 4X, stainless steel.
3. Starters and disconnect devices for motors shall be installed in common enclosures, combination type, with all accessories such as terminal blocks, push-to-test pilot lights, and H-O-A switches.
4. All wiring within starter enclosures shall be landed on terminal blocks. This shall include internal control wiring, field wiring, and any spare or unused wiring.
5. Control stations shall include devices as shown on the drawings and specified in Section 16940-Controls and Instrumentation.

L. Hardwired Motor Controls:
1. Equipment and wiring specified to be hardwired shall be physically wired independent of controllers, programmable relays, and communication systems to allow manual operation in the event of an emergency.
2. Motor control wiring and logic shall be set up such that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart equipment following a power failure.

2.03 MANUAL MOTOR CONTROLLERS

A. Where noted on the drawings, controllers for motors rated 2 hp or less, for operation at 120 V or 240 V single-phase, shall be specification grade wall switches as specified in Section 16141-Wiring Devices.

2.04 MAGNETIC MOTOR STARTERS

A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a solid-state overload relay, Allen-Bradley E1 Plus, Bulletin 592-EE, or equal.

B. Full-Voltage Starting: Reversing or Nonreversing type as shown on the drawings.

C. Coil Operating Voltage: 120 volts, 60 Hz.

D. Size: NEMA ICS 2; size as shown on drawings. Contactors shall be Allen-Bradley, Bulletin 509, or equal.

E. Overload relays shall have the following features:
1. Self-powered, solid-state.
2. Up to 5:1 adjustment range.

3. DIP switch settings for trip class and reset mode.
4. Current transformers (no heaters).
5. Thermal memory.
6. Ambient temperature compensation.
7. Visible trip indicators.
8. Phase loss protection.
9. Low energy consumption.

F. Magnetic motor starters shall be combined with thermal-magnetic molded case circuit breakers.

G. Through-the-door overload reset pushbuttons shall be provided for all magnetic starters installed in motor control centers and combination motor starters.

2.05 VARIABLE FREQUENCY DRIVES

A. A variable frequency drive (VFD) system consists of enclosed inverter, motor starter, bypass system when specified, motor, and any additional system control as specified. VFDs shall be provided to match the load type (constant or variable torque) of the specification application, as well as the full load amps of the motor furnished for the project.

B. System Operating Conditions:
1. 480 Vac ±10%.
2. 3-phase, 3-wire, any phase sequence.
3. 60 Hz ±2%.
4. Storage temperature -25°C to +55°C.
5. Operating temperature 0 to 40°C.
6. Altitude: 3,300 feet above sea level maximum.
7. Humidity: 95% noncondensing maximum.

C. Variable Frequency Unit:
1. Conform to NEMA and NEC standards.
2. CSA and ETL approved and/or UL approved.
3. Overall VFD efficiency shall be a minimum of 96.5%, ±1%, at 100% speed and motor load at nominal line voltage. Efficiency rating shall include control power supplies, control circuits, and all cooling fans.
4. Input:
   a. Withstand without component failure line voltage transients up to 3,000 volts per ANSI C37.
   b. Design to include DC bus chokes (two) to be used in conjunction with one or more capacitors. The DC bus chokes are to be incorporated in the design to minimize line-side harmonics. Magnetic-only designs need to include line filters to limit harmonics to a value no greater than in a system using dual DC bus chokes.
   c. Include MOV line-side protection.
   d. Inverter input for six pulse VFDs shall have a true power factor of 0.95 or better, at rated load and nominal line voltage throughout the entire speed range.
   e. Units shall be capable of operating attached to the same power bus without affecting each other's operations. If operational problems occur, an isolation transformer shall be added to each drive at no additional Contract cost.
   f. Drives larger than 40 hp shall include fuses on the drive input.

5. Inverter Output:
   a. Inverter shall utilize latest generation IGBTs, be microprocessor based, and isolated from power circuits.
   b. Match motor specified.
   c. 3-phase, 3-wire.
   d. Pulse width modulated wave form with selectable Sensorless Vector, Flux Vector, Volts/Hertz, and adjustable voltage control modes.
   e. Maximum output 460 volts.
   f. Frequency 2 to 650 Hz.
   g. Frequency accuracy ±1% of setting at any point in the specified speed range in a 24-hour period.
   h. Full load output current shall be rated in excess of the AC motor selected.
   i. Motor performance:
      (1) 3% regulation in the manual speed control mode.
      (2) Normal duty overload rating: 110% continuous current for 1 minute; 150% for 3 seconds.
      (3) Heavy-duty overload rating: 150% continuous current for 1 minute; 180% for 3 seconds.
      (4) 110% starting torque minimum.
6. AC drive features:
   a. Embedded I/O for discrete and analog signals. Analog signals shall include 4-20 mA circuitry mounted on separate printed circuit board to include offset, slope, minimum clamp, separate acceleration and deceleration adjustments from 0 to 3600 seconds. A light-emitting diode is to be provided to show signal presence and an internal manual speed potentiometer is to be supplied for simulating the 4-20 mA input for start-up and maintenance. The circuit is to be designed to accept either a positive or negative signal, grounded or ungrounded.
   b. Slot-based architecture for expansion control and communication cards including Ethernet/IP, ControlNet, DeviceNet, discrete I/O, and analog I/O.
   c. Real-time clock with battery for date/time stamping of events.
   d. Integral thermostat control of door-mounted cooling fans.
   e. Current limit circuitry: 0.1 amps to 160% of drive-rated amps.
   f. Additional features for constant torque units shall include:
      (1) IR compensation to provide automatic voltage boost or reduction to optimize both starting torque and system input kW.
      (2) Slip compensation to provide 0.5% regulation with a 100% load change.
      (3) Inner current loop regulator.
7. Enclosures:
   a. The VFD system shall be furnished with NEMA-rated (as previously specified) floor-mounting MCC structure or structures. MCC structures shall be 91 1/2 inches high by 20 inches deep with a width to accept the unit specified. MCC structure to incorporate bus where field wiring can be reduced.
   b. Items to be mounted in the VFD structure or structures:
      (1) Inverter.
      (2) Incoming door interlocked, thermal-magnetic, molded-case circuit breaker.
   c. NEMA 4/13 items to be door mounted on the MCC structure or portion of the structure:
      (1) Control devices, pilot lights, selector switches, etc., as shown on the drawings and specified herein.
      (2) Interface to the drive shall be via a removable Human Interface Module (HIM) with integral display. This unit shall be a 7-line by 21-character backlit LCD display with graphics capability. HIM shall be used to display

drive-operating conditions, fault/alarm indications, and programming information with full text support in multiple languages. The LCD HIM shall be rated IP20/Type 1 and may also be used as a handheld terminal by connecting via a separate cable. The HIM keypads shall include programming keys, drive operating keys (Start, Stop, Direction, Jog, and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow drive programming or operating functions to be accessed directly without knowledge of programming structure. The HIM unit shall be mounted on the front of the enclosure door so the operator does not have to open the enclosure to access the HIM.

8. Interlocks:
   a. Fault contact to terminals.
   b. VFD run contact to terminals.
9. VFD protection:
   a. Adjustable current limit of 20 to 160% minimum.
   b. Instantaneous overcurrent trip.
   c. Electronic ground fault and short-circuit protection to shut down the drive without fuse or component failure. Electronic ground- and short-circuit protection to be functional with an input line of 480 Vac ±10%. The drive manufacturer is to be prepared to demonstrate ground fault and short-circuit protection without the use of an isolation transformer at drive start-up.
   d. Input thermal-magnetic ambient compensated circuit breaker with a through-the-door interlocked operator.
   e. Shut down on loss of any input phase for longer than 3 cycles.
   f. Output phase sequence to be independent of input phase sequence.
   g. High- or low-sustained voltage.
   h. 120 Vac grounded control circuits.
   i. Electrically and/or optically isolated low voltage logic.
   j. Corrosion protection:
      (1) Gold-plated plugs (male and female section) on all printed circuit boards.
      (2) Protective board coating (conformal coating).
   k. MOV converter protection.
   l. DC bus chokes to minimize line side current harmonics.
   m. Additional features for constant torque units:
      (1) I^2T protection to provide 150% current for one minute.
      (2) Regenerative override protection.
10. VFD adjustments:
   a. Maximum speed: 50 to 100%.
   b. Minimum speed: 0 to 70%.
   c. Current limit: 20 to 110%, 160% on constant torque units.
   d. Linear acceleration 0 to 3,600 seconds.
   e. Linear deceleration 0 to 3,600 seconds.
   f. Output volts/Hz trim.
   g. Voltage boosts.
   h. Additional features for constant torque units:
      (1) Slip compensation.
      (2) IR compensation.
   i. All drives shall attempt to restart three times prior to indicating failure.
11. Inverter digital or LED diagnostic features:
   a. Current limit signal.
   b. Regenerative override signal.
   c. External fault (ex. motor overload).

d. Low line voltage.
e. High line voltage.
f. Current overload.
g. High DC bus voltage.
h. Current trip.
i. Short-circuit.

12. Inverter construction:
    a. Modular construction ease of maintenance.
13. Mount modules on enclosure subpanel:
    a. Easily accessible from front.
    b. Interconnect with plugs.
    c. Construct boards of fire-retardant materials in accordance with NEMA grade FR4 specifications.

D. Inverter Quality Control:
1. Test all power devices at rated temperature and current for dv/dt, tq, TRR, and leakage.
2. Test integrated circuits for programmed parameters at rated temperature.
3. Treat printed circuit boards for corrosion resistance (conformal coating).
4. Provide gold-plated connections at all points where plugs are used.
5. Thermal cycle all printed circuit boards for 10 cycles between 0° to 65°C prior to installation in inverter.
6. All units to be tested at a rated load and temperature after assembly.

E. The variable speed drives shall be Allen-Bradley, or equal, Powerflex 753. All drives shall be by the same manufacturer.

F. Minimum, maximum, and harmonic skip speed setpoints shall be programmed into each VFD. CONTRACTOR shall coordinate these setpoints with the manufacturer of the equipment served.

2.06 MOTOR CONTROL CENTERS

A. Starters and disconnect devices for motors shall be installed in motor control centers, except where shown to be remote-mounted at the motor location. Starters and disconnect devices shall be NEMA rated, sized according to application as specified. The MCC and NEMA Class IIB drawings shall be supplied as part of the Controls and Instrumentation package described in Section 16940–Controls and Instrumentation. MCC drawings provided by the MCC manufacturer or through any contractor will not be accepted as shop drawing submittals or O&M documents. System supplier described in Section 16940-Controls and Instrumentation shall wire and test all MCCs for the functions described herein in their shop prior to shipment to the site. Provide one copy of the test report to ENGINEER.

B. It shall be assumed that colors will be selected by OWNER and shall be nonstandard. Color shall match that specified for control enclosures specified in Section 16940-Controls and Instrumentation.

C. Auxiliary contacts shall be of quantity necessary for equipment functions.

D. Motor control center design shall be in accordance with latest applicable NEMA standards, shall have been tested to prove adequate mechanical and electrical capabilities, and all major components shall have been individually tested.

E. Structures shall be totally enclosed, dead front, free-standing vertical sections, 90 inches high and not less than 20 inches deep for front-mounted units and not more than 40 inches deep for units mounted back-to-back. Each vertical section shall have side panels extending the full height of the section to minimize fault-propagation to adjacent sections.

F. Each structure shall contain a main horizontal bus continuously braced within each section, with rating as specified, and vertical buss feeding unit compartments with a minimum rating of 300 amperes, or as necessary for load and feeder breakers. All horizontal and vertical buss of all MCC sections shall be powered regardless of location of transfer switch, unless otherwise noted. All motor control centers shall include a 1/4-inch by 2-inch ground bus. All buss shall be tin-plated copper and braced to withstand short-circuit currents as indicated.

G. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus, and shall be readily accessible by removal of its cover plate. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference and safely accessible without disrupting service.

H. A vertical wireway with a minimum of 28 square inches of cross-sectional area shall be adjacent to each vertical unit compartment and shall be covered by its own door. These vertical wireways shall be free of all live parts and shall contain cable supports. Exceptions to this are as shown on the drawings.

I. All units shall be provided with a mechanical interlock with the unit door to prevent access unless the disconnect is in the off position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect.

J. Padlocking facilities shall be provided to positively lock the disconnect in either the on or off position with from one to three padlocks whether the door is open or closed.

K. All unit heights shall be of modular dimensions to allow for unit layout, in any combination, without structural interference. Drawout units shall have a tin-plated stab assembly for connection to the vertical buss; no wiring to these stabs shall extend into the bus compartments. All buss access openings shall be provided with automatic shutters that close when the unit (e.g., starter, breaker), is withdrawn.

L. Terminal blocks for NEMA Type B assemblies shall be mounted within the unit and shall be factory wired. Provide a minimum of 25% spare terminals for all terminal blocks furnished.

M. Control centers shall be NEMA Class II.

N. Wiring in control centers shall be Type B. All conductors supplying power from the MCC buss to frame-mounted equipment shall have the phases identified as specified in Section 16120.

O. Provide neutral landing lugs for all motor control centers accepting utility service-entrance conductors. Neutral landing lugs shall be bonded to the ground buss at the utility service entrance, unless otherwise noted.

P. Control centers shall include NEMA 1 gasketed enclosures, unless otherwise noted.

Q. Remote-mounted controls shall be heavy-duty, oiltight (30 mm) of same quality and type furnished in starters and as shown on the drawings. Equipment controls that require a manual reset shall be accomplished through a reset pushbutton on the enclosure or motor control center bucket for the associated piece of equipment. All reset buttons shall be appropriately labeled, including mechanical type.

R. Motor control center enclosures must be in accordance with area designations shown on the drawings.

S. All lighting and small power transformers shall be dry type, Class H insulation, 80°C rise (kVA as indicated on drawings). Coil windings shall be copper, glass taped, dipped in silicone varnish, with two taps 2 1/2% above and below, 480-volt primary, Delta with 120/208-volt, three-phase, 4-wire secondary, unless indicated otherwise.

T. All lighting panelboards shall be Cutler Hammer Pow R-Line 1a, or equal, with 10,000 amps interrupting capacity, at 120/208-volt, three-phase, 4-wire with branch breakers as shown on drawings, unless indicated otherwise. Branch-mounted main circuit breakers will not be allowed. Minimum size shall be 20 inches wide by 5 3/4 inches deep. All bus shall be copper. Provide laminated, typewritten panel schedule for all panelboards at project final completion.

U. All motor control centers shall be factory-assembled, wired, and tested. All internal wiring shall be color-coded, numbered, and each wire shall be terminated on terminal strips, including internal spares, field wiring, and spare field wires. Schematic and wiring layout drawings following JIC Standards which show all connections to external devices, a complete bill of materials, and a detailed description of operation, shall be submitted for each piece of equipment.

V. Arrangement and physical locations of all equipment within each motor control center shall be subject to shop drawing approval.

W. All components shall be properly identified with laminated engraved nameplates with 3/8-inch-high letters (white or black). Nameplates located outdoors shall be mechanically fastened. Nameplates located indoors shall be adhesive type.

X. Unless otherwise indicated, all conduit entrances shall be through the bottom only.

Y. Motor control center interrupting rating shall be as shown on the drawings, minimum 42,000 A.

Z. The main service breaker or main lugs of each MCC shall be provided with a surge protection device and a three-phase monitor. This surge protection device shall be on the load side of the main and be as specified in Section 16412-Surge Protection Devices. The three-phase monitor shall be on the load side of the main and be Timemark *269, or equal. CONTRACTOR to select voltage to match electrical service. The three-phase monitor shall be hard-wired to a red, push-to-test indicating light on the MCC bucket door for indication of "Three-Phase Fail." This shall be in addition to PLC I/O or hard-wired interlocks.

AA. Main Breaker: Molded case circuit breaker, three-pole, amperes as shown on the drawings with lugs for 480-volt, 3-phase, 4-wire, 60-cycle entrance. Main breakers shall be 100% rated and service entrance rated.

PART 3–EXECUTION

3.01 INSTALLATION

A. Provide motor control equipment in accordance with manufacturer's instructions and drawings.

B. Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.

C. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the drawings is not acceptable. Where power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current due to improved power factor.

D. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.

E. Wireways in motor control centers shall be used only for routing of conductors. Splices are not allowed within wireways.

F. All wiring within motor control centers shall be landed on terminals inside buckets or equipment compartments, and not left unterminated within wireways. This shall include all internal MCC wiring and external field wiring, including spare wires.

G. Motor Data: Provide neatly-typed label inside each motor starter enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.

H. Control wiring and field wiring (120 V and below) within MCCs shall be separated from power wiring (277 V and above). Where possible, route control and field wiring in separate raceways or wireways. Provide a minimum of 2 inches separation between control wiring, field wiring, and power wiring.

I. All motors will be provided by other divisions, ready for connections. CONTRACTOR shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.

J. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, disconnect switches, etc.

K. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits, as specified in Section 16120-Wire.

L. Provide motor starters as specified for all motors, unless shown or specified that starters or control equipment will be furnished by others.

M. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

END OF SECTION

SECTION 16500

LIGHTING

PART 1–GENERAL

1.01 SUMMARY

A. Work includes a complete functional lighting system.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the UL label where practicable. In all cases the lighting fixtures shall be constructed with UL listed components.

B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.

D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.

1.03 SYSTEM DESCRIPTION

A. Intent: It is the intent of these specifications to obtain a completed lighting fixture installation by CONTRACTOR. Completed means lamped, cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above-indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.

B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features, accessories, and options specified, scheduled or required, are to be included for all fixtures provided.

C. Provide lamps for all fixtures of size and type as recommended by the fixture manufacturer and as scheduled.

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals. Shop drawings shall include, but not be limited to, the following:
   1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, prefinishes, metal thickness, fabrication methods, support method, ballasts, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents. Manufacturers' catalog cut sheets will not be acceptable.
   2. Installation instructions.
   3. Certified test data and reports.
   4. Shop drawings shall not only clearly indicate the assigned fixture type, but also the equipment location.
   5. Provide a submittal on all lamp types used. Submittal should include, but not be limited to, lumen output, lamp color temperature, and CRI value.

B. Submit for review samples requested by ENGINEER. The fixtures or components are to be tagged with the project name and the fixture type. Samples will be held by CONTRACTOR available for reference throughout the construction period. Fixtures or components under the Contract shall be identical with the accepted samples. No sample (fixture or component) is to be installed on the Project.
   1. In the event the submissions are not approved, the materials will be returned to CONTRACTOR to immediately make a new submission responding to the notations (corrections/revisions) of ENGINEER regarding compliance with the Contract Documents.
   2. All charges for these shipments shall be paid by CONTRACTOR.
   3. The fixture schedule shows the style of the fixture only. CONTRACTOR shall verify the types of ceiling and mounting construction prior to releasing fixtures for fabrication and delivery, and provide fixtures adapted to the ceiling construction used.

1.05 QUALITY ASSURANCE

A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.

B. Warranties: CONTRACTOR shall warrant all work under this section to be free from defects in materials and workmanship for a period of 1 year after substantial completion. CONTRACTOR shall secure and provide to OWNER manufacturer's warranties for ballasts and other such component items.

C. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.

D. Photometric Testing: Samples may be necessary to be subjected to photometric testing at the request of ENGINEER. Luminaire efficiency shall be determined in an integrating sphere not less than 100 inches in diameter. Testing will be at CONTRACTOR's expense.

E. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.

F. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices, lamps, and components necessary for the proper operation of the equipment.

B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.

C. Timely Purchasing: Luminaires and associated lamps and other allied equipment shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

PART 2–PRODUCTS

2.01 FABRICATION

A. Materials: Provide dimensional thickness of metal, plastic, and composite materials so that all fixtures are rigid, stable, and will resist deflection, twisting, and warping under normal installation and relamping procedures.
   1. All luminaire housings shall be minimum 22 gauge, cold-rolled steel, unless a heavier gauge is specified.
   2. All aluminum extrusion housings shall be minimum 3/16 inches thick.
   3. All spun, hydroformed, or sheet aluminum reflectors shall be fabricated from No. 12 aluminum sheets minimum, 15 gauge (0.57 inches), or heavier.
   4. All acrylic and polycarbonate lenses and/or diffusers shall be minimum 1/8-inch nominal thickness.

B. Joints: Provide positive, durable, means of connection at all joints. NO HOLLOW RIVETS shall be used.

C. Gaskets: Provide neoprene, silicone, rubber, or other appropriate gasketing, stops, and barriers where required, to prevent light leak, control sound and vibration, prevent water leaks, and if pertinent, water vapor penetration.

D. Edges: Provide finished product with the following minimum qualities:
   1. Ground and/or burr-free metal edges.
   2. Tight-fitting connections, hinges, and closures.
   3. Clean, neat corners, edges, trims, and frames.

E. Castings: All cast parts, including die-cast members, shall be of uniform quality; free from blow holes, pores, hard spots, shrinkage defects, cracks, or other imperfections that affect strength and appearance or are indicative of inferior metals or alloys.

2.02 FINISHES

A. Application: Fixture finishes shall be applied in a manner that will assure a durable wear-resistant surface:
   1. Prior to finishing, all surfaces must be free from foreign materials such as dirt, rust, oil, polishing compounds, and mold-release agents.
   2. All castings and extrusions shall be machined, sanded, or similarly treated and given minimum one coat of baked-on clear methacrylate lacquer, unless a painted finish is specified.
   3. Aluminum surfaces exposed to weather (other than anodized reflectors covered elsewhere) shall receive a duronodic or polyester powder paint finish as specified for corrosion resistance.
   4. Sheet steel fixture housings, iron and steel parts, which have not received phosphating treatment ("Bonderizing," or similar process) or are to be utilized in exterior applications, are to be made corrosion-resistant by zinc or cadmium plating or hot-dip galvanizing.
   5. Unless specified to the contrary, all fluorescent fixture housings shall have a complete coverage of white alkyd reflecting enamel, 85% minimum reflectivity, applied by either a spray or dip process, then baked in a temperature-controlled oven until paint is thoroughly cured. Prior to applying the enamel, each metallic surface shall be prepared for painting by using a five-stage hot zinc phosphatizing process.
   6. Plastic refractors diffusers material shall be light stable 100% virgin acrylic, translucent (98% minimum transmission), unless specified otherwise, conforming to minimum standards of IES-NEMA-SPI. Material shall perform as applied in a normal interior environment for a period of 20 years without noticeable deformation, and with a transmission loss not exceeding 5%. Nominal thickness of material shall be 0.125 inches for either extrusions or injections.

2.03 LAMPS

A. Lamps: Provide new lamps as specified for all lighting fixtures (luminaires) as shown on the drawings.

B. Fluorescent Lamps:
   1. All fluorescent lamps shall be of the same manufacturer.
   2. All fluorescent lamps shall be 3500 K color temperature.
   3. Color Rendering Index (CRI).
      a. Linear fluorescent lamps shall have a minimum CRI rating of 86.
   4. Lamps shall be of the wattage specified on the drawings.
   5. Initial lamp lumen output shall be as follows:

Lamp Type	Nominal Wattage	Minimum Initial Lamp Lumens
T8	32	3000

C. Lamps shall be manufactured by Phillips, Sylvania Osram, or equal, wattage as indicated on the drawings.

D. LED Downlight Inserts:
   1. All downlight LED lamps shall be of the same manufacturer.
   2. All downlight LED lamps shall be 3500 K color temperature.
   3. All downlight LED sources shall have a minimum CRI rating of 92.

4. All downlight LED lamps shall be of the wattage specified on the drawings.
5. Initial downlight LED source lumen output shall be minimum 650.

2.04 LAMP HOLDERS

A. Fluorescent Sockets: Fluorescent lamp sockets operating with an open-circuit voltage in excess of 300 volts shall be of the safety type that open the supply circuit when the lamp is removed from the sockets.

B. All fluorescent fixtures installed that have no glass or metal enclosure shall be equipped with safety-type lamp holders so that lamps shall not become dislodged from the holders.

2.05 WIRING

A. Minimum Standards: All wiring shall comply with the following standards:
1. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 16120–Wire.
2. Wiring between fluorescent lamp holders and associated operating and starting equipment shall be of similar or heavier gauge than the leads furnished with the ballasts.
3. Wiring within fixture construction is to be concealed, except where the fixture design or mounting dictates otherwise.
4. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
5. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

2.06 LAMP BALLASTS

A. Linear Fluorescent Electronic Ballast:
1. Fluorescent Ballast: Shall meet UL Standard 935. Ballasts shall be PROGRAM RAPID START (PRS) type.
2. Ballasts shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The input current third harmonic content shall not exceed 13% of the input current. The total harmonic distortion shall not exceed 10%.
3. Fluorescent ballasts shall conform to the performance criteria listed below:

Ballast	Nominal Lamp Watts	Max. Input Watts (ANSI)	Minimum Ballast Factor
3-F32T8	32	84	0.84-0.87
All others			0.84-0.87

4. Ballasts shall be universal voltage. The ballast must maintain constant high output through the entire input voltage ranges of 120 volts to 277 volts.
5. Ballast Requirements:
   a. Current crest factor shall be no greater than 1.7.
   b. The operating ambient temperature range shall be 50°F to 105°F.
   c. Fluorescent ballasts shall operate at 20 kHz or higher, with no detectable lamp flicker.
   d. Four lamp ballasts shall operate parallel circuit lamps that allow remaining lamps to maintain full output if companion lamps fail.

e. Ballasts shall not be affected by lamp failure and shall yield normal lamp life.
f. Ballast power factor shall be greater than 95%.
g. Ballast shall be rated Class P, thermally protected and have a Class A sound rating, or better.
h. Ballast shall comply with EMI and RFI limits set by FCC (CFR 47 Part 18).
i. Ballasts shall carry a 3-year warranty including labor allowance.
j. Program rapid start ballasts shall heat the filament prior to applying the starting voltage to the lamp, then remove lamp cathode heat.
k. Cold weather ballast(s) must reliably start and operate lamps in ambient temperatures down to 0°F for the rated life of the lamps.
l. Ballasts shall be provided with disconnects. Disconnects shall disconnect all ballast wiring including Hot, Neutral, and Ground conductors. Disconnect shall be UL listed.

B. Acceptable Manufacturers: Ballasts made by the following manufacturers will be accepted:
1. General Electric.
2. Universal.
3. Advance.
4. Motorola/Osram.

C. Emergency Fluorescent Ballasts:
1. Emergency ballast shall operate two lamps at 3,000 lumens output for minimum of 90 minutes.
2. Field replaceable. Nickel-cadmium battery.
3. Installed inside luminaries.
4. Solid-state charging.
5. Battery to be recharged within 24 hours.
6. Remote battery test switch.

2.07 MARKING OF FIXTURES

A. Voltage Identification: Fixtures designed for voltages other than 110- to 125-volt circuits shall be clearly marked.

B. Lamp Types: Fixtures equipped with ballasts, etc., for operation of rapid start lamps shall be plainly marked "Use Rapid Start Lamps Only." Similarly, fixtures equipped with ballasts, etc., for operation of instant start or other type lamps shall be plainly marked. Markings must be clear and shall be located to be readily visible to service personnel but invisible from normal viewing angles when lamps are in place.

PART 3–EXECUTION

3.01 LIGHTING CONTROLS

A. Complex Occupancy: Dual ballast fixtures shall be controlled with occupancy sensors in conjunction with wall switch(es).
1. The wall switch(es) shall control the respective ballast(s) as designated on the drawings.
2. With the switch in the "On" position, control shall be through the occupancy sensor such that if the sensor is activated the ballast(s) shall be energized.
3. If the wall switch(es) is in the "Off" position, the fixture shall be deenergized.

3.02 INSTALLATION

A. Install fixtures, lamps, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All lamps, glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.

B. Lamps installed for use as temporary lighting shall be replaced with new lamps.

C. All wall-mounted fixtures and all ceiling-mounted surface fixtures including exit lights, shall be fed through a fixture Stud/Hickey/Nipple assembly and with provisions to prevent fixture turning.

D. All fixtures shall be securely and adequately supported and installed.

E. Surface-mounted fixtures shall be attached to and supported from structural part of the building in a manner acceptable to ENGINEER. Fluorescent fixtures shall be supported by not less than two supports for each fixture. Where fluorescent fixtures are to be suspended, they shall be mounted on steel channel with the channel supported directly to the structure by a minimum of 3/8-inch rod inside rigid conduit stems. Any fixture which has an individual fixture weight of greater than 25 pounds shall have safety cable installed, in addition to other support means. Cable shall be 3/16-inch airplane cable. All fittings and connectors shall be compression type. Cables must be secured to the building structure and to a point or points on the fixture to ensure against falling parts.

F. Industrial-type fixtures in unfinished areas which are near obstructions such as ducts and pipes shall be suspended so that the bottom of the fixture is no higher than the bottom of the obstruction. All fixtures in each room should be located at the height of the lowest fixture, but not lower than 8 feet 0 inches A.F.F. Fixtures shall not be located until the locations of these obstructions are determined, and fixtures shall be accessible after installation of other equipment.

G. Provide inscription for exit signs to conform to codes.

H. Metal decking shall not be pierced for fixture support.

I. All fixtures whips shall be constructed of minimum No. 12 AWG conductors.

3.03 SUPPORTS

A. Mounting Frames: Provide mounting frames (plaster frames for example), as necessary, for installation and as called for under other sections. Frames are to be finished matte white baked enamel unless otherwise noted.

B. Mounting Accessories: Provide bars, angles, or other attachment devices for all recessed fixtures. Fixtures shall be securely attached so there is minimum possible movement up, down, or sideways. Fixtures shall be mounted to permit access to wiring. Fastening devices shall be of a positive, locking type, and will not require the use of special tools to apply or remove. Tie wires shall not be used in place of fastening devices.

C. Fire Codes: Where necessary to meet Code requirements, enclosure housings shall be constructed to provide a 1-hour fire rating.

D. CONTRACTOR Responsibility: CONTRACTOR shall verify all ceiling conditions from the drawings and furnish appropriate mounting details for each lighting fixture.

E. Adequate rigid, sturdy support shall be provided to prevent possibility of fixture falling. Surface fluorescent fixtures must be supported with two supports per 4-foot section, except that continuous 8-foot chassis shall have three supports. Support surface-mounted fluorescent fixtures from structural members other than ceiling tees by providing Unistrut members laid across main ceiling tees or by attachment directly to structure.

3.04 ADJUSTMENT

A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring (both interior and exterior units), shall be adjusted after dark under the observation of OWNER.

3.05 CLEANING

A. Cleaning: Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

3.06 FINAL INSPECTION

A. Upon completion of the installation, lighting equipment must be in first-class operating order and free from defects in condition and finish:
   1. At time of final inspection, all fixtures and equipment must be installed and lamped with new lamps, and be complete with all lenses, diffusers, reflectors, side panels, louvers, or other necessary components.
   2. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
   3. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection, shall be replaced at no expense to OWNER.
   4. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

SECTION 16723

FIRE ALARM SYSTEM

PART 1–GENERAL

1.01 SUMMARY

A. Work includes the furnishing of all labor, equipment, materials, and performance of all operations associated with the installation of the Fire Alarm System as shown on the drawings and as specified herein to meet the requirements of a complete Fire Alarm System.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NFPA 72, the National Fire Alarm Code.

B. ADA.

C. Underwriters Laboratories.

1.03 SCOPE

A. Furnish and install a complete Fire Alarm System to be wired, connected, and left in first class operating condition. The system shall be UL listed, cross-listed, and compatible for use with closed-loop initiating device circuits with individual zone supervision, individual NAC supervision, and incoming and standby power supervision. The project includes furnishing a system which includes manual stations, smoke detectors, heat detectors, audible/visual devices, visual only devices, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.

B. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the installation of the Fire Alarm System as shown on the drawings and as herein specified.

1.04 QUALITY ASSURANCE

A. System Supplier shall be a nationally-recognized company specializing in smoke detection and fire alarm systems. This organization shall employ factory-trained and NICET-certified technicians, and shall maintain a service organization within 100 miles of this project location. The System Supplier and service organization shall have a minimum of 10 years experience in the fire protective signaling systems industry.

B. The System Supplier shall supply the final checkout, contractual service, and testing.

C. The complete installation is to conform to the applicable sections of NFPA-72, NFPA-101a Local Code Requirements and National Electrical Code with particular attention to Article 760.

D. Each and all items of the complete Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer unless the primary equipment provider or manufacturer provides written documentation of compatibility, and assumes responsibility for compatibility with the control equipment.

E. Each and all items of the complete Fire Alarm System shall be listed under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the UL label.

1.05 SUBMITTALS

A. Submit shop drawings and product data sheets in accordance with provisions of Section 01300-Submittals.

B. Provide wiring diagrams, equipment ratings, dimensions, and finishes for all proposed devices and equipment.

C. Provide battery calculations to indicate both the Standby and Alarm loads due to various field devices and panel components/module. Battery calculations shall illustrate the minimum battery capacity required and the capacity actually provided.

D. Provide a complete Fire Alarm System riser diagram including: Point of origin of each circuit (usually a Panel, or a Module within a panel), circuit type and labeling, area served by each circuit, wire/cable type and size, locations of panelboards where primary system power is obtained and the device type circuit(s) to which device is connected, and locations of any End-Of-Line Resistor for each field device.

E. Provide "worst-case" notification appliance circuit voltage drop calculation.

1.06 AS-BUILT DRAWINGS

A. Record drawings shall include the location of all Fire Alarm System devices with their respective labels and the location of all end-of-line device locations.

B. Upon completion of the work, and final acceptance by the local authority, CONTRACTOR shall submit record drawings to OWNER and ENGINEER under the provisions of Division 1.

C. CONTRACTOR shall submit a copy of the Fire Alarm System; Record of Completion documentation to OWNER, ENGINEER, and AUTHORITY HAVING JURISDICTION. Included with the Record of Completion documentation shall be a copy of final acceptance testing results.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit Manufacturer data sheets for all equipment installed.

B. Include operating, installation, and routine maintenance instructions.

C. Submit a record copy of site-specific computer software for software-based Fire Alarm Systems.

D. Include manufacturer letter stating the date of installation on which the system is operational.

PART 2–PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Fire Alarm System: Provide a complete, supervised, power-limited, fire detection and evacuation system.

B. System Supervision: The fire protective signaling system shall be an electrically-supervised, power-limited system which shall monitor the integrity of circuit conductors and power supplies.

C. Equipment of another manufacturer may be submitted as an alternate, however, CONTRACTOR must provide a complete system.

2.02 ENCLOSURES

A. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.

B. Provide cabinets of sufficient size to accommodate the aforementioned equipment.

C. Cabinet shall be equipped with locks and transparent door panel providing tamperproof enclosure, yet allowing full view of the various lights and controls as required.

2.03 MULTIPLEX/INTELLIGENT FIRE ALARM CONTROL PANEL (FACP)

A. Multiplex intelligent fire alarm systems shall be installed where shown on the drawings.

B. The FACP shall allow for loading or editing special instructions and operating sequences as required. The system is to be capable of on-site programming to accommodate facility expansion, building parameter changes, or changes as required by local codes. All software operations are to be stored in a nonvolatile, programmable memory resident within the FACP. Loss of power shall not erase the instructions stored in memory.

C. The ability for selective input/output control functions based on ANDing, ORing, NOTing, and special coded operations is to also be incorporated in the resident software programming of the system.

D. To accommodate and facilitate jobsite changes, initiation circuits shall be individually configurable on-site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a nonlatching circuit, or an alarm verification circuit.

E. FACP shall be modular, expandable with solid-state, microprocessor-based electronics. It shall display through the front viewing window only those primary controls and displays essential to operation during a fire alarm condition.

F. The FACP shall provide the following features as standards:
   1. Support intelligent (analog) detection devices.
   2. The number of initiating device loops required for the specified quantity of initiating devices, plus one spare loop for each five active loops. Each active loop shall include 5% spare capacity.
   3. The number of indicating appliance (speakers) circuits required for the specified quantity speakers, plus one spare circuit for each ten active circuits. Each active circuit shall include 25% spare capacity.
   4. The number of indicating appliance (strobe) circuits required for the specified quantity of strobes, plus one spare circuit for each ten active circuits. Each active circuit shall include 25% spare capacity.
   5. 80-character liquid crystal display.
   6. Printer interface.
   7. History log file with a minimum of 400 events.
   8. Field programmable.
   9. Drift compensation.
   10. Sensitivity display in %.
   11. Sensitivity adjustment.
   12. Day/night sensitivity adjustment.
   13. Auto detector test to meet NFPA 72.
   14. Alarm verification with tally counter.
   15. Silent walk test.
   16. Maintenance alerts.
   17. AC fail delay.
   18. Other features as described below.

G. The FACP shall provide the ability to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history.

H. The FACP LCD shall have the capability of displaying the following information relative to the abnormal condition of a point in the system prior to acknowledgement:
   1. 40 characters for:
      a. Point address and loop number (i.e., 555-L5).
      b. Type of device (i.e., smoke, pull station, water flow).
      c. Point status (i.e., alarm, trouble).
   2. 40 characters for: Custom location label (i.e., 4th Floor–Room 444).

I. FACP keyboards or keypads shall not be required to operate the system during fire alarm conditions.

J. FACP shall have the following software functions:
   1. Setting of time and date.
   2. LED testing.
   3. Alarm, trouble, and abnormal condition listing.
   4. Enabling and disabling of each monitor point separately.
   5. Activation and deactivation of each control point separately.
   6. Changing operator access levels.
   7. Walk Test enable.
   8. Running diagnostic functions.
   9. Displaying historical logs.
   10. Point listing.

K. FACP shall have the following hardware functions:
   1. Acknowledge alarm or trouble.
   2. Silence alarm or trouble.
   3. Reset system after alarm.
   4. Connect/disconnect fire department tie.
   5. Provide manual evacuation (drill).
   6. Bypass door holders.
   7. Supervise system.
   8. Allow computer interface.

L. FACP shall have the following Status Indicators and Displays:
   1. Local audible device shall sound during Alarm, Trouble or Supervisory conditions. This audible device shall also sound during each key-press to provide an audible feedback to ensure that the key has been pressed properly. The visual display shall distinguish between alarm, trouble and supervisory conditions.
   2. The following indicators and displays shall be visible through the front viewing window:
      a. One red system alarm LED.
      b. One yellow supervisory service LED.
      c. One yellow trouble LED.
      d. Green "power on" LED.
      e. Eighty-character liquid crystal display.
   3. The 2-line by 40-character liquid crystal display shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
   4. The display shall support both upper and lowercase letters. Lowercase letters shall be used for soft-key titles and prompting the user. Uppercase letters shall be used for system status information. A cursor shall be visible when entering information.
   5. Scrolling through menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct the user. These controls shall be located behind an access door. The following status data shall be available on this display:
      a. Initiating device circuits.
      b. Indicating appliance circuits.
      c. Auxiliary relays.
      d. Feedback points.
      e. Primary state of point.
      f. Zone information.
      g. Class "A" status.
      h. Current priority of outputs.
      i. Disable/Enable status.
      j. Verification tallies of initiating devices.
      k. Automatic/Manual control status of output points.
      l. Acknowledge status.

M. Controls:
   1. The following controls (one switch per function per system) shall be visible through the front viewing window:
      a. Alarm Acknowledge key.
      b. Trouble Acknowledge key.
      c. Alarm Silence key.
      d. System Reset key.

2. The following controls shall be accessible with the front door open, though not visible, through the front viewing window:
   a. Supervising Station disconnect/switch.
   b. Manual evacuation (drill).
   c. Elevator bypass.
   d. Fan shutdown override/bypass switches.
   e. Door holder release bypass.
   f. Key pad for data input and microprocessor control.

N. FACP shall have the capability of supervising all slave modules LEDs for burnout or disarrangement.

O. Acknowledgement:
   1. Two methods of acknowledgment for each abnormal condition shall be provided. One may be chosen depending on the NFPA requirements.
   2. Acknowledge one event at a time from an unacknowledged list of events.
   3. Pressing the appropriate acknowledge button shall display the first unacknowledged condition in the appropriate list (either alarm, supervisory, or trouble) and require another acknowledge button. Press to acknowledge only the displayed point.
   4. After all points have been acknowledged, the LEDs shall glow steadily and the Sonalert will be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated by an end of list message "END of LIST."
   5. Systems not capable of password-protected manual command operations shall provide key-operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.
   6. All acknowledge functions shall be behind locked door or pass-code protected. In pass-code protection, if the user has insufficient privilege to acknowledge such conditions, a message shall indicate insufficient privilege, but allow the user to view the points without acknowledging them. Should the user have sufficient privilege to acknowledge, a message will be displayed informing the user that the condition has been acknowledged.

P. Silencing:
   1. If an alarm condition exists and the "Alarm Silence" button is pressed, all alarm signals shall cease operation. The strobes shall remain active until the system is reset.
   2. If trouble conditions exist in the system and the "Trouble Silence" button has been pressed, the aural trouble signal shall cease, but shall resound at time intervals to act as a reminder that the fire alarm system is not in a normal operating mode. Both the time interval and the trouble reminder signal shall be programmable to suit OWNER's application.
   3. Panel shall be equipped with an alarm silence inhibit function.

Q. Reset:
   1. The SYSTEM RESET button shall be used to return the system to its normal state after an alarm condition has been remedied. The display shall step the user through the reset process with simple English language messages. Messages shall provide operator assurance of sequential steps (i.e., "IN PROGRESS," RESET COMPLETED," and "SYSTEM NORMAL") as they occur, should all alarms conditions be cleared.
   2. Should an alarm condition continue to exist, the system shall provide indications that resetting cannot be completed and shall remain in an abnormal state. The Sonalert

and the Alarm LED shall remain activated. The display shall indicate the total number of alarms and troubles present in the system along with a prompt to use the ACK keys to review the points. These points shall not require acknowledgment if they were previously acknowledged.

R. Access Levels:
   1. There shall be three access levels with Level 4 being the highest level. Level 1 actions shall not require a passcode. Passcodes shall consist of up to five digits. Changes to passcodes shall only be made by authorized personnel.
   2. In order to maintain security when entering a passcode, the digits entered shall not be displayed, but a cursor shall move along filling the position with an X to indicate that the digit has been accepted. All key presses shall be acknowledged by a local audible sound.
   3. When a correct passcode is entered, the system shall indicate "Access Granted" to the operator. The new access level shall be in effect until the operator manually logs out or the keypad has been inactive for 5 minutes.
   4. Operator entering an invalid code shall be notified with the message "Incorrect Pass-Code" and shall be allowed up to three chances to enter a valid code. After three unsuccessful tries, the message "Access Denied" shall be displayed. The level shall not be altered, and the operator shall no longer be in the menu option.
   5. Access to a level shall allow the operator to perform all actions within that level plus all actions of lower levels but no actions of higher levels.
   6. The following keys/switches shall have access levels associated with them:
      a. Alarm Silence.
      b. System Reset.
      c. Set Time/Date.
      d. Manual Control.
      e. On/Off/Auto Control.
      f. Disable/Enable.
      g. Programming functions.
      h. Clear Historical Alarm Log.
      i. Clear Historical Trouble Log.
      j. Walk Test.
      k. Change Alarm Verification.
   7. Acknowledge keys shall also require privileged access to acknowledge points. If the operator presses an ACK key with insufficient access, an error message shall be displayed. The points shall scroll with ACK key presses to view the points on the list, but the points shall not get acknowledged in the database.

S. For maintenance purposes, the following lists shall be available from the point lists menu:
   1. All points list by address.
   2. Monitor point list.
   3. Signal/speaker list.
   4. Auxiliary control list.
   5. Feedback point list.

T. History Logging:
   1. The system shall be capable of logging and storing the last 400 events (alarm and trouble) in a history log. These events shall be stored in a battery-protected random access memory. Each recorded event shall include the time and date of that event's occurrence. Systems not having discrete alarm and trouble logging memory shall include an alternative supervised (e.g., USB drive, compact disk) historic recording

method with battery backup. Real time and date shall accompany all history event recording.

2. History logs shall be capable of being viewed separately or shall be selectable for viewing as a combined history log that displays both alarm and trouble events in chronological order.
3. The following historical alarm log events shall be stored:
   a. Alarms.
   b. Alarm Acknowledgment.
   c. Alarm Silence.
   d. System Reset.
   e. Alarm Historical log cleared.
4. The following historical trouble log events shall be stored:
   a. Trouble conditions.
   b. Supervisory alarms.
   c. Trouble acknowledgment.
   d. Supervisory acknowledgment.
   e. Alarm Verification tallies.
   f. Walk Test results.
   g. Trouble Historical log cleared.

U. FACP shall have Silent Walk Test Function With History Logging:
   1. The system shall be capable of being tested by one person.
   2. The panel shall have the capability of dividing the system into distinctive walk test groups, a minimum of 8 groups.
   3. Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations described above.
   4. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.
   5. Suppliers of systems not having this feature as functionally specified above shall include a testing agreement meeting the requirements of NFPA-72 in their Base Bid quotation. As a minimum, 2 years of scheduled testing shall be included.

V. Computer Interface:
   1. The FACP shall operate as a proprietary local system with the capability of sending status data to and receiving control data from a Central Processing Unit (CPU) at the central reporting stations.
   2. The CPU would monitor all alarms and troubles and would control selected functions of each FACP.
   3. The CPU shall supervise all data communication wiring between the CPU and FACP for opens, shorts, and grounds.

W. Field Programming:
   1. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory ICs. All programming may be accomplished through the standard control panel keyboard, or a keyboard at the printer, or the use of a PC. All programs shall be stored in nonvolatile memory.
   2. All programming or reprogramming shall be done by the supplier at no charge until the system is accepted by OWNER.

X. Terminal/Printer Interface:
   1. FACP shall be capable of operating remote monitors and/or printers.

2. The output shall be ASCII from an EIA RS-232-C connection with an adjustable baud rate.
3. Each RS-232-C port shall be capable of supporting and supervising up to four remote CRTs and Printers.
4. Data amplifiers shall be used to increase CRT or printer line distance, if required.
5. Each RS-232-C port shall only communicate with one keyboard. The FACP shall support up to five RS-232-C ports.

Y. Intelligent Network:
1. The system must provide communications with intelligent initiating and control devices individually. These devices shall be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
   a. Alarm.
   b. Trouble.
   c. Open.
   d. Short.
   e. Device missing/failed.
2. All intelligent devices shall have the capability of being disabled or enabled individually.
3. There shall be no limit to the number of detectors, stations, or addressable modules which may be activated or "in alarm" simultaneously.
4. Multiple intelligent devices shall be connected to a single pair of wires. Systems that require factory preprogramming to add or delete devices are unacceptable.
5. The communication format must be a completely digital poll/response protocol to allow T-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol. Systems that do not utilize full digital transmission protocol are not acceptable.

Z. The FACP shall provide a minimum of 4 amps for notification appliances and auxiliary devices. Provisions shall be available to provide additional signal expansion.

2.04 MULTIPLEX/INTELLIGENT PERIPHERAL DEVICES

A. All devices shall be supervised for trouble conditions. The system control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Failure of a device shall not hinder the operation of other system devices.

2.05 DEVICE IDENTIFICATION

A. Each intelligent device shall be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address shall not be acceptable. This address, along with the loop number, shall be indicated and be visible from the ground on the device in the field using machine-generated marking.

B. Location of the end-of-line (EOL) device shall be indicated on the fire alarm system device containing the EOL device.

C. Device identification schemes that do not use uniquely set addresses, but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate T-tapping, and the addition of an intelligent device between existing devices requires reprogramming all existing devices beyond added device.

D. The system must verify that proper type device is in place and matches the desired software configuration.

2.06 INTELLIGENT DETECTOR BASES

A. Either the base or the head shall contain electronic circuits that communicate the detector's status (normal, alarm, sensitivity status, trouble, etc.) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Contacts between the base and head shall be of the bifurcated-type using spring-type, self-wiping contacts.

B. The base shall be lockable. The locking feature must be field-removable when not required.

C. Upon removal of the detector's head, a trouble signal shall be transmitted to the control panel.

D. The detector base shall be sealed against rear airflow entry.

E. Each detector's base or head shall contain LED(s) which shall flash when the detector is being scanned by the control panel. The LED(s) shall turn on steady when the detector is in an alarm condition.

F. Each base shall provide means to allow for function testing of the detector at the detector's location.

G. The base shall be common with heat detector and smoke-type detectors and shall be compatible with other intelligent detectors, addressable manual stations, and addressable modules on the same circuit.

2.07 INTELLIGENT DETECTORS–GENERAL

A. All detectors must be approved by the State Engineer prior to installation.

B. The detectors shall be plugin units which mount to a common base, and shall be UL 268 approved.

C. The detector shall be a 24 Vdc type, which is compatible with the fire alarm panel and obtains its operating power from the supervisory current in the fire alarm detection loop. The 24 Vdc detector shall be reset by actuating the control panel reset switch.

D. To minimize false alarms, voltage and RF transient suppression techniques shall be employed.

E. Detectors shall be installed on circuits with alarm verification modules.

F. Detectors shall include an insect screen.

G. If field conditions so require, the detection devices shall not be installed until construction is completed.

2.08 INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

A. The detectors shall contain no radioactive material.

B. Detectors shall be of the solid-state photoelectric type and shall operate on the light-scattering photodiode principle using a pulsed infrared LED light.

C. Smoke detectors shall be listed for sensitivity testing from the control panel. Sensitivity test results shall be logged.

D. Smoke detectors shall communicate the actual smoke chamber values to the system control panel.

E. Smoke detectors shall be smoke density measuring devices having no self-contained alarm setpoint (fixed threshold). The alarm decision for each detector shall be determined by the control panel. The control panel shall determine the condition of each detector by comparing the detector's value to the stored value.

2.09 INTELLIGENT DUCT SMOKE DETECTORS

A. Duct detectors shall be of the photoelectric smoke or photoelectric smoke telescoping sampling tube type. It shall be possible to alarm the duct detector by using a remote or local test switch.

B. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housings front cover.

C. Detector shall include auxiliary SPDT relays and remote keyed test switch and alarm LED indicator.

D. Alarm LED indicators for duct detectors shall be labeled with the detectors loop and address.

2.10 PULL STATIONS

A. Pull stations shall contain circuits that communicate the station's status (alarm, normal) to the control panel over two wires, which also provide power to the pull station. The address shall be field programmable at the station.

B. Manual stations shall be double-action, constructed of high-impact red Lexan with raised white lettering, and a smooth high-gloss finish.

C. Station shall mechanically latch upon operation and remain so until manually reset by a master key common to all system locks. Stations which use Allen wrenches or special tools to reset will not be accepted.

D. The manual station shall be fitted with screw terminals for field wire attachment.

2.11 ADDRESSABLE INTERFACE MODULES–GENERAL

A. Addressable Interface Modules shall receive their 24 Vdc power from a separate two-wire circuit provided by an appropriate power supply.

B. The module shall be available in either a Class B or Class A supervision version.

C. In the Class B version, the wiring shall be supervised by an end-of-line device.

D. In the Class A version, the wiring shall be looped back and connected to the module to allow continual operation of the controlled devices even if the wiring sustains a single break.

E. The interface modules shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions.

F. Should the interface modules become nonoperational, tampered with, or removed, a discrete trouble signal unique to the device shall be transmitted to and annunciated at the control panel.

G. The interface modules shall be capable of being programmed for its "address" location on the intelligent device initiating circuit. The interface modules shall be compatible with addressable manual stations and intelligent detectors on the same intelligent initiating circuit.

2.12 ADDRESSABLE INTERFACE MODULES–SUPERVISED CONTROL

A. Interface Modules shall be suited for control of indicating appliances and AHU systems.

B. For signals, speakers, firefighter phone jacks, and other device control with Class B or Class A wiring supervision, the interface module shall provide double-pole/double-throw relay switching that can be used to connect any of the following through easily replaceable 2 amp fuses:
   1. A zone of signals to a power source.
   2. Speakers to an audio source.
   3. Firefighter phone jacks to a communications channel.
   4. A variety of controlled devices to the appropriate controlling circuits.

C. These interface modules shall communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and shall receive from the fire alarm control panel a command to transfer the relay.

2.13 HORN/STROBE UNITS

A. Horns shall have Lexan housing with field-adjustable output taps, three taps minimum. Sound pressure level output shall be 87 dB at 10 feet. Horns shall have vandal-resistant Lexan grills and sealed backs to protect the phenolic impregnated cone.

B. The unit shall be complete with a tamper-resistant Lexan lens with "FIRE" lettering visible from a 180-degree field of view. Strobes installed in open areas such as hallways, open office spaces, and assembly areas shall have an adjustable candela rating range from 15-75 candela. Strobes installed in mechanical areas shall have a peak candela rating of 110 candela. All strobes shall be in compliance with ADA requirements.

C. Strobe devices installed in NEMA 4X areas shall be installed in a clear Lexan enclosure. Enclosure shall be Model STI 1220 as manufactured by Safety Technology International Inc., or equal.

D. Horn devices installed in NEMA 4X areas shall be rated at 110 dBA at 10 feet. Horn device shall be model 300GCX as manufactured by Federal Signal Corporation. Horn device shall be powered through the FAS. Provide addressable relay modules and supervisory relays to activate this device from the FACP.

2.14 SPARE PARTS

A. CONTRACTOR shall provide spare parts as described in Section 16951 for all fire alarm system components.

PART 3–EXECUTION

3.01 FIRE ALARM SYSTEM CONFIGURATION

A. The FACP in the booster station shall function as the main panel for the entire site. All alarms and supervisory messages for the entire site shall be annunciated through this panel. Notification of alarms to off site monitoring agency shall be through this panel.

3.02 FIRE ALARM SYSTEM OPERATION

A. FACP:
   1. Under normal condition, the front panel shall display a "SYSTEM NORMAL" message with current time and date.
   2. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.
   3. In the event of an abnormal condition, the following three characteristics relative to the condition shall be displayed simultaneously in alphanumeric format. Systems not capable of such a display on the panel faceplate shall include a CRT display meeting the above requirements and must provide a secondary power supply to maintain CRT operation for the duration of the standby requirements of the panel. Information shall include:
      a. Custom location label (40 characters minimum).
      b. Type of device (i.e., smoke, heat, pull station).
      c. Status (i.e., alarm, trouble).
   4. Pressing the appropriate acknowledge button shall acknowledge the alarm or trouble condition.
   5. After all points in alarm have been acknowledged, associated LEDs shall glow steady and the panel audible signal shall be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated. The first 10 fire alarm zones shall be displayed simultaneously in chronological order.
   6. Alarm Silencing:
      a. Pressing the "Alarm Silence" button shall cause all notification appliances programmed for "On-Until-Silenced" to be deactivated. A separate panel-mounted yellow LED shall illuminate to indicate the alarm silenced mode.

b. All NACs programmed for "On-Until-Reset" shall remain activated until the system is Reset.

7. System Reset:
   a. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied.
   b. In the event an alarm condition continues to exist following system reset, the system shall remain in an abnormal state. System control relays shall not reset. The panel audible signal and the Alarm LED shall remain on. The display shall indicate the total number of alarms and troubles present in the system along with a prompting to review the points. These points shall not require acknowledgment if they were previously acknowledged.
   c. In the event the Alarm Silence inhibit function is active, the system shall ignore all Key presses. An indication of enabling and disabling the inhibit stator shall be provided as a feedback to the operation.
8. Walk Test System Testing:
   a. While in the test mode, the system shall display a trouble condition.
      (1) While in the walk test mode, the activation of an initiating device shall be silently logged as an alarm in the historical log. The panel shall automatically reset after logging the alarm.
      (2) The momentary disconnection of an initiating device or notification appliance shall be silently logged as a trouble condition in the historical log. The panel shall automatically reset itself after logging of the trouble condition.
      (3) Integrity of the installation conductors of IDCs and NACs shall be verified by momentarily opening any circuit.
      (4) Walk Test of ground fault circuit testing shall be verified by operating the Notification Appliances for 4 seconds.
   b. As an option, the Walk Test sequence shall have the capability of activating NACs to signal with a code associated with the alarmed zone. If this option is selected, any momentary opening of initiating or NAC wiring shall cause the notification appliances to sound for 4 seconds to indicate the trouble condition. The Walk Test feature shall automatically revert to the normal operating mode after 8 hours if it is not manually activated.
9. LED Supervision: All slave module LEDs shall be supervised for burnout or disarrangement. Should a problem occur, the panel shall display the module and the LED location numbers to facilitate location of that LED.
10. Active Status Reminder: Should any Alarm, Supervisory, or Trouble condition be present within the system and the audible signal silenced, the local tone alert shall resound every 8 hours as a reminder that the fire alarm system is not 100% operational.
11. Access Levels:
    a. There shall be a minimum of four access levels. Passcodes shall consist of up to four digits. Changes to passcodes shall be only by authorized personnel. Systems not capable of password-protected manual command operations shall provide key-operated switches for these functions. Function-key switches shall be keyed differently from any other keyed switches or locks used within the system.
    b. In order to maintain security when entering a passcode, the entered digits shall not be displayed.
    c. When a correct passcode is entered, a message indicating acceptance shall be displayed. The new access level shall be in effect until the operator manually logs out or leaves the keypad inactive for 10 minutes.
    d. When an incorrect passcode is entered, a message shall be displayed indicating that the passcode was invalid.

e. Access to a level shall only allow the operator to perform all actions within that level and all actions of lower levels, not higher levels.
f. The following keys/switches shall have access levels associated with them: Alarm Acknowledge–Supervisory Acknowledge–Trouble Acknowledge–Alarm Silence–System Reset.

B. Smoke Detection Operation:
1. The activation of any system smoke detector shall initiate an alarm verification operation whereby the FACP will reset the activated detector and wait for a second alarm activation. If after 20 seconds and within 1 minute after resetting a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within 1 minute, the system shall resume normal operation. The alarm verification shall operate only on single smoke detector alarm. Other activated initiating devices or multiple smoke detector alarms shall be processed and reported immediately. The alarm verification operation shall be selectable by device or zone.
2. The multiplex/intelligent system shall have the capability of displaying the number of times (tally) a detector has gone into a verification mode.
3. Smoke detectors shall be smoke density measuring devices having no self-contained alarm setpoint (fixed threshold). The alarm decision for each detector shall be determined by the FACP. The control panel shall determine the condition of each detector by comparing the detector's value to the stored values.
4. The FACP shall maintain a moving average of the detector's smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain a constant smoke obscuration sensitivity for each detector (via the floating threshold) by compensating for environmental factors. Photoelectric detector's smoke obscuration sensitivity shall be adjustable to within 0.3% of either limit of the UL window (0.5% to 4.0%) to compensate for any environment.
5. The system shall automatically indicate when an individual detector needs cleaning. When a detector's average value reaches a predetermined level, a trouble MESSAGE shall be audibly and visibly indicated at the FACP for the individual detector. Additionally, the LED on the detector base shall glow steady giving a visible indication at the detector's location. If the trouble condition is left unattended and the detector's average value increases to a second predetermined value, another trouble MESSAGE shall be indicated at the FACP for the individual detector. To prevent false alarms, these TROUBLE conditions shall in no way decrease the amount of smoke obscuration necessary for system activation. For scheduling of maintenance, the control panel shall be able to generate a MESSAGE indication for any detector approaching a trouble condition because of dirt or contamination.

C. FCU System Interface:
1. Duct Smoke Detectors and Addressable Control Modules, or Supervised Remote Relays shall be provided as specified below. Detectors shall be installed in compliance with the manufacturer's recommendations. Each Addressable Control Module or Supervised Remote Relay for FCU and/or fan shutdown shall be installed within 3 feet of the Temperature Control Panel to which it is connected. The division contractor shall provide all wiring and terminations required for shutdown of the specified FCU.
2. The Addressable Control Modules or Supervised Remote Relays provided for this purpose shall be provided by DPDT output contacts. One SPDT set of the DPDT contacts shall be utilized for the specified shutdown function. The second SPDT set of

the DPDT contacts shall be available for connection to the temperature controls to indicate that unit shutdown due to Smoke Duct has occurred.

3. The control panel shall provide an output alarm interface to the air handling/energy management system controllers, which in turn shall perform automatic function as specified in the applicable sections of Division 15.
4. An override feature/control switch shall be provided which shall prevent shutdown of the FCU when this function is active.
5. Operation: The associated fan shall be shut down only upon actuation of the Duct Smoke Detector associated with the particular unit. The FCU shall remain shut down until a valid System Reset occurs.

3.03 ALARM SEQUENCE

A. The system alarm operation subsequent to the alarm activation of any manual station or automatic detection device shall be as follows:
   1. All audible alarm notification appliances shall sound with the following characteristics: Temporal code pattern until silenced by the alarm silence switch at the FACP.
   2. All visible alarm notification appliances: Xenon Strobes shall display a continuous (synchronized where indicated on the drawings) pattern until system is reset. Strobe intensities are indicated on the plans for adherence with ADA.
   3. Alarm horns and strobes shall be wired and operate independently.
   4. All doors normally held open by door control devices shall release.
   5. A supervised signal to notify the central station is to be activated.

B. The FACP shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.

C. Activation of an auxiliary bypass means shall override the automatic functions either selectively or throughout the system.

D. The system shall have an alarm list means that shall allow the operator to display all alarms, troubles, and supervisory service conditions with the time of occurrence. This shall allow for the determination of the most recent alarm and may also indicate the path that the fire is taking.

3.04 POWER REQUIREMENTS

A. The FACP shall receive 120 VAC (as noted on the drawings) from a dedicated circuit. This branch circuit shall have a "breaker lock" to prevent accidentally deenergizing of the power to the fire alarm panel. Circuit breakers shall be painted red and labeled "FIRE ALARM."

B. The FACP shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC main's power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.

C. The FACP shall include a disconnect switch for the AC power inside an enclosure near the panel or within the panel itself. This switch shall be labeled "Fire Alarm Power Disconnect."

D. Isolated Loop Circuit Protectors (ILCP):
   1. The FACP shall include Isolated Loop Circuit Protector (ILCP) on all circuit which extends beyond the building. These circuits include, but are not limited to, the initiating device circuits, alarm notification appliance circuits, and signaling line circuits. ILCP shall be located as close as practical to the point where the circuits leave or enter a building.
   2. The ILCP grounding conductor shall be a No. 12 AWG wire having a maximum length of 25 feet. It shall be run in a straight line and connected to the building grounding electrode system.
   3. The ILCP shall have a line-to-line response time of less than one nanosecond. Spark gap devices or devices incorporated in or installed within the control panel in lieu of the ILCP are not acceptable.

3.05 SUPERVISION

A. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.

B. There shall be supervisory service initiation device circuits for connection of all sprinkler flow and tamper switches. Device activation shall be appropriately annunciated at the FACP.

C. Auxiliary manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble.

D. Auxiliary circuits for addressable relays shall be supervised so that a blown fuse or an open in the circuit shall be visibly and audibly annunciated.

E. Each independently supervised circuit shall include a discrete visible amber "Trouble" LED to indicate disarrangement conditions per circuit.

F. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present.

G. The system's batteries shall be supervised so that a low battery condition or disconnection of any battery shall be audibly and visually indicated at the control panel and the remote annunciator.

H. The System Modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.

I. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

3.06 INSTALLATION

A. The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable requirements of NFPA 70–Article 760 and the manufacturer's recommendations.

B. If field conditions require, cover all smoke detection devices with plastic bags immediately after installation to maintain cleanliness.

C. Class B circuiting shall be used.

3.07 RACEWAYS

A. All wiring shall be in a conduit system separate from all other building wiring. See Section 16110–Conduit for specifications.

B. All wiring shall be installed in minimum 3/4-inch conduit.

C. Surface access to existing alarm initiating circuits in public areas shall be via UL listed surface metal raceways (minimum equivalent to 3/4-inch conduit) and box extensions.

D. There shall be no sharp edges with installed materials.

3.08 CONDUCTORS

A. All cable shall be installed according to NEC Article 760.

B. All cables and wires shall be No. 14 AWG and larger and shall be stranded.

C. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in the system, an audible and visual trouble signal shall be activated until the system is restored to normal.

D. All conductors shall be color-coded. Coding shall be consistent throughout the facility. Green wire shall be used only for equipment ground.

E. FACP shall be connected to separate dedicated branch circuit from the building emergency panel, maximum 20 amperes. Circuit shall be labeled as "FIRE ALARM."

F. Power wiring for FACP shall be No. 12 AWG.

G. FACP shall have No. 12 AWG green equipment ground wire. Where fire alarm circuits enter or leave a building, additional transient 75 to 90-volt gas tube protection shall be provided for each conductor.

H. Leave 8-inch wire tails at each device box and 36-inch wire tails at the FACP.

I. Cable for Intelligent Detector Loops shall be 18 to 12 AWG twisted pair with a shield jacket installed in 3/4-inch conduit. Shield continuity must be maintained and connected to earth ground only at the control panel. Intelligent detector wiring must not be in the same conduit with 120/240 VAC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B intelligent loop circuits.

J. Wiring of alarm horn circuits and alarm strobe circuits shall be No. 14 AWG minimum.

K. Fire alarm cables shall be held in place at the device box by means of a two-screw connector (do not use squeeze- or crimp-type connectors).

L. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and/or labeled "FIRE ALARM SYSTEM" by decal or other approved markings.

M. Strobe wiring shall be 14 AWG minimum or as recommend by manufacturer.

N. Tray cable is not acceptable for use as fire alarm systems wiring.

3.09 DEVICE MOUNTING

A. Unless otherwise noted on the drawings, the recommended mounting heights and requirements are as follows:
   1. FACP: Mount control panels so all visual indicators and controls are at 60 inches above floor level. Cabinet shall be grounded to either a cold water pipe or grounding rod.
   2. Audio-Visual Devices:
      a. Install flush, semiflush, or surface mount at 6 inches below finished ceiling or at 80 inches from the bottom of the device to the highest level of the finished floor. No devices protruding 4 inches or more shall be installed lower than 80 inches.
      b. All audio/visual devices shall be installed at the same height throughout the facility.
      c. For surface mounting, use manufacturer-supplied back boxes and trim plates. Mark each device with its circuit number.
   3. Manual Stations:
      a. The operable part of the manual stations shall be installed not less than 3 1/2 feet (42 inches) and not more than 4 1/2 feet (54 inches) above finished floor. All Manual Stations shall be in unobstructed locations. Mark the unit's address on the inside and outside of housing. For surface mounting, use manufacturer-supplied backboxes and trim plates
      b. All pull stations shall be installed at the same height throughout the facility.
   4. Smoke Detectors:
      a. The location of detectors shown on the plans is schematic only. The detectors must be located according to code requirements.
      b. Surface mounted detectors shall be installed using backboxes equal to the base's size. Standard octagon and square boxes are not acceptable.
      c. Detectors should be located on the highest part of a smooth ceiling so that the edge of the detector is no closer than 4 inches from a sidewall. Ceilings with beams, joists, or soffits that exceed 8 inches in depth require special planning and closer spacing. Verify with manufacturer.
      d. If it is necessary to mount a detector upon a sidewall, the top of the detector shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.
      e. Smoke detectors should be installed to favor the air flow towards return openings and not located closer than 3 feet from air supply diffusers which could dilute smoke before it reaches the detector. No detectors shall be installed in direct airflow.
      f. Ideally, heat and smoke detectors should be located near the center of the open area which they are protecting, thus providing coverage generally for 15-foot radius for smoke detectors and a 25-foot radius for heat detectors. Verify location with ENGINEER.

g. Mark the address and loop number on each detector's base.

5. Identification: All junction boxes shall be painted red and labeled "Fire Alarm."

3.10 FIELD START-UP AND COMMISSIONING

A. Provide the services of a manufacturer's qualified NICET-certified technician to assist CONTRACTOR in installation and start-up of the equipment specified in this section. The manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general operation of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional checkout of the equipment. Upon completion of the manufacturer's start-up and checkout, the manufacturer shall generate a site start-up and functional checkout report, documenting all systems checked as well as any incomplete work remaining and operational deficiencies. CONTRACTOR shall provide three copies of the manufacturer's site start-up and functional checkout report to ENGINEER for review.

C. CONTRACTOR shall be responsible for all costs required to check operation of the system.

D. The completed fire alarm system shall be fully tested by the manufacturer in accordance with the Wisconsin Building Code, and all applicable local building codes in the presence of OWNER's representative and the local Fire Marshal. Upon completion of a successful test, a certification will be issued in writing to OWNER and CONTRACTOR.

3.11 TRAINING

A. Upon successful completion of checkout by ENGINEER, a manufacturer's representative shall provide a demonstration of the automated sequences of operation. After this demonstration and acceptance by OWNER, the manufacturer shall provide 4 hours of "hands-on" training for OWNER's operating personnel which shall cover the following topics:

1. Overall System Description and Theory of Operation.
2. Automatic Operation.
3. Manual Operation and Testing of System Devices.
4. Recommended System Check Lists and Log Sheets.
5. Recommended Preventative Maintenance.

B. Two 4-hour training session for two operators shall be provided. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, controls, protective devices, and other major components. Travel time and expenses to the jobsite shall be over and above the time required to perform the training and shall be included in the Bid.

3.12 WARRANTY

A. The manufacturer shall warrant that all equipment shall be free from defects in material and workmanship under normal and proper use and service for a period of 1 year after substantial completion.

3.13 FIRE ALARM WIRE AND CABLE COLOR CODE

A. Provide fire alarm circuit conductors with color-coded insulation or other permanent identification at each conductor termination and in each junction box. All fire alarm wiring must be in conduit.

END OF SECTION

SECTION 16930

INSTRUMENT AND COMMUNICATION WIRE AND CABLE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. Standards: Comply with standards specified in this section as listed in Division 1.

B. Qualifications of Installers: Use skilled workers who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

1.03 PRODUCT HANDLING

A. Instrument cable shall be furnished in lengths as necessary.

B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

PART 2–PRODUCTS

2.01 GENERAL

A. All materials of construction for cable and wire shall be compatible and noncontaminating.

B. Unless otherwise noted in these specifications, the requirements herein listed shall be strictly adhered to.

2.02 SHIELDED PAIR CABLING FOR ELECTRONIC INSTRUMENTS

A. Shielded pair cabling shall have stranded, tinned-copper conductors, No. 16 AWG, twisted with 2-inch lay.

B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.

C. Color coding shall be manufacturer's standard or as stated.

D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils thick, and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power-limited circuit cable.

E. If the cabling is not installed in steel conduits, a 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A No. 18 AWG, seven-strand, tinned-copper drain wire shall be furnished in continuous electrical contact with the shield.

F. Single-pair shielded cables shall be Belden 9316, or equal.

2.03 INDUSTRIAL ETHERNET AND CAT 5E CABLE

A. For communication with plant SCADA systems and equipment in motor control centers and areas with 480-volt power, provide 600 V-rated, 4-pair **shielded** twisted-pair industrial Ethernet cabling meeting EIA/TIA Category 5e requirements. Transmission characteristics of the cables shall meet full Category 5e performance criteria as defined by the referenced TIA/EIA documents and this specification. Jacket color shall be teal.

B. Industrial Ethernet cable shall be minimum 24 AWG with PVC jacket and foil and braided shield. The cable outer jacket shall be industrial-grade PVC with a nominal overall cable diameter of 0.32 inches. Cable shall be nonplenum rated, UL listed, 600 V UL AWM rated, and be as manufactured by Rockwell Automation Bulletin 1585-C8HB, Belden 7958A, or equal.

C. For communication with plant SCADA systems and equipment in all other areas, provide CAT5e cable. Transmission characteristics of Ethernet cables shall meet full Category 5e performance criteria as defined by the referenced TIA/EIA documents and this specification. The jacket color for Data cables shall be BLUE. The jacket color for "Voice" cables shall be WHITE. Provide Systimax Solutions 107IE Low Smoke PVC, or equal. For cables installed in underground conduits, provide direct burial rated cable, Belden 7937A, or equal.

D. Faceplates shall be stainless steel, Leviton 43080 series, or equal.

E. Cat 5e shielded connectors shall be Leviton 5S180-SH5, or equal.

PART 3–EXECUTION

3.01 INSTALLATION REQUIREMENTS AND SPECIAL CONSIDERATIONS

A. Shielded pair and Ethernet cabling specified in this section shall be installed in conduit, and may not be run in free-air or in nonmetallic tubing such as innerduct.

B. Although twisted conductors effectively reduce magnetic noise, where additional magnetic shield is necessary to minimize interference from stray magnetic fields armored cable shall be provided.

C. Since magnetic interference is produced by currents flowing through conductors and electrical equipment, any instrument wire run near electric motors, generators, transformers, induction heaters, circuit breakers, motor starters, power lines, or AC power and control cables may need additional magnetic shielding.

D. Armor may be necessary on instrument cables installed in nonmagnetic electrical ducts:
   1. Electronic instrument wiring, single pair. There shall be a steel wire armor of 24 gauge AISI 1006 soft annealed steel wire covering the inner jacket.
   2. The armor shall be covered by a flame-retardant and weather- and ultraviolet-resistant PVC, outer jacket 35 mil minimum thickness and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited cables.

3.02 GROUNDING

A. Shielded cabling shall be installed in accordance with manufacturer's instructions and to minimize electrical noise and interference to associated instruments. Refer to instrument manufacturer's instructions for additional requirements.

B. Ends of signal wires shall be sealed to prevent the migration of moisture into the cable and to prevent unintentional grounding of the shield at the open end. Seal signal wires using a minimum 1-inch piece of heat-shrink tubing installed over PVC jacket and individual wires, and heat-shrink to a watertight fit.

C. All shields must be grounded.

D. Shields shall be grounded at one point only. Shielded cabling shall be isolated and left open at the instrument.

E. Cable shield grounds shall be isolated from control system signal grounds, except at instrument system grounding electrodes.

END OF SECTION

SECTION 16940

CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

A. Allowances: System Supplier shall INCLUDE in the Bid the cost of the following items specified in this section. Refer to the individual sections listed below for a complete description of the work required.
   1. Item 2.13–Card Access System.
   2. Item 3.02I–Master Station SCADA modifications.

B. Related Sections and Divisions:
   1. Applicable provisions of Division 1 shall govern work in this section.
   2. Section 16941-Controls and Instrumentation Drawings.

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1.02 SYSTEM DESCRIPTION

A. The work includes furnishing, delivering, installing all items furnished, and placing in operation the Control System for Madison Booster Station 106.

B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all PLC cabinets and required interface hardware and internal wiring, hardware, system drawings, system software, and new MCC at the booster station. See paragraph 1.08 for other System Supplier requirements.

C. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in, or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.

D. CONTRACTOR shall be responsible for the placing of circuits and making of electrical and hydraulic connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to ensure proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise making of connections to power supplies, motor leads, communication circuits, and any other connections external to the new control equipment; adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in a manner fully satisfactory to ENGINEER. This will include on-site review of software/hardware controls from the central control point.

E. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by the System Supplier. All switches and control and indicating lights associated with the control panels shall be new and installed in the starter panels. All new and existing telemetry equipment and controls shall be installed in the new supervisory control panel.

1.03 QUALITY ASSURANCE

A. System Suppliers: Firms regularly engaged in the design and manufacture of SCADA systems of the size and complexity specified herein, and whose systems have been in satisfactory use in similar service for not less than 10 years.

B. Installer: A firm with at least 10 years of successful installation experience on projects with SCADA system design and installation work similar to that required for the project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, and connectors that have been listed and labeled by Underwriters Laboratories.

E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.

B. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

C. Provide product data on all equipment and devices specified herein, as well as wiring schematics for all systems.

D. Shop drawing submittals shall be assembled in two phases; in the first submittal, the following information shall be provided in booklet form:
1. Detailed catalog information, descriptive literature, and specifications of hardware. **All items being provided must be specifically noted on this literature.**
2. All field devices and instruments.
3. Project implementation plan, including information on project organization, project management, engineering, programming, configuration, training, start-up, and maintenance services. Plan shall include key personnel on project, point of contact, and communication protocol.
4. Overall network schematic showing all controllers and hardware addresses applicable to the system.
5. Wiring diagrams for all SCCs and MCCs.
6. PLC I/O Listing.

E. The second submittal shall include:
1. PLC programs and software.
2. Control narratives.
3. Graphic displays.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01300-Submittals.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

C. Submit Operation and Maintenance Manuals in accordance with Division 1. The following additional information shall apply:
1. Manuals shall contain, but not be limited to, the following:
   a. System Hardware.
   b. System Software.
2. Hardware section shall include:
   a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
   b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.

c. Listing of all hardware timers installed in MCCs and SCCs, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of start-up.

3. Software section shall include:
   a. Software manual shall describe system techniques, general philosophies, list, and description of all standard software. System techniques description shall include a detailed screen-by-screen description explaining where the various signals originate, how to change equipment setpoints and control modes, how alarms are acknowledged, and how to go from screen to screen. All menu selections and their functions shall also be described in detail.
   b. Program documentation (i.e., PLCs, OITs) shall include programs, documentation files, database and configuration as installed. Provide two copies of back-up disks of this information. Passwords for all programmable devices (i.e., PLCs, radios, OITs) shall be turned over to OWNER at the time of final completion.

1.06 DELIVERY, STORAGE, AND HOLDING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to SCC components, enclosure, and finish.

1.07 DESCRIPTION OF MADISON BOOSTER STATION NO. 106

A. The Madison Water Utility consists of multiple active wells and booster pumping facilities in various pressure zones. Booster Station 106 will be reconstructed and put back into service as specified in this Contract. There is a future chemical room that will be used to inject chlorine gas into the system at this site. This site will send booster station and reservoir information back to the existing City of Madison master site (Master Station).

B. System Supplier shall be responsible for the development of all required process control functions based on the algorithms described in this specification. Many systems encompass several algorithms for system components.

C. The individual station SCCs and the listing of control and monitoring functions are shown in the I/O Listing in Section 16990–SCADA System I/O Listing.

1.08 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

A. This specification, along with the Contract drawings, defines the requirements of a PLC-based process monitoring and control system. System Supplier shall construct a process monitoring and control system specifically for the demanding requirements of a real-time municipal water system.

B. It is the intent of this specification to define a fully-integrated open-type process monitoring and control system, factory-tested, delivered to the site, ready to function upon connection of power source and field instrument wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be

responsible for reviewing the wiring diagrams and control sequences for equipment provided under other divisions of these specifications and coordinating all interface requirements. CONTRACTOR shall submit to ENGINEER, in writing, any deficiencies noted during this review. Any changes required by CONTRACTOR because of failure to complete this review shall be the responsibility of CONTRACTOR, at no increase in cost to OWNER.

C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, sensors, and meters supplied with input and output signals, and contacts that are compatible with the systems as specified herein. CONTRACTOR shall also be responsible for complete coordination with manufacturers of other systems specified in other divisions of these specifications with which an interface is required. The Contract drawings and I/O Listing are symbolic representatives of the required work. It is not intended that the drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the drawings, specifications, and standard industry practices.

D. To ensure a complete and totally integrated system, a single manufacturer who has experience in furnishing similar networked PLC-based monitoring and control systems of the same complexity and size for municipal water distribution facilities shall provide specified equipment and services. The system proposed to meet this specification shall be of field-proven design, incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.

E. Design and specification of devices and completed system shall conform to applicable portions of the latest edition of the National Electrical Code (NEC).

F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled, but do not have UL approval as an assembled unit are not acceptable.

G. Training Program:
   1. Submit training plan including course syllabus, personnel who will be conducting the training, and schedule.
   2. Provide materials, instructors, and workbooks to complete the training.
   3. Training courses shall include:
      a. Operator training. Course length minimum 4 hours. Training shall utilize equipment specified herein following installation and field testing.
      b. Maintenance training. Course length minimum 4 hours.
   4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than the process itself.

H. System Supplier shall meet the following minimum requirements:
   1. System Supplier shall have a full-time staff of qualified programmers who are knowledgeable in the configuration of networked computer systems and the PLCs being provided.
   2. System Supplier shall have a minimum of one Microsoft-certified engineer.
   3. System Supplier shall have training capabilities and shall have conducted training courses in programming and maintenance.
   4. System Supplier shall have an adequate inventory of spare parts.

5. System Supplier shall have a full-time staff of qualified service technicians.
6. System Supplier shall be responsible for the programming and documentation of the system.
7. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
8. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.

I. All components are to be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid Supervisory System System Supplier shall be L.W. Allen-Altronex, (608) 222-8622. See General Conditions and Supplementary Conditions regarding substitutions to the Base Bid system suppliers.

1.09 SYSTEM START-UP AND SUPPORT SERVICES

A. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for test, ENGINEER will make one 2-day trip to check operation. If the equipment does not operate according to the specifications, there will be deducted from payments due CONTRACTOR the amount of $1,500 a day for ENGINEER's time plus travel and expenses, for all additional field and office time spent by ENGINEER checking equipment. OWNER will deduct the amount of these charges from payments made to CONTRACTOR and will make payment to ENGINEER.

B. Final acceptance and payment will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. CONTRACTOR shall include in Bid, field follow-up to ensure proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
1. Satisfactory operation of I/O control loops.
2. Satisfactory operation of software.
3. Satisfactory operation of control program.
4. Satisfactory operation of peripheral equipment.
5. The necessary debugging programs have been performed.
6. Data output is reliable.
7. Control loops are operational.
8. Checking and calibrating of systems have been completed.

C. CONTRACTOR, through System Supplier, shall provide the following support services:
1. Field Service Engineer: Field service engineer shall be responsible for programming of system PLCs in the factory and at the site. Field service engineer shall be present at the factory acceptance test and be present for start-up of all systems, and available throughout the entire construction process until final completion. Service technicians sent for system start-up will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
   a. Commissioning, installation, start-up, and testing of equipment.
   b. Revising or rewriting manuals to incorporate an installed and accepted system.
   c. On-site training.
   d. Software modifications.
2. In-factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:

a. Researching and answering questions related to the system operation, documentation, and system use and functions.
b. Program modifications.
c. Revising or rewriting manuals.

3. Post start-up support shall include follow-up services during the 1-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include 30 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. It shall be assumed that this 30 hours includes two trips to the site.

1.10 EQUIPMENT ENCLOSURES

A. New enclosures shall be front access only, minimum No. 12 gauge steel, and continuous-hinged doors, rotating lockable handle, 3-point latch on each supervisory equipment compartment door (not screws or bolts), with top and bottom bolts actuated by one rotating handle on large doors. Provide door stop kit for all panel doors, data pockets for wiring diagrams, and minimum 18-inch fluorescent light and switch. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, and OWNER-selected exterior color. All doors and panels shall be gasketed. All louvers shall be filtered with forced-air cooling as necessary by the supplier for conditions where installed. New enclosures shall be a minimum of 24 inches wide, 20 inches deep, and 90 inches high and shall be as manufactured by Hoffman, Lehman, or Saginaw. MCC structures are not acceptable. Where installed next to motor control centers, enclosure painting shall match that of the MCC.

B. Indication gauges shall be at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of gauge.

C. Plastic wiring troughs shall have removable covers. **Maximum fill for wiring troughs shall be 60%.** All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 1 1/2 inches between terminal strip and wiring trough.

D. Tubing and instruments containing water shall be in separate compartments located and constructed so that leakage or spray at 100 psi pressure cannot touch electrical conductors or devices. Leakage shall be conducted to the floor in duct or pipe.

E. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal strips shall be located either at the bottom or on the side of the enclosure, depending on where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. All wiring shall be labeled at each end with corresponding numbers. This numbering shall be shown on the shop and record drawings.

F. All door-mounted devices shall be furnished flush-mounted, and an exterior-engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided

for each compartment, device, and light. All components within the enclosures shall be identified with interior-mounted engraved labels. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.

G. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.

H. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals wired to terminal strips. Spares shall be provided for all voltage sources within the panel (e.g., 120 V, 24 V).

I. Enclosures that include motor controllers shall have a main disconnect for the enclosure.

1.11 COMMON REQUIREMENTS ALL EQUIPMENT

A. All indicating and recording devices shall be electric or electronic.

B. All motor control power shall be 120-volt with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.

C. Devices powered at 120 volts from supervisory control panels shall be fused. This shall include, but not be limited to, solenoid valves, flowmeters, and transducers.

D. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. 120-volt power shall be available at all control points. Lightning protection shall be completely solid-state and self-healing, and shall not require the use of fuses. Provide a single switch with an indicating light to deenergize the control power for each location. Each panel shall have a GFI, duplex, 20 ampere, 120-volt receptacle.

E. If enclosure and panel space is needed for future installation of devices and lights, the enclosure and panel shall be constructed for such installation. Supports shall be provided for future equipment, and panel openings shall be made and covered with neat cover plates matching the panel.

F. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided, even though the detailed enumeration at various control points may omit listing that equipment.

G. Where a certain accuracy of sensing and transmitting levels or flows and controlling operations are called for, means must be provided to read or determine that the levels or flows are within the limits or accuracy specified of the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of levels is necessary to set operating points, an indicating device of accuracy consistent with the operation of the system is required.

H. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.

1.12 GENERAL CONTROL ALGORITHMS

A. In general, the following is a definition of I/O at each MCC:
   1. Run from MCC or auxiliary starter contact (dry contact).
   2. Fail from MCC or starter auxiliary O.L. contact (dry contact).
   3. Command Run Maintained start or as required (dry contact).
   4. Hand-Auto from MCC or Controller Selector Switch (dry contact), feedback to SCADA.
   5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.

B. Programming algorithms described herein and in Part 3–Execution shall reside within the PLC associated with that equipment and not in the master PLC. Polling sequences shall be set-up to poll remote data based on the data type (e.g., alarms, historical) such that data transmission rates are not adversely affected.

C. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate the SCADA to the alarm state.

D. All analog and digital inputs shall be monitored and totalized in the PLC. This shall include, but not be limited to, flows (air, water, etc.), weights, pressures, and levels. The PLC shall calculate maximum, minimum, and running average for all analog inputs. Instantaneous values, totals, maximum, minimum, and average values shall be read by the HMI software and be reset on a daily basis as described below. Minimum, maximum, and average values shall be stored in the PLC for the current day and previous day.

E. PLCs shall calculate equipment runtimes and number of starts for all equipment where run signals are monitored. Runtimes and number of starts shall be read by the HMI software and be reset on a daily basis as described below.

F. Totalized flow values, chemical usage, and equipment runtimes as described above shall be stored in the PLC for a period of 5 days. This data shall be available for use by the HMI software for importing into a reporting software package for purposes of daily, weekly, and monthly reporting. The PLC shall indicate the specific date for each of the 5 previous days.

G. Daily flow totals, chemical usage, runtimes, number of starts, and number of cycles as described above shall be reset on a daily basis. This reset shall occur based on a time (hour and minute) setpoint stored in the PLC through the HMI software. The operator shall set the time when the daily reset will occur. Once this time setpoint matches the current time of the processor clock, the Master PLC shall send a reset signal to all remote PLCs to clear any totals that have accumulated locally.

H. In addition to the totalizers described above, the PLC shall also calculate cumulative totals for all runtimes, number of starts, flows, and chemical (weight) usage. Maximum, minimum, and running average for all analog inputs shall also be included as part of the cumulative total algorithm. Cumulative totals shall totalize until manually reset by the operator. There shall be a manual reset for each signal. The PLC shall display the date of the last cumulative totalizer reset for each signal.

I. System Supplier shall provide addressing for all hard-coded time delays and PLC settings that are not operator-adjustable. This shall include, but not be limited to, time delays for float switches, call-to-run fails, level alarms, pressure alarms, flow alarms, and data fail

alarms. Indication of time remaining for all timers (hard-coded and operator-adjustable) within PLCs shall be made available for indication at the SCADA system.

J. Float switches shall include time delays to prevent intermittent starting and stopping and/or alarming because of bouncing floats.

K. Solenoid valves that are not provided with position indication (e.g., opened, closed) shall include hard-coded time delays on the open and close signals to allow operation of the solenoid or valve.

L. System Supplier shall provide addressing for all PLC fault codes so that the error number and associated description can be displayed at the SCADA system.

M. All analog signals shall be scaled to engineering units in the PLC with implied decimal to allow storage in integer registers. System Supplier shall provide all analog ranges, PLC register values, and associated scaling factors to ENGINEER for use with the HMI software. This shall include upper and lower limits of PLC registers (i.e., -32768 to 32767 or 0 to 65535), as well as upper and lower limits for the associated device (i.e., 0 to 150 psi). Analog values specified to be displayed with decimal points shall be scaled by the HMI software.

N. For all pressure or level sensing devices, provide a Transducer Fail alarm at the SCADA system for each transducer. Transducer fail shall be defined as the signal from the transducer being out of range or not changing for an operator-adjustable time period (0 to 120 minutes).

O. Provide "Out of Service" indication for each piece of equipment when that equipment's MCC or SCADA H-O-A is not in the Auto position.

P. PLCs shall be set up so that the ranges of all analog input signals to the PLC I/O cards can be configured from the HMI software. Provide two operator-adjustable setpoints for each analog input, one corresponding to 4 mA and the other corresponding to 20 mA. These setpoints are applicable to devices attached to the master and remote PLCs. This feature is intended to be used for start-up and calibration purposes.

Q. All equipment controlled automatically from the SCADA system shall have "Call-to-Run" signals generated from their associated PLCs. These signals shall be displayed at the SCADA system through the HMI software. Each associated PLC shall also generate a "Call-to-Run Fail" if the equipment is called-to-run but does not start within a specific time period. Call-to-run signals may be generated by the master or remote PLC as determined by System Supplier. The "Call-to-Run" signal shall be generated within the PLC software and may not be combined with other fail signals such as hard-wired motor fails, and overtemperature.

R. All valves controlled automatically from the SCADA system shall have "Call-to-Open/Close" signals (as applicable) generated from their associated PLCs. These signals shall be displayed at the SCADA system through the HMI software. Each associated PLC shall also generate a "Call-to-Open/Close Fail" if the valve is called-to-open/close, but does not open/close within a specific time period. Call-to-open/close signals may be generated by the master or remote PLC as determined by System Supplier. The "Call-to-Open/Close Fail" signal shall be generated within the PLC software and may not be combined with other fail signals such as hard-wired motor fails, and overtemperature.

S. In cases where the automatic alternation of equipment is provided by the PLC, indication of the lead and lag pumps shall be provided and displayed at the SCADA system.

T. All controlled equipment as described herein shall have the capability of manual control from the HMI software through the manipulation of analog or digital variables. This shall be through the use of a "SCADA H-O-A" switch or by forcing a single I/O point as a manual start command. All analog and digital outputs shall be capable of being manually set from the HMI software.

U. Where a manual reset is required at the SCADA system (i.e., level lockout, pressure lockout), the HMI software shall be configured to set a discrete reset bit. Once the PLC receives the bit and the alarm condition has cleared, the PLC shall clear the alarm and place the associated equipment back in service.

V. The SCADA system shall allow the operator to change all setpoints and operating parameters within the PLCs as described herein. All control algorithms and alarms for equipment shall be programmed in the associated PLC and not in the master. There shall be no control algorithms or alarms in the computers. Control of each piece of equipment shall be accomplished as described herein and in Part 3–Execution of this section.

W. Battery status of each PLC shall be monitored by the SCADA system. In the event of a low battery condition, an alarm shall be generated at the SCADA system.

1.13 SPARE PARTS

A. System Supplier shall furnish spare parts for equipment specified herein as listed in Section 16951–Spare Parts.

PART 2–PRODUCTS

2.01 INDUSTRIAL CONTROL AND POWER RELAYS

A. Industrial control and power relays shall be installed in supervisory control centers, motor control centers, industrial control panels, and where required by System Supplier. Relays used to interface with PLC I/O shall be terminal style, interposing/isolation relays. Relays for motor control circuits, hard-wired control logic, and for loads less than 10 amps shall be general purpose, industrial, square base relays. Relays for lighting circuits and small motor loads shall be industrial, electrically held power relays.

B. Relays shall meet the following requirements:
   1. Interposing/isolation relays:
      a. Configuration: SPDT or DPDT as required by System Supplier.
      b. Mounting: DIN rail with screw terminal base socket.
      c. Voltage: 120 Vac, or as required by System Supplier.
      d. Contact rating: 8 A (DPDT), 16 A (SPDT).
      e. Operating life: 10 million cycles.
      f. Status: On-Off flag-type or LED indicator.
      g. UL listed.
      h. Manufacturer: Allen Bradley, 700-HK, or equal.

2. General purpose relays:
   a. Configuration: DPDT or 3PDT as required by System Supplier.
   b. Mounting: DIN rail with screw terminal base socket.
   c. Voltage: 120 Vac.
   d. Contact rating: 15 A, minimum; 3/4 hp.
   e. Operating life: 10 million cycles.
   f. Status: On-Off flag-type or LED indicator.
   g. UL listed.
   h. Manufacturer: Allen-Bradley, 700-HB, or equal.
3. Power relays:
   a. Configuration: Electrically held, 2-12 poles.
   b. Mounting: DIN rail, square base.
   c. Voltage: 120 Vac.
   d. Contact rating: 20 A continuous; 1 hp.
   e. Operating life: 10 million cycles.
   f. UL listed.
   g. NEMA rated.
   h. Manufacturer: Allen-Bradley, 700-PK, or equal.
4. Duplex Alternation Relay.
   a. Configuration: DPDT or DPDT cross-wired.
   b. Mounting: DIN rail with screw terminal base socket.
   c. Voltage: 120 Vac.
   d. Contact Rating: 10 A, minimum; 1/8 hp.
   e. Operating Life: 10 million mechanical operations and 100,000 electrical operations.
   f. Status: Output position indicating LEDs.
   g. Control: Three-position toggle switch permitting selection of normal duplexing action, locking in the A-B sequence, or locking in the B-A sequence. Alternation shall be able to be toggled every time a 120 Vac control signal is removed.
   h. Manufacturer: Diversified Electronics, ARA, or equal.

2.02 PLC TELEMETRY SYSTEMS AND PLC SOFTWARE

A. The booster station PLC shall communicate with the master station PLC via the City's Ethernet-based fiber-optic communications.

B. PLCs:
1. Each PLC shall consist of modular hardware-style PLCs that shall meet the requirements described below under paragraph G. PLC Systems.
2. Each PLC shall have a programmable address and shall accept incoming data that includes this address. In responding with data to the master, it shall include this address. In addition, every remote shall accept and process data that includes a single unique common address.
3. The PLCs shall be capable of stand-alone control to maintain programmed logic in the event of a master PLC failure.
4. The entire system shall be designed to accommodate all inputs and outputs in the Input/Output (I/O) list plus 25% spare for each type of input and output signal at each location or as indicated, whichever is greater. All spare and unused I/O shall be wired to terminal strips. This wiring shall include all auxiliary devices and components to complete the installation (e.g., interposing relays, wireways).
5. The system shall be programmed to implement the control sequences and to provide the monitoring according to this specification. It shall be the responsibility of System Supplier to include all the inputs and outputs required to meet all aspects of this

specification, regardless of whether they are specifically included in the I/O listing in this specification.

6. The PLC system I/O shall communicate at a rate sufficient to perform any command to operate control within 5 seconds and receive any status feedback signals within 5 seconds.
7. All PLCs shall be of expandable construction with all the cards necessary to process the signals specified, but with provisions for expansion.

C. It shall be the responsibility of System Supplier to ascertain that all field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:
   1. Power levels.
   2. Power sources.
   3. Logic schemes.
   4. Signal types and levels.
   5. Interface devices where required.
   6. All other aspects of field devices impacting on the design of the system.

D. PLC Systems:
   1. System Supplier shall provide all the equipment necessary for data gathering, monitoring, and control as required to meet this specification and in accordance with the drawings. The PLC system equipment shall include, but not necessarily be limited to, the following:
      a. Programmable Logic Controllers (PLC) consisting of CPUs with adequate memory and instructions, local I/O mounting racks, power supplies, I/O modules, communications modules and hardware, and all other components required to make the PLCs perform all the functions required in this specification. The PLCs shall be mounted in NEMA 12 enclosures as specified herein or as shown on the drawings; see Equipment Enclosures. The new PLC enclosures shall be completely assembled, prewired, and tested at System Supplier's factory.
      b. Telemetry system (where required) as described elsewhere in this specification.
      c. Fiber-optic data highway cable system terminated to interconnecting hardware such as station connectors at the various SCC system locations.
   2. PLC Programming and PLC Software: System Supplier shall provide all the PLC programming and PLC software required to meet this specification and shall be in accordance with the system configuration. The software shall include, but not necessarily be limited to, the following:
      a. PLC logic programs to be written by System Supplier for the PLC systems to accomplish the monitoring and control functions as specified elsewhere in this specification. The supplier shall document and annotate the programs, update them as required after start-up, and then turn the programs over to OWNER in the form of compact disks; two copies are required.
      b. All I/O addressing that is to be viewed or manipulated by the HMI Software shall be organized into contiguous blocks of integer registers to facilitate block data transfer between computers and PLCs. The I/O addressing shall be made available to OWNER during shop drawing review.
   3. Engineering:
      a. System Supplier shall provide all engineering necessary to accomplish and document the requirements of this specification and in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:

(1) PLC system layouts.
(2) Panel layouts.
(3) I/O configuration and wiring drawings.
(4) PLC programming.
(5) Fiber-optics communication layout.
(6) Network layout.

b. Submittals: In addition to submittals previously described provide:
(1) Shop drawing and product data.
(2) PLC logic programs.
(3) Recommended spare parts lists.

c. Installation: CONTRACTOR shall install all the system equipment including PLCs and local I/O enclosures, remote I/O enclosures, and interconnecting cabling as required. This work shall include all interconnection wiring from new and existing equipment as required for the completion of the system.

4. The PLC shall be a microprocessor-based controller.
5. The PLC processor shall meet the following minimum general specifications:
a. Voltage: 100 to 130 Vac.
b. Frequency: 47 to 63 Hz.
c. Temperature: 0 to 60°C.
d. Humidity: 5 to 95% noncondensing.
e. RFI: MIL-STD-461B.
f. EMI: IEEE 472-1974.
6. The PLC processor shall have the following minimum features:
a. 2 MB of battery-backed static RAM.
b. 64 MB nonvolatile memory (secure digital).
c. Utilize 32-Bit architecture.
d. Solve 1K words of logic in 0.9 milliseconds.
e. I/O scan time of 0.225 milliseconds per I/O rack.
f. Real-time clock.
g. Selectable timed interrupts.
h. Local I/O capability of 30 modules.
i. Memory protection.
j. RS-232 and two Ethernet communications ports for fiber-optic data highway (and radio) communications.
k. Remote I/O capability.
l. Status indicators.
7. The PLC must be capable of performing the necessary logic to control the system. PLC capabilities shall include, but not be limited to, the following:
a. Discrete I/O (120 Vac or isolated as required).
b. Isolated analog input (4-20 mA).
c. Isolated analog output (4-20 mA).
d. Timers.
e. Latch/unlatch relays.
f. Counters.
g. Comparators (setpoints for analog level).
h. Relay ladder logic.
8. The PLC must be capable of self-diagnosing the following error conditions resulting in orderly shutdown of the unit and annunciation of an error condition.
a. Memory parity error.
b. Loss of signal communication between master and I/O.
c. Loss of logic power.
d. Halt or interrupt of memory scan.

e. Detection of incomplete relay ladder rungs in memory.

9. The PLCs shall be of the modular hardware style as manufactured by Allen Bradley CompactLogix, or equal, with all accessories required to perform the operations described herein and to communicate with the fiber-optic data highway system.
10. Environmental ratings for all components of the PLC system shall meet or exceed the following requirements:
    a. Humidity rating of 0% to 95% relative humidity.
    b. Ambient temperature rating 0° to 55°C.
11. The vendor shall be able to attest that the PLC system has been designed and tested to operate in an industrial environment with all its associated electrical noise.
12. All components comprising the PLC system shall be manufactured by a company regularly engaged in the manufacture of programmable controllers.
13. The power supply shall be protected against short circuits.
14. The power supply shall contain its own overcurrent and overvoltage protection.
15. In the event of power loss, register or ladder information shall be retentive.
16. To allow monitoring of a malfunctioning machine or process, it shall be possible to connect or disconnect programming equipment at all times, even when the system is running.
17. Each PLC and remote I/O enclosure shall include, but not be limited to, the following equipment:
    a. Main PLC processor and remote I/O driver or remote I/O receiver.
    b. Main power supply.
    c. I/O modules and housing.
    d. Computer-grade transient and spike suppressor.
    e. Rail mounted terminal blocks for field wiring terminations.
    f. Plastic wiring ducts.
    g. General purpose duplex GFCI receptacle.
    h. 15 A, 120/240 Vac, branch circuit breakers to feed to the main PLC controller and the I/O controlled field devices.
    i. Other accessories required to provide a complete and working PLC system.
    j. True online UPS backup for the SCC.
    k. Fiber-optic patch panel.
    l. Network switch.
    m. Slot fillers for any unused I/O module slots.
18. The main PLC processor and remote I/O receivers shall receive power from their individual power supplies, which shall be fed from dedicated 15 ampere circuit breakers through transient and spike suppressors.

E. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for 3 years from start-up.

F. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.
    1. All wiring within the enclosure shall be through the plastic wiring ducts. All wiring not in ducts shall be in plastic spiral bindings. All I/O devices shall be wired to rail mounted terminal blocks.
    2. All field wiring shall terminate at the rail mounted terminal blocks that shall be mounted either at the bottom or on the side of the enclosure back panel depending on where the I/O conduits penetrate the enclosure.
    3. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired.

4. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer.

G. The color code for panel and field wiring shall be as follows:
   1. Discrete 120 Vac Input:
      a. Hot Wire: Red.
      b. Neutral Wire: White.
      c. Switched Wire: Brown.
   2. Discrete 120 Vac Output:
      a. Hot Wire: Red.
      b. Switched Wire: Dark Blue.
   3. 120 Vac Panel Power:
      a. Hot Wire: Red.
      b. Neutral Wire: White.
      c. Ground Wire: Green.

H. 24 Vdc power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.

I. Current-to-current isolators shall be provided and installed in remote-mounted enclosures for isolating all existing analog input signals. NEMA rating of enclosures shall be as required for the area where installed.

J. Manufacturer of Accessories:
   1. The plastic wiring duct shall be Electrovert "Electro-Duct," Panduit, or equal.
   2. Terminal blocks shall be Phoenix Contact UK 5 N, or equal.
   3. Wire markers shall meet the requirements of Section 16195-Electrical Identification.
   4. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be of the rail mounted-type such as Square D, Class 9080, Type GCB-150, or equal.
   5. Power supplies shall be Sola, rail mount, SPD or SDN Series, or equal.
   6. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.

K. System Supplier shall provide for the design and layout of the telemetry system, communication between the booster station and the Master Station.

L. System Supplier shall provide the necessary communication modules within the systems to allow the system to communicate with radio in the future.

M. System Supplier shall provide for the design and layout of the fiber-optic communication system between the SCC and the existing patch panel west of the reservoir. Spare runs of fiber-optic cable shall have connectors provided and be run to each terminating location. The fiber-optic network shall be set-up in a self-healing ring-type configuration. Daisy chaining of the SCC's communication system is not acceptable.

N. System Supplier shall provide the necessary communication modules within the systems to allow the system to communicate with the fiber-optic cabling.

O. System Supplier shall provide the necessary fiber-optic cable, fiber-optic termination units, connector kits, and terminator sets, as specified herein, to provide complete and working communication. Provide a fiber-optic patch panel for each PLC. The installation of the fiber-optic cable shall be by CONTRACTOR, with supervision by System Supplier.

P. Each SCC shall have a true on-line UPS backup that will allow for continuous communication with the master for up to 30 minutes following a power failure. Power to each SCC shall be through the UPS and shall be plug connected. UPS power shall be provided, at a minimum, to the following components: PLC and I/O racks, power supplies for PLCs, and I/O, indicating lights and devices associated with power fail and communication alarms, and power supplies for loop-powered instruments. Each UPS shall be provided with a relay card that provides a dry contact output to the PLC in the event that the UPS batteries need replacement. UPS shall be APC with relay I/O module, Liebert GXT3 with relay card, or Powerware 9000 series. Provide a stand or shelf within each SCC panel for the UPS such that the UPS does not sit on the bottom of the enclosure.

2.03 FLOAT SWITCHES

A. Float switches when specified herein, shown on the drawings, or necessary to complete an operating system shall be as follows:
   1. The float switches shall be mercury free and consist of a 316 stainless steel housing 5 1/2-inch diameter, stainless steel mounting clamp, a flexible two-conductor cable with a CPE jacket, and a potted SPST magnetic reed switch. Provide switch configuration (NO or NC) as required. The electrical load for the switch contacts shall be 100 VA at up to 250 volts. Float switches shall include a two-conductor cable 16 AWG with fine strands made for heavy flexing service and underwater use. Cable length shall be 50 feet minimum for a continuous run to the terminating control panel. A green grounding wire shall connect internally to the float housing. Floats shall be Siemens Model 9G-EF, or equal.
   2. Weight and buoyancy shall be such that contaminants will not result in the float switch changing operating level more than 1 inch.
   3. Operating temperature range shall be -31° to 194°F.
   4. Provide a level simulation test switch (momentary-type) in the control panel for each float.

B. Floats shall be mounted on a stainless steel cable with PVC covered anchor per manufacturer's instructions. All mounting hardware shall be stainless steel and provided with floats.

C. Provide stainless steel kellum grips for each float cable.

D. Station/building flooding alarms where called for shall be Siemens 101G, float switches, or equal.

2.04 LIMIT SWITCHES

A. Limit switches (door switches) where called for on the drawings shall be General Electric 2500 Series, or equal.

2.05 MAGNETIC FLOW METERS

A. Flow meter in 8-inch and 16-inch lines shall be Toshiba Electromagnetic Flowmeters Model LF 622 converters with LF 654 detectors, no equals allowed.

B. Flow meters shall be:

	Converter Model No.	Detector Model No.
8-inch meter	LF 622 FAC 211E	LF 654 LM1BNCAAF
16-inch meter	LF 622 FAC 211E	LF 434 QBCBECAAB

C. Meters detector shall be teflon lined with 316 stainless steel grounding rings, and Hastelloy C electrodes.

D. Meters detector shall be isophthalic acid resin coated.

E. Meter converters shall be provided a 100 VAC-240 VAC, 50 Hz/60 Hz power supply.

F. Converters and detector shall be separate units with remote-mounted converters. Provide accessories for wall mounting converters.

2.06 PRESSURE TRANSDUCERS

A. Pressure transducers shall sense gauge or differential pressure and provide a 4-20 maDC signal proportional to the sensed pressure. The control system will provide 24 Vdc loop power. Increasing pressure shall result in increasing signal.

B. Transducers shall be suitable for use in ambient conditions of 0° to 180°F and 0% to 100% relative humidity.

C. Accuracy (including linearity, hysteresis, and repeatability) shall be a minimum of ±0.10% of span. Long-term drift shall be less than ±0.1% of the upper range limit over a 12-month period. The transducer output signal shall not change more than 0.0005% of span for a 1 V change in the loop voltage. Ambient temperature affect shall be less than ±0.6 psi for a 10 to 300 psi transducer that experiences a 100°F change in ambient temperature within the normal operating range. Mounting position shall not affect transmitter performance. RFI effect shall be less than 0.1% of span for radio frequencies in the range of 27 to 1,000 MHz and field intensity of 30 V/m.

D. Process connection shall be 316L stainless steel fitting size and type as required by CONTRACTOR. Sensor material shall be 316L stainless steel, with silicone fill fluid. Sensor shall be suitable for use with process liquid/gas temperature from -50° to 250°F.

E. Calibrated range shall be determined by the CONTRACTOR based on process conditions. Calibrated range and process conditions used to determine range and span limits shall be included in submittal.

F. Pressure transducer housing shall be NEMA 4X, epoxy-coated aluminum with a minimum of one 1/2-inch NPT conduit connection. Housing shall provide separation between electronics and field connections.

G. Digital indicator with transducer configuration pushbuttons shall be provided in the transducer housing. Transducer configuration shall be performed using pushbuttons on the transducer. A Hart communicator or other electronic device **shall not** be required to configure the transducer.

H. Transducer shall be direct-connected to process unless specified otherwise on the drawings. Provide stainless steel bracket and mounting bolts for surface mounting of transducer if wall mounting is specified. Provide stainless steel two-valve manifold for pressure transducers and stainless steel three-valve manifold with test ports for differential pressure transducers.

I. Provide stainless steel information tag that indicates instrument number, service, and calibration range.

J. Pressure transducers shall be Foxboro Model IGP20, ABB, or equal.

2.07 THERMOSTATS

A. Thermostats associated with the SCADA system as specified in Section 16990-SCADA System I/O Listing shall be provided by System Supplier as specified in Section 16141-Wiring Devices. Thermostats not specified in Section 16990-SCADA System I/O Listing shall be provided as part of Section 16141-Wiring Devices.

2.08 TVSS DEVICES FOR CONTROL PANELS AND INSTRUMENTATION EQUIPMENT

A. The incoming power supply of each supervisory control center shall be protected with a transient voltage surge suppression (TVSS) device. TVSS unit shall be as manufactured by Citel Model DS4xS, or equal.

B. Each analog signal entering or leaving a supervisory control panel and leaving a building shall be provided with a DIN rail-mounted surge protection device as manufactured by Citel, Model DLA-2403, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel Model TSP-10, or equal, on the output and Citel Model DS4xS, or equal, on the power supply.

2.09 MOTION DETECTORS

A. The detector shall use passive infrared detection for detecting room occupancy. The unit shall fit on/in a standard box and shall require two wires and a grounded box for proper operation. Detector shall have gasketed, dustproof, water-resistant, die-cast aluminum enclosure.

B. Rated detector capacity shall be 10 mA at 12 Vdc.

C. Detector operating temperature shall be -40°F to 120°F and 10% to 90% humidity.

D. Sensitivity shall be fully adjustable and shall include an on-delay timer with adjustable range of 2 to 5 seconds. Sensor shall also include a manual override for positive off and positive on with test LED to indicate motion.

E. Detector coverage shall be 90° by 45 feet radius when wall-mounted. The sensor shall be equipped with special provisions, such as masking, to block out problem areas.

F. Power to detector shall be from the associated SCC panel. Provide power supplies in the panel as required

G. Wall-mount detectors shall be as manufactured by GE Security, Model 6187CTX, or equal.

H. Ceiling-mount detectors shall be as manufactured by GE Security, Model AP669, or equal.

2.10 INDUSTRIAL ETHERNET SWITCHES

A. Managed Ethernet switches shall be provided for networks shown on the drawings that include any of the following: PLCs, VFDs, operator interface panels, security cameras and/or equipment, and any other SCADA system Ethernet-based hardware. Managed switches shall be as manufactured by Hirschmann, RS20 series, or Siemens SCALANCE X-300 series and include fiber and copper ports to accommodate wiring shown on the drawings. Each switch shall include the following:

1. Selectable Ethernet star or ring topology with redundancy (ring configuration) and automatic detection of a failed fiber/ring. The switch shall automatically switch to the backup ring upon failure of the primary ring.
2. DIN rail mounting.
3. Store and forward switching.
4. Redundant power inputs.
5. Compliance with the following IEEE standards: 802.1D, 802.1p QoS, 802.3, 802.3u, 802.3x, 802.1w RSTP, and 802.1Q VLAN.
6. SNMP with Web Browsing for switch configuration and monitoring.
7. Dry contact output for indication that the primary fiber loop or switch has failed.
8. 25% spare copper ports available for future connection.
9. Provide Power-over-Ethernet (PoE) ports for cameras as shown on the drawings and 25% spare PoE ports. Provide manufacturers PoE power supply.

2.11 SUBMERSIBLE LEVEL TRANSMITTERS US FILTER

A. The liquid level of the influent wet well shall be sensed by a submersible level transducer. The transducer shall be a Bulletin A1000, Model 157GSCI, as manufactured by Siemens/US Filter, or equal. The transducer shall be of the head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with manufacturer's instructions. The bottom diaphragm face of the sensor shall be installed 6 inches above the reservoir access hatch opening. The sensor shall be mounted using a 316 stainless steel cable and weight system; location shall be determined in the field.

B. The transducer shall sense water level (pressure) variations and transform these variations directly into a standard process signal of 1 to 5 volts DC or 4-20 mA over the desired level range (span). The transducer shall be completely solid state, with no mechanical linkages or moving parts. Supply voltage shall be as required by CONTRACTOR.

C. The transducer shall incorporate a variable-capacitance transducer element to convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against a ceramic diaphragm that flexes minutely so as to vary its proximity to a ceramic substrate to vary the capacitance of an electrical field created between the two surfaces. A stable, hybrid, operational amplifier assembly shall be incorporated in the transducer to excite and demodulate the sensing mechanism. The transducer shall incorporate laser-trimmed, temperature compensation and high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory-calibrated range.

D. The transducer shall include easily accessible offset and span adjustments. Span shall be adjustable from 100% down to 15% of the sensor range. Fine and coarse adjustments for both span and offset shall be provided using 25-turn potentiometers. Offset and span adjustments shall be noninteractive for ease of calibration. Operating pressure range of the transducer shall be approximately 0 to 15 psig.

2.12 CARD ACCESS SYSTEM

A. Card access control panel, card readers, wiring, power supplies, programming, and setup shall be provided by Innovative Systems, 9880 South Ridgeway Drive, Oak Creek, Wisconsin 53154, 1-800-750-7350. CONTRACTOR shall coordinate requirements with Innovative Systems.

B. System supplier shall include an allowance of $10,000 in the Lump Sum base bid to be adjusted at final payment in accordance with the actual charges for all equipment required for a complete and operating card access system.

2.13 VIDEO CAMERAS

A. Coordinate camera licensing and installation of video camera network with OWNER and City of Madison IT Department.

B. Video cameras for indoor installation shall be color, Power-over-Ethernet, 1 megapixel/HDTV 720p with tamper-resistant casing, video motion detection, and digital pan/tilt/zoom. Provide ceiling mounting accessories and hardware as required. Video cameras shall be Axis, Model M3204, no equal to match OWNER's existing equipment.

C. Video cameras for outdoor installation shall be color, power over Ethernet, 1 megapixel, with low-light sensitivity, digital pan/tilt/zoom, video motion detection, and weatherproof, vandal-resistant construction. Provide mounting accessories and hardware as required. Video cameras shall be Axis, Model P3364-VE, no equal to match OWNER's existing equipment.

2.14 CHLORINE ANALYZER

A. Provide two chlorine analyzers at the Booster Station as shown on the drawings.

B. The chlorine analyzer shall employ a DPD colorimetric method of measurement using DPD indicator and a buffer solution.

C. The analyzer shall be capable of measuring free or total residual chlorine by changing the indicator and buffer solutions.

D. A measurement shall be taken every 2.5 minutes and results displayed by a three-digit LCD readout in the range of 0 to 5 mg/L.

E. The analyzer shall be designed for 30 days unattended operation and use only 473 mL of each reagent per month. An additional month's supply of free chlorine reagents shall be provided.

F. Provide a maintenance kit with preassembled tubing. Provide pressure reducing valve as required to meet manufacturer's maximum pressure requirements.

G. The analyzer shall operate with an LED light source with a peak wavelength of 510 mm.

H. The instrument shall measure a sample blank before each sample measurement to provide automatic zero reference to compensate for sample color and turbidity and changes in light intensity resulting from voltage fluctuations or light source aging.

I. The instrument shall provide a minimum detection limit of 0.035 mg/L or better, precision better than ±5% or 0.005 mg/L as Cl_2, and accuracy better than ±5% or 0.035 mg/L as Cl_2.

J. The analyzer shall be microprocessor controlled and provide a 4-20 mA output as well as two alarms.

K. Each alarm shall be user-selectable for sample concentration alarms (high or low), analyzer system warnings, or analyzer system shutdown alarms.

L. The sample concentration alarms shall be fully adjustable through the entire range.

M. The system warning shall activate for minor variations in analyzer performance.

N. A system alarm shall activate for major variations in analyzer performance and it shall shut down the analyzer until corrective action is taken.

O. The microprocessor shall provide self-diagnostic functions accessible through an alphanumeric, menu-driven keyboard.

P. Two SPDT normally open/normally closed dry contact relays rated at 5A resistive load at 230 VAC shall be provided.

Q. Recorder span minimum and maximum values shall be operator programmable at the menu-driven keypad over the entire operating range.

R. The chlorine analyzer shall be housed in a NEMA 4X rated, ABS plastic enclosure designed for wall mounting.

S. The enclosure shall have two clear polycarbonate windows for viewing the measurement readout and reagent levels.

T. Power requirements shall be 110-115/230 VAC, 50/60 Hz, switch selectable, 95 VA maximum. Provide power cord and plug with unit.

U. The instrument shall be the Model CL17 Chlorine Analyzer, manufactured by the Hach Company.

PART 3-EXECUTION

3.01 BOOSTER STATION MCC (MCC-106)

A. Booster Pumps (BP-106-01 and BP-106-02)
   1. With the H-O-A selector switch in the "Hand" position, the motor shall start and run at the speed set on the drive HIM, bypassing all controls unless noted otherwise. Hand position shall be hard-wired and not through the PLC.
   2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
   3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA and hard-wired backup floats system as described under SCC-106.
   4. Motor has internal thermal overloads that shall shut down the motor in the event of over-temperature (Hand and Auto modes). Manual reset shall be required to restart motor. Internal thermal overloads shall be wired so that momentary power interruptions do not shut down motor.
   5. There is a limit switch (ZS-106-05/ZS-106-06) located on the check valve that shall shut down the booster pump if the limit switch is not activated after a time delay (0-60 seconds) once the pump is called to run. Provide an interface relay to monitor the flow failure alarm indicated at the SCC. These controls shall be hardwired and not through the PLC. Manual reset shall be required to restart motor.
   6. Whenever a booster pump is in operation, the solenoid valve for the high zone chlorine analyzer (SV-106-01) and the power supply to the high zone chlorine analyzer shall be energized. If both booster pumps are off, the analyzer and solenoid valve shall be de-energized. This control shall be hard-wired and not through the PLC. Solenoid valve shall be powered from control power transformer and shall be fused. Provide interface relays as required. Provide 20 amp, single pole contactor to control power to chlorine analyzer half-hot receptacle.

3.02 SUPERVISORY CONTROL CENTER (SCC-106)

A. This control panel shall be a minimum of 24 inches wide by 20 inches deep by 90 inches high and be located in the Pump Room of the Booster Station Building where shown on the drawings. This panel shall be used as a termination point for all transmitting and receiving equipment associated with MCC-106 and the Booster Station Building. All control algorithms and alarms described herein shall be programmed into this PLC. Refer to the I/O listing for all required I/O that shall interface with this SCC. A minimum of 25% spares shall be provided for each type of input and output used.

B. In the event of a power failure at Booster Station 106, when power is restored, the PLC shall automatically stagger the restart of any controlled equipment that is being called to run by the PLC. The stagger time shall be HMI adjustable from 0 to 300 seconds.

C. Control panel shall have an exterior panel-mounted receptacle and programming port for the Ethernet network, mounted on the front of the panel. Receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door.

D. Control descriptions described herein are specific in nature to equipment associated with the SCC. CONTRACTOR shall refer to Section 1.12–General Control Algorithms for additional programming requirements.

E. Provide a power fail relay in SCC that shall be used for control power fail alarm as well as indication that operation is from the UPS. Provide a white, 30mm, push-to-test indicating

light on the front of the enclosure to indicate that power is being supplied by the UPS. Control power fail wiring shall be hard-wired and not through the PLC.

F. Provide motion sensors and door limit switches, as specified herein, in the Pump Room and future Chemical Room for intrusion alarm indication at this SCC and the Master Station. The motion sensors shall be located such that the area covered includes all doors and windows within the space. The Card Access Control System shall work in conjunction with the motion sensors and door switches such that a building entry alarm shall be generated at this SCC and the Master Station if a motion sensor or door switch is activated and a valid card access has not been received from the Card Access Control System. If a valid card access is received at this PLC within a time delay period, the motion sensors and door switches shall be deactivated for an operator-adjustable time period. The operator shall be able to disable/enable the building entry alarm system from this SCC or from a command from the Master Station. Provide a lighted, unlabeled pushbutton on the front of this SCC for enabling and disabling the building entry alarm system. A time-of-day timeclock shall also be provided in this PLC that will allow the operators to set activation and deactivation times for the entry alarm system based on the time of day. There shall be separate activation and deactivation times for weekdays and weekends.

G. Provide a Dell Optiplex 160, or equal computer inside the SCC enclosure. Computer shall be installed on stand. Provide SCADA software to match existing SCADA software at Master Station. Provide a Hope, 17-inch touchscreen monitor, model HIS-ML17-STAE, or equal installed on the front door of the enclosure. The touchscreen shall allow the operator to enter all control and alarm setpoints and shall be setup such that it prompts the operator for the setpoint to be entered. The touchscreen shall provide the following indication and operation functions for the system:

1. Indication of all analog signals.
2. Hand-Off-Auto (HOA) control for each piece of equipment controlled from this PLC.
3. Adjustment for all system setpoints.
4. Indication of Master Station control mode.
5. Running, failed, and required (where applicable) for each piece of equipment.
6. Status of all equipment.
7. Indication of all alarm conditions.

H. The above indications and control functions shall be programmed into the operator interface panel in graphic form. The screens shall be as follows:

1. The default screen shall be an overview of the system and shall show all analog values as well as run and fail indication of monitored equipment.
2. There shall be control setpoint screens that allow the operator to enter all system setpoints and select control modes for each piece of equipment. Associated analog values shall be indicated on these screens.
3. There shall be an alarm summary screen that shall indicate the last 10 alarms and indicate whether the alarm is active, unacknowledged, or returned to normal. The operator shall be able to acknowledge alarms from this screen. The current alarm shall blink until acknowledged. The alarms shall be in chronological order. Alarms shall not clear until manually reset individually.
4. The above screens are the minimum screens required. CONTRACTOR shall include an additional five screens in the Bid similar in size and complexity to those described above.

I. System Supplier shall include an allowance of $5,000 for PLC and SCADA software modifications at the Master Station.

J. The Booster Station 106 control system consists of two variable speed pumps (BP-106-01 and BP-106-02), two level transducers (LT-106-01 and LT-106-02) and station forward flow meter (FIT-106-02). Provide a three position selector switch (Remote-Local-Off/Reset) on the front of this SCC. Indication of control mode shall be monitored at the SCADA system. The selector switch shall allow the operator to manually select which control sequence is used to the control the booster pumps as follows:

1. With the R-L-O selector switch in the "Remote" position, the operator shall be able to select an "On" mode or "Off" mode for the facility from the Master Station. In the Master Station "Off" mode, the booster pumps shall be disabled. In the Master Station "On" mode the booster pumps shall be controlled as follows:
   a. The operator shall be able to select an "Auto" mode, "Off" mode or "Operator Control" mode, for each booster pump from the Master Station. Control for each of these modes shall be as follows:
      (1) In the Master Station "Auto" mode, the booster pumps shall be controlled as described below under SCC "Local" mode. There shall be a selection at the Master Station to allow the operators to switch the lead booster pump. When this input is seen at this PLC, the lead booster pump shall be shut down and the lag booster pump rotated to the lead position.
      (2) In the Master Station "Off" mode, the booster pumps shall be shut down.
      (3) In the Master Station "Operator Control" mode, the booster pumps shall start and run at the speed set on the drive HIM until switched to the "Off" or "Auto" mode. The operator shall be able to run booster pumps individually or simultaneously in this mode.
2. With the R-L-O selector switch in the "Local" position, there shall be three operator selectable modes of control: Auto Pressure Loop Control, Auto Flow Loop Control, and Auto Fire Control.
   a. In the Auto Pressure Loop Control mode, the two pumps shall be controlled as follows:
      (1) The operator shall be able to select either a fixed pump sequence or auto alternation of the pumps. In the fixed mode, the operator shall be able to assign the lead pump with the unselected pump automatically becoming the lag pump. In the auto alternation mode, the pumps shall alternate after each run cycle of the lead pump. In the event the lead pump fails or is out of service (H-O-A switch at MCC or SCADA not in Auto), the PLC shall automatically switch to the next pump in the sequence (fixed and auto alternation modes).
      (2) This PLC shall monitor the discharge pressure of the booster pumps (PIT-106-1). There shall be an operator-adjustable discharge pressure setpoint (0 to 125 psi). The PLC shall vary the pump speed in order to maintain the pressure setpoint. If the lead pump drops below an operator-adjustable low speed setpoint for an operator-adjustable time period (0 to 5 minutes), the PLC shall increase the speed to maintain the low speed setpoint and generate a low speed alarm at the SCADA system. If the pump operates at low speed for an operator- adjustable time period (0 to 15 minutes), the pump shall shut down and generate a low speed pump shut down alarm. A separate pump restart pressure setpoint shall be provided (0 to 125 psi). If discharge pressure drops below the pump restart pressure setpoint for an operator-adjustable time period (0 to 15 minutes), the pump shall restart and be controlled as described in this section.
      (3) If the lead pump is at full speed for an operator-adjustable time period (0 to 5 minutes), the lag pump shall be started. Lag pump shall start and ramp up

to an operator-adjustable speed setpoint (0 to 100%) prior to the lead pump speed decreasing. Once the lag pump speed setpoint is reached, the lead pump shall decrease in speed. Lead and lag pumps shall then operate at the same speed. The PLC shall vary the speed of the lead and lag pumps in order to maintain the pressure setpoint.

(4) In the event the speed of the lag pump drops below an operator-adjustable minimum speed (0 to 100%) for an operator-adjustable time period (0 to 5 minutes), lag pump shall be shut down.

(5) This PLC shall monitor the reservoir level (LT-106-01 and LT-106-02). There shall be an operator-adjustable low reservoir level setpoint (0 to 30 feet). If either reservoir level drops below the operator-adjustable setpoint, the SCADA system shall generate a low reservoir level alarm and the booster pumps shall be shutdown. The booster pumps shall remain disabled until either reservoir level rises above an operator-adjustable pump restore level setpoint (0 to 30 feet) for an operator-adjustable time delay (0 to 5 minutes) at which time normal operation as described in this section shall resume.

b. In the Auto Flow Loop Control mode, the two pumps shall be controlled as follows:

(1) The operator shall be able to select either a fixed pump sequence or auto alternation of the pumps. In the fixed mode, the operator shall be able to assign the lead pump with the unselected pump automatically becoming the lag pump. In the auto alternation mode, the pumps shall alternate after each run cycle of the lead pump. In the event the lead pump fails or is out of service (H-O-A switch at MCC or SCADA not in Auto), the PLC shall automatically switch to the next pump in the sequence (fixed and auto alternation modes).

(2) This PLC shall monitor the station discharge flow of the booster pumps (FIT-106-02). There shall be an operator-adjustable discharge flow setpoint (0 to 5,000 gallons) that shall be maintained by the booster pumps. This PLC shall vary the lead pump speed in order to maintain the discharge flow setpoint. If the lead pump drops below an operator-adjustable low speed setpoint for an operator-adjustable time period (0 to 5 minutes), the PLC shall increase the speed to maintain the low speed setpoint. If the lead pump operates at low speed for an operator-adjustable time period (0 to 15 minutes), the pump shall be shutdown and a low speed pump shutdown alarm shall be indicated at the SCADA system. A separate pump restart pressure setpoint shall be provided (0 to 125 psi). If discharge pressure (PIT-106-01) drops below the pump restart pressure setpoint for an operator-adjustable time period (0 to 15 minutes), the pump shall restart and be controlled as described in this section.

(3) If the lead pump is at full speed for an operator-adjustable time period (0 to 5 minutes), the lag pump shall be started. The lag pump shall start and ramp up to an operator-adjustable speed setpoint (0 to 100%) prior to the lead pump speed decreasing. Once the lag pump speed setpoint is reached, the lead pump shall decrease in speed. Lead and lag pumps shall then operate at the same speed. The PLC shall vary the speed of the lead and lag pumps in order to maintain the station discharge flow setpoint.

(4) In the event the speed of the lag pump drops below an operator-adjustable minimum speed (0 to 100%) for an operator-adjustable time period (0 to 5 minutes), the lag pump shall be shut down.

(5) This PLC shall monitor the reservoir level (LT-106-01 and LT-106-02). There shall be an operator-adjustable low reservoir level setpoint (0 to 30 feet). If either reservoir level drops below the operator-adjustable setpoint, the

SCADA system shall generate a low reservoir level alarm and the booster pumps shall be shut down. The booster pumps shall remain disabled until either reservoir level rises above an operator-adjustable pump restore level setpoint (0 to 30 feet) at which time normal operation as described in this section shall resume.

c. In the Auto Fire Control mode, the two pumps shall be controlled as follows:
   (1) The operator shall be able to select either a fixed pump sequence or auto alternation of the pumps. In the fixed mode, the operator shall be able to assign the lead pump with the unselected pump automatically becoming the lag pump. In the auto alternation mode, the pumps shall alternate after each run cycle of the lead pump. In the event the lead pump fails or is out of service (H-O-A switch at MCC or SCADA not in Auto), the PLC shall automatically switch to the next pump in the sequence (fixed and auto alternation modes).
   (2) This PLC shall monitor the station discharge pressure of the booster pumps (PIT-106-01). There shall be an operator-adjustable fire pressure setpoint (0 to 125 psi). Based on this pressure setpoint, the PLC shall vary the lead pump speed in order to maintain the fire pressure setpoint. If the lead pump speed falls below an operator-adjustable low speed setpoint for an operator-adjustable time period (0 to 5 minutes), the PLC shall increase the speed to maintain the low speed setpoint.
   (3) If the lead pump is at full speed for an operator-adjustable time period (0 to 5 minutes), the lag pump shall be started. The lag pump shall start and ramp up to operator-adjustable speed setpoint (0 to 100%) prior to the lead pump speed decreasing. Once the speed setpoint is reached, the lead pump shall decrease in speed. Lead and lag pumps shall then operate at the same speed. The PLC shall vary the speed of the lead and lag pumps in order to maintain the fire pressure setpoint.
   (4) In the event the speed of the lag pump drops below an operator-adjustable speed (0 to 100%) for an operator-adjustable time period (0 to 5 minutes), the lag pump shall be shut down.
   (5) This PLC shall monitor the reservoir level (LT-106-01 and LT-106-02). There shall be an operator-adjustable low reservoir level setpoint (0 to 30 feet). If either reservoir level drops below the operator-adjustable setpoint, the SCADA system shall generate a low reservoir level alarm and the booster pumps shall be shutdown. The booster pumps shall remain disabled until either reservoir level rises above an operator-adjustable pump restore level setpoint (0 to 30 feet) at which time normal operation as described in this section shall resume.

d. When transitioning between control modes, the system shall be setup for a smooth transition between control modes. When transitioning between control modes, the next control mode in the sequence shall start from the existing control mode (number of pumps in operation, pump speeds and setpoints) and transition to revised speeds for the selected operating mode based upon the current number of pumps in operation. The selected control sequence shall commence and the number of pumps and speeds required to meet the operating setpoints for that control mode shall be modified.

e. When transitioning to the manual mode, the pumps status (running and speed) shall be maintained. Operation may then manually change pumps in operation and speed setpoints.

3. With the R-L-O selector switch in the "Off/Reset" position, the booster pumps shall be disabled.

4. In ALL modes, there shall be an operator-adjustable low reservoir level setpoint (0-30 feet). If either reservoir level (LT-106-01 or LT-106-02) falls below the operator-adjustable setpoint, the SCADA system shall generate a low reservoir level alarm and the booster pumps shall be shut down.
5. There shall be a high to low zone transfer control included under both local and remote control. The operator shall be able to select "On" or "Off" for the pressure sustaining valve. The pressure sustaining valve "On" selection shall override all booster pump run commands from this SCC and shall shutdown all booster pumps and energize the solenoid valve (SV-106-03) located on the valve. The "Off" selection shall de-energize the solenoid valve and restore the booster pumps ability to run.
6. In the event a reservoir hatch (ZS-106-08, ZS-106-09, ZS-106-10, ZS-106-11) is opened and the entry alarm system has not been disabled, the booster pumps shall be shut down immediately and an entry alarm shall be generated at the SCADA.
7. Provide hard-wired, redundant float backup control (6 floats total) for booster pumps BP-106-01 and BP-106-02. The entire backup float system shall be hard-wired and shall be completely independent of the PLC. Once the level in the reservoir drops below either low level float (LS-106-04 or LS-106-07) both booster pumps shall shut down and a "Low Level/Backup Float Control Active" alarm shall be generated at the SCADA system. Once the level rises above the restore operation level float (LS-106-03 or LS-106-06) for an adjustable hard-wired time delay (0-30 minutes), the pumps shall start and ramp up to full speed. Once the level rises above either high level float (LS-106-03 or LS-106-05) both booster pumps shall start and ramp up to full speed. Both pumps shall operate continuously and shall be shut down by low level floats as described above. Under this condition, the system shall automatically switch control of both booster pumps to the backup floats. There shall be a blue pilot light on the front of this SCC to indicate when the control system is in backup float control. There shall be a manual reset pushbutton on this SCC so that once in the backup float mode, the pumps shall continue to operate from the floats until the system is manually reset by the operator. There shall be a two-position selector switch on this SCC to allow the operator to manually switch to the backup floats system. Indication and an alarm shall be provided at the SCADA system whenever the backup system is active (automatically or manually) as well as the position of the float mode selector switch.

K. Provide a SCADA On/Off switch for control of the solenoid valve for the low zone chlorine analyzer (SV-106-02) and the low zone chlorine analyzer power receptacle. Solenoid valve shall be powered from this SCC and shall be fused. Provide interface relays as required.

L. There is a future chlorine leak detector that will be installed in the Pump Room of the Booster Station. The leak detector shall be monitored at this SCC. In the event the chlorine leak alarm is activated by either the manual pushbutton or the leak detector, the PLC shall activate the future alarm lights and horn on the exterior of the building and generate an alarm at this SCC and the Master Station. The chlorine leak alarm horn shall be silenced from this SCC or the Master Station. Strobe shall be rotating 360 degrees; 520,000 candlepower, 165 effective candlepower, 75 revolutions per minute with 120V power and a red lens in a NEMA 4X enclosure. Strobe shall be Edwards Signal Model 52R-N5-40WH with wall mounting bracket WBR. Horn shall be 120V, Edwards Model 876 for outdoor use.

M. A future Chlorine Leak Detector will be installed in the Pump Room of the Booster Station. The leak detector shall be monitored at this SCC. In the event the chlorine leak alarm is activated by either the future manual pushbutton in the Future Chemical room or the leak detector, the PLC shall activate the alarm light on the exterior of the building and generate an alarm at this SCC.

N. A future Loss of Vacuum Switch will be installed in the Pump Room of the Booster Station. The vacuum switch shall be monitored at this SCC. In the event the switch is activated, a Chlorine Feed Failure Alarm shall be generated at this PLC.

O. There are two future electronic scales that will be installed in the future chemical room for indication of chlorine gas and fluoride weight at this SCC. The amount of chlorine gas and fluoride used in a 24-hour period shall be totalized within this PLC for indication at the SCADA System. The 24-hour period for totalization shall be operator-adjustable. When a chlorine gas and fluoride drum is filled, the PLC shall store the amount of chemical used up to that point and then begin to accumulate a new total. At the end of the 24-hour data gathering period, the two accumulated weights for each chemical shall be added together for a total usage over that 24-hour period. There shall be operator-adjustable high and low usage alarms setup within this PLC for each chemical such that if the usage is above/below these setpoints in a given time period, an alarm is given at the Master Station.

P. All motion sensors shall be powered from this SCC. Provide 12 and 24 VDC power supplies and fusing as required.

Q. Provide interface relays in this SCC as required for hardwired interlock of booster pump priming switches with motor starters in MCC.

END OF SECTION

SECTION 16941

CONTROLS AND INSTRUMENTATION DRAWINGS

PART 1-GENERAL

1.01 SUMMARY

A. Work Included: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit drawings in accordance with provisions of Section 01300-Submittals.

1.03 COORDINATION

A. The requirements set forth in this section are intended to apply to the drawings provided as specified in Section 16480-Motor Control, and Section 16940-Controls and Instrumentation.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 GENERAL REQUIREMENTS

A. All drawings shall have the following information:
1. Project information, including name of OWNER and specific project name.
2. Drawing title, accurately representing what is on the drawing.
3. Unique drawing identifier, consisting of a unique drawing number or drawing number with individual sheet number. If sheet numbers are used, total number of sheets must be identified on each sheet.
4. System Supplier company name, address, and phone number.
5. Original design information, including person responsible for design, date of original design, person responsible for checking of design, and date of design check.
6. Revision block indicating revision number, date, description of revision, and person responsible for revision.

B. All drawings shall have line numbers that can be uniquely referenced from other drawings.

C. All drawings showing wiring shall include unique wire numbers assigned to wiring that is installed between devices in the panel. The wire number shall be shown on the drawings.

D. All drawings showing relays shall include reference to the drawings where the relay contacts are shown. Spare relay contacts that are not used shall be identified.

3.02 DRAWINGS REQUIRED

A. Index of Drawings: Index of Drawings shall list drawing number, sheet number (if applicable), and drawing title for each drawing in drawing package.

B. Symbol Sheet: Symbol Sheet shall include:
   1. Explanation of all symbols used on the drawings, including, but not limited to, normally open/normally closed contacts, flow switches, limit switches, pressure switches, selector switches, pushbuttons, timers, control relays, solenoids, fuses, circuit breakers, terminal blocks, and contactors. Symbol sheet does not need to be specific to project, but must contain explanation of all symbols used on the drawings (i.e., special symbols used for a particular project must be added to standard symbol sheets).
   2. List of abbreviations used on the drawings.
   3. Explanation of continuation method for circuits that can not be shown on a single sheet.

C. Exterior Enclosure Layout Drawing: Exterior layout drawing shall show location of all externally-mounted equipment. Exterior layout drawing shall include:
   1. Enclosure dimensions, enclosure NEMA rating (i.e., NEMA 1, NEMA 4X stainless steel, NEMA 4X nonmetallic, etc.), and enclosure color or finish.
   2. Location and actual depiction of panel latches, hinges, mounting holes and lifting eyes.
   3. Location and accurate representation of equipment mounted on enclosure (i.e., switches should look like actual switches being installed; indicating lights should look like actual lights being installed).
   4. Equipment nameplate location.
   5. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
   6. Nameplate list including nameplate wording, size, construction (i.e., lamicoid with Black background and White letters), and mounting method (i.e., stainless steel screws). Label size must include size in inches or reference to standard sizes included on symbol sheet, or elsewhere in drawing package.
   7. Identification of area reserved for equipment located inside enclosure, but not actually mounted on enclosure back panel, such as UPS's, fiber optic patch panels, and lighting packages.

D. Interior Enclosure Layout Drawing: Interior layout drawing shall show location of all internally-mounted equipment. Interior layout drawing shall include:
   1. Back panel dimensions and finish.
   2. Location and accurate representation of equipment (i.e., terminal blocks should look like actual terminal blocks; receptacle should look like actual receptacle, etc.).
   3. Dimensions of internally-mounted equipment are not necessary, but equipment should be drawn to scale such that an accurate representation of the way equipment will be mounted is shown on the drawing.
   4. Description for each piece of equipment or unique identifier and parts list, or bill of materials.

E. Interconnection Diagram, Network Diagram or Block Diagram: Interconnection diagram, Network Diagram or Block Diagram shall show all cabling between system components and identify any station addressing or node numbers that are assigned to equipment. All cables shall be identified by cable type, including specific manufacturer and model/part

number. Party responsible for furnishing and installing cable shall also be included. Some examples of cables that must be shown are:

1. Antenna cables.
2. Communications cables between system components (fiber and/or copper). This includes fiber optic jumpers between fiber patch panels and equipment, and Ethernet patch cables between switches and devices.
3. Communications cables (fiber and/or copper) between PLCs, controllers, operator interface equipment and security devices (e.g., card readers, electric strikes, and motion detectors) that are not shown on the elementary schematics.

F. Elementary Schematic: Elementary schematics shall be developed for each motor or supplied equipment and shall include:

1. Nominal voltage, AC or DC designation, number of phases (if AC), and frequency in hertz (if AC) for each source of electrical supply to the enclosure.
2. Prospective short-circuit current available at the point of electrical supply to the enclosure.
3. Type of power supply system grounding (e.g., wye phase midpoint grounded, delta phases corner grounded, wye phases midpoint grounded, delta phases ungrounded, etc.).
4. Complete documentation of electrical circuit from supply to motor or supplied equipment. Documentation shall include disconnecting means, main overcurrent protection (when supplied), branch overcurrent protection (when supplied), control circuit and special purpose control protection, motor control, overload protection, local disconnect (when supplied) and motor horsepower, and full load amps from nameplate or supplied equipment full load amps.
5. Documentation of PLC or controller inputs and outputs.
6. Documentation of all circuit breaker/motor protector ratings, fuse sizes, control power transformer VA ratings, dip switch settings, etc.

G. Wiring Diagram: Wiring diagrams shall show all terminations for all cables external to the enclosure. Terminations may be shown on the elementary schematics as long as the termination information is concise and easily understood by the personnel installing the field wiring. Termination information shall be shown for all devices, including devices that are not part of System Supplier's scope of supply. A box with two dots or continuation arrows indicating continuation to a piece of equipment are not acceptable.

H. Calculations Summary: Calculations summary shall include calculations performed to:

1. Determine size of UPS.
2. Determine air conditioning equipment requirement.
3. Determine control power transformer sizing. Control power transformer sizing calculations may be generic based on typical circuits.

I. Functional Testing Recommendations: Testing recommendations shall include description of functional tests that must be performed by operators. Functional test description shall be included for UPS, indicating lights, and other devices whose condition can only be determined by testing.

3.03 SAMPLE DRAWINGS

A. Sample drawings showing an acceptable format are included in the appendix. The samples included in the appendix do not represent the only acceptable method of showing the required information.

END OF SECTION

SECTION 16949

SHORT-CIRCUIT, COORDINATION, AND ARC FLASH HAZARD STUDY

PART 1–GENERAL

1.01 SUMMARY

A. Work included:
   1. CONTRACTOR shall retain the services of an independent third-party firm to perform a Short-Circuit, Coordination, and Arc Flash Hazard Study, as specified herein. The studies shall be submitted to ENGINEER prior to receiving final approval of the equipment shop drawings and prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, ENGINEER may be provided with a preliminary submittal of sufficient study data so that the selection of device ratings and characteristics will be satisfactory.
   2. The studies shall include all portions of the new electrical distribution equipment from the service entrance down to, and including, each new motor over 50 hp, the Motor Control Center, and lighting panel. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

1.02 REFERENCES

A. NFPA70–National Electrical Code.

B. NFPA70E–Standard for Electrical Safety in the Workplace, Latest Edition.

C. IEEE Standard 1584–IEEE Guide for Performing Arc Flash Hazard Calculations.

D. OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S.

E. ANSI/IEEE Standards C37, 242, and 399.

F. UL 489-Underwriter's Laboratories.

1.03 QUALITY ASSURANCE

A. The firm shall be currently involved in high- and low-voltage power system evaluation. The study shall be performed, stamped, and signed by a registered Professional Engineer in the State where the project is located. Credentials of the individual(s) performing the study and background of the firm shall be submitted to ENGINEER for review prior to start of the work. A minimum of 5 years experience in power system analysis shall be required for the project manager.

B. The firm performing the study shall demonstrate capability and experience to provide assistance during start-up, as required.

1.04 SUBMITTALS

A. A preliminary submittal shall be provided prior to equipment shop drawing submittals and prior to commencement of short-circuit, coordination, and arc flash hazard studies. The

preliminary submittal shall include qualifications of individuals who will perform the work, specific software and analysis tools that will be utilized, and example studies and reports completed for previous projects.

B. After review of the preliminary submittal, the studies shall be prepared and completed based on final approved shop drawings for all equipment specified in Division 16. The results of the studies shall be summarized in a final report and meet the following requirements:
   1. Submit three bound copies of the final report with two copies in PDF format burned to compact disc. The two CDs shall also include all report files in Word format, one-line diagrams in PDF format, and all power analysis software files and associated libraries.
   2. Organize and submit the report with the following sections. Below are minimum requirements, and the report shall be tailored to meet specific project requirements and equipment:
      a. Part I: Overview.
      b. Part II: Short-Circuit Study:
         (1) Purpose.
         (2) Explanation of data.
         (3) Assumptions.
         (4) General and specific procedures followed.
         (5) Analysis of results.
         (6) Recommendations.
         (7) Fault Analysis Input Report.
      c. Part III–Coordination Study:
         (1) Purpose.
         (2) Explanation of data.
         (3) Assumptions.
         (4) General and specific procedures followed.
         (5) Analysis of results.
         (6) Recommendations, including trip curves and device settings for project-specific equipment.
         (7) Spreadsheet or report showing the range of all device settings and recommended settings.
      d. Part IV–Arc Flash Study:
         (1) Purpose.
         (2) Explanation of Data.
         (3) Assumptions.
         (4) Analysis of results, including all items in Motor Control Centers, control panels, disconnects, etc.
         (5) General and specific procedures followed.
         (6) Recommendations, including system modifications that may reduce arc flash hazard based on analysis of results.
         (7) Arc flash evaluation report including sample labels for major distribution equipment.

C. Refer to Part 3–Execution for additional requirements and specific analyses to be performed.

PART 2–PRODUCTS

2.01 POWER ANALYSIS SOFTWARE

A. The study and assessment shall be performed based on SKM PowerTools software utilizing Dapper, Captor, Arc Fault, and Arc Flash evaluation modules. Equivalent or alternative software packages may be used, but shall be submitted for review by ENGINEER as part of the preliminary submittal.

2.02 ARC FLASH HAZARD LABELS

A. Labels shall be provided for equipment specified in all Division 16 technical sections, as well as for equipment provided in Divisions 11 and 15 where an arc flash hazard may exist. Labels shall be as manufactured by Conney Safety Products, or equal, and meet the following minimum requirements:
   1. Self-adhesive, vinyl, 6 inches by 4 inches minimum.
   2. Equipment identification corresponding to the Contract Documents.
   3. Study date.
   4. Arc-flash boundary.
   5. Flash-hazard boundary.
   6. Flash hazard category (0-4).
   7. Shock-hazard boundaries (limited approach and restricted approach).
   8. Minimum arc rating (cal/cm^2).
   9. Personal Protective Equipment (PPE) level.
   10. Required PPE.

PART 3-EXECUTION

3.01 DATA COLLECTION

A. CONTRACTOR shall provide the required data to the firm for preparation of the studies. Firm performing the system studies shall furnish CONTRACTOR with a listing of the required data immediately after award of the Contract.

B. CONTRACTOR shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture. The following minimum information shall be collected and used:
   1. Available fault current from the local utility company.
   2. If applicable, existing equipment ratings including bus bracing, interrupting device ratings, and age/condition.
   3. Installed cable or busway lengths, along with the specific rating, type and manufacturer.

3.02 SHORT-CIRCUIT AND COORDINATION STUDY

A. Include in the appropriate report sections noted above, calculation methods and assumptions, base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculations shall be provided for multiple distribution system scenarios

when source equipment can provide multiple power feeds to downstream equipment (i.e., standby generators, etc.).

B. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at transformer primary and secondary terminals and the Motor Control Center, as well as other significant locations throughout the system, including all three phase motors. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations, fault impedance, X to R ratios, asymmetry factors, motor contribution, short-circuit kVA, and symmetrical and asymmetrical fault currents.

C. In the Protective Device Coordination Study, provide time-current curves graphically for new distribution equipment, indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time-delay settings.

D. Include on the curve sheets power company relay and fuse characteristics, pertinent transformer characteristics, and characteristics of other system load protective devices. Include at least all devices down to the largest three-feeder circuit breakers in the Motor Control Center.

E. Include all adjustable settings for new ground fault protective devices. Include manufacturing tolerance and damage bands in plotted circuit breaker characteristics. Show transformer full load and 150, 400, or 600% currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.

F. Select each primary protective device required for a Delta-Wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58% of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16% current margin to provide proper coordination and protection in the event of secondary line-to-line faults.

G. Include complete fault calculations as specified herein for each proposed and ultimate source combination for new equipment. Note that source combinations may include present and future supply circuits or large motors, as noted on one-lines.

H. Utilize equipment load data for the study obtained by CONTRACTOR from Contract Documents, including Contract addendums issued prior to Bid opening.

I. Include fault contribution of all motors in the study. Notify ENGINEER in writing of circuit protective devices not properly rated for fault conditions. Provide recommended settings for motor starters and note any system inadequacies or potentially hazardous conditions. Show each MCC full-load current plus symmetrical and asymmetrical of the largest motor-starting current to ensure protective devices will not trip major or group operation.

3.03 ARC FLASH HAZARD STUDY

A. As part of the Short-Circuit Study, the Arc Flash Hazard Study shall be included. Include in the appropriate report sections noted above, the following minimum requirements:
   1. Determine and document all possible utility sources and scenarios that are capable of being connected to each piece of electrical gear. Calculations shall be based on highest possible source connection.
   2. Arc flash values for two normal cases to define the highest values (low short-circuit and high short-circuit).
   3. Arc flash values for two maintenance cases which define the arc flash values available at the equipment, that would be available if the instantaneous trip of the upstream circuit breaker is set at a minimum value. This is recommended for personnel working on live equipment.
   4. Recommendations to reduce the arc flash incident energy in all areas that require Class 2 and higher PPE.
   5. Calculations to conform to National Fire Protection Association (NFPA) 70E calculation standards. All incident energy units shall be calculated in calories per square centimeter.

B. Furnish and install labeling as specified herein based upon the results of the Arc Flash Hazard Study.

3.04 FIELD SETTINGS

A. CONTRACTOR shall perform field adjustments of the new protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the final version of the Short-Circuit Study, Coordination Study, and Arc Flash Hazard Study.

B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the final version of the Short-Circuit and Protective Device Coordination Study shall be carried out by CONTRACTOR at no additional cost to OWNER.

END OF SECTION

SECTION 16951

SPARE PARTS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Spare parts for applicable sections of Division 16 as noted below.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.

B. NEMA/ANSI Compliance: Comply with National Electrical Manufacturer's Association, American National Standards Institute, and other standards pertaining to material, construction, and testing where applicable.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All electrical equipment and material shall be received and stored with the factory winter-proof wrapping intact. Provide factory-wrapped waterproof flexible barrier metal for factory packaging of equipment and material to protect against physical damage in transit. When applicable, equipment stored shall be in factory coverings in a clean, dry, indoor space which provides protection against the weather.

B. All spare parts shall be suitably boxed or wrapped to prevent deterioration and shall be completely identified on the outside.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Spare parts specified herein shall be provided by the manufacturer listed in the section where the equipment is specified.

2.02 MOTOR CONTROL CENTERS

A. The following shall be furnished:
   1. Two spare fuses for each type of control and current-limiting fuse provided.
   2. One set of fuses for each VFD size (horsepower) provided.
   3. Twenty replacement lamps and lamp replacement tool for push-to-test indicating lights.
   4. One replacement relay for each type of relay provided, including time-delay relays.
   5. Replacement contacts, along with all related springs, bolts, and other materials necessary to completely rebuild one line contactor of each type furnished.

6. One control power transformer for each size provided.

2.03 CONTROLS AND INSTRUMENTATION

A. The following shall be furnished.
   1. 10% of PLC communication cards, minimum of one each.
   2. One PLC processor for each type provided.
   3. 10% of PLC input/output cards for each type provided (analog and discrete), minimum one each.
   4. Two transient/spike suppressors.
   5. One network switch.

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SCADA SYSTEM I/O LISTING

STRAND ASSOCIATES, INC.
CITY OF MADISON - BOOSTER PUMPING STATION 106
CONTRACT 1-2012
SCADA SYSTEM I/O LISTING - DESCRIPTION (SCC-106)

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
106	**CONTROL POWER FAIL**		1	0	0	0	2~#14	FROM CONTROL POWER RELAY IN THIS SCC
106	**MCC POWER FAIL**		1	0	0	0	2~#14	FROM PHASE MONITOR IN MCC
106	**REPLACE UPS BATTERY**		1	0	0	0	2~#14	FROM UPS IN THIS SCC
106	**DATA FAIL**		0	0	0	0	-	FROM LOGIC WITHIN THIS PLC
106	**PLC SCAN FAIL**		0	0	0	0	-	FROM LOGIC WITHIN THIS PLC
106	**NETWORK SWITCH FAIL**		1	0	0	0	2~#14	FROM NETWORK SWITCH IN THIS SCC
106	**PLC LOW BATTERY**		0	0	0	0	-	FROM LOGIC WITHIN THIS PLC
106	**AUTOMATIC TRANSFER SWITCH**							
106	IN NORMAL POSITION		1	0	0	0	2~#14	FROM AUTOMATIC TRANSFER SWITCH
106	IN EMERGENCY POSITION		1	0	0	0	2~#14	FROM AUTOMATIC TRANSFER SWITCH
106	**CARD READER INTRUSION SYSTEM**		1	0	0	0	2~#14	FROM LIGHTED PUSHBUTTON ON THE FRONT OF THIS SCC
106	**CARD READER INTRUSION SYSTEM DISABLE**		0	1	0	0	2~#14	TO LIGHTED PUSHBUTTON ON THE FRONT OF THIS SCC
106	**CARD READER INTRUSION DISABLED**		1	0	0	0	2~#14	FROM CARD ACCESS CONTROL SYSTEM
106	**PUMP ROOM/CHEMICAL ROOM ENTRY TO CARD ACCESS CONTROL**		0	1	0	0	2~#14	FROM PLC TO CARD ACCESS CONTROL SYSTEM
106	**FUTURE CHEMICAL ROOM INTRUSION**	MS-106-05	1	0	0	0	4~#14	FROM MOTION SENSOR IN FUTURE CHEMICAL ROOM
106	**PUMP ROOM INTRUSION**	MS-106-06	1	0	0	0	4~#14	FROM MOTION SENSOR IN PUMP ROOM
106	**PUMP ROOM INTRUSION**	ZS-106-4	1	0	0	0	2~#14	FROM DOOR SWITCH IN PUMP ROOM
106	**FUTURE CHEMICAL ROOM INTRUSION**	ZS-106-3	1	0	0	0	2~#14	FROM DOOR SWITCH IN FUTURE CHEMICAL ROOM
106	**PUMP ROOM LOW TEMPERATURE**	T-106-1	1	0	0	0	2~#14	FROM THERMOSTAT IN PUMP ROOM
106	**FUTURE CHEMICAL ROOM LOW TEMPERATURE**	T-106-2	1	0	0	0	2~#14	FROM THERMOSTAT IN FUTURE CHEMICAL ROOM
106	**FIRE ALARM CONTROL PANEL**	FACP-106						
106	FIRE ALARM SYSTEM TROUBLE		1	0	0	0	2~#14	FROM FIRE ALARM CONTROL PANEL
106	FIRE ALARM SYSTEM ALARM		1	0	0	0	2~#14	FROM FIRE ALARM CONTROL PANEL
106	FIRE ALARM SYSTEM SUPERVISORY SERVICE		1	0	0	0	2~#14	FROM FIRE ALARM CONTROL PANEL
106	**SPRINKLER SYSTEM FLOW SWITCH**	FS-106-01	1	0	0	0	2~#14	FROM SPRINKLER SYSTEM FLOW SWITCH IN PUMP ROOM
106	**BOOSTER PUMP CONTROL SYSTEM**							
106	LOCAL MODE		1	0	0	0	2~#14	FROM R-L-O SWTICH ON THIS SCC
106	REMOTE MODE		1	0	0	0	2~#14	FROM R-L-O SWTICH ON THIS SCC
106	**BOOSTER PUMP NO. 1**	BP-106-01						

STRAND ASSOCIATES, INC.
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CONTRACT 1-2012
SCADA SYSTEM I/O LISTING - DESCRIPTION (SCC-106)

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
106	IN AUTO		1	0	0	0	2~#14	FROM HOA SWITCH ON MCC
106	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
106	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC
106	FLOW FAIL		1	0	0	0	2~#14	FROM HARDWIRED LOGIC IN MCC
106	MOTOR OVERTEMP		1	0	0	0	2~#14	FROM MOTOR THERMOSTATS/MCC
106	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
106	SPEED INDICATION		0	0	X	0	ENET	FROM VFD IN MCC
106	SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
106	KW		0	0	X	0	ENET	FROM VFD IN MCC
106	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
106	KWH		0	0	X	0	ENET	FROM VFD IN MCC
106	**BOOSTER PUMP NO. 2**	BP-106-02	3	X	X	X		SAME AS BP-106-01
106	**FUTURE CHEMICAL ROOM EXHAUST FAN**	EF-106-02						
106	START*		1	0	0	0		FROM FUTURE CONTROL STATION AT FUTURE CHEMICAL ROOM EXTERIOR DOOR
106	STOP*		1	0	0	0		FROM FUTURE CONTROL STATION AT FUTURE CHEMICAL ROOM EXTERIOR DOOR
106	RUNNING*		0	1	0	0		TO FUTURE CONTROL STATION AT FUTURE CHEMICAL ROOM EXTERIOR DOOR
106	START*		1	0	0	0		FROM FUTURE CONTROL STATION AT FUTURE CHEMICAL ROOM INTERIOR DOOR
106	STOP*		1	0	0	0		FROM FUTURE CONTROL STATION AT FUTURE CHEMICAL ROOM INTERIOR DOOR
106	**CHLORINE LEAK DETECTOR***							
106	CHLORINE LEAK HORN ON/OFF*		0	1	0	0		TO FUTURE ALARM HORN OUTSIDE FUTURE CHEMICAL ROOM
106	CHLORINE LEAK STROBE ON/OFF*		0	1	0	0		TO FUTURE ALARM STROBE OUTSIDE FUTURE CHEMICAL ROOM
106	CHLORINE LEAK WARNING*		1	0	0	0		FROM FUTURE CHLORINE LEAK DETECTOR
106	CHLORINE LEAK CONTROL STATION ALARM*		1	0	0	0		FROM FUTURE CONTROL STATION OUTSIDE CHEMICAL ROOM
106	**CHLORINE FEED SYSTEM***							
106	FAIL*		1	0	0	0		FROM FUTURE CHLORINE FEED PUMP IN FUTURE CHEMICAL ROOM

STRAND ASSOCIATES, INC.
CITY OF MADISON - BOOSTER PUMPING STATION 106
CONTRACT 1-2012
SCADA SYSTEM I/O LISTING - DESCRIPTION (SCC-106)

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
106	WEIGHT*		0	0	1	0		FROM FUTURE CHLORINE SCALE IN FUTURE CHEMICAL ROOM
106	GAS FLOW*		0	0	1	0		FROM FUTURE GAS FLOW METER IN FUTURE CHEMICAL ROOM
106	**HIGH ZONE CHLORINE**	AIT-106-01	0	0	1	0	SH. PR.	FROM CHLORINE ANALYZER IN PUMP ROOM
106	**HIGH ZONE CHLORINE ANALYZER SOLENOID VALVE OPEN/CLOSE**	SV-106-01	0	1	0	0	2~#14	TO HIGH ZONE CHLORINE ANALYZER SOLENOID VALVE
106	**LOW ZONE CHLORINE**	AIT-106-02	0	0	1	0	SH. PR.	FROM CHLORINE ANALYZER IN PUMP ROOM
106	**LOW ZONE CHLORINE ANALYZER SOLENOID VALVE OPEN/CLOSE**	SV-106-02	0	1	0	0	2~#14	TO LOW ZONE CHLORINE ANALYZER SOLENOID VALVE
106	**STATION REVERSE FLOW**	FIT-106-01						
106	INSTANTANEOUS FLOW		0	0	1	0	SH. PR	FROM MAGNETIC FLOW METER TRANSMITTER IN PUMP ROOM
106	TOTAL FLOW		1	0	0	0	2~#14	FROM MAGNETIC FLOW METER TRANSMITTER IN PUMP ROOM
106	**STATION FORWARD FLOW**	FIT-106-02						
106	INSTANTANEOUS FLOW		0	0	1	0	SH. PR	FROM MAGNETIC FLOW METER TRANSMITTER IN PUMP ROOM
106	TOTAL FLOW		1	0	0	0	2~#14	FROM MAGNETIC FLOW METER TRANSMITTER IN PUMP ROOM
106	**LOW ZONE FLOW**	FIT-106-03						
106	INSTANTANEOUS FLOW		0	0	1	0	SH. PR	FROM MAGNETIC FLOW METER TRANSMITTER IN PUMP ROOM
106	TOTAL FLOW		1	0	0	0	2~#14	FROM MAGNETIC FLOW METER TRANSMITTER IN PUMP ROOM
106	**BOOSTER STATION HIGH ZONE/DISCHARGE**	PIT-106-01	0	0	1	0	SH. PR.	FROM PRESSURE TRANSMITTER IN LOWER LEVEL
106	**BOOSTER STATION LOW ZONE PRESSURE**	PIT-106-02	0	0	1	0	SH. PR.	FROM PRESSURE TRANSMITTER IN LOWER LEVEL
106	**PRESSURE SUSTAINING VALVE OPEN/CLOSE**	SV-106-03	0	1	0	0	2~#14	TO SOLENOID VALVE IN LOWER LEVEL
106	**PRESSURE SUSTAINING VALVE CLOSED**	ZS-106-01	1	0	0	0	2~#14	FROM PRESSURE SUSTAINING VALVE POSITION SWITCH
106	**ALTITUDE VALVE CLOSED**	ZS-106-02	1	0	0	0	2~#14	FROM ALTITUDE VALVE POSITION SWITCH
106	**BOOSTER PUMP NO. 1 PRIMING SWITCH**	ZS-106-07	1	0	0	0	2~#14	FROM VACUUM PRIMING POSITION SWITCH
106	**BOOSTER PUMP NO. 2 PRIMING SWITCH**	ZS-106-12	1	0	0	0	2~#14	FROM VACUUM PRIMING POSITION SWITCH
106	**VACUUM PRIMING SYSTEM**	VAC-106-01						

STRAND ASSOCIATES, INC.
CITY OF MADISON - BOOSTER PUMPING STATION 106
CONTRACT 1-2012
SCADA SYSTEM I/O LISTING - DESCRIPTION (SCC-106)

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
106	HIGH WATER LEVEL		1	0	0	0	2~#14	FROM VACUUM PRIMING SYSTEM CONTROL PANEL
106	LOW VACUUM LEVEL		1	0	0	0	2~#14	FROM VACUUM PRIMING SYSTEM CONTROL PANEL
106	**SUBMERSIBLE MIXER CONTROL PANEL NO. 1**							
106	RUNNING		1	0	0	0	2~#14	FROM SUBMERSIBLE MIXER CONTROL PANEL NO. 1
106	FAIL		1	0	0	0	2~#14	FROM SUBMERSIBLE MIXER CONTROL PANEL NO. 1
106	REMOTE START/STOP		0	1	0	0	2~#14	TO SUBMERSIBLE MIXER CONTROL PANEL NO. 1
106	**SUBMERSIBLE MIXER CONTROL PANEL NO. 2**		2	1	0	0		SAME AS SUBMERSIBLE MIXER CONTROL PANEL NO.1
106	**RESERVOIR LEVEL - SOUTH**	LT-106-01	0	0	1	0	SH. PR.	FROM SOUTH LEVEL TRANSMITTER IN RESERVOIR
106	**RESERVOIR LEVEL - NORTH**	LT-106-02	0	0	1	0	SH. PR.	FROM NORTH LEVEL TRANSMITTER IN RESERVOIR
106	**FLOOD ALARM - BOOSTER STATION LOWER LEVEL**	LS-106-01	1	0	0	0	2~#14	FROM LOWER LEVEL FLOOD FLOAT SWITCH
106	**HIGH LEVEL/BACKUP FLOAT CONTROL ACTIVE**		1	0	0	0	2~#14	FROM RELAY IN THIS SCC
106	**BOOSTER PUMP CONTROL MODE**							
106	BACKUP FLOATS CONTROL MODE		1	0	0	0	2~#14	FROM CONTROL MODE SELECTOR SWITCH ON THIS SCC
106	SCADA CONTROL MODE		1	0	0	0	2~#14	FROM CONTROL MODE SELECTOR SWITCH ON THIS SCC
106	**BACKUP FLOAT CONTROL INDICATION**		0	1	0	0	2~#14	TO BLUE PILOT LIGHT ON THIS SCC
106	**RESERVOIR HIGH LEVEL - SOUTH**	LS-106-02	1	0	0	0	2~#14	FROM HIGH LEVEL FLOAT SWITCH IN RESERVOIR SOUTH
106	**RESERVOIR RESTORE OPERATION LEVEL - SOUTH**	LS-106-03	1	0	0	0	2~#14	FROM RESTORE LEVEL FLOAT SWITCH IN RESERVOIR SOUTH
106	**RESERVOIR LOW LEVEL - SOUTH**	LS-106-04	1	0	0	0	2~#14	FROM LOW LEVEL FLOAT SWITCH IN RESERVOIR SOUTH
106	**RESERVOIR HIGH LEVEL - NORTH**	LS-106-05	1	0	0	0	2~#14	FROM HIGH LEVEL FLOAT SWITCH IN RESERVOIR NORTH
106	**RESERVOIR RESTORE OPERATION LEVEL - NORTH**	LS-106-06	1	0	0	0	2~#14	FROM RESTORE LEVEL FLOAT SWITCH IN RESERVOIR NORTH
106	**RESERVOIR LOW LEVEL - NORTH**	LS-106-07	1	0	0	0	2~#14	FROM LOW LEVEL FLOAT SWITCH IN RESERVOIR NORTH
106	**EAST RESERVOIR ACCESS STRUCTURE - NORTH HATCH OPEN**	ZS-106-08	1	0	0	0	2~#14	FROM DOOR SWITCH AT EAST RESERVOIR ACCESS STRUCTURE
106	**EAST RESERVOIR ACCESS STRUCTURE - SOUTH HATCH OPEN**	ZS-106-09	1	0	0	0	2~#14	FROM DOOR SWITCH AT EAST RESERVOIR ACCESS STRUCTURE
106	**WEST RESERVOIR ACCESS STRUCTURE - NORTH HATCH OPEN**	ZS-106-10	1	0	0	0	2~#14	FROM DOOR SWITCH AT WEST RESERVOIR ACCESS STRUCTURE
106	**WEST RESERVOIR ACCESS STRUCTURE - SOUTH HATCH OPEN**	ZS-106-11	1	0	0	0	2~#14	FROM DOOR SWITCH AT WEST RESERVOIR ACCESS STRUCTURE

STRAND ASSOCIATES, INC.
CITY OF MADISON - BOOSTER PUMPING STATION 106
CONTRACT 1-2012
SCADA SYSTEM I/O LISTING - DESCRIPTION (SCC-106)

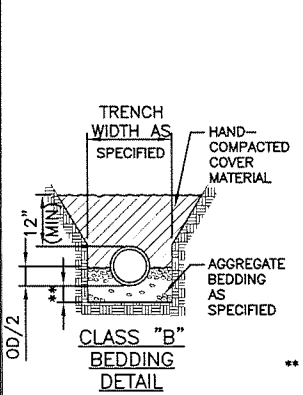
SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	{This line intentionally left blank}							
	TOTALS		68	15	14	0		

*Provide I/O for future signals in addition to 25% spare I/O specified.

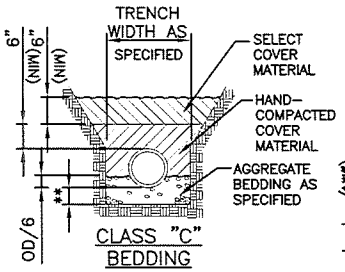
DRAWINGS

SANITARY SEWER APPURTENANCES

STANDARD DETAIL

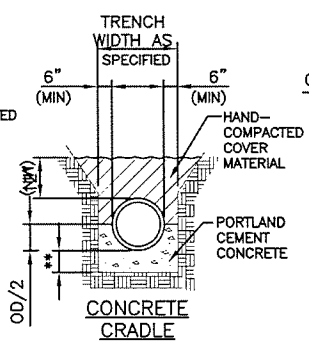


CLASS "B" BEDDING DETAIL

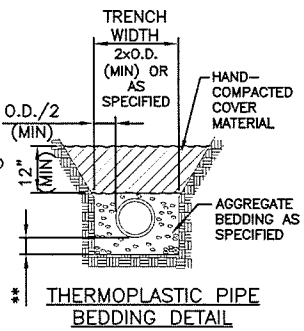


CLASS "C" BEDDING DETAIL

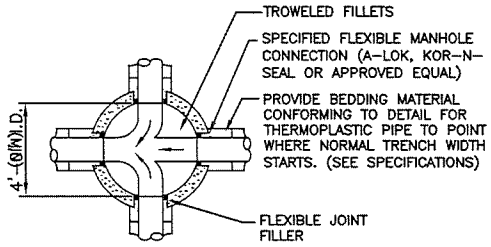
** OUTSIDE DIAMETER/4, 4" MINIMUM.



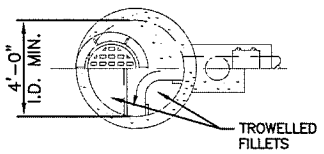
CONCRETE CRADLE DETAIL



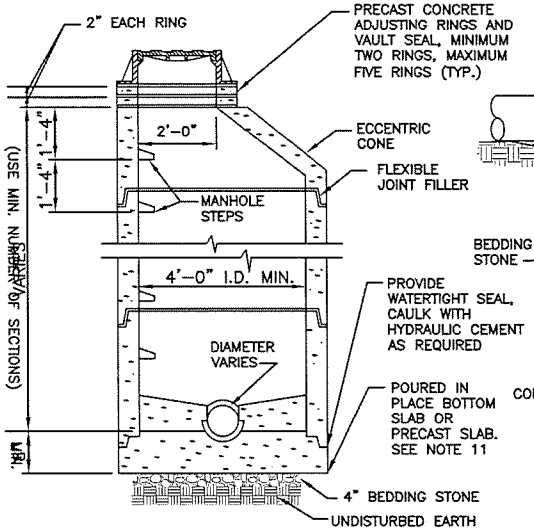
THERMOPLASTIC PIPE BEDDING DETAIL



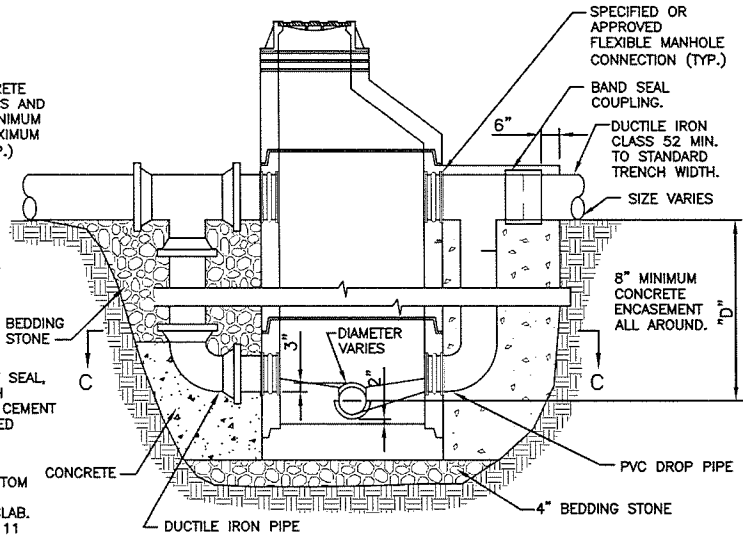
JUNCTION MANHOLE



HALF SECTION C-C



STANDARD PRECAST MANHOLE



DROP TYPE ENTRANCE OPTIONS TO STANDARD MANHOLE

DROP TYPE ENTRANCE TO BE USED WHEREVER DIMENSION "D" EXCEEDS 2'-0".

NOTES

1. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

2. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSABLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.

3. ALL CONCRETE FILLETS SHALL BE HAND TROWELED WITH A 1/4"/FT. SLOPE.

4. INSIDE DIMENSIONS FOR MANHOLES: USE MINIMUM 4' DIAMETER FOR SEWER LESS THAN 18" IN DIAMTER; USE MINIMUM 5' DIAMETER FOR SEWER 18" THRU 24" IN DIAMETER; USE MINIMUM 6' DIAMETER OR MINIMUM 6' SQUARE FOR SEWER OVER 24" IN DIAMETER.

5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.

6. DROP TYPE ENTRANCE TO STANDARD MANHOLE WILL BE PAID FOR SEPARATELY IF SO LISTED IN THE BID.

7. SEE DRAWINGS FOR DROP TYPE ENTRANCES FOR SANITARY SEWERS LARGER THAN 15".

8. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.

9. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.

10. FLAT SLAB TOPS SHALL BE DESIGNED FOR H-20 TRUCK LOADING AND SHALL MEET REQUIREMENTS OF ASTM C-478.

11. BASE SLABS SHALL BE REINFORCED AS FOLLOWS: REINFORCING SHALL BE PLACED IN EACH DIRECTION AT 2" CLEAR FROM TOP SURFACE OF SLAB, REINFORCING SHALL BE GRADE 60. USE OF CAST-IN-PLACE SLAB SHALL NOT RELIEVE CONTRACTOR OF REQUIREMENTS TO PROVIDE WATERTIGHT JOINTS.

INSIDE DIA.	DEPTH	REINF.
4'	≤ 30'	#3@8"
5'	≤ 20'	#3@8"
5'	20'-30'	#4@10"
6'	≤ 20'	#4@10"
6'	20'-25'	#4@8"
6'	25'-30'	#4@6"

12. FLAT SLABS SHALL BE PROVIDED IN SHALLOW DEPTH SITUATIONS IN LIEU OF ECCENTRIC CONES.

STRAND ASSOCIATES®

01-975-43A

OCTOBER 2011

D-454

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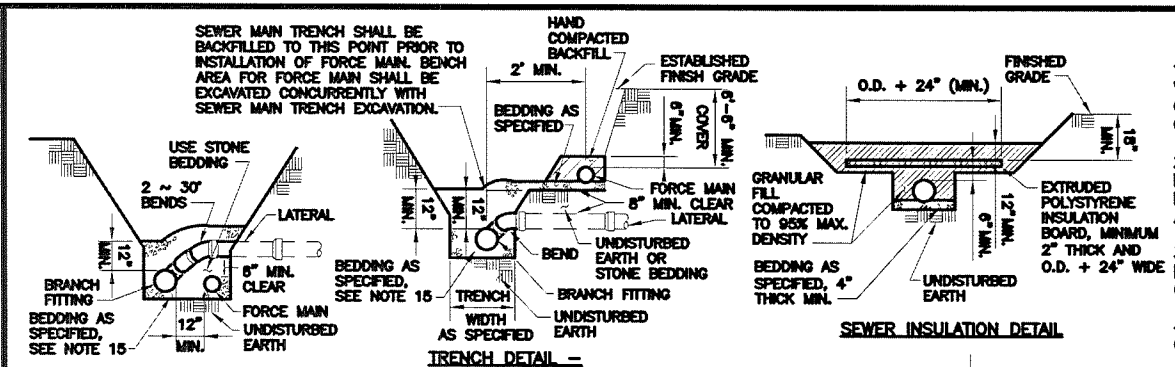
SANITARY SEWER LATERALS

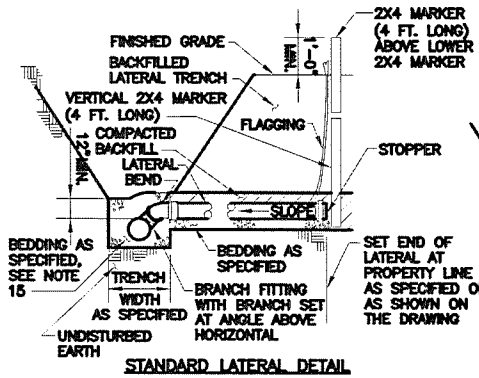
STANDARD DETAIL



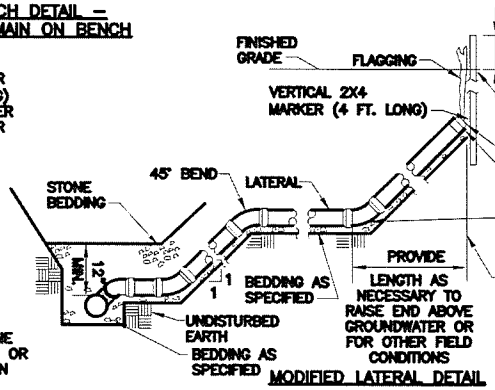
TRENCH DETAIL – FORCE MAIN AND GRAVITY SEWER AT THE SAME ELEVATION

TRENCH DETAIL – FORCE MAIN ON BENCH

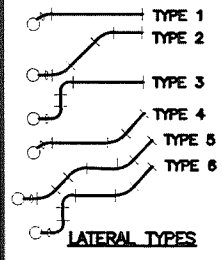
SEWER INSULATION DETAIL



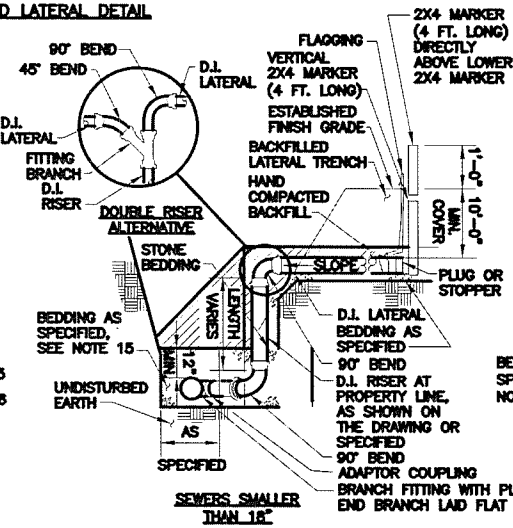
STANDARD LATERAL DETAIL



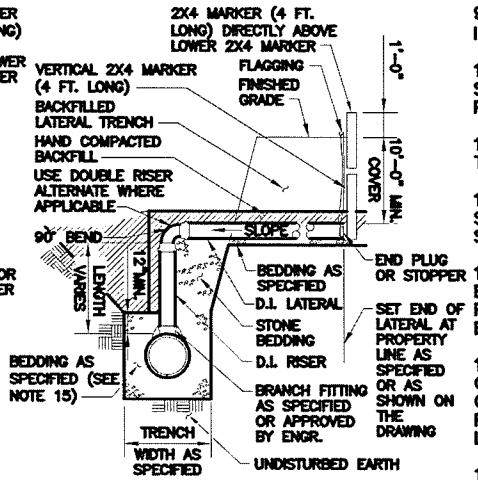
MODIFIED LATERAL DETAIL



LATERAL TYPES



SEWERS SMALLER THAN 18"



SEWERS 18" AND LARGER

STANDARD RISER DETAILS

NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.

2. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

3. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSABLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.

4. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.

5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.

6. ALL LATERALS SHALL BE LAID AT A STANDARD SLOPE OF 1/4–INCH PER FOOT UNLESS OTHERWISE NOTED ON THE DRAWINGS, OR SPECIFIED. IN NO CASE SHALL LATERAL SLOPE BE LESS THAN 1/8–INCH PER FOOT. MAXIMUM LATERAL SLOPE SHALL BE 1 TO 1.

7. END PLUGS OR STOPPERS FOR THE ENDS OF LATERALS AND BRANCH FITTINGS SHALL BE PROVIDED.

8. 2x4'S SHALL BE PLACED AT ALL LATERALS ENDS SO THAT ONE PROTRUDES 12 INCHES ABOVE FINISHED GRADE AND ONE IS LOCATED IN THE GROUND AT THE END OF THE LATERAL. 2x4'S SHALL BE PAINTED FLOURESCENT ORANGE. 2x4'S SHALL EACH BE AT LEAST 4 FT. LONG.

9. BAR STEEL REINFORCEMENT SHALL BE IMBEDDED 1 1/2–INCH CLEAR MINIMUM.

10. THE TOP OF ANY MANHOLE STRUCTURE SHALL BE LEFT SUFFICIENTLY LOW TO PERMIT PROPER ADJUSTMENT OF COVER TO GRADE.

11. INSTALL DOUBLE RISERS WHERE SHOWN ON THE DRAWINGS OR SPECIFIED.

12. STANDARD LATERALS AND MODIFIED LATERALS SHALL BE CONSTRUCTED OF MATERIAL AS SPECIFIED.

13. RISERS AND LATERALS FROM RISERS SHALL BE CONSTRUCTED OF DUCTILE IRON. FITTINGS FOR RISERS AND LATERALS FROM RISERS SHALL BE GRAY IRON OR DUCTILE IRON.

14. FLAGGING SHALL BE 4–INCH WIDE STANDARD ORANGE VINYL TAPE. TIE FLAGGING AROUND END OF ALL LATERALS AND EXTEND UNBROKEN TO FINISHED GRADE DIRECTLY ABOVE ENDS OF LATERALS.

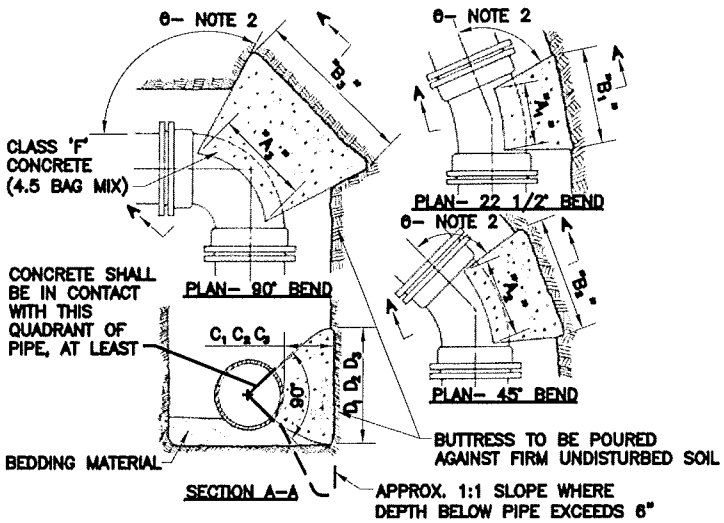
15. STONE BEDDING SHALL BE USED AROUND AND TO ONE FT. ABOVE TOP OF ALL SEWER MAINS AT LATERAL CONNECTIONS. PROVIDE BEDDING AS SPECIFIED ELSEWHERE.

STRAND ASSOCIATES

01-975-75A

OCTOBER 2011

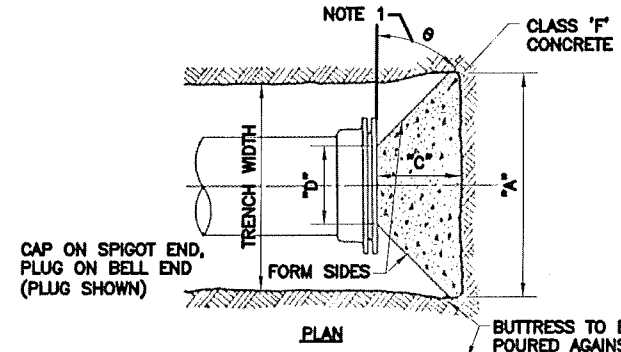
D-455



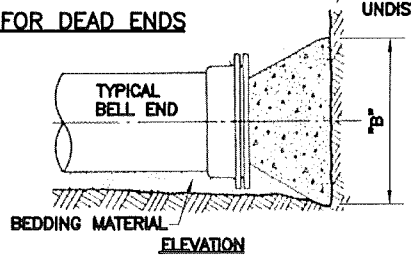
BUTTRESS FOR BENDS

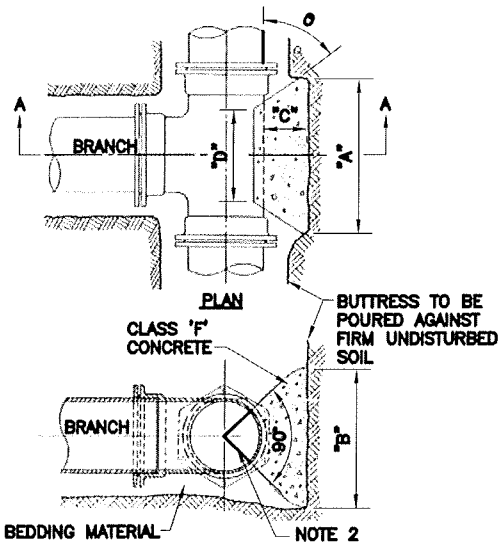
NOTES:
1. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND ON EARTH RESISTANCE OF 2 TONS PER SF.
2. DIMENSION C_1, C_2, C_3, SHOULD BE LARGE ENOUGH TO MAKE ANGLE θ EQUAL TO OR LARGER THAN 45°.
3. DIMENSION A_1, A_2, A_3, SHOULD BE AS LARGE AS POSSIBLE WITHOUT INTERFERING WITH MJ BOLTS.
4. SHAPE OF BACK OF BUTTRESS MAY VARY AS LONG AS POUR IS AGAINST FIRM UNDISTURBED EARTH.
5. ALL IRON PIPE AND FITTINGS SHALL BE WRAPPED IN POLYETHYLENE.

BUTTRESS DIMENSIONS						
PIPE SIZE	22 ½° BENDS		45° BENDS		90° BENDS	
	B_1	D_1	B_2	D_2	B_3	D_3
6"	1'–0"	1'–0"	1'–0"	1'–0"	1'–4"	1'–2"
8"	1'–0"	1'–0"	1'–4"	1'–2"	1'–10"	1'–6"
12"	1'–4"	1'–4"	1'–10"	1'–10"	2'–8"	2'–3"
16"	1'–10"	1'–8"	2'–6"	2'–4"	3'–10"	2'–10"
20"	2'–4"	2'–0"	3'–3"	2'–10"	5'–0"	3'–4"
24"	2'–10"	2'–4"	4'–0"	3'–3"	6'–4"	3'–10"
30"	3'–6"	3'–0"	5'–4"	3'–10"	8'–0"	4'–8"



BUTTRESS FOR DEAD ENDS





BUTTRESS FOR TEES

NOTES:
1. DIMENSION "C" SHOULD BE LARGE ENOUGH TO MAKE ANGLE θ EQUAL TO OR LARGER THAN 45°.
2. CONCRETE SHOULD BEAR ON THIS QUADRANT OF PIPE AS MINIMUM.
3. DIMENSION "D" SHOULD BE AS LARGE AS POSSIBLE BUT CONCRETE SHOULD NOT INTERFERE WITH MECHANICAL JOINTS.
4. BUTTRESS DIMENSIONS ARE BASED ON A SOIL RESISTANCE OF TWO TONS PER SF AND A WATER PRESSURE OF 150 PSI.
5. ALL IRON PIPE AND FITTINGS SHALL BE WRAPPED IN POLYETHYLENE.

BUTTRESS DIMENSIONS				
BD	A	B	C	D
6"	1'–3"	1'–0"	SEE NOTE 1	SEE NOTE 3
8"	1'–6"	1'–4"		
12"	2'–3"	2'–0"		
16"	3'–2"	2'–6"		
20"	4'–0"	3'–0"		
24"	5'–3"	3'–4"		
30"	6'–3"	4'–3"		

NOTES:
1. DIMENSION "C" SHOULD BE LARGE ENOUGH TO MAKE ANGLE θ EQUAL TO OR LARGER THAN 45°.
2. DIMENSION "D" EQUALS APPROX. I.D. OF PIPE LESS 2". AN EFFORT SHOULD BE MADE TO PREVENT THE CONCRETE FROM COVERING THE MJ BOLTS.
3. WHERE BUTTRESSES ARE NOT POSSIBLE BECAUSE OF POOR SOIL CONDITIONS OR LACK OF ROOM, STRAPPING SHALL BE PERMITTED.
4. BUTTRESS DIMENSIONS ARE BASED ON A SOIL RESISTANCE OF TWO TONS PER SF AND A WATER PRESSURE OF 150 PSI.

BUTTRESS DIMENSIONS				
BD	A	B	C	D
6"	1'–6"	1'–2"	SEE NOTE 1	SEE NOTE 2
8"	2'–0"	1'–4"		
12"	2'–5"	1'–10"		
16"	3'–4"	2'–4"		
20"	4'–3"	2'–10"		
24"	5'–2"	3'–4"		
30"	6'–9"	4'–0"		

THRUST BLOCKING DETAILS

STANDARD DETAIL

STRAND ASSOCIATES®

01-975-92A

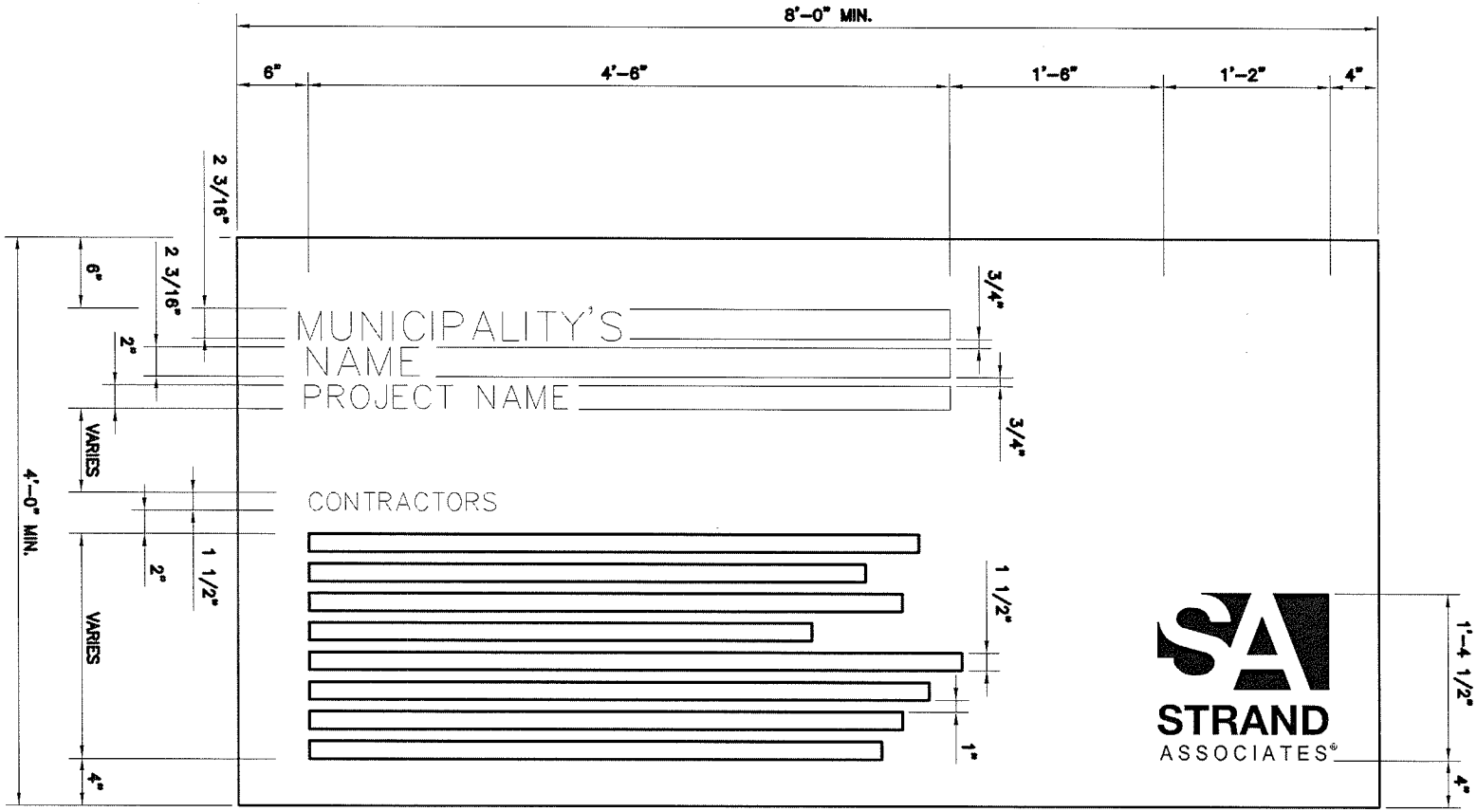
OCTOBER 2011

File: T:\MAD\APPS\ACAD\ALL-STRAND\STD-DWG\Madison Files\Std-092A.dwg Time: Oct 18, 2011 - 10:33am

File: T:\MAD\APPS\ACAD\ALL-STRAND\STD-DWG\Madison Files\Std-158A.dwg Time: Oct 18, 2011 - 10:34am

PROJECT SIGN LAYOUT

STANDARD DETAIL



NOTES:

BLUELINE FOR LOGO WILL BE FURNISHED TO CONTRACTOR FOR SIGN PAINTING.

SEE SPECIFICATIONS FOR SIGN CONSTRUCTION DETAILS AND SPECIAL REQUIREMENTS

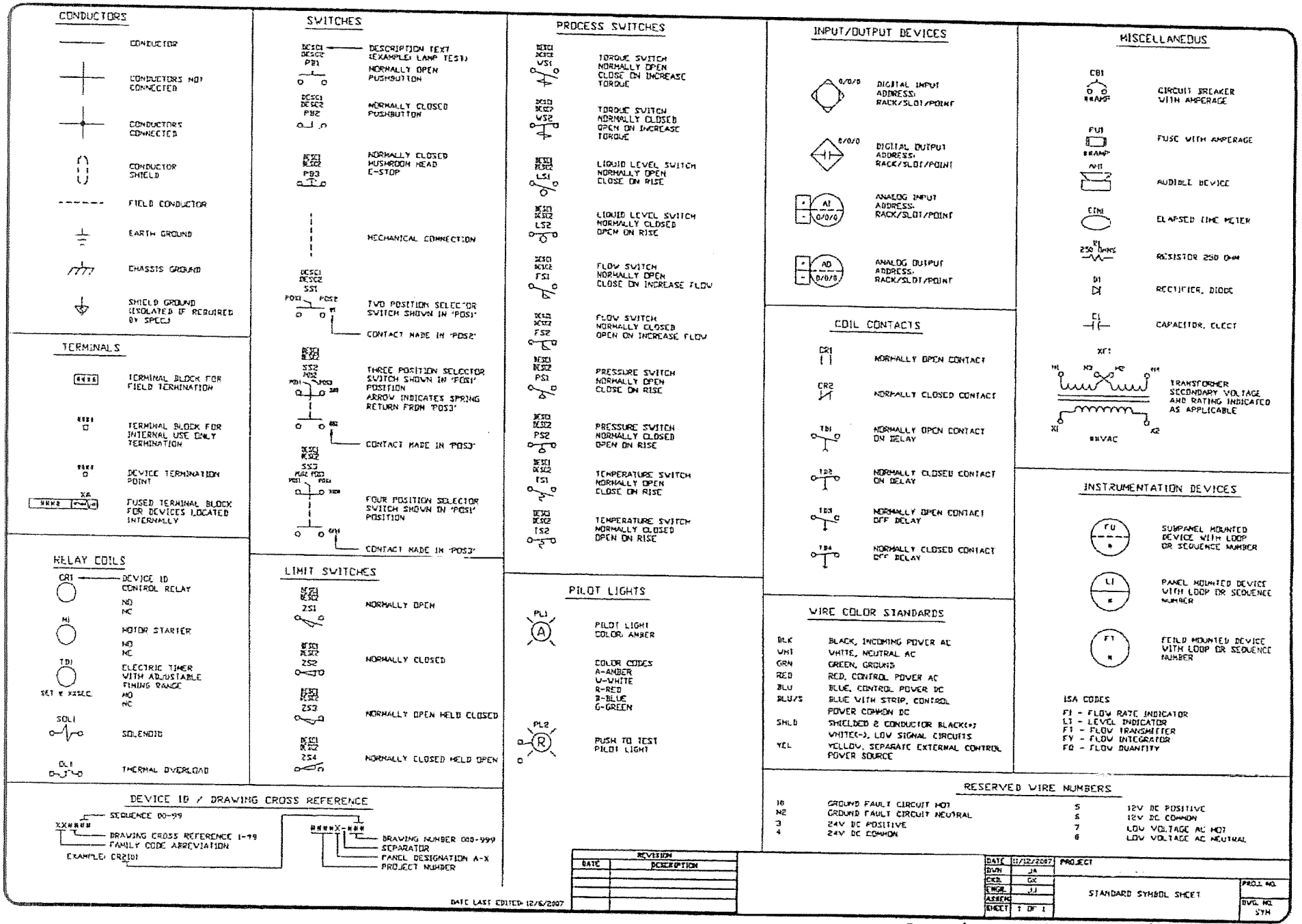
STANDARD COLORS ARE TO BE AS NOTED:
- "SA" LOGO = SLATE GRAY
- LETTERING = BLACK
- BACKGROUND = WHITE

STRAND ASSOCIATES®

01-975-158A

OCTOBER 2011

SAMPLE DRAWINGS



D-459

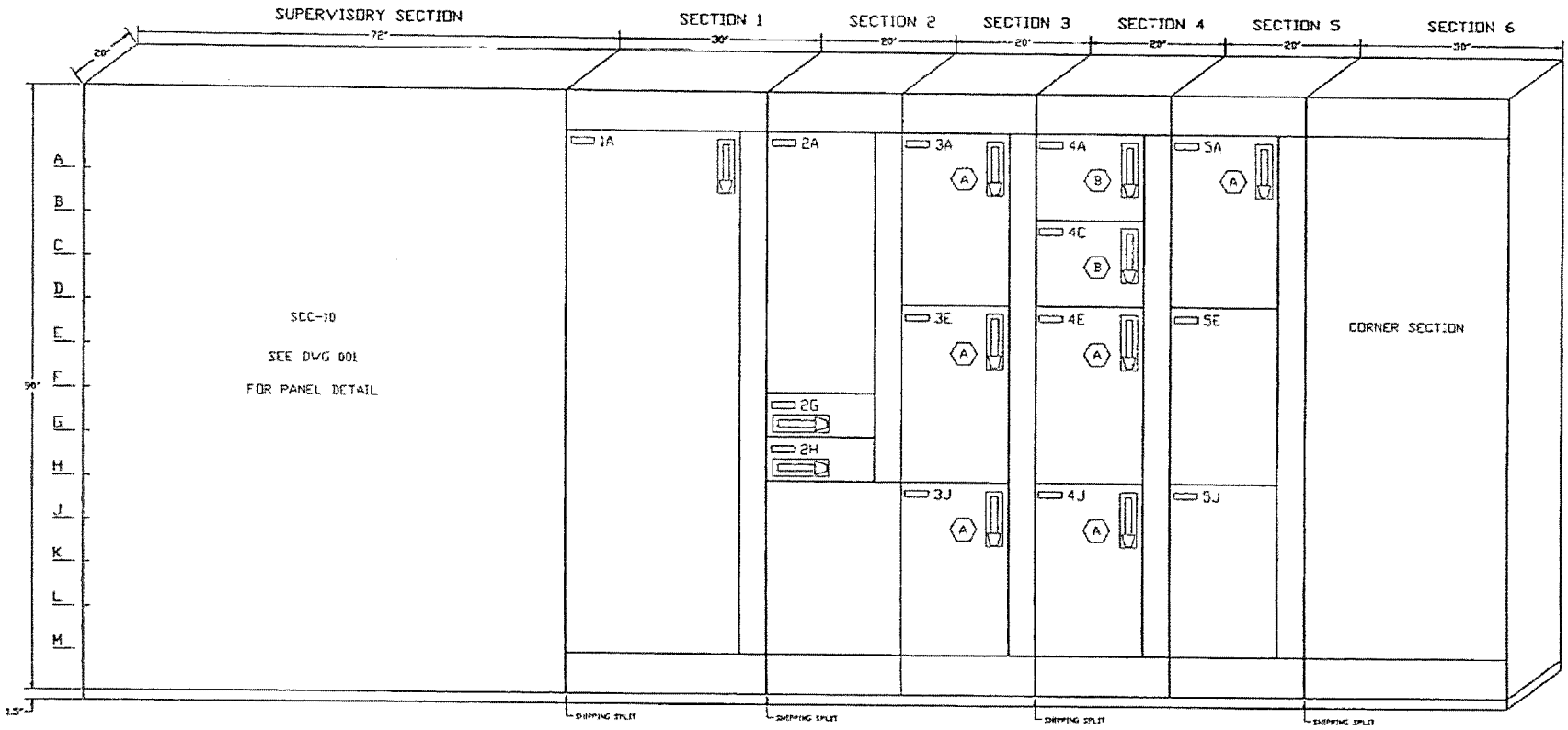
Sample Symbol sheet

Standard Abbreviations

Abbreviation	Description
A	Air Compressed
AC	Air Condition
AD	Auto Dialer
AH	Alarm Horn
AL	Alarm Light
AM	Amp Meter/Ammeter
ANN	Annunciator
AR	Alternating Relay
AWG	American Wire Gauge
BA	Battery
BLU	Blue
BRN	Brown
CA	Cable
CB	Circuit Breaker
CR	Control Relay
CT	Current Transformer
DB	Distribution Block
DI	Diode
DS	Disconnect Switch
EC	Electronic Control Device
ETM	Elapsed Time Meter
EN	Enclosure
FO	Fiber Optic
FS	Flow Switch
FU	Fuse
GFI	Ground Fault Interrupter
GND	Ground
GRN	Green
HTR	Heater
LA	Lightning Arrestor
LP	Lighting Panel
LR	Latching Relay
LS	Level Switch
MS	Motor Starter Contactor
M	Motor
NP	Nameplate
OIT	Operator Interface Terminal
OL or O/L	Overload
ORG	Orange

Abbreviation	Description
OV	Overvoltage
PB	Pushbutton
PC	Pull Cord
PC	Personal Computer
PFC	Power Factor Capacitor
PL	Pilot Light
PLC	Programmable Logic Controller
PM	Power or Phase Monitor
PN	Pneumatic
PR	Pressure Regulator
PS	Pressure Switch
PS	Power Supply
PSH	Pressure Switch High
PSL	Pressure Switch Low
REC	Receptacle
SP	Surge Protector
SS	Selector Switch
STP	Shielded Twisted Pair
SV	Solenoid Valve
TD	Time Delay Relay
TG	Toggle Switch
TS	Temperature Switch
TSP	Twisted Shielded Pair
TT	Temperature Transmitter
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair
VA	Voltampere
VFD	Variable
VM	Voltmeter
WHT	White
WS	Weight Switch
WT	Weight Transmitter
XFMR	Transformer
SI	Signal Isolator
SS	Speed Switch
ZS	Position Switch

Sample List of Abbreviations



NOTE: SEE DETAILS ON DRAWINGS 004 AND 005.

SCALE

0 15" 30" 60"

REVISION	
DATE	DESCRIPTION
6/13/05	RELEASE FOR CONSTRUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE LAST EDITED 2/15/2007

DATE	3/16/05
DWN	JA
CKD	GK
ENGR.	BA
ASSEM.	
SHEET	4 OF 149

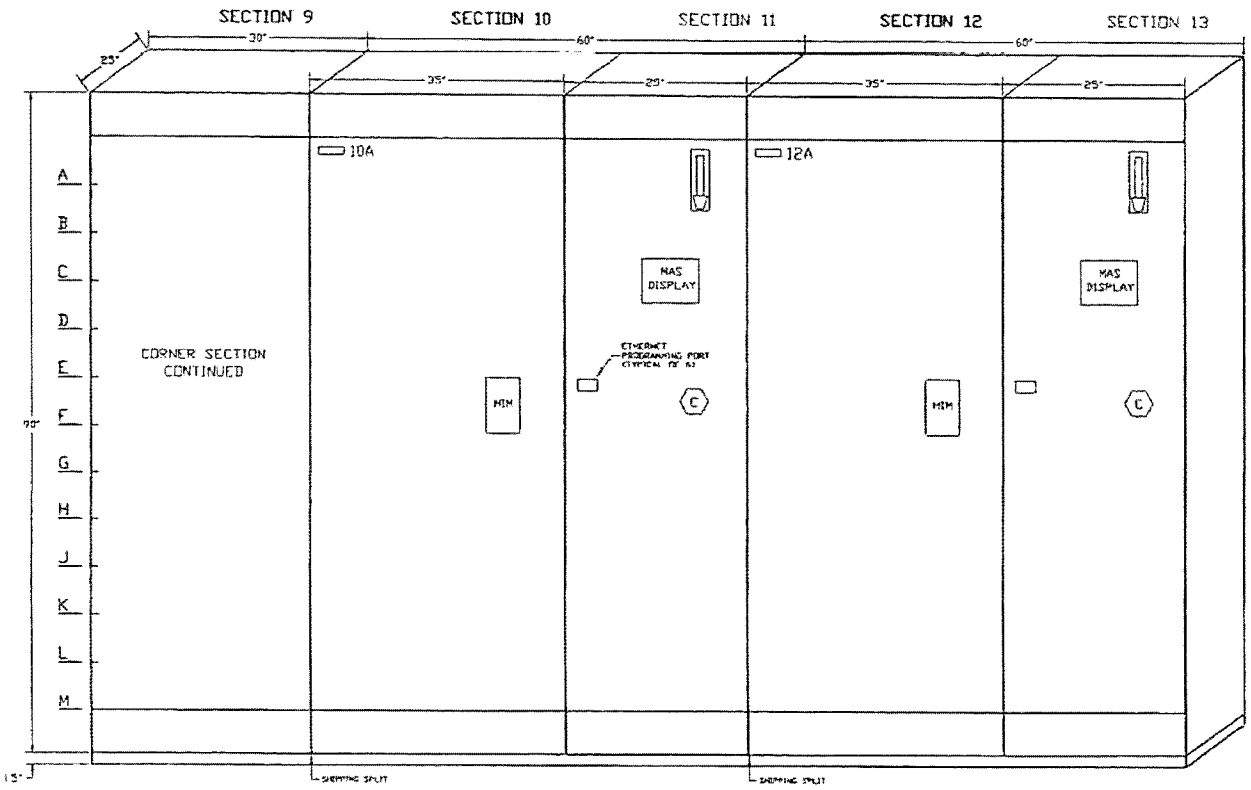
PROJECT

MCC-10
ELEVATION DETAIL

PROJ. NO. A

DWG. NO. 0038

Sample Exterior Layout Drawing



NOTE: SEE DETAILS ON DRAWINGS 004 AND 005.
SECTIONS 10 THROUGH 13 ARE MOUNTED BACK-TO-BACK
WITH SECTIONS 14 THROUGH 17.

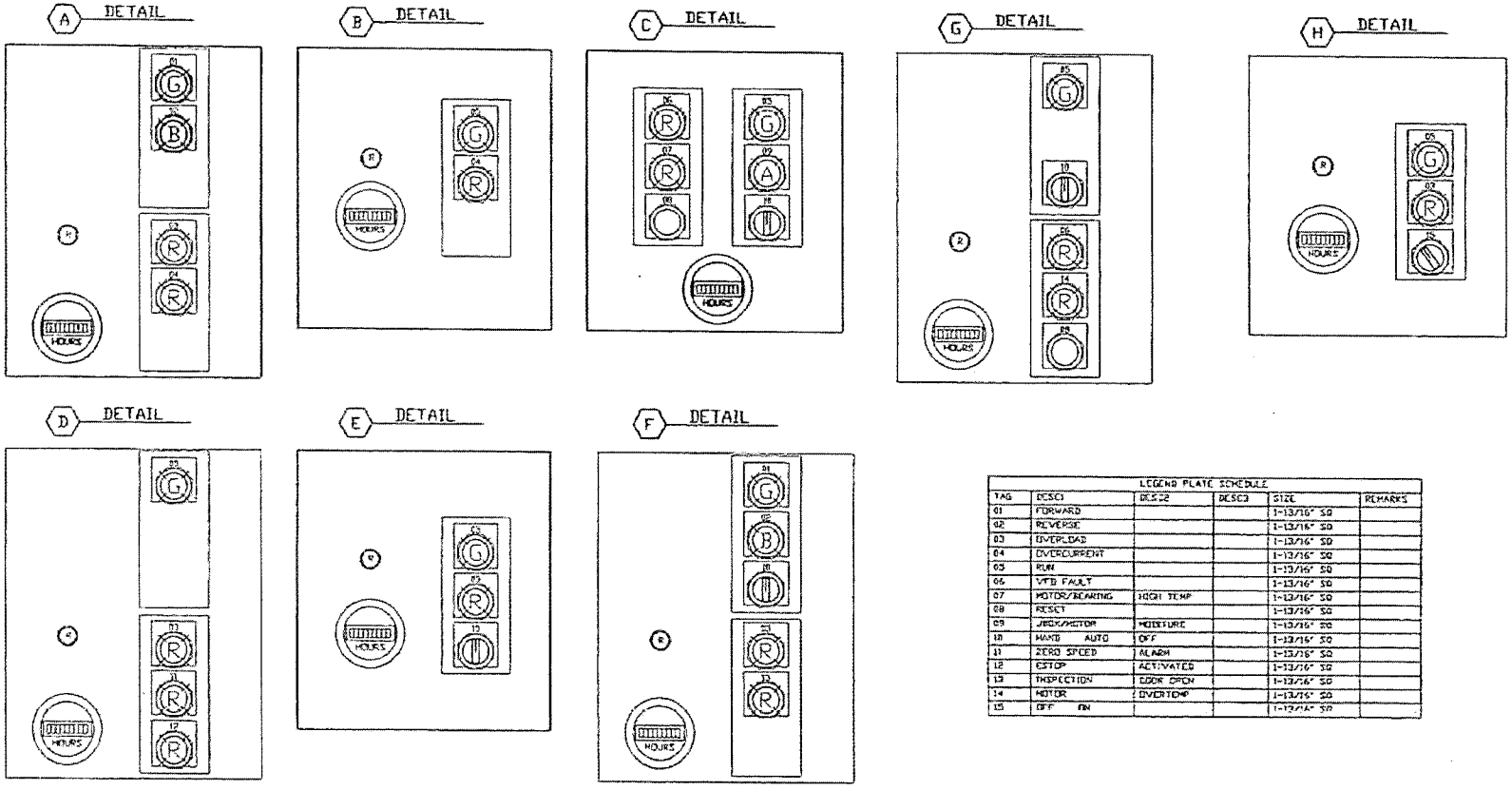
SCALE
0 15" 30" 60"

DATE LAST EDITED 2/15/2007

REVISION	
DATE	DESCRIPTION
6/13/05	RELEASE FOR CONSTRUCTION
7/26/06	AS BUILT
2/15/07	AS INSTALLED

DATE	3/16/06	PROJECT
DWN	JA	-
CKD	GK	MCC-10 ELEVATION DETAIL
ENGR	RA	PROJ. NO. -
ASSEM		DWG. NO. 003D
SHEET	6 OF 149	

Sample Exterior Layout Drawing



LEGEND PLATE SCHEDULE

TAG	DESC1	DESC2	DESC3	SIZE	REMARKS
01	FORWARD			1-13/16" SQ	
02	REVERSE			1-13/16" SQ	
03	OVERLOAD			1-13/16" SQ	
04	OVERCURRENT			1-13/16" SQ	
05	RUN			1-13/16" SQ	
06	VFD FAULT			1-13/16" SQ	
07	MOTOR/BEARING	HIGH TEMP		1-13/16" SQ	
08	RESET			1-13/16" SQ	
09	JACK/MOTOR	MOISTURE		1-13/16" SQ	
10	HAND AUTO	OFF		1-13/16" SQ	
11	ZERO SPEED	ALARM		1-13/16" SQ	
12	ESTOP	ACTIVATED		1-13/16" SQ	
13	INSPECTION	DOOR OPEN		1-13/16" SQ	
14	MOTOR	OVERTEMP		1-13/16" SQ	
15	OFF ON			1-13/16" SQ	

SCALE

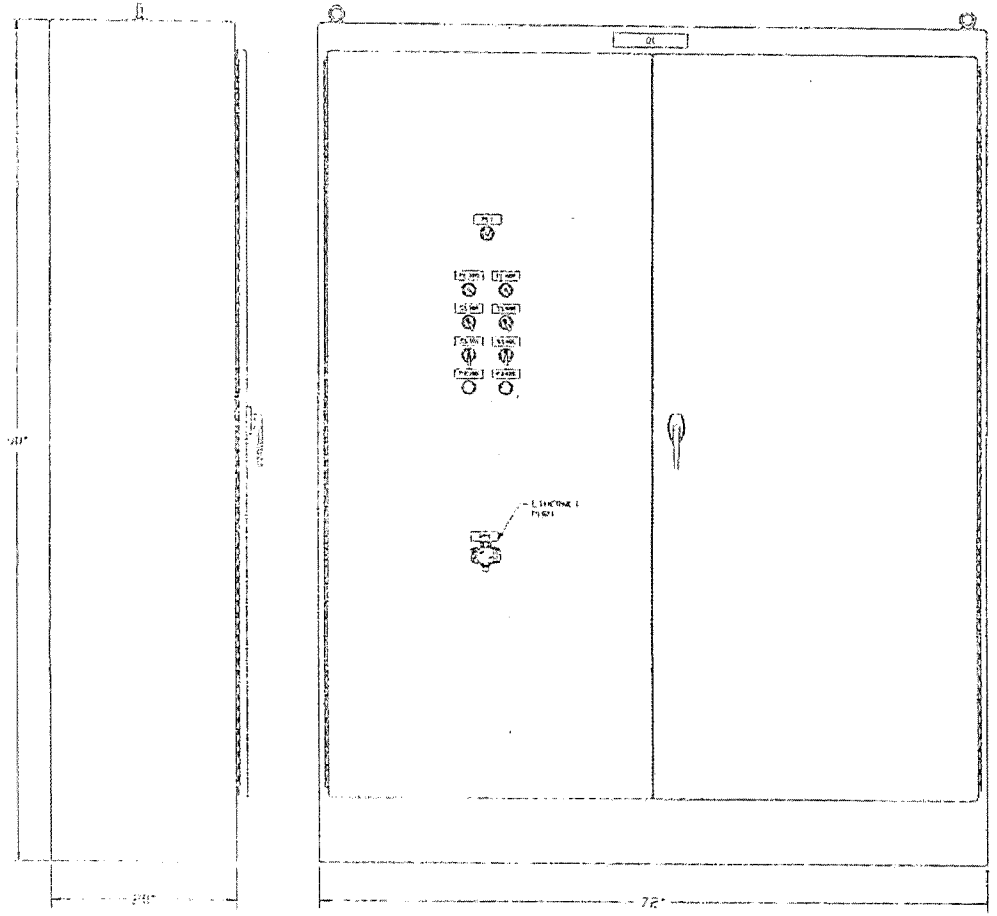
0 3" 6" 12"

REVISION	
DATE	DESCRIPTION
6/13/05	RELEASE FOR CONSTRUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE LAST EDITED 2/15/2007

DATE	3/16/06	PROJECT
DWN	JA	
CKD	DK	MCC-10 BUCKET DETAILS
ENGR.	RA	
ASSEM.		
SHEET	13 OF 149	PROJ. NO. / DWG. NO. 004

Sample Exterior Layout Drawing



SIDE VIEW

FRONT VIEW

NAMEPLATE SCHEDULE					
TAG	DESC1	DESC2	DESC3	SIZE	REMARKS
01	SCC-10			15x8	
PB300	RESET			1X3	
PB400	RESET			1X3	
PL1	POWER ON UPS			1X3	
PL300	INFLUENT	WET WELL NO1	BACKUP FLOATS ACTIVE	1X3	
PL400	INFLUENT	WET WELL NO2	BACKUP FLOATS ACTIVE	1X3	
SS300	BACKUP FLOATS	ON - AUTO		1X3	
SS301	LEAD PUMP	03 - AUTO - 05		1X3	
SS400	BACKUP FLOATS	ON - AUTO		1X3	
SS401	LEAD PUMP	04 - AUTO - 06		1X3	
RP1	ETHERNET	PROGRAMMING PORT		1X3	

NAMEPLATES ARE BLACK WITH WHITE LETTERS

NOTES

1. ENCLOSURE IS A NEMA TYPE 12 FREESTANDING (KEPTNAY & 902240FSS WITH WAFER PANEL (HOFFMAN A-60P72C)
2. FINISH IS ANSI 61 GRAY
3. [illegible] 317536

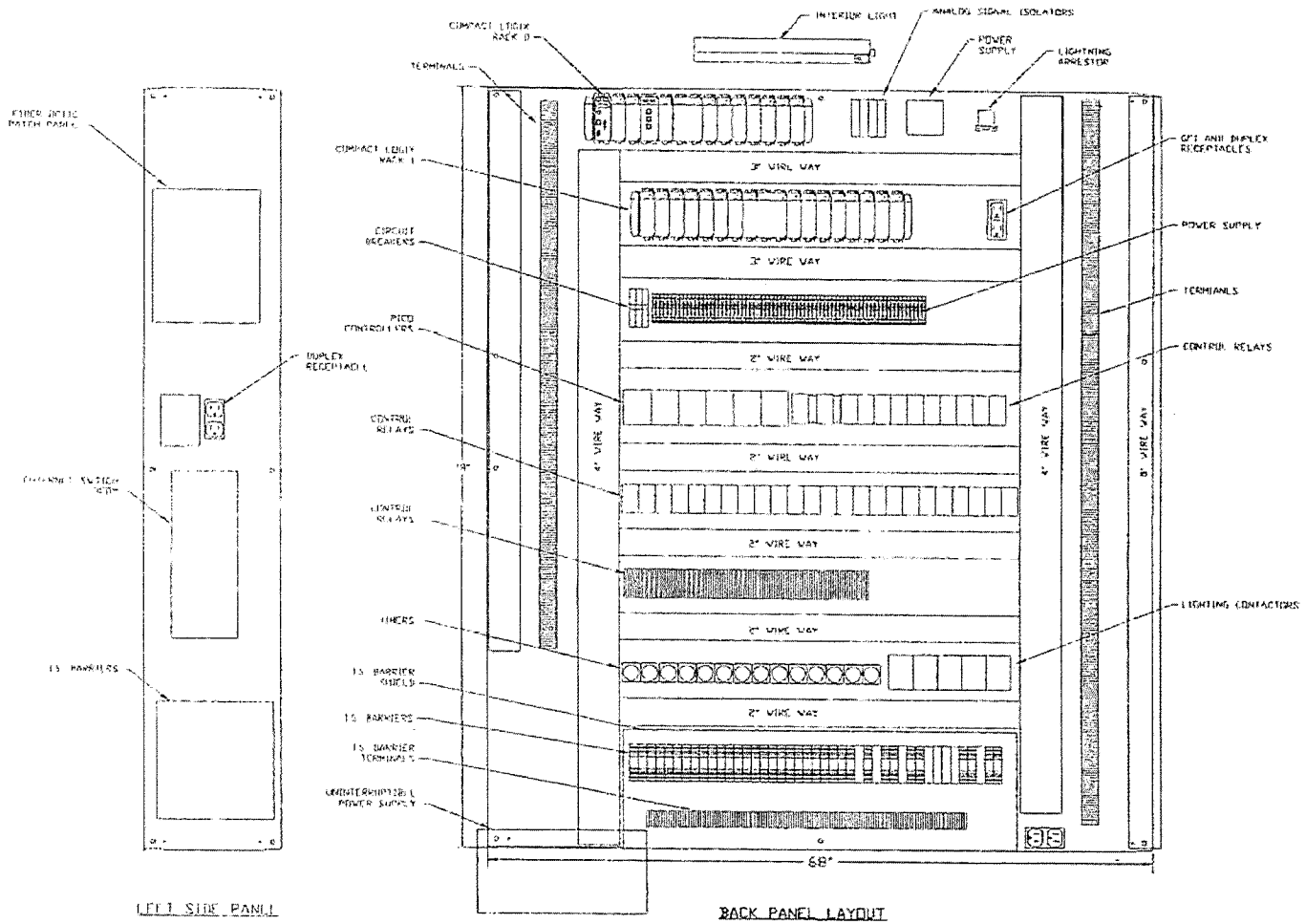
SCALE

REVISION	
DATE	DESCRIPTION
6/12/05	RELEASE FOR CONSTRUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE LAST EDITED 2/15/2007

DATE	3/16/06	PROJECT
DWN	AA	
CKD	DK	SCC-10 ENCLOSURE BETA1
ENGR	BA	PROJ. NO.
ASSEM		DWG. NO. 001
SHEET	1 OF 149	

Sample Exterior Layout Drawing



SCALE

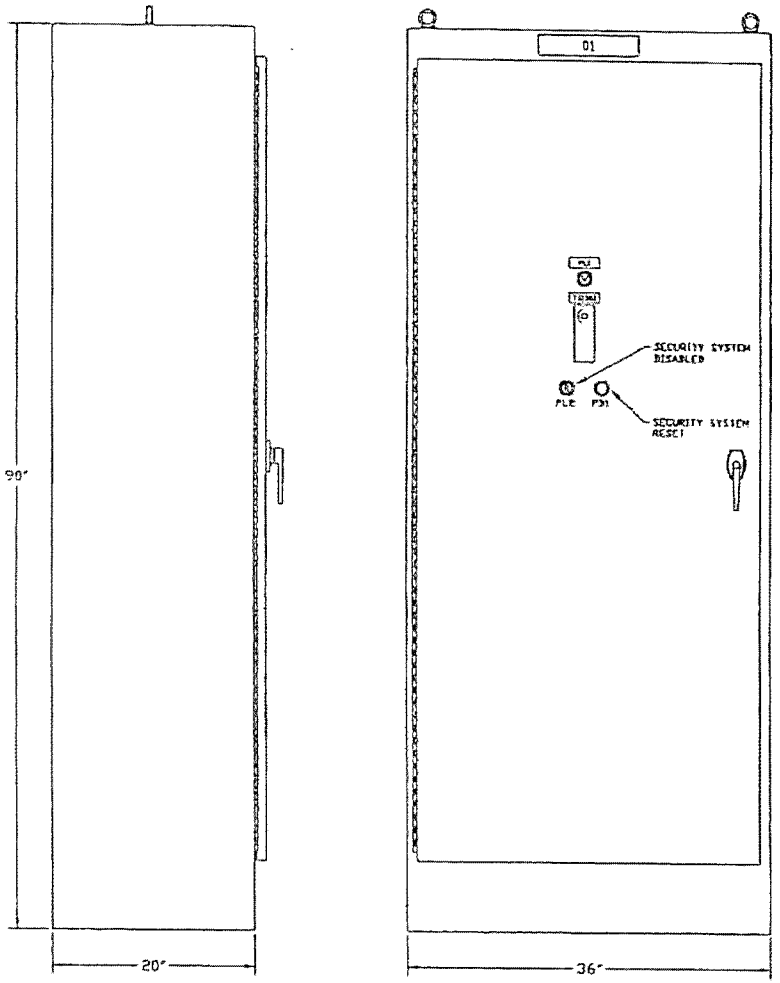
0 6" 12" 24"

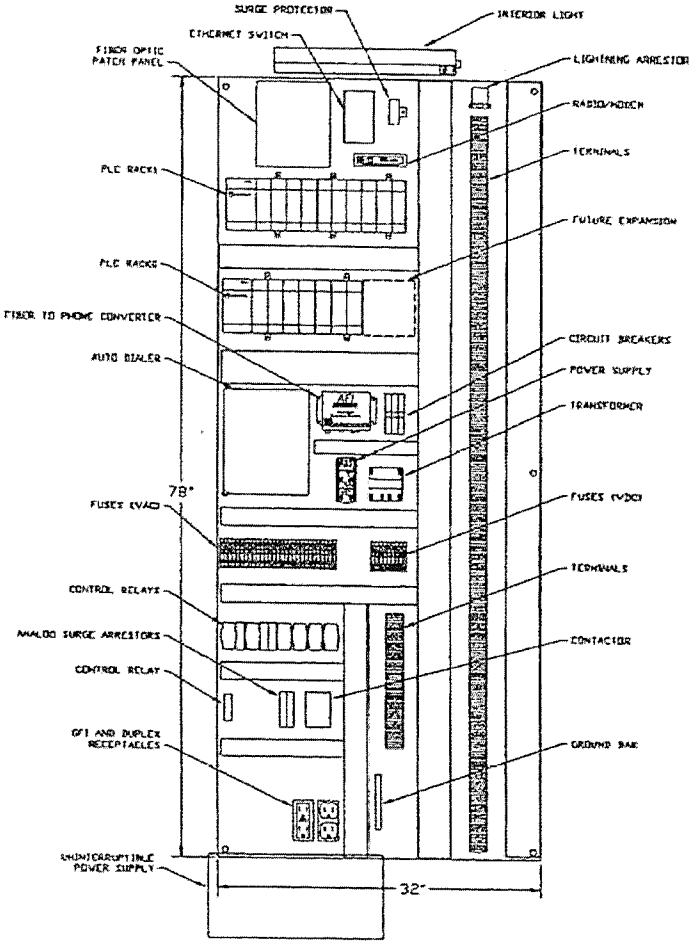
REVISION	
DATE	DESCRIPTION
6/10/05	RELEASE FOR CONSTRUCTION
7/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE LAST EDITED 2/15/2007

DATE	2/15/06	PROJECT
DWN	JR	
DES.	GK	SCC-10 BACK PANEL LAYOUT
ENGR.	BA	PROJ. NO.
ASSEM.		DWG. NO. 1012
SHEET	2 OF 149	

Sample Interior Layout Drawing





PANEL LAYOUT

NOTES:

1. ENCLOSURE IS A NEMA TYPE 12 FREESTANDING HOFFMAN A90G20FS, WITH INNER PANEL HOFFMAN A90P36FL
2. FINISH IS ANSI 61 GRAY.
3. UL 508A

NAMEPLATE SCHEDULE

TAG	LINE 1	LINE 2	LINE 3	SIZE	REMARKS
DI	SCC-MAIN			2x10	
PLI	POWER ON UPS			1X3	
TR1548	LOW BUILDING TEMPERATURE			1X3	

NAMEPLATES ARE BLACK WITH WHITE LETTERS

SCALE

0 6" 12" 24"

SUBMITTAL USE ONLY
NOT FOR CONSTRUCTION
DATE LAST EDITED: 12/6/2007

REVISION	
DATE	DESCRIPTION

DATE	11/12/2007
DWN	JA
CKD.	GK
ENGR.	JJ
ASSIGN.	
SHEET	1 OF 24

PROJECT

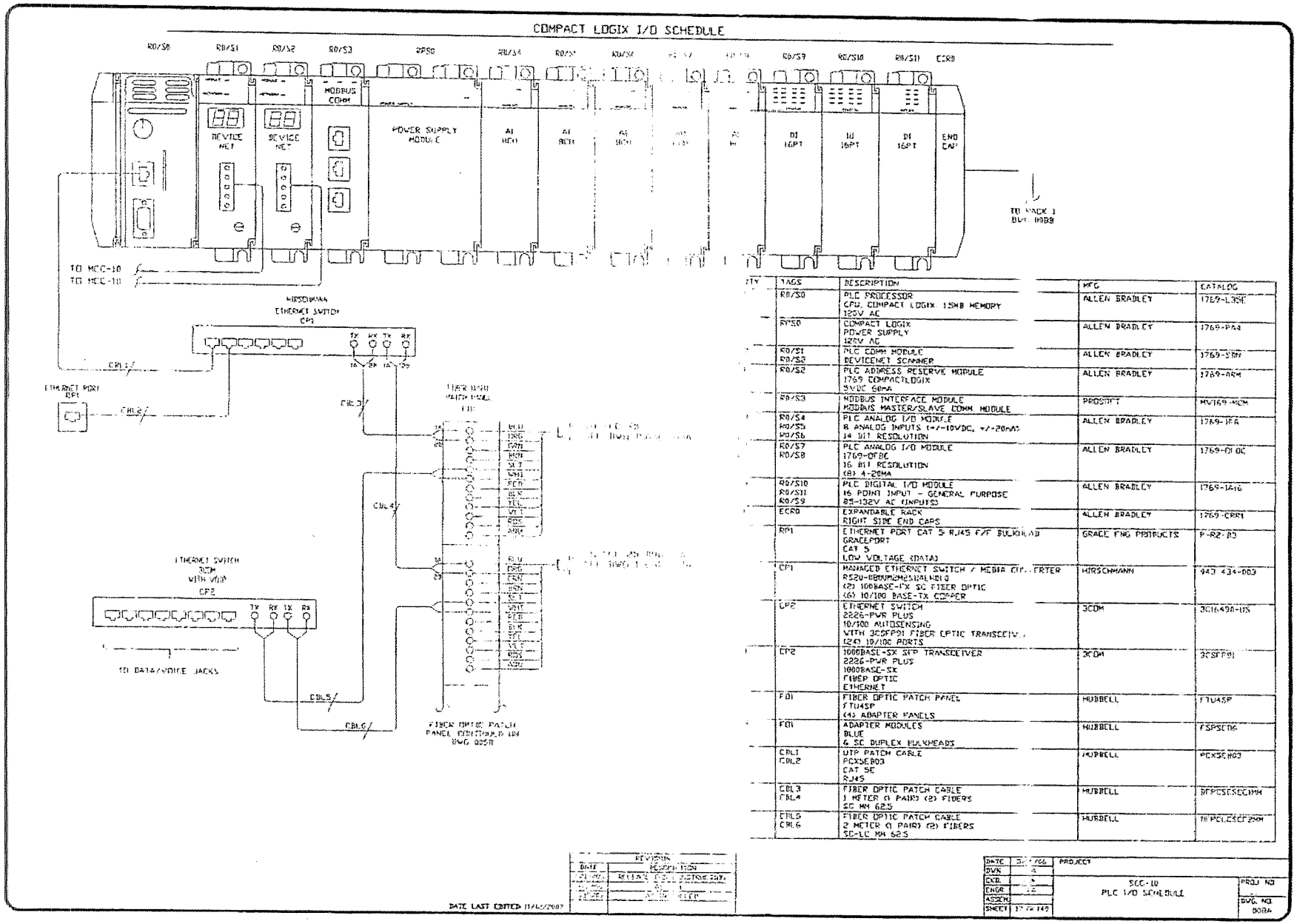
SCC-MAIN ENCLOSURE DETAIL

PROJ. NO.

DWG. NO. 001

D466

Sample Exterior and Interior Layout



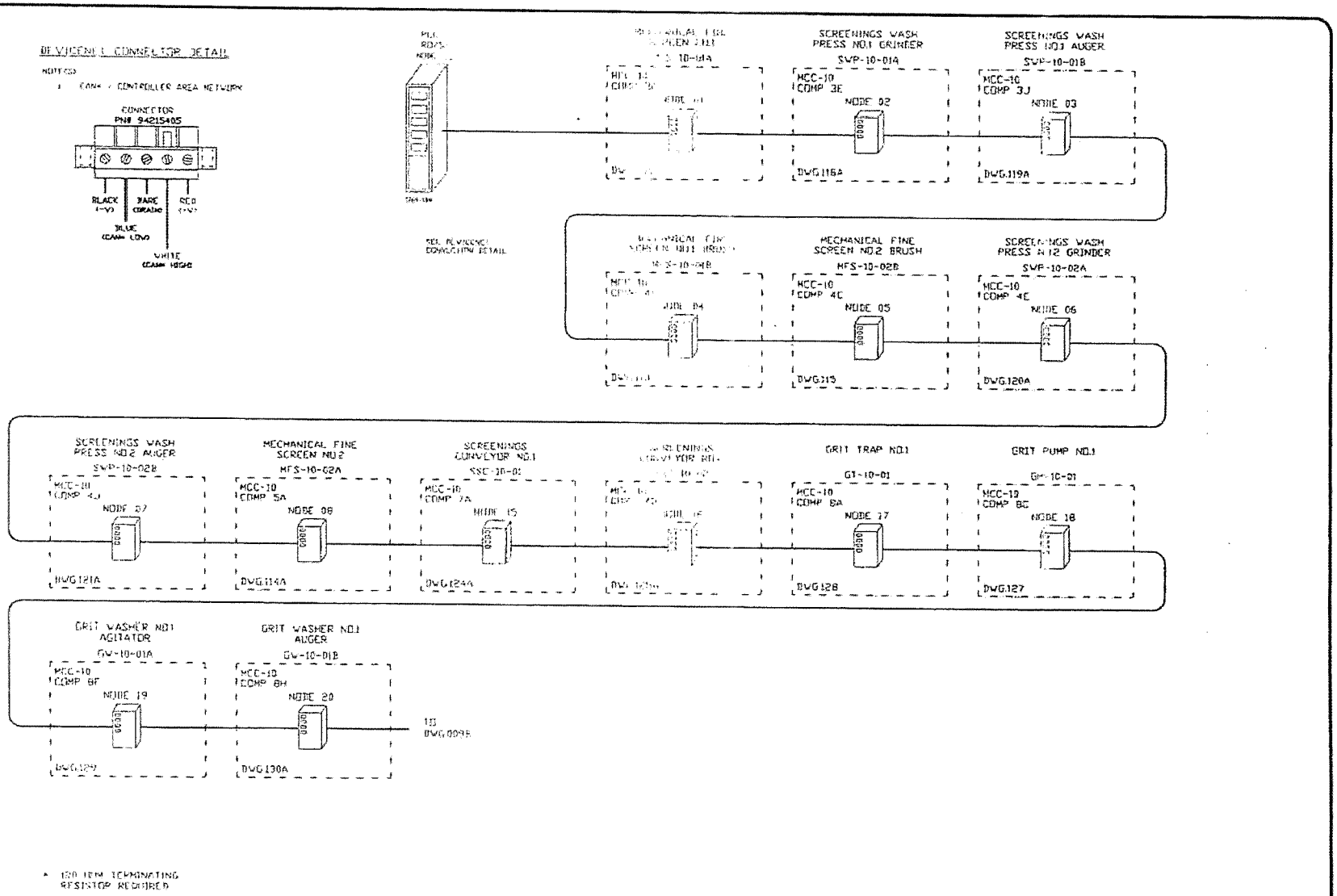
QTY	TAGS	DESCRIPTION	MFG	CATALOG
	RO/S0	PLC PROCESSOR CPU, COMPACT LOGIX 1.5MB MEMORY 120V AC	ALLEN BRADLEY	1769-L35E
	RYS0	COMPACT LOGIX POWER SUPPLY 120V AC	ALLEN BRADLEY	1769-PA4
	RO/S1 RO/S2	PLC COMM MODULE DEVICENET SCANNER	ALLEN BRADLEY	1769-SDN
	RO/S2	PLC ADDRESS RESERVE MODULE 1769 COMPACTLOGIX 5VDC 60mA	ALLEN BRADLEY	1769-ARM
	RO/S3	MODBUS INTERFACE MODULE MODBUS MASTER/SLAVE COMM MODULE	PROSOFT	MVI69-MCM
	RO/S4 RO/S5 RO/S6	PLC ANALOG I/O MODULE 8 ANALOG INPUTS (+/-10VDC, +/-20mA) 14 BIT RESOLUTION	ALLEN BRADLEY	1769-IF8
	RO/S7 RO/S8	PLC ANALOG I/O MODULE 1769-OF8C 16 BIT RESOLUTION (8) 4-20MA	ALLEN BRADLEY	1769-OF8C
	RO/S10 RO/S11 RO/S9	PLC DIGITAL I/O MODULE 16 POINT INPUT - GENERAL PURPOSE 85-132V AC (INPUTS)	ALLEN BRADLEY	1769-IA16
	ECRO	EXPANDABLE RACK RIGHT SIDE END CAPS	ALLEN BRADLEY	1769-CRR1
	RP1	ETHERNET PORT CAT 5 RJ45 F/F BULKHEAD GRACEPORT CAT 5 LOW VOLTAGE (DATA)	GRACE ENG PRODUCTS	P-R2-R0
	CP1	MANAGED ETHERNET SWITCH / MEDIA CONVERTER RS20-0800M2M2SAUHDLO (2) 100BASE-FX SC FIBER OPTIC (6) 10/100 BASE-TX COPPER	HIRSCHMANN	943 434-003
	CP2	ETHERNET SWITCH 2226-PWR PLUS 10/100 AUTOSENSING WITH 3CSFP91 FIBER OPTIC TRANSCEIVER (24) 10/100 PORTS	3COM	3C16498-US
	CP2	1000BASE-SX SFP TRANSCEIVER 2226-PWR PLUS 1000BASE-SX FIBER OPTIC ETHERNET	3COM	3CSFP91
	FO1	FIBER OPTIC PATCH PANEL FTU4SP (4) ADAPTER PANELS	HUBBELL	FTU4SP
	FO1	ADAPTER MODULES BLUE 6 SC DUPLEX BULKHEADS	HUBBELL	FSPSCDB
	CBL1 CBL2	UTP PATCH CABLE PCXSE803 CAT 5E RJ45	HUBBELL	PCXSE803
	CBL3 CBL4	FIBER OPTIC PATCH CABLE 1 METER (1 PAIR) (2) FIBERS SC-MM 62.5	HUBBELL	FFPSCSCCIMM
	CBL5 CBL6	FIBER OPTIC PATCH CABLE 2 METER (1 PAIR) (2) FIBERS SC-LC MM 62.5	HUBBELL	FFPCLCSCF2MM

DATE LAST EDITED 11/15/2007

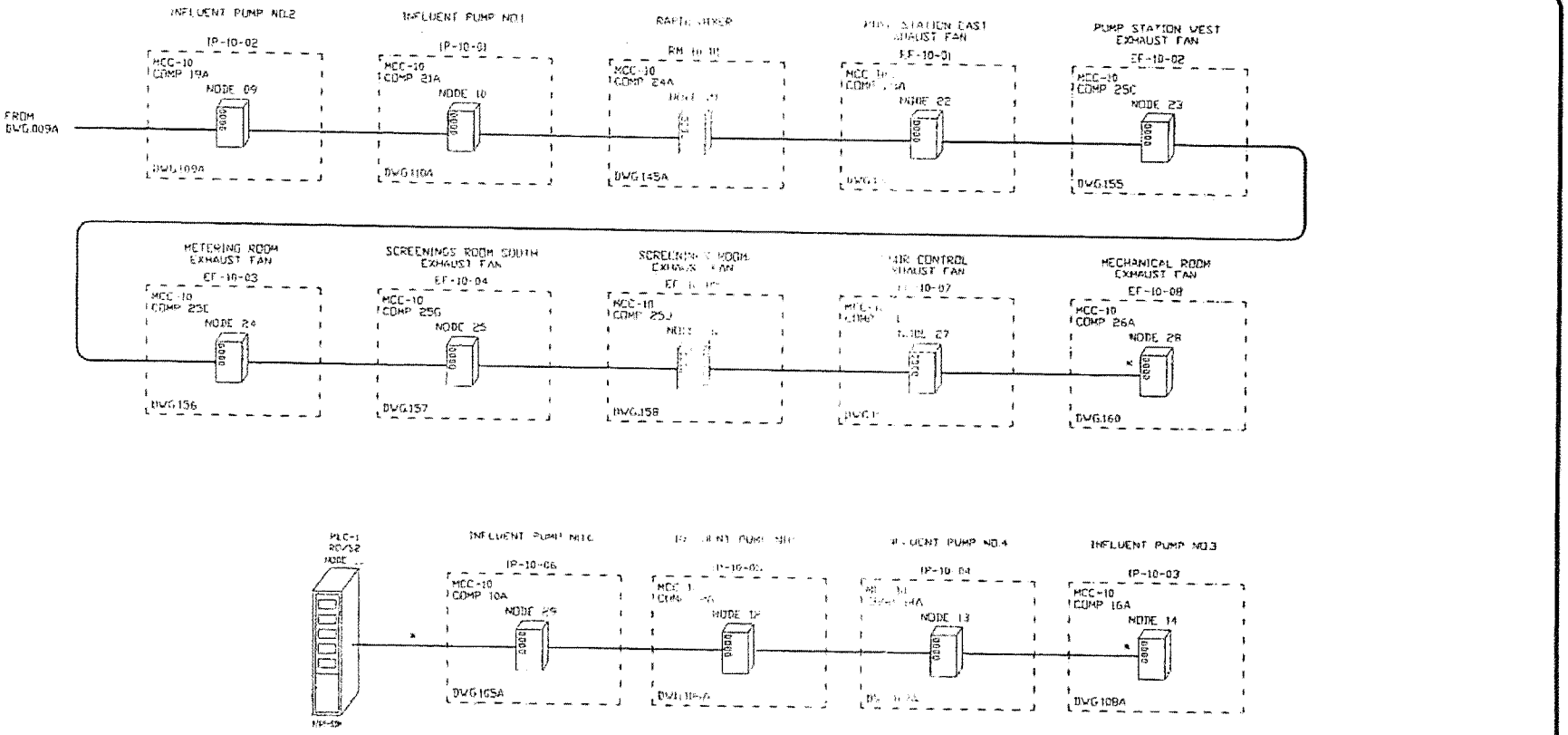
REVISION			
DATE	DESCRIPTION		
[illegible]	[illegible]	[illegible]	[illegible]

DATE	5/[illegible]/06	PROJECT	
DWN	[illegible]	SCC-10 PLC I/O SCHEDULE	PROJ NO
CKD	[illegible]		DWG NO 9088
ENGR	[illegible]		
ASSOC			
SHEET	1 OF [illegible]		

Sample Interconnection Diagram



Sample Network Diagram



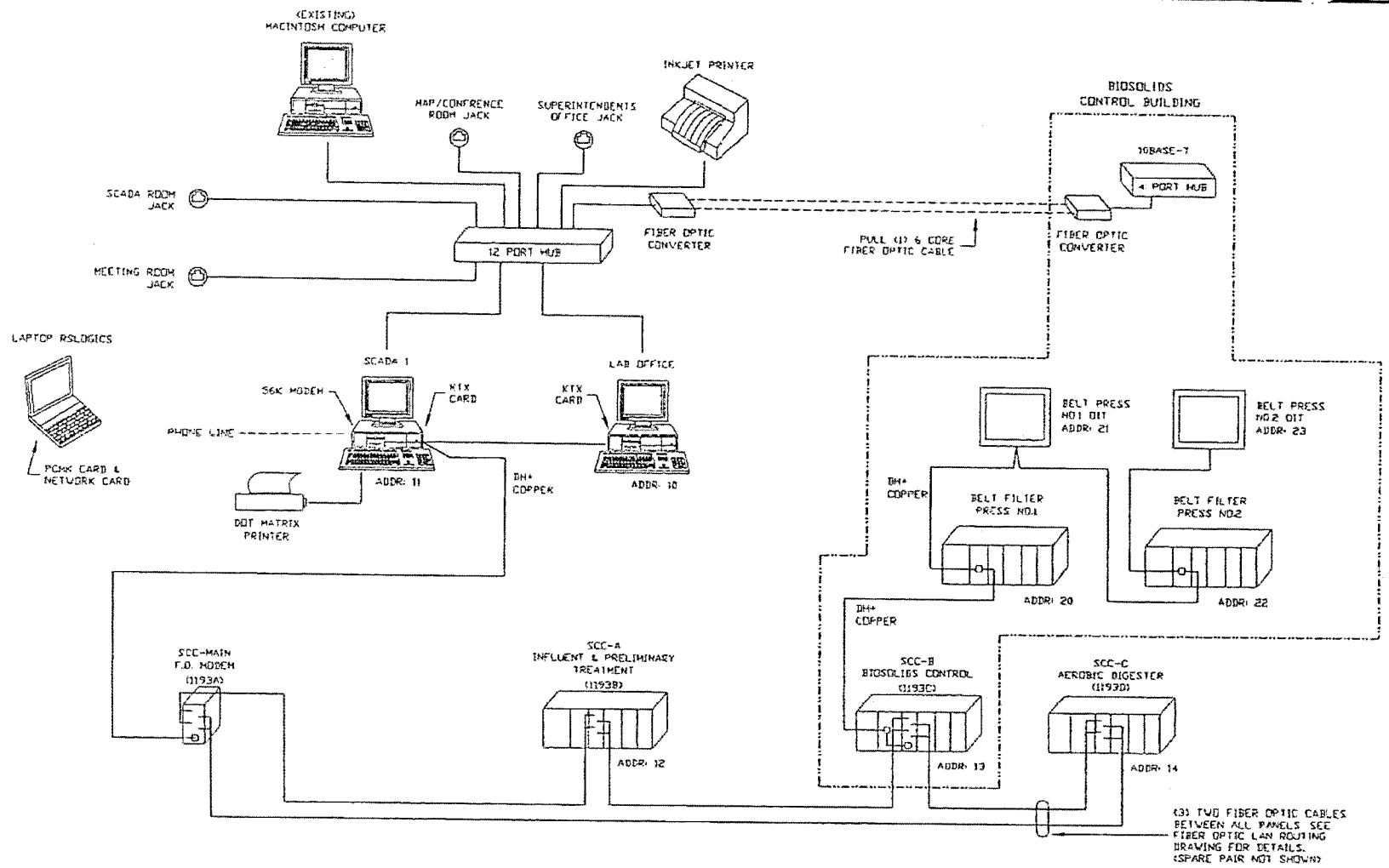
* 120 OHM TERMINATING RESISTOR REQUIRED

REVISION		
DATE	DESCRIPTION	
RELEASE TYPE	DISTRIBUTION	
AS-BUILT		
AS INSTALLED		

DATE LAST EDITED: 7/16/2008

DATE	3/16/06	PROJECT
DWN	JS	
CKD	MC	
ENGR	JS	MCC-10 DEVICENET NODE ADDRESSING
ASSEM		
SHEET	28 OF 149	PROJ. NO.
		DWG. NO. 0098

Sample Network Diagram



D-470

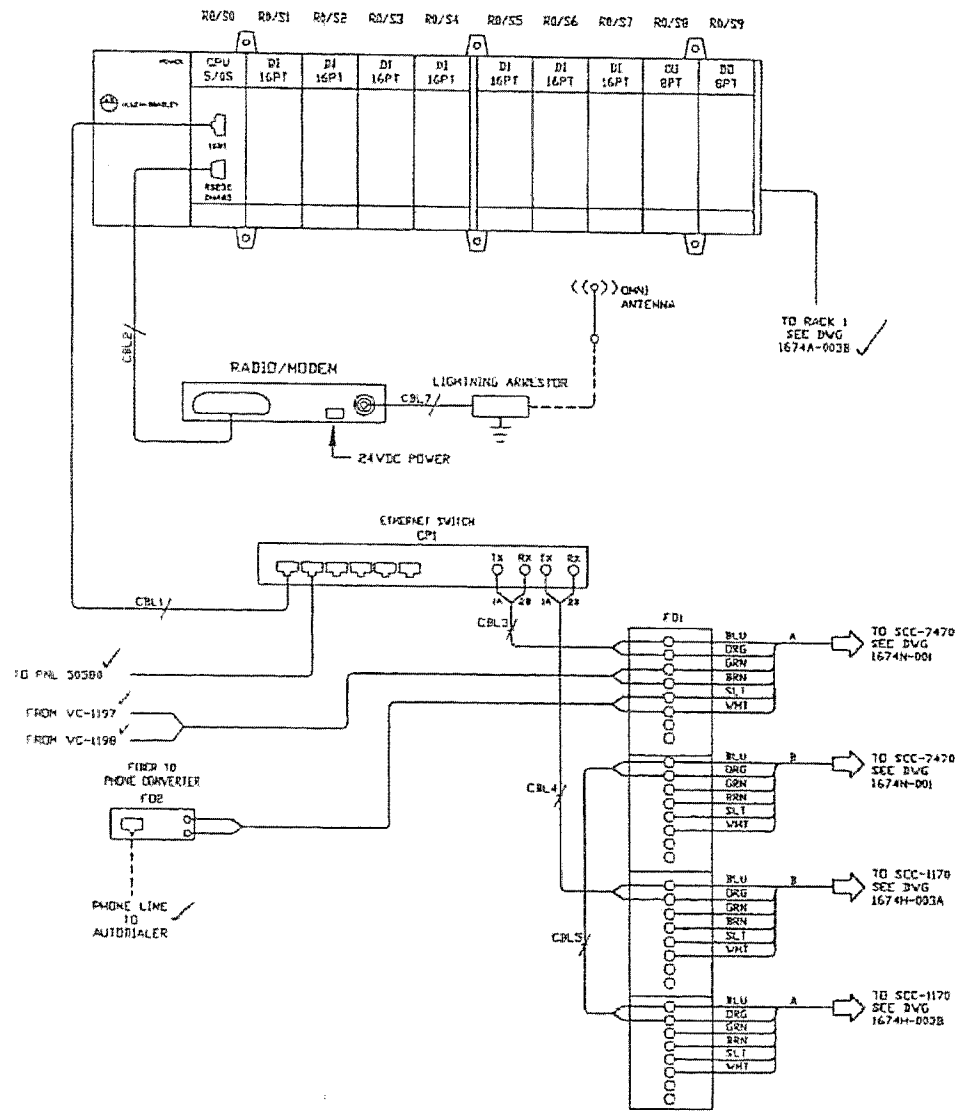
REVISION	
DATE	DESCRIPTION

DATE	3/12/01	PROJECT
DWN	JA	
CKD.	GK	SCADA SYSTEM LAYOUT
ENGR.	PE	PROJ. NO.
ASSGN.		
SHEET	OF	DWG. NO. 001

DATE LAST EDITED: 02/09/01

Sample Network Diagram

SLC500 I/O SCHEDULE



QTY	TAGS	DESCRIPTION	MFG	CATALOG
1	R0	PLC RACK 10 SLOT BASE RACK	ALLEN BRADLEY	1746-A10
1	RPS0	PLC POWER SUPPLY RACK POWER SUPPLY (5A @ 5VDC) 120/240V AC	ALLEN BRADLEY	1746-P2
1	R0/S0	PLC CPU WITH ETHERNET CPU S/05 WITH 32K MEMORY	ALLEN BRADLEY	1747-L552
7	R0/S1 R0/S2 R0/S3 R0/S4 R0/S5 R0/S6 R0/S7	PLC DIGITAL I/O MODULE 16 POINT INPUT - GENERAL PURPOSE 85-132V AC	ALLEN BRADLEY	1746-IA16
2	R0/S8 R0/S9	PLC DIGITAL I/O MODULE 8 POINT RELAY CONTACT OUTPUT (ISOLATED) 3A @ 120V AC	ALLEN BRADLEY	1746-OX8
1	CP1	8 PORT ETHERNET HUB RS20-0800M2M2SAEHH01.0 10/100 MBIT/S AUTOSENSING (2) SC DUPLEX FIBER OPTIC (6) RJ45 PORTS	HIRSCHMANN	943 434-021
1	FD1	FIBER OPTIC PATCH PANEL, BLACK SVIC3-H	SIEMON COMPANY	SVIC3-N-01
4	FD1	ST BULKHEAD CONNECTOR MODULE RIC-F-SCB-01	SIEMON COMPANY	RIC-F-SCB-01
1	FD2	TELEPHONE LINE EXTENDER 86 SERIES 12VAC 500mA N/A N/A	AMERICAN FIBERTEK	MT-86CC
1	CBL1	UTP PATCH CABLE PCXSE CAT 5E RJ45	HUBBELL	PCX5EB03
1	CBL2	SERIAL COMMUNICATIONS CABLE 1001 3 FEET D59F/D59M STRAIGHT THROUGH	CABLE WHOLESALE	1001-03203
3	CBL3 CBL4 CBL5	FIBER OPTIC PATCH CABLE 1 METER (1 PAIR) 62 FIBERS SC MM 62.5 SC MM 62.5	HUBBELL	DFPCSCSCC1MM
1	CBL7	ANTENNA CABLE RG142B/U RG142 - 3FT LENGTH NMALE - TNC	TESSCO	448350

SUBMITTAL USE ONLY
NOT FOR CONSTRUCTION
DATE LAST EDITED: 12/6/2007

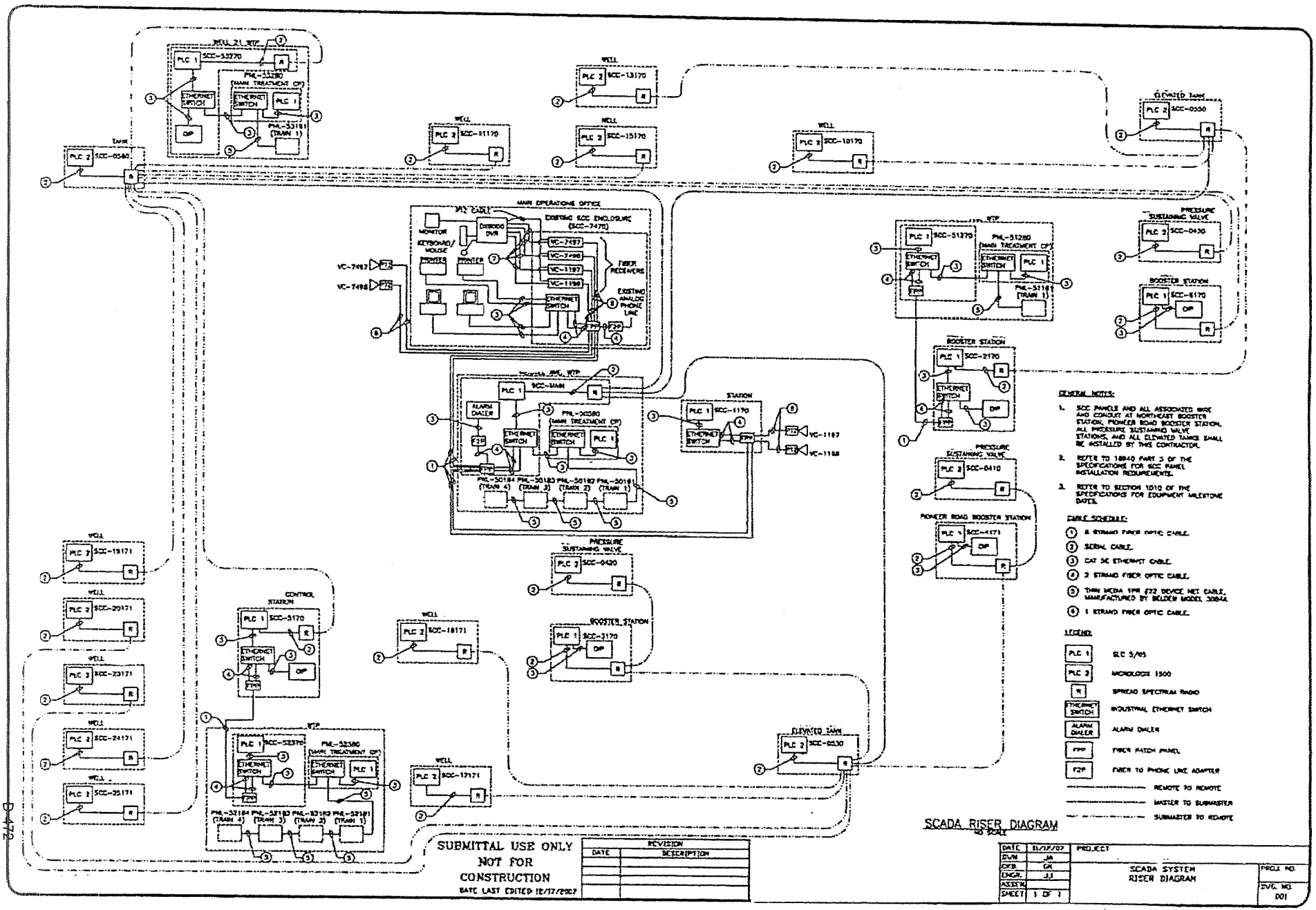
REVISION	
DATE	DESCRIPTION

DATE	11/12/2007
DWN	JA
DES.	GK
ENGR.	JJ
ASSEM.	
SHEET	3 OF 34

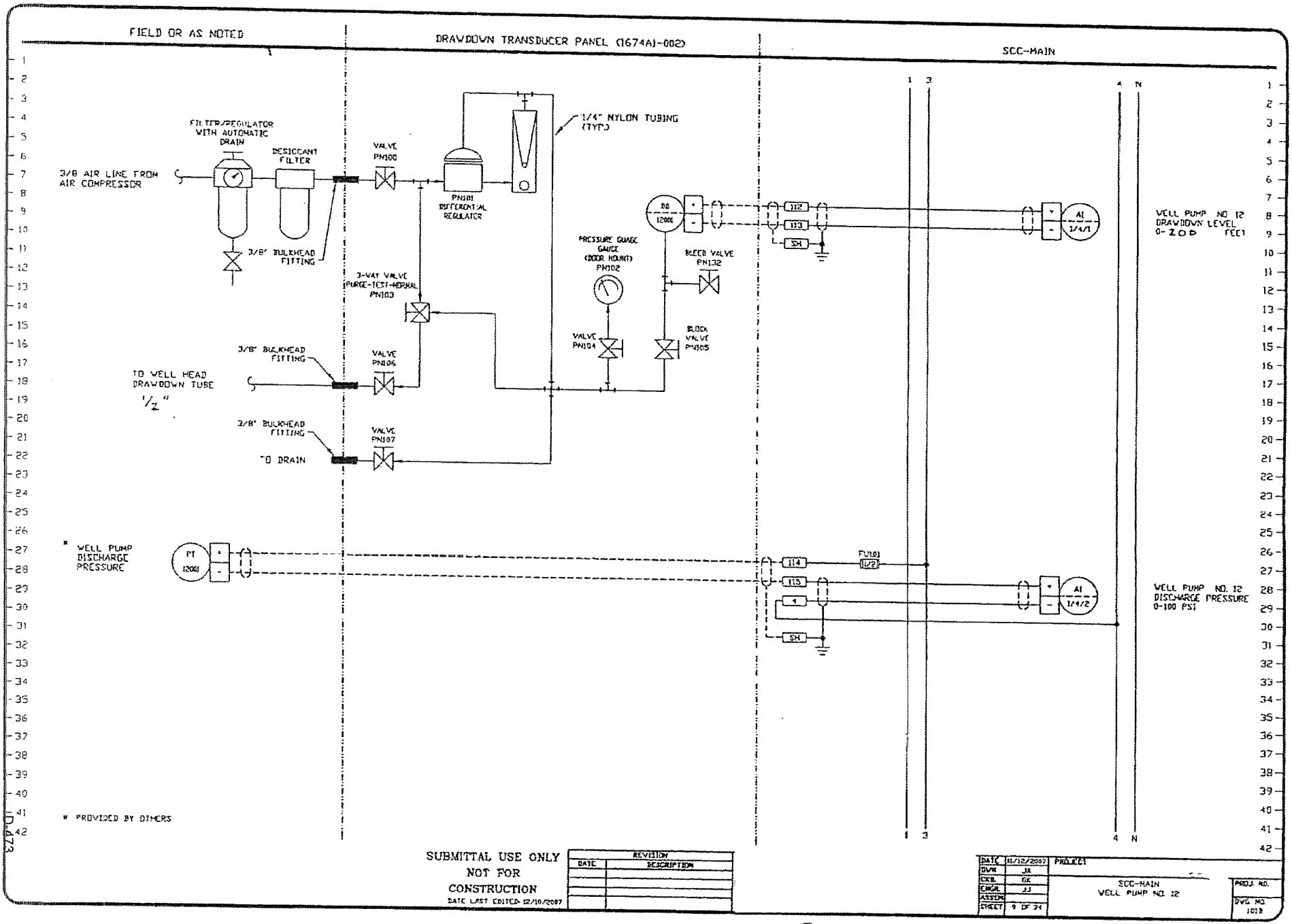
PROJECT
SCC-MAIN
PLC I/O SCHEDULE
PROJ. NO.
DWG. NO. 003A

D-471

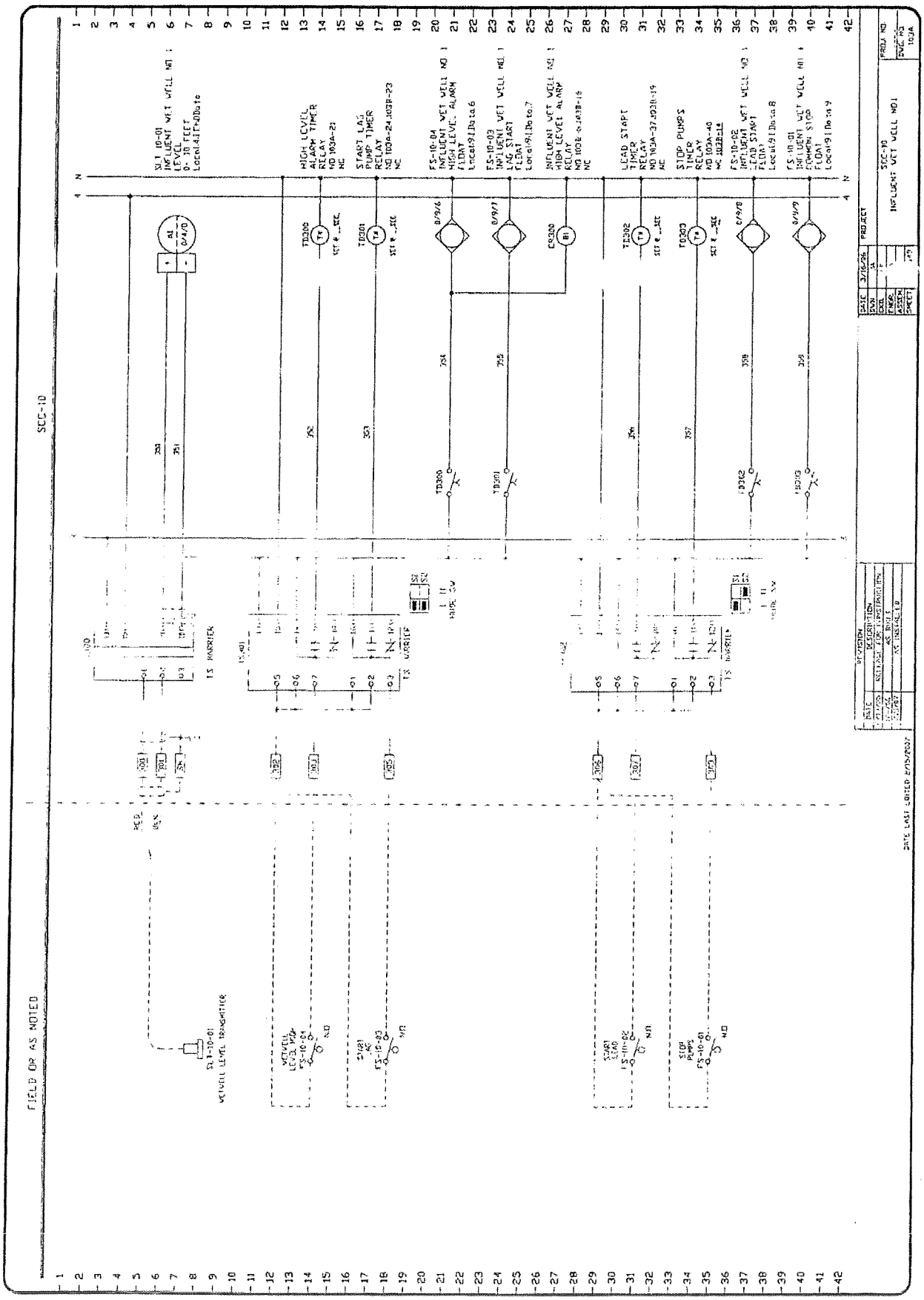
Sample Interconnection Diagram



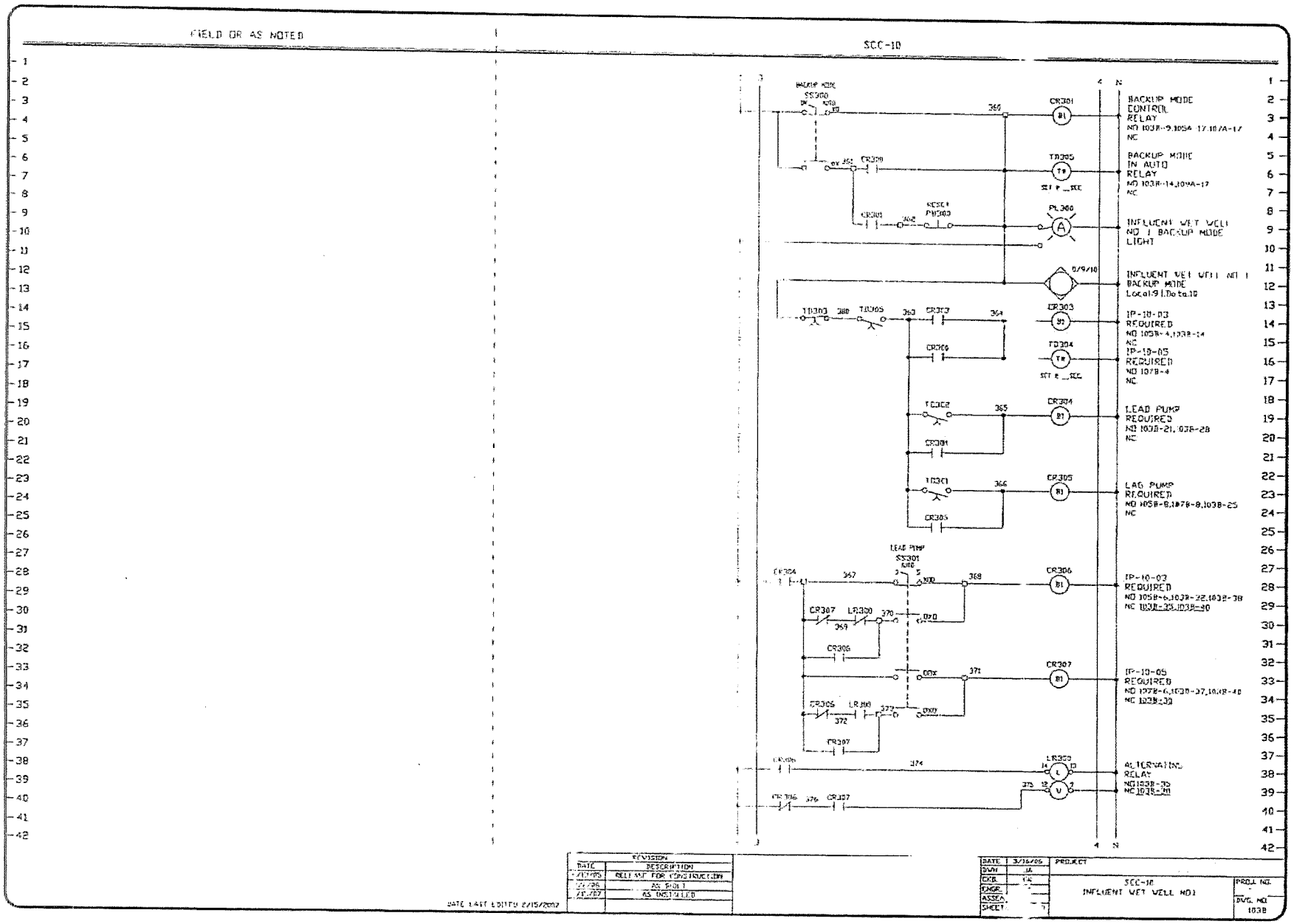
Sample Interconnection Diagram



Sample Elementary schematic



Sample Elementary schematic



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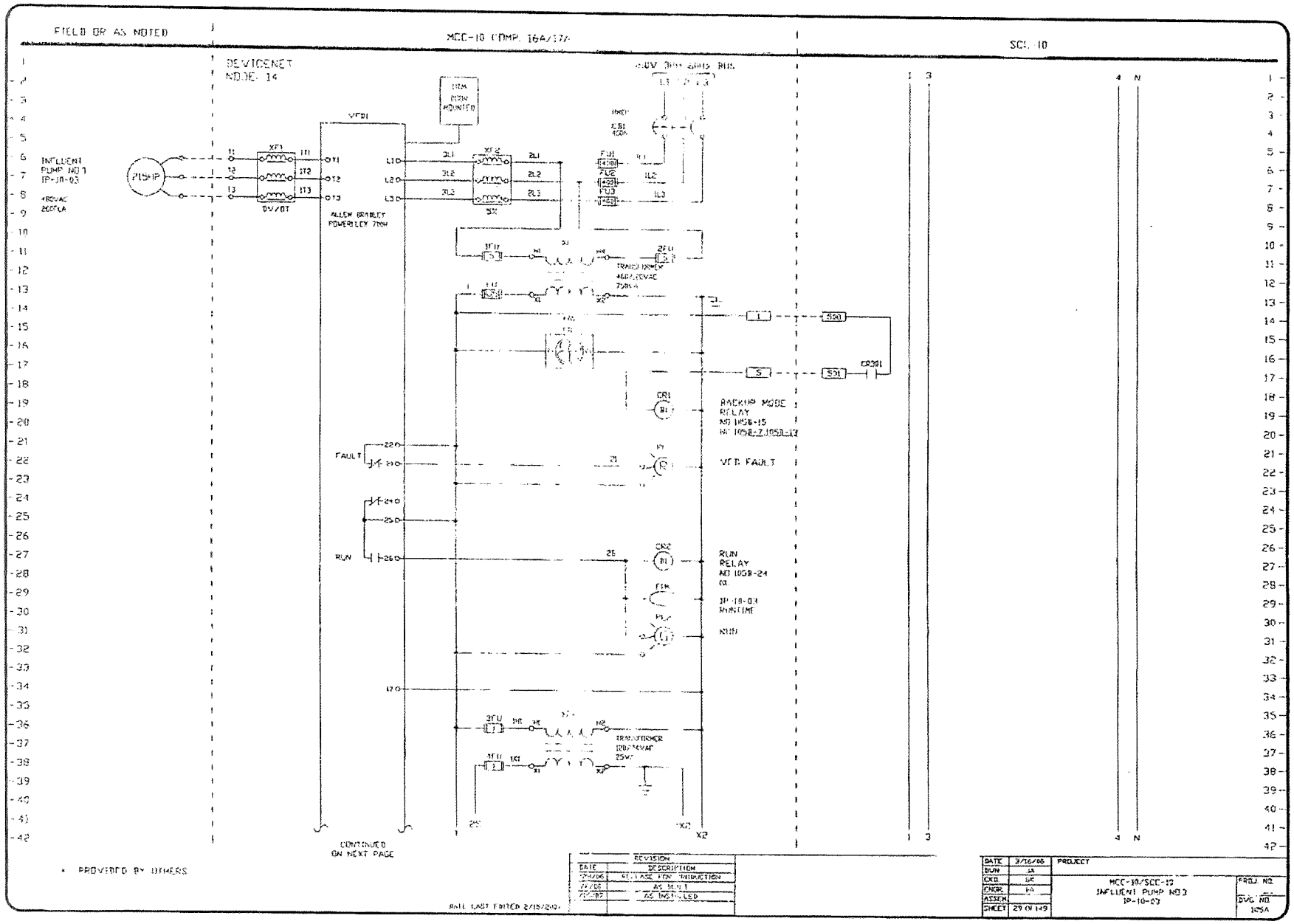
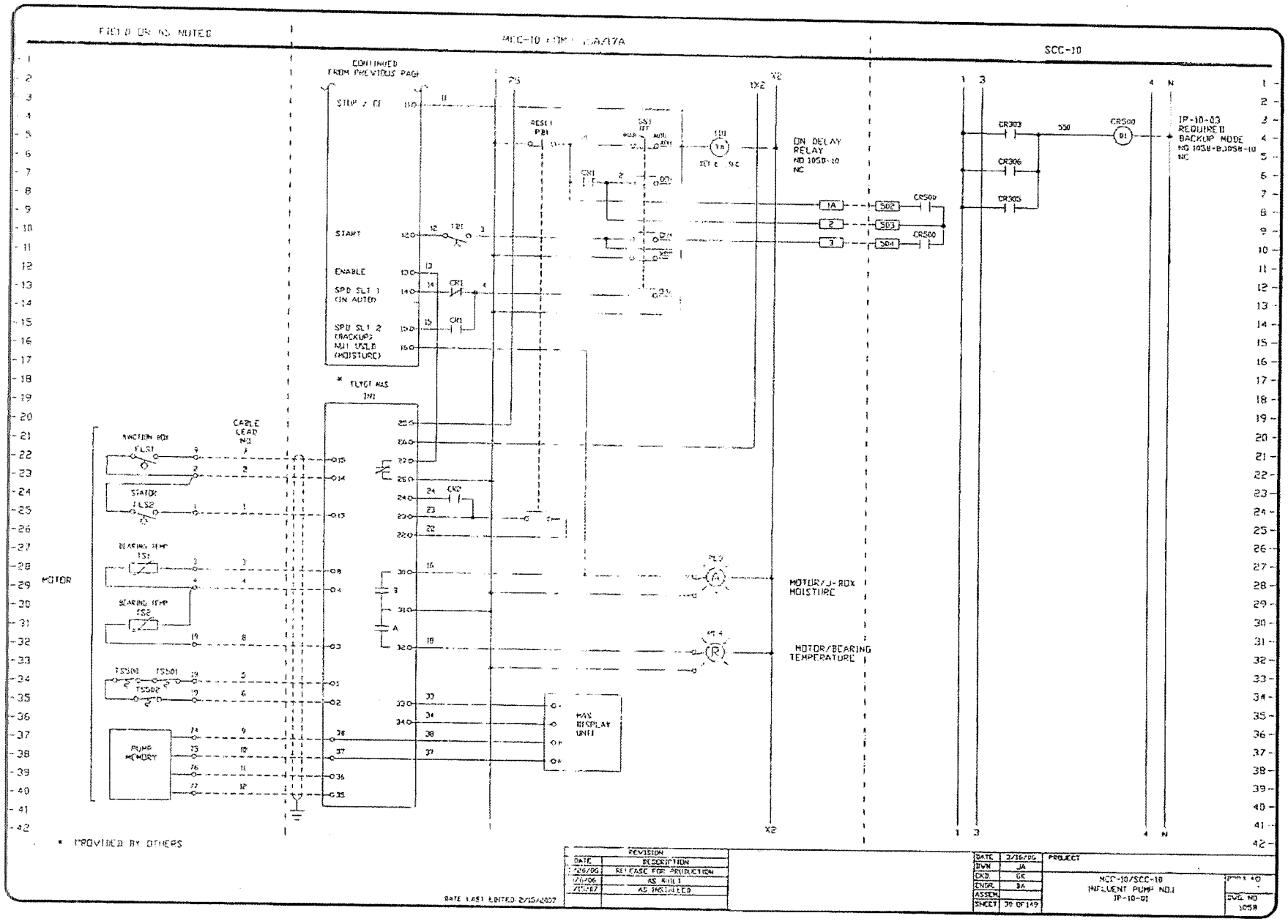
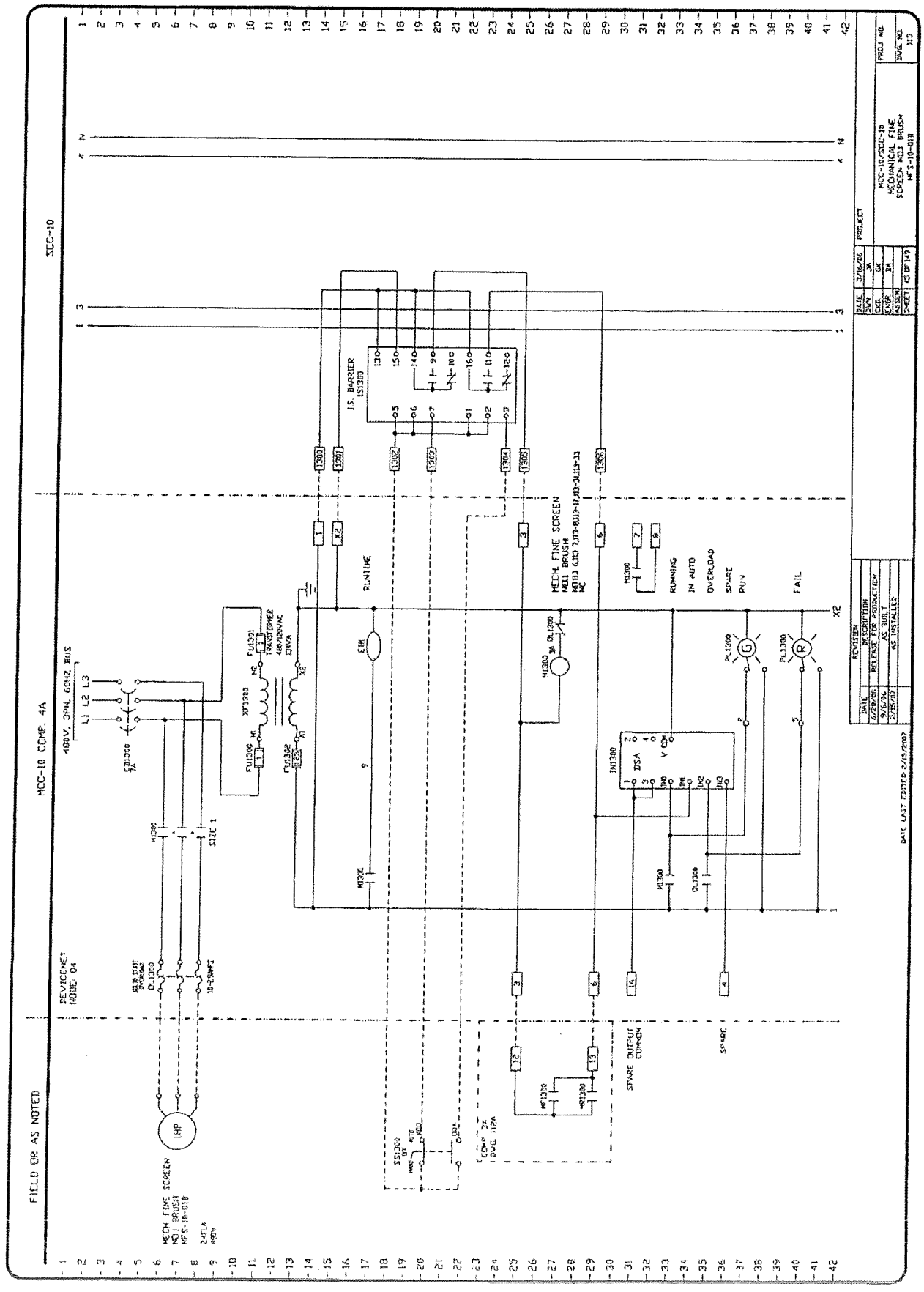


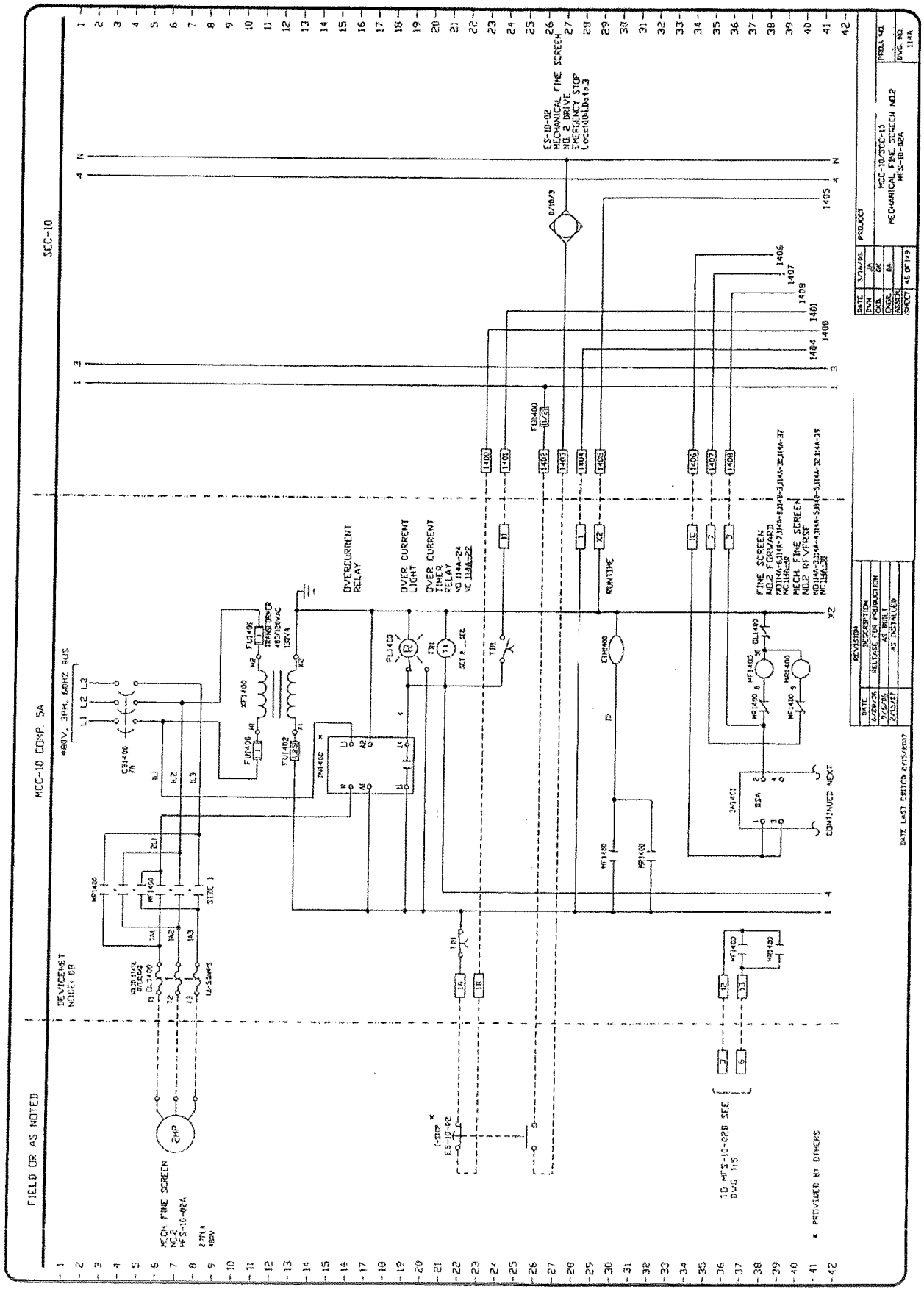
Sample Elementary schematic



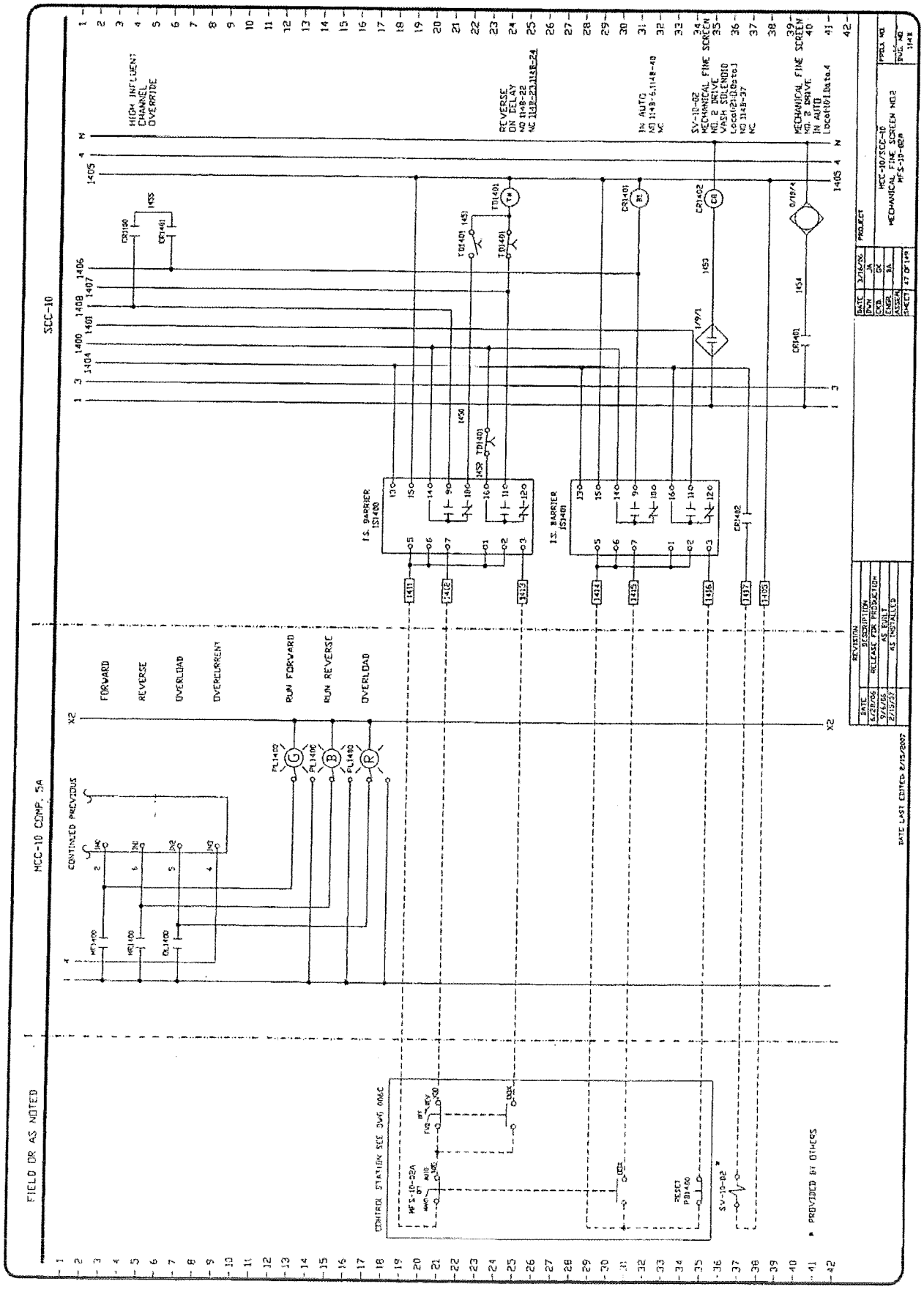
Sample Elementary Schematic



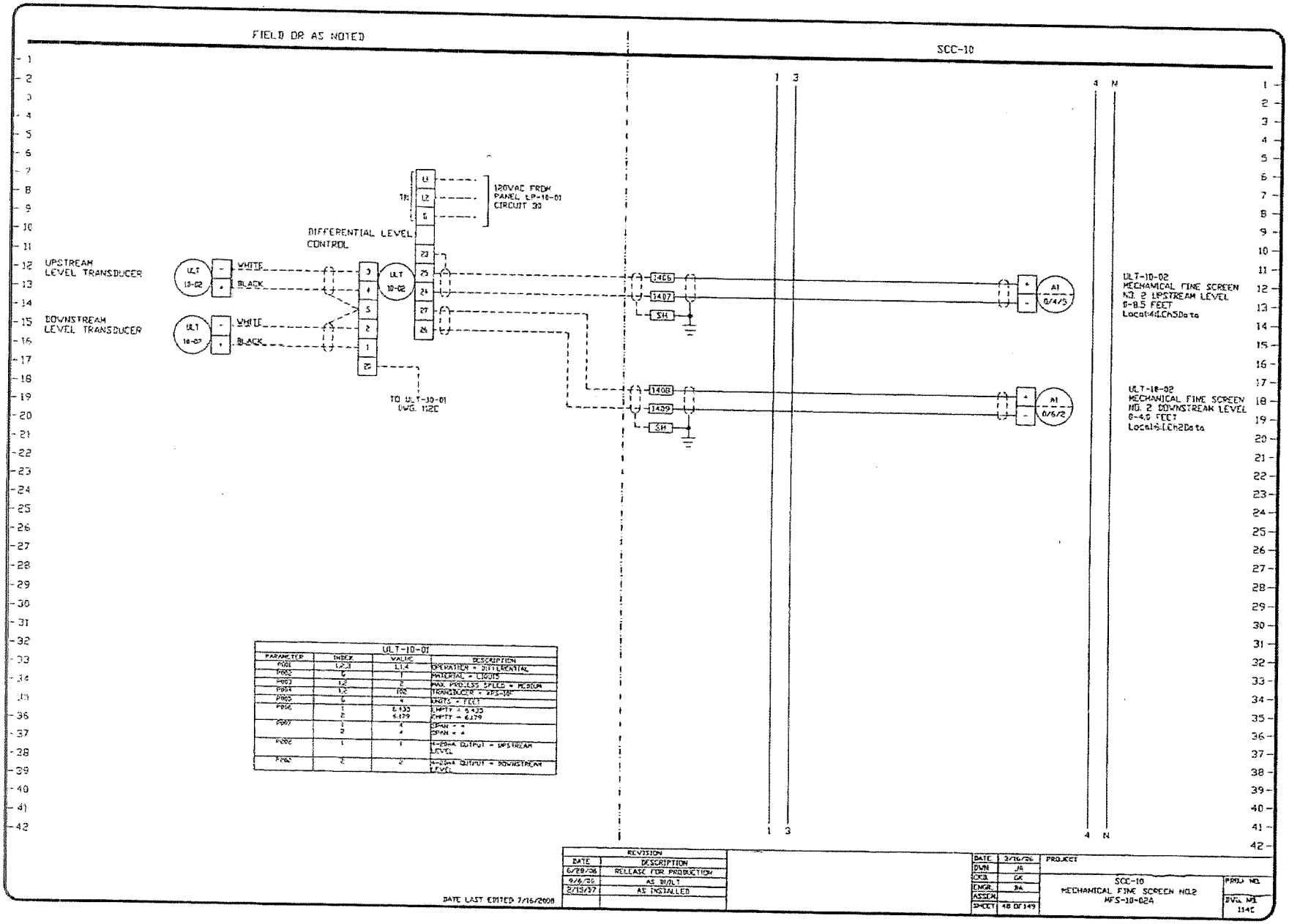
Sample Elementary Schematic



Sample Elementary Schematic



Sample Elementary Schematic



Sample Elementary Schematic

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May 20, 2013

NOTICE OF ADDENDUM

ADDENDUM NO. 01

CONTRACT NO. 7101

PROJECT 53W1629: BOOSTER PUMPING STATION 106 RECONSTRUCTION

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

SPECIFICATIONS:
Replace sheet A-1. The bid submission deadline and subsequent pre-bid/prequalification deadlines have been extended by two weeks. The new bid submission deadline is June 21, 2013 (1:00 PM). Bids will be opened at 1:30 P.M. June 21, 2013.

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 Bid Express at https://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.

Alan L. Larson, PE, BCEE
Principal Engineer

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:	Booster Pumping Station 106 Reconstruction
CONTRACT NO.:	7101
SBE GOAL	12%
BID BOND	5%
PRE BID MEETING (1:00 P.M.)	June 14, 2013 *(revised – Addendum 01 5/20/13)*
PREQUALIFICATION APPLICATION DUE (1:00 P.M.)	June 14, 2013 *(revised – Addendum 01 5/20/13)*
BID SUBMISSION (1:00 P.M.)	June 21, 2013 *(revised – Addendum 01 5/20/13)*
BID OPEN (1:30 P.M.)	June 21, 2013 *(revised – Addendum 01 5/20/13)*
PUBLISHED IN WSJ	May 10, 2013 & May 17, 2013

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.

Plans and Specifications are also available at 1600 Emil St., Madison, WI, 53713; (608) 267-1197.

STANDARD SPECIFICATIONS

The City of Madison's Standard Specifications for Public Works Construction - 2013 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

Madison Water Utility

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June 10, 2013

NOTICE OF ADDENDUM

ADDENDUM NO. 02

CONTRACT NO. 7101

PROJECT 53W1629: BOOSTER PUMPING STATION 106 RECONSTRUCTION

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

A. SPECIFICATIONS

1. DIVISION 1–GENERAL REQUIREMENTS

a. Page 01010-2, SECTION 01010-SUMMARY OF WORK, PART 1-GENERAL, 1.04 CONSTRUCTION REQUIREMENTS, A. Construction Sequence, Paragraph 5.

CHANGE the date from "April 10, 2013" to "April 10, 2014" in the second sentence of this paragraph.

b. Page 01010-3, SECTION 01010-SUMMARY OF WORK, PART 1-GENERAL, 1.05 CONTRACTOR USE OF SITE, A. General

ADD the following paragraph to the end of this section:

"12. The City of Madison Parks Department shall be installing new playground equipment and a paved path to the playground area on the south side of the site in the vicinity of the sanitary sewer lateral that serves the booster station. CONTRACTOR shall coordinate efforts with the work performed by the Parks Department.

13. The City of Madison Engineering Department shall be installing fiber optic conduit and fiber to the site prior to or during construction of this project. The conduit shall be routed from the antenna enclosure located just off of Larkin Street to the conduit noted by Keynote 15 on Sheet 8 of the Drawings. CONTRACTOR shall coordinate efforts with the work performed to install the fiber optic connections."

2. DIVISION 15-MECHANICAL

a. Page 15510-2, SECTION 15510-HYDRONIC PIPING AND SPECIALTIES, PART 2-PRODUCTS, 2.03 CONTROL VALVES, Paragraph A.

REPLACE the table with the following:

Valve Serving	Type	Input Signal	Fail Position	Spring Return Required?
AHU Cooling Coil	Ball	On/Off	Closed	Yes

b. Page 15510-2, SECTION 15510-HYDRONIC PIPING AND SPECIALTIES, PART 2-PRODUCTS, 2.03 CONTROL VALVES, Paragraph C.

REPLACE item 4 with the following:

"4. On/Off spring return actuators shall be Belimo AFRB24, or equal. Actuator shall operate at 24 VAC/DC."

DELETE item 5.

3. DIVISION 16–ELECTRICAL

a. Page 16723-3, SECTION 16723–FIRE ALARM SYSTEM, PART 1–GENERAL, 2.01 SYSTEM DESCRIPTION, Paragraph A.

ADD the following to Paragraph A:

"The Fire Alarm System shall include area smoke detection for the Pump Room and the Lower Level."

b. Page 16723-11, SECTION 16723–FIRE ALARM SYSTEM, PART 2-MATERIALS, 2.09 INTELLIGENT DUCT SMOKE DETECTORS.

DELETE Item 2.09 in its entirety.

c. Page 16723-15, SECTION 16723–FIRE ALARM SYSTEM, PART 3-EXECUTION, 3.02 FIRE ALARM SYSTEM OPERATION, Paragraph C.

REPLACE all references to "duct smoke detectors" with "smoke detectors."

B. DRAWINGS

1. SHEET NO. 27–ELECTRICAL FLOOR PLANS

REPLACE Key Note 15 with the following:

"Provide required addressable control modules and supervisory relays in junction box next to thermostat that disables FCU-106-01 when smoke is detected. Provide conduit and wire as

required from the FACP."

DELETE reference to Key Note 15 next to SFS-106-01 on the Pump Room North wall.

ADD reference to Key Note 15 next to Key Note 21 on the Pump Room West wall.

DELETE the exit sign over the double doors to the Pump Room.

2. SHEET NO. 29–ELECTRICAL MCC SCHEDULE, MCC ELEVATION, ONE-LINE DIAGRAM, AND SCADA RISER DIAGRAM

   CHANGE the first line of control wiring for BP-106-01 and BP-106-02 from "4~#14, 2~#12, 3/4"C." to "6~#14, 2~#12, 3/4"C" in the MCC schedule under the "CONDUIT AND WIRE" column.

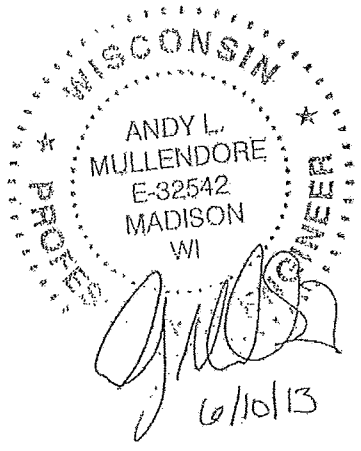
Please acknowledge this addendum on page E1 of the contract documents and/or in Section E: Bidder's Acknowledgement on Bid Express.

Electronic version of these documents can be found on Bid Express at https://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.

6/10/13

Alan L. Larson, PE, BCEE
Principal Engineer



Prepared by: STRAND ASSOCIATES, INC.®, 910 West Wingra Drive, Madison, WI 53715

Madison Water Utility

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June 18, 2013

NOTICE OF ADDENDUM

ADDENDUM NO. 03

CONTRACT NO. 7101

PROJECT 53W1629: BOOSTER PUMPING STATION 106 RECONSTRUCTION

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

A. SPECIFICATIONS

1. DIVISION 11–EQUIPMENT

   a. Page 11211-3, SECTION 11211-CENTRIFUGAL PUMPS, PART 2-PRODUCTS, 2.02 EQUIPMENT, A. Design Requirements

   ADD the following to the end of paragraph 2:

   "No negative tolerance for flow or head shall be permitted at the design point."

   REPLACE "125" with "12.5" in the second sentence of paragraph 5.

   b. Page 11730-5, SECTION 11730- SUBMERSIBLE RESERVOIR MIXING SYSTEM, PART 3-EXECUTION, 3.02 EQUIPMENT INSTALLATION AND COORDINATION

   ADD the following to the end of Paragraph 3.02:

   "C. The location of the mixers in the reservoir bays shall be as recommended by the mixer manufacturer."

2. APPENDICES

   ADD the attached GEOTECHNICAL INVESTIGATION following the SAMPLE DRAWINGS.

B. DRAWINGS

1. SHEET NO. 12 - SITE DETAILS

   REPLACE detail C/5.1 with the attached revised detail C/5.1 on Drawing AD-3.1.

2. SHEET NO. 16–BUILDING SECTIONS

   REPLACE Key Note 24 with the following:

   "12-inch swing check valve."

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 Bid Express at https://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.

6/18/13

Alan L. Larson, PE, BCEE
Principal Engineer

Prepared by: STRAND ASSOCIATES, INC.®, 910 West Wingra Drive, Madison, WI 53715

GEOTECHNICAL INVESTIGATION

CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

February 11, 2013 (Revised)
C13017

Mr. Alan Larson, P.E.
Madison Water Utility
119 East Olin Avenue
Madison, WI 53713

Re: Geotechnical Exploration
Booster Pump Station 106
110 Glenway Street
Madison, Wisconsin

Dear Mr. Larson:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration program for the above-referenced project. The purpose of this program was to evaluate the subsurface conditions within the proposed construction area and to provide geotechnical recommendations regarding site preparation, foundation, floor slab and below-grade wall design/construction. A determination of the site class for seismic design is also included. In addition to the electronic copy we are sending you, we are also forwarding pdf copies of this report to Mr. Adam Wiederholt of Madison Water Utility and Messrs. Scott Herkert and Andy Mullendore of Strand Associates.

PROJECT DESCRIPTION

We understand the project will include demolition of an existing portal and stairway leading down to a valve chamber on the east side of the below-ground reservoir in Reservoir Park on Glenway Street near the intersection with Hillcrest Drive. A new booster pump station will then be constructed measuring about 25 ft by 44 ft in plan dimension. The south and west portion of the structure will be in a trench extending about 10 ft below the main floor level to match up with the elevation of the pipes entering and leaving the reservoir. The floor slab elevation in this portion of the building will therefore roughly match the bottom of the reservoir which is at about EL 184 ft (Madison city datum). The main floor level will likely be at about EL 194 ft (MCD) or 1039.5 ft (USGS datum). The south, west, and north walls will be buried in the slope, with the east face exposed along Glenway Street. We estimate that footing grade will be at about EL 190 (or EL 1035.5 USGS) along the exposed face, but will step down about 7 to 8 ft for the deeper portion of the structure.

We understand the building will be a reinforced concrete structure with masonry veneer on the exposed walls. The flat, reinforced concrete roof will span between exterior bearing walls. Light to moderate structural loads are anticipated.

2921 Perry Street, Madison WI 53713
Telephone: 608/288-4100
FAX: 608/288-7887

SITE CONDITIONS

The existing reservoir and valve chamber portal date back to about 1925. The reservoir is built about 25 ft below grade and is covered with soil on its top and sides. Plans from the original construction indicate the excavation side slopes for the reservoir were cut at slopes ranging from 1H:3V to 1H:1V. As a result, the excavation for the reservoir in the area near the proposed booster station likely did not extend more than about 10 to 15 ft beyond the outer reservoir wall. However, comparing current grades to original grades indicates that 5 to 14 ft of backfill may have been placed along the west side of the proposed booster station to bury the reservoir. Moving away from the reservoir, existing grades on the east side of the booster station footprint (which is further east of the reservoir and lower in elevation) appear to be close to original grades.

The reservoir is located in a City park with mature trees surrounding the reservoir. The roof of the reservoir is flat, but the terrain on the east side, where the booster pump station is proposed, is very steep at about a 1.7H:1V slope. A quarry stone wall retains part of the slope along Glenway Street.

SUBSURFACE CONDITIONS

Access conditions at the site seriously limited the locations where borings could be performed, as we anticipated and discussed in our proposal. The combination of very steep slopes and both overhead and buried utilities made it practical to attempt only one boring, located as close as possible to the north side of the proposed building footprint. However, even the intended location could not be accessed safely because of icy conditions on the slope; as a result the boring had to be moved further north than planned. Nevertheless, it is our opinion that the soil boring information, when combined with the geologic setting and past project records indicating probable fill depths, should give a fairly representative picture of the anticipated subsurface conditions.

Subsurface conditions on site were explored by drilling one Standard Penetration Test (SPT) soil boring to a depth of 40 ft below existing site grades. As noted above, the location was selected by CGC and adjusted by the drillers due to safety concerns related to the snow and ice-covered slope. The boring was drilled on January 16, 2013 by Badger State Drilling (under subcontract to CGC) using a balloon-tired ATV rotary CME750 drill rig equipped with hollow-stem augers and an automatic SPT hammer. The boring location is shown in plan on the Soil Boring Location Map attached in Appendix B. The ground surface elevation at the boring location was interpolated from the topographic map provided to us and is referenced to USGS datum (subtract 845.6 ft to convert to MCD). The borehole was found to have no water and was therefore backfilled with bentonite upon completion.

The subsurface profile at the boring location can generally be described by the following strata (in descending order):

- About 12 in. of ***topsoil fill***, underlain by
- 5 ft of medium dense, reddish brown ***sand fill***, followed by
- 27.5 ft of medium dense to dense, light brown ***silt***, underlain by
- 7.5 ft of very stiff, brown ***lean clay*** extending to the maximum depth explored.

As discussed previously, based on a comparison of original (prior to the reservoir construction) to existing grades, we estimate that the uppermost 5 to 14 ft of soil along the west side of the proposed building footprint may be backfill placed against the reservoir. The boring is located in an area where about 5 ft of fill was anticipated (and confirmed by the boring), but the fill is expected to be deeper near the proposed pump station.

Groundwater was not encountered in the boring during or after drilling. Groundwater levels are expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration and other factors but are not likely to be encountered within the expected excavation depths on this project. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B. Particle size distribution test reports on two representative samples for classification purposes are included in Appendix B.

The samples were screened for volatile organics with a photoionization detector (PID meter) by IverTech personnel under subcontract to CGC. Screening results are indicated on the far right column of the boring log. There were no visual indications or odors suggesting the presence of waste materials noted by the drillers or by CGC in the soil samples.

DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion that the site is suitable for the proposed construction and that the structure can be supported by conventional spread footing foundations. Our recommendations for site preparation, foundation, floor slab and below-grade wall design/construction are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

1. Site Preparation

We anticipate that the existing structure will be demolished in its entirety, including foundations and floor slabs, where it lies within or close to the proposed building footprint or where substructure elements might interfere with new utility lines. Topsoil, vegetation and tree roots

should be stripped to at least 5 ft beyond the proposed construction areas, including areas required for cuts beyond the building footprint. Following demolition and site stripping, excavation to proposed rough grade should proceed. Exposed soils in areas to receive fill (if any) should be recompacted with a vibratory roller, large plate compactor or hoe-pak and checked for soft/yielding areas. If loose, soft or yielding areas are detected, they should be undercut/removed. Grade should be re-established using granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D 1557) or stabilized with breaker rock compacted into the subgrade until no further deflection is evident.

We recommend using granular soils as fill because sand/gravel soils are relatively easy to place and compact. Clay soils are not recommended as structural fill because moisture conditioning will be required to achieve desired compaction levels, which could delay construction progress especially in late fall to early spring. We recommend that fill/backfill be compacted to at least 95% compaction (ASTM D1557) in accordance with our Recommended Compacted Fill Specifications presented in Appendix D. Periodic field density tests should be taken by CGC staff within the fill/backfill to document the adequacy of compactive effort.

2. Foundation Design

In our opinion, the proposed structure can be supported on reinforced concrete spread footing foundations bearing on the native silt soils, and the following parameters should be used for foundation design:

- Maximum net allowable bearing pressure: 4,000 psf

- Minimum foundation widths:
  -- Continuous wall footings: 18 in.
  -- Column pad footings: 30 in.

- Minimum footing depths:
  -- Exterior/perimeter footings: 4 ft
  -- Interior footings: no minimum requirement

Undercutting below footing grade will be required if clays with pocket penetrometer readings (an estimate of the unconfined compressive strength of cohesive soil) less than 2.0 ton/sq ft or looser silt or granular soils are observed at or below footing grade. Where undercutting is required, the base of the undercut excavations should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes. Grade can be restored using granular fill compacted to 95% compaction (ASTM D 1557) or compacted coarse stone (breaker run, select crushed material or 3-in. dense graded base course, as described in

Appendix D). CGC should be present during footing excavations to check that adequate soil conditions exist or recommend corrective measures, if necessary.

It is important for contractors to recognize that the silt layer which predominates at this site is a suitable bearing stratum in its undisturbed condition but is very susceptible to disturbance when wet. Extra care will be required to protect footing subgrades during wet weather, including possibly covering them with a 3 to 4-in. thick 'mud mat' of lean mix concrete immediately after excavation or stabilizing them with a thin (6 in. ±) layer of coarse stone compacted until deflection ceases. If subgrades become wet after excavation, they will be very easily disturbed under foot traffic alone while setting forms and rebar.

We recommend using a smooth-edged backhoe bucket for footing excavations. Further, moist to dry silt subgrade soils should be recompacted with a vibratory plate compactor or hoe-pak (backhoe mounted compactor), and clay soils should be hand-trimmed or recompacted with a jumping jack to densify soils loosened/disturbed during excavation. Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should not exceed 1.0 and 0.5 in., respectively.

3. Site Class for Seismic Design

In our opinion, the average soil/rock properties in the upper 100 ft of the site (based on SPT blow counts (N-values) greater than 15 blows/foot, on average) can be characterized as a stiff soil profile. This characterization would place the site in Site Class D for seismic design according to the International Building Code (see Table 1613.5.2).

4. Floor Slab

The floor slabs for the proposed structure are expected to be supported on either native silt or sand fill and may be designed using a subgrade modulus of 100 pci. Prior to slab construction, the subgrades should be recompacted to densify soils that may become disturbed or loosened during construction activities. The design subgrade modulus is based on a recompacted subgrade such that non-yielding conditions are developed. Areas which do not proof-roll or recompact satisfactorily should be undercut and replaced with compacted breaker rock or granular fill. To serve as a capillary break, the final 4 in. of soil placed below the slabs should consist of imported well-graded sand or gravel with no more than 5 percent by weight passing a No. 200 U.S. standard sieve. (Note that some structural engineers require a 4 to 6 in. layer of dense-graded base course immediately below the floor slab, in lieu of the capillary break, to improve the subgrade modulus.) To further minimize the potential for moisture migration, a plastic vapor barrier could also be utilized. Fill placed below the floor slabs should be placed as described in the Site Preparation

section of this report. The slabs should be structurally separate from the foundations and have construction joints and wire mesh for crack control.

A number of the preceding recommendations would not apply if the building, or a portion of it, is designed as a watertight structure. We can provide modified recommendations if appropriate.

5. Below-Grade Walls

We anticipate that below-grade walls will be laterally restrained by the floor slab and ground level framing. Therefore, *at-rest* lateral earth pressures should be used during design. To minimize the development of such pressures, granular backfill should be placed within 4 to 6 ft of the walls. Unless the structure is designed to be water-tight, we recommend that perimeter drainage systems be installed to intercept potential surface water infiltration and that the granular backfill placed behind the walls be continuously connected to this system. The perimeter drainage system should be sloped to drain to a sump pit. To impede the inflow of surface moisture, the final 2 ft of backfill placed along the below-grade walls should consist of a clayey fill cap or other semi-impermeable material such as asphaltic or concrete pavement. The clay cap or pavement should be graded in a manner which promotes positive drainage away from the walls. Recommended perimeter drain details are attached to this report in Appendix E.

Before placing the wall backfill, the exterior walls should be damp-proofed with a spray-applied or mopped-on rubber or bituminous sealer. Note that the on-site silt soils would not be suitable as "free-draining" backfill, but could be used if a three-dimensional drainage composite layer is installed on the walls. Compaction of the backfill within 3 to 5 ft of the walls should be performed with lightweight compaction equipment. The granular backfill should be compacted to a minimum of 90% compaction based on modified Proctor (ASTM D1557) methods following Appendix D guidelines.

Walls constructed in accordance with the above recommendations may be designed for an *at-rest* equivalent fluid pressure of 55 psf per foot of depth. An equivalent fluid pressure of 200 psf per foot of depth can be used for calculating passive resistance. This value includes a factor of safety of 2.0 to reduce lateral deflection. The below-grade wall design should also take into account surcharge effects which could be applied during or after construction. Exterior retaining walls (if any) which are free to rotate slightly will be subjected to *active* lateral earth pressures and may be designed for an *active* equivalent fluid pressure of 35 psf per foot of depth.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil related difficulties which could be encountered on the site are discussed below:

Due to the potentially sensitive nature of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.

- Contingencies in the project budget for subgrade stabilization with breaker run stone in footing and floor slab areas should be increased if the project schedule requires that work proceed during adverse weather conditions.

- Earthwork construction during the early spring or late fall could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.

- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards. Siltier sand layers are likely to be categorized as OSHA Type B soils (1H:1V slopes), while sands with less silt may fall in the Type C category (1.5H:1V). The excavation side slopes should be determined by a "competent person" during excavation. If temporary earth retention is required, this system should be designed by a registered professional engineer.

- Based on observations made during the field exploration, groundwater infiltration into footing excavations is not expected to be a problem. However, water accumulating at the base of excavations as a result of precipitation or seepage should be controlled and quickly removed using pumps operating from filtered sump pits.

- When excavating adjacent to the existing reservoir, take care to avoid undermining its base slab.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the foundation and floor slab subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation construction

proceeds in accordance with our recommendations, the following operations should be monitored by CGC:

- Topsoil stripping/subgrade proof-rolling within the construction areas;
- Fill/backfill placement and compaction;
- Foundation excavation/subgrade preparation; and
- Concrete placement.

* * * * *

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

William W. Wuellner, P.E.
Senior Geotechnical Engineer

David A. Staab, P.E., LEED AP
Consulting Professional

Encl: Appendix A - Field Exploration
Appendix B - Soil Boring Location Plan
Logs of Test Boring (1)
Log of Test Boring-General Notes
Unified Soil Classification System
Particle Size Distribution Test Reports
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications
Appendix E - Perimeter Drain Details

cc: Adam Wiederholt, Madison Water Utility (via email)
Scott Herkert and Andy Mullendore, Strand Associates (via email)

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

Subsurface conditions on site were explored by drilling one Standard Penetration Test (SPT) soil boring to a depth of 40 ft below existing site grades. The location was selected by CGC and adjusted by the drillers due to safety concerns related to the snow and ice-covered slope. The boring was drilled on January 16, 2013 by Badger State Drilling (under subcontract to CGC) using a balloon-tired ATV rotary drill rig equipped with hollow-stem augers and an automatic SPT hammer. The boring location is shown in plan on the Soil Boring Location Map attached in Appendix B. The ground surface elevation at the boring location was interpolated from the topographic map provided to us and is referenced to USGS datum (subtract 845.6 ft to convert to MCD). The borehole was found to have no water and was therefore backfilled upon completion.

In each boring, soil samples were obtained at 2.5 foot intervals to a depth of 10 ft and at 5 ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

   The boring is extended downward, between samples, by a hollow-stem auger.

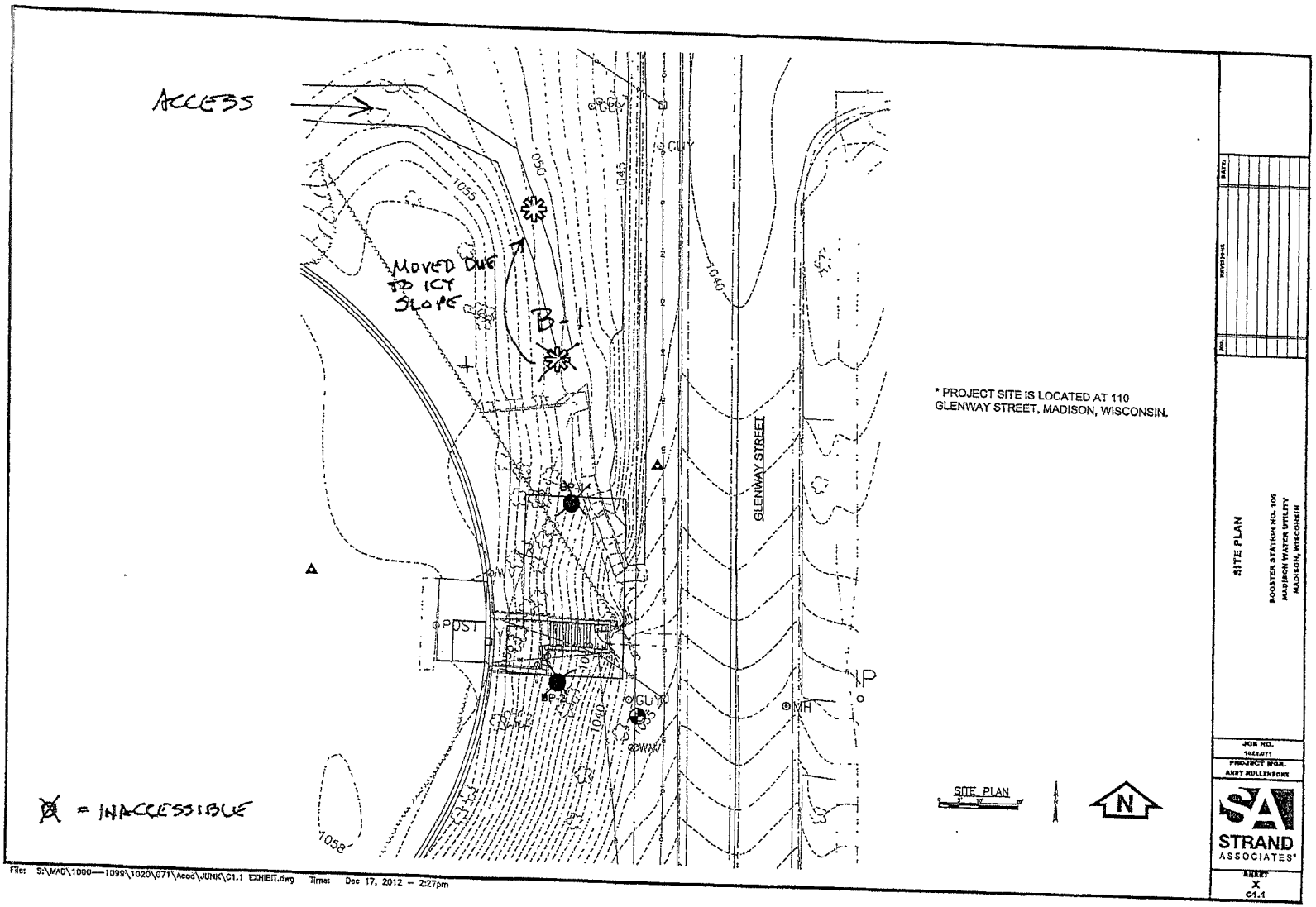
2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (ASTM Designation: D 1586)

   This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. Upon completion of drilling, the borings were backfilled with bentonite (where required) to satisfy WDNR regulations and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The samples were screened for volatile organics with a photoionization detector (PID meter) by IverTech personnel under subcontract to CGC. Screening results are indicated on the far right column of the boring log. Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. The soils were then visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

SOIL BORING LOCATION MAP
LOG OF TEST BORINGS (1)
LOG OF TEST BORING - GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM
PARTICLE SIZE DISTRIBUTION TEST REPORTS (2)



Legend

⊕ Denotes Soil Boring Location and Number

Scale: As Shown

Notes

1. Base map provided by Strand Associates.
2. Soil boring performed by Badger State Drilling in January, 2013.
3. Boring location is approximate.

Date: 1/24/13	CGC, Inc.	SOIL BORING LOCATION MAP Booster Pump Station 106 110 Glenway Street Madison, Wisconsin
Job No. C13017		

CGC Inc.

LOG OF TEST BORING

Project: Booster Pump Station 106
110 Glenway Street
Location: Madison, Wisconsin

Boring No. 1
Surface Elevation (ft) 1052.0
Job No. C13017
Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu (qa) (tsf)	W	LL	PL	LI
						12 in. Dark Brown Clayey/Silty TOPSOIL FILL (OL)					
1		18	M	11							0
						FILL: Medium Dense, Reddish Brown Fine Sand, Some Silt, Little Gravel, Scattered Clay Pockets (SM)					
2		18	M	13	5						1
						Medium Dense to Dense, Tan SILT, Little Sand, Occasional Fine Sand Seams/Lenses (ML)					
3		16	M	10							0
4		18	M	22	10						2
5		18	M	28							1
					15	Increasing Sand Content with Depth					
6		18	M	36	20						0
7		18	M	34							1
					25						
8		18	M	20							0
					30						
9		18	M	25		Very Stiff, Light Brown/Gray Lean CLAY (CL)	(2.5-3.5)				0
					35						
10		18	M	20			(2.5-3.25)				0
					40	End of Boring at 40 ft					
						Backfilled with Bentonite Chips					
					45						

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling NW
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 1/16/13 End 1/16/13
Driller BSD Chief KD Rig CME-75
Logger GM Editor AJB
Drill Method 2.25" HSA; Autohammer

CGC, Inc.

LOG OF TEST BORING
General Notes

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	¾" to 3"	¾" to 3"
Fine	4.76 mm to ¾"	#4 to ¾"
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 to mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

General Terminology

Physical Characteristics
Color, moisture, grain shape, fineness, etc.
Major Constituents
Clay, silt, sand, gravel
Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.
Geologic Origin
Glacial, alluvial, eolian, residual, etc.

Relative Density

Term	"N" Value
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

Relative Proportions Of Cohesionless Soils

Proportional Term	Defining Range by Percentage of Weight
Trace	0% - 5%
Little	5% - 12%
Some	12% - 35%
And	35% - 50%

Consistency

Term	q_u-tons/sq. ft
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

Organic Content by Combustion Method

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4 – 12%
Sedimentary Peat	12% - 50%
Fibrous and Woody Peat	More than 50%

Plasticity

Term	Plastic Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

SYMBOLS

Drilling and Sampling

CS – Continuous Sampling
RC – Rock Coring: Size AW, BW, NW, 2"W
RQD – Rock Quality Designation
RB – Rock Bit/Roller Bit
FT – Fish Tail
DC – Drove Casing
C – Casing: Size 2 ½", NW, 4", HW
CW – Clear Water
DM – Drilling Mud
HSA – Hollow Stem Auger
FA – Flight Auger
HA – Hand Auger
COA – Clean-Out Auger
SS - 2" Dia. Split-Barrel Sample
2ST – 2" Dia. Thin-Walled Tube Sample
3ST – 3" Dia. Thin-Walled Tube Sample
PT – 3" Dia. Piston Tube Sample
AS – Auger Sample
WS – Wash Sample
PTS – Peat Sample
PS – Pitcher Sample
NR – No Recovery
S – Sounding
PMT – Borehole Pressuremeter Test
VS – Vane Shear Test
WPT – Water Pressure Test

Laboratory Tests

q_a – Penetrometer Reading, tons/sq ft
q_a – Unconfined Strength, tons/sq ft
W – Moisture Content, %
LL – Liquid Limit, %
PL – Plastic Limit, %
SL – Shrinkage Limit, %
LI – Loss on Ignition
D – Dry Unit Weight, lbs/cu ft
pH – Measure of Soil Alkalinity or Acidity
FS – Free Swell, %

Water Level Measurement

▽ - Water Level at Time Shown
NW – No Water Encountered
WD – While Drilling
BCR – Before Casing Removal
ACR – After Casing Removal
CW – Cave and Wet
CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

CGC, Inc.

Madison - Milwaukee

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

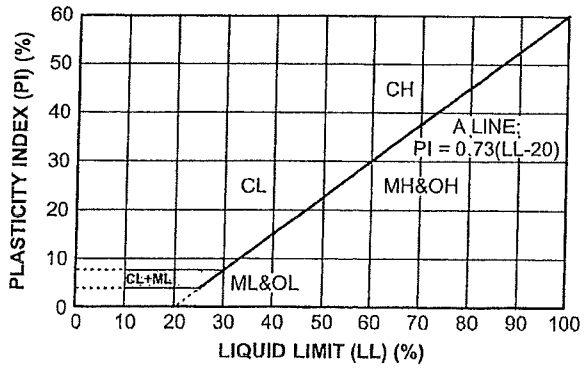
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

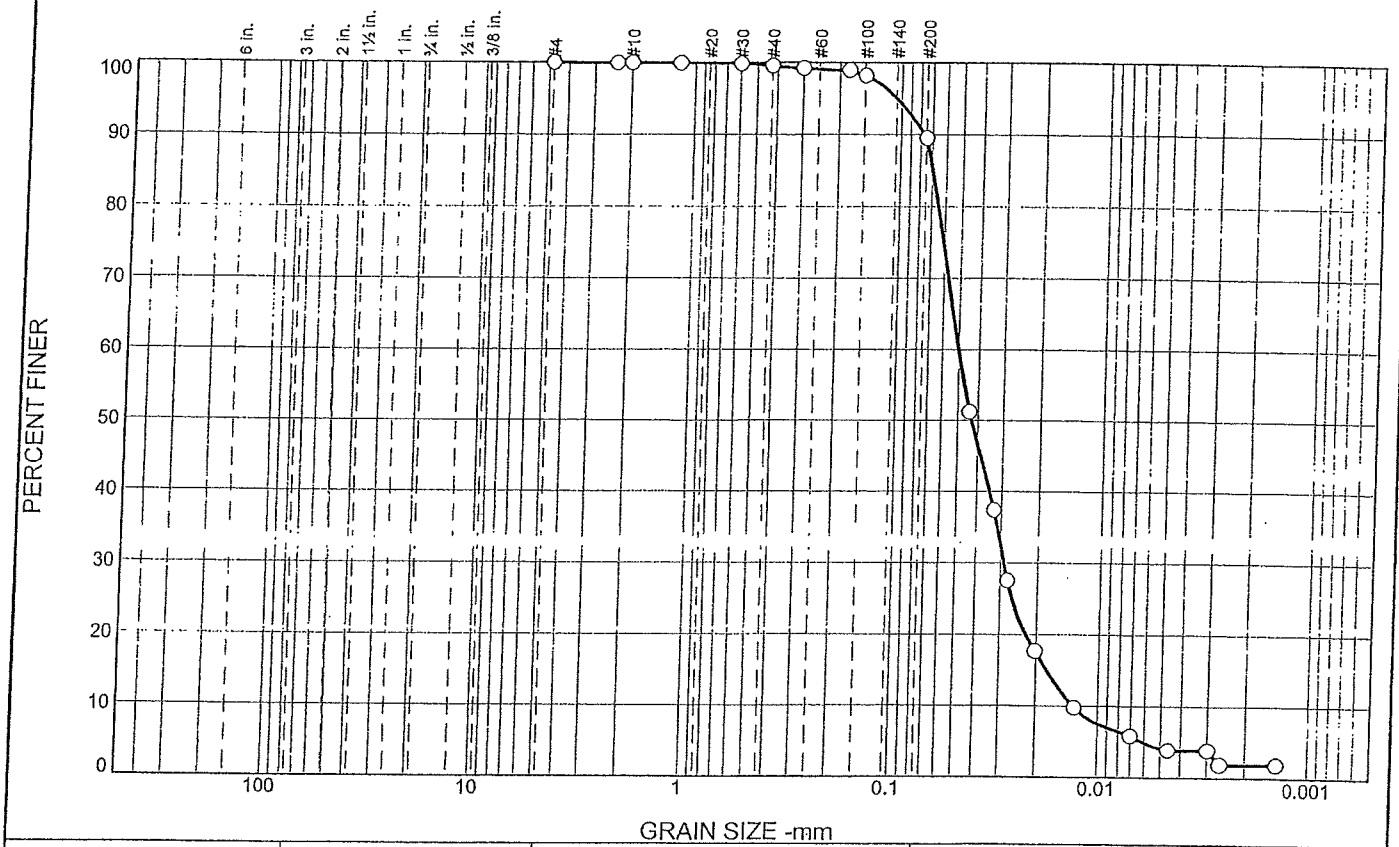
Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	10.0	85.4	4.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#10	100.0		
#16	99.9		
#30	99.8		
#40	99.5		
#50	99.2		
#80	98.9		
#100	98.2		
#200	89.5		

* (no specification provided)

Material Description

Light Brown Silt, Little Sand, Trace Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0770 D_{85}= 0.0696 D_{60}= 0.0502
D_{50}= 0.0430 D_{30}= 0.0289 D_{15}= 0.0177
D_{10}= 0.0133 C_u= 3.78 C_c= 1.25

Classification

USCS= ML AASHTO=

Remarks

Natural Moisture = 8.7%

Sample Number: B1 S3

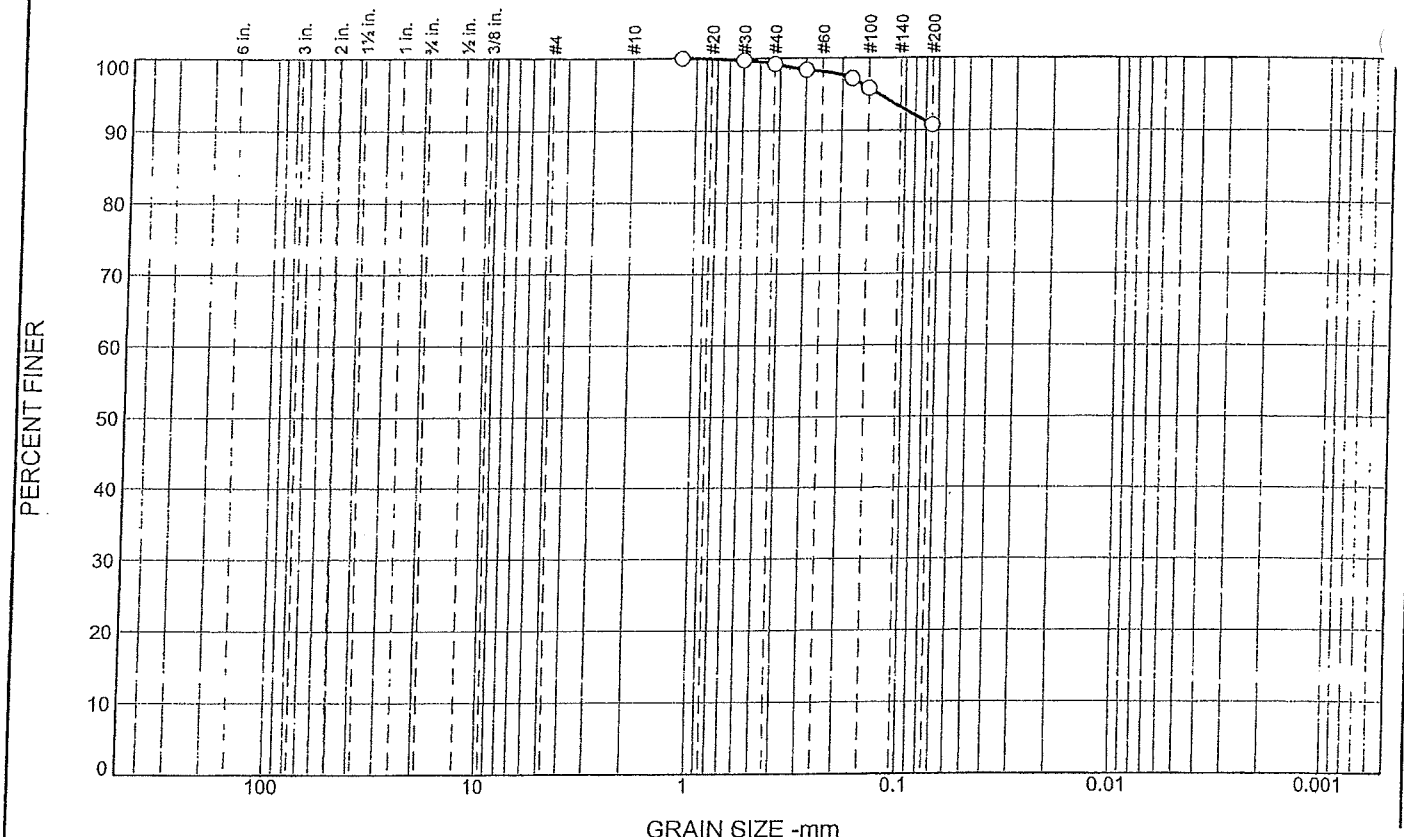
Date: 1/30/13

CGC, Inc.

Client: Madison Water Utility
Project: Booster Pump Station 106
Project No: C13017 **Figure**

Tested By: KJS Checked By: DAS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.8	8.5	90.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#30	99.7		
#40	99.2		
#50	98.4		
#80	97.2		
#100	95.9		
#200	90.7		

* (no specification provided)

Material Description

Light Brown Silt, Little Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Natural Moisture = 7.9%

Sample Number: B1 S6

Date: 1/30/13

CGC, Inc.

Client: Madison Water Utility
Project: Booster Pump Station 106

Project No: C13017 Figure

Tested By: KJS Checked By: DAS

APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C
DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, , *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not Informed.*

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where surface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion, geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's recommendations if we do not perform construction observation.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having CGC participate in prebid and preconstruction conferences, and by providing construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

GEOENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of ASFE, for more information.

Modified and reprinted with permission from:

ASFE/The Best People on Earth
881 Colesville Road, Suite G 106
Silver Spring, MD 20910

APPENDIX D

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX D

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at a moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

Table 1
Gradation of Special Fill Materials

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55	75 (2)		
No. 40			5-20	8-28	10-35	15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction.*
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

Table 2
Compaction Guidelines

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
Within 10 ft of building lines		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
Beyond 10 ft of building lines		
Under walks and pavements		
- Less than 2 ft below subgrade	92	95
- Greater than 2 ft below subgrade	90	90
Landscaping	85	90

Notes:

1. Based on Modified Proctor Dry Density (ASTM D 1557)

APPENDIX E

TYPICAL PERIMETER DRAIN DETAILS

General Notes

1. This system's primary function is to intercept infiltrating surface water. These Alternates are not appropriate for use in situations of high groundwater (i.e., cases where the water table approaches floor slab elevation).

2. Grade surface cap to slope away from structure.

3. Exterior surface of walls below grade should be damp-proofed.

4. A plastic vapor barrier should be installed below the slab.

5. Recommended types of drain pipes:

Specification	Description
ASTM D2729	Polyvinyl Chloride (PVC) Drain Pipe
ASTM F405	Corrugated Polyethylene Drain Pipe
ASTM D2852	Styrene-Rubber Plastic Drain Pipe
AASHTO M136	Corrugated Metal Underdrain Pipe

6. Minimum slope of drain pipes should be 2 in. per 100 lin ft.

7. Place drain pipe below basement floor level and orient the perforations toward the bottom.

8. Clean-outs should be provided to service the pipe.

9. Collected field water should be discharged to a sump, storm sewer or drainage field.

10. The geotextile for Alternative Nos. 2 and 3 may be eliminated if filter requirements are satisfied between the wall and pipe backfill, as well as between backfill materials and natural soils.

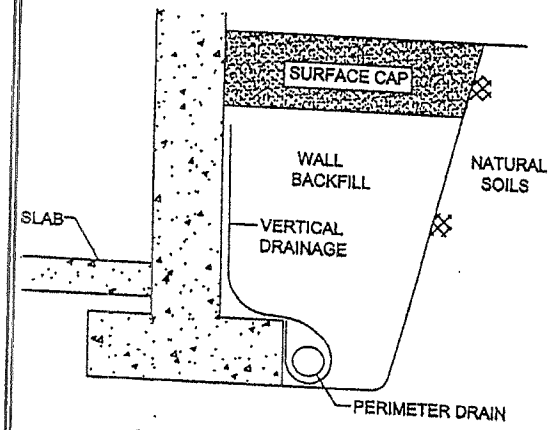
11. Pipe backfill materials should satisfy filter requirements for the slot width or hole diameter of the perforated pipe.

12. Care should be taken during backfilling not to damage the integrity of the system. For compaction requirements, refer to geotechnical report.

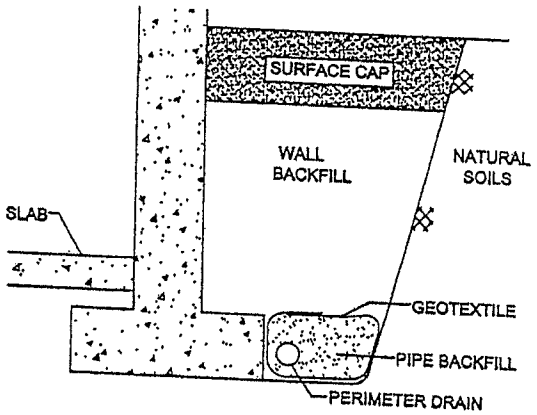
13. Pipe, geotextile, and geocomposite should be installed according to manufacturer specifications.

CGC, Inc.

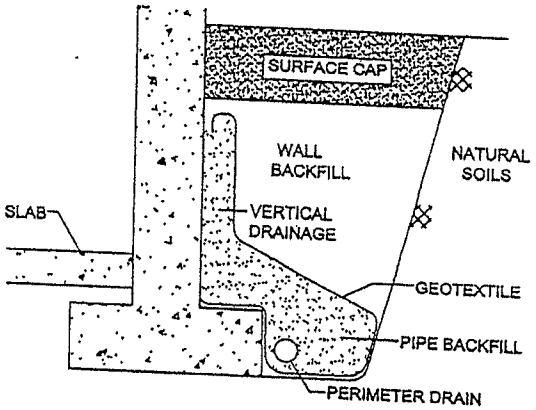
Typical Perimeter Drain Detail
General Notes



ALTERNATE NO. 1



ALTERNATE NO. 2



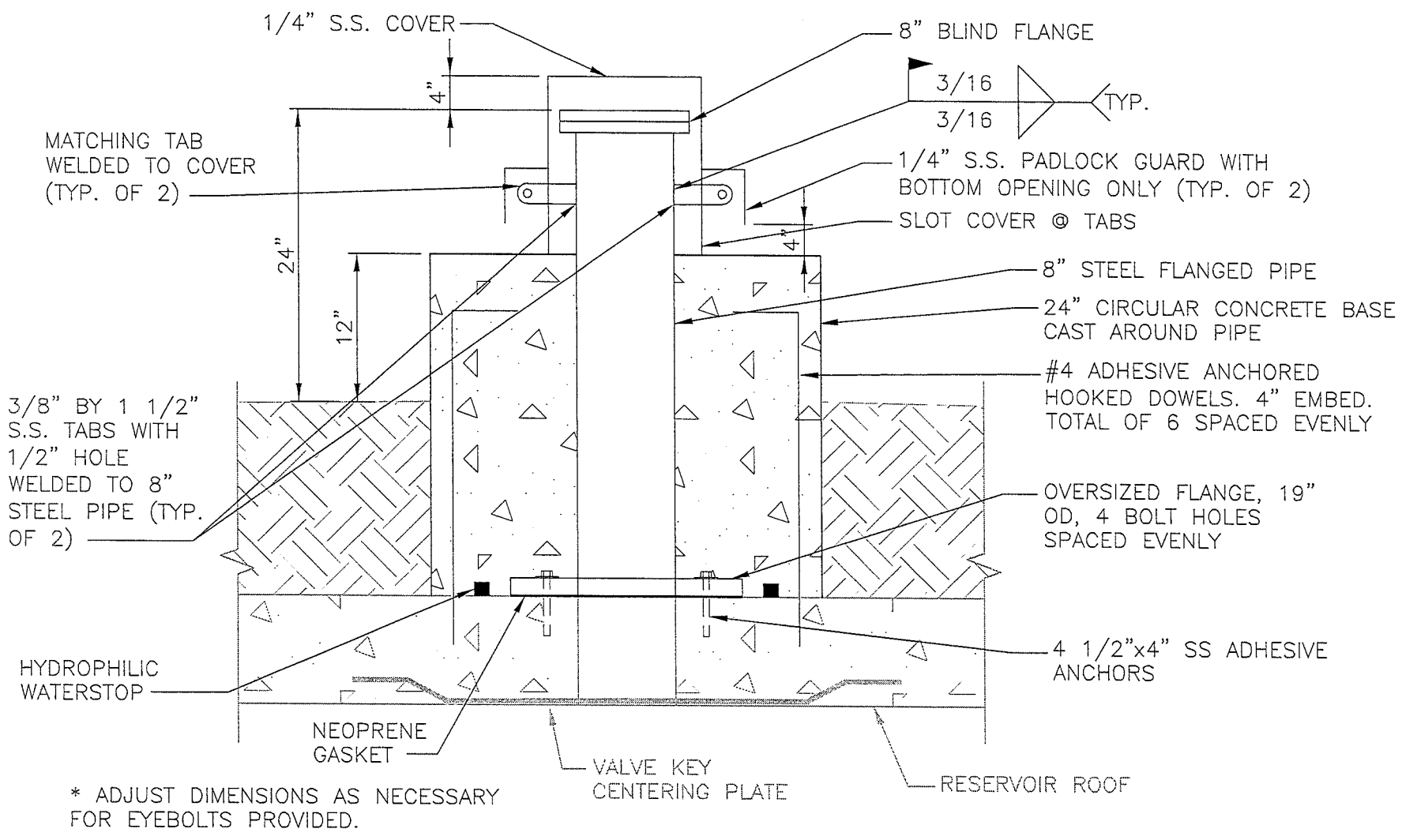
ALTERNATE NO. 3

DRAINAGE SYSTEM COMPONENTS

Component	Alternate No. 1	Alternate No. 2	Alternate No. 3
Surface Cap	1 to 2 ft. of clayey soils. Minimum 1 ft. thick if overlain by pavement	Refer to Alternate No. 1	Refer to Alternate No. 1
Vertical Drainage	3-dimesional drainage geocomposite hydraulically connected to perimeter drain.	Relatively Free-draining granular soils with P200 (% fines) ≤12%.	Minimum 6-in. wide zone of free-draining granualr soils with P200 ≤5% hydraulically connected to perimeter drain. Provide geotextile as required (see note 10).
Perimeter Drain	Perforated pipe encapsulated in geocomposite.	Perforated pipe surrounded by free-draining granular pipe backfill with P200≤5%. Provide geotextile as required (See Note 10).	Refer to Alternate No. 2
Wall Backfill	Excavation spoils or imported materials (granular soils preferred).	Relatively Free-draining granular soils with P200≤12%.	Refer to Alternate No. 1

CGC, Inc.

Typical Perimeter Drain Detail



VALVE ACCESS DETAIL

BOOSTER PUMPING STATION 106 RECONSTRUCTION
110 GLENWAY STREET
MADISON WATER UTILITY
MADISON, WISCONSIN

Madison Water Utility

STRAND ASSOCIATES®

AD-3.1

JOB NO.1020.071

SECTION E: BIDDERS ACKNOWLEDGEMENT

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

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.

1. 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 - 2013 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 to the Contract Nos. 1 through 3 issued thereto, 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)
2. 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.
3. 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.
4. 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).*
5. I hereby certify that all statements herein are made on behalf of Staab Construction Corp. (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 Marshfield State of Wisconsin; 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.

SIGNATURE Aaron E. Staab

President
TITLE, IF ANY

Sworn and subscribed to before me this 20 day of June, 2013.
(Notary Public or other officer authorized to administer oaths)
My Commission Expires 7-6-2014

Bidders shall not add any conditions or qualifying statements to this Proposal.

JEFFREY A GRAVES
Notary Public
State of Wisconsin

NAME OF BIDDER: Staab Construction Corporation

SCHEDULE OF UNIT PRICES AND TOTAL BIDS

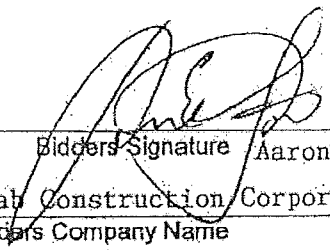
BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

Item No.	Estimated Quantities	Unit	Unit Cost	Total Bid
1.	Booster Pumping Station 106 Reconstruction (Entire Project)	Lump Sum	$ online	$ online

CASH ALLOWANCES

The following Cash Allowances will apply in the event that estimated quantities to be included in the Lump Sum Base Bid are different from final measured quantities. A single price shall be bid for each item.

Item Number	Description	Quantity Included in the Lump Sum Base Bid	Unit	Unit Price	Total Amount Included in the Lump Sum Base Bid
1.	Remove and Replace Unsuitable Foundation Material for Structures and Roads Section 02222–Excavation, Fill, Backfill, and Grading	50	CY	25.00	1,250
2.	Remove and Replace Unsuitable Foundation Material for Utility Trenches Section 02222–Excavation, Fill, Backfill, and Grading	25	CY	25.00	625
3.	Concrete Repair Mortar–Underside of Reservoir Roof Slab Repairs Section 03560–Concrete Surface Repair	300	CF	415.00	124,500
4.	Concrete Repair Mortar–Reservoir Wall Vertical Surface Repairs Section 03560–Concrete Surface Repair	100	CF	335.00	33,500
5.	Underground Electrical Service Section 16420-Electrical Service System	1	LS	$5,000	$5,000
6.	SCADA Software Implements at Master Station Section 16940-Controls and Instrumentation	1	LS	$5,000	$5,000
7.	Card Access System Section 16940-Controls and Instrumentation	1	LS	$10,000	$10,000
8.	Telephone Company Allowance Section 16420–Electrical Service System	1	LS	$2,000	$2,000



6/21/13

Bidders Signature Aaron E. Staab, President — Date

Staab Construction Corporation

Bidders Company Name

1800 Laemle Ave. PO Box 900

Marshfield, WI 54449-0900

Company Address

Phone 715-387-8429

E-mail bid@staabco.com

EQUIPMENT ALTERNATIVES

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

The name of the Base Bid Equipment item which Bidder shall include in the Lump Sum Base Bid is listed for each equipment item. Where the name of an Equipment Alternative is listed, Bidder is requested to include an add or deduct to the Base Bid Equipment. Where spaces are provided, Bidder may also bid other Equipment Alternatives by writing in the name of an Equipment Alternative. Equipment Alternative Bid prices shall include the entire cost of the Alternative, including cost for engineering changes to accommodate the Alternative, and additional work (including, but not limited to, structural, mechanical, and electrical work) to be performed which is not shown on the Drawings, but which is required as a result of selection of the Alternative.

Whether or not an Equipment Alternative is offered to one or more of the Base Bid items provided for in the Bid, Bidder shall write (in numbers) the price for providing the Base Bid item, as included in the Lump Sum Base Bid.

When more than one Base Bid manufacturer name is listed for a Base Bid item, CONTRACTOR shall circle the name of the equipment selected for the Lump Sum Base Bid and write in the price for the selected equipment.

EQUIPMENT ALTERNATIVES

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

	Item	Name of Manufacturer Included in the Lump Sum Base Bid (Circle One)	Cost of Equipment Included in the Lump Sum Base Bid	Alternative Manufacturer	Add to Base Bid for Alternative Manufacturer	Deduct From Base Bid for Alternative Manufacturer
A.	Centrifugal Pumps (Section 11211)	Fairbanks Morse	$ 50,300	Crane Deming	(+) 3,000	(-)
					(+)	(-)

6/21/13

Bidders Signature Aaron E. Staab, President — Date

Staab Construction Corporation

Bidders Company Name

1800 Laemle Ave. PO Box 900

Marshfield, WI 54449-0900

Company Address

Phone 715-387-8429

E-mail bid@staabco.com

Contract #7101- Staab Construction Corporation

Section F: Disclosure of Ownership and BVC

This section is a required document for the bid to be considered complete. There are two methods for completing the Disclosure of Ownership and 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.

Please select the method of submission below. The form can be found below for filling out
online or download and submit by hand.

Please check the box in the Upload section if submitting the report by hand.

Method of Submittal for Disclosure of Ownership and BVC (click in box below to choose) *
I will submit Bid Express fillable online form (Disclosure of Ownership and BVC).

Section F: Disclosure of Ownership and Best Value Contracting

Notice required under Section 15.04(1)(m), Wisconsin Statutes. The statutory authority for the use of this form is prescribed in Sections 66.0903(12)(d), Wisconsin Statutes. The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12). Personal information you provide may be used for secondary purposes.

(1) On the date a contractor submits a bid to or completes negotiations with a state agency or local governmental unit, on a project subject to Section 66.0903 or 103.49, Wisconsin Statutes, the contractor shall disclose to such state agency or local governmental unit the name of any "other construction business", which the contractor, or a shareholder, officer or partner of the contractor, owns or has owned within the preceding three (3) years.

(2) The term "other construction business" means any business engaged in the erection, construction, remodeling, repairing, demolition, altering or painting and decorating of buildings, structures or facilities. It also means any business engaged in supplying mineral aggregate, or hauling excavated material or spoil as provided by Sections 66.0903(3), 103.49(2) amd 103.50(2), Wisconsin Statues.

(3) This form must ONLY be filed, with the state agency or local governmental unit that will be awarding the contract, if both (A) and (B) are met.

(A) The contractor, or a shareholder, officer or partner of the contractor:

1. Owns at least a 25% interest in the "other construction business", indicated below,on the date the contractor submits a bid or completes negotiations.

2. Or has owned at least a 25% interest in the "other construction business" at any time within the preceding three (3) years.

(B) The Wisconsin Department of Workforce Development (DWD) has determined that the "other construction business" has failed to pay the prevailing wage rate or time and one-half the required hourly basic rate of pay, for hours worked in excess of the prevailing hours of labor, to any employee at any time within the preceding three (3) years.

Other Construction Business

☑ Not Applicable

Name of Business
None

Street Address or PO Box
City
State and Zip Code

Name of Business

Street Address or P O Box
City
State and Zip Code

Name of Business

Street Address or P O Box
City
State and Zip Code

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.

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

- [x] CEMENT MASON / CONCRETE FINISHER
- [ ] CEMENT MASON (HEAVY HIGHWAY)
- [x] CONSTRUCTION CRAFT LABORER
- [ ] DATA COMMUNICATION INSTALLER
- [ ] ELECTRICIAN
- [ ] ENVIRONMENTAL SYSTEMS TECHNICIAN / HVAC SERVICE TECH/HVAC INSTALL / SERVICE
- [ ] GLAZIER
- [x] 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

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

Small Business Enterprise Compliance Report

This information may be submitted electronically through Bid Express or submitted with bid in sealed envelope.

Cover Sheet

Prime Bidder Information

Company: Staab Construction Corporation

Address: 1800 Laemle Ave. PO Box 900 Marshfield, WI 54449-0900

Telephone Number: 715-387-8429 Fax Number: 715-384-4846

Contact Person/Title: Steve Prahl, Project Manager

Prime Bidder Certification

I, Aaron E. Staab (Name), President (Title) of Staab Construction Corporation (Company) certify that the information contained in this SBE Compliance Report is true and correct to the best of my knowledge and belief.

Witness' Signature

6/21/13
Date

Bidder's Signature Aaron E. Staab, President

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

Small Business Enterprise Compliance Report

Summary Sheet

SBE Subcontractors Who Are NOT Suppliers

Name(s) of SBEs Utilized	Type of Work	% of Total Bid Amount
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%
Subtotal SBE who are NOT suppliers:		0 %

SBE Subcontractors Who Are Suppliers

Name(s) of SBEs Utilized	Type of Work	% of Total Bid Amount
		%
		%
		%
		%
		%
		%
Subtotal Contractors who are suppliers:	0 % x 0.6 =	0 % (discounted to 60%)

Total Percentage of SBE Utilization: 0 %.

Contract #7101- Staab Construction Corporation

Section B: Lump Sum Proposal

$2,317,000.00
Booster Pumping Station 106 Reconstruction (Entire Project) *
$2,317,000.00

SECTION G: BID BOND

KNOW ALL MEN BY THESE PRESENT, THAT Staab Construction Corporation (a corporation of the State of Wisconsin) (individual), (partnership), hereinafter referred to as the "Principal") and Western Surety Company, a corporation of the State of South Dakota (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, (hereinafter referred to as the "Obligee"), in the sum of five per cent (5%) of the amount of the total bid or bids of the Principal herein accepted by the Obligee, for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such that, whereas the Principal has submitted, to the City of Madison a certain bid, including the related alternate, and substitute bids attached hereto and hereby made a part hereof, to enter into a contract in writing for the construction of:

CONTRACT NO. 7101

1. If said bid is rejected by the Obligee, then this obligation shall be void.

2. If said bid is accepted by the Obligee and the Principal shall execute and deliver a contract in the form specified by the Obligee (properly completed in accordance with said bid) and shall furnish a bond for his/her faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

   If said bid is accepted by the Obligee and the Principal shall fail to execute and deliver the contract and the performance and payment bond noted in 2. above executed by this Surety, or other Surety approved by the City of Madison, all within the time specified or any extension thereof, the Principal and Surety agree jointly and severally to forfeit to the Obligee as liquidated damages the sum mentioned above, it being understood that the liability of the Surety for any and all claims hereunder shall in no event exceed the sum of this obligation as stated, and it is further understood that the Principal and Surety reserve the right to recover from the Obligee that portion of the forfeited sum which exceed the actual liquidated damages incurred by the Obligee.

   The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by an extension of the time within which the Obligee may accept such bid, and said Surety does hereby waive notice of any such extension.

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.

Seal

Staab Construction Corporation — June 17, 2013
Principal — Date

By: _____
Aaron E. Staab, President

Western Surety Company
Name of Surety

By: _____ June 17, 2013
Attorney-in-Fact — Date

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under License No. 2480137 for the year 2013, and appointed as attorney in fact with authority to execute this bid bond and the payment and performance bond referred to above, which power of attorney has not been revoked.

June 17, 2013
Date

Jay Zahn
Agent

P O Box 160
Address

Menomonee Falls, WI 53052
City, State and Zip Code

262-255-5100
Telephone Number

NOTE TO SURETY & PRINCIPAL

The bid submitted which this bond guarantees may be rejected if the following instrument is not attached to this bond:

Power of Attorney showing that the agent of Surety is currently authorized to execute bonds on behalf of the Surety, and in the amounts referenced above.

Western Surety Company

POWER OF ATTORNEY APPOINTING INDIVIDUAL ATTORNEY-IN-FACT

Know All Men By These Presents, That WESTERN SURETY COMPANY, a South Dakota corporation, is a duly organized and existing corporation having its principal office in the City of Sioux Falls, and State of South Dakota, and that it does by virtue of the signature and seal herein affixed hereby make, constitute and appoint

Jenny L Hirth, Kathryn Weidner, Jay Zahn, Individually

of Menomonee Falls, WI, its true and lawful Attorney(s)-in-Fact with full power and authority hereby conferred to sign, seal and execute for and on its behalf bonds, undertakings and other obligatory instruments of similar nature

- In Unlimited Amounts -

and to bind it thereby as fully and to the same extent as if such instruments were signed by a duly authorized officer of the corporation and all the acts of said Attorney, pursuant to the authority hereby given, are hereby ratified and confirmed.

This Power of Attorney is made and executed pursuant to and by authority of the By-Law printed on the reverse hereof, duly adopted, as indicated, by the shareholders of the corporation.

In Witness Whereof, WESTERN SURETY COMPANY has caused these presents to be signed by its Vice President and its corporate seal to be hereto affixed on this 15th day of February, 2013.

WESTERN SURETY COMPANY

Paul T. Bruflat, Vice President

State of South Dakota }
County of Minnehaha } ss

On this 15th day of February, 2013, before me personally came Paul T. Bruflat, to me known, who, being by me duly sworn, did depose and say: that he resides in the City of Sioux Falls, State of South Dakota; that he is the Vice President of WESTERN SURETY COMPANY described in and which executed the above instrument; that he knows the seal of said corporation; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said corporation and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said corporation.

My commission expires
June 23, 2015

J. MOHR
NOTARY PUBLIC
SOUTH DAKOTA

J. Mohr, Notary Public

CERTIFICATE

I, L. Nelson, Assistant Secretary of WESTERN SURETY COMPANY do hereby certify that the Power of Attorney hereinabove set forth is still in force, and further certify that the By-Law of the corporation printed on the reverse hereof is still in force. In testimony whereof I have hereunto subscribed my name and affixed the seal of the said corporation this 17th day of June, 2013.

WESTERN SURETY COMPANY

L. Nelson, Assistant Secretary

Form F4280-7-2012

Authorizing By-Law

ADOPTED BY THE SHAREHOLDERS OF WESTERN SURETY COMPANY

This Power of Attorney is made and executed pursuant to and by authority of the following By-Law duly adopted by the shareholders of the Company.

Section 7. All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, and Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys in Fact or agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers of Attorney or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile.

SECTION H: AGREEMENT

THIS AGREEMENT made this 17 day of JULY in the year Two Thousand and Thirteen between STAAB CONSTRUCTION CORPORATION 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 JULY 16, 2013, 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:

CONTRACT NO. 7101

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 **TWO MILLION THREE HUNDRED SEVENTEEN THOUSAND ($2,317,000) Dollars** being the amount bid by such Contractor and which was awarded to him/her as provided by law.

4. **Wage Rates for Employees of Public Works Contractors**

   General and Authorization. The Contractor shall compensate its employees at the prevailing wage rate in accordance with section 66.0903, Wis. Stats., DWD 290 of the Wisconsin Administrative Code and as hereinafter provided.

   "Public Works" shall include building or work involving the erection, construction, remodeling, repairing or demolition of buildings, parking lots, highways, streets, bridges, sidewalks, street lighting, traffic signals, sanitary sewers, water mains and appurtenances, storm sewers, and the grading and landscaping of public lands.

   "Building or work" includes construction activity as distinguished from manufacturing, furnishing of materials, or servicing and maintenance work, except for the delivery of mineral aggregate such as sand, gravel, bituminous asphaltic concrete or stone which is incorporated into the work under contract with the City by depositing the material directly in final place from transporting vehicle.

   "Erection, construction, remodeling, repairing" means all types of work done on a particular building or work at the site thereof in the construction or development of the project, including without limitation, erecting, construction, remodeling, repairing, altering, painting, and decorating, the transporting of materials and supplies to or from the building or work done by the employees of the Contractor, Subcontractor, or Agent thereof, and the manufacturing or furnishing of materials, articles, supplies or equipment on the site of the building or work, by persons employed by the Contractor, Subcontractor, or Agent thereof.

"Employees working on the project" means laborers, workers, and mechanics employed directly upon the site of work.

"Laborers, Workers, and Mechanics" include pre-apprentices, helpers, trainees, learners and properly registered and indentured apprentices but exclude clerical, supervisory, and other personnel not performing manual labor.

Establishment of Wage Rates. The Department of Public Works shall periodically obtain a current schedule of prevailing wage rates from DWD. The schedule shall be used to establish the City of Madison Prevailing Wage Rate Schedule for Public Works Construction (prevailing wage rate). The Department of Public Works may include known increases to the prevailing wage rate which can be documented and are to occur on a future specific date. The prevailing wage rate shall be included in public works contracts subsequently negotiated or solicited by the City. Except for known increases contained within the schedule, the prevailing wage rate shall not change during the contract. The approved wage rate is attached hereto.

Workforce Profile. The Contractor shall, at the time of signature of the contract, notify the City Engineer in writing of the names and classifications of all the employees of the Contractor, Subcontractors, and Agents proposed for the work. In the alternative, the Contractor shall submit in writing the classifications of all the employees of the Contractor, Subcontractors and Agents and the total number of hours estimated in each classification for the work. This workforce profile(s) shall be reviewed by the City Engineer who may, within ten (10) days, object to the workforce profile(s) as not being reflective of that which would be required for the work. The Contractor may request that the workforce profile, or a portion of the workforce profile, be submitted after the signature of the contract but at least ten (10) days prior to the work commencing. Any costs or time loss resulting from modifications to the workforce profile as a result of the City Engineer's objections shall be the responsibility of the Contractor.

Payrolls and Records. The Contractor shall keep weekly payroll records setting forth the name, address, telephone number, classification, wage rate and fringe benefit package of all the employees who work on the contract, including the employees of the Contractor's subcontractors and agents. Such weekly payroll records must include the required information for all City contracts and all other contracts on which the employee worked during the week in which the employee worked on the contract. The Contractor shall also keep records of the individual time each employee worked on the project and for each day of the project. Such records shall also set forth the total number of hours of overtime credited to each such employee for each day and week and the amount of overtime pay received in that week. The records shall set forth the full weekly wages earned by each employee and the actual hourly wage paid to the employee.

The Contractor shall submit the weekly payroll records, including the records of the Contractor's subcontractors and agents, to the City Engineer for every week that work is being done on the contract. The submittal shall be within twenty-one (21) calendar days of the end of the Contractor's weekly pay period.

Employees shall receive the full amounts accrued at the time of the payment, computed at rates not less than those stated in the prevailing wage rate and each employee's rate shall be determined by the work that is done within the trade or occupation classification which should be properly assigned to the employee.

An employee's classification shall not be changed to a classification of a lesser rate during the contract. If, during the term of the contract, an employee works in a higher pay classification than the one which was previously properly assigned to the employee, then that employee shall be considered to be in the higher pay classification for the balance of the contract, receive the appropriate higher rate of pay, and she/he shall not receive a lesser rate during the balance of the contract. For purposes of clarification, it is noted that there is a distinct difference between working in a different classification with higher pay and doing work within a classification that has varying rates of pay which are determined by the type of work that is done within the

classification. For example, the classification "Operating Engineer" provides for different rates of pay for various classes of work and the Employer shall compensate an employee classified as an "Operating Engineer" based on the highest class of work that is done in one day. Therefore, an "Operating Engineer's" rate may vary on a day to day basis depending on the type of work that is done, but it will never be less than the base rate of an "Operating Engineer". Also, as a matter of clarification, it is recognized that an employee may work in a higher paying classification merely by chance and without prior intention, calculation or design. If such is the case and the performance of the work is truly incidental and the occurrence is infrequent, inconsequential and does not serve to undermine the single classification principle herein, then it may not be required that the employee be considered to be in the higher pay classification and receive the higher rate of pay for the duration of the contract. However, the Contractor is not precluded or prevented from paying the higher rate for the limited time that an employee performs work that is outside of the employee's proper classification.

Questions regarding an employee's classification, rate of pay or rate of pay within a classification, shall be resolved by reference to the established practice that predominates in the industry and on which the trade or occupation rate/classification is based. Rate of pay and classification disputes shall be resolved by relying upon practices established by collective bargaining agreements and guidelines used in such determination by appropriate recognized trade unions operating within the City of Madison.

The Contractor, its Subcontractors and Agents shall submit to interrogation regarding compliance with the provisions of this ordinance.

Mulcting of the employees by the Contractor, Subcontractor, and Agents on Public Works contracts, such as by kickbacks or other devices, is prohibited. The normal rate of wage of the employees of the Contractor, Subcontractor, and Agents shall not be reduced or otherwise diminished as a result of payment of the prevailing wage rate on a public works contract.

Hourly contributions. Hourly contributions shall be determined in accordance with the prevailing wage rate and with DWD. 290.01(10), Wis. Admin. Code.

Apprentices and Subjourney persons. Apprentices and sub journeypersons performing work on the project shall be compensated in accordance with the prevailing wage rate and with DWD 290.02, and 290.025, respectively, Wis. Admin. Code.

Straight Time Wages. The Contractor may pay straight time wages as determined by the prevailing wage rate and DWD 290.04, Wis. Admin. Code.

Overtime Wages. The Contractor shall pay overtime wages as required by the prevailing wage rate and DWD 290.05, Wis. Admin. Code.

Posting of Wage Rates and Hours. A clearly legible copy of the prevailing wage rate, together with the provisions of Sec. 66.0903(10)(a) and (11)(a), Wis. Stats., shall be kept posted in at least one conspicuous and easily accessible place at the project site by the Contractor and such notice shall remain posted during the full time any laborers, workers or mechanics are employed on the contract.

Evidence of Compliance by Contractor. Upon completion of the contract, the Contractor shall file with the Department of Public Works an affidavit stating:

a. That the Contractor has complied fully with the provisions and requirements of Sec. 66.0903(3), Wis. Stats., and Chapter DWD 290, Wis. Admin. Code; the Contractor has received evidence of compliance from each of the agents and subcontractors; and the names and addresses of all of the subcontractors and agents who worked on the contract.

b. That full and accurate records have been kept, which clearly indicate the name and trade or occupation of every laborer, worker or mechanic employed by the Contractor in connection with work on the project. The records shall show the number of hours worked by each employee and the actual wages paid therefore; where these records will be kept and the name, address and telephone number of the person who will be responsible for keeping them. The records shall be retained and made available for a period of at least three (3) years following the completion of the project of public works and shall not be removed without prior notification to the municipality.

Evidence of Compliance by Agent and Subcontractor. Each agent and subcontractor shall file with the Contractor, upon completion of their portion of the work on the contract an affidavit stating that all the provisions of Sec. 66.0903(3), Wis. Stats., have been fully complied with and that full and accurate records have been kept, which clearly indicate the name and trade or occupation of every laborer, worker or mechanic employed by the Contractor in connection with work on the project. The records shall show the number of hours worked by each employee and the actual wages paid therefore; where these records shall be kept and the name, address and telephone number of the person who shall be responsible for keeping them. The records shall be retained and made available for a period of at least three (3) years following the completion of the project of public works and shall not be removed without prior notification to the municipality.

Failure to Comply with the Prevailing Wage Rate. If the Contractor fails to comply with the prevailing wage rate, she/he shall be in default on the contract.

5. **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, 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 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 or national original 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 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 Director of Affirmative Action.

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 five thousand dollars ($5,000), 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.

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

IN WITNESS WHEREOF, the Contractor has hereunto set his/her hand and seal and the City has caused these presents to be sealed with its corporate seal and to be subscribed by its Mayor and City Clerk the day and year first above written.

Countersigned:

Susan K. Knuchenmaster 7/17/13
Witness Date

Witness 7/17/13 Date

STAAB CONSTRUCTION CORPORATION
Company Name

President Aaron E. Staab 7/17/13 Date

~~Secretary~~ Kevin J. Leick, Vice President 7/17/13 Date

CITY OF MADISON, WISCONSIN

Provisions have been made to pay the liability that will accrue under this contract.

Finance Director

Approved as to form:

City Attorney

Signed this 26th day of August, 20 13

Witness

Witness

Mayor 8-26-13 Date

Thomas Lund for 08/09/13
City Clerk Date

BOND NO.: 929561718

SECTION 1: PAYMENT AND PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we STAAB CONSTRUCTION CORPORATION as principal, and Western Surety Company Company of Sioux Falls, SD as surety, are held and firmly bound unto the City of Madison, Wisconsin, in the sum of TWO MILLION THREE HUNDRED SEVENTEEN THOUSAND ($2,317,000.00) 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:

BOOSTER PUMPING STATION 106 RECONSTRUCTION
CONTRACT NO. 7101

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 17th day of July 2013

Countersigned:

Witness

Secretary Jeffrey A.Graves

STAAB CONSTRUCTION CORPORATION
Company Name (Principal)

President Aaron E. Staab Seal

Approved as to form:

City Attorney

Western Surety Company
Surety Seal

☒ Salary Employee ☐ Commission

By Kathryn A. Weidner
Attorney-in-Fact

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under License No. 2163632 for the year 20 13, and appointed as attorney-in-fact with authority to execute this payment and performance bond which power of attorney has not been revoked.

7/17/2013
Date

Kathryn A. Weidner
Agent Signature

Western Surety Company

POWER OF ATTORNEY APPOINTING INDIVIDUAL ATTORNEY-IN-FACT

Know All Men By These Presents, That WESTERN SURETY COMPANY, a South Dakota corporation, is a duly organized and existing corporation having its principal office in the City of Sioux Falls, and State of South Dakota, and that it does by virtue of the signature and seal herein affixed hereby make, constitute and appoint

Jenny L Hirth, Kathryn Weidner, Jay Zahn, Individually

of Menomonee Falls, WI, its true and lawful Attorney(s)-in-Fact with full power and authority hereby conferred to sign, seal and execute for and on its behalf bonds, undertakings and other obligatory instruments of similar nature

- In Unlimited Amounts -

and to bind it thereby as fully and to the same extent as if such instruments were signed by a duly authorized officer of the corporation and all the acts of said Attorney, pursuant to the authority hereby given, are hereby ratified and confirmed.

This Power of Attorney is made and executed pursuant to and by authority of the By-Law printed on the reverse hereof, duly adopted, as indicated, by the shareholders of the corporation.

In Witness Whereof, WESTERN SURETY COMPANY has caused these presents to be signed by its Vice President and its corporate seal to be hereto affixed on this 15th day of February, 2013.

WESTERN SURETY COMPANY

Paul T. Bruflat, Vice President

State of South Dakota
County of Minnehaha } ss

On this 15th day of February, 2013, before me personally came Paul T. Bruflat, to me known, who, being by me duly sworn, did depose and say: that he resides in the City of Sioux Falls, State of South Dakota; that he is the Vice President of WESTERN SURETY COMPANY described in and which executed the above instrument; that he knows the seal of said corporation; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said corporation and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said corporation.

My commission expires
June 23, 2015

J. MOHR
NOTARY PUBLIC
SOUTH DAKOTA

J. Mohr, Notary Public

CERTIFICATE

I, L. Nelson, Assistant Secretary of WESTERN SURETY COMPANY do hereby certify that the Power of Attorney hereinabove set forth is still in force, and further certify that the By-Law of the corporation printed on the reverse hereof is still in force. In testimony whereof I have hereunto subscribed my name and affixed the seal of the said corporation this 17th day of July, 2013.

WESTERN SURETY COMPANY

L. Nelson, Assistant Secretary

Form F4280-7-2012

Authorizing By-Law

ADOPTED BY THE SHAREHOLDERS OF WESTERN SURETY COMPANY

This Power of Attorney is made and executed pursuant to and by authority of the following By-Law duly adopted by the shareholders of the Company.

Section 7. All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, and Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys in Fact or agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers of Attorney or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile.

SECTION J: PREVAILING WAGE RATES

PREVAILING WAGE RATE DETERMINATION
Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Wis. Stats.
Issued On: 01/10/2013
Amended On: 02/18/2013

DETERMINATION NUMBER: 201300080

EXPIRATION DATE: Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2013. If NOT, You MUST Reapply.

PROJECT NAME: ALL PUBLIC WORKS PROJECTS UNDER SEC 66.0903, STATS - CITY OF MADISON

PROJECT LOCATION: MADISON CITY, DANE COUNTY, WI

CONTRACTING AGENCY: CITY OF MADISON-ENGINEERING

CLASSIFICATION:	Contractors are responsible for correctly classifying their workers. Either call the Department of Workforce Development (DWD) with trade or classification questions or consult DWD's Dictionary of Occupational Classifications & Work Descriptions on the DWD website at: dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm.
OVERTIME:	Time and one-half must be paid for all hours worked: - over 10 hours per day on prevailing wage projects - over 40 hours per calendar week - Saturday and Sunday - on all of the following holidays: January 1; the last Monday in May; July 4; the 1st Monday in September; the 4th Thursday in November; December 25; - The day before if January 1, July 4 or December 25 falls on a Saturday; - The day following if January 1, July 4 or December 25 falls on a Sunday. Apply the time and one-half overtime calculation to whichever is higher between the Hourly Basic Rate listed on this project determination or the employee's regular hourly rate of pay. Add any applicable Premium or DOT Premium to the Hourly Basic Rate before calculating overtime. A DOT Premium (discussed below) may supersede this time and one-half requirement.
FUTURE INCREASE:	When a specific trade or occupation requires a future increase, you MUST add the full hourly increase to the "TOTAL" on the effective date(s) indicated for the specific trade or occupation.
PREMIUM PAY:	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whevenever such pay is applicable.
DOT PREMIUM:	This premium only applies to highway and bridge projects owned by the Wisconsin Department of Transportation and to the project type heading "Airport Pavement or State Highway Construction." DO NOT apply the premium calculation under any other project type on this determination.
APPRENTICES:	Pay apprentices a percentage of the applicable journeyperson's hourly basic rate of pay and hourly fringe benefit contributions specified in this determination. Obtain the appropriate percentage from each apprentice's contract or indenture.
SUBJOURNEY:	Subjourney wage rates may be available for some of the trades or occupations indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer interested in using a subjourney classification on this project MUST complete Form ERD-10880 and request the applicable wage rate from the Department of Workforce Development PRIOR to using the subjourney worker on this project.

This document **MUST BE POSTED** by the **CONTRACTING AGENCY** in at least one conspicuous and easily accessible place **on the site of the project** . A local governmental unit may post this document at the place normally used to post public notices if there is no common site on the project. This document **MUST** remain posted during the entire time any worker is employed on the project and **MUST** be physically incorporated into the specifications and all contracts and subcontracts. If you have any questions, please write to the Equal Rights Division, Labor Standards Bureau, P.O. Box 8928, Madison, Wisconsin 53708 or call (608) 266-6861.

The following statutory provisions apply to local governmental unit projects of public works and are set forth below pursuant to the requirements of s. 66.0903(8), Stats.

s. 66.0903 (1) (f) & s. 103.49 (1) (c) "PREVAILING HOURS OF LABOR" for any trade or occupation in any area means 10 hours per day and 40 hours per week and may not include any hours worked on a Saturday or Sunday or on any of the following holidays:

1. January 1.
2. The last Monday in May.
3. July 4.
4. The first Monday in September.
5. The 4th Thursday in November.
6. December 25.
7. The day before if January 1, July 4 or December 25 falls on a Saturday.
8. The day following if January 1, July 4 or December 25 falls on a Sunday.

s. 66.0903 (10) RECORDS; INSPECTION; ENFORCEMENT.
(a) Each contractor, subcontractor, or contractor's or subcontractor's agent performing work on a project of public works that is subject to this section shall keep full and accurate records clearly indicating the name and trade or occupation of every person performing the work described in sub. (4) and an accurate record of the number of hours worked by each of those persons and the actual wages paid for the hours worked.

s. 66.0903 (11) LIABILITY AND PENALTIES.
(a) 1. Any contractor, subcontractor, or contractor's or subcontractor's agent who fails to pay the prevailing wage rate determined by the department under sub. (3) or who pays less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor is liable to any affected employee in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional amount as liquidated damages as provided under subd. 2., 3., whichever is applicable.
2. If the department determines upon inspection under sub. (10) (b) or (c) that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the department shall order the contractor to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages within a period specified by the department in the order.
3. In addition to or in lieu of recovering the liability specified in subd. 1. as provided in subd. 2., any employee for and in behalf of that employee and other employees similarly situated may commence an action to recover that liability in any court of competent jurisdiction. If the court finds that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the court shall order the contractor, subcontractor, or agent to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages.
5. No employee may be a party plaintiff to an action under subd. 3. unless the employee consents in writing to become a party and the consent is filed in the court in which the action is brought. Notwithstanding s. 814.04 (1), the court shall, in addition to any judgment awarded to the plaintiff, allow reasonable attorney fees and costs to be paid by the defendant.

BUILDING OR HEAVY CONSTRUCTION

'ncludes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
101	Acoustic Ceiling Tile Installer	30.16	15.31	45.47
102	Boilermaker	31.09	24.52	55.61
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add $ .80 on 6/1/2013 Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.01	17.35	49.36
104	Cabinet Installer	30.16	15.31	45.47
105	Carpenter	30.16	15.31	45.47
106	Carpet Layer or Soft Floor Coverer	30.16	15.31	45.47
107	Cement Finisher	31.48	13.19	44.67
108	Drywall Taper or Finisher	25.10	14.78	39.88
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.94	18.80	51.74
110	Elevator Constructor	44.94	23.84	68.78
111	Fence Erector	22.50	3.98	26.48
112	Fire Sprinkler Fitter	36.07	18.60	54.67
113	Glazier	37.13	12.32	49.45
114	Heat or Frost Insulator	33.93	23.26	57.19
115	Insulator (Batt or Blown)	27.47	19.16	46.63
116	Ironworker	30.90	19.11	50.01
117	Lather	30.16	15.31	45.47
118	Line Constructor (Electrical)	37.05	16.94	53.99

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
119	Marble Finisher	20.00	0.00	20.00
120	Marble Mason	32.01	16.85	48.86
121	Metal Building Erector	18.05	8.08	26.13
122	Millwright	31.76	15.36	47.12
123	Overhead Door Installer	13.50	0.00	13.50
124	Painter	24.80	14.78	39.58
125	Pavement Marking Operator	30.00	0.00	30.00
126	Piledriver	30.66	15.31	45.97
127	Pipeline Fuser or Welder (Gas or Utility)	30.18	19.29	49.47
129	Plasterer	30.03	16.36	46.39
130	Plumber	36.17	15.37	51.54
132	Refrigeration Mechanic	42.45	16.71	59.16
133	Roofer or Waterproofer	30.40	2.23	32.63
134	Sheet Metal Worker	34.23	20.19	54.42
135	Steamfitter	41.20	16.28	57.48
137	Teledata Technician or Installer Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	21.89	11.85	33.74
138	Temperature Control Installer	41.20	16.21	57.41
139	Terrazzo Finisher Future Increase(s): Add $ .80 on 6/1/2013	26.57	16.50	43.07
140	Terrazzo Mechanic	29.51	17.63	47.14
141	Tile Finisher Future Increase(s): Add $ .80/hr on 6/1/2013.	23.77	16.50	40.27
142	Tile Setter Future Increase(s): Add $ .80/hr on 6/1/2013.	29.71	16.50	46.21
143	Tuckpointer, Caulker or Cleaner Future Increase(s): Add $ .80 on 6/1/2013 Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.01	17.35	49.36

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
144	Underwater Diver (Except on Great Lakes)	34.16	15.31	49.47
146	Well Driller or Pump Installer Future Increase(s): Add $.20/hr on 06/01/2013.	25.32	15.45	40.77
147	Siding Installer	37.20	17.01	54.21
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	28.24	15.10	43.34
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	29.64	14.64	44.28
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.94	13.57	39.51
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.08	12.96	37.04
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	24.00	11.57	35.57

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	31.89	17.98	49.87
203	Three or More Axle	18.00	11.45	29.45
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $1/hr on 6/2/2013.	32.39	18.46	50.85
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	18.00	11.45	29.45

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $.75/hr. on 06/03/2013 Premium Increase(s): Add $1.00/hr for certified welder; Add $.25/hr for mason tender	24.19	13.90	38.09
302	Asbestos Abatement Worker	18.00	0.00	18.00
303	Landscaper	15.00	3.90	18.90
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	20.94	12.65	33.59

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased) Premium Increase(s): DOT PREMIUMS: Pay two times the hourly basic rate on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	18.31	12.67	30.98
314	Railroad Track Laborer	23.41	6.91	30.32
315	Final Construction Clean-Up Worker	24.69	12.90	37.59

HEAVY EQUIPMENT OPERATORS
SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
501	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). Future Increase(s): Add $1/hr on 6/2/2013.	32.39	18.46	50.85
502	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under). Future Increase(s): Add $1/hr on 6/2/2013.	32.39	18.46	50.85
503	Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1/hr on 6/2/2013.	30.32	18.46	48.78

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	37.45	19.45	56.90
505	Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator. Future Increase(s): Add $2.19/hr on 01/01/2013; Add $2.00/hr on 01/01/2014. Premium Increase(s): Add $.50/hr for Friction Crane, Lattice Boom or Crane Certification (CCO).	38.80	20.17	58.97
506	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery. Future Increase(s): Add $2.08/hr on 01/01/2013; Add $2.00/hr on 01/01/2014.	34.50	20.04	54.54
507	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY. Future Increase(s): Add $1.88/hr on 01/01/2013; Add $2.00/hr on 01/01/2014.	28.70	19.86	48.56

HEAVY EQUIPMENT OPERATORS
EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
508	Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add $1/hr on 6/2/2013. Premium Increase(s): Add $.50/hr for >200 Ton / Add $1/hr at 300 Ton / Add $1.50 at 400 Ton / Add $2/hr at 500 Ton & Over.	35.12	18.46	53.58

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
509	Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over). Future Increase(s): Add $1/hr on 6/2/2013. Premium Increase(s): Add $.25/hr for all >45 Ton lifting capacity cranes.	34.12	18.46	52.58
510	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type).	32.42	17.97	50.39
511	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add $1/hr on 6/2/2013.	32.39	18.46	50.85
512	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames. Future Increase(s): Add $1/hr on 6/2/2013.	30.32	18.46	48.78

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
513	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1/hr on 6/2/2013.	29.69	18.46	48.15
514	Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment). Future Increase(s): Add $2/hr on 1/1/2013.	34.89	20.59	55.48
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment). Future Increase(s): Add $1.60/hr on 06/01/2013; Add $1.60/hr on 06/01/2014; Add $1.65/hr on 06/01/2015.	31.32	17.95	49.27
516	Fiber Optic Cable Equipment Future Increase(s): Add $1.75/hr on 02/01/2013; Add $1.75/hr on 02/01/2014	26.69	16.65	43.34

SEWER, WATER OR TUNNEL CONSTRUCTION

Includes those projects that primarily involve public sewer or water distribution, transmission or collection systems and related tunnel work (excluding buildings).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add $1.45/hr on 6/01/2013 Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	35.80	16.87	52.67
105	Carpenter Future Increase(s): Add $.75/hr on 6/3/2013. Add $1.25/hr on 6/2/2014. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.93	19.81	52.74
107	Cement Finisher Future Increase(s): Add $1.87 on 6/1/13; Add $1.87 on 6/1/14; Add $1.87 on 6/1/15; Add $1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	32.09	16.13	48.22
109	Electrician Future Increase(s): Add $1.60/hr on 6/1/2013. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.20	21.71	53.91
111	Fence Erector	22.50	3.98	26.48
116	Ironworker	30.90	19.11	50.01
118	Line Constructor (Electrical)	37.05	16.94	53.99
125	Pavement Marking Operator	28.10	15.00	43.10
126	Piledriver	30.66	15.31	45.97
130	Plumber	36.97	17.66	54.63

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
135	Steamfitter	41.20	16.28	57.48
137	Teledata Technician or Installer	21.26	11.75	33.01
143	Tuckpointer, Caulker or Cleaner	32.01	16.85	48.86
144	Underwater Diver (Except on Great Lakes)	37.45	19.45	56.90
146	Well Driller or Pump Installer	21.00	2.23	23.23
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	28.24	15.10	43.34
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	29.64	14.64	44.28
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.94	13.57	39.51
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.08	12.96	37.04
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	11.90	33.65

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	25.87	13.00	38.87
203	Three or More Axle	17.54	13.85	31.39
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	31.89	17.98	49.87
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	17.00	0.00	17.00

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $.80/hr. on 06/03/2013 Premium Increase(s): Add $.20 for blaster, bracer, manhole builder, caulker, bottomman and power tool; Add $.55 for pipelayer; Add $1.00 for tunnel work 0-15 lbs. compressed air; Add $2.00 for over 15-30 lbs. compressed air; Add $3.00 for over 30 lbs. compressed air.	25.53	13.89	39.42
303	Landscaper	26.92	12.51	39.43

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
304	Flagperson or Traffic Control Person	17.33	15.53	32.86
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.81	12.22	30.03
314	Railroad Track Laborer	23.41	6.91	30.32

HEAVY EQUIPMENT OPERATORS
SEWER, WATER OR TUNNEL WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
521	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver. Future Increase(s): Add $1/hr on 6/2/2013. Premium Increase(s): Add $.50/hr for >200 Ton / Add $1/hr at 300 Ton / Add $1.50 at 400 Ton / Add $2/hr at 500 Ton & Over.	35.12	18.46	53.58
522	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skid Rig; Telehandler; Traveling Crane (Bridge Type). Future Increase(s): Add $1/hr on 6/2/2013.	32.92	18.46	51.38
523	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add $1/hr on 6/2/2013.	32.39	18.46	50.85

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
524	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.	31.89	18.11	50.00
525	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1/hr on 6/2/2013.	29.69	18.46	48.15
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler.	30.44	19.10	49.54
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	37.45	19.45	56.90
528	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	37.45	19.45	56.90
529	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	27.75	19.15	46.90
530	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	27.75	19.15	46.90

AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION

Includes all airport projects (excluding buildings) and all projects awarded by the Wisconsin Department of Transportation (excluding buildings).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	35.58	19.20	54.78
105	Carpenter	30.16	15.31	45.47
107	Cement Finisher Future Increase(s): Add $1.87 on 6/1/13; Add $1.87 on 6/1/14; Add $1.87 on 6/1/15; Add $1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	32.09	16.13	48.22
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.94	18.80	51.74
111	Fence Erector	28.00	4.50	32.50
116	Ironworker	30.90	19.11	50.01
118	Line Constructor (Electrical)	31.29	15.34	46.63
124	Painter	26.65	13.10	39.75
125	Pavement Marking Operator	29.22	16.71	45.93
126	Piledriver	30.66	15.31	45.97
133	Roofer or Waterproofer	30.40	2.23	32.63
137	Teledata Technician or Installer	21.26	11.75	33.01
143	Tuckpointer, Caulker or Cleaner	32.01	16.85	48.86
144	Underwater Diver (Except on Great Lakes)	37.45	19.45	56.90
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	29.64	17.00	46.64
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	35.50	15.09	50.59

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.94	13.57	39.51
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.08	12.96	37.04
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	11.90	33.65

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	33.22	18.90	52.12
203	Three or More Axle Future Increase(s): Add $1.85/hr on 6/1/2013. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	23.31	17.13	40.44
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	27.77	19.90	47.67
205	Pavement Marking Vehicle	23.84	14.94	38.78
206	Shadow or Pilot Vehicle	33.22	18.90	52.12
207	Truck Mechanic	22.50	16.19	38.69

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $1.70/hr on 6/1/2013; Add $1.60/hr on 6/1/2014. Premium Increase(s): Add $.10/hr for topman, air tool operator, vibrator or tamper operator (mechanical hand operated), chain saw operator and demolition burning torch laborer; Add $.15/hr for bituminous worker (raker and luteman), formsetter (curb, sidewalk and pavement) and strike off man; Add $.20/hr for blaster and powderman; Add $.25/hr for bottomman; Add $.35/hr for line and grade specialist; Add $.45/hr for pipelayer. / DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	28.35	13.90	42.25
302	Asbestos Abatement Worker	18.00	0.00	18.00
303	Landscaper Future Increase(s): Add $1.70/hr on 6/1/13; Add $1.60/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	28.35	13.90	42.25
304	Flagperson or Traffic Control Person Future Increase(s): Add $1.70/hr on 6/1/2013; Add $1.60/hr on 6/1/2014. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	24.70	13.90	38.60
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.81	12.22	30.03
314	Railroad Track Laborer	23.41	6.91	30.32

HEAVY EQUIPMENT OPERATORS
AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
531	Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Traveling Crane (Bridge Type). Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	35.22	19.90	55.12
532	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs., & Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	34.72	19.90	54.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
533	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boatmen (NOT Performing Work on the Great Lakes); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	34.22	19.90	54.12
534	Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s):	33.96	19.90	53.86

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
	DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.			
535	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	33.67	19.90	53.57
536	Fiber Optic Cable Equipment.	25.74	15.85	41.59
537	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	37.45	19.45	56.90
538	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	37.45	19.45	56.90
539	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	27.75	19.15	46.90
540	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks-Great Lakes ONLY.	27.75	19.15	46.90

LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION

Includes roads, streets, alleys, trails, bridges, paths, racetracks, parking lots and driveways (except residential or agricultural), public sidewalks or other similar projects (excluding projects awarded by the Wisconsin Department of Transportation).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	33.00	15.00	48.00
105	Carpenter	30.16	15.31	45.47
107	Cement Finisher	31.48	15.68	47.16
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.94	18.80	51.74
111	Fence Erector	22.50	3.98	26.48
116	Ironworker	30.90	19.11	50.01
118	Line Constructor (Electrical)	37.05	16.94	53.99
124	Painter	24.80	14.78	39.58
125	Pavement Marking Operator	28.10	15.00	43.10
126	Piledriver	30.66	15.31	45.97
133	Roofer or Waterproofer	30.40	2.23	32.63
137	Teledata Technician or Installer	21.26	11.75	33.01
143	Tuckpointer, Caulker or Cleaner	32.01	16.85	48.86
144	Underwater Diver (Except on Great Lakes)	37.45	19.45	56.90
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	29.64	14.55	44.19
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	30.60	14.64	45.24
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.94	13.57	39.51
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.08	12.96	37.04
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	11.90	33.65

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	25.87	13.00	38.87
203	Three or More Axle	17.00	0.00	17.00
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $1/hr on 6/2/2013.	32.39	18.46	50.85
205	Pavement Marking Vehicle	20.85	11.02	31.87
206	Shadow or Pilot Vehicle	25.87	13.00	38.87
207	Truck Mechanic	17.00	0.00	17.00

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer	27.20	13.37	40.57
303	Landscaper	18.25	1.11	19.36
304	Flagperson or Traffic Control Person	17.33	15.53	32.86
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.81	12.22	30.03
314	Railroad Track Laborer	23.41	6.91	30.32

HEAVY EQUIPMENT OPERATORS
CONCRETE PAVEMENT OR BRIDGE WORK

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
541	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	35.22	19.90	55.12
542	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	34.72	19.90	54.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
543	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	34.22	19.90	54.12
544	Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (WIth or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	33.96	19.90	53.86

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.	29.82	17.98	47.80
546	Fiber Optic Cable Equipment.	25.74	15.85	41.59
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	37.45	19.45	56.90
548	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	37.45	19.45	56.90
549	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	27.75	19.15	46.90
550	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	27.75	19.15	46.90

HEAVY EQUIPMENT OPERATORS
ASPHALT PAVEMENT OR OTHER WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
551	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	34.62	17.98	52.60
552	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add $1/hr on 6/2/2013.	32.92	18.46	51.38

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
553	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add $1/hr on 6/2/2013.	32.39	18.46	50.85
554	Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14.	33.67	19.55	53.22
555	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14.	33.67	19.55	53.22
556	Fiber Optic Cable Equipment.	25.74	15.85	41.59

RESIDENTIAL OR AGRICULTURAL CONSTRUCTION

Includes single family houses or apartment buildings of no more than four (4) stories in height and all buildings, structures or facilities that are primarily used for agricultural or farming purposes, excluding commercial buildings. For classification purposes, the exterior height of a residential building, in terms of stories, is the primary consideration. All incidental items such as site work, driveways, parking lots, private sidewalks, private septic systems or sewer and water laterals connected to a public system and swimming pools are included within this definition. Residential buildings of five (5) stories and above are NOT included within this definition.

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
101	Acoustic Ceiling Tile Installer	19.50	11.10	30.60
102	Boilermaker	31.09	24.52	55.61
103	Bricklayer, Blocklayer or Stonemason	23.00	0.00	23.00
104	Cabinet Installer	16.25	3.22	19.47
105	Carpenter	30.16	1.36	31.52
106	Carpet Layer or Soft Floor Coverer	23.95	6.48	30.43
107	Cement Finisher	22.46	2.71	25.17
108	Drywall Taper or Finisher	15.50	0.00	15.50
109	Electrician	17.00	13.64	30.64
110	Elevator Constructor	44.94	23.84	68.78
111	Fence Erector	18.52	5.93	24.45
112	Fire Sprinkler Fitter	36.07	18.60	54.67
113	Glazier	37.13	12.32	49.45
114	Heat or Frost Insulator	35.00	0.00	35.00
115	Insulator (Batt or Blown)	18.50	13.98	32.48
116	Ironworker	30.90	19.11	50.01
117	Lather	30.16	1.36	31.52
119	Marble Finisher	16.50	2.38	18.88
120	Marble Mason	23.00	0.00	23.00
121	Metal Building Erector	16.52	1.82	18.34
123	Overhead Door Installer	17.00	0.00	17.00
124	Painter	23.00	11.27	34.27
125	Pavement Marking Operator	28.10	15.00	43.10

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
129	Plasterer	20.00	0.00	20.00
130	Plumber	38.90	0.00	38.90
132	Refrigeration Mechanic	33.00	1.79	34.79
133	Roofer or Waterproofer	17.50	3.73	21.23
134	Sheet Metal Worker	21.03	3.40	24.43
135	Steamfitter	41.20	16.28	57.48
137	Teledata Technician or Installer	19.23	1.46	20.69
138	Temperature Control Installer	21.00	0.00	21.00
139	Terrazzo Finisher	26.57	16.00	42.57
140	Terrazzo Mechanic	30.01	17.13	47.14
141	Tile Finisher	20.60	4.88	25.48
142	Tile Setter	19.00	0.00	19.00
143	Tuckpointer, Caulker or Cleaner	32.50	2.84	35.34
146	Well Driller or Pump Installer	19.00	7.30	26.30
147	Siding Installer	19.07	0.00	19.07

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	28.05	4.18	32.23
203	Three or More Axle	20.00	4.37	24.37
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	19.00	1.85	20.85

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer	19.80	7.22	27.02
302	Asbestos Abatement Worker	18.00	6.24	24.24
303	Landscaper	13.15	6.51	19.66

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.81	12.22	30.03
315	Final Construction Clean-Up Worker	15.00	0.00	15.00

HEAVY EQUIPMENT OPERATORS
RESIDENTIAL OR AGRICULTURAL CONSTRUCTION

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
557	Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type); Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Crane, Shovel, Dragline, Clamshells; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type); Winches & A-Frames.	31.89	18.20	50.09
558	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Backfiller; Belting, Burlap, Texturing Machine; Boiler (Temporary Heat); Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Jeep Digger; Lift Slab Machine; Mulcher; Oiler; Post Hole Digger or Driver; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Roller (Rubber Tire, 5 Tons or Under); Screed (Milling Machine); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Stump Chipper; Telehandler; Vibratory Hammer or Extractor, Power Pack.	28.70	4.91	33.61

********** END OF RATES **********