Attachment C

10/9/2015

Parking Ramp Design Criteria
ATC Underground Transmission

Background: ATC and MGE met on October 1, 2015 to discuss design criteria that ATC requires if a parking ramp is constructed within the ATC underground transmission line easement at the Livingston St. MGE property. The following design criteria items were discussed as the ones needed and ATC came up with the numbers following the meeting. They are presented here:

1) Distance from ATC pipe to wall – 2.5 feet. Clearances are from the outermost surface of the respective cable system.

2) Distance from ATC pipe to footings or pilings
   a) There is no established horizontal clearance applied to pile driving. The concern to share with the developer and eventually the excavation crew is to request they expose ATC pipe(s) including 5 feet below the pipe and support the pipe(s) where required before the start of pile driving. If necessary ATC can prepare a sketch showing the location of pipe excavation, length of pipe that needs to be exposed and include the backfill requirements.

3) Garage opening height – 16 feet, width – 25 feet (South Livingston)
   a) May be able to consider minimizing the height and width if an existing grade change reduces ATC's pipe depth. Details would need to be reviewed with ATC.

4) Overhead clearance above grade over pipe – 16 feet
   a) May be able to consider lowering the overhead clearance if an existing grade change reduces ATC's pipe depth. Details would need to be reviewed with ATC.

5) Plantings
   a) No trees within 12.5 ft from ATC's center pipe
   b) ATC requests any landscaping plan (i.e. shrubs) that include plantings within 12.5 ft. of ATC's center pipe be reviewed by ATC.

Attachment D

AMERICAN TRANSMISSION COMPANY®	**Guide**	Department:	Asset Management
		Document No:	**GD-0265 v02**
Title: **UNDERGROUND TRANSMISSION LINE CLEARANCES**		Issue Date:	03-02-2011
		Previous Date:	02-27-2007

Table of Contents

Approved By: **Andrew Dolan** Signed original on file	**Author:** **Ron Knapwurst**

1. SCOPE

This guide defines the required clearances between American Transmission Company (ATC) underground electric transmission cable systems and other utilities, for the purpose of design and right-of-way encroachment reviews. For the purpose of this document underground cable systems may be 69kV to 345kV pipe-type, duct bank, conduit, direct buried, or casings.

2. INTRODUCTION

This guide provides clearance guidelines for the design of the underground transmission (UGT) lines and/or adjacent underground utilities and facilities by others occupying the same general area. It will also provide review guidance for proposed encroachments on ATC underground cable systems. This guide will address the following issues:

- Determine the potential impact of the proposed encroachment for code compliance.
- Ensure access to, as well as, the safety and integrity of the ATC underground electric transmission facilities.
- Preserve the ATC easement rights as indicated in the original ATC easement documents.
- Maintain the electrical rating (ampacity) of the ATC underground cable system.

3. GENERAL

3.1 Cable System Considerations

3.1.1 Electrical Rating / Thermal Capability – The electrical rating of all types of underground cable systems are dependent on their ability to dissipate the heat generated within them during the flow of electrical power. Specific attention is paid to the thermal heat transfer capability of the cable systems and the surrounding soils and backfills during the initial cable system design. Generally ATC can not tolerate a reduction of any cable electrical rating for operational reasons during peak loadings.

3.1.2 The electrical rating of the cable circuit is directly related to the heat transfer capability. The heat transfer capability decreases as the thermal resistivity of the soils / backfill material increases and with the depth of burial of the cable. For this reason, thermal backfill (special fluidized concrete mixtures and/or granular materials) are placed around and above the cable to improve the heat transfer capability.

3.1.3 The depth of burial of the cable from the top of the cable to the existing grade will vary along the length of the line. The burial depth was a consideration in the present cable circuit rating, and the depth can not be increased unless special considerations are made to compensate for the increased depth, such as improved thermal backfills. Generally, the cable will be buried three to five feet in depth.

3.1.4 Access to the specific cable system shall be maintained, so that crews have the ability to make repairs and/or perform routine maintenance on the cable system. Any proposed alterations to the areas above and surrounding the cable shall take this into consideration.

3.2 Special Cable Considerations

3.2.1 For pipe-type cable systems, typical cable pipe sizes will be 5-9/16”, 6-5/8”, 8-5/8”, and 10-5/8” outside diameters (OD), sometimes also having 2” or 3” OD fluid return lines. These pipes are fabricated using carbon steel and are used over the majority of the line. Buried 2”, 3” or 4” OD stainless steel may be used for terminations, underground trifurcators and spreader heads. These pipes will have a corrosion resistant coating on the outer surface that must be maintained to ensure that corrosion and subsequent leaks don’t develop in the pipe. Should the pipe(s) be subjected to

abnormally high stresses, the physical properties of the pipe shall be evaluated. Two examples of a situation where the mechanical strength of the pipe shall be evaluated are 1) an installation under railroad tracks and 2) an excavation which undermines the pipe for an extended length.

3.2.2 Pipe-type cable systems are also equipped with a cathodic protection system. This consists of cathodic protection rectifiers an each end of the pipe line or of anodes buried adjacent to the pipe periodically over the pipes length. In addition to keeping these cathodic systems in tact, other underground utilities and structures may also use cathodic protection systems. Interference between adjacent cathodic systems can result in inadequate cathodic protection and/or accelerated corrosion. The influence of all cathodic systems shall be taken into consideration.

3.2.3 Pipe-type and duct type cable systems generally have manholes associated with them. Access to all manholes shall be maintained. Temporary exceptions may be considered on a case by case basis.

3.2.4 Direct buried cable systems generally consist of three cables laid in a flat configuration with a deliberate spacing between the individual cables. Special care shall be taken to identify the location of all three cables, especially the outer cables. Identification shall be prior to design and construction of other facilities in the area of the direct buried cable system.

3.3 Underground Electric Right-of-Way

Underground cable systems may be installed using several different types of rights-of-ways. The type of right-of-way shall be considered in determining the response to an encroachment request. The following are the types of right-of-ways used for underground transmission (UGT) lines. The UGT may consist of pipe-type, duct or direct buried cable systems.

3.3.1 Permit

Most installations in road right-of-way are accomplished via a permit from the city or municipality. Should the permitting authority request that the ATC facilities be relocated and show the necessity, the cable system will be relocated. If the request is made for contractor convenience or a third party, the contractor or third party shall bear the cost of the relocate.

3.3.2 Easement

When the cable system is installed within an easement, any requests for relocation will be at the expense of the requester.

3.3.3 Fee-owned

When a cable system is installed on ATC fee-owned right-of-way, any request for relocation shall be at the expense of the requester.

3.3.4 Railroad License

When a cable system is installed within an existing railroad right-of-way, and the railroad company requests ATC to remove, relocate or protect its UGT, the license should be reviewed to determine if ATC is required to or not. If the railroad right-of-way has been abandoned and is owned by a private landowner, the ATC Legal Department shall be consulted to determine the ATC rights. If the request is made for contractor convenience or a third party, the contractor or third party shall bear the cost of the relocate.

3.4 Relocation Lead Time

If relocation of the ATC underground transmission facility is required, the lead time to design, procure material and construct the UGT may exceed one and one-half to two (1-1/2 to 2) years, with the lead time possibly reducing to one (1) year if materials are readily available. The request shall be reasonable, allowing enough time for the safe design of the relocation, material procurement and construction.

3.5 Protection of ATC Facilities

ATC underground transmission facilities shall be adequately protected using mats or steel road plating during all work activities positioned over the UGT facilities. When construction equipment, of substantial size and weight (such as a crane), is positioned over the UGT facilities, the entire area under the equipment shall be reinforced using appropriate construction matting to equalize the weight. The requestor is responsible for taking any and all precautions to avoid soil compaction, sinking, undermining and any other circumstances that would cause damage to the ATC underground transmission facilities.

4. APPLICATION

4.1 Clearance between Cable System and Other Underground Utilities

In addition to the general considerations listed in Section 3, the horizontal and vertical clearances between the cable system and other underground utilities structures and facilities, Structures and facilities are to be designed and constructed to permit access to and maintenance of either facility without damage to the other. All underground utilities, structures and facilities shall be designed and constructed in such a manner as to not impact the electrical rating of the electric transmission cable system. Additionally, all underground facilities shall be designed with suitable support on each side of the adjacent underground facility to limit the transferring of any direct load, unless otherwise agreed upon with ATC. It should be noted that some municipalities may have codes that govern minimum required distances between facilities.

4.1.1 Horizontal Clearance / Parallel Installations

The minimum horizontal or parallel clearances from the outer most surface of the electric cable pipe, duct bank, conduit or direct burial cable system to the other utility or structure shall be those shown in Table 1.

Table 1 – Horizontal or Parallel Clearances from Cable System to Other Utilities or Structures

Utility or Structure	Clearances (feet)		
	Preferred Design	Minimum Design	Minimum Acceptable
Gas, Distribution Main or Service	2	1	1
Storm or Sanitary Sewer	2	1	1
Water Main or Service	2	1.5	1
Electric Ducts	10	10	10 [1]
Steam Main or Tunnel	10	10	10 [1]
Oil or Gas Transmission Pipeline [2]	4	3	2
Communication and Other Ducts	2	1	1
Manholes	2	1	1
Other Structures or Foundations	2	1.5	1

[1] A lesser clearance may be acceptable with the approval of ATC of an adequately designed insulation barriers and/or additional thermal backfill to isolate/dissipate heat from the adjacent heat producing utility.

[2] ATC underground transmission facilities within 100 feet of an oil or gas pumping/compressor facility shall have at least a 15 foot horizontal separation from the extremity of that facility.

4.1.2 Vertical Clearance /Crossing Installations

The minimum vertical or crossing clearances from the outer most surface of the electric cable pipe, duct bank, conduit or direct burial system to the other utility or structure shall be those shown in Table 2.

Table 2 – Vertical or Crossing Clearances from Cable System to Other Utilities or Structures

Utility or Structure	Clearances (feet)		
	Preferred Design	Minimum Design	Minimum Acceptable
Gas Distribution Main or Service	2	1	1
Storm or Sanitary Sewer	2	1	0.5
Water Service	2	1	0.25[3]
Water Main	2	1.5	0.5
Electric Ducts	4	2	1.5
Steam Main or Tunnel	6	5	4
Oil or Gas Transmission Pipeline	4	2	1
Communication and Other Ducts	2	1	0.25 [4]
Manholes (under ATC cable)	2	1	1
Railroad Track (in street) [5]	5	5	3
Railroad Track [4]	5	5	4.25
Grade	3.5	3	2[6]

4.1.3 Trenchless Construction Clearances

When a trenchless type of construction is utilized adjacent to underground transmission (UGT) lines, a minimum of 5 foot or the clearance as stated in Tables 1 and 2 above, whichever is greater, shall be maintained in all direction from the UGT lines. Field exploratory excavations shall be preformed, to verify the exact location of the UGT cables, prior to any trenchless construction. Trenchless construction includes horizontal directional boring, jack and bore, micro-tunneling and other similar types of construction.

4.1.4 Clearance Considerations

4.1.4.1 All clearances are from the outer most surface of the respective cable system. The outer surface will be the coated pipe, duct bank, conduit, duct bank or direct buried cable, as appropriate for the cable system at any given location.

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[3] For water service of 2” or less in size. Water service large than 2” shall maintain at least 0.5 foot Minimum Acceptable clearance

[4] Separation shall include at 3” of concrete, via encasement and/or barrier between the facilities.

[5] Clearance from top of rail.

[6] Galvanized Steel Plate required if less than 2.5 foot.

4.1.4.2 Normal design clearances shall use the Preferred Design clearances listed in Table 1 and Table 2 to ensure normal safe working clearances from the other utility or structure. In special design situations, such as gravity fed sewers, the Minimum Design clearances may used, with demonstrated necessity shown to ATC.

4.1.4.3 Prior to final design, the location of the ATC facilities shall be verified, in the presence of an ATC representative, by small exploratory excavation(s). The exploratory excavation(s) shall be done, using vacuum excavation, small hand tools or other approved methods, to verify all cable system locations in the field. ATC drawings, showing cable system locations, were accurate at the time of installation only and shall not be solely relied upon in the place of field examination. Diggers Hotline markings can be considered as being accurate to within 18 inches of the ATC cable system. Pipe-type cable systems shall be inspected for defects in the pipe coating while it is exposed. All underground electrical cable systems shall be assumed to be energized during all exploration and construction activities.

4.1.4.4 Minimum Acceptable clearances shall only be used if field exploratory excavations indicate that the actual facility location are less than the Minimum Design clearances or special design consideration have be incorporated to compensate for the reduced clearances. Special design consideration may include special thermal backfills, thermal insulating shields and stress relief barriers. All uses of Minimum Acceptable clearances shall be coordinated with and approved in advance by ATC engineering.

4.1.4.5 Clearances to adjacent heat sources (electric ducts, steam main/tunnels and oil or gas pumping/compressor facility) may be reduced to less than specified in Tables 1 and 2 if a thermal analysis has been performed to justify the reduced clearance. Consideration for the use of thermal barriers and/or enhanced thermal backfills shall be used when reduced clearances are desired. In all cases of requested reduced clearances for the proposed facilities and the design shall be coordinated with and approved in advance by ATC engineering.

4.1.4.6 No other utilities or structures that extend parallel to the ATC cable system shall be located directly above or below the cable system.

4.1.4.7 Water mains shall be installed as far as practical from the cable system to protect it from being undermined in the event of a water main break.

4.2 Vertical Clearance Space above Underground Cable Systems

An open space shall be provided above the cable system to all permanent structures and objects constructed, to provide access for maintenance, repairs and/or replacements of the cable system. The open space shall be a minimum of 12 foot vertical clearance above grade of the cable system, and be a minimum of 10 foot in width or the width of the cable system right-of-way (R/W), whichever is greater.

4.3 Cable Trench Construction

The construction of the cable trench is an important part in the ability of the respective cable system to handle the electrical (and therefore thermal) load that was considered in the original design of the cable circuit. Thermal backfill is an important part of the original trench design and is vital for the effectively transfer of heat away from the cable.

4.3.1 In situations where construction will occur in the area of the cable system, care shall be taken to ensure that the cable trench remains undisturbed. When working close to the cable system, consideration shall be given to installing sheet pile or other protective means, to avoid collapsing the original cable trench that would result in loss of thermal material and/or its compaction.

4.3.2 If the integrity of the cable trench is compromised or is intentionally excavated, actions shall be taken to return the cable trench to its original or better construction. This will ensure that the cable's thermal surrounding continue to meet the original electrical design for the circuit.

4.3.3 Pipe-type cable systems shall be inspected for defects in the pipe coating while it is exposed by and ATC representative prior to backfilling.

4.4 Cable Depth

4.4.1 Additional cable depth may result in a reduced rating capacity of the cable. If it is determined that the additional depth will reduce the cable rating, the additional thermal backfills shall be added to restore the cable rating at the original depth. Additional cover material shall not be placed over the cable system without the review and approval of ATC engineering.

4.4.2 Cable systems (i.e. pipe, duct bank, conduit or cable), where the top of the cable system is less than 30" depth, shall to be covered with a galvanized steel plate. The steel plate(s) shall be a minimum of 16" in width, centered over the cable system extending at least 4" beyond the outer edges of all cable system components and be at least ¼" in thickness. An alternate to flat plate, is a section of casing (large pipe) placed in an inverted half moon position (cap) over the cable pipe/duct. The vertical separation between the cable system and the plate/cap shall be a minimum of 6" with 12" preferred. All protective steel plates/caps shall have an ATC approved thermal backfill, with no voids, placed between the cable system and plate/cap and may require additional thermal backfill over the steel plate/cap. The steel plate/cap installation shall be coordinated with and approved in advance by ATC.

4.5 Cable Thermal Backfilling

There are two types of thermal backfill material approved for use on ATC cable systems, thermal flowable backfill and thermal granular backfill. All exploratory and construction excavations shall use thermal backfill within two (2) feet of the cable system or re-establish the existing thermal backfill extent, whichever is greater.

4.5.1 Thermal Flowable Backfill

The preferred material is thermal flowable fill, which is specified in ATC Construction Specification section 31 23 23.53 Thermal Backfill. Thermal flowable fill is a weak cement mix that has special thermal properties. Additionally the flowable fill assures good compaction and support around the cable, sets up quickly allowing for rapid site restoration, minimizes potential for cable damage and generally reduces the overall backfilling construction costs.

4.5.2 Thermal Granular Backfill

4.5.2.1 Thermal granular fill is also specified in ATC Construction Specification section 31 23 23.53 Thermal Backfill. Care shall be taken that no sharp materials or objects come in contact with pipe coating, conduit or direct buried cables. The thermal properties for granular backfills are largely dependent upon the grading of the granular material and its optimum compaction.

4.5.2.2 Care shall be taken to assure that the backfill materials are not dropped directly on cable pipes or direct buried cables. Use plywood baffles or similar method to protect the cables during the backfilling.

4.5.2.3 Thermal backfill shall generally be placed to a level two (2) feet above the uppermost surface of the respective cable system, unless the specific situation requires otherwise due to special considerations.

4.6 Vegetation Adjacent to Cable Systems

4.6.1 The ampacity of the underground cable system is dependant on the thermal heat dissipation through the surrounding native soils and backfill materials. When trees and shrubs are planted along the right-of-way (R/W), the root system can absorb the moisture in the soil/backfill, altering the thermal properties of the surrounding soil/backfill and thereby negatively impacting the cable ampacity rating. Also, root systems of large trees near the cable system can structurally damage associated underground facilities.

A useful rule of thumb is that a mature tree or shrub will have a root system that is twice as wide as the above ground canopy. Most trees and shrubs have the majority of their roots (>80%) in the top 2 feet of soil.

4.6.2 Tall growing trees and large shrubs, with a mature height of greater than 10 feet, shall not be planted near the cable systems. The minimum distance shall be 12 feet horizontally away from the outermost component of the cable system.

4.6.3 Woody shrubs or plants with a mature height of 2 to 10 feet typically have a shallow root system, and shall not be allowed over the underground cable system. The minimum distance shall be 8 feet horizontally from the outermost component of the cable system.

4.6.4 Annuals, perennials, and ornamental grasses can safely be grown over the underground cable systems.

4.6.5 This requirement serves as a guide for new landscaping instalations, as well as serves as an ATC maintenance guide, to ensure that the cable system is not degraded.

5. ADDITIONAL INFORMATION

5.1 References

National Electric Safety Code, IEEE Publication C2, latest edition.

Public Service Commission of Wisconsin, Wisconsin State Electric Code, Volume 1, Chapter PCS 114, latest edition.

Electric Power Research Institute (EPRI), Underground Transmission Reference Book, Chapter 13, Cable System Construction, Section 13.2.6, Bed of Trench, 2007.

National Association of Corrosion Engineers (NACE), Electrical Isolation of Cathodically Protected Pipelines, NACE Report RP-02-86, 2002.

Office of Pipeline Safety, US Department of Transportation, Publication 49CFR192, Sections 192.325 and 192.327.

Public Service Commission of Wisconsin, Wisconsin State Gas Safety Code, Chapter PCS 135, latest edition.

ATC Construction Specification, Excavation Around Cable Pipe, SN-2500

ATC Construction Specification, Thermal Backfill, 31 23 23.53

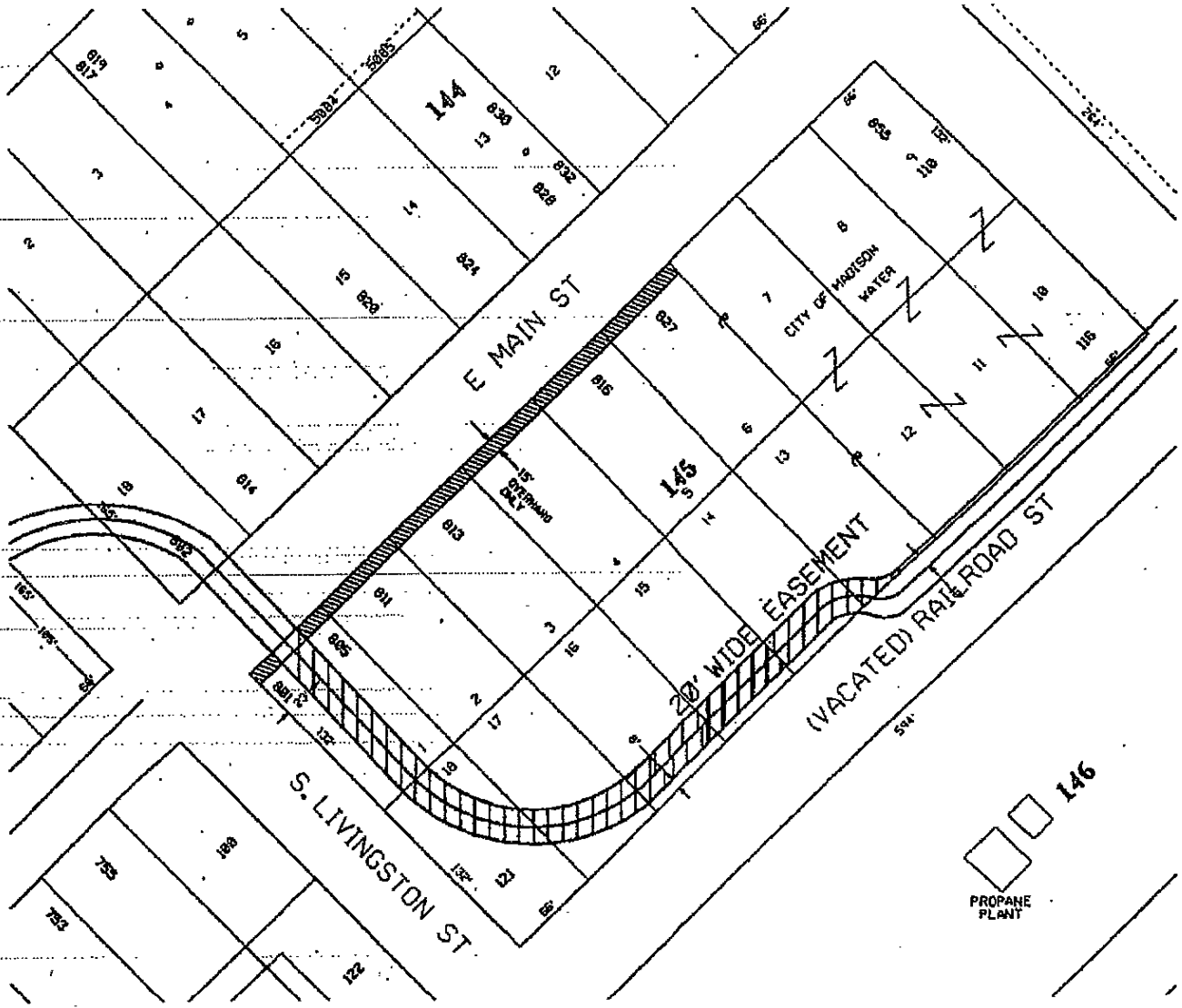
5.2 Revision Information

ATC Transmission Line Services is responsible for review and updating of this guide. It will be reviewed and updated on an as needed basis.

Version	Author	Date	Section	Description
01	R Knapwurst	02-27-2007	All	Original version
02	R Knapwurst	03-02-2011	All	Reduced Oil/Gas pipeline clearances, added Vertical Clearance, Cable Depth and Vegetation sections,

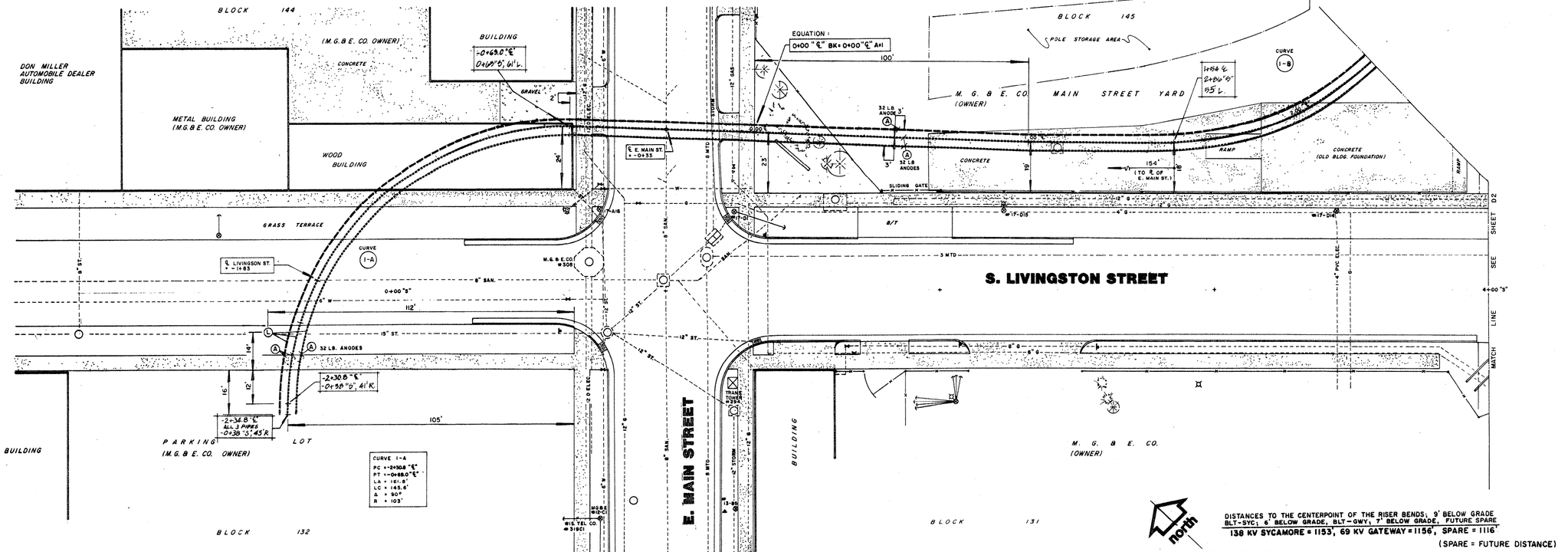
Attachment E

00059



REVISED	MADISON GAS & ELECTRIC CO. MADISON, WISCONSIN
DATE 12/08/00	
SCALE NONE	GRANT OF EASEMENTS TO ATC OVER MGE'S MAIN STREET STORAGE YARD PROPERTY
DRAWN BY JGK	
SHEET NO.	JOB NO.
	DRAWING NO. EXHIBIT B-2

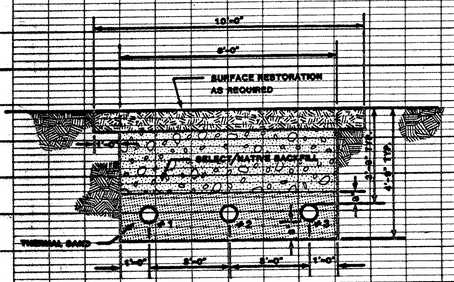
Attachment F



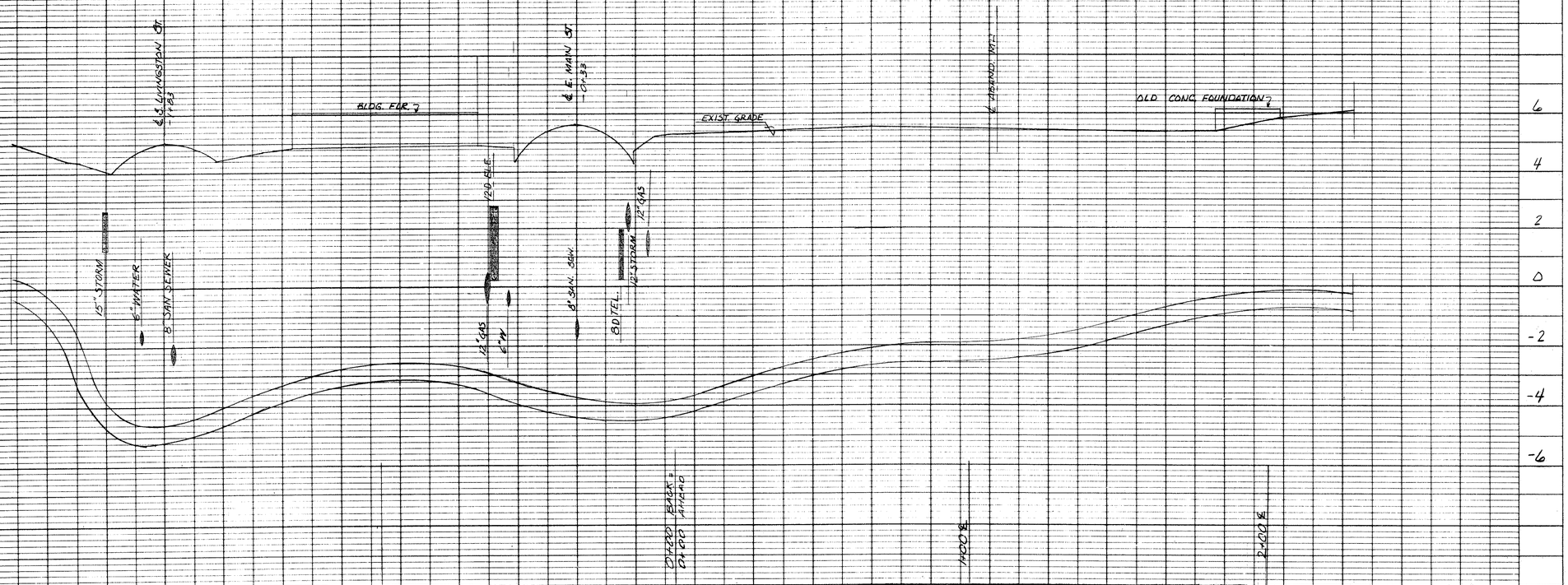
DISTANCES TO THE CENTERPOINT OF THE RISER BENDS, 9' BELOW GRADE
BLT-SYC; 6' BELOW GRADE, BLT-GWY, 7' BELOW GRADE, FUTURE SPARE
138 KV SYCAMORE = 1153', 69 KV GATEWAY = 1156', SPARE = 1116'
(SPARE = FUTURE DISTANCE)

AS BUILT

PLAN
SURVEYED
PLOTTED
NOTE BOOK
No.
ALIGNMENT CHECKED
ST. OF WAY CHECKED
DATE
BY



TYPICAL TRENCH SECTION
LOOKING EAST
3 PIPES



REV.	DATE	DESCRIPTION	BY	APPROVED	DATE
1	Nov. 2, '05	RELEASED FOR CONSTRUCTION	W.R.S.	J.G. TILLIARD	Nov. 2, '05
2	JUL. '06	AS-BUILT.	P.J.W.	W.R.S. / J.G.H.	JUL. '06

PLAN AND PROFILE DATA / CARL C. CRANE & ASSOC.

FIELD SURVEY : CARL C. CRANE & ASSOCIATES BY DATE

LAYOUT OF FACILITIES CARL C. CRANE & ASSOCIATES BY DATE

MADISON GAS & ELECTRIC CO.

PLOUNT TO SYCAMORE

138 KV TRANSMISSION LINES

COPY

DWN. NO. 2295 D1 A

W.O.NO.

REV. NO. 2

Attachment G

REV.	DATE	DESCRIPTION	BY	APPROVED	DATE
1	Nov. 2 '83	Released for Construction (except Manhole #1)	W.R.G.	J.G. Hilliard	Nov. 2, '83
2	JUL. '84	AS-BUILT	E.J.W.	W.R.S./J.G.H.	JUL. '84

PLAN AND PROFILE DATA / CARL C. CRANE & ASSOC.

FIELD SURVEY: CARL C. CRANE & ASSOCIATES BY DATE

LAYOUT OF FACILITY: CARL C. CRANE & ASSOCIATES BY DATE

MADISON GAS & ELECTRIC CO.

MADISON WISCONSIN

BLOUNT TO SYCAMORE

COPY

DWN. NO. 2295 D2

W.O. NO.

REV. NO. 2