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Building Name
Project Description
Project Number 10000000

SPECIFICATION DIVISION 33

NUMBER SECTION DESCRIPTION

DIVISION 33 UTILITIES
SECTION 336313 - UNDERGROUND STEAM AND CONDENSATE DISTRIBUTION PIPING

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DIVISION 33 UTILITIES
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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 01 Specification Sections, and other applicable Specification Sections, in particular the Related Sections listed below, apply to this Section.

B. Related Sections:

1. Section 017823 - Operation and Maintenance Manuals
2. Section 019100/019110 - Commissioning
3. Section 336200 - QA/QC for Tunnel Projects
4. Section 336330 Utility Tunnels - Steam & Condensate Distribution Systems

1.2 SCOPE OF WORK

A. Provide an engineered high temperature, pre-insulated conduit system for direct-buried steam and condensate piping, using Aerogel insulation technology as detailed in the drawings and specified here.

B. Provide separate pre-insulated conduit system for each piping system type as detailed in the drawings and specified here. Multi-piping systems in common conduit are not permitted without prior approval by U of M Utilities Department.

C. The conduit system shall be a combination of testable, drainable and dryable type conduit system, suitable for all ground water and soil conditions, site classification A (Federal Construction Guide Specification 02695).

D. The systems shall be furnished in numbered, cut-to-length factory-assembled pieces, based on certified field dimensions. Anchor, guide, oversized elbow, tee, expansion loop and similar project-specific components shall be furnished such that all field welds are straight butt weld type.

1.3 MANUFACTURER'S FIELD INSTALLATION INSTRUCTOR:

A. Manufacturer's trained representative who is technically qualified to determine whether or not the installation is being made in accordance with the manufacturer's recommendation shall be present during critical periods (see paragraph 3.1) of installation and test of the system. On completion of the installation, the contractor shall deliver to the owner a certificate from the manufacturer stating that the installation has been made in accordance with the manufacturer's recommendations.

1.4 SUBMITTALS AND GUARANTEES

A. The supplier shall provide written temperature performance certification for the insulation from the insulation manufacturer and an independent testing agency report that the insulation to be provided for the casing meets the requirements specified.

B. Final stress model shall be submitted to the Owner in electronic format compatible with CAEPIPE or an approved equal.

C. Submit third-party gradation test report (ASTM C 136) for pipe trench backfill material.

D. Submit concrete mix design for anchor blocks.

E. Product Data: Insulation materials, thickness and performance characteristics.

F. Layout Drawings indicating sizes of each piece as it will be delivered to the job site. Supplier will deliver all straight pipe in no larger than 40 foot lengths.

G. All piping shall be certified to be non-magnetized by manufacturer prior to assembly and shipping, and if necessary de-gaussed to remove any magnetic field.

H. Details:

1. Oversized elbows.
2. Supports and guides.
3. Wall penetrations.
4. Cathodic protection.

I. Special Submittal: After fabrication and prior to conduit piping system delivery, submit certification that:

1. All factory welds have been 100% x-ray inspected and passed.
2. All factory joints have been air-tested inspected and passed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide direct-buried high temperature piping conduit system by one of the following manufacturers:

1. Rovanco Insul-800 Elite
2. Ultra-Therm Systems by Perma-Pipe/Ricwil
3. Thermacor

2.2 PERFORMANCE REQUIREMENTS

A. Each piping system layout as shown in the drawings shall be analyzed by the supplier for stresses and movements and the results submitted confirming code compliances with ANSI B31.1 latest edition. The calculations shall be stamped and sealed by a registered professional engineer. For the purposes of stress calculations the steam temperature used shall be 450F for the low pressure steam piping and 250F for low pressure condensate piping.

B. Temperature gradient calculations shall be made for each system to be provided to indicate the temperature at the annular air space within the conduit and to confirm the conduit temperature is less than 340F or the rated temperature of the conduit insulation, whichever is less. For the purposes of this calculation assume fluid temperatures as scheduled, burial depth as indicated on Drawings, soil conductivity of 15 BTU-inch/HR/sq.ft.F, soil temperature of 55F, and flowable-fill conductivity of 3.3 BTU-inch/HR/sq.ft.F. For the purpose of temperature gradient calculations use temperature corresponding to steam temperature with 10F superheat with an up to an 8-hour excursion of 450F for both LPS.

2.3 CONDUIT:

A. All conduit straight lengths shall be welded smooth wall of not less than 10 gauge wall thickness black steel for pipe sizes up to 26",6 gauge up to 36",4 gauge up to 42" conforming to ASTM A-211, A-139, A-134 and A-135. Conduit shall be tested at the factory to ensure air and watertight welds prior to any fabrication or application of the fiberglass cladding. The steel conduit shall be cleaned and made free of all loose scale and mill coatings by shot blasting to clean, bright metal, and care shall be taken to maintain the surfaces free of oil and grease before application of coatings.

B. Conduit field joints shall consist of 10-gauge steel suitably rust proofed and in cylindrical form with a single horizontal split and shall be field welded over adjacent units after pipe insulation. After hydro tests, all exposed joints shall be covered in the field with insulation to match factory insulation and outer jacket.

C. The conduit system shall be capable of withstanding H-20 Highway loading at a burial depth of 24" to the top of the conduit from grade. The conduit gauge thickness and outer jacket thickness shall be increased, if required, to meet this requirement.

D. Inner Pipe Supports: All pipes shall be aligned and supported within the casing with galvanized steel supports on centers approximately 10'-0". The carrier pipe shall not bear directly on the steel support. The support shall be designed to permit drainage and free air passage. All pipes passing through supports shall be insulated.

E. Inner Conduit Casing Insulation: High-temp polyisocyanurate insulation applied to the inner conduit casing shall have the following properties.

1. Minimum Density-2.0 pcf per ASTM D 1622
2. Closed Cell Content-90% per ASTM D 2856
3. Compressive Strength-30 PSI per ASTM D 1621
4. K factor:

   Initial @ 75°F Mean Temperature…….…. 1.130
   @ 200°F Mean Temperature……... 0.235
   Aged @ 400°F for 28 days…… 0.220
   @ 400°F service temperature and 75° Amb….… 0.240
   Dimensional Stability-% change per ASTM 2126
   400°F Exposure of 2” cube foam sample:
   1 Day + 1.3% length +0.1% Volume
   7 Day + 2.3% length -2.3% Volume

450°F Exposure of 2” cube foam sample:
1 Day + 10.31% length +14.6% Volume
7 Day + 7.1% length +1.5% Volume

2.4 SERVICE (CARRIER) PIPE MATERIAL:

A. Steam piping shall be A106/A53, Grade B, Schedule 40 black steel piping.

B. Condensate piping shall be Type 316 stainless steel, Schedule 40 piping.

C. All joints within conduits shall be welded.

D. All pipes within shop assembled conduit lengths shall be single length seamless, without butt joints or couplings.

2.5 SERVICE (CARRIER) PIPE INSULATION:

A. Steam and condensate piping within the conduit shall be insulated with Aero-Gel Pyrogel XT-E insulation. Pyrogel high temperature insulation blanket of silica Aerogel, reinforced with a non-woven, glass fiber batting. Sectional insulation shall be banded on pipe with aluminum banding on 18” center. Insulation thickness shall be as specified or recommended by system supplier.

B. The insulation integrity shall be maintained (insulation shall not separate and expose bare pipe when the pipe expands) when the pipe expands to maintain the annular air temperature to less than 340F. This may be accomplished with overlapping insulation or other means at the joints. Provide details as to how this is accomplished with the shop drawings.

C. Insulation thicknesses shall be as indicated on the drawings.

D. A minimum of 3/4" air space is required as calculated between the nominal OD of the carrier pipe insulation and the ID of the conduit.

2.6 INSULATION AND JACKET:

A. Insulation shall be capable of handling intermittent temperature spikes to 450F for 8-12 hours. Insulation shall completely fill the annular space between the conduit and outer jacket. Quality assurance procedures for the insulation shall include either infrared or X-ray inspection of the entire length to ensure there are no insulation voids.

B. The exterior protective jacket shall be heavyweight, seamless, minimum .175 mils thickness high impact, polyethylene conforming to ASTM D1248 & D3350. Field joints shall be insulated with mineral wool on carrier and half shells of high temperature polyisocyanurate foam for outer insulation. The outer polyethylene joint shall be certified EN489, Rhinojoint by Rovanco or equal.

C. All field joints must be air-tested in a way that the polyethylene is not drilled into. Air test from the side of joint is recommended. The Contractor shall log each joint and present the test log to the owner at time of final test No FRP jacket of electrofusion casing joints is allowed.

D. Perform a visual inspection of the conduit to ensure no damage (penetration of jacket and puncture of foam).

2.7 MOISTURE BARRIER END SEALS:

A. Moisture barrier end seals shall be factory applied, sealed to the jacket and carrier pipe. End seals shall be certified as having passed a 20-foot head pressure test. End seals shall be mastic completely sealing the exposed end of the insulation. Field applied end seals shall be installed at each field cut to the piping before continuing with the installation.

2.8 PIPE SUPPORT AND GUIDES:

A. Piping shall be suitably spaced and supported in conduit by specially designed full-round insulating support-guides which permit the pipe to expand or contract without stress or wear to the pipe or insulation as well as provide for drainage and free air circulation.

2.9 EXPANSION LOOPS, ELLS AND TEES:

A. Ells, expansion loops and tees shall be prefabricated in the factory, meeting all the requirements specified for the conduits. They shall be oversized as required to accommodate the calculated pipe movements.

2.10 END AND GLAND SEALS:

A. Terminal ends of conduits inside manholes, pits or buildings shall be equipped with end seals consisting of a steel bulkhead plate welded to the conduit and carrier pipe if there is an anchor within five feet of the end seal. Where there is no anchor within five feet of a terminal end, conduits shall be equipped with gland seals consisting of a high temp gasket and follower plate. End seals or gland seals shall be made of 1/2 inch steel plate with drain and vent openings on the vertical center line of the mounting plate.

2.11 ANCHORS:

A. Provide anchors as recommended by conduit supplier and as indicated on the Drawings. Anchors shall be pre-fabricated onto the piping units and shall be equipped with drain and vent openings at the top and bottom of the anchor plate. Anchor plates shall be made of minimum 1/2 inch steel plates.

B. At the anchor, the anchor plate and conduit shall be sealed watertight with Raychem Dirax, Canuse GT-65 wrap, or as approved by the system manufacturer.

2.12 ANCHOR BLOCKS

A. Anchor block shall be per plan detail.

2.13 PIPE TRENCH BACKFILL

A. Clean, granular backfill should be tamped in place so as to assure a stable surface. No rock should be used within 24” of the pipe. Top of pipe grade shall not be less than 24” to meet H-20 Highway loading. Backfill shall be in accordance with ASTM C136-Standard Test Method.

PART 3 - EXECUTION

3.1 GENERAL:

A. The complete piping system installation shall be made in accordance with plans, specifications, and manufacturers’ installation instructions.

B. A fully qualified and certified manufacturer’s representative shall be present during the installation of the underground steam and condensate distribution system. Crucial periods of installation shall be defined as periods which include work on one or more of the following types of work:

1. Inspection upon unloading
2. Inspection of trench prior to laying conduit
3. Inspection of concrete anchor blocks prior to cold springing (if applicable).
4. Cold springing (if applicable).
5. Welding.
6. Hydrostatic Test of all service line
7. Field joint closure work
8. Air test of conduit
9. Repair of any coating patch work
10. Holiday test of conduit coating
11. Initial backfill up to 10" above top of conduit casing

3.2 CERTIFICATION:

A. Upon satisfactory completion of the installation, the conduit manufacturer shall provide the installing contractor with certification that the materials have been installed in accordance with conduit manufacturer's approved brochure, plans and specifications. Certification shall include dates of each field test and a pass/fail indication.

3.3 FIELD TESTS:

A. All welds will be 100% X-ray inspected and passed.

B. The inner pipes of this system shall be hydrostatically tested to 1-1/2 times the rated pressure of the line or 90 lbs., whichever is higher. If a leak is found, it shall be repaired and the test repeated. The outer casing shall be tested with air at 15 psig and a soap solution shall be applied to field joints to locate leaks. If leaks occur, they shall be repaired and the test repeated. After the conduit air test has been approved, all field joints shall be insulated and sealed by the contractor.

END OF SECTION 336313