SECTION 33 63 00
STEAM ENERGY DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies materials and procedures for construction of underground steam distribution and condensate return piping system, including manholes, outside the buildings. Existing system shall be: walk through concrete tunnels.

B. Definitions:

1. System: The complete underground steam and condensate distribution system including all components such as carrier piping, pipe supports, insulation, protective enclosures, anchors, corrosion protection, stress analysis, and accessories.
2. Walk-through Concrete Tunnels: A system located below grade with sufficient space for carrier pipes, other services, and space to walk upright along the entire length of the system.
3. Carrier Pipe: Pipe carrying the steam or condensate.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS: Erosion and Sediment Controls.

D. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

E. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete Work, Reinforcing, Placement and Finishing.

F. Section 05 50 00, METAL FABRICATIONS: Steel for trench and tunnel pipe supports.

G. Section 09 91 00, PAINTING, Painting exposed steel and other surfaces.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Association of State Highway and Transportation Officials (AASHTO):

M300-03-UL-2007.....Standard Specification for Inorganic Zinc-Rich Primer

M273-11-UL-2011.....Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Feet of Cover Subjected to Highway Loadings

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

90.1-2013.....Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

D. American Society of Mechanical Engineers (ASME):

B1.20.1-2013.....Pipe Threads, General Purpose (Inch)

B16.5-2013.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

B16.9-2012.....Factory-Made Wrought Buttwelding Fittings

B16.11-2011.....Forged Fittings, Socket-Welding and Threaded

B16.21-2011.....Nonmetallic Flat Gaskets for Pipe Flanges

B18.2.1-2012.....Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

B31.1-2014.....Power Piping

B31.9-2014.....Building Services Piping

B40.100-2013.....Pressure Gauges and Gauge Attachments

ASME Boiler and Pressure Vessel Code -

BPVC Section VIII-1-2015 Rules for Construction of Pressure Vessels, Division 1

BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications

E. American Society for Testing and Materials (ASTM):

A36/A36M-2014.....Standard Specification for Carbon Structural Steel

A53/A53M-2012.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A105/A105M-2014.....Standard Specification for Carbon Steel Forgings for Piping Applications

A106/A106M-2015.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A126-2004 (R2014).....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A139/A139M-2016.....Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)

A193/A193M-2016.....Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications

A194/A194M-2015a.....Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

A234/A234M-2015.....Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

A240/A240M-2015b.....Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A733-2015.....Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless-Steel Pipe Nipples

B61-2015.....Standard Specification for Steam or Valve Bronze Castings

C177-2013.....Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

C411-05.....Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

C552-07.....Cellular Glass Thermal Insulation

C655-2015.....Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe

C920-2014a.....Standard Specification for Elastomeric Joint Sealants

C1728-2013.....Standard Specification for Flexible Aerogel Insulation

E84-2015b.....Standard Test Method for Surface Burning Characteristics of Building Materials

F. American Welding Society (AWS):

B2.1/B2.1M-2014.....Specification for Welding Procedure and Performance Qualification

D10.12M/D10.12-2000.....Guide for Welding Mild Steel Pipe

Z49.1-2012.....Safety in Welding and Cutting and Allied Processes

G. Federal Specifications (Fed. Spec.):

A-A-60005-2015.....Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

L-S-125-1987.....Screening, Insect, Nonmetallic

H. Manufacturer’s Standardization Society (MSS):

MSS SP-58-2009.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation

I. Military Specifications (Mil. Spec.):

MIL-S-901-1989.....Shock Tests H.I. (High Impact) Shipboard Machinery, Equipment and Systems, Requirements for

J. NACE International (NACE):

SP0169-2013.....Control of External Corrosion on Underground or Submerged Metallic Piping Systems

K. National Fire Protection Association (NFPA):

255-2006.....Standard Method of Test of Surface Burning Characteristics of Building Materials

L. Society for Protective Coatings (SSPC):

SP-2-2004.....Hand Tool Cleaning

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 33 63 00, STEAM ENERGY DISTRIBUTION”, with applicable paragraph identification.

C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.

D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references. COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.

G. Manufacturers' Literature and Data including: Full item description and optional features and accessories of the complete system including, but not limited to, dimensions, weights, materials, applications, standard compliance, model numbers, size and capacity. Submit as one package for pipes, fittings and appurtenances, including jointing materials, insulation, hangars, expansion and power set fasteners, and other miscellaneous items.

H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.

I. Coordination/Shop Drawings:

1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
2. The coordination/shop drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot). Clearly identify and dimension

the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed locations and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All equipment requiring service shall be provided with an access door sized for the complete removal of device, component, or servicing of the equipment. Access for service and access for removal of components may be separate as necessary. Provide detailed coordination/shop drawings and loading calculations for all piping systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.

3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.

J. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls and instruments, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent

requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.

4. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

B. Contractor shall restore damaged items to as-new operating condition or replace damaged items as directed by the COR, at no additional cost or time to the Government.

1.6 DELIVERY, STORAGE AND HANDLING

A. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of equipment and material against damage or theft.

B. Protect piping systems against the entry of water, mud or other foreign substances by installing watertight covers on open ends at all times. Both inside and outside shall be cleaned before painting or placing equipment in operation. Protect direct-buried system coatings from ultraviolet light (sunlight). Existing equipment worked on by the Contractor or in the Contractor's working area shall be considered to be in the custody and responsibility of the Contractor and shall be protected as required for new work.

C. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. All insulated piping systems exposed to water must be replaced prior to installation at no additional cost or time to the Government.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD, inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

   1. Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.

D. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal

pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 COORDINATION

A. Coordinate exterior steam lines and associated systems and connections to building services up to the actual extent of building wall.

1.9 UTILITY LOCATION SERVICES

A. Prior to any demolition provide for utility location services to mark on the ground with fluorescent paint the location of existing underground utilities, and their identification. The term "utility(ies)" includes both public utilities and VA-owned utilities, for all underground services.

PART 2 - PRODUCTS

2.1 PRE-ENGINEERED, FACTORY-FABRICATED, DIRECT-BUIRED, DRAINABLE-DRYABLE-TESTABLE (DDT) SYSTEMS

A. All components of system shall be suitable for carrier pipe pressures and temperatures as follows:
   1. Steam System: 1035 kPa (150 psig); 185 degrees C (366 degrees F).
   2. Condensate System: 345 kPa (50 psig); 154 degrees C (310 degrees F).

B. Carrier Pipe Insulation:
   1. Conform to minimum thickness and type of insulation listed in Tables 1 and 2 below as required for service temperature in carrier pipe as listed below.
   2. Allowable Carrier Pipe Insulation Type and Minimum Insulation Thickness:

TABLE 1
Minimum Pipe Insulation Thickness mm (inches)
For Steam 110 to 2800 kPa (16 to 406 psig) gauge

Nominal Pipe Diameter mm (inches)	Pre-Formed Mineral Wool	Calcium Silicate
25 (1)	65 (2-1/2)	100 (4)
40 (1-1/2)	65 (2-1/2)	100 (4)
50 (2)	90 (3-1/2)	115 (4-1/2)
65 (2-1/2)	90 (3-1/2)	115 (4-1/2)
75 (3)	100 (4)	125 (5)
100 (4)	100 (4)	125 (5)
125 (5)	100 (4)	125 (5)

150 (6)	115 (4-1/2)	140 (5-1/2)
200 (8)	115 (4-1/2)	140 (5-1/2)
250 (10)	125 (5)	150 (6)
300 (12)	125 (5)	150 (6)
355 (14)	125 (5)	150 (6)
406 (16)	125 (5)	150 (6)
457 (18)	125 (5)	150 (6)

Notes:

1. Submittals shall include manufacturer’s certification that all insulation have passed the 96-hour boiling water test.
2. Pipes smaller than 25 mm (1 inch) shall have same insulation thickness as required for 25 mm (1 inch) pipe.

TABLE 2
Minimum Pipe Insulation Thickness mm (inches)
For Steam Less than 110 kPa (16 psig) gauge,
Condensate Return

Nominal Pipe Diameter mm (inches)	Pre-Formed Mineral Wool	Calcium Silicate
25 (1)	50 (2)	75 (3)
40 (1-1/2)	50 (2)	75 (3)
50 (2)	50 (2)	75 (3)
65 (2-1/2)	50 (2)	75 (3)
75 (3)	65 (2-1/2)	90 (3-1/2)
100 (4)	65 (2-1/2)	90 (3-1/2)
125 (5)	65 (2-1/2)	90 (3-1/2)
150 (6)	75 (3)	115 (4-1/2)
200 (8)	75 (3)	115 (4-1/2)
250 (10)	100 (4)	125 (5)
300 (12)	100 (4)	125 (5)
355 (14)	100 (4)	125 (5)
406 (16)	100 (4)	125 (5)
457 (18)	100 (4)	125 (5)

Notes:

1. Submittals shall include manufacturer’s certification that all insulation have passed the 96-hour boiling water test which

indicates that satisfactory performance in underground service can be expected.

2. Pipes smaller than 25 mm (1 inch) shall have the same insulation thickness as required for 25 mm (1 inch) pipe.

C. Insulation Banding and Jacket: 304 stainless steel bands and clips, at least 13 mm (1/2 inches) wide, maximum spacing 457 mm (18 inches). A minimum of two bands is required for each 1200 mm (4 foot) section of insulation.

D. Vinyl-coated Fiberglass Scrim Jacket: Fed. Spec. L-S-125, Type II, Class 2, with 18 x 16 mesh (number of filaments per inch) and made of 0.335 mm (0.013 inch) diameter vinyl-coated fibrous glass yarn. Install bands over the jacket to secure the insulation to the carrier pipe.

PART 3 - EXECUTION

3.1 GENERAL

A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

B. Connect new work to existing work in a neat and workmanlike manner. Where an existing structure must be cut or existing utilities interfere, such obstruction shall be bypassed, removed, replaced or relocated, patched and repaired. Piping connections shall be made only in manholes, tunnels or buildings.

C. Coordinate the location of all items of equipment and work of all trades. Maintain operability and maintainability of the equipment and systems. The contractor at his cost shall perform any relocation of equipment or systems to comply with the requirement of operability and maintainability.

D. Contractor shall replace all removed or damaged insulation and jacketing that occurs during construction. Field verify pipe size at each location affected.

3.2 DEMOLITION

A. Perform work in accordance with requirements for phasing and the Drawings. Phasing shown on drawings is an outline from which the contractor will use to provide more details in executing the work in each phase.

B. Completely remove all pipe, valves, fittings, insulation, and all hangers including the connection to the structure and any fastenings.

C. Seal all openings in manhole or building walls after removal of piping.

D. All material and equipment removed shall become the property of the Contractor and shall be removed from Government property and shall not be stored in operating areas unless designated as being turned over to the owner.

E. All flame cutting shall be performed with facility burn permit in place and adequate fire protection facilities available as required by safety codes and COR.

3.3 THERMAL INSULATION

A. Steam, condensate and drip return piping, other than in pre-engineered direct-buried systems, shall be insulated as follows:

1. Exposed piping in walk through tunnels: Insulated with mineral wool, and canvass jacket. Condensate return piping may be insulated with mineral wool insulation, and canvass jacket.
2. Minimum insulation thickness: Insulation thicknesses given in Table 1 and 2 are minimum nominal thickness.

B. Parts not to be insulated are:

1. Threaded valves
2. Steam traps
3. Check valves
4. Unions
5. Threaded strainers
6. Strainer basket removal cover and bolting
7. Dielectric flanges and unions
8. Expansion joints
9. Flexible connectors
10. Ball joints except piping between joints

C. Installation of Insulation:

1. Pressure Tests: Complete all pressure tests and cleaning before installing.
2. Insulation Material: New, clean, dry and stored in a clean dry environment; jacketing materials to be clean and unmarred; store adhesives in original containers. Materials shall not have exceeded the predicted shelf life as set by manufacturer.
3. Identify all materials incorporated in the job on manufacturer’s container by name, type and description.

4. Apply materials on clean, dry surfaces from which all dirt, loose scale, construction debris has been removed by wire brushing.
5. The installation shall be neat, thermally and structurally tight without sag, neatly finished at all hanger or other penetrations and shall provide a smooth finished surface primed as required to receive specified painting.
6. Do not use scrap insulation. Repair any work damaged by welding, burning, compressing due to concentrated construction loads.
7. Apply pipe covering protection saddles, MSS SP-58, Type 39, at all hanger points. Fill space between saddle and piping with high density insulation, thoroughly packed. Terminate jacket clear of saddle bearing area.
8. Insulation and jacket shall terminate hard and tight at all anchor points.
9. Insulation termination at piping facilities not to be insulated shall stop short, and be finished with 45-degree chamfered section of insulating and finishing cement, and covered with jacket.
10. Flanged fittings and valves shall be insulated with sections of pipe insulation cut, fitted and arranged neatly, and firmly wired in place. Insulating cement shall fill all cracks, voids and outer surface for covering with glass cloth. Insulation of valve bonnet shall terminate on valve side of bonnet flange to permit valve repair.
11. On calcium silicate, and cellular glass insulated piping systems, fittings shall be insulated with field or factory-shaped sections of insulation, finished with specified insulating and finishing cements and covered with specified jacket.
12. On mineral wool insulated piping systems fittings over 50 mm (2 inches) shall be insulated with specified molded pipe fitting insulation or compressed blanket, finished with specified insulating and finishing cements and covered with jacket. On sizes 50 mm (2 inches) and less apply insulating and finishing cements and cover with specified jacket.
13. Apply glass cloth jacket using an approved adhesive. Glass cloth shall be smooth, tight and neatly finished at all edges; prime cloth to receive paint.

3.4 CLEANING OF PIPING

A. Cleaning of piping shall be witnessed by the COR, their representative, or the Commissioning Agent.

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