SECTION 33 63 00
STEAM ENERGY DISTRIBUTION

PART 1 – GENERAL:

1.1 DESCRIPTION:

Underground steam distribution and condensate return piping system, including manholes. Type of system shall be: concrete shallow trenches.

1.2 DEFINITIONS:

A. System: A complete underground steam and condensate distribution system including all components such as carrier piping, pipe supports, insulation, protective enclosures, anchors, corrosion protection and accessories.

B. Concrete Shallow Trench: System with removable concrete covers located at grade. Carrier pipes are located within trench. Cross-section of trench is sufficient size only for piping, insulation, supports, air space and drainage. Designed by project engineer and field erected. Prefabricated concrete trench sections may be used. No equipment requiring access for operation or maintenance can be located in the trench because there is no access except by removing the heavy concrete covers.

C Carrier Pipe: Pipe carrying the steam or condensate.

D. Project Drawings: The “MS” project drawings accompanying this specification provide information on:

1. The size of carrier pipes, approximate length, and site location of the system.
2. The elevation and routing of the piping on the site.
3. The obstacles located within approximately 25 m (8 feet) of the centerline of the system, including crossing utilities, that must be avoided or altered.
4. Type of system required - shallow concrete trench.
5. Location of piping anchors.
6. Operating pressure and temperature of systems.
7. Details applicable to type of system specified.
8. Other pertinent general information.

E. Pressures: Pressures listed in this section are gage pressure unless otherwise noted.

1.3 RELATED WORK:

A. Phasing of work: Section 01 00 00, GENERAL REQUIREMENTS.

B. Concrete work: Section 03 30 00, CAST-IN-PLACE CONCRETE.

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

1.4 QUALITY ASSURANCE:

A. Approval by Contracting Officer is required of products or services of proposed manufacturers, suppliers and installers.

B. Products Experience Record:

The designs shall be of current production and have been in satisfactory operation on at least three installations for approximately five years.

C. Provide a complete installation with all necessary specialties, materials and equipment fully and properly connected and coordinated. Installation shall be fully operational upon completion of work defined and as phased.

D. Apply and install systems, materials, equipment and specialties in accordance with manufacturer's instructions. Printed instructions shall be available at the site prior to and during construction.

E. Materials, design, installation and workmanship shall conform to applicable local codes, and to national codes and standards as referenced in this specification.

F. Radiographic Testing of Welds: Weld examination methods and procedures and the interpretation of examining films shall conform to ASME B31.1. The testing firm shall utilize the proper film exposure, techniques, and penetrameter to produce density and geometric sharpness required for first quality film, and all radiographs shall be reviewed and interpreted and reading reports signed by not less than an American Society for Non-Destructive Testing (ASNT) Certified Level III Radiographer.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submit all items listed under each group simultaneously (except for items that can only be submitted during construction and upon completion of construction).

2. Group II, Piping in Manholes, Concrete Tunnels, Concrete Shallow Trenches, Open Areas:
   a. Pipe insulation, jackets, adhesives and cements. Submit samples and technical information.
4. Group IV, Concrete Shallow Trenches:
   a. Trench plans, profiles, sections and details.
   b. Shop drawings for prefabricated trench sections including removable covers.

1.6 STORAGE AND HANDLING:

A. Equipment and material placed on the job shall remain in the custody of the Contractor until final acceptance whether or not the Government has reimbursed the Contractor for the equipment and material.

B. The Contractor is solely responsible for the protection of the equipment and material against damage from any source. Protect piping systems against entry of water and mud and all foreign substances by installing watertight protection on open ends at all times. 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 under the custody and responsibility of the Contractor.

C. All insulated piping systems exposed to water must be replaced with new systems.

D. Place all damaged items in first class new operating condition or replace damaged items as determined and directed by the Project Engineer/Contracting Officers Technical Representative (COTR), at no additional cost to the Government.

1.7 JOB CONDITIONS:

A. Phasing of demolition and construction shall be in accordance with the provisions of Section 01 00 00, GENERAL REQUIREMENTS, and as shown on steam distribution drawings.

B. Interruption of Existing Service: Arrange, phase and perform work and provide temporary facilities, materials, equipment, and connections to utilities, to assure adequate steam and condensate return service for existing installations at all times. Only such absolutely necessary interruptions as may be required for making connections will be permitted, and only at such times when approval is obtained from PE/COTR. Interruptions to steam and

condensate service shall be only with prior approval, and be the minimum possible duration. All interruptions shall be as scheduled under Article "Phasing" of Section 01 00 00, GENERAL REQUIREMENTS as approved by the PE/COTR.

1.8 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. Federal Specifications (Fed. Spec.):

A-A-60005 NOT 1 ..... Frames, Covers, Grating, Steps, Sump And Catch Basin, Manhole

L-P-535E ..... Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate)

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

C. Military Specifications (Mil. Spec.):

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

D. ASTM International (ASTM):

A36/A36M-05 ..... Structural Steel

A47/A47M-99(2004)..... Ferritic Malleable Iron Castings

A53/A53M-06a ..... Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A105/A105M-05 ..... Carbon Steel Forgings for Piping Applications

A106/A106M-06a ..... Seamless Carbon Steel Pipe for High-Temperature Service

A126-04..... Gray Iron Castings for Valves, Flanges and Pipe Fittings

A134-96(2005) ..... Pipe, Steel, Electric-Fusion(Arc)-Welded (Sizes NPS 16 and over)

A135/A135M-06 ..... Electric-Resistance Welded Steel Pipe

A139/A139M-04 ..... Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and over)

A167-99(2004) ..... Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

A193/A193M-07 ..... Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service

A194/A194M-07a ..... Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both

A197/A197M-00(2006)..... Cupola Malleable Iron

A216/A216M-07 ..... Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

A234/A234M-07 ..... Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

A240/A240M-07e1 ..... Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications

A395/A395M-99(2004)..... Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

A536-84(2004) ..... Ductile Iron Castings

B61-02 ..... Steam or Valve Bronze Castings.

B209-06 ..... Aluminum and Aluminum-Alloy Sheet and Plate

C411-05 ..... Hot-Surface Performance of High-Temperature Thermal Insulation

C449/C449M-00..... Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C533-07 ..... Calcium Silicate Block and Pipe Thermal Insulation

C547-06 ..... Mineral Fiber Pipe Insulation

C552-03 ..... Cellular Glass Thermal Insulation

C591-07 ..... Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

C655-04e1 ..... Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe

C920-05 ..... Elastomeric Joint Sealants

C1126-04 ..... Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1136-06 ..... Flexible, Low Permeance Vapor Retarders for Thermal Insulation

D1784-06a ..... Rigid Poly (Vinyl Chloride)(PVC) Compounds and Chlorinated Poly (Vinyl Chloride)(CPVC) Compounds

D2310-06 ..... Machine-Made "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe

D2487-06 ..... Soils for Engineering Purposes (Unified Classification System)

D2996-01(2007)e1 ..... Filament-Wound Fiberglass (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe

E. American Society of Mechanical Engineers (ASME):

B16.3-2006 ..... Malleable Iron Threaded Fittings

B16.5-2003 ..... Pipe Flanges and Flanged Fittings NPS ½ - 24

B16.9-2003 ..... Factory-Made Wrought Buttwelding Fittings

B16.11-2005 ..... Forged Fittings, Socket-Welding and Threaded

B31.1-2004 ..... Code for Pressure Piping, Power Piping, with Amendments

B31.9-2004 ..... Code for Pressure Piping, Building Services Piping, with Amendments

B40.100-2005 ..... Pressure Gauges and Gauge Attachments

Boiler and Pressure Vessel Code, Section VIII: 2007 Edition, with Amendments

F. American Welding Society (AWS):

AWS B2.1-00 ..... Welding Procedure and Performance Qualification

G. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS):

SP45-03 ..... By-Pass and Drain Connection Standard

SP58-02 ..... Pipe Hangers and Supports-Materials, Design and Manufacture

SP69-03 ..... Pipe Hangers and Supports-Selection and Application

SP80-03 ..... Bronze Gate, Globe, Angle and Check Valves

H. National Fire Protection Association (NFPA):

255-06 ..... Test of Surface Burning Characteristics of Building Materials

I. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
ASHRAE Handbook ..... 2004 HVAC Systems and Equipment

J. American Concrete Institute (ACI):
318-05..... Building Code Requirements for Reinforced Concrete

K. NACE International (Corrosion Engineers) (NACE):
RP0169-02..... Standard Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems

L. Expansion Joint Manufacturers Association (EJMA):
8th Edition-2003..... Standards of the Expansion Joint Manufacturers Association

M. American Association of State Highway and Transportation Officials (AASHTO):
M300-03 ..... Inorganic Zinc Rich Primer

N. Society for Protective Coatings (SSPC):
SP-10/NACE No. 2-2004..... Near White Blast Cleaning

O. Unified Facilities Guide Specifications (UFGS):
UFGS 33 63 13..... Exterior Underground Steam Distribution System (April 2006 or later)

PART 2 – PRODUCTS:

2.1 CONCRETE SHALLOW TRENCHES:

A. Construct with tops of trench covers at grade.

B. Construction: Reinforced concrete with minimum thickness 150 mm (6 inches). Construct trenches of poured concrete conforming to Section 03 30 00, CAST-IN-PLACE CONCRETE. Construct trenches of precast concrete in full compliance with the requirements of ACI 3l8 and conforming to ASTM C655. Manufacturer shall have a minimum of five years successful experience in the design and fabrication of similar precast concrete units and shall have an established quality assurance program in operation and show current certification in the Precast/Prestressed Concrete Institute (PCI) plant certification program. Concrete mix and reinforcing shall be manufacturers standard product.

C. Concrete Trench Covers: Pre-cast reinforced concrete sections meeting requirements of ACI 3l8 and ASTM C655. Cover shall be flat and true at all points of contact on trench wall. Design trench and cover to form a watertight envelope when assembled.

D. Gaskets and sealants: Provide 6 mm (l/4 inch) thick neoprene pad with a minimum width of 50 mm (2 inches) between covers and tops of walls. All trench joints must be sealed with ASTM C920 elastomeric sealants that are available as a one or two component system. Asphaltic sealants are not permitted. Sealants must resist 50% total joint movement. Non-sagging sealant must be used for vertical joints. Self-leveling sealant must be used for trench top butt joints.

2.2 INSULATION MATERIALS (IN MANHOLES, TUNNELS, CONCRETE TRENCHES, OPEN AREAS):

A. Calcium Silicate Insulation:

1. Preformed Piping Insulation: ASTM C533, Type I.
2. Blocks: ASTM C533, Type I.
3. Fitting Insulation: ASTM C533, with polyvinyl chloride, Fed. Spec. L-P-535, Type II Grade GU, and Type III, premolded fitted covering 0.5 mm (0.020 inches) thick.

B. Fiberglass Insulation:

1. Preformed Piping Insulation: ASTM C547, 230 °C (450 °F).
2. Fitting Insulation: ASTM C547, 230 °C (450 °F), with polyvinyl chloride, Fed. Spec. L-P-535, Type II Grade GU, and Type III, premolded fitted covering 0.5 mm (0.020 inches) thick.

C. Rigid Closed Cell Phenolic Foam: Preformed Piping Insulation: ASTM C1126, Type III, Grade 1, 121 °C (250 °F).

D. Cellular Glass Insulation: Preformed Piping Insulation: ASTM C552.

E. Insulating and Finishing Cements: Best grade recommended by printed instructions of manufacturer for the type of insulation system and service conditions. Conform to ASTM C449.

F. Insulation Bands: Minimum 12 mm (1/2 inch) wide by 0.4 mm (0.015 inch) thick ASTM A167 stainless steel.

G. Aluminum Jackets: Minimum 0.4 mm (0.016 inch) thick aluminum, ASTM B209, 3003 alloy, H-14 temper, with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory fabricated to match material and construction of the straight run jackets. Factory fabricated stainless steel bands shall be furnished and installed on all circumferential joints. Bands shall be 20 mm (0.75 inch) wide on 450 mm (18 inch) centers. Bands shall be applied with manufacturers recommended sealant. Entire system shall be watertight.

H. All-Service Jackets: White kraft bonded to 0.025 mm ((0.001 inch) thick aluminum foil, fiberglass reinforced, pressure sensitive adhesive closure. Beach puncture 50 units, suitable for painting without sizing. Comply with ASTM C1136. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and not less than 100 mm (4 inch) butt strips on end joints. Butt strip material shall be same as the jacket. Lap and butt strips may be self-sealing type with factory-applied pressure sensitive adhesive.

I. Glass Cloth Jacket: Minimum 0.24 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psi) bursting strength, weathertight for outside service. Beach puncture 50 units.

J. Pipe Covering Protection Saddles: MSS SP-58, Type 39 at all hanger points except where Type 3 pipe clamps are provided.

K. Fire and Smoke Ratings: Assembled insulation systems shall meet flame spread (25) and smoke developed (50) ratings as developed under ASTM C411 and NFPA 255 standards and specifications.

PART 3 – EXECUTION:

3.1 GENERAL:

A. Connecting to Existing Work: 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. Work disturbed or damaged shall be replaced to its prior condition, as required by Section 01 00 00, GENERAL REQUIREMENTS. Piping connections shall be made only in manholes, tunnels or buildings.

B. Coordination: 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.

3.2 DEMOLITION:

A. Perform work in accordance with requirements for phasing.

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 within one week and shall not be stored in operating areas.

E. All flame cutting shall be performed with adequate fire protection facilities available as required by safety codes and Project Engineer.

3.3 PAINTING EXPOSED STEEL SURFACES IN MANHOLES, TUNNELS AND CONCRETE SHALLOW TRENCHES:

A. Manholes and Walk-Through Tunnels: Provide surface cleaning and preparation and apply prime coat of rust resistant metal primer.

B. Concrete Shallow Trenches: Provide surface cleaning and preparation, apply primer and finish coat of zinc-rich paint.

3.4 THERMAL INSULATION:

A. For piping in pre-engineered direct-buried systems refer to Part 2 of this specification.

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

1. Piping in concrete trenches and manholes shall be insulated with calcium silicate, fiberglass, or cellular glass pipe insulation, glass cloth or aluminum jacket.
2. Exposed piping in walk-through tunnels shall be insulated with calcium silicate, fiberglass, or cellular glass pipe insulation, all service jacket. Condensate return piping may be insulated with rigid cellular phenolic, all service jacket.

3. Piping in manholes shall be insulated with calcium silicate or cellular glass pipe insulation, glass cloth or aluminum jacket.
4. Minimum Insulation Thickness: Insulation thicknesses given in Table 5 and 6 are manufacturer's nominal thickness.

TABLE 5
Minimum Pipe Insulation Thickness mm (inches)
For Steam 110 to 1724 kPa (16 to 250 psi) gage

Nominal Pipe Diameter mm (inches)	MPT-PC MPT-PF	Delta	Thermo-12 Super Caltemp	Foamglas
25 (1)	50 (2)	63 (2 1/2)	100 (4)	110 (4 1/2)
40 (1 1/2)	50 (2)	63 (2 1/2)	100 (4)	110 (4 1/2)
50 (2)	63 (2 1/2)	85 (3 1/2)	110 (4 1/2)	125 (5)
65 (2 1/2)	63 (2 1/2)	85 (3 1/2)	110 (4 1/2)	125 (5)
80 (3)	75 (3)	100 (4)	125 (5)	150 (6)
100 (4)	75 (3)	100 (4)	125 (5)	150 (6)
125 (5)	75 (3)	100 (4)	125 (5)	150 (6)
150 (6)	85 (3 1/2)	110 (4 1/2)	135 (5 1/2)	150 (6)
200 (8)	85 (3 1/2)	110 (4 1/2)	135 (5 1/2)	150 (6)
250 (10)	100 (4)	125 (5)	150 (6)	165 (6 1/2)
300 (12)	100 (4)	125 (5)	150 (6)	165 (6 1/2)
350 (14)	100 (4)	125 (5)	150 (6)	165 (6 1/2)
400 (16)	100 (4)	125 (5)	150 (6)	165 (6 1/2)
450 (18)	100 (4)	125 (5)	150 (6)	165 (6 1/2)

TABLE 6
Minimum Pipe Insulation Thickness mm, (inches)
For Steam less than 110 kPa (16 psi) gage, Condensate Return

Nominal Pipe Diameter mm (inches)	MPT-PC MPT-PF	Delta	Foamglas Thermo-12 Super Caltemp	Insul-phen
25 (1) and under	35 (1 1/2)	50 (2)	75 (3)	25 (1)

TABLE 6 Minimum Pipe Insulation Thickness mm, (inches) For Steam less than 110 kPa (16 psi) gage, Condensate Return				
Nominal Pipe Diameter mm (inches)	MPT-PC MPT-PF	Delta	Foamglas Thermo-12 Super Caltemp	Insul-phen
40 (1 1/2)	35 (1 1/2)	50 (2)	75 (3)	25 (1)
50 (2)	35 (1 1/2)	50 (2)	75 (3)	25 (1)
65 (2 1/2)	35 (1 1/2)	50 (2)	75 (3)	25 (1)
80 (3)	50 (2)	63 (2 1/2)	85 (3 1/2)	25 (1)
100 (4)	50 (2)	63 (2 1/2)	85 (3 1/2)	38 (1 1/2)
125 (5)	50 (2)	63 (2 1/2)	85 (3 1/2)	38 (1 1/2)
150 (6)	63 (2 1/2)	76 (3)	110 (4 1/2)	38 (1 1/2)
200 (8)	63 (2 1/2)	76 (3)	110 (4 1/2)	38 (1 1/2)

Insulation listed has passed a boiling test:

Delta is available from Rockwool Manufacturing Co., Leeds, AL.

Foamglass is available from Pittsburgh Corning Corp., Pittsburgh, PA.

MPT is available from Mineral Products of Texas, Houston, TX.

Thermo-12 and Super Caltemp are available from Johns-Manville, Denver, CO.

Insul-phen is available from Resolco International Div. www.resolco.com

5. Parts Not Insulated:

Threaded valves

Steam traps

Check valves

Unions

Threaded strainers

Strainer basket removal cover and bolting

Dielectric flanges and unions

Expansion joints

Flexible connectors

Ball joints except piping between joints

6. Installation:
   a. Complete all pressure tests before installing insulation.
   b. All insulation material shall be new, clean, dry and stored in a clean dry environment; jacketing materials shall be clean and unmarred; store adhesives in original containers. Materials shall not have exceeded the predicted shelf life as set by manufacturer.
   c. Identify all materials incorporated in the job on manufacturers container by name, type and description.
   d. Apply materials on clean, dry surfaces from which all dirt, loose scale, construction debris has been removed by wire brushing.
   e. 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.
   f. Do not use scrap insulation. Repair any work damaged by welding, burning, compressing due to concentrated construction loads.
   g. 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.
   h. Insulation and jacket shall terminate hard and tight at all anchor points.
   i. 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.
   j. 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.
   k. On calcium silicate, cellular glass and rigid cellular phenolic 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 jacket or

PVC premolded cover. On sizes 50 mm (two inches) and smaller it is permissible to apply insulating and finishing cements, and cover with jacket or PVC premolded cover.

l. Fiberglass insulated piping systems fittings over 50 mm (two inch) size shall be insulated with specified molded pipe fitting insulation or compressed blanket, finished with specified insulating and finishing cements and covered with specified PVC fitting jacket. On sizes 50 mm (two inches) and under apply insulating and finishing cements and cover with PVC fitting jacket.

m. 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.

3.5 IDENTIFICATION SIGNS:

A. Valve Identification: Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16 inch) high, on all isolating valves on steam and condensate return system, identifying building or area served. Attach to the valves with corrosion-resistant chains.

B. Pipe Identification: Label service of all pipes in manholes and walk-thru tunnels.

APPENDIX II			
ALLOWABLE SITE CHARACTERISTICS FOR CONCRETE SHALLOW TRENCH APPLICATION (SEE NOTE 1)			
SITE CONDITION	GENERAL CONDITIONS OF GROUND WATER DURING THE WETTEST PERIOD OF THE YEAR	SURFACE WATER ACCUMULATION RAINFALL/ IRRIGATION	TRENCH CONSTRUCTION
A. Fine grained impervious or semipervious and coarse grained impervious	Water table generally 300 mm (one foot) below lowest point of water entry (See Note 5) with not more than 25% of the length of the proposed concrete trench system showing water within 300 mm(one foot) of the lowest point of water entry.	5 year - 7 day rainfall equal to or less than 250 mm (10 inches). (See Note 2)	Continuous wall and bottom.
B. Coarse grained semipervious and pervious (See Note 2)	Same as for A. above.	5 year - 7 day rainfall equal to or less than 250 mm (10 inches).	Same as for A. above
	Water table generally 600 mm (two feet) or more below point of water entry with not more than 10% of the length of trench system showing water within 600 mm (two feet) but not closer than 300 mm (one foot) to lowest point of water entry.	5 year - 7 day rainfall equal to or less than 200 mm (8 inches). (See Note 2)	Continuous wall; openings may be provided in trench bottom to provide drainage.
C. Swelling soils (See Note 3)	Same as for A. above.	Same as for A. above.	Same as for A. above plus design of joint spacing and joint details to accommodate movement.

NOTES:

1. Shallow concrete trench system shall not be used if any conditions defined by these criteria are exceeded.
2. As shown in U. S. Weather Bureau (USWB) Technical Paper 40 and confirmed with local data and local weather patterns
3. Swelling soils are materials with high swell potential when subjected to an increase in moisture content.

4. Precipitation rates for a specific site should be used to design drainage systems and select sump pumps.
5. Lowest point of water entry is defined as the joint between trench wall and trench bottom.

- - - END – - -

APPENDIX III

CLASSIFICATIONS FOR DIRECT BURIED SYSTEMS

1. Groundwater conditions:

Site Classification	General Conditions for Such Classifications
A - Severe	1. The water table is expected to be frequently above the bottom of the system and surface water is expected to accumulate and remain for long periods in the soil surrounding the system, or 2. The water table is expected to be occasionally above the bottom of the system and surface water is expected to accumulate and remain for long periods in the soil surrounding the system.
B - Bad	1. The water table is expected to be occasionally above the bottom of the system and surface water is expected to accumulate and remain for short periods (or not at all) in the soil surrounding the system, or 2. The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for long periods in the soil surrounding the system.
C - Moderate	The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for short periods in the soil surrounding the system.
D - Mild	The water table is expected never to be above the bottom of the system and surface water is not expected to accumulate or remain in the soil surrounding the system.

2. System Temperature Classifications: High -- 127 to 232 °C (261 to 450 °F); Medium -- 94 to 126 °C (201 to 260 °F); Low -- 93 °C (200 °F) or lower.

3. Soil Conditions:

   A. Soil Corrosiveness Classification

   The soil at the site should be classified as corrosive or noncorrosive on the basis of the following criteria:

   Corrosive -- The soil resistivity is less than 30,000 ohm-centimeter (ohm-cm) or stray direct currents can be detected underground.

   Noncorrosive -- The soil resistivity is 30,000 ohm-cm or greater and no stray direct currents can be detected underground.

The classification should be made by an experienced corrosion engineer based on a field survey of the site carried out in accordance with recognized guidelines for conducting such surveys.

B. Soil pH

If there is any reason to suspect that the soil pH will be less than 5.0 anywhere along the proposed path of the system, pH measurements should be made at pipeline depth at close intervals along the proposed route, and all locations at which the pH is less than 5.0 should be indicated in the contract documents. An experienced soils engineer, preferably the same engineer responsible for other soil engineering work, should determine soil pH.

4. Type of Underground System Allowed:

Drainable-Dryable-Testable (DDT): Allowed for Site Classifications A, B, C, D.

Water-Spread-Limiting (WSL): Allowed for Site Classifications B, C, D.

- - - END - - -