APPENDIX 3T – NEU PIPING

PART 1. GENERAL

1.1 Scope

1.1.1 This Appendix covers additional details associated with minimum requirements for on-site buried NEU piping, fittings, valves, supports, and appurtenances.

1.1.2 Provide all labour, materials, and incidentals required to construct complete and operable mechanical piping systems, regardless of whether such are specifically called for in Schedule 3 [Design and Construction Specifications].

1.1.3 Read this Appendix in conjunction with Schedule 3 [Design and Construction Specifications] and its Appendices. Where there is a conflict, the NEU/Owner will be notified to resolve it. The NEU/Owner has the right to apply the more stringent requirement in such cases.

1.1.4 This Appendix refers to those portions of the work that are unique to the requirements for flushing, cleaning, and passivating installed process piping.

1.1.4.1 Hydrostatic testing will be completed prior to commencing pipe conditioning.

1.1.4.2 All pipes will be flushed, cleaned, and passivated prior to the commencement of any commissioning.

1.1.4.3 Flushing refers to circulation of water with the objective to remove solids that in process water suspension has the potential to cause damage to instrumentation and/or equipment or deposit and foul equipment.

1.1.4.4 Cleaning refers to the circulation of chemical cleaners to remove grease and petroleum products, and iron oxides from the interior of piping systems.

1.1.4.5 Passivation refers to pipe treatment by circulation of a chemical to cause the deposit of a non-reactive scale and corrosion inhibitor film on the internal surface of the pipe.

1.1.4.6 All water quality testing associated with the pipe conditioning will be at Project Co's expense.

1.1.4.7 Project Co will pursue any permit requirements for drainage/disposal generated during the pipe conditioning process.

1.2 Quality Assurance

1.2.1 All components, products, and fabrication techniques will be provided in compliance with the Regulations and Requirements of the Province of British Columbia "Power Engineers Boiler and Pressure Vessel Safety Act and Regulations".

1.2.2 Pipe welding:

1.2.2.1 Installation and repair or alterations to, pressure piping systems will be performed only by licensed welders, certified for the work being done in accordance with the

Regulations and Requirements of the Province of British Columbia "Power Engineers Boiler and Pressure Vessel Safety Act and Regulations".

1.2.2.2 All field welding to be in accordance with the procedures of CSA-W117.2 and the current edition of ASME/ANSI B31.1 Code and the British Columbia Boiler and Pressure Vessel Act.

1.2.2.3 Project Co will submit names and qualifications of all personal (including sub-trades) intended for this project within twenty-one (21) days of contract award. The NEU/Owner reserves the right to accept or reject any individual proposed for the project, based on qualifications.

1.2.2.4 Welders must be qualified for the process for which they are welding in. Typical field welding processes are listed below:

1.2.2.4(1) SMAW (Shielded Metal Arc Welding), also known as stick welding; and

1.2.2.4(2) FCAW (Flux-cored arc welding), also known as wire welding.

1.2.2.5 Welder Qualifications

1.2.2.5(1) Welding qualifications in accordance with CSA B51.

1.2.2.5(2) Use qualified and licensed welders possessing certificate for each procedure performed from Authority Having Jurisdiction.

1.2.2.5(3) Furnish welder's qualifications to NEU/Owner.

1.2.2.5(4) Each welder will possess identification symbol issued by the Authority Having Jurisdiction.

1.2.2.6 Inspectors Qualifications

1.2.2.6(1) Inspectors qualified to CSA W178.2.

1.2.3 Submit official Logstor Training Certificates.

1.2.4 Conform to all standards and specifications referenced in this Appendix.

1.3 Reference Standards

1.3.1 American Society of Mechanical Engineers (ASME).

1.3.1.1 ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.3.1.2 ASME B16.9, Factory-Made Wrought Butt Welding Fittings.

1.3.1.3 ANSI/ASME B31.1 Power Piping.

1.3.1.4 ASME B31.9, Building Services Piping.

1.3.2 American National Standards Institute (ANSI).

1.3.2.1 ANSI B32.1 Metal Products.

1.3.3 Canadian Standards Association (CSA International).

1.3.3.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code

1.3.3.2 CSA CAN3-S16.1-M Steel Structures for Buildings (Limit State Design).

1.3.3.3 CSA W59-M Welded Steel Construction (Metal Arc Welding).

1.3.3.4 CSA W47.1 Certification of Companies for Fusion Welding of Steel Structures.

1.3.3.5 CSA W117.2, Safety in Welding, Cutting, and Allied Processes.

1.3.3.6 CSA W178.2 Certification of Welding Inspectors.

1.3.4 European Standards

1.3.4.1 EN 253 Pre-insulated bonded pipe for hot water district heating

1.3.4.2 EN 448 Pre-insulated fittings

1.3.4.3 EN 488 Pre-insulated valves

1.3.4.4 EN 489 Joint Kits

1.3.4.5 EN 1434 Heat Meters – Part 1: General Requirements

1.3.4.6 EN 14419 District Heating Pipes

1.4 Submittals

1.4.1 Provide shop drawings for all fabricated steel and piping, supports and appurtenances.

1.4.2 Submit manufacturers' literature and catalogue information for all valves and equipment.

1.4.3 Submit welder qualifications (WPQ) and welding procedures (WPS) as specified by ASME B31.1 Section 127.5.

1.4.4 Provide data sheets, including safety and first aid data, for all chemicals.

1.4.5 Provide information on chemicals to demonstrate the non-toxicity of the blow down water and environmental acceptability.

1.4.6 Submit detailed procedure and concentration calculations for the determination of chemical feed rate.

1.4.7 Submit hydraulic calculations for every step for all branches.

1.4.8 Provide detailed drawings of any branches that will be manually cleaned if cleaning and/or flushing is not possible due to configuration.

1.4.9 Provide detailed drawings of temporary pipe routing that is required to complete pipe conditioning to the requirements specified herein.

1.4.9.1 Quality Control: Field Quality Control Submittals as specified in Part 3 of this Appendix.

1.4.9.2 Samples: Welders must demonstrate their qualifications and be certified. Witnessed welding will be required. Refer to Part 3 Quality Control of this Appendix.

1.5 Delivery, Storage and Handling

1.5.1 Packing, shipping, handling, and unloading:

1.5.1.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5.2 Storage and Protection:

1.5.2.1 Store in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.5.2.2 Protect thermal insulation from getting wet and damp.

1.5.2.3 Store and protect piping, insulation, and jackets from damage.

1.6 Temporary Drainage & Pumping

1.6.1 Temporary drains and/or offset sumps or dewatering, either by pumping or other means, will be employed as may be necessary to keep water away from work under all conditions.

1.6.2 Trenches will be kept water-free during joining and for a sufficient period thereafter to allow the jointing material to become fully set and completely resistant to water penetration.

1.6.3 Temporary drains will not be discharged to sanitary sewers.

1.7 Preparation of Trench

1.7.1 Trench will be dug to the alignment and depth required in advance of the pipe laying. Width of the trench will be 300 mm (12") greater than the outside diameter of the pipe. Where shoring is required, the width of the trench will be extended by an amount equal to the thickness of the shoring material. The floor of the trench will be devoid of all lumps or irregularities and will extend a minimum of 150 mm (6") below pipe.

1.7.2 Trench width at any point will not be less than trench width at any depth below such point.

PART 2. PRODUCTS

2.1 General

2.1.1 All products will conform to the pipe specifications (pressure rating, temperature, etc.) described below.

2.1.2 All products will be new, undamaged, and free from rust and defects.

2.1.3 All products of a similar nature will be the product of a single manufacturer.

2.1.4 It will be taken into the total evaluation of the supplier's tender if suppliers cannot live up to the technical description in all details.

2.2 Acceptable Manufacturers

2.2.1 Logstor.

2.3 Pipe Bedding Materials

2.3.1 Bedding material will conform to MMCD requirements and be free of sharp objects, large stones or any other material that can damage the piping.

2.3.2 Granular material, general:

2.3.2.1 Gradation will be within specified limits when tested to ASTM C136/C136M-14 and giving a smooth curve without sharp breaks when plotted on a semi log grading chart.

2.3.2.2 Bedding Sand: Natural sand or crushed rock screenings will conform to the following grading requirements:

ASTM Sieve Size	Percent Passing
9.525 mm [3/8"]	100
4.7625 mm [3/16"]	50 – 100
2.00 mm [0.0787"]	30 – 90
0.425 mm [0.0167"]	10 – 50
0.075 mm [0.003"]	0 – 10

Liquid Limit: ASTM D4318-17e1 Maximum 25.
Plasticity Index: ASTM D4318-17e1 Maximum 6.

2.3.2.3 Bedding Stone: Crushed stone or crushed gravel will conform to the following grading requirements:

ASTM Sieve Size	Percent Passing
22.40 mm [0.882"]	100
19.00 mm [3/4"]	70 - 100
16.00 mm [0.63"]	50 – 100
9.50 mm [3/8"]	25 – 75
4.75 mm [3/16"]	0 - 20
2.00 mm [0.0787"]	0 – 10

2.4 Backfill Materials

2.4.1 Backfill materials will conform to MMCD requirements and be free of organic matter, frozen materials, building debris, sharp objects, large stones or any other materials that can damage the piping.

2.4.2 Type 1 and Type 2 fill:

2.4.2.1 Crushed, pit run or screened stone, gravel or sand.

2.4.2.2 Gradations will be within limits when tested to ASTM C136/C136M-14.

2.4.2.3 Table:

ASTM Sieve Size	Type 1 % Passing	Type 2 % Passing
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

2.4.3 Clean native excavated soil free from organic matter, frozen materials, stones larger than 75mm, building debris and other foreign substances.

2.5 Pipe – Pre-Insulated, Direct Buried

2.5.1 General:

2.5.1.1 The piping system layout will be analyzed by the piping system manufacturer to determine the stresses, expansion and any displacements of the service pipe. The system manufacturer will provide all necessary engineering and components; including offsets, anchors, expansion compensation as required for a complete installation.

2.5.1.2 All straight sections, fittings, anchors and other accessories will be factory fabricated, insulated and jacketed.

2.5.2 Pre-insulated Steel Piping System:

2.5.2.1 The piping system design and manufacture will comply with ASME B31.1 Power Piping.

2.5.2.2 Steel Pipe: Refer to table below.

Type		Pre-Insulated Carbon Steel Process Piping
Service		Hot Water (underground)
Operating Pressure rating		1,600 kPa (232 PSI)
Temperature rating		120°C
Test Condition		2,400 kPa (348 PSI) for 240 minutes
Item	**Sizes**	**Specification**
Basic Material & Reference Standard	1 inch and above	Beveled Ends ASTM A106, grade A seamless, or

		ASTM A53, grades B seamless
Thickness	2½ inch to 12 inch	ASME B36.10, schedule 40 (see Note 1 below)
Fittings / Joints	Above 2½ inch	Butt-welded, black steel with beveled ends for welding, to ASME B16.9, same wall thickness as pipe (Elbows will be long radius) Factory prefabricated and pre-insulated. Straight tangent lengths will be added to all ends so that all field joints are at straight sections of pipe. Elbow jackets will be molded HDPE. Tee jackets will be extrusion welded or butt fusion welded HDPE. Gluing, taping or hot air welding is not allowed.
Accessories	All	Elbows, tees, reducers, anchors, field joints, and end seals will be designed and factory fabricated to prevent ingress of moisture into the system.
Insulation	All	Will be a bonded system and conforms to BS EN 253. 1½" void free polyurethane foam. Unaged thermal conductivity will not exceed 0.029W/ (m.K) when tested in accordance to Section 5.4.4 of BS EN 253. Unaged minimum compressive strength: 0.3 MPa when tested in accordance to Section 5.3.3 of BS EN 253. Unaged minimum shear strength: 0.08 MPa when tested in accordance to section 5.4.1.5 of BS EN 253. Insulation will be factory applied, except at joints where field welding is required.
Jacket	All	Black HDPE conforming to BS EN 253.
Test Procedure	All	Testing procedures to confirm to BS EN 253.
Leak Detection	All	The bonded system will include a leak detection system built-in within the jacket.
Notes		
Full conformance to BS EN 253 takes precedence over pipe thicknesses outlined in this section.		

2.6 Curved Pipes

2.6.1 The supplier must be able to deliver pre-insulated curved pipes from DN100 up to DN600. Smaller pipes may be curved on Site using special tools, available from the pipe manufacturer.

2.6.2 When the curved pipes are produced from a straight pre-insulated pipe, then the machine that curves the pipe must support the entire pipe length during the curving process so that the risk of buckling of the steel is eliminated. The production process must be documented.

2.7 Pre-Insulated Bends

2.7.1 It is permissible to use cold bended steel pipe up to dimension DN500.

2.7.2 Pre-insulated bends may be used for directional changes and changes in levels. Standard pre-insulated bends are available in 45° and 90° assemblies. Other bends are available in 5° increments.

2.7.3 The supplier must be able to document that the bended steel pipe fulfills requirements in EN448 with respect to minimum wall thickness of the steel, ovality and folding in the bent area.

2.8 Pre-Insulated Branches

2.8.1 All branch combinations will be made with prefabricated branches. Branches are available in 45° for perpendicular branching from main pipes, 90° for parallel branching from main pipes and tee fitting for perpendicular branching from main pipes.

2.8.2 In dimensions up to DN300 the main pipe must be supplied in reinforced design in order to resist the axial forces corresponding to 330 MPa. The T-fitting must be produced with a hot drawn collar from a pipe with higher wall thickness

2.8.3 Provided that the dimension of the main pipe and the branch are the same, the T-piece must be able to resist axial forces corresponding to 190 MPa.

2.8.4 For bigger dimensions, the static of each T-fitting must be calculated and documented by the supplier.

2.9 BX-joint (Preformed PEX Joint Kit)

2.9.1 Joint kit to include: a shrinkable cross-linked polyethylene (PEX) BX sleeve, pre formed insulation shells (PUR foam) and shrink foil membrane.

2.9.2 Input of the right welding parameters (type of joint, dimension, resistance in the integrated copper wires) into the welding machine must be secured by scanning a tack on the joint with a PDA.

2.9.3 It must be possible to upload the welding data (current, effect, temperature, and welding time) directly to a web server to secure that it is possible to inspect the welding of each joint.

2.9.4 There must be a traceability to each joint. The traceability must consist of date of welding, person who has welded the joint, machine number and the file number, which is marked on the joint.

2.9.5 It must be possible via a GPS module in the PDA to register the location of the joint.

2.9.6 The welding pressure must be controlled during the welding process for example via air pressure.

2.9.7 The installer must be able to follow the welding process and the welding parameters during the installation.

2.10 Expansion Foam Pads

2.10.1 Foam pads are used for partial absorption/distribution of thermal expansion movements. The application is restricted to first time expansion movements of a maximum of 84mm and a maximum continuous surface temperature of the outer casing of 50°C.

2.10.2 Foam pads are made of polyethylene foam, non-decomposable with closed cells.

2.11 Expansion Anchors

2.11.1 Pre-insulated anchors are used to fix the pipeline for absorption of expansive forces in order to avoid undesirable expansion movements.

2.11.2 Maximum operating pressure of 25 bar.

2.11.3 Maximum axial tension on the anchor plate corresponding to a differential stress of 150 MPa from the two sides .

2.11.4 Anchors will be delivered with embedded copper wires for surveillance.

2.11.5 Flange made of coated steel, S 235 JR.

2.11.6 Inner skirts made of stainless steel.

2.11.7 Produced according to EN 448.

2.12 Surveillance System, Active System, Nordic System (Logstor Detect)

2.12.1 Detectors must have 4 channels with a range of minimum 7000 m each.

2.12.2 The detector must be able to measure insulation values, wire resistance, and galvanic voltage.

2.12.3 The measurements must be documented in a graphic way where the historic values are kept back in time from when the detector was taken into operation. Therefore, the development of the system and changes can be surveyed and compared to the historic values.

2.12.4 The data must be communicated to an external PC via 3G.

2.12.5 The NEU graphic software must be able to manage alarm levels where a message is given automatically when measured values are outside the alarm levels.

2.12.6 It must be possible to establish the detectors with battery with at least 6 years of operation

2.12.7 It must be possible to establish long distance support from the supplier without the necessity for the supplier to be on Site.

2.12.8 The detector must locate eventual errors.

2.12.9 Standard of acceptance: Logstor Detect model X4 c/w cabinet, transformer, and all associated cables for a complete installation.

2.13 Air Vents

2.13.1 Lever type air release valve, Cast iron ASTM A126, Class B

2.13.2 Temperature rating - 120°C (250°F), pressure rating – 1,600 kPa (232 psi)

2.13.3 304 SS float and float arm, EPDM valve head, Epoxy coating.

2.13.4 Valve discharge piping will be routed to the floor.

2.14 Chemicals

2.14.1 All chemicals required for pipe conditioning will be supplied by Project Co.

2.14.2 Chemicals will be selected to achieve suitable cleaning and passivation of the piping system. The system will include both copper and stainless-steel components, in addition to carbon steel pipe.

2.14.3 All chemicals will be non-foaming and acceptable to the environment.

2.14.4 Cleaning chemical to be Purgex L-24.

2.14.5 Corrosion inhibitor will be Corrshield* NT4206. Provide chemicals directly to NEU engineering plant to be added into NEU circulation system.

2.15 Equipment

2.15.1 Project Co will be responsible for the supply, installation, and removal of all temporary piping, hoses, and appurtenances to complete the requirements of pipe conditioning specified in this Appendix.

2.15.2 Project Co will provide all equipment required to complete pipe conditioning as specified, including pumps, strainers, compressor, hose, and manual cleaning tools.

PART 3. EXECUTION

3.1 Manufacturer’s Instructions

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Site Survey

3.2.1 Conduct survey, prior to beginning Work, to confirm

3.2.1.1 Profile along intended route; and

3.2.1.2 Locations and inverts of storm drains, catch basins, drainage ditches to which conduit drains will be connected.

3.2.2 Conduct survey to established benchmark.

3.2.3 Inform NEU/Owner immediately of conflicts or discrepancies.

3.3 Coordination

3.3.1 Coordinate with work completed under Schedule 3 [Design and Construction Specifications] and its Appendices to avoid conflict.

3.3.2 Locate system to ensure minimum interference and to provide maximum space for operation and maintenance.

3.3.3 Where interference occurs, relocate as reviewed with the NEU/Owner.

3.4 Proving Route

3.4.1 Prove grades of system far enough in advance of installation to permit relocation or design necessitated by unforeseen obstacles.

3.4.2 Unless specified otherwise, install work only after next section has been fully excavated and intervening line proven feasible.

3.4.3 Demolish and remove work constructed in contravention of these requirements and which have to be relocated or redesigned because of unforeseen obstacles along route.

3.5 Preparation of Trenches

3.5.1 Prepare and drain to manufacturer's recommendations: run drainage piping to disposal point(s) as indicated.

3.5.2 Bedding: smooth and level and provide continuous and uniform support except at concrete anchors.

3.5.3 Trench width: provide spacing for distribution piping, and sufficient width to provide working space.

3.6 General Piping System Installation Requirements

3.6.1 Carefully place and support all pipe at proper lines and grades; where possible slope to permit complete drainage.

3.6.2 Blow or flush all piping clean after assembly and before connecting to equipment.

3.6.3 Handle pipes with care at all times and use equipment designed for the purpose. Replace any pipe damaged in handling or installing.

3.6.4 Install and join pipe in accordance with manufacturer's written instructions and good practice.

3.6.5 Repair factory coatings at field cuts or where otherwise damaged.

3.7 Installation

3.7.1 General:

3.7.1.1 Installation will conform to the provisions of latest release of ASME B31.1 and CSA B51.

3.7.1.2 Installation will conform to the Technical Safety BC requirements.

3.7.1.3 Follow supplier installation recommendations.

3.7.1.4 Seal open ends of insulation to prevent entry of moisture.

3.7.1.5 Keep entire system dry during installation.

3.7.1.6 Pipe to pipe branch connections will not be used.

3.7.1.7 Ream all cut tube and pipe ends to the full inside diameter at the tube or pipe to remove burrs.

3.7.1.8 Remove any burrs on the outside of cut tube and pipe ends.

3.7.1.9 Provide air vents and drains on pipelines and manual vent / drain at any high / low point.

3.7.1.10 Spring supports will be locked during testing. Follow supplier recommendations for locking methods.

3.7.2 Isometrics:

3.7.2.1 Provide detailed isometric schematics of the piping system.

3.7.2.1(1) Provide one isometric schematic for each line.

3.7.2.1(2) Provide weld maps for all welds.

3.7.2.2 The isometric schematic will contain the following data as a minimum:

3.7.2.2(1) All shop weld joints and field weld joints;

3.7.2.2(2) Pipe supports type and location;

3.7.2.2(3) Pipe anchor points location;

3.7.2.2(4) Straight piping sections length and elevation, and branch angles; and

3.7.2.2(5) Isometric spool numbering.

3.7.2.3 The Weld Maps will contain the following data as a minimum:

3.7.2.3(1) Welder ID no. for shop-welded joints;

3.7.2.3(2) Weld number;

3.7.2.3(3) Weld joints subjected to non-destructive test (NDT); and

3.7.2.3(4) Welding procedure specification number.

3.7.3 Permissible Welded Assemblies:

3.7.3.1 Weld rings:

3.7.3.1(1) Prepare pipe as recommended by manufacturer.

3.7.3.2 Butt welds:

3.7.3.2(1) Prepare pipe ends in accordance with ASME B31.1.

3.7.3.3 Weldolets:

3.7.3.3(1) Required at branch connections where the branch diameter is smaller than the header diameter.

3.7.3.3(2) Reducing tee may be provided, subject to the NEU/Owner acceptance.

3.7.3.3(3) Remove slag from inside pipe following installation on 6 inch and larger shop fabrications.

3.7.3.4 Sockets:

3.7.3.4(1) Small diameter sockets for instruments, vent, drain, etc. to be rated for 3,000 PSI.

3.7.3.5 Caps:

3.7.3.5(1) Use butt-welded caps installed in accordance with ASME B31.1.

3.7.3.6 Elbows:

3.7.3.6(1) Use butt-welded fittings.

3.7.3.6(2) Elbows to be long radius only or as stated in the steel pipe table under Products.

3.7.3.7 Reducers:

3.7.3.7(1) Concentric transitions will be used on vertical piping system.

3.7.3.7(2) Eccentric transitions will be used on horizontal piping systems.

3.7.3.7(2)(a) Install flat-on-top.

3.7.3.8 Tees: required at branch connections where a standard reducing tee fitting is available.

3.7.4 Welder Qualifications

3.7.4.1 Qualify welding process and operator for piping according to ASME “Boiler and Pressure Vessel Code”, Section IX: “Welding and Brazing Qualifications”.

3.7.4.2 On-line welder qualification will be applied by radiographing the first three different production welds of each welder.

3.7.4.3 Comply with provisions of ASME B31 series “Code of Pressure Piping”.

3.7.4.4 Have completed an official Logstor Training program and comply with manufacturer installation recommendations.

3.7.5 Pipe Welding:

3.7.5.1 All welding of piping will be performed in accordance with the latest edition of the Code for Pressure Piping ASME B31.1 and CSA B51.

3.7.5.2 All welders performing under these specifications will have been fully qualified in accordance with the test requirements of Section IX of the ASME Boiler Code.

3.7.5.3 Each welder’s certificate of qualification will be supplied to the NEU/Owner before any welding is performed.

3.7.5.4 Provide welding procedure specification and procedure qualification record for each type of weld joint to be used.

3.7.5.5 Each welder will identify his/her work by stamping each weld, indicating joint number and welder ID number. Project Co's name (in abbreviation form or initial), will prefix the welder's number, thus identifying the entire work. Each welder will identify his/her work by stamping each weld, indicating joint number and welder ID number. Project Co’s name (in abbreviation form or initial), will prefix the welder’s number, thus identifying the entire work.

3.7.5.6 Tack welds during fabrication will be made by certified welders.

3.7.5.7 Each welder will carry an identification badge while working. Badge will be presented to the NEU/Owner on request.

3.7.6 Process Piping:

3.7.6.1 Install systems in accordance with ASME B31.1 and CSA B51.

3.7.6.2 Perform welding in accordance with ASME Standards.

3.7.6.3 Pitch at 1 mm/m for drainage and air elimination.

3.7.7 Pipe bedding:

3.7.7.1 Bottom bedding will be a quarter of pipe diameter or 150mm thick, whichever is greater. Top bedding will be a minimum 300mm thick. Side bedding will be 300mm thick. (If shoring used in pipe trench, side bedding will be extended to allow for thickness of shoring.)

3.7.7.2 Hand place granular bedding material in uniform layers. Dumping of material directly on top of pipe is not permitted.

3.7.7.3 Shape bed true to grade and to provide continuous uniform bearing surface for length of pipe. Do not use blocks when bedding pipe.

3.7.7.4 Place layers of bedding material uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

3.7.7.5 Compact each layer to at least 95% maximum density ASTM D698-12e2.

3.7.7.6 Backfill of piping will not be commenced until tests have been accepted by the Authority Having Jurisdiction.

3.7.8 BXJoint installation:

3.7.8.1 The shrinkable cross-linked polyethylene (PEX) BX sleeve will be pre-installed on the pipe prior to welding the pipe joint. The BX sleeve is complete with a secondary water seal on either side of the sleeve. No cutting of the BX sleeve is permitted.

3.7.8.2 Pre-insulated pipe casing will be prepared and cleaned as per manufacturer's recommendations.

3.7.8.3 Pre-formed insulation (PUR Foam) will be measured to length and cut on site to fit the opening.

3.7.8.4 Leak detection wires to be installed extended outside of PUR foam as per manufacturer recommendations.

3.7.8.5 Leak detection system to be tested and documented prior to closing the pipe joint.

3.7.8.6 Shrink foil to be applied, heated, and installed over PUR foam and leak detection wires. Visual and physical inspection to be completed to ensure proper adhesion of the shrink foil sealant.

3.7.8.7 BX sleeve to be fit over the sealed joint and heated to shrink and form the second seal of the joint. Visual and physical inspection to be completed to ensure proper adhesion of the sealant.

3.8 Placement and Compaction of Backfill Material

3.8.1 Backfill trenches using backfill materials specified.

3.8.2 Place backfill material in uniform layers not exceeding 150mm and uniformly compact each layer of backfill to 95% standard proctor density.

3.8.3 Installation of backfill material will avoid damage and displacement of services.

3.9 Termination of Distribution Piping

3.9.1 Unless noted otherwise, terminate system 150 mm beyond inside face of building wall to protect exposed insulation from damp wall conditions.

3.9.2 Building and manhole entry:

3.9.2.1 Through sleeve. Fill annular space between jacket and sleeve with specified sealant.

3.9.3 All tunnel and building distribution piping will be constructed and tested in accordance with ASME B31.1. The tunnel and building distribution piping will be welded carbon steel construction with insulation applied on Site.

3.9.4 The transition from the buried pre-insulated pipe to standard weight tunnel or building piping will occur after the wall penetration.

3.10 Expansion Foam Pads

3.10.1 Provide factory foam pads at expansion loops. Provide sufficient quantity of foam pads to absorb the thermal expansion.

3.10.2 Install as per manufacturer’s requirements.

3.11 Anchors and Thrust Blocks

3.11.1 Provide factory pre-insulated anchors as required and as shown on plans. Locate where indicated and also within 1500 mm of entry into buildings and manholes.

3.11.2 Anchor blocks: 760 mm long or as per pipe manufacturer’s requirements.

3.11.2.1 Extend minimum of 230 mm beyond top and bottom of anchor plate and into undisturbed side walls and bottom of trench.

3.11.3 Install in accordance with manufacturer's recommendations.

3.11.4 Use forms where necessary.

3.11.5 Ensure maximum contact with piping and trench surfaces, free of voids.

3.12 Installation of Alarm System

3.12.1 Before installations of a joint, an alarm drawing must be approved by the NEU/Owner before installation starts on Site and handed over to installer.

3.12.2 After finishing the work, the alarm drawing must be updated and as-builts will be provided to the NEU/Owner for final approval.

3.12.3 There will be no leak detection system in portions of pipe installed in tunnels.

3.12.4 The leak detection system terminates upon entry into each building.

3.12.5 The system must be controlled and have a minimum insulation value of 10/km wire => Mohm. For example, a 10 km wire must have 1 Mohm, and 1 km wire must have 10 Mohm.

3.12.6 After finishing each joint, the fitter will use a megger to test the section according to manufacturer's requirements for:

3.12.6.1 Continuity of measuring wires; and

3.12.6.2 No electrical contact or moisture between the wires and pipes.

3.12.7 Upon assembly of the leak detection system zone, the system functional test will be conducted with a fault simulation.

3.12.8 All data will be recorded and presented to NEU/Owner and City NEU department.

3.12.9 After four (4) weeks of operation, the leak detection system functional test must be repeated by Project Co and result to be recorded. Test will be witnessed by NEU/Owner and NEU representative.

3.12.10 Before extending or renovating an existing leak detection system the actual state of the system will be measured and documented:

3.12.10.1 Wiring ohmic resistance from conductor to conductor; and

3.12.10.2 Isolation resistance from conductor to pipe.

3.13 Quality Control

3.13.1 Delivery on site of all piping and fittings:

3.13.1.1 Prior to delivery, the Mill Test Report (MTR) will be submitted to the NEU/Owner for review and acceptance of material.

3.13.1.2 Upon delivery to the Site of all pipes, Project Co will verify that the materials received match the MTR submitted by Project Co's supplier and that it complies with the specifications.

3.13.1.3 If there is a discrepancy between the documentation and the identification markings on the material or the materials specified, the delivery will be rejected without any costs to the NEU/Owner.

3.13.1.4 Project Co will protect pipe and fittings from oxidation due to the elements or water.

3.13.2 Pre-fabrication of piping spools:

3.13.2.1 Project Co will maintain a proper control and traceability documentation to verify compliance with the applicable codes and standards and with Schedule 3 [Design and Construction Specifications].

3.13.2.2 Piping spools are permitted to be fabricated on site, outside of the NEU trench.

3.13.2.3 The NEU/Owner will be provided free access to Project Co's fabrication site at any time during the fabrication of the piping spools.

3.13.2.4 The NEU/Owner will review the produced piping spools and control the documents at Project Co's fabrication site prior to installation on Site.

3.13.2.5 NEU pipes will be fully supported along its length at all times. Installation into NEU trench to be clearly coordinated with manufacturers recommendations for lifting and handling of pipes:

3.13.2.5(1) Lifting straps with a width of minimum 100mm will be used; and

3.13.2.5(2) Pipes will not be lifted from a single location; a minimum of 2 straps will be evenly spaced across the pipes.

3.13.3 Inspection of joint installations:

3.13.3.1 Project Co will test all leak detection systems prior to sealing the joints. Provide a log and documentation of the test results.

3.13.3.2 All pipe joints will be inspected by the NEU/Owner once the leak detection system has been tested. The NEU/Owner must be on Site to witness the installation of the waterproof membranes (shrink wrap foil and BX sleeve).

3.13.3.3 All joints in the piping systems will remain uncovered until all tests are completed and the systems have been reviewed by the NEU/Owner and the Authority Having Jurisdiction.

3.13.4 Welder Qualifications:

3.13.4.1 Welder certificates will be signed by Project Co and a third-party Inspector certifying that all welder and operator qualifications comply with the latest edition of the Code for Pressure Piping, ANSI/ASME B31.1 and all addenda.

3.13.4.2 All welders performing under these specifications will have been fully qualified in accordance with the test requirements of Section IX of the ASME Boiler Code.

3.13.4.3 The NEU/Owner may disqualify any welder based on observed competence and/or ability to complete quality work.

3.13.4.4 Project Co will utilize the following ASME forms. All copies will be submitted to the NEU/Owner for review and final acceptance:

3.13.4.4(1) Welding Procedures Specification (WPS) - Form QW-482.

3.13.4.4(2) Procedure Qualifications Record (PQR) - Form QW-483.

3.13.4.4(3) Welding Operator Qualifications (WPQ) - Form QW-484.

3.13.4.5 Provide welding procedures and welding procedure qualification for each type of weld joint to be used.

3.13.4.6 Each welder will identify his/her work by stamping each weld, indicating joint number and welder ID number. Project Co's name (in abbreviation form or initial), will prefix the welder's number, thus identifying the entire work.

3.13.4.7 Each welder must carry an identification badge while working. Badge will be presented on request.

3.13.4.8 Inspection and testing:

3.13.4.8(1) All welds will be examined by radiography (included in Project Co's price) as specified below:

3.13.4.8(1)(a) Examination will be undertaken by a third-party agency, which is specialized in this type of inspection.

3.13.4.8(1)(b) Provide radiographic examination in accordance with the ASME Boiler and Pressure Vessel Code Section V, Article 2.

3.13.4.8(1)(c) Acceptable criteria will be per ASME Code Section VII Par UW-51. The standard of weld quality will meet the applicable standard ANSI/ASME B31.1.

3.13.4.8(2) Each weld will be filed as necessary before inspection.

3.13.4.8(3) Clean each weld with a power brush to remove slag, platter, etc.

3.13.4.8(4) Provide all material, tools, and labor to execute non-destructive tests (NDT).

3.13.4.9 Weld radiographic examination:

3.13.4.9(1) 100% of all welded joints for below ground will undergo radiographic examination.

3.13.4.9(2) Radiograph over full circumference.

3.13.4.9(3) Any rejected weld will be repaired and tested at Project Co's expense.

3.13.4.9(4) Excessive rejected welds by the same welder may disqualify a welder from any further work on Site, at the discretion of the NEU/Owner.

3.13.4.9(5) Where radiographic examination is not possible, ultrasonic examination may be used, with the NEU/Owner's permission.

3.13.4.10 Ultrasonic examination may be used:

3.13.4.10(1) To verify the minimum pipe thickness after grinding;

3.13.4.10(2) For initial testing of automatic welds;

3.13.4.10(3) Where radiographic examination does not clearly show compliance of the weld; and

3.13.4.10(4) Where radiographic examination is prohibited for safety concerns.

3.13.4.11 Magnetic particle examination may be used:

3.13.4.11(1) For fillet welds;

3.13.4.11(2) Any re-beveling;

3.13.4.11(3) On completion of weld repairs; and

3.13.4.11(4) On removal of arc strikes.

3.14 Pressure Tests

3.14.1 General

3.14.1.1 The use of additives, liquids, compounds, and similar substances in pipe systems to provide a leak free system is prohibited.

3.14.1.2 Valves will not be used for dead ending a pressure test pipe section. Blind flanges / end caps can be utilized.

3.14.1.3 Pressure test limits will be as per the steel pipe table under Products.

3.14.2 Pressure test requirements

3.14.2.1 All piping will be hydro-tested in accordance with the requirements of ANSI B31.1, NEU/Owner's technical guidelines, and Project Co's inspection and test plan.

3.14.2.2 Submit piping pressure test method statement prior to proceeding to any pressure test.

3.14.2.3 Hydro test will be performed using clean, filtered fresh or city water. There will be no leakage in the pipeline.

3.14.2.4 The district heating primary piping will be hydraulically tested after installation and before painting, insulating, and concealing in any way, at a minimum test pressure of 2,400 kPa (348 psi) for 4 hours without a drop in pressure. The secondary heating will be hydraulically tested at 1.5 times NEU design pressure or a minimum of 690 (100 psi) as per ANSI B31.9.

3.14.2.5 Any equipment not capable of withstanding the NEU design test pressure will be isolated. Flow meters, heat exchangers, and control valves will be removed and spool pieces installed before commencing pressure tests.

3.14.2.6 Obtain all approvals from the Authority Having Jurisdiction for carrying out pressure tests on piping with joints not exposed for visual examination.

3.14.2.7 Initial and final pressure tests will be witnessed by the NEU/Owner.

3.14.2.8 Notify the NEU/Owner one week prior to scheduled test date.

3.14.2.9 Submit test report for all pressure tests.

3.14.2.10 Costs for pressure testing will be borne by Project Co.

3.15 Insulation of Field Joints in Distribution Piping

3.15.1 Install insulation to field joints after field joints in distribution piping have been completed and pressure tests have been completed, witnessed, and certified.

3.15.2 Use manufacturer's recommended materials and procedures.

3.16 Field Joints in Outer Jacket

3.16.1 Install insulation to field joints in outer jacket after insulation of distribution piping is complete.

3.16.2 Use manufacturer's recommended materials and procedures.

3.17 Piping Through Concrete, Masonry and Walls

3.17.1 Where pipe passes through walls, exercise extreme care to ensure that joints are watertight.

3.17.2 Free pipe of all dirt and grease to secure a tight bond with concrete.

3.18 Grading and Clearances

3.18.1 Grade distribution piping in trenches as indicated.

3.18.2 Install inside piping precisely to the dimensions shown on drawings.

3.18.3 Install exterior piping with minimum clearances, as follows:

3.18.3.1 Between each pipe: 150 mm;

3.18.3.2 Between pipe and trench wall: 150 mm; and

3.18.3.3 Between top of piping and final grade:

3.18.3.3(1) Roads, parking areas: 1,200 mm; and

3.18.3.3(2) Elsewhere: 600 mm.

3.18.4 Cast sections of major piping into place only after piping has been assembled in place. Spool pieces may be substituted for long delivery items.

3.19 Backfilling

3.19.1 Backfilling: in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling, supplemented as follows:

3.19.1.1 Hand place and hand tamp in 100 mm layers to 300 mm above top of highest jacket;

3.19.1.2 Compaction: 640 to 670 kg/m³; and

3.19.1.3 Do not use wheeled or tracked vehicles for tamping remainder of backfill.

3.20 Flushing, Cleaning and Passivation

3.20.1 Supply all temporary equipment and bypasses required for pipe flushing.

3.20.2 Supply manpower to remove all temporary bypasses after the completion of the flushing and to complete connections to equipment.

3.20.3 Provide all the manpower, tools, chemicals, and equipment required for the flushing, cleaning, and passivation as instructed by the NEU/Owner.

3.21 General Pipe Conditioning

3.21.1 Project Co will arrange for the assistance and supervision of the Chemical Supplier during pipe conditioning. A supplier representative will be present on Site during flushing, cleaning, and passivation.

3.21.2 The Chemical Supplier will review the method proposed for pipe conditioning and provide comments prior to approval by the NEU/Owner.

3.21.3 Prior to proceeding to the next step of conditioning, the Chemical Supplier must confirm satisfactory results of water analysis.

3.21.4 Upon pipe conditioning completion, the Chemical Supplier will submit a report confirming the condition of the piping network and the proper execution of the chemical cleaning and passivation.

3.22 Manual Cleaning

3.22.1 Manual cleaning will be completed for any piping section that cannot be flushed and/or cleaned as a result of configuration. Steel particulates and other solid contaminants will be removed.

3.22.2 Manual cleaning will be accomplished by scrubbing the internal surface of the piping.

3.22.3 Final cleaning will be completed with compressed air.

3.22.4 All piping that has been manually cleaned will be visually inspected and cannot be further processed (e.g. welding).

3.22.5 Any piping section that cannot undergo the chemical cleaning step as specified herein will be filled with diluted chemical as per supplier recommendation for 24 hours.

3.23 Flushing

3.23.1 Submit a flushing procedure to the NEU/Owner for review.

3.23.2 Project Co will ensure all heat exchangers, equipment, and instrumentation are bypassed or replaced by a spool piece.

3.23.3 Project Co will supply temporary means to determine flow/speed at the pump.

3.23.4 Project Co will supply a temporary strainer with a 3 mm screen and 30 mesh.

3.23.5 Install all temporary piping, hoses, and appurtenances to complete the requirements of flushing.

3.23.6 Fill the system with potable quality water and circulate the water to ensure a minimum of three (3) complete cycles of water at any location in the system. System will be flushed at the water velocity of 1.5 m/s.

3.23.7 Typical acceptable system water concentrations:

3.23.7.1 Iron less than 2 ppm;

3.23.7.2 Hardness less than 2 ppm;

3.23.7.3 Chloride levels to a maximum of 250 ppm is 316 stainless steel heat exchanger plate material is used or 50 ppm for 304 stainless steel; and

3.23.7.4 pH level of 9.5–10.

3.23.8 Flushing will be done in a sequence in accordance with the hydraulic calculations submitted to allow circulation of water in all pipes of the system.

3.23.9 Drain the system and refill with clean potable water. Continue procedure until water is visually clear.

3.23.10 Retain and test a sample of the water.

3.23.11 Take all necessary precautions to prevent damage to the pipe, insulation, or structures from the cleaning operation. Flow meters, heat exchangers, and control valves will be replaced with spool pieces.

3.23.12 Install and remove all temporary piping and support to introduce and dispose of flushing water at a safe discharge.

3.24 Cleaning

3.24.1 Project Co will ensure that all heat exchangers, equipment, and instrumentation are bypassed or replaced by a spool piece.

3.24.2 Project Co will supply temporary means to determine flow/speed at the pump.

3.24.3 Project Co will supply a temporary strainer with a 4 mm screen and 30 mesh.

3.24.4 Add the cleaning agent in the water at the specified concentration level and as per recommendation of Chemical Supplier.

3.24.5 The cleaning mixture will be circulated for a minimum of 48 hours or as required by Chemical Supplier for all pipe sections. Flow velocity of the cleaning mixture will be between 1 to 1.5 m/s.

3.24.6 Purge the system with clean potable water.

3.24.7 Repeat steps 4 to 6 as many times as required by Chemical Supplier.

3.24.8 Retain and test a sample of the water.

3.25 Passivation

3.25.1 Add chemical treatment in the water at the specified concentration level and as per recommendation of Chemical Supplier.

3.25.2 The chemical treatment will be circulated for 24 hours or as required by Chemical Supplier. Flow velocity of the chemical treatment will be between 0.5 to 1.0 m/s.

3.25.3 Project Co is responsible for achieving an iron content of 1.0 ppm at this point. If this content cannot be achieved by bleeding and increasing the chemical concentration, Project Co will repeat the pipe condition procedure.

3.25.4 Retain a sample of the final water for testing.

3.25.5 Once the passivation is completed, the concentration of chemicals within the piping system will be brought to the normal plant operation. The pipes will be maintained full of water, and a circulation of at least one complete cycle of water at any location in the system will be done 2-3 times a week.

3.26 Nitrogen Blanket

3.26.1 After the NEU/Owner deems the pipe conditioning complete, the all water will be drained in accordance with local code requirements.

3.26.2 The air will be purged to the NEU/Owner's satisfaction using nitrogen.

3.26.3 Nitrogen pressure to be maintained at 10 psi.

3.26.4 Project Co will supply and install a pressure gauge and a valve arrangement with a nitrogen filling connection and nitrogen cylinder in one building as directed by the NEU/Owner.

3.26.5 Project Co will allow for a $10,000 cash allowance for a nitrogen blanket as noted above. Project Co will note that phasing and installation of the future piping phases may or may not require the use of this nitrogen blanket. Project Co will confirm with NEU/Owner and prior to commencing pipe conditioning on Site.