LOW ACTIVITY WASTE PRETREATMENT SYSTEM

Project No. 31269 (T5L01)

Document No. 16-2-010
CSI Section 40 05 23.23

Safety Related ☒ Non-Safety Related ☐

DOUBLE CONTAINMENT PIPING for WASTE TRANSFER

Prepared for
Washington River Protection Solutions, LLC

Revision: A Status: Preliminary
## REVISION PAGE

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### REVISION SIGNATURES

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- No [ ]

### Quality Level:
- Full QA [x]  
- Enhanced QA [ ]  
- Commercial QA [ ]
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<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
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<tr>
<td>ASTM</td>
<td>ASTM International</td>
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<tr>
<td>AFC</td>
<td>Approved for Construction</td>
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<tr>
<td>AWS</td>
<td>American Welding Society</td>
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<tr>
<td>BPVC</td>
<td>Boiler &amp; Pressure Vessel Code</td>
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<tr>
<td>CGD</td>
<td>Commercial Grade Dedication</td>
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<tr>
<td>CoC</td>
<td>Certificate of Conformance</td>
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<tr>
<td>CMTR</td>
<td>Certified Material Test Report</td>
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<tr>
<td>CQA</td>
<td>Commercial Quality Assurance</td>
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<tr>
<td>CWI</td>
<td>Certified Weld Inspector</td>
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<tr>
<td>DCN</td>
<td>Design Change Notice</td>
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<tr>
<td>DCP</td>
<td>Double Containment Piping</td>
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<tr>
<td>ECN</td>
<td>Engineering Change Notice</td>
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<tr>
<td>EQA</td>
<td>Enhanced Quality Assurance</td>
</tr>
<tr>
<td>FRP</td>
<td>Fiberglass-Reinforced Polyester</td>
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<tr>
<td>FW</td>
<td>Field Weld</td>
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<tr>
<td>FQA</td>
<td>Full Quality Assurance</td>
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<tr>
<td>ID</td>
<td>Identification</td>
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<tr>
<td>IOM</td>
<td>Installation and Operation Manual</td>
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<tr>
<td>LAWS</td>
<td>Low Activity Waste Pretreatment System</td>
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<tr>
<td>MT</td>
<td>Magnetic Particle Testing</td>
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<tr>
<td>NACE</td>
<td>National Association of Corrosion Engineers</td>
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<tr>
<td>NCR</td>
<td>Nonconformance Report</td>
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<tr>
<td>NDE</td>
<td>Nondestructive Examination</td>
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<tr>
<td>NIST</td>
<td>National Institute of Standards and Testing</td>
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<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
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<tr>
<td>P&amp;ID</td>
<td>Process and Instrumentation Drawing</td>
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<tr>
<td>PFI</td>
<td>Pipe Fabrication Institute</td>
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<td>PMI</td>
<td>Positive Material Identification</td>
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<tr>
<td>PQR</td>
<td>Procedure Qualification Records</td>
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<tr>
<td>PT</td>
<td>Liquid Penetrant Testing</td>
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<tr>
<td>PWHT</td>
<td>Post Weld Heat Treatment</td>
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<tr>
<td>RFI</td>
<td>Request for Information</td>
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<tr>
<td>RT</td>
<td>Radiographic Testing</td>
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<tr>
<td>SDS</td>
<td>Safety Data Sheet</td>
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<tr>
<td>UT</td>
<td>Ultrasonic Testing</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>WPS</td>
<td>Weld Procedure Specifications</td>
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<td>WQTR</td>
<td>Welder Qualification Test Records</td>
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<tr>
<td>XRF</td>
<td>X-Ray Fluorescence</td>
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**Units**

- \( ^\circ C \) Degree Celsius
- \( ^\circ F \) Degree Fahrenheit
- in Inch
- ppm Parts Per Million

**Definitions**

**BUYER** – The company for whom the VENDOR is performing work or services.

**COMMERCIAL QUALITY ASSURANCE (CQA)** – Level of controls for those items, services, or processes where, based on an evaluation of risk or nuclear safety, no additional quality controls beyond the provider’s published or stated attributes of the item, service, or process is required.

**DESIGN CHANGE** – Within the context of this specification, a DESIGN CHANGE is technically equivalent to a SUBSTITUTION (see SUBSTITUTION). However, the term DESIGN CHANGE may be used to refer to more significant changes to the design compared to a simple substitution.

**DEVIATION** – Any departure from the requirements contained in the purchase order and specification which VENDOR proposes to incorporate if approved by BUYER.

**ENHANCED QUALITY ASSURANCE (EQA)** – Level of controls for those items, services, or processes where, based on an evaluation of risk or nuclear safety, additional controls beyond the provider’s published or stated attributes of the item, service, or process are needed to verify critical attributes.

**FULL QUALITY ASSURANCE (FQA)** – Level of controls applied for items services, or processes that are commensurate with the controls invoked under ASME NQA-1 or other appropriate national consensus standard.
HANDLING – The movement or transportation of items following receipt from offsite/project locations. This includes movement within storage areas and movement/transportation from receipt or storage areas to field locations. Handling requirements include the need for special handling tools and equipment, restrictions on material composition of surfaces in contact with the item, protection against damage or deterioration, which could occur during movement and placement, protection against physical damage due to excessive shock or vibration, and protection against entry of dirt, water, or other contaminants.

HOLD POINT – A mandatory inspection activity beyond which work shall not proceed until (1) the inspection is performed by an independent inspector and/or BUYER and acceptance is authenticated, or (2) a written release is authorized by the organization who established the hold point.

MANUFACTURER – The party responsible for making the product.

MORE CONSERVATIVE – “More conservative” shall be interpreted as “more protective of the health, safety and well-being of Site workers and facilities, the public, and environment, as applicable.”

NONCONFORMANCE – a deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate.

PRESSURE-CONTAINING COMPONENTS – Items that form the pressure-containing envelope of the piping system.

PROCUREMENT QUALITY CLAUSES (QA CLAUSES) - Procurement quality clauses are to be used for the acquisition of items and services. The clauses establish contractual obligations for quality program systems, identification, traceability, documents submittals, testing, reporting, qualification, special process controls, inspections, etc.

PRODUCT DATA – Printed information including, but not limited to, catalog cuts, color charts, illustrations, diagrams, templates, performance curves, brochures, and other forms of Product literature.

QUALITY ASSURANCE RECORDS – Quality assurance plans, procedures, and records, including completed documents that furnish evidence of the quality of an item or activities affecting quality.

SHALL / MUST – Denotes project requirements, compliance is required

SHIPPING – The movement of items from an off-site/project location (VENDOR, warehouse, etc.) to an on-site/project location, or movement from an onsite/project location to an off-site/project location. Shipping requirements include packaging and securing of items to protect against damage or deterioration which could occur during movement and transportation, protection against physical damage due to excessive shock or vibration, protection against entry of dirt, water, or other contaminants, and protection against other environmental conditions such as temperature or humidity.
SHOULD – Denotes recommendation or expectation, compliance is expected.

SPECIFICATION – Refers to any design, fabrication or supply specification.

STORAGE – Holding of items in areas that address: the probable maximum period to be held, the inherent physical limitations of the item itself, and required protection from potential hazards such as fire, corrosion, chemical attack and environmental conditions. Storage also includes the requirements for maintaining the integrity and operability of items through routine maintenance, cleaning, or other means of preservation.

SUBSTITUTION – Any change or deviation from issued approved drawings, designs, methods, or contract terms and conditions. Changes in products, materials, equipment, methods of construction, and test criteria required by the Contract Documents proposed by the VENDOR after award of the Contract are considered to be requests for substitution.

VENDOR – The Company responsible for the supply of equipment or services.

WITNESS POINT – An inspection activity beyond which work shall not proceed until an inspector and/or BUYER is notified and (1) the inspection is performed and released, or (2) the inspection is deferred and can be completed at a later time, or (3) a written waiver is issued by the organization who established the witness point.
1.0 PART 1 – GENERAL

1.1 Section Scope

1.1.1 This specification establishes the following minimum requirements for double containment piping (DCP) systems. This specification includes requirements for:

1.1.1.1 The procurement of piping components as specified in the purchase order and/or as shown on contract drawings

1.1.1.2 The furnishing, receiving, storing, handling, fabricating, assembling, cleaning, filling, flushing, examining, inspecting, and testing of piping

1.1.1.3 The surface preparation, application and inspection of protective coatings

1.1.1.4 Insulation materials, storage and handling of materials, insulation application, extent of insulation and documentation

1.1.2 This specification does not address the requirements for the following:

1.1.2.1 Non-double containment piping systems

1.1.2.2 Site services and installation or operation of equipment

1.1.2.3 Leak detection system

1.1.2.4 Non-pipe components (excluding pipe supports)

1.1.3 This specification shall be used in conjunction with ASME B31.3 and other referenced codes and standards.

1.1.4 It is not the BUYER’s intent to specify all technical requirements or to set forth those requirements adequately covered by applicable codes and standards.

1.1.5 In case of a conflict between the purchase order and this specification and its references, the order of precedence is as follow:

1.1.5.1 Requirements of the purchase order

1.1.5.2 This specification

1.1.5.3 References in this specification

1.1.6 The BUYER shall be advised immediately in writing of any conflicts as soon as they are identified.
1.1.7 No material substitutes or deviations shall be made to this specification without written approval from the BUYER. All substitutions and deviations shall be submitted to the BUYER for resolution via the request for information (RFI) process in accordance with CSI Section 01 25 00 “Substitutions and Design Changes”. If differences exist between the drawings, the specifications, or the referenced codes and standards, the BUYER shall be contacted to resolve the conflict. The BUYER’s final resolution shall govern.

1.1.8 The VENDOR shall not prepare pipe spool or fabrication drawings until drawings designated “APPROVED FOR CONSTRUCTION” (AFC) are received.

1.1.9 The VENDOR is not authorized to begin fabrication until the VENDOR’s drawings are reviewed and approved by the BUYER.

1.1.10 The VENDOR’s drawings will be reviewed as requested by the BUYER. The BUYER’s review will not relieve the VENDOR of the responsibility for either the accuracy of the VENDOR’s drawings or compliance with this specification and the referenced drawings.

1.1.11 The VENDOR will be furnished copies of isometric drawings prepared by the BUYER’s Engineer. Computer format isometric files may be provided, but record AFC isometric drawings shall be followed.

1.1.12 The scope of the VENDOR’s work for shop fabrication includes the following:

1.1.12.1 Fabricating all piping in accordance with the requirements of this specification

1.1.12.2 Furnishing all labor, supervision, tools, equipment and consumable materials required to perform all work specified herein

1.1.12.3 Procuring, handling, protecting and maintaining records or accounting of all materials required to complete the fabrication of pipe

1.1.12.4 Preparing dimensioned spool drawings, which shall be extracted from piping isometrics when provided by the BUYER’s Engineer

1.1.12.5 Fabrication of pipe spools, including installation of all welded pipe supports and any other structural attachments shown on the engineering drawings as complete as practical to minimize field work

1.1.12.6 Performing nondestructive examinations (NDE) for welds and bends as required by this specification

1.1.12.7 Performing wall thickness verification for all carrier piping

1.1.12.8 Performing shop leak testing of carrier pipe spools (if required) in accordance with ASME B31.3 as required by this specification

1.1.12.9 Providing cleaning and identification of piping

1.1.12.10 Providing weld end prep for both carrier and containment piping

1.1.12.11 Applying protective coating, insulation, and insulation jacketing to surfaces of the containment piping after fabrication, as required by this specification
1.1.12.12 Perform holiday testing on the applied protective coating
1.1.12.13 Providing and installing temporary protective covers
1.1.12.14 Providing packaging, crating, loading and shipping of fabricated spools and loose components with associated spool drawings

1.1.13 The scope of the VENDOR’s work for field fabrication includes the following:

1.1.13.1 Receiving, handling and storing all piping spools and loose components as provided by the shop fabricator
1.1.13.2 Assembling and erecting all piping in accordance with the requirements of this specification
1.1.13.3 Performing leak testing and NDE for remaining welds not examined in the shop, including field welds, as required by ASME B31.3 and this specification
1.1.13.4 Performing Positive Material Identification (PMI) for the carrier piping and pressure testing of containment piping in accordance to ASME B31.3 and this specification
1.1.13.5 Applying protective coating, insulation, and insulation jacket to the remaining system after weld examination, holiday testing, and satisfactory leak testing

1.2 Related Sections

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<tr>
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<td>Substitutions and Design Changes</td>
</tr>
<tr>
<td>01 33 00</td>
<td>Submittals</td>
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<td>01 40 00</td>
<td>Quality Assurance</td>
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<td>Labeling</td>
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<td>01 66 00</td>
<td>Delivery Storage and Handling</td>
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<tr>
<td>31 23 00</td>
<td>Excavating, Backfilling and Compaction for Utilities</td>
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<tr>
<td>40 05 00.11</td>
<td>Piping Materials Specification</td>
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<tr>
<td>40 05 05.33</td>
<td>Pipe Welding</td>
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<tr>
<td>40 46 00</td>
<td>Piping Protective Coatings</td>
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1.3 Codes and Standards

1.3.1 Work shall be performed in accordance with the referenced codes, standards and documents for this specification.

1.3.2 The following documents, of the exact issue shown, form a part of the basis of design to the extent specified in the applicable sections of this document and establish the Codes of Record. In the event of a conflict between documents referenced herein and the requirements of this specification, the requirements of this specification shall take precedence only when this specification's requirements are more stringent or conservative. If the Code date is not defined, apply the latest Code as of April 16, 2015.
1.3.3 Government Documents

1.3.3.1 Occupational Safety and Health Administration (OSHA)

A. 29 CFR 1910

1.3.4 Non-Government Documents

1.3.4.1 American Petroleum Institute (API)

A. API Recommended Practice 578 (2010); Material Verification Program for New and Existing Alloy Piping Systems

1.3.4.2 American Society of Mechanical Engineers (ASME)

A. ASME B16.9 (2012); Factory-Made Wrought Buttwelding Fittings
B. ASME B31.3 (2012); Process Piping
C. ASME B36.10M (2004), Welded and Seamless Wrought Steel Pipe
D. ASME B36.19M (2004); Stainless Steel Pipe
E. ASME Boiler and Pressure Vessel Code, Section IX (2013); Welding, Brazing, and Fusing Qualifications: Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators
F. ASME Boiler and Pressure Vessel Code, Section V (2013); Nondestructive Examination
G. ASME NQA-1 (2008/2009A); Quality Assurance Requirements for Nuclear Facility Applications

1.3.4.3 American Welding Society (AWS)

A. AWS A2.4 (2012); Standard Symbols for Welding, Brazing, and Nondestructive Examination

1.3.4.4 ASTM International (ASTM)

A. ASTM A380 (2013); Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
C. ASTM C929 (2014); Standard Practice for Handling, Transporting, Shipping, Receiving and Application of Thermal Insulation Materials for Use in Contact with Austenitic Stainless Steel
E. ASTM D1622 (2014); Standard Test Method for Apparent Density of Rigid Cellular Plastics
F. ASTM D5162 (2015); Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
G. ASTM D6226 (2015); Standard Test Method for Open Cell Content of Rigid Cellular Plastics


1.3.4.6 Pipe Fabrication Institute (PFI)
   A. PFI ES-3 (2009); Fabricating Tolerances
   B. PFI ES-5 (2013); Cleaning of Fabricated Piping
   C. PFI ES-24 (2013); Pipe Bending Methods, Tolerances, Process and Material Requirements

1.4 System Description

1.4.1 The DCP system shall consist of a stainless steel carrier pipe (safety significant) inside a carbon steel containment pipe (general service) with appurtenances as shown on the design drawings. Piping shall comply with CSI Section 40 05 00.11 “Piping Materials Specification” specification designations P7 and P8, respectively.

1.4.2 Epoxy coating and rigid foam insulation shall be applied to the exterior of the containment piping with a final insulation jacket, as indicated on the design drawings.

1.4.3 The DCP shall be shop fabricated as complete as practical and supplied as piping spools in order to minimize field fabrication. Field welds shall be as shown on the BUYER supplied design drawings. Spools shall be suitable for transport by truck.

1.4.4 Shop generated drawings shall be used to install the pipe spools in the field.

1.5 Submittals

1.5.1 Submittals that are listed within the section shall be prepared and processed in accordance with requirements of CSI Section 01 33 00 “Submittals” and shall include all of the required Quality Assurance documentation in accordance with CSI Section 01 40 00 “Quality Assurance”.

1.5.2 Requests for Information (RFI) shall be submitted on form A-6003-417 (provided by BUYER).

1.5.3 Final Data Package submittal items (per spool) listed in section 1.5.6 through 1.5.31 below shall be submitted by the VENDOR and approved by the BUYER prior to release for shipment (or for site construction, upon completion of work).

1.5.4 Design Codes and standards including revision and/or issue date shall be provided by the VENDOR.

1.5.5 A quality system for materials specifying testing per ASME shall be provided in accordance with QA Clause B10.
1.5.6 Calibration certificates for VENDOR owned test instruments and measuring tools that will be used during fabrication, inspection, and testing in accordance with QA Clause B12.

1.5.7 A fabrication, inspection, and test plan, including a cleaning procedure, shall be provided (for inspections and tests specified herein) in accordance with QA Clause B13.

1.5.8 ASME B31.3 design calculations shall be performed by the VENDOR for items such as branch reinforcement and unlisted components in accordance with QA Clause B18.

1.5.9 Nonconformance documentation and reports (NCR) shall be provided in accordance with QA Clause B22. NCRs dispositioned as “use-as-is” or “repair” shall be submitted prior to component final acceptance.

1.5.10 Certified Weld Inspector (CWI) records shall be provided in accordance with QA Clause B25.

1.5.11 Welding Procedure Specifications (WPS), Procedure Qualification Records (PQR) and Welder Qualification records shall be provided in accordance with QA Clause B28. Procedures as well as welder continuity records shall be qualified in accordance with ASME B31.3, Para. 328.2 and ASME Boiler & Pressure Vessel Code (BPVC) Section IX Form QW-482.

1.5.12 Bending procedures, which includes forming temperatures, procedures for heat treatment after bending and inspection procedures, shall be submitted by the VENDOR.

1.5.13 An outline of welding procedures, heat treatment and nondestructive examination (NDE) shall be included for each pipe material class. The outline shall follow the format of CSI Section 40 05 05.33 “Pipe Welding,” Appendix B - Weld Procedure Log for Piping or a BUYER pre-approved substitute.

1.5.14 NDE process, NDE personnel, and Records of Annual Vision Tests shall be provided in accordance with QA Clause B31. NDE includes the following:

1.5.14.1 Nondestructive inspection reports and evaluations of radiographic film, magnetic particle examinations, ultrasonic examinations, visual examinations and any other examinations performed by the VENDOR.

1.5.14.2 Radiographic evaluations shall show date, line number, weld identification number, developed (exposed) radiographic film originals and other pertinent information (i.e., image quality indicators, penetrometers, etc.) for each weld radiographed.

1.5.14.3 Minimum wall thickness measurements, including sampling plan, reports containing each heat/lot along with sample results per this specification.

1.5.14.4 Hydrostatic/Pneumatic/PMI Test personnel Qualifications

1.5.15 All components shall be identified and traceable in accordance with QA Clause B37.

1.5.16 Liquid Penetrant Material Certification shall be provided in accordance with QA Clause B46.
1.5.17 Certified Material Test Reports (CMTR's) shall be provided for all carbon and stainless steel components that provide containment in accordance with QA Clause B49. CMTR's for weld rod/filler material and anchor plates shall be provided for FQA items only.

1.5.18 The following inspections and test reports shall be provided in accordance with QA Clause B52:

1.5.18.1 Weld inspection and NDE inspection reports
1.5.18.2 Weld maps and weld history
1.5.18.3 Weld gas certificates of analysis - % purity
1.5.18.4 Records of PWHT for welds, including temperature charts identifying each piece number and line number, set point temperature and holding time, a description of the equipment used, and calibration dates of thermocouples and the recorder.
1.5.18.5 Record of joint repairs (including date, extent of repairs, and responsible individual)
1.5.18.6 Cleaning and inspection of cleaning reports, including:
   A. Date and name of VENDOR and responsible individual.
   B. Inspection or examination records.
   C. Cleaning methods.
   D. Certification of visual examination for surface preparation, surface profile, materials.
   E. Humidity data, temperature data and coating total Dry Film Thickness data of coating, including holiday test results, pinhole repairs, etc.
   F. A ppm halogen content test analysis.
1.5.18.7 Final inspection reports including critical dimension verification and weight
1.5.18.8 PMI reports and documentation
1.5.18.9 Pressure test records
1.5.18.10 VENDOR shall provide a chemical analysis report, per ASTM C871, for all insulation.

1.5.19 Final fabrication travelers shall be provided for each component.

1.5.20 All piping components furnished by the VENDOR shall conform with QA Clause B70.

1.5.21 Certification against the procurement of potentially suspect or counterfeit items (i.e. all supplied materials shall be genuine, new and unused), in accordance with QA Clause B76.

1.5.22 Certificates of Conformance (CoC) shall be provided for all carbon and stainless steel components, coating and insulation in accordance with QA Clause B79.

1.5.23 For safety (FQA) items, the VENDOR shall be NQA-1 qualified.

1.5.24 Packing and shipping procedures shall be provided in accordance with QA Clause B85.
1.5.25 Direct drop shipment shall be provided for procurement of all ASME materials in accordance with QA Clause B88.

1.5.26 Copies of waivers granted by the BUYER to deviate from requirements of the purchase order or this specification shall be included with the piping materials at shipment.

1.5.27 VENDOR shall submit technical data sheets and Safety Data Sheets (SDS) for non-metallic components such as surface coatings, insulation and all such materials being provided. Identification of age control items shall be in accordance with QA Clause B43.

1.5.28 Installation and Operation Manuals (IOM) shall be provided and shall include the following:
   1.5.28.1 Installation instructions for split encasement in the field
   1.5.28.2 Commissioning and startup instructions including any special instructions for heating the insulation to its operating temperature for the first time
   1.5.28.3 Instructions shall be provided for removing and reinstalling any removable insulation components
   1.5.28.4 Detail drawings for insulation installation including details depicting how insulation and insulation jacketing will be installed on straight pipe, bends, fittings, equipment and other components
   1.5.28.5 A list of all materials to be used in the insulation installation

1.5.29 Procedures for mixing of coatings, mastic, cement and all other compounds requiring mixing shall be provided by the VENDOR.

1.5.30 VENDOR shall submit approved design changes (Engineering Change Notice’s (ECN’s) and Design Change Notice’s (DCN’s)) per BUYER’s procedures.

1.5.31 VENDOR shall provide shop spool/as-built drawings that, as a minimum, show the following:
   1.5.31.1 Location of all field welds identified as "FW" (Field Weld).
   1.5.31.2 Location and identification number of all shop welds, including weld symbols in accordance with American Welding Society (AWS) A2.4.
   1.5.31.3 Line Number and Shop Weld Number. Shop welds examined by NDE shall be added to the drawing after completion of NDE.
   1.5.31.4 Piece numbers, line numbers and flow direction arrows as identified on piping drawings.
   1.5.31.5 Weld end preparation details.
   1.5.31.6 Heat and lot number or some type of approved code number that provides traceability for materials requiring Certified Material Test Reports (CMTR’s).
   1.5.31.7 Location of hanger lug attachments, etc.
1.5.31.8 Bill of Materials.
1.5.31.9 Pipe spool dimensions, assembly weight and pressure testing pressure.
1.5.31.10 Applicable Code and PWHT.
1.5.31.11 Reference notes, specifications and drawings.
1.5.31.12 WPS

1.6 Delivery, Storage, and Handling

1.6.1 Refer to related CSI Section 01 66 00 “Delivery, Storage and Handling” for general delivery, storage and handling related requirements in addition to the requirements of this section.

1.6.2 Piping Components

1.6.2.1 All materials shall be shipped, handled and stored in a manner that will eliminate carbon to stainless steel contact, corrosion, foreign material and prevent damage to pipe and piping components including their end connections.

1.6.2.2 Weld preps shall be protected with covers that will prevent damage to the weld preps during shipment and handling.

1.6.2.3 Covers shall be either wood or plastic bolted, snapped or wired on covers.

1.6.2.4 Self-fastening plastic covers are acceptable.

1.6.2.5 Covers and seals containing fluorides, chlorides, sulfur, lead, zinc, copper and mercury are not allowed on stainless steel piping ends.

1.6.2.6 Protect uncoated ends of carbon steel piping.

1.6.2.7 Austenitic stainless steel shall be sealed in plastic or otherwise completely protected from exposure to ocean and road salt during shipment (salt water, salt water spray, mist etc.). In the event that piping components may have become exposed to salt they shall be washed with water having chloride content no greater than 50 ppm and then thoroughly dried.

1.6.2.8 When these piping components must be stored outdoors, they shall be stored on wooden pallets and covered with black polyethylene sheeting to the satisfaction of the BUYER.

1.6.2.9 Pipe shall be supported with cribbing as necessary to comply with CSI Section 01 66 00 requirements for shipping.

1.6.2.10 Piping shall be covered during shipping as specified by CSI Section 01 66 00.
1.6.3 Insulation

1.6.3.1 Mastics, adhesives, and sealers that are exposed to temperatures outside the recommended temperature ranges during storage shall be removed from the site and replaced with new material.

1.6.3.2 Furnish, store and protect from weather all insulating and jacketing materials and any other miscellaneous accessories that are either required by this specification or necessary to completely insulate all items listed in this specification.

1.6.3.3 To prevent contamination with chlorides materials shall be shipped, stored and handled in accordance with ASTM C929.

1.6.4 The following requirements supplement the requirements in CSI Section 01 60 00 “Labeling”:

1.6.4.1 To facilitate identification and assembly in the field, each pipe spool shall be conspicuously marked on the outside surface of each end with the spool piece number as identified on the isometric drawing.

1.6.4.2 The identification numbers shall be permanently attached text, number or bar code adhesive labels for shop traceability. Crayon markings are not permissible, except for temporary markings. Other forms of labels shall be approved by the BUYER.

1.6.4.3 All materials (including adhesives) contacting austenitic stainless steel and nonferrous alloy surfaces shall comply with CSI Section 01 60 00 and shall contain less than 50-ppm chlorides. Markings shall not be water soluble.

1.7 Quality Assurance

1.7.1 Applicable Procurement Quality Clauses are summarized in the table below. The full QA Clause definition and associated requirements are located in CSI Section 01 40 00.

Table 1.7.1-1 Procurement Quality Clause

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<thead>
<tr>
<th>SUPPLIER FABRICATION</th>
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<td>B12 Supplier Use of Calibrated Equipment</td>
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<td>B13 Fabrication/Inspection/Test Plan</td>
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<td>B16 Source Inspection</td>
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<td>B18 Supplier Use of Spreadsheet Calculations Using Commercial-Off-The-Shelf Software</td>
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<td>B22 Nonconformance Documentation and Reporting</td>
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<td>B25 Certified Weld Inspector (CWI)</td>
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### B31 Nondestructive Examination Process

#### MATERIAL IDENTIFICATION

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#### TESTING AND TEST DATA

<table>
<thead>
<tr>
<th>B46 Liquid Penetrant Material Certification</th>
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<td>B49 Certified Material Test Report</td>
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#### INSPECTION AND ACCEPTANCE CRITERIA

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#### MATERIAL HANDLING

<table>
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<th>B85 Packaging/Shipping Procedures</th>
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1.7.2 There are multiple quality assurance levels applied within this document.

1.7.2.1 For Commercial Quality Assurance (CQA) level items all requirements addressed within this specification apply as applicable with the exception of “Safety Significant” or “Carrier Piping” labeled requirements. CQA level items include:

A. Containment Piping Components
B. Exterior Coating
C. Insulation and Insulation Jacket

1.7.2.2 For Full Quality Assurance (FQA) level items all requirements addressed in this specification apply including all additional requirements such as cleaning, PMI and wall thickness verification which are labeled as “Safety Significant” or “Carrier Piping”. The VENDOR shall meet the applicable requirements of ASME NQA-1. FQA level items include:

A. Carrier Piping Components
B. Piping Supports

1.7.3 Hold Points

1.7.3.1 The following verification points required by this section shall be in accordance with CSI Section 01 40 00 and verified by the BUYER, as applicable.
1.7.3.2 At a minimum, the following witness and hold points shall apply:

Table 1.7.3.2-1: Hold Point Verification

<table>
<thead>
<tr>
<th>Verification Point Description</th>
<th>Type of Verification</th>
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<tr>
<td>Prior to Initial Production Welding (First Weld*)</td>
<td>H</td>
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<tr>
<td>Prior to Shop Bends</td>
<td>H</td>
</tr>
<tr>
<td>Prior to Testing*</td>
<td>W</td>
</tr>
<tr>
<td>Prior to Inspections*</td>
<td>W</td>
</tr>
<tr>
<td>Prior to Shipping</td>
<td>H</td>
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</tbody>
</table>

*First Weld Strike for Each Weld

(H) Hold,
(W) Witness Procedure

*Verification for Test and Shipping is applicable for both Shop and Field work.

1.7.3.3 The VENDOR shall provide required notifications of verification points in accordance with Specification CSI Section 01 40 00 as applicable, and shall not proceed past required hold points without written authorization from the BUYER QA representative.

1.7.3.4 The BUYER's Inspector shall be notified in advance of shipment. The shipment shall be placed on hold until BUYER's Inspector:

A. Performs a walk-down to verify that the work is in accordance with the Piping and Instrumentation Diagrams (P&IDs), drawings and this specification.
B. Verifies marking and identification is in accordance with marking and identification requirements.
C. Visually examines items that are accessible without disassembly for general workmanship, cleanliness and quality.
D. Verifies PMI and all applicable manufacturing records/documentation are in accordance with this specification.
E. Verifies packaging and shipping preparation to ensure compliance to this specification.
F. Verifies that each component of the packing list is included in the shipment.

1.7.3.5 Source inspections will be performed in accordance with QA Clause B16.

1.7.3.6 The VENDOR shall have a qualified ASME NQA-1 quality program.

1.8 Site Conditions

1.8.1 Refer to CSI Section 01 66 00 Site Conditions section.
2.0 PART 2 - PRODUCTS

2.1 Manufacturers

2.1.1 Materials which are specified by manufacturer and/or proprietary name on engineering datasheets or specified herein are so specified only for the purpose of establishing the type and standard of quality required. The manufacturer and/or proprietary names do not preclude the use of BUYER-approved substitutes. Where names of manufacturers are listed, the order of listing is not indicative of an order of preference. All substitutions shall be per CSI Section 01 25 00. Requests for substitutes shall be accompanied with manufacturer's catalog data.

2.2 Materials

2.2.1 All materials shall be new and shall be used before the expiration date. Materials that have exceeded shelf life and dates shall be removed from the site and replaced with new material.

2.2.2 All materials shall be asbestos-free, noncorrosive, compatible with adjacent materials and used in accordance with the manufacturer's recommendations.

2.2.3 Materials used shall meet or exceed the requirements specified herein. Any additional materials which may be required, but which are not described hereinafter, will be subject to the BUYER's approval.

2.2.4 All carrier and containment pipe and piping components shall be furnished in accordance with the requirements stated in the applicable material classes found in CSI Section 40 05 00.11 and this specification.

2.2.5 Pipe supports, guides and anchors shall be furnished in accordance with the requirements in H-16-000410, "Double Contained Piping Standard Details."

2.2.6 Coating for the containment piping exterior shall be 20.0 minimum DFT (mils) Fusion Bonded Epoxy in accordance with CSI Section 40 46 00.

2.2.7 Insulation shall be 2 in. thick closed cell polyurethane foam-in-place 2-component system or spray-on foam with the following physical properties. Pre-molded ridged-polyurethane insulation sections are not permitted.

2.2.7.1 Minimum Density (lb./cu. ft.): 2.1 at 74°F per ASTM D1622

2.2.7.2 85-95% closed cells at 74°F per ASTM D6226

2.2.7.3 Maximum “k” factor (Btu in./hr.. sq. ft. °F at 75°F): 0.13 per ASTM C177

2.2.7.4 Minimum compressive strength (lb./sq. in.) at 74°F: 25 (parallel to rise) and 17 (perpendicular to rise) per ASTM D1621
2.2.8 Insulation jacketing shall be 200-mils thick Fiberglass-Reinforced Polyester (FRP) casing with a waterproof resin-rich liner. The amount, type, and orientation of individual glass fibers in the jacket shall be adequate for resistance to piping stresses from a site outdoor air temperature. Waterproof shrink sleeves shall be provided for field joints.

2.3 Equipment

2.3.1 NOT USED

2.4 Components

2.4.1 NOT USED

2.5 Fabrication

2.5.1 Segregation of carbon steel and stainless steel shall be maintained throughout the welding and fabrication process. Tools used for carbon steel shall not be used for stainless steel fabrication unless proper methods have been executed to prevent carbon contamination. Keep piping systems clean and dry.

2.5.2 Refer to the Shop Quality Control section of this specification for examination and testing requirements.

2.5.3 Welded Joints

2.5.3.1 All welding shall be performed in accordance with ASME B31.3, CSI Section 40 05 05.33 and the requirements of this specification.

2.5.3.2 The Weld Procedure Log in CSI Section 40 05 05.33 shall be completed by the VENDOR.

2.5.3.3 All welding under this specification shall be placed on hold until the WPS, PQRs and Welder Qualification Test Records (WQTRs) have been approved by the BUYER’s Engineer.

2.5.3.4 The carrier piping shall be protected from containment piping weld splatter by a BUYER approved method.

2.5.3.5 Finished pipe spools shall have both the carrier pipe and containment pipe ends machine beveled in accordance with ASME B31.3.

2.5.3.6 Unless noted otherwise on the isometric drawing, field fit up welds shall include 6” of piping beyond the length required to meet dimensions shown on the isometric drawings.

2.5.3.7 Spools shall be furnished with 6” of carrier piping exposed at each end of the piping spool in accordance with H-16-000410.
2.5.3.8 The VENDOR shall supply materials and installation instructions for split encasement in the field.

2.5.3.9 Refer to CSI Section 40 05 05.33 for requirements for weld defects.

2.5.4 Piping Supports

2.5.4.1 The carrier piping shall be aligned and supported within the containment piping with pipe guides or pipe supports, as shown on the isometric drawings.

2.5.4.2 Supports which are located on AFC drawings shall not be relocated or reoriented without the BUYER's approval.

2.5.4.3 Supports, guides and anchors shall be fabricated as shown in H-16-000410.

2.5.4.4 Supports, guides and anchors shall be designed to allow for continuous airflow and draining of the containment piping

2.5.4.5 All weldments of supports to piping shall be made prior to PWHT.

2.5.5 Surface Finish

2.5.5.1 Repair of base metal shall be allowed only with prior written authorization by the BUYER.

2.5.5.2 The VENDOR shall be responsible for surface finish after the repair of weld defects. Remove weld splatter, sharp edges, corners, projections, pits, scratches, or other sharp depressions and surface irregularities.

2.5.5.3 The surfaces shall be ground if necessary, to eliminate irregularities that can obscure or confuse the interpretation of imperfections.

2.5.5.4 Blend grinding is permitted as long as the metal wall thickness is not reduced to less than that permitted in the applicable ASTM standard, without BUYER's approval. Repairs shall be made in accordance with the qualified welding procedures with PWHT as required per ASME B31.3.

2.5.6 Fabrication Tolerance and Alignment

2.5.6.1 Unless otherwise specified, dimensions of all shop fabricated piping shall be within the tolerances specified in Pipe Fabrication Institute (PFI) Standard ES-3 and the BUYER's Drawings.

2.5.6.2 All piping shall be plumb and square. Unless otherwise specified, the internal misalignment of ends to be joined shall not exceed the lesser of 1/16 inch or as permitted by the WPS. Where misalignment exceeds the permitted misalignment, the end of the thicker pipe shall be bored in accordance with Paragraph 328.4.3 of ASME B31.3.
2.5.6.3 Templates, pantographs, or other suitable methods shall be used in laying out stub-ons, laterals, and other irregular details to ensure accurate cutting and proper fit-up. Caution shall be used in fitting up pipe and components for tack welding, to ensure a proper gap for full-penetration welds.

2.5.7 Pipe Bending and Forming

2.5.7.1 Pipe bending, forming, and tolerances shall conform to the requirements of PFI ES-24 and ASME B31.3.

2.5.7.2 Bends identified on the drawings shall be formed with the radii specified.

2.5.7.3 Pipe bend shall be checked for thinning in the extrados of the bend by the VENDOR. Thinning shall not exceed the minimum wall thickness per ASME B31.3.

2.5.7.4 All bends shall be placed on hold and approved by the BUYER prior to commencement of fabrication, and the VENDOR shall submit a bending procedure which includes forming temperatures, procedures for heat treatment after bending and inspection procedures.

2.5.7.5 Tolerances for dimensions of pipe bends shall be in accordance with PFI ES-24.

2.5.7.6 All bends shall be induction bent per Paragraph 332 of ASME B31.3. Where induction bends are not practical cold bends shall be utilized per Paragraph 332 and 304.2.1 of ASME B31.3. No alternates or substitutions will be allowed without prior written approval of the BUYER. Use methods and equipment that produce bends free of wrinkles, bulges or kinks.

2.5.8 Heat Treatment

2.5.8.1 Preheating and PWHT of welding zones, bends and hot-formed sections shall be in accordance with ASME B31.3, CSI Section 40 05 05.33, and the requirements of this specification.

2.5.8.2 All spools shall be checked for dimensions and alignment after heat treatment. Pipe shall also be checked for straightness. Deviation from a straight line shall not exceed 0.2 percent of the length. Piping shall be replaced if pipe is not straight.

2.5.8.3 After all hot bending, welding, grinding and heat-treating operations have been completed the threads shall be "chased" with the appropriate size pipe tap to remove scale and weld spatter, and to ensure full engagement of threads and a tight joint.

2.5.9 Cleaning

2.5.9.1 All piping shall have loose foreign material such as scale, sand, weld spatter particles, cutting chips, etc., removed from the inside of piping assemblies and supports per PFI Standard ES-5. Cleaning solvents for stainless steel piping shall be non-halogenated solvents or potable water containing no more than 50-ppm chloride.
2.5.9.2 Cleaning acceptance criteria for the carrier piping shall be class C in accordance with ASME NQA-1, Part II, Subpart 2.1, Para. 302.3. Stainless steel piping components shall be cleaned, de-scaled and passivated in accordance with ASTM A380.

2.5.9.3 Use new mechanical cleaning tools (e.g. grinding wheels or tools utilized for cleaning austenitic stainless steel or nickel alloys shall not be previously used on carbon steels). Wire brushes, steel wool or similar items or tools for conditioning and cleaning surfaces shall be made from 300 series stainless steel.

2.5.9.4 Stainless steel components shall not be blasted with reclaimed sand or grit.

2.5.9.5 A cleaning procedure shall be submitted for approval before fabrication.

2.5.9.6 The carrier piping shall be cleaned prior to installation into the encasement pipe. The complete pipe-in-pipe assembly shall be protected to prevent contamination of the carrier piping for shipping and storage.

2.5.9.7 Visually examine cleaned system components and parts to verify cleanliness requirements are met and record results in a cleaning report.

2.5.10 Coating

2.5.10.1 To the extent possible, the VENDOR shall perform all surface preparations and coating application in accordance with CSI Section 40 46 00.

2.5.10.2 The exterior of the containment piping shall be fusion bonded epoxy coated.

2.5.10.3 Surface preparations and coating applications shall be in strict accordance with the coating manufacturer’s recommendations, SDS, and the requirements herein. BUYER reserves the right to inspect surface preparations and coating applications at any time.

2.5.10.4 Chlorinated solvents shall not be used with stainless steel during the surface preparation procedure.

2.5.10.5 All piping and spool identification marking shall be transferred back onto the pipe after application of the coating.

2.5.10.6 Coating shall not be applied to the internal surfaces of pipe, to the exterior of the carrier piping, or within 5 inches of any expected field welds. These surfaces shall be wrapped prior to the application of coatings to protect them from overspray.

2.5.10.7 Welded joints shall not be coated until non-destructive examination and pressure testing have been completed, unless otherwise approved by the BUYER.

2.5.10.8 Coating shall be 100% inspected by a National Association of Corrosion Engineers (NACE) Level 2 Coating Inspector for holidays, pinholes and discontinuities in accordance with ASTM D5162 and the coating manufacturer’s instructions prior to installation of the insulation and jacketing. Documentation shall be submitted by the VENDOR.
2.5.11 Insulation and Insulation Jacket

2.5.11.1 To the extent possible, the VENDOR shall perform installation of insulation materials in such a manner that the insulation and insulation jacket shall be free from hot spots, blisters and discoloration in accordance with the requirements of this specification and per manufacturer’s recommendations.

2.5.11.2 All surfaces which are to be insulated shall be cleaned of dirt, grease and other similar foreign matter and shall be dry prior to the application of insulation.

2.5.11.3 Insulation shall be applied to the containment piping after the application of coating. Insulation shall be held back 6 to 9 inches from any expected field welds. Welded joints shall not be insulated until non-destructive examination and pressure testing have been completed, unless otherwise approved by the BUYER.

2.5.11.4 All insulation shall be protected from moisture and weather before and during installation. The insulation jacket shall not be installed over wet insulation. Wet insulation shall be discarded.

2.5.11.5 Insulation shall be a foam-in-place 2-component system or pour/spray. Procedure for application of insulation, examination/testing and repair of voids shall be submitted to the BUYER for approval prior to installation of insulation.

2.5.11.6 Installed insulation shall be examined for voids. Voids greater than or equal to ½” are unacceptable and shall be repaired.

2.5.11.7 A FRP insulation jacket shall be installed to protect the insulation from damage during handling, shipment, outside storage and installation as well as provide a waterproof barrier at final installation.

2.6 Shop Quality Control

2.6.1 All work associated with this specification shall be performed in accordance with the quality control requirements specified in the contract documents and CSI Section 01 40 00.

2.6.2 The VENDOR shall be responsible for ensuring that all applicable requirements set forth in CSI Section 40 05 00.11 and this specification have been satisfied.

2.6.3 VENDOR shall maintain a nonconformance program. Nonconforming material shall be physically segregated from acceptable items when possible and shall be in strict accordance to the Quality Assurance section of this specification.

2.6.4 The VENDOR shall be responsible for performing all examinations, inspections, tests, and repairs of welds in accordance with ASME B31.3, CSI Section 40 05 05.33, and this specification.

2.6.5 ASME examination personnel shall provide certification per ASME BPVC Section V, and the requirements of B31.3, Para. 342.
2.6.6 All weld examinations shall be performed in accordance with CSI Section 40 05 05.33. Examination of the carrier pipe joints shall be completed prior to the closure of the containment piping.

2.6.7 Each shop bend for both carrier and containment piping shall require 100% ultrasonic examination with reports provided to the BUYER for approval.

2.6.8 VENDOR shall ensure that a means to track total welds, welds performed, and NDE completed, at a minimum, is maintained throughout fabrication and is available to BUYERs Engineer.

2.6.9 Wall Thickness Verification

2.6.9.1 Wall thickness measurement procedures and reports shall be provided for all carrier piping.

2.6.9.2 Wall thickness measurements apply to carrier pipe bends, piping and butt-weld fittings.

2.6.9.3 Wall thickness measurement samples shall be completed for each heat/lot used for spool fabrication and as a minimum shall meet the “Normal Sampling Plan” per Report TR-017218-R1 Table 2-1.

2.6.9.4 Thickness measurements shall be made, as a minimum, in the following locations:

A. Four locations, evenly spaced around the circumference of the pipe, at the midpoint of each bend.
B. Four locations, evenly spaced around the circumference of the pipe, along each straight section at an interval 3 ft. or less.
C. Four locations, evenly spaced around the circumference, within 6 in. of both ends of each piping spool.
D. Two locations, diametrically opposed, at a minimum of three equally spaced locations along each pipe connected to the exterior of the containment piping.

2.6.9.5 A sampled item is considered defective if the measured wall thickness does not meet the established acceptance criteria. The lot acceptance basis is as follows:

A. The lot shall be accepted if the sample metal wall thickness is within the permitted thickness tolerances in the applicable ASTM standard.
B. The lot shall be rejected (considered nonconforming) if the sample has one or more metal wall thicknesses not within the permitted thickness tolerances in the applicable ASTM standard.

2.6.9.6 Nonconforming lots shall require metal wall thickness measurements of each component in the lot with the established acceptance criteria above applied.

2.6.9.7 Reports containing each heat/lot along with sample results shall be submitted for the required components. In addition, the applicable bulk pipe and butt-weld fitting wall thickness report is to be linked to every pipe and fitting on each extended spool sheet or referenced on each extended spool sheet where that heat/lot of pipe or butt-weld fittings has been used. The term “butt-weld fitting” includes elbows and reducers.
2.6.10 Pressure Testing

2.6.10.1 Carrier pipe shall be leak-tested before closure of the containment piping and all carrier pipe welds shall be visible during the leak test. Field testing is preferred; however, shop testing of spools is permitted if required to facilitate visual inspection of each carrier weld.

2.6.10.2 Containment piping shall be leak-tested in the field following final installation and non-destructive examination.

2.6.10.3 Pretest Inspection

A. All lines shall be thoroughly flushed prior to pressure testing.
B. The VENDOR shall place the spool/system on hold and notify the BUYER in advance of when a spool/system is ready for a pretest inspection.
C. The pretest inspection shall verify that all components in a spool/system conform to the appropriate pipe material specification (e.g., material, wall thickness, etc.) and the latest revision of the design drawings, and is ready for pressurization.
D. The BUYER’s Inspector will inspect each spool/system using a copy of Appendix B and subsequently notify the VENDOR of any problems that need to be corrected prior to pressure testing.
E. All joints shall be inspected by the BUYER’s Inspector to ensure they have been assembled in accordance with ASME B31.3 and this specification. All joints shall be left uncoated and uninsulated until testing has been completed, as applicable.
F. All supports, guides and anchors shall be inspected by the BUYER’s Inspector for proper type, installation and location.
G. All items listed in Appendix C shall be isolated from spools/systems that will be pressure tested unless approved for testing by the BUYER.

2.6.10.4 Pressure Testing Procedure

A. Pressure testing personnel shall be qualified in accordance with ASME B31.3.
B. The Piping Line List specifies the test pressure and test media for each spool/system. Pressure testing for carrier piping shall be done hydrostatically. Containment piping shall be pressure tested pneumatically.
C. The VENDOR shall place the spool/system on hold and notify the BUYER in advance when a spool/system is ready for testing. All tests shall be documented with a test report and witnessed by the BUYER.
D. An initial service leak test is not permitted.
E. If in-line items are not designed for the test pressure, replace items with a spool and test the whole piping system. Decision shall be approved by the BUYER prior to testing.
F. The quality of a test fluid shall not be detrimental to the piping materials. Approval by the BUYER shall be obtained before using any test fluid.
G. Water for testing piping containing austenitic stainless steel materials shall contain less than 50-ppm chloride ion.
H. Pneumatic testing shall be done with nitrogen when pneumatic testing is approved by the BUYER.
I. Unless otherwise approved by the BUYER, pneumatic testing shall not be performed when any of the following conditions exist:
   - When the temperature of the piping system is less than $21^\circ C$ (70ºF).
   - The test pressure exceeds 110 psig.
   - The product of pressure (psig) times volume (cubic feet) exceeds 50,000.

J. Pressure gages and recorders shall be calibrated before tests. Pressure gages shall have a dial scale ≥ $4 \frac{1}{2}$" diameter, a range such that the test pressure is within 40% to 80% of the full scale and be calibrated within 2% at the full scale reading.

K. Unless otherwise approved by the BUYER, pressure testing shall not be performed when the temperature of test fluid is less than $4^\circ C$ (40ºF).

L. Filter elements and strainers that may have been installed shall be removed from the spool/system prior to pressure testing.

M. The VENDOR shall verify that all components included in the test can withstand the test pressure.

N. Each pipe spool/system shall be observed to ensure that all supports are not overloaded due to weight of the test medium.

O. Piping that is free of leakage for the duration of the specified tests shall be accepted.

P. Test diagrams or isometric drawings shall identify the test parameters. The drawing shall show actual configuration of piping during the test.

2.6.10.5 Pressure Testing of Fully Welded Systems

A. Where there’s an inability to isolate a fully welded system for leak testing, temporary flanges may be welded and blind flanges installed or temporary weld caps may be welded to isolate the system. The system shall be hydrostatically tested. Upon successful testing in accordance with ASME B31.3, Para. 345, the temporary flanges or caps shall be cut off, and the ends shall be prepared, welded and piping system installed in accordance to this specification.

B. Other methods (e.g. Test plugs or joints) to isolate the system are allowed, but the selected method shall fulfill all requirements of ASME B31.3 and be the most economical without damaging the pipe.

2.6.10.6 The final closure welds connecting piping spools or systems which have been successfully leak-tested shall be in-process examined per ASME B31.3, Para. 345.2.3(c) applying the visual examination method per ASME BPVC Section V. Records of individual examinations are required. The weld shall pass with 100% radiographic examination in accordance with ASME B31.3, Para. 344.5 or 100% ultrasonic examination in accordance with ASME B31.3, Para. 344.6.

2.6.10.7 Repair of Leaks and Defects

A. The VENDOR shall be responsible for repairing all leaks and the additional examination or tests required as a result of those leaks. Leaks shall be repaired as directed by the BUYER.

B. Defective joints shall be either removed or reworked as required by the BUYER.
C. Reworks shall be made in accordance with procedures approved by the BUYER.
D. Examination and/or inspection of a completed joint rework shall be as required for the original joint or by a BUYER approved alternate method which will ensure equal or greater soundness.

2.6.10.8 Restoration

A. After successful completion of pressure testing, all spools/systems shall be flushed and completely drained.
B. Oil, gas, air and chemical piping which has been either flushed or hydrostatically tested shall be thoroughly purged with air or nitrogen and dried to the satisfaction of the BUYER.
C. Care shall be exercised in draining piping so as not to create a vacuum. All vents within a spool/system shall be opened prior to draining. After piping spools/systems are completely drained, all vents and drains which were opened prior to testing shall be closed.
D. All temporary blanks and blinds shall be removed, and piping components which have been removed shall be reinstalled.
E. After lines have been drained, temporary piping supports shall be removed.

2.6.10.9 Post-Test Inspection

A. The VENDOR shall place the spool/system on hold and notify the BUYER in advance of when a spool/system is ready for post-test inspection.
B. The BUYER will inspect each spool/system using Appendix D and subsequently notify the VENDOR of any problems that need to be corrected prior to operation.
C. The post-test inspection shall verify that a piping system has been flushed, dried, restored, and connected (if applicable) to the satisfaction of the BUYER, and is ready for operation.
3.0 PART 3 - EXECUTION

3.1 Preparation

3.1.1 NOT USED

3.2 Erection, Installation, and Application

3.2.1 General

3.2.1.1 Each pipe spool shall be closely inspected for damage and internal cleanliness immediately prior to installation of piping.

3.2.1.2 All piping shall be installed as dimensioned on the design documents in accordance with the requirements of both ASME B31.3 and this specification. Reference H-16-000410 for fabrication details.

3.2.1.3 VENDOR shall be furnished with pipe spools and associated pipe spool drawings to properly install pipe and support system per isometric drawings. VENDOR shall be furnished with field joint kits for the installation of coating, insulation and jacketing over all field welds.

3.2.1.4 All piping shall be installed in a neat, rectangular form. Special attention shall be given to securing a neat appearance.

3.2.1.5 All excavating, trenching, bedding, pipe laying, filling, backfilling and compacting shall be done in accordance with CSI Section 31 23 00, “Excavating, Backfilling and Compaction for Utilities.”

3.2.1.6 Refer to the Fabrication Tolerance and Alignment section of this specification for tolerance requirements.

3.2.1.7 Drilling, cutting, and patching of structures required for proper installation of piping or bolts shall be performed only when shown on the drawings or only with permission of the BUYER.

3.2.1.8 Penetrations through concrete shall be provided with sleeves and packing as specified per structural design documents.

3.2.2 PMI

3.2.2.1 PMI shall be completed for all for pressure-containing carrier piping components in order to:

A. Verify that the nominal composition of alloy components are of acceptable chemical composition independent of any certificate and marking that may exist.
B. Assure that correct alloy materials are used at the places where intended.
3.2.2.2 General

A. PMI shall be performed as close to the actual final installation as practical to ensure installation of the proper materials.
B. Components shall not be disassembled, and welds shall not be excavated to perform PMI.
C. PMI may not be possible at final installation due to the lack of accessibility of components or welds requiring PMI. Inaccessible items requiring PMI shall be tested at the appropriate time during the fabrication or assembly process.

3.2.2.3 Extent of PMI

A. The extent of PMI examination shall be applied to all alloy pressure-containing components that make up the containment piping. All pressure-containing parts shall be 100% verified, with the exception of bolting. PMI examination of bolting samples shall be completed for each heat/lot used for spool fabrication and shall meet the “Normal Sampling Plan” per Report TR-017218-R1 Table 2-1.
B. Shop fabricated spools that have undergone PMI do not require additional PMI testing in the field.
C. This shall consist of a minimum of one test point for each pressure piping component of piping. This includes each:
   - Plate, pipe length, pipe fittings (elbows, reducers, etc.), etc.
   - Pressure containing weld. Welds exceeding 48" in length shall include one additional test point for every 48" weld length.
D. The extent of PMI shall be limited to alloy materials.

3.2.2.4 PMI Test Methods

A. PMI, where required, shall be performed by one of the following methods:
   - Portable X-Ray Fluorescence (XRF) spectrometers with direct reading of alloy grade or percentage of each element present
   - Optical Emission Spectrometry
B. Testing of any material grades not suitable for testing by the above methods shall be tested as agreed upon by the BUYER.
C. Other methods such as chemical spot testing, thermoelectric, mechanical methods etc. are not acceptable.

3.2.2.5 PMI Procedures

A. The VENDOR performing PMI shall submit a PMI testing procedure for approval by the BUYER. This specification shall be met as a minimum.
B. The VENDOR performing the PMI testing shall comply with the manufacturer’s recommendations when calibrating and/or verifying the test equipment performance. Calibration shall occur daily at the start of work if possible.
C. The BUYER’s Inspector shall be allowed to witness any or all PMI testing.
3.2.2.6 Personnel and Qualifications

A. Personnel performing PMI testing shall be certified in the operation of the equipment and the test method used by completing a training course approved by the manufacturer of the PMI test equipment. Personnel qualifications shall include certification and be submitted for review and approval by the BUYER.

B. Personnel using PMI equipment shall calibrate and maintain equipment in accordance with the manufacturer’s specification.

3.2.2.7 Acceptance Criteria

A. All materials shall meet the chemical composition percentages specified in the relevant ASTM material specifications as defined by the drawings. Alternatively, a match against the relevant reference spectra stored in the instrument, i.e. 316 stainless steel or 16Cr – 12Ni – 2Mo, is acceptable.

B. The testing results shall fall within the chemical range while allowing for the accuracy of the machine.

C. If testing leads to the potential rejection of a component then the component shall be rejected and replaced or analyzed with a more accurate method for acceptance.

D. Component replacements shall undergo PMI and conform to the acceptance requirements.

E. The BUYER shall be notified of all rejected items and the reason for rejection.

F. If a component is rejected, all items within the lot should be considered suspect. A more extensive inspection shall be performed on the lot.

G. All rejected material, items and welds shall be marked and segregated.

H. CMTR’s or CoC’s should not be considered a substitute to PMI testing.

3.2.2.8 Materials Identification

A. Alloy materials are to be identified by their alloy designation (i.e. ASTM description) or nominal composition.

B. PMI test locations shall be marked, preferably with low-stress stamp or semi-permanent paint applied to each item. The marker shall not contain additives such as aluminum, chlorides, sulfur, lead or zinc which may be detrimental to the material.

3.2.2.9 The VENDOR shall record results and provide documentation on a PMI Report containing the following as a minimum:

A. VENDOR name (fabricator)
B. Specific job reference (PO#)
C. PMI procedure(s) and revision used
D. Testing date and location
E. Testing personnel and company performing the tests
F. Test equipment identification number or serial number
G. Date of calibration of the alloy analyzer
H. Recorded results of the tests for each item
I. Material specification and grade
J. Traceability (heat number and welding joint number)
K. Number of items examined
L. Documentation as described in API 578 Section 7.5.f and g.
M. Signature and date of the VENDOR's representative assuring compliance to the requirements of this specification
N. Signature and date by the BUYER's Inspector verifying the review and acceptance of results
O. VENDOR shall repair or replace and retest any piping assembly that does not perform satisfactorily during BUYER's hydrostatic or pneumatic pressure tests as a result of defective workmanship by the VENDOR, or as a result of faulty materials supplied by the VENDOR.

3.2.3 Trenching and Bedding

3.2.3.1 All trenching and bed preparation shall be performed in accordance with the requirements of this specification and CSI Section 31 23 00.

3.2.3.2 Excess soil from trenching shall be disposed of on-site as directed by the BUYER.

3.2.3.3 The VENDOR shall maintain the trench in good condition to prevent caving either before or after the pipe is installed.

3.2.3.4 Trench widths shall be sufficient to allow adequate compaction around the pipe.

3.2.3.5 The bottom of the trench shall be shaped to give substantially uniform circumferential support to the bottom quadrant of each length of pipe. The trench bottom shall be continuous, relatively smooth, and free of rock. When rocks, boulder, or large stones are encountered which may cause point loading on the pipe, they shall be removed. The bedding material shall conform to CSI Section 31 23 00.

3.2.3.6 Pipe and fittings shall be carefully lowered into the trench. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Each pipe shall be laid true to line and grade.

3.2.3.7 At times when work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other foreign material enters the pipe. Pipe ends left for future connections shall be blind flanged, capped or closed in accordance with the drawings.

3.2.3.8 Open trenches shall be adequately barricaded in accordance applicable OSHA standards, local codes having jurisdiction, the requirements of this specification and any BUYER guidelines that may exist.

3.2.3.9 Pipes passing under or through walls shall be protected from breakage. Reference TBD (HOLD).

3.2.3.10 Any pipe passing under a footing or through a foundation wall shall be provided with a steel or cast iron pipe wall sleeve two (2) pipe sizes greater than the pipe passing through unless otherwise specified on the construction drawings.
3.2.3.11 Pipe termination and pipe anchors shall be installed per H-16-000410 and TBD (HOLD).

3.2.3.12 Risers shall be heat traced or otherwise protected from freezing.

3.2.4 Backfilling and Compaction

3.2.4.1 All backfilling and compaction shall be performed in accordance with CSI Section 31 23 00 and the additional requirements of this Section, and only after written approval of the BUYER.

3.2.4.2 Backfilling and tamping for all systems shall not be performed until after a successful field pressure test (or radiographic examination) and the completion of any necessary coating and insulation/insulation jacket.

3.3 Field Quality Control

3.3.1 Refer to the Shop Quality Control of this specification.

3.3.2 VENDOR shall perform a continuity test on all tracer wire in presence of BUYER Inspector’s representative. If the tracer wire is found to be not continuous after testing, contractor shall repair or replace the failed segment of wire at the VENDOR’s expense.

3.3.3 Before the completion of installation, the BUYER’s Inspector shall:

3.3.3.1 Perform a final walk-down to verify that the work is in accordance with the Piping and Instrumentation Diagrams (P&IDs), drawings and this specification.

3.3.3.2 Verify marking and identification is in accordance with marking and identification requirements.

3.3.3.3 Visually examine items that are accessible without disassembly for general workmanship, cleanliness and quality.

3.3.3.4 Verify examination and testing and the associated documentation is in accordance with this specification.

3.4 Adjusting and Cleaning

3.4.1 NOT USED

3.5 Demonstration

3.5.1 NOT USED
3.6 Protection

3.6.1 NOT USED
4.0 LIST OF APPENDICES

4.1 Appendix A – Supporting Document(s) Issued with this Specification

4.2 Appendix B – Piping Pre-Pressure Test Checklist

4.3 Appendix C – Status of Instruments During Pressure Test

4.4 Appendix D – Piping Pressure Test Checklist
Appendix A – Supporting Document(S) Issued With This Specification

Lists: 31269-16-LST-0001, Piping Line List

Drawings:
- Piping Orthographic Drawings and Piping Isometric Drawings as indicated in purchase order
- H-16-000410, Double Contained Piping Standard Details
- TBD, Wall Penetration Piping Standard Details (HOLD)
Appendix B – Piping Pre-Pressure Test Checklist

<table>
<thead>
<tr>
<th></th>
<th>BUYER</th>
<th>VENDOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>All material/equipment (valve numbers, nipple schedules, flange ratings, etc.) complies with specifications and Piping and Instrumentation Diagrams</td>
<td>(Initials) Date</td>
</tr>
<tr>
<td>2.</td>
<td>All PWHT completed and acceptable</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>All NDE (hardness, MT, PT, RT, UT) acceptable</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Instrumentation protected/secure</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Rotating equipment internals protected/secure.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Vents installed at system high points.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Gauges calibrated and installed.</td>
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</tr>
<tr>
<td>8.</td>
<td>Status of check valve internals has been tagged.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Temporary plugs and caps have been replaced.</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Low point drains are installed as needed.</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>All welded attachments have been installed and accepted</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Instrument status in compliance with Appendix B</td>
<td></td>
</tr>
</tbody>
</table>

REMARKS

________________________________________________________________________________________
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## Appendix C – Status of Instruments During Pressure Test

<table>
<thead>
<tr>
<th>Instrument Type</th>
<th>Block &amp; Vent</th>
<th>Remove</th>
<th>Blind Off</th>
<th>Include in Test</th>
<th>Refer to Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzers</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Control Valves</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Flame Arrestors</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Flow Indicating Switches-Bellows Types</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow Instruments-D/P Cell &amp; Bellows Type</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Flow Instruments-Rotameters</td>
<td></td>
<td></td>
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<td></td>
<td>2</td>
</tr>
<tr>
<td>Flow Meters-Positive Displacement Type</td>
<td></td>
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<td>X</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Flow Meters-Turbine Type</td>
<td></td>
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<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Flow Switches-Vane Type</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Gage Glasses</td>
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<td>X</td>
<td></td>
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<tr>
<td>Level Instruments-Displacer Type</td>
<td></td>
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<td></td>
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<tr>
<td>Level Instrument-D/P Cell &amp; Bellows Type</td>
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<td></td>
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<tr>
<td>Level Switches-Float Type</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Orifice Plates</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Pressure Gages</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Pressure Instruments-All Types</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Pressure Regulators</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Pressure Switches</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>PSV’s</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>2</td>
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<tr>
<td>PSV’s-3/4” and 1” Screwed</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>2</td>
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<tr>
<td>Rupture Discs</td>
<td></td>
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<td>X</td>
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<tr>
<td>Steam Traps</td>
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<td>X</td>
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<td>2</td>
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<tr>
<td>Thermowells</td>
<td></td>
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<td>X</td>
</tr>
</tbody>
</table>

**NOTES:**

1. All instruments shall be protected from damage due to freezing. In preparation for cold weather and during cold weather all instruments must be drained and process lead lines blown out with air or nitrogen.
2. Fabricate and install temporary spool if necessary for test.
3. Caution - do not overpressure instrument. Check with Instrument Engineer for maximum test pressure allowed by manufacturer.
4. Install after pressure testing and line flushing.
Appendix D – Piping Pressure Test Checklist

INSPECTION DATE

INSPECTED BY

PLANT __________________________________________ VENDOR ________________________________

SYSTEM/LINE NO. __________________________________________ DWG REF. ________________________________

TEST MEDIUM (INCLUDING PPM CHLORIDE) _______

TEST PRESSURE, PSIG ______ TEST TEMP, °F _______

TEST GAGE __________________ TEST GAGE PRESSURE, PSIG __________________

CALIBRATION DUE DATE ______ AMB TEMP / TIME OF DAY / TEST DURATION __________________

BUYER VENDOR

<table>
<thead>
<tr>
<th>(Initials)</th>
<th>Date</th>
<th>(Initials)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pressure Test Complete and acceptable</td>
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</tr>
<tr>
<td>2. Test boundary sketch with ID of any joints not tested attached.</td>
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<tr>
<td>3. If partial tests were made, define:</td>
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<tr>
<td>a.</td>
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<td>b.</td>
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<tr>
<td>c.</td>
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<tr>
<td>d.</td>
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</tr>
<tr>
<td>a. Test blinds removed.</td>
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<tr>
<td>b. Final line flush complete.</td>
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<tr>
<td>c. Vents properly plugged.</td>
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<tr>
<td>d. Drains properly valved and plugged.</td>
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<td></td>
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<tr>
<td>e. Instruments properly installed.</td>
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<tr>
<td>f. Expansion joints, relief valves, control valves, in-line meters, filter elements orifice plates, in-line strainers, and other special items properly installed.</td>
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<tr>
<td>g. Rotating equipment properly in-line.</td>
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<tr>
<td>h. Temporary supports removed.</td>
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</tbody>
</table>

REMARKS

____________________________________________________________________________________________

Page D-1 of D-1