1.0 Purpose

The purpose of this specification is to establish minimum quality assurance requirements for shop or field fabrication of piping components and assemblies that will be incorporated in ASME B31.1 piping systems.

2.0 Scope

2.1 This specification shall apply to piping components under the jurisdiction of the ASME B31.1 Power Piping Code, for both Non-Boiler External Piping (NBEP) and Boiler External Piping (BEP). All references to "Code" in this specification refer to ASME B31.1, Power Piping Code.

2.2 This specification shall be used in conjunction with a project specification that contains the material, quantity, bid, contract, schedule, transportation, delivery, and other job, plant and site-specific requirements.

3.0 Definitions

3.1 ANSI – American National Standards Institute

3.2 API – American Petroleum Institute

3.3 ASME – American Society of Mechanical Engineers

3.4 ASME B&PV Code – ASME Boiler and Pressure Vessel Code

3.5 ASNT – American Society for Nondestructive Testing

3.6 ASTM – American Society for Testing and Materials

3.7 AWS - American Welding Society

3.8 NRG - The NRG individual responsible for the overall management of the project

3.9 ISO - International Organization for Standardization

3.10 Manufacturer - The organization making the pipe, flanges and fittings

3.11 Supplier - The organization assembling the fabricated components

3.12 QAS - NRG Quality Assurance Specification

4.0 References

4.1 ASME B31.1 Power Piping code

4.2 ASME B16.5, “Steel Pipe Flanges and Fittings”

4.3 ASME Boiler & Pressure Vessel Code, Section I, “Rules for Construction of Power Boilers”

4.4 ASME Boiler & Pressure Vessel Code, Section II, Parts A and B, “Ferrous and Nonferrous Material Specifications”

4.5 ASME Boiler & Pressure Vessel Code, Section V, “Nondestructive Testing”

4.6 ASME Boiler & Pressure Vessel Code, Section IX, “Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators”

4.7 SNT TC-1A, “Personnel Qualification and Certification in Nondestructive Testing"

4.8 NRG Quality Assurance Specification (QAS) 4.01, “Welding – ASME BPVC Section I VIII ASME B31.1 Boiler External Piping“

4.9 NRG QAS 4.02, “Welding – ASME B31.1 Non-Boiler External Piping “

4.10 NRG QAS 4.03, “Welding – Structural Steel“

4.11 NRG QAS 4.05, “Welding - Heat Treatment”

4.12 MSS Manufacturers Standardization Society

The latest edition of the above codes, standards, and specifications shall apply. In the event of conflicts between this specification and the references cited above, the Supplier shall notify NRG, who will make the final judgment and interpretation.

5.0 Responsibility

5.1 The Supplier shall be responsible for fulfilling the requirements as set forth in this specification including all required inspection and testing and the submission of all required documentation. Exceptions to and deviations from this specification shall be clearly delineated in the Vendor's bid for disposition by NRG.

5.2 The Supplier shall hold the applicable valid "S", "A" or "PP" Stamp issued by the ASME.

5.3 The Supplier shall provide the applicable Manufacturer's Partial Data Report Form P-4A with the shipment of any BEP piping components.

5.4 The Manufacturer shall have a Quality Program in compliance with and certified to ISO 9001.

5.5 The Supplier must have a formal program for qualifying their manufacturers and must have evidence of periodically monitoring their performance.

5.6 The Supplier shall assume complete responsibility for the design and construction of the piping assemblies and their integral components and supports, and shall consider any information shown in the bid documents, purchase order or project specification as minimum design requirements subject to a design verification by the supplier.

5.7 The Supplier shall identify clearly in their proposal any and all subcontractors intended to be used. All subcontractors must be approved by NRG prior to the issuance of a purchase order.

5.8 NRG shall furnish the Supplier with the design temperature, pressure, loadings, service application, and corrosion allowance for all applicable piping systems and equipment.

6.0 Material

6.1 Materials shall be as stipulated in the project specification or, if not specified, suitable for the intended service and permitted by the Code. All materials shall be identified by their ASME or ASTM designation as required by the Code.

6.2 All base materials used for pressure boundaries shall be listed in Appendix A of the Code.

6.2 All materials of construction shall be new. All plate and pipe shall be free of injurious mill scale, grit, flaking, and rust prior to fabrication.

6.3 All piping shall be seamless manufactured pipe unless specified otherwise by NRG. Associated fittings shall be of seamless construction.

6.4 Forged fittings, such as laterals, wyes, and tees shall be of seamless construction and designed to satisfy the requirements of the Code.

6.5 The Supplier shall provide certified material test reports (CMTR) for all pipe and plate used in the fabrication of Code piping assemblies. CMTRs shall report chemical and mechanical test data as required by the applicable ASME Boiler & Pressure Vessel Code, Section II material specification. CMTRs shall be prepared in English units or in metric units with conversions to English units.

6.6 The following requirements apply to bolting:

6.6.1 For temperature between -20° F and 850° F, bolting shall be SA-193 B7 studs, threaded full length, with SA-194 Grade 2H heavy hex nuts.

6.6.2 Above 850° F, bolting shall be SA-193 B16 studs with SA-194 heavy hex nuts of a grade suitable for the temperature.

6.7 Reinforcing pads and attachments that are fabricated from plate shall be the same material as the piping to which they are attached.

7.0 Design

7.1 All piping components shall be designed, fabricated, and tested in accordance with the Code.

7.2 All piping components and supports shall comply with any applicable federal, state, and local codes and regulations. Supports shall be manufactured to MSS standard SP58.

7.3 All piping components and supports shall be designed for the pressure and temperature specified in the project specification and the load conditions specified in Paragraphs 7.7, 7.8, and 7.9.

7.4 The Supplier shall submit general arrangement (GA) drawings to NRG for review and approval prior to the start of work. All construction details and dimensions specified in the project specification shall be clearly shown. The fabrication drawings shall include the following as a minimum:

7.4.1 Applicable ASME Code edition and addenda
7.4.2 The bill of materials, design data, and schedule of openings
7.4.3 Details of all weld preparations and the locations of all welds
7.4.4 The location, bill of material, and details of all branch connections, attachments, and other openings, penetrations or supports
7.4.5 Support drawings with weld details
7.4.6 Corrosion allowances
7.4.7 Joint efficiencies
7.4.8 Requirements for nondestructive examination, postweld heat treatment, and pressure testing
7.4.9 Lifting and handling procedures

7.5 Complete and checked ASME Code calculation for all designs shall be submitted for review with the first set of drawings. All subsequent calculations which may be necessary shall be concurrently submitted with revised drawings.

7.6 If the project specification requires re-designed assemblies, the design shall account for potential corrosive environment to which the piping components will be exposed. The wall thickness shall be designed to account for these conditions.

7.7 The piping and its structural supports shall be designed for the hydrostatic test conditions including the test pressure, vessel dead load, attachment loads, and the weight of water. Stresses shall be calculated using the metal thickness less corrosion allowance at test temperature.

7.8 The piping and structural supports shall be designed for the operating loads plus external attachment loads (such as exerted by lateral piping), plus wind or earthquake loading when applicable.

7.9 Supports for the piping shall be designed for the piping dead weight and the weight of water or other test fluid which may be specified in the project specification (whichever is heavier).

7.10 Welds attaching non-pressure parts to the pressure containing parts and welds attaching highly loaded supports shall be designed using the Code allowable stresses for pressure containing parts at the design temperature.

7.11 The following requirements apply to flanges:

7.11.1 Flanges may be weld neck, long weld neck, or slip-on type. Slip-on type flanges are not permitted for ratings greater than 300#.

7.11.2 The finish of the gasket contact surface of flange facings shall conform to ASME B16.5.

7.11.3 Gaskets for raised face flanges shall have the outside diameter and inside diameter conform to the dimensions specified by ASME B16.5, to the inside edge of the bolts or shall be provided with a centering ring.

8.0 Fabrication

8.1 The Supplier shall have a procedure for maintaining material traceability throughout fabrication. Heat numbers shall be transferred whenever material is cut.

8.2 At wall thickness transitions, the thicker pipe shall be worked to match the inside diameter of the thinner pipe transition shall be in accordance with the Code.

8.3 For all bent piping the Supplier shall submit their procedure including heating and PWHT instructions to NRG for review and approval prior to the start of work.

8.4 Seamless ferritic alloy steel pipe shall be heat treated after bending in accordance with ASME Boiler & Pressure Vessel Code, Section II, SA-335.

8.5 Seamless austenitic stainless steel pipe shall be solution annealed after bending in accordance with ASME Boiler & Pressure Vessel Code, Section II, SA-312.

8.6 Butt welds in piping bend area are prohibited. Mitered joints shall be approved by NRG.

8.7 Welding of fit-up lugs and dogs shall be done in accordance with an approved WPS.

8.8 Fit-up lugs and dogs shall be removed flush with pipe wall without diminishing wall thickness. Lugs may be torch cut or gouged to within a ¼" and the remainder removed by grinding. Areas will be MT or PT inspected and documented.

8.9 Attachments such as lugs, clips, supports and similar items shall not be located within 3" of the toe of a weld.

8.10 Lubricants, thread compounds, paints, crayon markers, ink markers, tapes and adhesives containing chlorides shall not be used on stainless steel or nickel alloy piping.

8.11 Mechanical force or cold spring to attain proper alignment is prohibited unless required by design drawings approved by NRG.

9.0 Welding

9.1 All welding shall be performed in accordance with the requirements of the Code and the quality control requirements of Paragraph 13.0.

9.2 Welding procedures, welders and welding operators shall be qualified per the Supplier's Quality Program and the ASME Boiler & Pressure Vessel Code, Section IX.

9.3 Weld procedure specifications (WPS) and supporting procedure qualification records (PQR) shall be made available to NRG for review upon request.

9.4 Copies of all welding operator and welder performance qualifications, along with applicable welder continuity data, shall be made available to NRG for review upon request.

9.5 The Supplier shall have a documented weld filler material control procedure that describes the technical requirements for the receipt

inspection, storage and handling of welding filler metal, electrodes and fluxes and is consistent with the material manufacturer's recommendations.

9.6 Backup strips or consumable inserts are not permitted without written approval from NRG.

9.7 The following welding processes are allowed:

9.7.1 SMAW - Shielded Metal Arc Welding
9.7.2 SAW - Submerged Arc Welding
9.7.3 FCAW - Flux Cored Arc Welding
9.7.4 GTAW - Gas Tungsten Arc Welding
9.7.5 GMAW - Gas Metal Arc Welding (spray transfer)

9.8 NRG restricts the following welding processes as follows:

9.8.1 The gas metal arc welding process (GMAW) shall not be used in the short circuiting arc transfer mode.

9.8.2 The Flux Cored Arc Welding process (FCAW) shall be used with gas shielding.

9.8.3 Fluxes for submerged arc welding (SAW) used on piping assemblies where the design temperature is at or above 850°F shall be neutral or basic.

9.8.4 Welding processes employed for applications with a design temperature over 850°F shall limit heat input to 60,000 joules/inch maximum. Heat input shall be determined by the following formula:

$$\frac{\text{volts x amps x 60}}{\text{travel speed (in/min.)}} = \frac{\text{Joules}}{\text{inch}}$$

9.9 All circumferential butt welds shall utilize a GTAW welded root pass unless otherwise approved by NRG.

9.10 Butt welds in pipe shall be full penetration.

9.11 A backing gas (argon) purge shall be used for the GTAW process on all austenitic stainless steels and when the base metal contains an excess of 3% chromium for ferritic steels.

9.12 Low hydrogen electrodes shall be used for SMAW process.

9.13 Welding materials utilized for fabrication shall be in accordance with the ASME Boiler & Pressure Vessel Code, Section II, Part C except that low carbon ('L' Grade) filler materials are prohibited when fabrication involves ferritic materials.

9.14 All slip-on flanges shall be welding on the inside and outside. Flange faces shall be free of weld spatter and shall not require refacing.

9.15 All fillet (including slip-on flanges and non-pressure attachments) and socket welds shall be two (2) pass minimum. Fillet welds shall be sized in accordance with the Code and approved design drawings. Fit-up for socket welds shall leave a 1/16" (1.6 mm) gap between the inserted pipe and the step on the female side of the joint.

9.16 Tack welds shall be made with the same ASME classification consumable that is used for the root pass.

9.17 Grinding wheels and austenitic stainless steel wire brushes used on austenitic stainless or other higher nickel and nonferrous alloys shall not have been previously used on ferrous materials, copper alloys, aluminum or zinc coatings (paint or galvanized).

9.18 Peening or quenching of welds to control distortion is prohibited.

9.19 Welding on piping assemblies after post-weld heat treatment is prohibited.

10.0 Preheat and Post-weld Heat Treatment

10.1 Preheat temperatures for thermal cutting, tack welding and welding shall be performed in accordance with para. 131 of the Code.

10.2 Preheating of piping components shall be limited to either electric resistance heating pads, induction heating or oxy-fuel torches.

10.3 Either temperature indicating crayons or contact pyrometers (thermocouples) shall be used for monitoring minimum preheat and maximum interpass temperature.

10.4 The maximum interpass temperature shall be 800° F for carbon and low alloy steels and 350° F for manual welding of austenitic

stainless steels including dissimilar metal welds and nickel base alloys.

10.2 For austenitic stainless steel and Inconel butt welds made with an automatic welding process, the maximum interpass temperature shall not exceed 500° F unless the weld receives a heat treatment.

10.3 Post-weld heat treatment shall be performed in accordance with para. 132 of the Code and QAS 4.05.

10.4 Post-weld heat treatment shall be limited to either electric resistance heating pads, induction heating or by heating piping components in a gas or electric furnace.

10.5 Post-weld heat treatment with the exothermic process or using localized torch or heating tips is prohibited.

10.6 The Supplier shall make available the post-weld heat treatment procedure to NRG for review upon request prior to the start of heat treatment.

10.7 Post-weld heat treatment temperatures shall be continuously monitored by the Heat Treatment Contractor's technician.

10.8 Post-weld heat treatment charts shall be made available to NRG upon request.

11.0 Inspection and Testing

11.1 The requirements for non-destructive examination (NDE) shall be in accordance with the Code.

11.2 NDE procedures shall be in accordance with the ASME B&PV Code, Section V. The Supplier shall make available all NDE procedures to NRG for review upon request.

11.3 Personnel performing NDE shall have Level II qualifications and certified in accordance with the requirements of SNT TC-1A. The Supplier shall make available all NDE personnel qualifications to NRG for review upon request. Visual inspections may be performed by an AWS Certified Weld Inspector or designated QC Inspector.

11.4 If the specification, codes, laws, ordinances, or any state agency or the Supplier's Authorized Inspector having jurisdiction require any

work to be specifically tested or approved, the Supplier shall assume the responsibility and cost thereof and shall give NRG timely notice of its readiness for inspection or testing.

11.5 All piping assemblies shall be hydrostatic pressure tested after fabrication in accordance with the requirements of the applicable code and in the presence of NRG. BEP shall be hydrostatically tested in accordance with PG-99 of Section I of the ASME Boiler and Pressure Vessel Code and in the presence of the Authorized Inspector. NBEP shall be hydrostatically tested in accordance with para. 137.4 of the Code. It shall be NRG's prerogative to waive the witnessing of the test after being contacted by the Supplier.

11.6 Hydrostatic pressure testing shall be accomplished with clean, demineralized water at a temperature of not less than 60° F. Water used for testing shall not exceed 5 ppm of chlorides and fluorides. After testing, the assembly shall be drained and air dried. Air, if used for drying, shall be free from all oil or oil vapors.

11.7 After completion of the hydrostatic test, additional welding is not permitted without prior approval by NRG.

11.8 All radiographs, including original weld reject film, subsequent repair reshots and final acceptable film, shall be made available to NRG upon request.

11.9 Final inspections shall be performed prior to application of any protective coating and capping of the piping assemblies for shipping or storage.

12.0 Repairs

12.1 All weld repairs shall meet the requirements of para. 127.4.11 of the Code.

12.2 Repairs to correct weld defects shall be made using the same WPS used for the original weld.

12.3 Repairs to the outside surface of piping due to physical damage or arc strikes shall be done using the same WPS as that being used for other welds on that material.

12.4 When arc-gouging or flame gouging is used for defect removal, the material shall be preheated as specified on the WPS.

12.5 The repaired areas shall be reexamined using the same inspection procedure that was used to detect the original defect.

12.6 Two repair attempts will be allowed on any one defective area. No further attempts to repair shall be conducted without the approval of NRG.

13.0 Marking

13.1 All completed piping assemblies shall be clearly marked with the material designation and size, assembly/component number, Supplier's Job Number, and the NRG Purchase Order Number.

13.2 For austenitic stainless steel and nickel pipe, the marking paint or ink shall not contain any chlorides, phosphorus or sulfur metals and metal salts such a zinc, lead or copper.

14.0 Quality Control Requirements

14.1 The Supplier shall develop and implement a Quality Program for the control of quality for all materials and services to be supplied. The Supplier's Quality Program shall be documented by written policies, procedures, and instructions, which, as a minimum, shall comply with the requirements of the codes and standards in Paragraph 4.0. The Supplier's Quality Program shall be submitted to NRG for review upon request.

14.2 Supplier's Quality Program shall address inspection planning, inspections, inspection personnel, inspection results, and shall include, but not be limited, to the following:

14.2.1 The Supplier shall establish a documented, pre-planned inspection program that shall be used by the Supplier for inspections to be performed at receiving, during storage, during in-process work, upon completion of fabrication, and prior to shipment.

14.2.2 The inspection program shall identify those elements, characteristics, and processes essential for verification by the Supplier's inspection personnel to assure conformance to applicable specification and drawing requirements. The Supplier shall prepare inspection checklists identifying the specific elements, characteristics, and steps in the process to be inspected, and shall include the accept/reject criteria for each. Criteria and recording of inspection results shall be quantitative where possible.

14.2.3 The Supplier's utilization of approved inspection checklists does not relieve the Supplier of responsibility for compliance with the requirements of the contract, specifications, and drawings.

14.2.4 The Supplier shall implement the pre-planned inspection program by performing the inspections identified on the checklists and documenting actual inspection observations, measurements, and results. The inspection shall be performed and documented as work progresses. A copy of the actual results of each inspection shall be submitted to NRG at the completion of the work.

14.2.5 Supplier personnel performing NDE shall be qualified and certified in accordance with the Supplier's written program. Evidence of their qualification and certification shall be available to NRG for review upon request.

14.3 The Supplier shall arrange for NRG to have free access to all Supplier's or Supplier's Subcontractor's facilities concerned with the supply or manufacture of materials, for the purpose of performing inspection or surveys of parts, prior to or during assembly and to witness any or all fabrication processes, testing, or NDE. The Supplier shall advise NRG of any advance-notice requirements which must be met in order to gain access to the Supplier's or Supplier's Subcontractor's facilities.

14.4 The Supplier's inspection checklist shall be submitted to NRG at least four (4) weeks in advance of scheduled inspections to which they apply. NRG will indicate Inspection Witness Points on the Supplier's inspection checklist.

14.5 Supplier shall notify NRG of the expected fabrication start date, expected dates of Witness Point(s), and expected date of final inspection by the Supplier.

14.6 The Supplier shall provide any documents and copies of or access to all drawings, procedures, or test reports related to the job as deemed necessary by NRG.

14.7 NRG inspections or surveys at the Supplier's facilities and the Supplier's Subcontractor's facilities may be performed at NRG's discretion. Specific NRG inspections or surveys may be identified upon receipt of the Supplier's Quality Program.

14.8 Supplier shall initiate, disposition, and control Nonconformance Reports (NCRs), to report deficiencies in characteristics, documentation, or procedures, which do not comply with specification or drawing requirements. Items which can be corrected (reworked) by completion, re-machining, reassembly, or other means to conform to drawing/specification requirements shall be documented by Supplier on the appropriate inspection checklists. Items which cannot be corrected to original drawing/specification requirements shall be reported immediately on an NCR. Supplier shall provide recommended disposition for each deficiency and shall route the NCR form to NRG for review and approval. Upon NRG's approval of the recommended disposition of the NCR, Supplier shall take the necessary actions to correct the nonconforming item in accordance with the disposition on the approved NCR.

14.9 The Supplier's work shall comply in all respects with applicable drawings, specifications, and contract documents. NRG's final acceptance of Supplier's work shall be based upon satisfactory completion of inspection/tests, and upon resolution of all open or incomplete items.

15.0 Shipping

15.1 All accumulative fabrication debris shall be thoroughly cleaned out and all water completely drained and dried from all piping components.

15.2 Exposed flanged connections shall be protected by steel or wooden covers which extend to the edge of the flange. All threaded connections shall be filled with threaded steel caps or plugs. Socketweld couplings shall have plastic caps. Welded stub ends shall be provided with steel weld bevel protectors.

15.3 All weld spatter, mill scale, arc strikes, rust, loose particles, and any potentially harmful foreign matter shall be removed from the completed assemblies. All sharp edges and roughness shall be ground smooth to a rounded contour. Sponging or similar operation shall be performed to ensure internal cleanliness.

15.4 All exterior carbon steel surfaces, except machined surfaces, shall be cleaned of dirt, grease and loose scale by power wire brushing or equal, and shall receive one prime coat of zinc chromate or red oxide primer.

15.5 Suitable weather protection shall be provided to protect the piping assemblies from damage in transit and during storage for up to six months. Such protection shall include, but not be limited to, applying deoxaluminate on weld end preps and protective end caps. Capping shall not be done prior to final inspection or release by NRG. The method of protection shall be submitted to NRG for review and approval.

15.6 Exposed machined surfaced shall be properly protected with an easily removable rust preventative coating.

15.7 Piping assemblies shall be suitably supported and/or braced to prevent damage during handling and transport.

15.8 For large and/or heavy piping assemblies, skids or crates, the weight and lifting points to be used for handling shall be indicated on the assembly.

15.9 Small, easily damaged parts shall be removed for shipment. Individually packed items shall be painted or coated with rust preventive and wrapped in a heavy moisture-proof paper. These parts shall be properly identified and reference in the purchase order or contract document.

16.0 Documentation

The Supplier's final documentation package shall include the following:

16.1 Signed Data Report forms for BEP piping components
16.2 Certified material test reports
16.3 General arrangement and fabrication drawings with weld joint map, design data and assumptions
16.4 Hydrostatic Test Records

16.5 Heat treatment charts or certificate of compliance (when applicable)
16.6 NDE (VT, PT, MT, UT and RT) examination reports required by project specification and the Code
16.7 Repair procedures (when applicable)
16.8 Nonconformance reports