

BSC

Specification Cover Sheet

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Page 1 of 64

YUCCA MOUNTAIN PROJECT ENGINEERING SPECIFICATION

WASTE PACKAGE FABRICATION

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¹ The item produced is a prototype for engineering tests and will not be used for operations. ¹ Design verification is not required. This specification, although developed as a generic specification, will be used for acquisition of prototype waste packages, incorporating lessons learned into an evolving design process. The design is not yet complete.

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1. SCOPE

1.1 PROJECT DESCRIPTION

The primary purpose of this fabrication specification is to detail the requirements for the fabrication of a waste package that will be used within the repository program.

Bechtel SAIC Company, LLC (BSC), BUYER that supports the U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM) has developed this Waste Package Fabrication Specification. The OCRWM is a program of DOE assigned to develop and manage a federal system for disposing of spent nuclear fuel from commercial nuclear reactors and high-level radioactive waste from national defense activities.

Yucca Mountain is located in a remote desert on federally protected land within the secure boundaries of the Nevada Test Site in Nye County, Nevada. It is approximately 100 miles northwest of Las Vegas, Nevada.

Based in Las Vegas, BSC is implementing solutions for the Yucca Mountain Project (YMP). YMP has a requirement to develop, validate, and defend, to the U.S. Nuclear Regulatory Commission (NRC) and other regulatory organizations, the technical position regarding the design and licensing of the repository.

The environment within which the waste package must perform (contain nuclear waste) for extended time periods is complex and is described in detail in other DOE documents that indicate the presence of high humidity. The material performance has been shown to be a function of the corrosion resistance of the outer corrosion barrier material. The primary mechanism has been found to be stress corrosion cracking (SCC). SCC is influenced by the presence of a solute (water containing a variety of soluble elements), material microstructure, and residual stresses within the waste package material.

1.2 PROJECT SUMMARY

Some of the early waste packages to be fabricated will be prototypes. The Prototype Waste Package is intended to provide a demonstration of the containment system for the disposal of high-level radioactive waste and will be used for testing. In the future, actual Waste Packages will be fabricated, filled with waste, and placed within drifts at the Yucca Mountain facility. All such activities will be in accord with the technical and quality requirements of this document and any improvements discovered during the prototyping efforts. Improvement is part of the reason for a prototyping program.

1.3 DESCRIPTION OF THE WASTE PACKAGE

The major parts of the Waste Package are:

A. Outer Corrosion Barrier

1. Outer Corrosion Barrier

2. Outer Lid
3. Shell Interface Ring
4. Inner Vessel Support Ring
5. Bottom Lid
6. Upper Sleeve
7. Lower Sleeve

B. Inner Vessel

1. Inner Vessel
2. Inner Bottom Lid
3. Inner Lid
4. Spread Ring
5. Purge Plug
6. Purge Gasket

1.4 REQUIREMENTS

This Specification provides requirements for materials, marking, fabrication, welding, heat treatment, examination, testing, quality assurance (QA), quality control (QC), documentation, packaging, and shipping for the Waste Package (referred to throughout this Specification as Waste Package.) The Waste Package consists of an Inner Vessel and an Outer Corrosion Barrier. The Waste Package Inner Vessel shall be fabricated and have the American Society of Mechanical Engineers (ASME) N Code Symbol Stamp in accordance with the requirements of the ASME Boiler and Pressure Vessel Code (ASME BPVC) Section III, Division 1, Subsection NC (Class 2 pressure vessel.) The Outer Corrosion Barrier shall be constructed to the specific provisions of the ASME BPVC Section III, Division 1; Subsection NC (Class 2 pressure vessel) identified herein, but it will not be ASME BPVC Stamped. It shall be inspected by an Authorized Nuclear Inspector and certified as to meeting the specific provisions of the ASME BPVC identified in this Specification.

For waste packages that contain a Divider Plate Assembly, the requirements of the ASME BPVC, Section III, Division 1, shall be applied to its construction; however, it will not be ASME BPVC stamped. In all cases, the procurement documents and the drawings contained in this specification define the hardware to be fabricated.

The items described in this Specification and the associated Drawings are mandatory and must be carefully controlled and verified during fabrication and assembly.

1.5 WORK INCLUDED

1.5.1 General

Work by SELLER set forth by this Specification shall include:

- A. Furnishing of all labor, planning, procedures, drawings, material, and equipment necessary to fabricate, test, and ship a complete Waste Package as described by the Drawings

(Appendix A) and content of this Specification, the ASME Design Specification (Appendix B), and purchase order documents. SELLER shall be responsible for furnishing all labor and materials related to gauges, fixtures, and equipment required to perform tests and activities required by this Specification. SELLER shall be responsible for the calibration, maintenance, protection, and storage of test equipment required by this Specification.

- B. Preparation and submittal of a Waste Package manufacturing plan, schedule, welding procedures, examination procedures, heat treatment procedures, and shop detail and assembly drawings to BUYER for review in accordance with the requirements of this Specification.
- C. Preparation and submittal of a Waste Package Records Package that includes fabrication travelers and checklists, certified material test reports (CMTRs) for base and filler materials, examination reports, measurement procedures and reports, and other documentation as defined in this Specification, all of which will be used to verify that the material and work conforms to the requirements of this Specification.

1.6 TECHNICAL TERMS AND ACRONYMS

The following definitions and acronyms shall apply as used within this Specification.

1.6.1 Definitions

- A. Bechtel SAIC Company, LLC (BSC), located in Las Vegas, Nevada, will be referred to as **BUYER** or **BSC**.
- B. The entity awarded the purchase order for furnishing the equipment that meets requirements specified herein will be referred to as **SELLER** or **SUPPLIER**.
- C. **OWNER** is the United States Department of Energy (DOE), Las Vegas, Nevada.
- D. The **Work** is all equipment, material, apparatus, item, and process, and parts or portions thereof, to be supplied by SELLER in accordance with the Purchase Order.
- E. The **Purchase Order** is any and all contractual documents, and changes thereto, prepared by BUYER and issued to SELLER delineating the scope of work to which this Specification applies. The agreements are between SELLER and BUYER regarding the Work to be performed and the equipment and documentation to be provided for the Work, including all terms and conditions under the Purchase Order.
- F. **Hold Point** is a step in the process at which SELLER must contact BUYER and obtain written authorization to proceed. Hold Points are designated in this Specification.
- G. **Witness Point** is a step in the process at which SELLER must contact BUYER so that BUYER can inspect or observe a process before SELLER proceeds. Witness Points are designated in this Specification.

H. **Major Dimension** is a dimension that requires inspection and formal documentation with actual results in the Document Package. Major Dimensions are all dimensions other than Reference Dimensions as shown in Drawings. As applicable, Major Dimensions are recorded after final welding, final heat-treating, and machining operations.

I. **UNS N06022 (SB-575)** is a generic designation for the specific low-carbon nickel-molybdenum-chromium alloy. This material is known to be difficult to machine.

J. **316** is defined as stainless steel per ASME BPVC SA 240 (UNS S31600 w/modified N & C) with restrictions on chemical composition.

C – 0.020% max
N – 0.060% min to 0.10% max

K. **516 Carbon Steel Grade 70** is defined as ASME BPVC SA-516, Grade 70 (UNS K02700) carbon steel plate.

L. **304 Stainless Steel** is defined as UNS S30400 in accordance with ASME BPVC SA-240.

M. **UNS S21800** is defined as ASME BPVC SA-276 S21800. A nitrogen strengthened austenitic stainless steel material used to fabricate the purge port plug.

N. **UNS N07718** is defined as a nickel alloy (ASME BPVC SB-637 N07718) with nominal 0.0020-inch thick silver-plating for the purge port gasket (defined as Jet Seal 03058).

1.6.2 Acronyms

ASME	American Society of Mechanical Engineers
ASME BPVC	ASME Boiler and Pressure Vessel Code
ASTM	American Society of Testing and Materials
BSC	Bechtel SAIC Company, LLC
CMTR	certified material test report
DOE	(U.S.) Department of Energy
M&TE	measuring and test equipment
NDE	nondestructive examination
NRC	Nuclear Regulatory Commission
NIST	National Institute of Standards and Technology
OCRWM	Office of Civilian Radioactive Waste Management
PQR	Procedure Qualification Record
PT	liquid penetrant examination
PWR	pressurized water reactor

QA	quality assurance
QC	quality control
RT	radiographic examination
SCC	stress corrosion cracking
SDDR	supplier deviation disposition request
SOW	Statement of Work
UT	ultrasonic examination
VT	visual examination
WPQR	welder performance qualification record
WPS	welding procedure specification
YMP	Yucca Mountain Project

2. APPLICABLE DOCUMENTS

Equipment and services for the Work furnished in accordance with this Specification shall comply with applicable laws and with the following codes and standards to the extent referenced herein and on the drawings and within Purchase Order documents. Unless otherwise noted, later Editions and Addenda of the ASME BPVC may be used if mutually consented to in writing between SELLER and BUYER. Any conflicting requirements must be submitted to BUYER in writing for resolution before proceeding with any phase of the Work.

2.1 CODES AND STANDARDS

The materials, design, fabrication, testing, examination, and shipping of the Waste Package shall meet the requirements of the following codes and standards as referenced herein. The codes and standards are applicable to the extent referenced in this Fabrication Specification and referenced Drawings however the ASME BPVC requires the use of the latest edition and addenda for Sections II and V. The sections shown in A through G are for clarity only.

- When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or referenced document, only those chapters, sections, parts or paragraphs of the document shall be applied.
- For the codes and standards listed below, the specific revision or effective date identified, as well as the specific revision or effective data of codes and standards that they incorporate by reference shall be followed.
- In the case of conflict between this specification and referenced codes and standards, the more conservative requirements shall apply.

- A. 2001 ASME Boiler & Pressure Vessel Code Section II, Materials, (includes the 2002 Addenda).
- B. 2001 ASME Boiler & Pressure Vessel Code, Section III, Rules for Construction of Nuclear Power Plant Components, Division 1, Subsection NB, Class 2 Components, 2001 Edition with the 2002 Addenda.
- C. 2001 ASME Boiler & Pressure Vessel Code, Section III, Rules for Construction of Nuclear Power Plant Components, Division 1, Subsection NC, Class 2 Components, 2001 Edition with the 2002 Addenda.
- D. 2001 ASME Boiler & Pressure Vessel Code, Section III, Rules for Construction of Nuclear Power Plant Components, Division 1, Subsection NF, Supports, 2001 Edition with the 2002 Addenda.
- E. 2001 ASME Boiler & Pressure Vessel Code, Section III, Rules for Construction of Nuclear Power Plant Components, Division 1, Subsection NCA, General Requirements for Division 1 and Division 2, 2001 Edition with 2002 Addenda.
- F. 2001 ASME Boiler & Pressure Vessel Code, Section V, Nondestructive Examination, 2001 Edition with 2002 Addenda.
- G. 2001 ASME Boiler & Pressure Vessel Code, Section IX, Welding and Brazing Qualifications, 2001 Edition with 2002 Addenda.
- H. ASME Y14.5M-1994, “Dimensioning and Tolerancing”, 1999 Edition.
- I. ASME Y14.36M, “Surface Texture Symbols”, 1996 Edition.
- J. ANSI/AWS A2.4-98, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- K. ASME B46.1-2002, Surface Texture (Surface Roughness, Waviness, and Lay), 2003 Edition.
- L. ASME NQA-1-2000, Quality Assurance Requirements for Nuclear Facility Applications, Subpart 2.1, Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components for Nuclear Power Plants, 2000 Edition (for cleaning, packaging, and shipping only).
- M. ASME NQA-1-2000, Quality Assurance Requirements for Nuclear Facility Applications, Subpart 2.2, Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items of Nuclear Power Plants, 2000 Edition.
- N. ANSI/AWS A5.32/A5.32M-97, Specification for Welding Shielding Gases, 1998 Edition.

2.2 DRAWINGS

The Engineering Drawings (Exhibit F of the procurement documents) specified in the Purchase Order are hereinafter referred to as drawings and set forth the extent of the Work to be performed under the Purchase Order. It is the responsibility of SELLER to produce all drawings SELLER will use to fabricate and test items produced to meet the requirements of this Specification. SELLER'S drawings must be reviewed by BUYER before proceeding with any Work in response to this Specification.

2.3 DESIGN REPORT

An ASME Design Report for the Inner Vessel (Appendix B) shall be prepared by SELLER in accordance with the ASME BPVC Section III, Division 1, NCA-3250 before fabrication can proceed. This design report shall be reviewed and released by BUYER before Work can begin.

3. DESIGN REQUIREMENTS

3.1 QUALITY LEVEL

The waste package is classified as a Quality Level 1 item and requires the application of very stringent quality requirements, including the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III requirements. These are the same requirements applied to the fabrication and construction of nuclear power plants.

Materials, fabrication processes, and examination and testing shall comply with the requirements of this Specification. SELLER shall accept complete responsibility for all the Work performed in compliance with this Specification. Review or acceptance of data or procedures by BUYER, with regard to the Work performed to accomplish the requirements of this Specification, does not constitute a release from conformance to the Statement of Work established within this Specification. The requirements of this Specification must be met.

Alternative fabrication details proposed by SELLER shall be submitted to BUYER in writing using SELLER Deviation Disposition Request (SDDR) as described in Appendix C. These alternative details shall not be incorporated in SELLER'S fabrication drawings without BUYER'S prior written direction to proceed.

3.2 MATERIAL BACKGROUND

As a part of the ongoing effort at YMP, the design and fabrication of a waste package to store and contain waste for extended time periods has evolved over several years. The current design uses two different materials as barriers (shells) within which the high level nuclear waste will be contained; the inner vessel for strength and the outer shell for corrosion protection.

3.2.1 Suspect and Counterfeit Materials

Items furnished under this Subcontract are intended for use in a U.S. Government-owned facility. Items delivered under this Subcontract may not contain potentially suspect or counterfeit items

or materials (i.e., fasteners, electrical components, mechanical devices, piping/piping system components, and/or raw-stock metals). SUBCONTRACTOR and its lower tier subcontractors and suppliers shall maintain sufficient control to prevent the procurement, installation, use, and delivery of materials and equipment that contain or exhibit suspect or counterfeit item characteristics or conditions. Additional information and guidance, to include the DOE Suspect Headmark List, can be obtained at:

<http://www.pppl.gov/eshis/procedures/qa020.pdf#search='DOE%20Headmark%20List>

SUBCONTRACTOR is solely responsible for all costs associated with the discovery, removal, replacement, and impoundment of materials and equipment that contain or exhibit suspect or counterfeit item characteristics or conditions.

1. Unless otherwise specified, all materials and all material components and parts associated with manufactured equipment, including that permanently installed into systems, subsystems, and/or assemblies, shall be new and unused. New surplus, refurbished, rebuilt, or modified items are strictly prohibited unless specifically authorized in writing by CONTRACTOR.
2. Materials and equipment delivered under this Subcontract shall exhibit the Manufacturer's original labels and identification and will be inspected by CONTRACTOR for indications of suspect or counterfeit characteristics and/or conditions.
3. Materials, equipment, or assemblies that consist of or contain fasteners (e.g., grades 5, 8, 8.2, A325, and A490, internally/externally threaded and greater than 0.25 in. in diameter), shall exhibit both grade marks and the Manufacturer's identification symbol (headmark), in accordance with the applicable specification (i.e., ASTM, SAE, etc.). Fasteners with headmarkings identified on the DOE Headmark List are STRICTLY PROHIBITED. Materials, equipment, or assemblies consisting of or containing fasteners, which DO NOT exhibit both grade marks and the Manufacturer's identification symbol in accordance with the applicable fastener specification constitute a nonconformance with the Subcontract requirements.
4. Materials, equipment, or assemblies that consist of or contain electrical components shall exhibit, as applicable, legible amperage and voltage ratings, operating parameters, and the product manufacturer's labels and identification. Electrical components shall exhibit, as applicable to the item or component, Underwriters Laboratory (UL) or Factory Mutual (FM) labels.
5. Materials, equipment, or assemblies that consist of or contain mechanical, piping, and piping system components and/or parts, shall clearly exhibit all markings as required by the ordering data or specifications and the original Manufacturer's labels and identification.
6. The critical lift path of lift equipment (cranes, forklifts, manlifts, etc.) used at the Jobsite (rentals or owned) shall be inspected for inclusion of Suspect/Counterfeit items prior to use of the equipment.

Detection by CONTRACTOR of any suspect or counterfeit condition leading to evidence of deliberate misrepresentation of any supplied item may result in an investigation into the validity of certification, fraud, and/or forgery, by the U.S. Government. Provisions of 10 CFR Part 21 apply.

3.3 SERVICE ENVIRONMENT

The environment within which the waste package must contain nuclear waste for extended time periods is complex and is described in other DOE documents that conclude that the humidity will be quite high and temperatures vary over a wide range for many thousands of years. The waste package performance has been shown to be a function of the corrosion resistance of the outer corrosion barrier material. The primary mechanism has been found to be stress corrosion cracking (SCC). SCC is influenced by the presence of a solute (water containing a variety of soluble element), outer corrosion barrier material microstructure, and residual stresses. Therefore, the goal is to produce an outer corrosion barrier with minimal surface defects and residual stresses.

3.4 DIMENSIONAL INTERFACES AND LIMITATIONS

Major Dimensions and tolerances identified on the drawings (Exhibit F of the procurement documents) are mandatory for the finished product after welding, solution heat treating, and machining. Piece part tolerances are shown in paragraph 5.3.1.

3.5 WASTE PACKAGE SURFACE CONDITION

The surface condition of the waste package specified in the drawings contained in Appendix A is mandatory for the functional performance of the waste package. The performance is impacted directly by the surface roughness. Machining, or other mechanical means, must be used to produce the surface and all surfaces must be essentially identical. Surface texture is the result of the processing method(s). For this reason the appearance in surface roughness, waviness, and lay for external parts must meet specified tolerances.

The outer surfaces of the waste package shall meet the requirements of ASME B46.1-2002 and have a surface roughness of 125 μ inch (3.2 μ meter) or better as described by Table 12-1 of ASME B-46.1. The method of producing the surfaces required shall include a final electro-polishing or other surface conditioning method such as grit blasting. The entity applying the surface conditioning process to the outer surface shall have a process designed to produce the required surface conditions while protecting the internals within the waste package and not leave an organic contaminate. Should a subcontractor be used, the QA program requirements that shall be applied are the normal requirements in the electro-polishing industry. This entity may work within the controls defined by SELLER and provide documentation describing the work performed as defined in the quality requirements applicable to the surface conditioning industry. The final emissivity of the surface shall be 0.70-0.88. A slightly grey surface is acceptable and preferred, however, the surface shall be smooth consistent with the electro-polishing process.

SELLER shall conduct a final inspection of the waste package surface condition and shall provide documentation attesting to the method(s) used and any related calibration information. Should visual inspection be performed using a micro finish comparator, visual acuity

documentation of the individual performing the inspection shall be included as part of the documentation in addition to the inspection record.

4. MATERIALS

4.1 GENERAL REQUIREMENTS

CMTRs for all materials of fabrication shall be provided to BUYER in the final documentation package. No materials may be substituted or changed without written direction by BUYER. SELLER may propose alternative materials, components, or parts, other than those specified in this Specification, in accordance with the SDDR process described in paragraph 9.6 and Appendix C. SELLER must substantiate in writing that any substitution is more economical and better qualified to operate under the conditions and performance requirements and is equivalent to, and, as applicable, in compliance with the applicable ASME BPVC requirements. All proposed substitutions shall be clearly defined by SELLER, with a complete description including supporting data establishing equivalence to the specified item, and submitted 15 calendar days prior to material order.

4.1.1 Inner Vessel and Outer Corrosion Barrier Materials

Materials for the Inner Vessel and the Outer Corrosion Barrier shall comply with the requirements of the ASME BPVC, Section III, NC-2000, and the applicable Section II Material Specification(s). The inner vessel shall be 316 stainless steel (SA-240)(UNS S31600) having restrictions as follows:

$$\begin{aligned}C &= 0.020\% \text{ max} \\N &= 0.060\% \text{ min to } 0.10\% \text{ max}\end{aligned}$$

The outer corrosion barrier shall be made from ASME SB-575, type UNS N06022. SELLER must be cognizant of the difficulty in machining and solution heat treatment of ASME SB-575, type UNS N06022.

Materials for the Divider Plate Assembly, if required by drawings, shall comply with the requirements of the ASME BPVC, Section III, NC-2000, and the applicable Section II Material Specifications. Note that all waste packages do not contain divider plates.

A. Material Identification and Traceability Marking

Permanent marking shall be done by any permanent method that will not result in sharp discontinuities as identified in Section 5.4.2.1. Marking of all materials shall be maintained in a manner that provides traceability to the associated material records.

Temporary marking(s) shall not result in sharp discontinuities on the material as identified in Section 5.4.2.1.

B. Examination and Repair of Plate

No weld repairs shall be performed until BUYER has accepted SELLER'S written procedure. The weld repair shall be in accordance with Section 5.5.1.5 of this Specification.

1. Inner Vessel

Examination and repair of the Inner Vessel shall be in accordance with the ASME BPVC, Section III, Division 1.

2. Outer Corrosion Barrier

Examination and repair of the Outer Corrosion Barrier shall be in accordance with the ASME BPVC, Section III, Division 1, NB-2530 (Class 1) and the following additional requirements.

- a. The Outer Corrosion Barrier base material shall be examined by the angle beam ultrasonic method in accordance with ASME Section III, NB-2532.2, and reportable indications shall be charted, reported, and included in the records package.
 - b. In lieu of the examination requirements of ASME Section III, NB-2539.4, repair welds in the Outer Corrosion Barrier base material shall be examined using radiographic methods, angle beam ultrasonic methods, and liquid penetrant examination (PT) methods in accordance with ASME Section III, NB-5110. The acceptance standards are ASME Section III, NB-5320, NB-5330, and NB-5350 except for ASME Section III, NB-5320 (b) and NB-5331 (a), where the maximum acceptable indication length shall be 1/16 inch regardless of material thickness.
3. The Divider Plate Assembly, if required, shall be examined and repaired in accordance with the requirements of ASME BPVC, Section III, Division 1, NC-4000 and NC-5000.
4. BUYER Responsible Engineer shall review requests for repairs, obtain resolution of comments, release any proposed repairs and release repair procedures for use prior to any repair work being performed.

C. Welding Materials

All welding filler metals shall conform to the requirements of the ASME BPVC Section III, Division 1, NC-2400. Welding materials may be purchased in accordance with the Edition and Addenda of the ASME BPVC effective at the time the material purchase order is placed. Filler metals shall be tested as specified below. Actual CMTRs shall accompany each lot or heat of the material purchased.

1. Stainless Steel

- a. Covered stainless steel electrodes for shielded metal arc welding shall conform to the requirements of ASME SFA-5.4, Classification E316 or E308 (as applicable).
- b. Bare stainless steel welding electrodes and rods shall conform to ASME SFA-5.9, Classification ER316 or ER308 (as applicable).

2. UNS N06022

Bare welding electrodes and rods shall conform to ASME SFA-5.14, Classification ERNiCrMo-10.

3. Carbon Steel

Carbon steel electrodes and rods shall conform to ASME SFA-5.5 or ASME SFA-5.18.

4. Shielding Gases

All shielding gases shall meet the requirements specified in ANSI/AWS A5.32/A.5.32M-97.

5. Carbon Steel to Stainless Steel

- a. Covered stainless steel electrodes for shielded metal arc welding shall conform to the requirements of ASME SFA-5.4, Classification E309L.
- b. Bare stainless steel welding electrodes and rods shall conform to ASME SFA-5.9, Classification ER309L.

4.1.2 Other Materials

Piece parts and standard products incorporated into the Waste Packages have been designated on the Drawings as American Society of Testing and Materials (ASTM) or ASME materials or by manufacturer's call-out, when applicable. CMTR's for all materials shall be provided in the records package.

5. FABRICATION

All cutting, forming, machining, and fitting operations shall be performed in accordance with approved shop procedures, including drawings that incorporate the provisions of this Specification. All cutting, forming, machining, and fitting operations applied to the Inner Vessel and the Outer Corrosion Barrier shall meet the requirements of ASME BPVC Section III, Division 1, NC-4000.

5.1 CUTTING

When practical, weld preparations shall be prepared using non-thermal means. Thermally cut surfaces and associated heat affected zones shall be ground or machined to provide base metal that is slag-free and not heat-affected. See Section 6.1.D.1 for nondestructive examination (NDE) requirements for weld edge preparation surfaces.

5.2 MACHINING

Tooling used during machining shall be suitable for the task and capable of producing the required dimensional control and surface finishes specified on the shop Drawings and by this Specification.

5.3 FITTING AND ALIGNING

The accuracy of fit-up for all parts shall be as required to meet the component and assembly tolerances contained on the Drawings included or produced in response to this Specification.

5.3.1 Piece Part Tolerance

When piece part tolerances are not shown on the Drawings, SELLER shall establish piece part tolerances that provide a documented method to assure that the finished product meets the overall tolerances specified in the Drawings. All piece part tolerances shall be stated on the shop drawings.

SELLER may recommend variations in the piece part tolerances established by the Drawings, provided a system is established that ensures that the finished product meets the overall tolerances specified in the drawings required by this Specification.

SELLER shall adjust dimensions, as needed, to perform all fabrication processes to accommodate shrinkage and distortion. Appropriate changes required, complying with the finished dimensions and tolerances, shall be documented on the Drawings. Adjustments shall be shown on the Drawings used.

5.3.2 Dimensional Verification

SELLER shall prepare and submit In-Process Reports in accordance with this Specification. Measurement Reports shall be used to record the measured Major Dimensions necessary to certify the Major Dimensions of each assembly and component. This report shall contain the component serial number and Major Dimension label that shows compliance with Major Dimensions as shown on the Drawings. Verification of dimensions shall be performed with calibrated equipment. Drawing dimensions stated in decimal notation shall be checked with suitable calibrated equipment. Drawing dimensions stated in numeric fractions shall be checked with instruments appropriate to that measurement; however, normal fabrication measuring tools such as rules and tapes do not require calibration. The ambient temperature shall be recorded and reported for all precision dimensional verifications utilizing calibrated equipment.

Trial fit of the Inner Vessel Lid and Spread Ring to the Inner Vessel, and Outer Lid to the Outer Corrosion Barrier is required. The parts used in the trial fit shall be identified in the Measurement Reports by their unique serial numbers.

5.4 ASSEMBLY

SELLER shall develop a manufacturing plan and schedule that provides sufficient detail to clearly define the proposed assembly chronological sequence including the required cutting, fitting, aligning, and welding steps necessary to ensure that the overall tolerances are maintained. The manufacturing plan and schedule shall be submitted to BUYER for review forty-five (45) calendar days before fabrication. This review, resolution of comments, and release to proceed is required before fabrication can begin.

5.4.1 Assembly Requirements

SELLER shall establish tolerance criteria for each sub-assembly consistent with the overall finished dimensions and tolerances specified in the Drawings. These tolerances shall be included on the shop drawings. Parts shall be cleaned in accordance with section 5.7 of this Specification prior to assembly.

5.4.2 Marking (Labeling) of Completed Assemblies

This section lists the requirements for permanent marking of completed assemblies. It does not include temporary markings used to maintain CMTR/heat/lot traceability during shop fabrication of piece-parts. Completed Waste Packages shall be sequentially identified with a unique number that will be stated in the Purchase Order.

5.4.2.1 Waste Package Marking

Each piece (e.g., cylinder(s), lids, divider plates) shall be uniquely identified. SELLER shall produce a weld map, material map, and radiographic map for the Waste Package. These maps shall provide traceability of all materials to heat (lot) numbers throughout the fabrication sequence and final assembly. Each weld shall be marked to identify the welder and weld material by heat or lot number and shall be traceable to generated NDE reports and fabrication travelers. These maps shall be included in the final record package. Identification necessary to ensure traceability of materials is required.

- A. Method: Vibro-etching, direct engraving, laser marking, or photo engraving shall be used for identification for any Outer Corrosion Barrier Component and may be used for identification for any Inner Vessel and Divider Plate Assembly Component. Any Inner Vessel and Divider Plate Assembly Component may be impression-stamped using low-stress blunt-nosed continuous or blunt-nosed interrupted-dot die stamps. High-stress die stamping or pin stamping is not permitted on any part.
- B. Marking Text Font: The text font shall be an upright, sans serif, and modern type font such as Gothic, Arial, or equivalent. Height-to-width ratio of the letters and numbers in the font may be from 1/1 to 2/1. All text shall be upper case.
- C. Marking Text Height: Text height shall be a minimum of 5/8 inch and a maximum of one (1) inch.
- D. Marking Die Stamp: Die stamps shall be low-stress type (blunt-nosed continuous dies or blunt-nosed interrupted-dot die) stamps. The tip radius of the dies for 5/8 inch character size letters shall be 0.010 inch minimum. The impression depth shall not exceed 0.010 inch.

E. The Inner Vessel Lid shall be marked with the ASME BPVC “N” stamp information as required for nameplates, as specified in ASME BPVC NCA-8200. The location of the stamp shall be immediately in-board from the serial number stamp location specified in Table 5-1 of the Inner Vessel Lid. The format of figure ASME NCA-8212-1 “Form of Stamping” shall be as follows:

1. Code symbol, method: stamp
2. Class of construction, method: stamp
3. “Certified by” method: stamp or electro-etch
4. Certificate Holder’s name, method: stamp or electro-etch
5. Serial Number, method: stamp or electro-etch

TABLE 5-1. WASTE PACKAGE LABELING		
Item	Serial Number*	Location and Orientation on Component
Outer Corrosion Barrier Cylinder	OC-002	Outside surface, middle of cylinder, opposite long seam of upper shell course
Inner Vessel Cylinder	IC-002	Outside surface, middle of cylinder, opposite long seam of upper shell course and top edge
Outer Lid	OL-002	Outside surface of lid, six inches from the outer edge
Inner Vessel Lid	IVL-002	Outside surface of lid, 12 inches outboard from Lifting Ring
Bottom Lid	BL-002	Outside surface of lid, six inches from the outer edge
Inner Vessel Bottom Lid	IVBL-002	Outside surface of lid, six inches from the outer edge
Shell Interface Ring	IR-002	Top surface of ring, in the middle
Inner Vessel Support Ring	IVSR-002	Top surface of ring, in the middle
Spread Ring	SR-002	Top surface of ring, in the middle
Upper Sleeve	UTS-002	Outside Surface
Lower Sleeve	LTS-002	Outside Surface

Purge Plug	PPP-002	Top Surface
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*Note: Serial number changes with each unit produced.

5.5 WELDING

Temporary welded attachments during fabrication shall be avoided as much as possible. If they are used, every effort shall be made to place them in locations that would normally be discarded. If they are placed on material to be left in the completed Inner Vessel, Outer Corrosion Barrier, or Divider Plate Assembly, they must be removed and the heat affected zone completely removed by grinding. The area shall be examined by the liquid dye penetrant (PT) method in accordance with ASME Section III, and Section 6.1.D of this Specification.

5.5.1 Welding Processes

Welding processes shall be qualified in accordance with ASME BPVC Section IX. Only the welding processes described in this Specification may be used.

Welding processes used on the Inner Vessel, the Outer Corrosion Barrier, and the welds that attach the Divider Plate Assembly to the Inner Vessel shall comply with ASME BPVC Section III, NC-4000, and Section IX. The remaining Divider Plate Assembly welds shall use welding processes that comply with Section III, NF-4000, and Section IX (applies only to 5-DHLW/DOE Short, 5-DHLW/DOE Long, and 2-MCO/2-DHLW).

5.5.1.1 Allowable Welding Processes

A. Gas Tungsten Arc

Gas tungsten arc welding may be used for stainless and nickel alloy weldments. An inert gas backing purge must be used for the first 3/16 inch of deposited weld metal thickness for full penetration welds having an open to the environment backside. The gas tungsten arc welding process may be either manual or automated. Either technical approach shall be qualified prior to use.

B. Gas Metal Arc

Gas metal arc welding may be used for stainless, nickel alloy, and carbon steel. This process shall not use the short-circuiting arc mode for welding of any component.

C. Shielded Metal Arc

Shielded metal arc welding processes may be used to fabricate the inner vessel (stainless steel) or carbon steel parts, however, the welder must ensure that all slag is removed between layers and that no slag is left on the outer surface. Shielded metal arc welding shall not be used to fabricate the outer corrosion barrier (UNS N06022).

D. Alternative welding processes

Alternative welding processes may be proposed by SELLER, subject to review and release to proceed by BUYER. The use of processes using coated electrodes or producing slag of any type is prohibited for use on the Outer Corrosion Barrier.

5.5.1.2 Welding Procedure Specifications and Procedure and Performance Qualifications

SELLER shall prepare written Welding Procedure Specifications (WPSs).

Each WPS used for welding on any Waste Package material, except for Divider Plate Assembly welds that do not attach Divider Plate Assembly to the Inner Vessel, shall be prepared and qualified in accordance with the requirements of ASME BPVC Section III, NC-4000, ASME BPVC Section IX, and this Specification. The WPSs used for welding Divider Plate Assembly welds that do not attach Divider Plate Assembly to the Inner Vessel shall be prepared and qualified in accordance with the requirements of ASME BPVC Section III, NF-4000, Section IX, and this Specification. SELLER shall qualify all welders used to make any weld in the Waste Package except for Divider Plate Assembly welds that do not attach Divider Plate Assembly to the Inner Vessel in accordance with ASME BPVC Section III, NC-4000, and Section IX. SELLER shall qualify all welders used to make any weld for Divider Plate Assembly that do not attach Divider Plate Assembly to the Inner Vessel in accordance with ASME BPVC Section III, NF-4000, and Section IX.

WPSs, Procedure Qualification Records (PQRs), and Welder Performance Qualification Records (WPQRs) shall be clear, sharp, reproducible documents and must include all applicable essential and nonessential variables listed in the ASME BPVC, Section IX.

Approved WPSs shall be identified on SELLER'S shop drawings. SELLER shall submit, thirty (30) calendar days before the start of welding operations, one (1) copy of the WPS, corresponding procedure qualification record, qualification procedure for the welders, and WPQRs to BUYER for review, resolution of comments, and release to proceed. The welding and QC procedures shall include the requirement that no welder shall have in his possession more than one (1) type of filler metal at any one time.

5.5.1.3 Preheat and Interpass Temperatures

- A. The maximum interpass temperature for welding austenitic stainless steel materials shall be 350°F and the minimum preheat temperature is 50°F. The maximum interpass temperature for welding UNS N06022 is 200°F and the minimum preheat temperature is 50°F. The maximum interpass temperature for welding carbon steel is 500°F and the minimum preheat temperature is 50°F.
- B. Preheat and interpass temperatures shall be measured using temperature indication crayons, optical or contact pyrometers, or other suitable means accepted by BUYER. Temperature indication crayons that contain inorganic sulfate, halogens, or sulfur shall not be used on austenitic stainless steel or UNS N06022. The in-process documentation shall accommodate the recording of these temperatures.
- C. Interpass temperature requirements listed above shall apply to all welds.

5.5.1.4 Workmanship and Visual Weld Quality

The following workmanship criteria shall be applied to each weld as applicable to the type of weld:

- A. Each weld shall be essentially uniform in width and size throughout its full length. Each layer of welding shall be visually free of slag, inclusions, cracks, porosity, and lack of fusion.
- B. Fillet welds shall be of the specified size with full throat thickness. Fillet welds shall meet the minimum size required by the drawings, but may vary in size above the minimum as long as a reasonably uniform appearance is maintained.
- C. Elimination of defects and surface preparation of welds by chipping, grinding, or gouging shall be done in such a manner as not to gouge, groove, or reduce the adjacent base-material thickness below the required design thickness. Only BUYER-released repair procedures shall be used.
- D. Precautions shall be taken to minimize weld spatter and arc strikes. If these occur, they shall be removed by procedures released by BUYER.
- E. Peening shall not be used without the prior written BUYER'S acceptance of the method and controls to be used. Use of pneumatic tools for slag removal is not considered peening and is acceptable.
- F. Welds shall be considered ground flush when they are within 1/8 inch of the base metal surface. Weld caps reinforcement on all shell seams shall be a maximum of 1/8 inch high. The weld reinforcement will be blended smoothly into base material to accommodate NDE. If grinding is required to maintain the maximum weld height, the finish shall be equivalent to a finish produced by 120 grit or finer abrasive media.
- G. Tack welds used to secure alignment shall be removed completely, or, when they have served their purpose, their stopping and starting ends shall be properly prepared to assure that they are satisfactorily incorporated into the final weld. Qualified welders using qualified welding procedures, in accordance with Section 5.5.1.2 of this Specification, shall make tack welds and temporary attachment welds. Tack welds and temporary attachment welds shall be performed using welding processes and personnel qualified to the requirements of ASME BPVC Section IX for the process used.

5.5.1.5 Repair by Welding

A. Weld Repair of Defects in Base Material:

Defects in plates used in the Inner Vessel, the Outer Corrosion Barrier, and Divider Plate Assembly shall be repaired as specified in Section 4.1.1 of this Specification. Repair welding shall be performed using welding procedures and welders qualified in accordance with ASME BPVC Section III and Section IX.

B. Repair of Defects in Completed Welds:

Defects in welds in or on the Inner Vessel, Outer Corrosion Barrier, or Divider Plate Assembly shall be repaired in accordance with ASME BPVC Section III. Repairs to welds shall be examined in accordance with the requirements for examination of the welds in Section 6.1.

Repair welding shall be performed using welding procedures and welders qualified in accordance with Section 5.5.1.2 of this Specification. All repairs to completed welds are to be documented on a NDE/Weld History record that shall include the type, location of defect repaired, subsequent heat treatment, if performed, and the results of re-examination(s) performed after repair.

C. Number of Weld Repair Cycles

BUYER shall be notified in accordance with Section 9.6 when either the weld or base material defect exceeds two cycles for any individual repair.

5.6 HEAT TREATMENT

- A. Heat treatment shall be accomplished by any suitable method of heating and cooling, provided the required heating and cooling rates, metal temperature uniformity, and temperature control are maintained. Personnel performing heat treatment shall be qualified in accordance with the SELLER's QA program. The heat treatment shall provide for heating of the entire outer shell with one (1) heat treatment. This heat treatment shall be performed with calibrated thermocouples protected from direct contact with water that is in contact with the material. This shall be appropriately documented.
- B. SELLER shall prepare written Heat Treatment Procedure(s) meeting the ASME BPVC Section III, Division 1, NC-4600, and this Specification. This procedure shall include the number of thermocouples and show their locations. Heat Treatment Procedure(s) shall be clear, sharp, reproducible documents and shall be submitted thirty (30) calendar days before fabrication for BUYER'S review, resolution of comments, and release. Time-Temperature Recordings of all heat treatments shall be maintained and included in the document package.

C. Solution Annealing of Outer Corrosion Barrier

The solution annealing operation is a critical operation. Particular attention must be paid to the method and planning to achieve annealing that meets the requirements below especially if the Outer Corrosion Barrier is not subsequently machined. This process can require special tooling and this expense needs to be factored into the manufacturing plan.

The Outer Corrosion Barrier shall be solution annealed after completion of all required work. The final machining of the inner diameter of the Outer Corrosion Barrier, if required, the final closure weld area, and the sleeve configuration shall be machined after the solution annealing process is complete. The outer diameter of the Outer Corrosion Barrier, including the bottom lid, shall not be machined after the solution annealing.

The Outer Corrosion Barrier shall be furnace heated at a temperature of 2050°F+ 50°F/-0°F for 20 minutes minimum and then quenched. Cooling will be achieved by immersion in

water or spray quenching with water. The cooling rate for the entire outer shell shall be greater than 275°F/minute from soak temperature to below 700°F. The quench delay (time from removal from furnace to start of quench) shall be engineered to be as short as achievable and shall assure that the quench initiation starts at 2020°F or higher. Either thermodynamic calculations or test data based on Alloy 22 that take into account any quench delay shall be provided to demonstrate that this cooling rate can be achieved. This calculation or test data shall be a prerequisite to performance of the solution annealing. Heat treating fixtures, if used, shall be fabricated in accordance with released drawings and submitted to BUYER for review and release prior to use. Recording devices used shall provide continuous cooling data and be capable of precisely confirming the times and cooling rates.

No repairs shall be performed on the Outer Corrosion Barrier after solution annealing.

D. Sleeve Heat Treatment

The sleeve are subject to distortion during final heat treatment. Because the rings contain significant cold work resulting from the forming operations, each ring shall be annealed at a temperature of 2050°F+ 50°F/-0°F for 20 minutes minimum and then quenched. Cooling will be achieved by immersion in water. The cooling rate for the entire outer shell shall be greater than 275°F/minute from soak temperature to below 700°F. The quench delay (time from removal from furnace to start of quench) shall be engineered to be as short as achievable and shall assure that the quench initiation starts at 2020°F or higher.

This first annealing operation shall be performed after final welding to produce the rings from pate material and before machining to fit onto the outer corrosion barrier. The machining shall be performed on the inside diameter and weld preparations only then performing the final machining after the outer corrosion barrier is solution annealed. This annealing step is to minimize distortion of the outer corrosion barrier assembly when it is annealed.

5.7 CLEANING AND SURFACE PREPARATION

Cleaning and surface preparation shall be as specified on the Drawings and in accordance with the following requirements:

- A. All metal surfaces shall have a surface cleanliness classification C as defined in ASME NQA-1-2000 Edition, Subpart 2.1 Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components for Nuclear Power Plants.
- B. All welding by-products such as slag, spatter, or smoke stains shall be removed.
- C. Use of any mechanical method that produces excessive surface roughness or cleaning agents that have corrosive effects or alter the performance or the material, is prohibited.

- D. No materials nor methods used during cleaning may contain halogens, sulfur, or other deleterious materials in concentrations greater than 25 ppm. Copies of the halogen and sulfur content certification shall be included in the final document package.
- E. Written procedures prepared in accordance with ASME NQA-1-2000 Edition, Subpart 2.1 for cleaning, inspection, and testing of cleanness shall be submitted to BUYER for review, resolution of comments, and release thirty (30) calendar days before fabrication begins.
- F. Components shall be degreased before welding using a cleaning agent that does not contain more than twenty-five (25) ppm halogens and sulfur. No markings made with dye or paint markers shall remain. The cleaning technique shall be included in the cleaning procedure. Copies of the halogen and sulfur content certification shall be included in the final document package.
- G. The inside and outside surfaces of all finished parts shall be free from mill scale, machining chips, grease, oil, weld spatter, arc strikes, or foreign matter. It is essential that the annulus between cylinders and divider plate spaces be clean and not contain any foreign matter. This cleaning shall be done before any heat treatment and verified by inspection after heat treatment.
- H. During fabrication, contact with clean carbon steel bedplates, cutting tables, lathes, boring mills, tooling, handling equipment, test equipment, and similar items is permitted. Polymer shims or coatings should be used between carbon steel and UNS N06022 where appropriate. Any of the above carbon steel surfaces shall be clean of any loose scale, rust, or steel particles that could become embedded in the stainless steel or UNS N06022.
- I. Grinding wheels shall be made of aluminum oxide and wire brushes shall be Type 300 series stainless steel. Grinding wheels and wire brushes shall only be used on one (1) type of material. Nonferrous materials shall be isolated from grinding or welding of carbon steels to avoid cross contamination.
- J. Cutting oils, lubricants, inks, labels, or other means of marking fabrication progress, and other materials/chemicals used during the fabrication and examination (e.g., ultrasonic testing couplants) shall have a maximum halogen and sulfur content of two hundred and fifty (250) ppm. Certifications of halogen and sulfur content shall be included in the final document package. This requirement does not apply to the material suppliers for their in-process lubricants and fluids in the production of materials. These materials shall be clean and marked with agents that do not contain more than twenty-five (25) ppm halogens and sulfur. Certifications of halogen and sulfur content shall be included in the final documentation package.
- K. In-process lubricants and fluids that are required in the manufacture of raw materials (plate and bar) have no requirements for halogen and sulfur content. However, prior to shipment of raw material from sub-tier suppliers to SELLER, the raw material will be cleaned with materials or methods that shall not contain halogens, sulfur, or other deleterious materials in concentrations greater than twenty-five (25) ppm. Copies of the halogen and sulfur content certification shall be included in the final document package.

- L. Caution should be exercised when planning machining operations on Alloy 22 material. This material does not machine like normal Inconel material. It requires much lower feeds and speeds to prevent tool damage. Long machining spans will be required.
- M. Should the manufacturing plan call for machining the inside of the Outer Corrosion Barrier after annealing, care should be taken to assure that the machine shop has appropriate tooling to accomplish this task.

6. EXAMINATION AND TESTING REQUIREMENTS

The Waste Package shall receive the tests, examinations, performance tests, and leakage tests described herein. The purpose of these tests and examinations is to ensure the quality of workmanship and to assure that the Waste Package meets the functional requirements specified herein. Forty-five (45) calendar days before fabrication, a test plan and a test schedule shall be provided by SELLER for BUYER'S review and release. SELLER shall furnish all examination and test facilities, materials, and labor necessary for performance of tests and examinations or for any modifications resulting from the tests or examinations. SELLER shall repair in accordance with the requirements of this Specification or replace all or any parts of the Work not in compliance with this Specification as determined by such examinations and tests.

BUYER and OWNER reserve the right to use a designated Representative of BUYER during tests and examinations including hold/witness point activities. The presence of either BUYER or OWNER'S Representative during fabrication shall not relieve SELLER from performing required in-house QC functions. SELLER is responsible for first line examination and verification of items and services within the contractual Statement of Work. OWNER'S Representative shall be entitled to the same site access privileges as BUYER and shall be provided all necessary documents and records necessary to perform BUYER'S inspection work and surveillance duties during hold and witness point activities.

SELLER shall provide sufficient office space for BUYER'S on-site technical and quality representatives when present. Free access to all manufacturing areas containing BUYER'S equipment shall be granted.

SELLER shall notify BUYER fifteen (15) or more calendar days in advance of hold or witness points. Hold points may not be waived without specific written consent of BUYER. Work may proceed past a designated witness point upon notification and written agreement from BUYER. Agreements may be in the form of e-mail and shall be included in the records package.

For tests and examinations that are to occur during manufacturing, assembly, and testing, SELLER shall submit to BUYER documentation identifying SELLER'S QA examination, test, and hold points. This list will be used by BUYER to select the required surveillance hold and witness points stated in this Specification. The minimum hold and witness points are listed in Appendix D.

6.1 NONDESTRUCTIVE EXAMINATION (NDE)

A. General

NDE shall be performed after final machining, surfacing, or heat treatment, except that PT shall be performed prior to heat treatment. Level II or III NDE personnel shall examine welds in or on the Inner Vessel and the Outer Corrosion Barrier in accordance with the requirements of the ASME BPVC Section III, NC-5200 and NC-5300. Welds that become inaccessible after assembly or heat treatment shall be examined prior to assembly or heat treatment. NDE is not required after electro-polishing of the outer corrosion barrier unless SELLER has reason to believe that some defect was introduced.

SELLER shall submit the following documentation for BUYER's review:

1. SELLER'S NDE personnel qualification and certification written practice.
2. SELLER'S NDE personnel qualification and certification records. These records shall include:
 - a. Valid vision acuity and color differentiation examination.
 - b. Objective evidence of NDE training, experience, and examinations.
 - c. Level of formal education.
 - d. Statement of certification (level and method) signed by a company official attesting to personnel qualifications.
 - e. Dates of certification and recertification and the dates of assignment to NDE.
3. SELLER'S NDE method procedures for radiographic examination (RT), ultrasonic examination (UT), PT, and visual examination (VT) shall be submitted for BUYER's review, resolution of comments, and release thirty (30) calendar days before fabrication.

B. Radiographic Examination (RT)

All 316 and UNS N06022 full penetration welds and top weldment of the upper Sleeve to Outer Corrosion Barrier shall be radiographically examined in accordance with the requirements of the ASME BPVC Section III, NC-5320. As a supplemental requirement, the maximum acceptable indication length shall be 1/16 inch (1.6 millimeter) for all UNS N06022 full penetration welds and 1 millimeter (0.04 inches) for the top weldment of the upper Sleeve to Outer Corrosion Barrier. The following additional requirements apply:

1. SELLER shall use a National Institute of Standards and Technology (NIST)-traceable, calibrated densitometer when verifying the optical density of the radiograph. Comparator strips are not acceptable.
2. A written report containing the results of the examination shall be prepared and signed by the level II or III radiographer for each weld radiographically examined.
3. A complete radiographic history, including exposure diagram, reader sheet, record of defects, record of repairs, and final cleared exposure record, shall be submitted to

BUYER. Film and reader sheets shall be marked or noted to show any condition other than normal (e.g., surface conditions or defects within acceptance standards) and reader sheets shall be marked to show the level of the qualification of the reader. Radiographic film shall be sent to BUYER as part of the document package.

C. Ultrasonic Examination (UT)

All UNS N06022 full penetration welds and top weldment of the upper Sleeve to Outer Corrosion Barrier shall be ultrasonically examined in accordance with the requirements of ASME BPVC Section III, NC-5330. As a supplemental requirement, the maximum acceptable indication length shall be 1/16 inch (1.6 millimeter) for all UNS N06022 full penetration welds and 1 millimeter (0.04 inches) for the upper Sleeve to the Outer Corrosion Barrier. The following additional requirements apply:

1. Couplants used on nickel based alloys and austenitic stainless steels shall not contain more than two hundred and fifty (250) ppm of halides (chlorides plus fluorides) or sulfur.
2. A written report of each weld examined by UT shall be prepared and signed by a level II or III UT examiner. As a minimum, the report shall include part or weld number, couplant manufacturer, couplant type, batch numbers, sulfur content for nickel base alloys only, halides (chlorides plus fluorides) content for austenitic stainless steel only, and examination results.

D. Liquid Penetrant Examination (PT)

Welds using ASME BPVC Section III, Subsection NC shall be examined by liquid penetrant methods in accordance with the requirements of the ASME BPVC Section III, NC-5350. Welds shall be examined prior to heat treatment. Field weld joint preparation surfaces shall be examined by the liquid penetrant method after heat treatment unless assembly and heat treatment make them inaccessible. The acceptance criteria for PT shall be ASME BPVC Section III, NC-5352. The following requirements apply:

1. The weld preparation and adjacent base material for at least two (2) inches on each side of the weld at the external and accessible internal surfaces shall be included in the examination.
2. Penetrant materials used for examination of austenitic stainless steels and nickel-based alloys shall be analyzed for contaminant as specified in the ASME BPVC Section V, Article 6, T-640, and meet the proper limits. Copies of the analysis reports shall be included in the document package.
3. PT shall be by the solvent removable method.
4. Flushing the surface with solvent following the application of the penetrant and prior to application of developer is prohibited.

5. The penetrant materials shall be thoroughly removed after the examination has been completed, followed by a wiping or flushing of the area with demineralized water, approved solvents, or isopropyl alcohol.
6. A written report of each weld examined by liquid penetrant shall be prepared and signed by a level II or III PT examiner. At a minimum, the report shall include part or weld number, penetrant manufacturer, penetrant type, batch numbers, and results of examination.

E. Visual Examination (VT)

1. All welds shall be examined by the visual method, by Level II or III NDE personnel qualified in accordance with ASME BPVC, Section III.
2. The length and location of welds shall be specified on the Drawing, except that weld lengths may be longer than specified. For weld lengths less than 3 inches, the permissible under length is 1/8 inch, and for welds 3 inches or longer, the permissible under length is 1/4 inch. Intermittent welds shall be spaced within one (1) inch of the specified location.
3. Arc strikes and associated blemishes on the weld or in the base-material shall be removed by grinding.
4. A written report containing the results of the examination shall be prepared and signed by the level II or III VT examiner for each weld visually examined.

6.2 PRESSURE TESTING

The Inner Vessel shall be hydrostatic or pneumatically tested in accordance with ASME BPVC Section III, NC-6220 or NC-6320. SELLER shall provide to BUYER thirty (30) calendar days prior to start of testing, written pressure testing procedure for review, resolution of comments, and release. Pressure testing shall be performed after the installation of all internals within the inner vessel (divider plate, etc.).

6.2.1 Hydrostatic Testing

If the Inner Vessel is hydrostatically tested it shall be tested to 1.25 times the Design Pressure as stated in Appendix B of this specification for at least ten (10) minutes prior to initiation of the examination. The examination of leakage shall be performed in accordance with ASME BPVC Section III, NC-6224.

6.2.2 Pneumatic Testing

If the Inner Vessel is pneumatic tested, it shall be pressurized with helium to 1.1 times the Design Pressure as stated in Appendix B for a minimum total time of ten (10) minutes, after which the pressure shall be reduced to that required by section 6.3.1 below. The examination for leakage required by ASME BPVC Section III, NC-6324 shall be satisfied by checking Inner Vessel surfaces for helium leakage in accordance with Section 6.3.1.

6.3 HELIUM LEAKAGE TESTS

Personnel performing and interpreting helium leakage test results shall be certified in accordance with Section 6.1.A.

6.3.1 Helium Leakage Test for Inner Vessel

The helium leakage test shall be in accordance with the ASME BPVC, Section V, Article 10, Appendix IX, Hood Technique. The helium leakage test shall be performed using a pressure differential of not less than 0.1 MPA (1 atmosphere). The maximum acceptable leakage is 1×10^{-6} std-cm³/sec helium.

The helium leakage test system must be calibrated with a NIST traceable calibrated standard. The helium leakage standard shall be positioned in the system such that it represents the spectrometer leakage detector. The helium standard must be continuously evacuated by an auxiliary pump just prior to being released into the system. The helium response time and system sensitivity shall be included in the test report.

Leakage from the temporary seal between the lid and vessel is permitted, provided any such leakage is directed away from the surface of the Inner Vessel to avoid masking any other leakage.

SELLER shall provide BUYER thirty (30) calendar days prior to the start of testing, with written procedures for the helium leakage test for release. The results of each helium leakage test shall be provided to BUYER as part of the applicable document package.

6.4 PERFORMANCE TESTS

SELLER shall provide to BUYER written procedures for all performance tests for review thirty (30) calendar days prior to the start of testing. All performance tests shall be conducted at room temperature (65-75⁰ F) with test pieces and gauges at the same nominal temperature. No intentional heating or cooling of either the gauge or the test piece will be allowed.

Empty Weight Measurement: SELLER shall weigh the Waste Package components and the fully assembled Waste Package and record the weights. The dry weight of the following components shall be supplied to BUYER:

- Outer Corrosion Barrier
- Inner Vessel including Divider Plate Assembly; if divider plate is applicable
- Inner Vessel Lid including Spread Rings
- Outer Lid
- Fully Assembled Waste Package
- Prior to performing the weight tests, the calibration of the weighing device shall be verified. Calibration certificates for the weighing device shall be provided to BUYER.

7. PACKAGING AND SHIPPING REQUIREMENT

7.1 GENERAL REQUIREMENTS

7.1.1 Applicable Guidelines from the American Society of Mechanical Engineers and American National Standards Institute

Packaging and shipping shall be in accordance with ASME NQA-1-2000 Edition, Subpart 2.2, QA Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Power Plants. All packaging and shipping shall conform to Level C requirements or better. SELLER, ninety (90) calendar days before shipment, shall provide a packaging plan with details by component, to BUYER for release.

7.1.2 Shipping Information

On the date of shipment, SELLER shall inform BUYER of the following: The carrier bill of lading number, the routing and destination instructions, and a list of the items being shipped.

7.1.3 Supplier Liability for Shipping

SELLER shall ensure that the as-fabricated, as-tested condition of the Waste Package is maintained, and that distortion or creep during shipment is prevented. Any damage or distortion of the Waste Package because of improper packaging, in-transit handling, or shipping, shall be repaired at the expense of SELLER. The Buyer's release of these procedures does not relieve the Seller of the responsibility for repair of the Waste Package if damage or distortion occurs during in-transit handling or shipping.

7.2 PACKAGING & SHIPPING REQUIREMENTS

SELLER shall provide BUYER with the written procedures (including drawings or sketches as appropriate) for packaging, wrapping, labeling, and shipping the Waste Package. The procedure shall include maintaining shell roundness, restricting movements of the outer shell, inner vessel, and divider plate assembly, package lift point provisions, and lifting weight. SELLER shall obtain BUYER's release of the packaging, labeling, and shipping procedures before shipment of the Waste Package.

7.3 DELIVERY

Truck or other conveyance unloading will be the responsibility of BUYER. The truck or other conveyance may be unloaded within the OWNER'S protected area at a location designated by BUYER. BUYER'S representative shall be given at least twenty-four (24) hours' notice of truck or other conveyance prior to arrival at BUYER's location.

8. DOCUMENT AND RECORD SUBMITTAL REQUIREMENTS

This section contains the requirements for document and record submittals that are listed in the List of Supplier Submittals. Appendix G and Appendix H summarize the required documents to

be submitted for review and release for use, and the required records to be submitted at the time of shipment. The engineering document requirements are defined in Appendix G and the quality verification document requirements are defined in Appendix H.

8.1 DOCUMENTS

8.1.1 Shop Drawings

SELLER shall prepare shop drawings as necessary for normal shop practice for all assembly, sub-assembly, and piece parts associated with the waste package. SELLER shall prepare and submit, thirty (30) calendar days before fabrication, one (1) print of all shop drawings to BUYER for review and release. If shop drawings are prepared using a computer-aided design (CAD) system, only paper copies are submitted for review/comment and release to the Contractor. When final drawings are completed and are records, the electronic files shall become records and be submitted with the records package. SELLER shall provide the format of the files and the name and version of the application used to create them.

The shop drawings are to be full-sized (D size) and legible with uniform background density suitable for microfilming and subsequent reproduction from microfilm. The electronic geometry database (lines, circles, arcs, and splines) in CAD files shall be drawn using nominal-size dimensions of parts to accurately represent the physical layout of components. Intersecting lines, arcs, splines, and circles used to draw parts shall be trimmed to exact intersections and/or endpoints at terminations.

The shop drawings will be reviewed and, if satisfactory, will be released by BUYER. BUYER must release the shop drawings before fabrication begins. If not satisfactory, SELLER will be notified of the items requiring further explanation or correction. SELLER shall appropriately note any changes by dated revisions on the shop drawings.

All shop drawings must be checked for accuracy prior to submission for release. BUYER'S release for use of shop drawings shall not be construed as a complete check. BUYER'S release for use of shop drawings will not relieve SELLER of the responsibility for any error that may exist on the shop drawings. BUYER'S release for use of the shop drawings does not relieve SELLER of the responsibility for meeting BUYER'S Engineering Sketch requirements that are part of this specification.

If SELLER uses sub-tier suppliers, SELLER is responsible for assuring that the sub-tier supplier uses BUYER-released drawings for finished pieces and that the sub-tier supplier meets all applicable specification requirements.

8.1.2 Drawing Standards

Weld symbols shall be in accordance with the requirements of ANSI/AWS A2.4-98. Surface texture symbols shall be in accordance with ASME Y14.36M-96.

The following Drafting Lettering Standards shall apply, such as supplemented by ASME Y14.5M series:

- E. Minimum character height (A, B, C, size drawings): 1/8"
- F. Minimum character height (D and E size drawings): 1/8"
- G. Minimum spacing between lines of characters: height of characters;
- H. Machine and guide generated characters: 12 point size minimum;
- I. Density of characters and lines: dense, sharp, and uniform.

8.2 GENERAL REQUIREMENTS FOR DOCUMENT PACKAGES

Each Document Package shall comply with the following requirements:

- A. Each package shall have a Table of Contents.
- B. Each page of the document package is to be consecutively numbered and marked with the unique Waste Package serial number. Consecutive numbering by section is acceptable provided the Document Package clearly identifies the total number of pages for each section and that each page identifies the page and section number.
- C. All records must be legible and reproducible, including signatures (signatures must be legible and typed or printed), inspection stamps, page numbers, and similar items. When assigned initials are allowed, a log containing the printed name, signature, and initials shall be provided. Copies of records will not be acceptable if legibility or reproducibility is in question.
- D. Inspection records shall include M&TE traceability, M&TE serial number, and calibration due date.
- E. All recorded information shall be typed or recorded neatly in reproducible ink.
- F. Corrections to records shall be made by one of the following methods:
 1. Draw a single line through the changed or incorrect information (without obliterating incorrect information), and if applicable, inserting the new or correct information in close proximity.
 2. Transcribe or enhance faint characters.
 3. Insert new information.
 4. Obtain a legible copy.

The authorized SELLER'S individual shall date and initial, stamp, or sign the corrected information so it is clear as to what corrections are being made.

- G. SELLER, at SELLER'S expense, shall replace unacceptable records found during review by BUYER in an expedited manner.

- H. The document package shall include, but is not limited to, the items identified in Appendix G. BUYER shall review package content.
- I. SELLER shall prepare and submit the document package Table of Contents for release by BUYER. The Table of Contents shall include the documents identified in Appendix H, as well as any documents used by SELLER'S QA Program, to trace the record to the equipment used during fabrication and inspection. Documents previously submitted for review, as well as the ones marked "submit with final document package", shall be included in the package.
- J. SELLER shall compare test results and reports to the acceptance criteria. These reports shall contain the signature of the authorized representative or the agency performing the tests. The reports are for BUYER'S review and acceptance, prior to release for shipment.
- K. Following satisfactory completion of all examinations and tests, SELLER shall prepare a complete set of as-built dimension documentation. All dimensions shall be verified to be within the drawings tolerances specified. Only Major Dimensions, as specified in Section 5.3.2 and as indicated on the Drawings, shall be measured and recorded on the as-built drawings or on separate examination sheets. As-built drawings, if accompanied by dimensional examination documents recording Major Dimensions, may consist of the final revision of the shop drawings depicting the as-built condition, including nonconformances (i.e., use-as-is and repair). All as-built shop drawings shall be certified as to correctness.
- L. Records shall be maintained as required by ASME BPVC Section III, NCA-4134.17.

9. QUALITY ASSURANCE PROGRAM REQUIREMENTS

9.1 ACCEPTANCE OF SELLER'S QUALITY ASSURANCE PROGRAM

- A. As evidence that SELLER has a QA program, SELLER shall submit, as part of their Bid/Proposal, evidence indicating the portions of their QA program that satisfies the quality criteria in ASME BPVC Section III, Subsection NCA, BUYER'S procurement documents, elements of OWNER'S QA program identified in procurement documents (material requisition), and SELLER'S ASME Certificate of Authorization. SELLER'S QA program shall be reviewed, have comments resolved, and be accepted by BUYER prior to the award of the subject procurement. BUYER reserves the right to perform a survey of SELLER'S or sub-tier supplier's facility to verify implementation of SELLER'S QA program. Any conditions adverse to quality identified during a survey shall be documented by BUYER in the Survey Report and forwarded to SELLER or sub-tier supplier for resolution. No work will be awarded until acceptance of the resolution by BUYER.
- B. BUYER may accept, or accept with comments, the QA program. SELLER may not proceed with activities related to the QA program until acceptable changes to their QA program documents have been agreed to by BUYER. All changes must be submitted to BUYER for final acceptance.
- C. Acceptance of a Supplier's QA program by BUYER does not relieve SELLER of the obligation to comply with the requirements of the procurement documents. If the QA

program is subsequently determined by BUYER to be ineffective or inadequate in providing acceptable quality, BUYER reserves the right to impose restrictions as necessary to bring SELLER in compliance with the procurement requirements. All proposed QA program revisions shall be submitted to BUYER for review and acceptance prior to implementation of the revision.

9.2 SELLER'S SUB-TIER SUPPLIER REQUIREMENTS

All materials shall conform to the Drawings and requirements of this Specification. CMTRs shall be provided for each heat (lot) used, and the actual CMTRs (not typical CMTRs) must be included in the document package.

9.2.1 Sub-tier Supplier Selection Requirement

A. SELLER shall select sub-tier supplier(s) based on formal audit and evaluation of the sub-tier supplier's capability to provide items and services in accordance with BUYER'S procurement documents and placement of the sub-tier supplier on SELLER'S Qualified Supplier List or other similar internal document. Should the electro-polishing or other surface enhancement process be performed by an entity other than SELLER, the quality requirements to be implemented shall be the normal program used by that industry. Measures for evaluating, selecting, and reevaluating procurement sources shall be based on one or more of the following:

1. For the pressure-retaining materials and fabrication on the Inner Vessel, and welds thereto, sub-tier suppliers must have the appropriate ASME Accreditation for the scope of work performed.
2. For all materials and fabrication of the Inner Vessel, Outer Corrosion Barrier, and Divider Plate Assembly, SELLER shall evaluate and document the sub-tier supplier's current QA program and records supported by quantitative and qualitative objective evidence that demonstrate compliance to BUYER'S QA program requirements specified in BUYER'S procurement documents. In addition, SELLER shall evaluate and document the sub-tier supplier's technical and quality capability based on an evaluation of the sub-tier supplier facilities, personnel, and QA program implementation. If a sub-tier supplier is performing any fabrication, an on-site audit by SELLER shall also be performed.
3. For UNS S21800 material, SELLER may use unqualified source material from a sub-tier supplier in accordance with ASME BPVC NCA-3855.5. This unqualified source material requires each piece to be tested by an audited laboratory to show that the material meets the requirements of its material specification. It also requires traceability to the material manufacturer and a no-weld-repair statement is required.

B. Acceptance of sub-tier supplier qualification based on third party certification is not sufficient.

9.2.2 Application of Quality Assurance and Technical Requirements to Sub-tier Suppliers.

SELLER is responsible for assuring the performance of all BUYER QA and Technical Requirements by their sub-tier suppliers. Required, appropriate QA and technical requirements of BUYER'S procurement documents shall be documented in sub-tier supplier's purchase orders describing those requirements as stated below:

A. The following items do not apply to sub-tier suppliers of any class:

1. ASME NQA-1-2000 Edition, Subpart 2.1 – cleaning to meet this specification applies to the completed Waste Package only.
2. ASME NQA-1-2000 Edition, Subpart 2.2 – packaging and shipping to meet this Specification applies to the completed Waste Package only.
3. Section 7 – Packaging and Shipping, as described in this section, applies to the finished Waste Package only.
4. Section 8 – Documentation, as described in this section applies to the finished Waste Package only.

B. QA and Technical Requirements for Raw Materials (Plate and Bar) are as follows:

1. Section 1.6.1 I through N – Definitions of material type, including product restrictions are appropriate.
2. Sections 3.4 through 3.5 – Dimensional interfaces and limitations and surface finish are not appropriate – these requirements apply to the finished Waste Package and no raw material is incorporated into the finished Waste Package without forming or machining.
3. Section 4.1 – Material requirements are appropriate.
4. Section 5.1 – Restrictions on thermal cutting are appropriate.
5. Section 5.3.2 – Dimensional verification is not appropriate – these requirements apply to the finished Waste Package and no raw material will be used in the finished Waste Package without being formed or machined.
6. Section 5.5 – Welding is not appropriate – weld repair of raw material is forbidden.
7. Section 5.7 – Cleaning requirements are appropriate or not appropriate as follows:
 - a Sections that concern cleaning, marking, and fabrication materials and chemicals are appropriate.
 - b Sections that concern ASME NQA-1 2000 Edition, welding, surface roughness, assembly, and fabrication are not appropriate.

8. Section 6 – Examination and testing, as described in this section, applies to the finished Waste Package and are not appropriate.
9. Section 9.2 – Demonstration of sub-tier supplier QA systems to meet this paragraph and the above requirements are appropriate.
10. Sections 1.5.1, 6 and 9.5 – Requirements to supply manufacturing plans, procedures, and access are appropriate.
11. Section 9.10 – Calibration records are not appropriate – providing the material under the QA systems in Section 4.1 is sufficient.

C. QA and Technical Requirements for Gaskets are as follows;

1. Section 1.6.1 I-N – Definition of material type, including product restrictions is appropriate.
2. ASME BPVC Section III, Division 1, NC-2121 (b) exempts gaskets from consideration by the ASME BPVC – gaskets are therefore treated as commercial grade items. SELLER shall identify the manufacturer’s published product description of the gaskets in the procurement document. SELLER shall submit the manufacturer’s product description and material test reports for the gaskets prior to use. SELLER shall verify the following after receipt of the gaskets,
 - a. was not sustained during shipment.
 - b. The item received was the item ordered.
 - c. The dimensions conform to the requirements of manufacturer’s published product description and the drawings.
 - d. The material test reports were Damage received and the material complies with the manufacturer’s published product requirements, the drawings, and the specification.
3. Section 9.2.1 and 9.5 – Auditing of the sub-tier supplier to verify implementation of cleaning and handling requirements is appropriate.

D. QA and Technical Requirements for Forming and Pre-Machining are as follows:

1. All forming and pre-machining operations fall in the category Piece Part Tolerances (Section 5.3.1). All dimensions specified to the sub-tier supplier are those as determined by SELLER to support compliance with the finished dimensions, but are not the finished dimensions. References to Dimensional Verification (Section 5.3.2) and Calibration Records (Section 9.10) are not appropriate.
2. Section 5.7 – Cleaning requirements are appropriate or not appropriate as follows:

- a Sections that concern cleaning, marking, and fabrication materials and chemicals are appropriate.
 - b Sections that concern surface roughness and fabrication are appropriate.
 - c Sections that concern ASME NQA-1 2000 Edition, welding and assembly are not appropriate.
3. Section 5.7 – Auditing of the sub-tier supplier to verify implementation of cleaning and handling requirements is appropriate.

E. QA and Technical Requirements for Finish-Machining are as follows:

1. All finish-machining operations are controlled by Section 5.2. All required dimensions, limitations, and surface finishes are to be communicated to the sub-tier supplier.
2. References to Dimensional Verification (Section 5.3.2) and Calibration Records (Section 9.10) are appropriate.
3. Section 5.7 – Cleaning requirements are appropriate or not appropriate as follows:
 - a Sections that concern cleaning, marking, and fabrication materials and chemicals are appropriate.
 - b Sections that concern surface roughness and fabrication are appropriate.
 - c Sections that concern ASME NQA-1 2000 Edition, welding and assembly are not appropriate.
4. Section 5.7 and 9.5 – Auditing of the sub-tier supplier to verify implementation of cleaning, handling, and calibration requirements is appropriate.

F. QA and Technical Requirements for Heat Treating are as follows:

1. The heat-treating of the Outer Corrosion Barrier is to be performed in accordance with Section 5.6.C. All technical requirements in this section are to be communicated to the sub-tier supplier.
2. Calibration Records (Section 9.10) for thermocouples are appropriate.
3. Section 5.7 – Cleaning requirements are appropriate or not appropriate as follows:
 - a Sections that concern cleaning, marking, and fabrication materials and chemicals are appropriate.
 - b Sections that concern surface roughness and fabrication are appropriate.
 - c Sections that concern ASME NQA-1 2000 Edition, welding and assembly are not appropriate.

4. Sections 5.7 and 9.5 – Auditing of the sub-tier supplier to verify implementation of cleaning, handling and calibration requirements are appropriate.

SELLER shall forward an un-priced copy of their procurement documents to BUYER thirty (30) calendar days after procurement and shall maintain records to substantiate the evaluation and acceptance of the sub-tier supplier's technical capabilities and QA program, as appropriate.

9.3 EXAMINATION POINTS

SELLER'S manufacturing plan shall include a listing of all SELLER witness points and hold points.

9.4 SELLER QUALITY CONTROL PROCEDURES

SELLER'S and SELLER'S sub-tier supplier's QC procedures shall include the use of fabrication travelers or other process control documents. Fabrication travelers shall reference or describe the procedures used in accomplishing the tasks, the examination, the test requirements, and any witness, hold points, and sign offs. The traveler shall provide a method to ensure the accumulation of signatures attesting to the completion of a sequence.

9.5 ACCESS TO FACILITIES FOR QUALITY ASSURANCE AND QUALITY CONTROL

- A. BUYER, OWNER, or their representative(s) shall be given free access to SELLER'S and SELLER'S sub-tier supplier's facilities to perform audits, surveillance, or verification to ensure QA program requirements are being met.
- B. Copies of all records, procedures, and personnel qualifications shall be available for review by BUYER, OWNER, or their representative(s).
- C. All phases of the specified work performed by SELLER and sub-tier suppliers may be subjected to audit, surveillance, or verification at BUYER'S or OWNER's discretion.
- D. OWNER's QA program requires that SELLER be audited a minimum of every three years on site at SELLER'S facility. BUYER performs an annual evaluation of SELLER'S QA program. Based on the results of this annual evaluation, additional audits or surveillance may be necessary. Any conditions adverse to quality identified because of the audits, surveillance, or annual evaluations will be reported on the appropriate form and communicated to SELLER for timely resolutions.

9.6 NONCONFORMANCE AND CORRECTIVE ACTION

- A. SELLER shall prepare a Supplier Deviation Disposition Request (SDDR) form in accordance with Appendix C and the instructions provided in the procurement documents for each reportable condition adverse to quality as defined in 9.6.B. Alternatively, SELLER may attach their nonconformance or corrective action report to the SDDR and submit to BUYER prior to offering the service for acceptance. SELLER shall include a recommended

disposition as well as a technical justification for the disposition of each condition adverse to quality.

- B. For work performed for BUYER, SELLER shall notify BUYER whenever a condition adverse to quality is identified that meets one or more of the following:
 - 1. Technical or material requirements of the procurement documents are violated.
 - 2. A requirement in SELLER documents released for use by BUYER is violated.
 - 3. The item/service for BUYER does not conform to the original BUYER requirement(s) even though the item can be restored to a condition such that the item's capability to function is unimpaired.
 - 4. The disposition of the condition adverse to quality is "use-as-is" or "repair to other than original".
 - 5. Any repair work, except for weld repairs that are not in excess of the number of cycles allowed in Section 5.5.1.5C.
- C. BUYER shall evaluate and release for use, in writing, SELLER's proposed dispositions of "use-as-is" or "repair" and shall verify the implementation of the disposition before the item may be offered for acceptance.
- D. A stop work condition exists when continuing work would cause one or more of the following:
 - 1. The quality of results are irreparably compromised or rendered indeterminate.
 - 2. An item does not function as intended due to condition adverse to quality in processing, installation, modification, or operation.
 - 3. A significant hazard is presented to the health or safety of workers and/or the public.
 - 4. A significant break down or failure in the implementation of QA program requirements compromises the quality of the trunnion collar.
- E. All conditions adverse to quality shall be resolved between SELLER and BUYER before the item may be offered for acceptance in the manner specified in the procurement documents.
- F. SELLER shall respond to all BUYER-initiated supplier condition reports by the due date(s) indicated on the report.
- G. Any work that is done to piece or assembly after the normal processing/fabrication steps are complete is considered rework. (This includes use of filler material added to the vessel to rework surface defects and meet specifications.) SELLER shall keep a record (in the form of a map) of all locations where rework or repair has been performed on the Waste Package.

H. SELLER shall report any nonconformance discovered after delivery of the Waste Package, in writing, to BUYER, within fifteen (15) calendar days of discovery.

9.7 SERIAL AND LOT TRACEABILITY RECORDS

SELLER shall prepare and maintain serial and lot traceability records and provide these to BUYER for review. Materials used must be identifiable by lot number, material type, and specification and shall be traceable to records of acceptance. When two (2) or more parts are joined to form an assembly, SELLER shall prepare an assembly parts list identifying each part in the assembly by part number or lot control number and the lot of material from which the part was fabricated.

SELLER shall serialize piece parts, components, and assemblies as required by drawings and specifications. Serialization shall be accomplished so that duplication of serial numbers is precluded. SELLER shall provide for traceability of all serialized parts and materials to the source. When two or more serialized parts are joined in an assembly, a list for each assembly number with part numbers and component serial numbers must accompany each shipment.

9.8 QUALITY REQUIREMENTS FOR SHIPPING RELEASE

The Waste Package shall not be shipped until the following requirements are met:

- A. All tests, examinations, and final inspections have been performed with acceptable results obtained.
- B. The Waste Package document package is complete and reviewed by BUYER'S Technical and Quality representatives. SELLER shall notify BUYER fifteen (15) calendar days before his intended shipping date and allow BUYER sufficient time prior to shipment to review the document package as described in Section 8.2. The document package shall be complete and final before it is submitted for review, including documentation of the performance tests in Section 6.4.

9.9 CERTIFICATE OF CONFORMANCE

SELLER shall submit to BUYER, in the document package, Quality Verification Document requirements (Certificate of Conformance) (Appendix E) that shall be signed by the Authorized Nuclear Inspector for the Outer Corrosion Barrier with the documentation package.

9.10 CALIBRATION RECORDS

SELLER shall provide Certificates of Calibration attesting to the validity of the results.

SELLER Certificates of Calibration shall include:

- A. Procurement document number (Purchase Order)
- B. SELLER'S name and location

- C. Unique identification is required for all of the calibrated measuring and test equipment (M&TE). This includes model number, serial number, and description of the calibrated M&TE.
- D. Unique identification of the calibration standard used and a statement of traceability to the NIST or other nationally recognized standard.
- E. Identification of the person who performed the calibration.
- F. Signature or other authentication by a person who is responsible for approving the certificates or providing the objective evidence.
- G. A statement certifying the results of the calibration and certifying conformance to the procurement documents requirements.
- H. Identification of the requirements used in the calibration (e.g., codes, standards, procedures, inspection or test methods specifications, and any approved changes, waivers, or deviations). Include document title or number and revision level.
- I. Identification of SELLER'S QA Program, including revision level that was used to provide the calibration service.
- J. Calibration data, next calibration date, and calibration interval.
- K. For re-calibrations, identification of the "as-found" and "as-left" condition, including actual measurements, specified tolerances, and the identification of the M&TE use range. When M&TE is found to be out of calibration, include the evaluation result that identifies the extent of the error(s) over a specified range.
- L. Environmental condition that could affect any measurement.

9.11 MANUFACTURING DATA REPORTS

SELLER will complete, for each Inner Vessel, an ASME BPVC Data Report, Form N-1, Certificate Holders' Data Report for Nuclear Vessels. The N-1 form shall be signed by SELLER and his Authorized Nuclear Inspector.

SELLER will complete, for the Outer Corrosion Barrier, a Manufacturer's Data Report, Manufacturer's Data Report for Nuclear Vessels (Appendix F). SELLER and his Authorized Inspector shall sign this Report.

APPENDIX A – Drawings

Drawings are included as part of the material requisition and are contained in the purchase order.

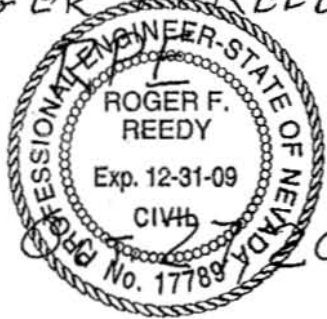
APPENDIX B — ASME BPVC Design Specification for the Inner Vessel

COVER PAGE FOR
ASME BPVC Design Specification for the Inner Vessel

CERTIFICATION

I, the undersigned, being a Registered Professional Engineer competent in the applicable field of design and related nuclear power plant requirements relative to this Design Specification, certify that to the best of my knowledge and belief it is correct and complete with respect to the Design and Service Conditions given and provides a complete basis for construction in accordance with NCA-3250 and other applicable requirements of the ASME boiler and Pressure Vessel code, Section III, Division 1, Subsection NC, 2004 Edition with Addenda up to and including 2006 ADDENDA.

ROGER F REEDY



2006

B1. SCOPE

This Specification provides requirements for construction of the Inner Vessel of the Waste Package. The Inner Vessel shall be constructed and ASME BPVC Symbol Stamped in accordance with the requirements of the ASME BPVC Section III, Division 1, Subsection NC (Class 2 pressure vessels). The Inner Vessel will be inserted into an Outer Corrosion Barrier that is not an ASME BPVC item. A Divider Plate Assembly (also not an ASME BPVC item) will be inserted into and welded to the inside of the Inner Vessel.

The required certification document to be provided by the Registered Professional Engineer is shown in Appendix E.

B2. APPLICABLE DOCUMENTS

The documents listed in this section form a part of this specification. Different Editions and Addenda may be used if mutually consented to in writing between the N Certificate Holder and BUYER. Any perceived conflict between this specification and the referenced documents shall be brought to the attention of BUYER for resolution. The following documents are applicable only to the extent specifically referenced.

B2.1 CODES AND STANDARDS

The materials, design, fabrication, testing, examination, and shipping of the Inner Vessel will meet the requirements of the following Codes and Standards:

- ASME Boiler & Pressure Vessel Code, Section II, Materials, 2001 Edition with the 2002 Addenda.
- ASME Boiler & Pressure Vessel Code, Section III, Rules for Construction of Nuclear Power Plant Components, Division 1, Subsection NC, Class 2 Components, 2001 Edition with the 2002 Addenda.
- ASME Boiler & Pressure Vessel Code, Section III, Rules for Construction of Nuclear Power Plant Components, Division 1, Subsection NCA, General Requirements for Division 1 and Division 2, 2001 Edition with the 2002 Addenda.
- ASME Boiler & Pressure Vessel Code, Section V, Nondestructive Examination, 2001 Edition with the 2002 Addenda.
- ASME Boiler & Pressure Vessel Code, Section IX, Welding and Brazing Qualifications, 2001 Edition with the 2002 Addenda.

B2.2 DRAWINGS

See Appendix A Drawings for reference to drawings.

B3. INTRODUCTION

B3.1 FUNCTIONAL DEFINITION

The following functions are applicable:

- The Waste Package contains the waste form within its boundary for the preclosure period.
- The Waste Package restricts the transport of radionuclide to the outside of the Waste Package boundary after closure.
- The Waste Package, in conjunction with the waste form, provides criticality control during and after loading.
- The Waste Package provides conditions needed to maintain the physical and chemical stability of the waste form.

B3.2 PHYSICAL DESCRIPTION

The Inner Vessel will be inserted into the Outer Corrosion Barrier after the Inner Vessel has been Code Stamped. BUYER will seal the Inner Vessel after loading with fuel.

B4. REQUIREMENTS

The specified dimensions and tolerances shown on the drawings shall be maintained.

B4.1 DIMENSIONAL INTERFACES AND LIMITATIONS

All dimensions are essential. Dimensions identified in the Drawings are for acceptance at the assembly level. Dimensions apply after final machining and welding.

B4.2 INNER VESSEL DESIGN

B4.2.1 Code Requirements

The Inner Vessel shall be designed and constructed to the requirements of ASME BPVC, Section III, Rules for Construction of Nuclear Power Plant Components, Subsection NC for pressure vessels (not NC-3200). The Stainless Steel Vessel and Inner Vessel Lid shall be designed with a gasket and secured by the Spread Ring. SELLER is responsible for assuring leak-tightness during the pressure test.

The Code boundaries for the Inner Vessel are:

- Vessel
 - Inner Vessel
 - Inner Vessel Bottom Lid
- Inner Vessel Lid

- Spread Ring
- Purge Port Cap Plug
- Divider Plate Assembly attachment weld

B4.2.2 Design Pressure and Temperature

The design pressure is 150 psi at 650°F

The Design Level A (design) pressure is 62.1 psia (47.4 psig) at 662°F.

The Design Level B pressure is 69.6 psia (54.9 psig) at 662°F.

The Design Level D pressure is 140 psia (125.3 psig) at 707°F.

The loaded dead weight is 100,700 lbs.

Service conditions are identical to design conditions. No other loadings, including seismic, drop loads, and fatigue, are considered in the design. The consideration of these loadings are the BUYER'S responsibility. The SELLER shall produce an ASME Section III Design Report.

B4.2.3 Inner Vessel Dimensions

The nominal outside diameter of the Inner Vessel is 62.5 inches. The overall Vessel length is 186.0 inches.

B4.3 MATERIALS

The Inner Vessel (except for purge port plug and purge plug gasket) is to be fabricated from Type 316 stainless steel with carbon limited to 0.020% max and nitrogen limited to 0.060% to 0.10%.

B4.4 PROTECTION AGAINST CORROSION

The Outer Corrosion Barrier serves as a barrier against corrosion of the Inner Vessel. Internal and external corrosion of the Inner Vessel need not be considered.

B4.5 WELDED JOINTS

All Inner Vessel pressure boundary welds shall be made in accordance with ASME Section III requirements. All welds shall be sufficiently smooth to enable easy decontamination. Butt welds shall be ground flush. Weld joint designs shall avoid potential contamination traps to the greatest extent practicable. All pressure boundary welds shall be radiographically examined.

B4.6 OVERPRESSURE PROTECTION

Overpressure protection for the Inner Vessel is not required.

APPENDIX C – Supplier Deviation Disposition Request (SDDR)

The SDDR Form is used by SELLER to communicate needed changes and/or deviant conditions to the BUYER. The SDDR is the primary means of communication with the BUYER. It should be viewed as a positive process because it provides the ability to make necessary changes in an expedited manner. The SDDR is not viewed by the BUYER as a negative, nor can it be used to modify cost, however, it does demonstrate SELLERS dedication to resolving problems and implement effective communication.

INSTRUCTIONS FOR COMPLETING THE SDDR FORM

This form is to be used by a Supplier to:

- a) Notify BSC when manufactured product or service does not meet established design and control contract requirements and to document the Supplier's proposed disposition with their technical (and where appropriate, Cost/Schedule) justification.
- b) Notify BSC when the Supplier wants to propose changes to the contract documents, which establish design and control requirements unanticipated at time of award.
- c) Record BSC disposition of the SDDR.
- d) Identify the supplier NCR number, when applicable.

The supplier may use the version of this form that is attached to the Buyer's order or may use a subsequent version as provided by the Buyer.

A deviation is any departure from the requirements of the procuring documents that the Supplier has incorporated or proposes to incorporate in the completed item or service provided. The SDDR form is not to be used after shipment release. Deviation disposition can be classified as Use-As-Is, Repair, or Modify BSC Requirement. Any deviation shall be considered unacceptable until accepted by BSC in writing. Additionally, Suppliers are required for deviations, which occur after work has reached a completion state (e.g., base metal repair, incorrect drilled hole), to generate and disposition a nonconformance report (NCR). In other words, the Supplier is required to have an internal NCR procedure requiring disposition as reject, repair, rework, or use-as-is. The Supplier shall generate and disposition an NCR when appropriate and submit a copy of their NCR employing use-as-is or repair disposition (Section 4a of the SDDR form).

Repair is defined as the process of restoring a nonconforming characteristic to a condition such that the capability of an item to function reliably and safely is unimpaired, even though the item may not conform to the original requirement. Repair includes alterations to the properties of the material through heat-treating, welding, metal disposition, chemical processing, etc. The SDDR form is not to be used for cases where BSC has previously provided authorization to proceed using an accepted repair procedure covering a specific type of repair; however, records must be maintained for each specific repair.

Supplier shall make changes on their engineering documents to reflect changed conditions and resubmit engineering documents in accordance with purchase order document submittal requirements. The Supplier shall include a copy of each BSC accepted SDDR in the quality verification documentation package for each applicable item.

Acceptance of the SDDR by BSC does not relieve the Supplier from responsibility for the accuracy, adequacy, or suitability of the item or service being provided as defined in the procuring documents, nor does it constitute a waiver of the right to renegotiate the terms of the procuring documents.

SUPPLIER INSTRUCTIONS

Block No.

Entry Information

1. Supplier's name and address - city, state, and zip. List same information for lower tier Suppliers, if applicable.
2. Supplier's order number if one has been assigned.
3. BSC Purchase Order or Subcontract Number and Revision Number.
4. Describe the deviating characteristics and define the extent of the out-of-specification condition for each identified piece affected. Include quantities and serial, lot, batch, heat, or other numbers as appropriate. Identify the location of the deviating characteristic by print coordinates or specific location, as applicable. Attach reproducible-quality extra sheets, sketches, photographs, etc., as necessary. When proposing a change in either Supplier or BSC documents, describe the change and identify the documents completely, including title or subject, date and revision, and where appropriate, attach a copy of areas in question. Identify an associated NCR in Box 4a, when applicable.
5. State proposed disposition.
6. Enter cost impact, including cost savings, that would result from proposed changes and which will be reflected in appropriate procurement documents. An approximate cost impact is acceptable.
7. Enter delivery schedule impact that would result from proposed changes.
8. Describe the proposed disposition and provide technical (and where appropriate Cost/Schedule) justification for BSC evaluation. Attach reproducible-quality copies when required. If the deviation is correctable by repair, submit a detailed repair procedure or reference the procedure previously submitted and approved by BSC for use in similar situations. Provide control number, Supplier control number, and procedure title. For documents, provide suggested corrective wording, procedure, documents, etc. Provide a copy of each SDDR attachment to the BSC Source Verification Representative (SVR) at the Supplier's location, if applicable.
9. Enter the name (typed or printed) and title of the Supplier representative authorizing the disposition request and appropriate signature and date signed.

Transmittal of SDDR to BSC:

INSTRUCTIONS FOR COMPETING THE SDDR FORM
(continued)

BSC ENGINEERING INSTRUCTIONS:

RE identifies the records designator (QA:N/A or QA:QA) based on the designator(s) of the Purchase Order or Subcontract.

10. Indicate BSC disposition.
11. Provide appropriate justification for the BSC action(s) indicated in Block 10, including identification of any interface resolution, affected documents, license or permit revision, authorization basis review, or client approval that is required.
12. RE/STR - Signature of the responsible engineer or Subcontract Technical Representative and the printed name.
DEM/PE - Signature of the responsible DEM/PE accepting the Engineering action and the date signed.
QA - Signature of the authorized BSC Quality Assurance representative and the date signed (only if classified QL-1 or quality level is changed).
Procurement - Signature of the authorized Procurement representative (when required), the date signed and the printed name.
Client - Signature of the authorized Customer representative and the date signed (when required by Project procedure).
Project Manager. - Signature of the Project Manager and the date signed (when required by Project procedure).
13. Signature of the Supplier's inspector or other representative authorized to verify that the accepted disposition was correctly accomplished and the date signed.
14. Signature of the BSC SVR, when source verification is required, and date. This signature indicates that the accepted disposition was correctly implemented and verified.

APPENDIX D — Engineering Hold and Witness Points

Hold Points are as follows:

1. Initial Organizational Meeting between BUYER and SELLER
2. Start of manufacturing
3. Annealing of Outer Corrosion Barrier
4. Assembly of Inner Vessel into Outer Corrosion Barrier
5. Final inspection of the Waste Package
6. Prior to shipment
7. Pressure Test
8. Helium Leak Test
9. Prior to shipment documentation verification
10. Material Receipt
11. First welding of each WPS`

Witness Points are as follows:

1. Final machining of Inner Vessel and Outer Corrosion Barrier
2. Empty Weight Measurements

APPENDIX E – Certificate of Conformance

CERTIFICATION

I, the undersigned, being a Registered Professional Engineer competent in the applicable field of design and related nuclear power plant requirements relative to this Design Specification, certify that, to the best of my knowledge and belief, it is correct and complete with respect to the Design and Service Conditions given and provides a complete basis for construction in accordance with NCA-3250 and other applicable requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, 2001 Edition with Addenda up to and including 2002.

(name), RPE

Date: _____ My commission expires: _____

APPENDIX F — YMP-1 Manufacturer's Data Report for Outer Corrosion Barrier

YMP-1 Manufacturer's Data Report for Outer Corrosion Barrier

Manufactured and certified by: _____
(Name and Address of Manufacturer)

Manufactured for: United States Department of Energy Yucca Mountain Project

Manufacturer's Serial Number: _____ Year built: _____

Fabrication Specification Number and Revision: _____

Dimensions: _____
(overall length) (outside diameter) (minimum design thickness)

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this report are correct and that this Outer Corrosion Barrier conforms to the requirements of the above-referenced Fabrication Specification.

Name of Manufacturer _____

Signature of authorized representative _____ Date _____

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and the State of _____ and employed by _____ have inspected the Outer Corrosion Barrier described in this Data Report on _____, and state that to the best of my knowledge and belief, the Manufacturer has constructed this Outer Corrosion Barrier in accordance with the above-referenced Fabrication Specification.

By signing this certificate, neither the inspector nor his employer makes any warranty, expressed or implied, concerning the Outer Corrosion Barrier described in this Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date _____ Signed _____ Commissions _____
(Authorized Nuclear Inspector) (Nat'l Bd. (including endorsements) and State No.)

APPENDIX G – Engineering Document Requirements – Form G-321-E

BSC

Engineering Document Requirements Form G-321-E

QA: QA

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Complete only applicable items.

Project Entity (Name): Waste Package Fabrication Specification

1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required	5. Submittal Schedule	6. Quantity Required		7. Kind of Copies	8. Remarks
					Initial	Final		
1.0	8.2	Drawings (As-Built)	No	S	1	1	O	30 days before shipment
1.0	8.0	List of supplier submittals`	Yes	F	1	1	O	45 days before fabrication
1.2, 1.3	8.1	Assembly and Shop Drawings	Yes	F	3	3	O, R E	30 days before fabrication
5.0	1.5	Schedule – Manufacturing & Test plans	Yes	F	1	1	O	45 days before fabrication
6.0	9.2.2	Procurement Documents	No	U	1	1	R	30 days after procurement
6.0	9.1	ASME Certificate & QA Programs Manual	Yes		1	1	O	Submit with bid
8.0	2.3, Appendix B	ASME Design Report	Yes	F	1	1	O	30 days before fabrication
11.0	1.5.1, 4.1	CMTR's	Yes	U	1	2	O	Final Document Package
12.0	5.5.1.2	Welding Procedures and Qualifications (WPS & PQR's)	Yes	F	1	1	O	30 days prior to welding
14.0	5.5.1.5	Repair Procedures	Yes	U	1	1	O	Prior to implementation
15.0	5.7	Cleaning Procedures	Yes	F	1	1	O	30 days before fabrication
16.0	5.6	Heat Treatment Procedures	Yes	U	1	1	O	30 days before use
19.0	6.1.A	UT Procedures	Yes	U	1	1	O	30 days before use
20.0	6.1.A	RT Procedures	Yes	U	1	1	O	30 days before use
22.0	6.1.A	PT Procedures	Yes	U	1	1	O	30 days before use
24.0	6.2, 6.3	Pressure Test (hydrostatic/pneumatic)	Yes	U	1	1	O	30 days before use
25.0	6.1.A	VT Procedures	Yes	U	1	1	O	30 days before use
26.0	6.4	Empty Weight Measurement	No	U	1	1	O	Final records package
28.0	6.1.A	Personnel Qualifications (NDE)	Yes	U	1	1	O	30 days prior to use
28.0	5.5.1.2	Personnel Qualifications (WPQR)	Yes	U	1	1	O	30 days prior to use
29.0	7.1.1	Supplier Shipping Procedure (information)	No	U	1	1	O	Day of shipment
30.0	9.6, Appendix C	Comp data sheet (SDDR)	Yes	U	1	1	O	Prior to implementation.
31.0	4.1	Material Substitution	Yes	U	1	1	O	15 days prior to material order
33.0	3.1, 5.5.1.1.D	Alternate fabrication processes	Yes	U	1	1	O	Prior to implementation

9. Requisition Title:

10. Job No.:

11. Requisition No.:

12. Rev. No.:

BSC

Engineering Document Requirements Form G-321-E

QA:QA

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Complete only applicable items.

ENGINEERING DOCUMENT CATEGORY DEFINITIONS G-321-E - SUP A

(E) Engineering Documents. This term comprises procedures, drawings, specifications, QA plans, prototype qualification test reports, and other similar documents that require BSC permission to proceed prior to fabrication or prior to use of the document on the design, fabrication, installation, or other work progress. The term is also applied to price lists, instructions for erection/installation, operation, maintenance, and site storage and handling.

A. DEFINITION OF TERMS

(Note: Standard abbreviated titles follow the category definitions.)

Supplier – This is a comprehensive term and includes seller, vendor, contractor, subcontractor, subsupplier, etc.

Original – The initial document of which copies are made, i.e., handwritten copy, typed copy, printed matter, tracings or drawings, and photographs.

Reproducible – A master copy that can be legibly duplicated by either microreproduction, diazo, or electrostatic process. Diazo sepias may be submitted only if they meet and satisfy BSC imaging requirements.

Electronic – Electronic media formatted as specified in the Purchase Order. Seller should contact BSC for formatting requirements if not clearly specified or if not clear.

Permission to Proceed Required – BSC review required prior to use of documents in the design, fabrication, installation, or other work process.

Initial – The first submittal of a document in accordance with the schedule mutually agreed to by BSC and the supplier.

Final – The submittal that reflects the required resolution of review comments or the complete submittal required. Drawings submitted as final shall show BSC job title, job number, procurement document number, line, equipment, tag or code number, and the manufacturer's serial number(s).

B. SUBMITTAL

In column 5 BSC Engineering places the following codes where applicable:

F - Before Fabrication	I - Before Installation	W - With Shipment
S - Before Shipment	P - Before Final Payment	D - Before Design
U - Before Use		

or

Expressed in calendar days after notice of award.

In column 7, BSC Engineering to place the following letter as applicable:

E - Electronic
R - Reproducible
O - Original
P - Print

In column 8, BSC Engineering provides any further explanation or comments.

C. DISTRIBUTION

Items and/or documents required to be provided by the G-321-E shall be forwarded to BSC as identified in Section 3 of the MR/Purchase Order.

D. DOCUMENT CATEGORY NUMBERS AND ABBREVIATED DESCRIPTIONS

Engineering Documents are identified and defined as follows:

- 1.0 SUPPLIER'S INDEX/SCHEDULE – The Supplier shall list all drawings and documents, including submittal dates. The supplier shall identify exactly how data requested on the G-321-E and G-321-V forms will be submitted and shall identify and agree to the schedule dates for the submittal of documents.
- 1.1 OUTLINE DIMENSIONS, SERVICES, FOUNDATIONS, AND MOUNTING DETAILS (OUTLINE DIM, SERVICES, AND FDN/MTG DETS) – Drawing providing external envelope, including lugs, centerline(s), location and size for electrical cable, conduit, fluid, and other service connections, isometrics, and details related to foundations and mountings.
- 1.2 ASSEMBLY DRAWINGS (ASSEMBLY DWGS) – Detailed drawings indicating sufficient information to facilitate assembly of the component parts of an equipment item.
- 1.3 SHOP DETAIL DRAWINGS (SHOP DET DWGS) – Drawings that provide sufficient detail to facilitate fabrication, manufacture, or installation. This includes pipe spool drawings, internal piping and wiring details, cross-section details, and structural and architectural details.
- 1.4 WIRING DIAGRAMS (WIRING DIAGS) – Drawings that show schematic diagrams, equipment internal wiring diagrams, interconnection wiring diagrams for electrical items, and the security program.
- 1.5 CONTROL LOGIC DIAGRAMS (CONT LOGIC DIAGS) – Drawings that show paths that input signals must follow to accomplish the required responses.
- 1.6 PIPING AND INSTRUMENTATION DIAGRAMS (P&IDs) – Drawings that show piping system scheme and control elements.

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BSC

Engineering Document Requirements Form G-321-E

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Complete only applicable items.

-
- 2.0 PARTS LIST AND COST – Sectional view with identified parts, detailed parts description (material, size, etc.), Original Equipment Manufacturer and vendor part number, lead time, and recommended spare parts and source information for operations, testing, and maintenance activities with unit cost. When available, update information for replacement parts for newer models or equipment. When referring to gaskets, seals, etc., identify material type (i.e., Viton, EPDM, BUNA-N, etc.). For fasteners, identify grade, material, length, diameter, thread, etc.
- 3.0 COMPLETED BSC DATA SHEETS AND SPREADSHEETS (COMP DATA SHT) – Information provided by a supplier on data sheets (e.g., QA data sheet, design data sheet, Design Verification data sheet) furnished by BSC.
- 4.1 ERECTION/INSTALLATION INSTRUCTIONS (EREC/INSTL INST) – Detailed written procedures, instructions, and drawings required to erect or install material or equipment.
- 4.2 OPERATING INSTRUCTIONS – Detailed written instructions describing how an item or system should be operated. Operation manuals for systems, subsystems, and equipment that include system descriptions and controls, operating standards and codes, recommended personal protective equipment, operating procedures, operating logs, wiring diagrams, control diagrams, instrument and piping diagrams, precautions and licensing requirements. Operation and maintenance documentation directory that includes lists of documents, systems, equipment, components, and a table of contents. The general manual layout includes title page, table of contents, manual contents, and vendor contact information (such as telephone and fax numbers, and e-mail address).
- 4.3 MAINTENANCE INSTRUCTIONS – Detailed written instructions required to disassemble, reassemble, and maintain items or systems in an operating condition. Maintenance manuals for the care and maintenance of products, materials, finishes, systems, and equipment that include content divided into sections for each system/subsystem and individual products outside of a system, source information, product information, maintenance procedures, repair materials, lubricants [API (American Petroleum Institute) or SAE (Society of Automotive Engineers) service standard and at least 3 substitutions], and sources including vendor service representative contact information, maintenance and service schedules, maintenance and service contracts, and warranties and bonds, special tools (including measurement and test equipment), and related certificate of compliance or calibration. The general manual layout includes title page, table of contents, manual contents, and vendor contact information (such as telephone and fax numbers, and e-mail address). Photographs could be provided under this category. Schedule for submittal shall be 90 days prior to shipment.
- 4.4 SITE STORAGE AND HANDLING INSTRUCTIONS (SITE STOR & HDLG) – Detailed written instructions which define the requirements and time period for lubrication, rotation, heating, lifting, packaging, cure date for elastometrics (e.g., gaskets, seals, o-rings, etc.) or other handling requirements to prevent damage or deterioration during long or short term storage (i.e., ANSI A, B, C, D) and handling at jobsite. This includes return shipping instructions. Schedule for submittal shall be 90 days prior to shipment.
- 4.5 EMERGENCY MANUALS – Emergency manuals that include the type of emergency, emergency instructions, emergency procedures, and emergency call-out personnel and contact numbers. The general manual layout includes title page, table of contents, manual contents and vendor contact information (such as telephone and fax numbers, and e-mail address).
- 4.6 TRAINING MATERIALS – If available, Training materials or media (such as videotapes, compact disks) that include information or instruction (courses) from the manufacturers to use in training personnel to properly operate and maintain the equipment and systems.
- 5.0 SCHEDULES: ENGINEERING AND FABRICATION/ERECTION (SCHED) (ENGRG & FAB EREC) – Bar charts or critical path method diagrams which detail the chronological sequence of activities. (See Section 6 of the MR/Purchase Order.)
- 6.0 QUALITY ASSURANCE MANUAL/PROCEDURES (QA MNL/PROC) – The document(s) that describe(s) the planned and systematic measures that are used to assure that structures, systems, and components will meet the requirements of the procurement documents.
- 6.1 INSPECTION AND TEST PLAN – Detailed description of the inspections and tests planned during the receipt, manufacturing, and conformance verification activities. Includes identification of BSC and supplier witness and hold points.
- 7.0 SEISMIC DATA REPORT – The analytical or test data that provides data and demonstrates suitability of material, component, or system in relation to the conditions imposed by the stated seismic criteria. Includes seismic qualification test program and weight and center of gravity report.
- 8.0 ANALYSIS, CALCULATION, AND DESIGN REPORT (ANAL & DSGN RPRT) – The analytical data (stress, electrical loading, fluid dynamics, thermal, chemical, fatigue, structural, radiation tolerance, code, etc.) that demonstrates that an item satisfies specified requirements. Include calculations for detailed design, code, nozzle load, etc.
- 9.0 ACOUSTIC DATA REPORT (ACST DATA RPRT) – The noise, sound, and other acoustic vibration data required by the procurement document.
- 10.0 SAMPLES – Physical such as weld samples, surface finish, coatings, or linings.
- 10.1 TYPICAL QUALITY VERIFICATION DOCUMENTS (TYP QUAL VERIF DOC) – A representative data package that will be submitted for the items furnished as required in the procurement documents and **G-321-V**.
- 10.2 TYPICAL MATERIAL USED (TYP MAT USED) – A representative example of the material to be used.
- 11.0 MATERIAL DESCRIPTION (MAT DESCRPT) – The technical data describing a material that a supplier proposes to use. This also applies to architectural items and manufacturer's data, e.g., metal siding, decking, doors, paints, and coatings. Material safety data sheets will be provided for all hazardous material including gaskets, lubricants, paints, coatings, etc.
- 12.0 WELDING PROCEDURES AND QUALIFICATIONS (WLDG PROC & QUALF) – The welding procedure, specification, and supporting qualification records required for welding, hard facing, overlay, brazing, and soldering.
- 13.0 MATERIAL CONTROL PROCEDURES (MATERIAL CONT PROC) – The procedures for controlling issuance, handling, storage, and traceability of materials such as weld rod, production items, or Government Owned Materials.

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BSC

Engineering Document Requirements Form G-321-E

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Complete only applicable items.

- 14.0 REPAIR PROCEDURES (REPAIR PROC) – The procedures for controlling material removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection.
- 15.0 CLEANING AND COATING PROCEDURES (CLNG & CTG PROC) – The procedures for removal of dirt, grease, or other surface contamination and preparation and application of protective coatings.
- 16.0 HEAT TREATMENT PROCEDURES (HEAT TR PROC) – The procedures for controlling temperature and time at temperature as a function of thickness, furnace atmosphere, cooling rate and method, etc. This includes a Descaling Procedure, if applicable.
- 19.0 UT – ULTRASONIC EXAMINATION PROCEDURES (UT PROC) – Procedures for detection of presence and certain characteristics of discontinuities and inclusions in materials by the use of high frequency acoustic energy.
- 20.0 RT – RADIOGRAPHIC EXAMINATION PROCEDURES (RT PROC) – Procedures for detection of presence and certain characteristics of discontinuities and inclusions in materials by x-ray or gamma ray exposure of photographic film.
- 20.1 RT FILM – RADIOGRAPHIC FILM WITH TECHNIQUE AND READER SHEETS (RT FILM) – Original set of radiographic film with associated radiographic technique sheets and film reader sheets.
- 21.0 MT – MAGNETIC PARTICLE EXAMINATION PROCEDURES (MT PROC) – Procedures for detection of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.
- 22.0 PT – LIQUID PENETRANT EXAMINATION PROCEDURES (PT PROC) – Procedures for detection of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.
- 23.0 EDDY CURRENT EXAMINATION PROCEDURES (EDDY CUR EXAM PROC) – Procedures for detection of discontinuities in materials by distortion of an applied electromagnetic field.
- 24.0 PRESSURE TEST – HYDRO, AIR, LEAD, BUBBLE OR VACUUM TEST PROCEDURES (PRESS TEST – HYDRO, AIR, BUBBLE – VAC TEST PROC) – Procedures for performing hydrostatic or pneumatic structural integrity and leakage tests.
- 25.0 INSPECTION PROCEDURES (INSPECT PROC) – Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance results, etc.) are met. Includes procedures for dimensional inspection, hardness testing, and wall thickness.
- 26.1 MECHANICAL TEST PROCEDURE (MECH TEST PROC) – Tests performed to demonstrate that functional design and operational parameters are met, e.g., pump performance data, valve stroking, load, temperature rise, calibration, environment, remote handling, load test, pipe bending, etc.
- 26.2 ELECTRICAL TEST PROCEDURE (ELEC TEST PROC) – Tests performed to demonstrate that functional design and operational parameters are met, e.g., impulse, overload, continuity, voltage, temperature rise, calibration, saturation loss, etc.
- 27.0 PROTOTYPE TEST REPORT (PROTO TYP TEST REPORT) – Report of a test which is performed on a standard or typical example of equipment or item, and is not required for each item produced in order to substantiate the acceptability of equal items. This may include tests that result in damage to the item(s) tested and failure data reports.
- 28.0 PERSONNEL QUALIFICATION PROCEDURES (PERSONL QUAL PROC) – Procedures for qualifying welders, inspectors, and other special process personnel.
- 29.0 SUPPLIER SHIPPING PREPARATION PROCEDURE (SPLR SHPNG PREP PROC) – The procedure used by a supplier to prepare finished materials or equipment for shipment from its facility to the jobsite.
- 30.0 SUPPLIER DEVIATION DISPOSITION REQUEST (SDDR) – Form required to document deviation requests from supplier.
- 31.0 POSITIVE MATERIAL IDENTIFICATION PROCEDURE (PMI) – The procedure for performing PME testing of materials.
- 32.0 SOFTWARE DOCUMENTATION – Required documentation that is needed to utilize supplier provided software.
- 33.0 COMMERCIAL GRADE DEDICATION DOCUMENTATION – Required documentation to support Commercial Grade Dedication activities.
- 34.0 FACTORY ACCEPTANCE TEST (FAT) – This applies to factory acceptance tests conducted at the supplier's facility.

Note: Where additional space is needed to provide requested information, attach additional pages. All pages must be identified and traceable to the applicable form (G-321-E).

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APPENDIX H — Quality Verification Document Requirements – Form G321-V

BSC

Quality Verification Document Requirements Form G-321-V

QA:QA

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Complete only applicable items.

Project Entity (Name): Yucca Mountain Project -- Waste Package Fabrication Specification						
1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. BSC Release	5. Field Receipt Inspection Check-In	6. Remarks	7. Document Supplier Page Count
12.0	5.5.1.2, 6.1.A	WELD & QUALIF VERIF DOC	YES			
14.0	5.5.1.5.B, 9.6 Item G	REPAIR MAP	YES			
15.0	5.7	CLNG VERIF REPORT	YES			
16.0	5.6	HEAT TREATMENT VERIF REPORT	YES			
17.1	1.5.1.C, 4.1	MAT PROP REPORT (CMTR's)	YES			
19.0	1.5.1, 6.1	UT - REPORT (Final)	NO			
20.0	1.5.1, 6.1	RT - REPORT (Final)	NO			
22.0	1.5.1, 6.1	PT - REPORT (Final)	NO			
24	6.3	LEAK TEST REPORT	NO			
25.0	9.1	INSPECTION & VERIFICATION REPORT (Calibration Records)	YES			
25.0	8.2	INSPECTION & VERIFICATION REPORT (Dimensions)	YES			
25.0	1.5.1, 6.1	VT-REPORT (Final)	NO			
25.0	9.11, Appendix F	MANUFACTURER'S DATA REPORT	YES			
25.0	5.4	WELD, MATERIAL AND RADIOGRAPHIC MAPS	NO			
25.0	6.0, Appendix D	E-MAIL NOTIFICATION FOR HOLD/WITNESS POINTS	YES			
25.0	9.7	INSPECTION & VERIFICATION REPORTS (Serial & lot Traceability)	YES			
25.0	1.5.1	INSPECTION & VERIFICATION REPORTS (Travelers an/or Checklists - whichever is used)	YES			
25.0	9.6, Appendix C	INSPECTION & VERIFICATION REPORTS (SDDR's)	YES			
35.0	8.2	OPEN (TABLE OF CONTENTS)	YES			
35.0	5.5.1.2	PERSONNEL QUAL RECORDS (WPQR's)	YES			
35.0	6.1	PERSONNEL QUAL RECORDS (NDE)	YES			
8. Supplier's Order No.:		9. Supplier's Part No.:		10. Supplier's Part Name:		11. Quantity:
12. BSC PO No.:		13. BSC Tag or Equipment No.:		14. BSC Part Name:		15. PO Item No.:
16. SUPPLIERS CONFORMANCE STATEMENT: We certify that the work and required documents meet the requirements of the procuring documents.			Authorized Supplier Signature:		Title:	Date:
17. BSC QUALITY REPRESENTATIVE AT PLANT: Work was released based on satisfactory completion of quality surveillance and review of documentation.			<input type="checkbox"/> With authorized deviations noted in Column 6 <input type="checkbox"/> No deviations		Signature of BSC SVR:	Date:
18. RECEIVING INSPECTION AT THE FIELD This form and the Quality Verification Documents referenced hereon have been received and their relationship to the hardware items verified.			Signature of BSC Field Inspector:			Date:
19. FORWARD COPIES TO:			SPECIAL INSTRUCTIONS: Each page on the documentation package shall be identified with the applicable Document Category Number (column 1) listed above. Documents should not be tabulated (column 7) in more than one category. Mail the complete package to BSC Field Procurements Manager within 3 days. One complete copy of the package to be sent with the shipment within 3 days after shipment.			

BSC

**Quality Verification Document Requirements
Form G-321-V**

QA:QA

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Complete only applicable items.

20. Requisition Title:	21. Requisition No.: (MR No.)
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**INSTRUCTIONS FOR THE PREPARATION OF
FORM G-321-V**

- A. **PURPOSE:** Form G-321-V is initially prepared by BSC Engineering and completed by the supplier when providing Quality Verification Documents to BSC in support of the work. This is a multi-purpose form to:
 - (1) Transmit quality verification documents from the supplier.
 - (2) Provide a Certificate of Conformance from the supplier.
 - (3) Evidence SQR release of documentation and/or work.
 - (4) Provide evidence of a Field Inspection check of the quality verification documentation received at the installation site.
- B. **GENERAL INFORMATION:** Instructions for filling out form G-321-V are found in Sections E & F. Detailed quality verification document categories and definitions are found in Section G.
- C. **DISTRIBUTION:** Quality verification documents required to be provided by form G-321-V shall be forwarded to the group(s) and destination(s) designated under entry #19, "Forward copies to." For the PO Item number(s) being released (Entry 15), the supplier shall provide the completed G-321-V forms and the supporting Quality Verification Documents.
- D. **DEFINITIONS OF TERMS:** (Also see document category definitions in Section G).
 - Supplier - This is a seller, vendor, contractor, subcontractor, sub-supplier, etc.
 - Reproducible - A master copy which can be legibly duplicated by either micro-reproduction, diazo, or electrostatic process. Diazo sepias may be submitted only if they meet and satisfy BSC imaging requirements.
 - Electronic - Electronic data submitted in formats identified in the Drawing and Data Requirements Form or as directed by BSC.
 - Drawings submitted as final show title, job number, purchase order number, line, equipment, tag or code number, and the manufacturer's serial number.

E. BSC ENTRY INSTRUCTIONS

Entry No.	Information Required	Entry No.	Information Required
1.	Enter Document Category Number as shown in Section G.		Upon satisfactory review of the Quality Verification Document Package and Associated Deviations, if any, the SQR or BSC's Authorized Representative signs and dates this block denoting release for shipment.
2.	Enter Specification Paragraph Reference which address the subject document.		
3.	Enter Description or Abbreviated Description corresponding to the Document Category Number.		Upon receipt of the Quality Verification Documentation Package at the jobsite, the Field Inspector will review the documents and the appropriate hardware and found to be satisfactory, signs and dates this block. Missing, incomplete, or deficient items will be brought to the attention of the supplier by BSC Field Procurement personnel.
4.	When BSC Source Verification is required as noted on the PO cover sheet, the SQR or Authorized Representative will initial upon satisfactory review of the document(s).		
	BSC Field Inspection at the jobsite will complete upon satisfactory checks of the document(s).		Enter the name and address to which items or documents are to be forwarded.
5.	Enter "Remarks" as appropriate. When a deviation has occurred, reference the deviation(s) and Authorization Document(s) in this column and include the authorization document(s) in the verification package.		Description as stated on the Material Requisition. MR Number. MR Revision Number.

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Complete only applicable items.

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F. SUPPLIER ENTRY INSTRUCTIONS

Entry No.	Information Required	Entry No.	Information Required
7.	Enter the number of pages of Quality Verification Document being submitted, corresponding to the unit being released. Sign Entry 16.	15.	Enter the BSC PO Item Number(s) that apply to the item(s) being shipped.
8, 9, 10, 11.	Enter information required. Enter the quantity of units covered by the Quality Verification Documents being submitted with this form. Enter information required.	16.	Supplier - Signature, title, and date of the person responsible for the prime supplier's QA function and whose function and position are described in the prime supplier's QA program.
12, 13, 14		19.	Upon Inspection Release, Entry 17, the completed Quality Verification Documents are forwarded by the supplier to the address(es) shown.
		Note:	Where additional space is needed to provide requested information, attach additional pages. All pages must be identified and traceable to the applicable form G-321-V.

G. DOCUMENT CATEGORY NUMBERS AND DETAILED DESCRIPTIONS - Quality Verification Documents. This term comprises material test reports, heat treatment charts, welding records, NDE results, performance test reports, and similar document(s), which demonstrate or certify conformance to the technical or inspection requirements of the procurement documents.

- 12.0 WELDING QUALIFICATION VERIFICATION REPORTS – A verification report of welds performed including the identification of the qualified weld(s), and certification that the weld(s) were qualified.
- 13.0 MATERIAL VERIFICATION REPORTS – Reports relative to materials that confirm, substantiate or assure that an activity or condition has been implemented in conformance with code and material specifications imposed by the procurement documents.
- 14.0 MAJOR REPAIR VERIFICATION REPORTS – Verification reports may include weld repair locations (maps), material test reports for filler material, pre- and post-weld heat treatment records, NDE records, etc. The resolution of whether a repair is major or not is a BSC responsibility.
- 15.0 CLEANING AND COATING VERIFICATION REPORTS – Verification reports include certification of visual examination for surface preparation, surface profile, materials, etc., humidity data and coating thickness data as required by the procurement documents.
- 16.0 HEAT TREATMENT REPORTS – Verification reports normally include furnace charts or similar records, that identify and certify the item(s) treated, the procedures used, furnace atmospheres, time at temperature, cooling rate, etc.
- 17.1 MATERIAL TEST REPORTS (MTR) – These reports include all chemical, physical, mechanical, and electrical property test data required by material specification and applicable codes. This also includes corrosion testing or other Buyer specified material testing. This is applicable to cement, concrete, metals, cable jacket materials, rebar, rebar splices, etc.
- 17.2 IMPACT TEST DATA – Results of Charpy or drop weight tests including specimen configuration, test temperature and fracture data.
- 17.3 FERRITE DATA – Report of the ferrite percentage for stainless steel materials used, including castings and welding filler metals as deposited.

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Complete only applicable items.

- 17.4 MATERIAL CERTIFICATE OF COMPLIANCE – Verification document that certifies conformance to the requirements of the applicable material specification.
- 17.5 ELECTRICAL PROPERTY REPORTS – Reports of electrical characteristics, e.g., dielectric, impedance, resistance, flame tests, corona, etc.
- 18.0 CODE COMPLIANCE – Verifying documents (such as Forms U-1, N-1, State, etc.), that are prepared by the manufacturer and certified by the Authorized Code Inspector.
- 19.0 UT – ULTRASONIC EXAMINATION AND VERIFICATION REPORTS – Examination results of presence and certain characteristics of discontinuities and inclusions in material by the use of high-frequency acoustic energy.
- 20.0 RT – RADIOGRAPHIC EXAMINATION AND VERIFICATION REPORTS – Examination results of presence and certain characteristics of discontinuities and inclusions in materials by x-ray or gamma ray exposure of photographic film.
- 21.0 MT – MAGNETIC PARTICLE EXAMINATION AND VERIFICATION REPORTS – Examination results of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.
- 22.0 PT – LIQUID PENETRANT EXAMINATION AND VERIFICATION REPORTS – Examination results of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.
- 23.0 EDDY CURRENT EXAMINATION AND VERIFICATION REPORTS – Examination results of discontinuities in materials by distortion of an applied electromagnetic field.
- 24.0 PRESSURE TEST – HYDRO, AIR, LEAD, BUBBLE, OR VACUUM TEST AND VERIFICATION REPORTS – Results of hydrostatic or pneumatic structural integrity and leakage tests.
- 25.0 INSPECTION AND VERIFICATION REPORTS – Documented findings resulting from an inspection.
- 26.1 MECHANICAL TEST REPORTS – For pump performance data, valve stroking, load, temperature rise, calibration, environment, etc.
- 26.2 ELECTRICAL TEST REPORTS – For load, impulse, overload, continuity, voltage, temperature rise, calibration, saturation loss, etc.
- 27.0 PROTOTYPE TEST REPORT – Report of a test that is performed on a standard or typical example of equipment, material, or item and is not required for each item produced in order to substantiate the acceptability of equal items. This normally includes tests, that may, or could be expected to, result in damage to the item(s) tested.
- 30.0 SUPPLIER DEVIATION DISPOSITION REQUEST – Completed and approved form documenting supplier deviations to the order.
- 31.0 POSITIVE MATERIAL IDENTIFICATION (PMI) RESULTS – Documentation of PMI showing chemical properties and material classification.
- 33.0 COMMERCIAL GRADE DEDICATION DOCUMENTATION – Required documentation to support Commercial Grade Dedication activities.
- 34.0 FACTORY ACCEPTANCE TEST (FAT) – System test(s) conducted at the supplier’s facility to demonstrate item or equipment performance meets specified requirements.

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