GE Nuclear Energy

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EIS IDENT: FAB SHROUD STABILIZER

REVISION STATUS SHEET

DRAFT

DOCUMENT TITLE FABRICATION OF SHROUD STABILIZER

LEGEND OR DESCRIPTION OF GROUPS

TYPE FABRICATION SPECIFICATION

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MPL NO: PRODUCT SUMMARY SECTION 7
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THIS ITEM IS OR CONTAINS A SAFETY-RELATED ITEM YES [X] NO [ ] EQUIP CLASS CODE P

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PRINTS TO

MADE BY	APPROVALS	GENERAL ELECTRIC COMPANY 175 CURTNER AVENUE SAN JOSE CALIFORNIA 95125
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1. SCOPE

1.1 This specification defines the requirements for fabrication of the shroud stabilizer hardware. These requirements apply as described herein to wrought austenitic stainless steels, types 304, 304L, 316, 316L, stainless steel type XM-19, and Ni-Cr-Fe alloy X-750 materials.

1.2 Definitions

Buyer - General Electric Nuclear Energy (GENE)

Fabricator - The supplier authorized by GENE to perform fabrication services for the hardware items comprising the shroud stabilizers.

2. APPLICABLE DOCUMENTS

2.1 GE Nuclear Energy Documents. The following documents form a part of this specification to the extent specified herein. In case of any conflict between this document and any of the following, the requirements of this document shall govern.

a. P50YP102 Arc Welding of Austenitic Stainless Steels

b. P50YP211 Cleaning and Cleanliness Control of Reactor System Components

c. E50YP20 Determination of Carbide Participation in Wrought Austenitic Stainless Steels

d. E50YP11 Examination for Intergranular Surface Attack

e. E50YP22 Liquid Penetrant Examination

f. Y1010A3 Shop Applied Practices

g. P10JYP2 Age Hardening of Ni-Cr-Fe Alloy X-750

2.2 Codes and Standards. The following codes and standards (issue in effect at the date of the purchase order, or as specified in this specification or its supporting documents) form a part of this specification to the extent specified herein.

2.2.1 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code

a. Section III, Subsection NG, Core Support Structure, 1989 Edition

b. Section IX, Welding and Brazing Qualifications

2.2.2 American Welding Society (AWS) Standards

a. AWS-A2.4, Symbols for Welding and Nondestructive Testing

b. AWS-A3.0, Terms and Definitions

2.2.3 American Society for Testing and Materials (ASTM)

a. ASTM A-370, Specification for Mechanical Testing of Steel Products

b. ASTM A-182, Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

c. ASTM A-240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

d. ASTM A-479, Specification for Stainless and Heat-Resisting Steel Wire, Bars, and Shapes for Use in Boilers and Other Pressure Vessels

e. ASTM B-637, Specification for Precipitation Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service

f. ASTM A-262, Detecting Susceptibility to Intergranular Attack in Stainless Steel

2.2.4 US Federal Register Code of Federal Regulations (CFR)

a. 10 CFR 50 - Title 10, Energy; Chapter 1, Nuclear Regulatory Commission; Part 50, Licensing of Production and Utilization Facilities, Appendix B, Quality Assurance Criteria for Nuclear Power Plants.

b. 10 CFR 21, Reporting of Defects and Noncompliance

3. REQUIREMENTS

3.1 General. This specification is for use in conjunction with detail product drawings which define the requirements for each part of the shroud stabilizers. It is intended that all parts will be fabricated without welding. Welding requirements are only included herein as a repair contingency.

3.2 Materials. Parts shall be fabricated from materials specified on the detail product drawings and the additional requirements of this specification. The material for each completed part shall be traceable to its certified material test report (CMTR). Physical and chemical overcheck tests are required for each heat number of material in accordance with ASTM A-370

3.2.1 X-750 Material. Nickel-chrome-iron (Ni-Cr-Fe) alloy X-750 shall be in accordance with ASTM B-637, UNS N07750, Type 3 and the additional requirements specified below.

3.2.1.1 X-750 Maximum Cobalt. The maximum cobalt content of Ni-Cr-Fe alloy X-750 material shall be 0.090 percent.

3.2.1.2 X-750 Hot Forming. Ni-Cr-Fe alloy X-750 shall be hot formed in accordance with a buyer approved fabricator's procedure.

3.2.1.3 X-750 Heat Treatment. Ni-Cr-Fe alloy X-750 shall be annealed at 1975 $\pm$ 25°F (metal temperature) and air cooled after hot forming operations. The center of the cross-section shall be held at this temperature for 60 to 70 minutes. Equalizing heat treatment at 1500°F to 1800°F is prohibited. Product forms with both cross section dimensions less than six inches by six inches may be water quenched after annealing as a vendor option, and with buyer approval. Materials tests shall be performed at both 70°F and 550°F, on specimens which have been annealed and age hardened

3.2.1.4 X-750 IGA Testing. Intergranular attack (IGA) testing per E50YP11 shall be performed after annealing for each heat and heat treat lot. IGA examination is not required if a minimum of 0.030 inch of material is removed from all surfaces of the product form after final heat treatment. IGA examination is not required after age hardening.

3.2.1.5 X-750 Age Hardening. Ni-Cr-Fe alloy X-750 shall be age hardened at 1300 $\pm$ 15°F for 20 hour minimum and air cooled in accordance with P10JYP2D, and a buyer approved procedure. Age hardening may be performed before or after machining as long as the final part meets all dimensional requirements.

3.2.2 Austenitic 300 Stainless Steel. Austenitic 300 series stainless steel shall be in accordance with ASTM A-479, A-182 or A-240 type 304, 304L, 316 or 316L with a maximum carbon content of 0.020 percent. The type and applicable ASTM specification shall be as specified on the specific part drawing. The additional requirements below also apply

3.2.2.1 Austenitic 300 SST Heat Treatment. Austenitic 300 series stainless steel shall be solution annealed at 2000 $\pm$ 100°F (metal temperature) for a minimum of 15 minutes per inch of thickness, but not less than 15 minutes total, immediately followed by quenching in circulating water to a temperature below 400°F. The solution anneal shall be performed after completion of final reduction, sizing, and straightening operations. Successful completion of the sensitization testing of paragraph 3.2.2.2 shall be accepted as evidence of the correct solution heat treatment, if time and temperature charts are not available.

3.2.2.2 Austenitic 300 SST Sensitization. Austenitic 300 series stainless steel shall have sensitization testing performed for each heat and heat treat lot in accordance with the requirements of E50YP20, or by ASTM A-262 Practice E if no welding will be performed on the part.

3.2.2.3 Austenitic 300 SST IGA Testing. Intergranular attack (IGA) examination shall be performed for each heat and heat treat lot in accordance with the requirements of E50YP11. IGA examination is not required if a minimum of 0.030 inch of material is removed from all surfaces of the product form after final heat treatment.

3.2.2.4 Austenitic 300 SST Hardness. The maximum hardness of austenitic 300 series stainless steel material and completed parts shall be R_B 90 for types 304 or 304L, and R_B 92 for types 316 or 316L.

3.2.3 XM-19 Stainless Steel. Type XM-19 stainless steel shall be in accordance with ASTM A-479, A-182, or A-240. The maximum carbon content is limited to 0.040 per cent. The applicable ASTM specification shall be as specified on the specific piece part drawing. The additional requirements below also apply.

3.2.3.1 XM-19 SST Heat Treatment. XM-19 stainless steel shall be solution annealed at 2000°F ± 50°F (metal temperature) for 15 to 20 minutes for each inch of thickness, but for not less than 15 minutes regardless of thickness. The material shall be quenched in circulating water to a temperature below 800°F. As a vendor option to avoid distortion, the tie rods may be air cooled so that the metal temperature is below 800°F within 20 minutes of removal from the furnace. The solution anneal shall be performed after completion of final reduction, sizing, and straighting operations. Sucessful completion of the sensitization testing of paragraph 3.2.3.2 shall be accepted as evidence of the correct solution heat treatment, if time and temperature charts are not available.

3.2.3.2 XM-19 SST Sensitization. Each heat and heat treat lot of XM-19 material shall be tested for sensitization in accordance with the requirements of ASTM A-262 Practice E.

3.2.3.3 XM-19 SST IGA Testing. Intergranular attack (IGA) examination shall be performed for each heat and heat treat lot in accordance with the requirements of E50YP11. IGA examination is not required if a minimum of 0.030 inch of material is removed from all surfaces of the product form after final heat treatment.

3.2.3.4 XM-19 SST Hardness. The maximum hardness of XM-19 stainless steel material and completed parts shall be R_c 30.

3.3 Cutting, Forming, and Cleaning

3.3.1 Mechanical Cutting Methods. Methods such as machining, grinding (see also paragraph 3.6) and sawing are acceptable. Methods such as shearing or punching that form a hardened layer on the metal surface shall not be used, except where the cold-worked material is subsequently and completely removed by machining, grinding, or solution heat treatment.

3.3.2 Thermal Cutting Methods. Plasma arc cutting may be used with the following restrictions: Interpass temperature control shall be in accordance with P50YP102 for stainless steels. If a minimum of 0.12 in of the cut surface is subsequently removed by machining or grinding, the interpass temperature control is not required. Surfaces shall be machined or ground to a bright metal finish following the cutting operation. Preventive measures shall be taken to assure that spatter will not enter areas that are inaccessible to cleaning operations.

3.3.3 Bending and Forming Control for Stainless Steel. There shall be no cold forming, bending, or cold reduction for austenitic stainless steel, unless otherwise specified in the paragraphs below, or unless the component is subsequently solution heat treated.

3.3.4 Prohibited Processes. Processes such as shot peening, hammering, or power deslagging of final surfaces are prohibited.

3.3.5 Straightening. Straightening or reforming shall be performed in accordance with an approved procedure.

3.3.6 Control of Deformation. For parts that are straightened, reformed, or otherwise subjected to deformation as part of the normal fabrication process, the following controls shall be met: (1) Hardness of any wrought stainless steel in the final fabricated condition shall not exceed the hardness requirements of paragraphs 3.2.2.4 and 3.2.3.4 as determined by an approved procedure. The buyer approved procedure shall include the specification of locations for hardness testing. The hardness shall be measured with a test device specifically designed to perform Rockwell B measurements for 300 series stainless steel, and with a test device specifically designed to perform Rockwell C measurements for XM-19 stainless steel. (2) Cold bending strain, after solution annealing, shall be limited to two and one-half percent maximum.

3.3.7 Cleaning and Control of Miscellaneous Process Materials. Miscellaneous process materials include such things as machining lubricants, liquid penetrants, solvents, tapes, ultrasonic testing couplant, abrasive grit, packing materials, marking materials, weld spatter compounds, and other materials which will be in contact with the part being fabricated. All miscellaneous process materials shall be controlled to prevent contamination of stainless steel and Ni-Cr-Fe materials. The known contaminates of concern are chlorides, fluorides, sulfur, lead, mercury and all metals with low melting points. In addition, when welding or heat treating is involved, all carbonaceous material and phosphates must be considered harmful on stainless steel which can pick up these contaminates. Parts may be cleaned in accordance with P50YP211 as one method to control contamination.

3.4 Heating Control for Stainless Steel. Austenitic stainless steel shall not be heated above 800°F except by welding or thermal cutting unless the process will be followed by solution heat treatment

3.5 Solution Heat Treatment. Solution heat treatment of complete 300 series stainless steel assemblies, if required, shall be performed in accordance with qualified procedures approved by the buyer and shall meet the following requirements:

a. Parts and any fixtures used in the heat treatment shall be visibly clean prior to heat treatment.

b. Heat up and cool down rates shall be controlled to prevent distortion.

c. Parts shall be heated from 1900°F to 2100°F for not less than 15 minutes.

d. Parts shall be water quench-cooled from 1900°F to 800°F quickly enough to assure passing the tests required by subparagraph "f" below.

e. All surfaces shall appear reasonably bright and clean after heat treatment and shall meet buyer approved limits for oxide discoloration.

f. Solution heat treated parts shall be tested by demonstrating with a mockup that the temperature is obtainable at a location in the center thickness, farthest from all heated surfaces or perform testing in accordance with E50YP11 and E50YP20.

3.6 Control of Grinding. Where possible, grinding shall be performed prior to any solution heat treatment. Grinding should be restricted to instances required by fit-up or nondestructive testing needs. Where practical, machining should be used in place of grinding (see also paragraph 4.6.2).

3.7 Repair Not Requiring Welding. Minor surface grinding or machining, without subsequent weld repair, may be performed to remove surface defects or to change contour provided the following conditions are met:

a. The thickness of the section is not reduced to less than minimum required thickness.

b. The depression or ground area is blended uniformly into the surrounding surface with not less than a 4 to 1 taper.

c. After final grinding or machining, examine the surfaces by liquid penetrant to insure that no unacceptable defects remain.

3.8 Electropolishing. When electropolishing is specified by the detail part drawing, a buyer approved procedure shall be used. Electropolishing shall remove 0.0002 to 0.0006 inch of the surface after all mechanical cutting is completed. The process shall use mixed phosphoric/sulfuric acid.

3.9 Final Surfaces. All nicks and scratches are to be removed. Surface finishes shall be uniform in appearance.

3.10 Shop Applied Practices. The buyer's specification Y1010A3, "Shop Applied Practices", shall be considered an intergral part of the fabrication drawings, and be so implemented during fabrication and inspection.

3.11 Identification and Marking. Finished parts shall be marked as specified on the detail product drawings. Low stress interrupted dot stamping is an acceptable method of marking. Parts which are too small for practical marking may be identified by individual bagging and tagging.

4.0 WELDING

4.1 General. Welding requirements for 300 series stainless steel are included in this section as a repair contingency. Buyer approval shall be obtained prior to making repairs involving welding.

4.2 Welding Filler Materials

4.2.1 Certification. A certified chemical analysis shall be obtained for each heat or lot of welding filler metal to be used.

4.2.2 Weld Filler Material. Welding filler materials shall conform to the requirements of the applicable welding process specification (see paragraph 4.2.4).

4.2.3 Filler Material Control and Storage Welding materials shall be controlled in such a manner that it can be proven which heats of material were used for component fabrication. All welding filler materials shall be stored, issued, and handled in a manner that assures that filler materials are dry, clean, identified until consumed, and that the proper filler metal was used. A written procedure shall include procurement, baking, storage, issue, use, and return to storage of unused welding filler materials.

4.2.4 Allowed Filler/Base Metal Combinations The allowable welding filler metal types for the given base materials shall be in accordance with the welding process specifications listed below:

	Base Material	Process Specification
a.	300 Series Austenitic Stainless Steels	P50YP102

4.3 Backing Bars and Straps. All backing materials such as bars and straps shall have the same requirements as the base materials or, where complete removal is assured, backing materials shall meet the chemistry requirements (as a minimum) of the base material.

4.4 Temporary Attachments. Temporary welded attachments shall meet the chemistry requirements of the base material, or shall be carbon or low alloy steel buttered with a minimum of two layers of weld deposit utilizing filler metal in accordance with paragraph 4.2.2 unless otherwise specified.

4.5 Shielding Gases. Shielding gases shall be welding grade argon or mixtures of argon with helium or hydrogen.

4.6 Qualification for Welding. All welding procedures and welders shall be qualified in accordance with ASME Section IX (the latest edition and addenda).

4.6.1 Fillet and Partial Penetration Welds. Fusion requirements for partial penetration and fillet welds with less than 90° included angle shall be demonstrated by approved test welds.

4.6.2 Control of Grinding. For procedure or welder qualification, the test assembly weld joint shall be welded in strict accordance with the approved welding procedure with no added precautions which will not be used in production. Excessive grinding to overcome poor welding technique shall be unacceptable. Grinding shall be used only for dressing of starts, stops, occasional reshaping of beads for accessibility, smoothing of surfaces prior to required penetrant examinations, and smoothing of final surfaces. Each case of grinding for accessibility shall be specifically approved by the responsible welding engineer and so noted in the records. Adequate supervision shall be provided to assure adherence to these requirements.

4.7 Welding

4.7.1 Weld Symbols and Definitions. Interpretation of weld symbols shall be in accordance with AWS A2.4 and definitions in accordance with AWS A3.0.

4.7.2 Welding Process Specifications. All welding shall be performed to the requirements of this specification and P50YP102.

4.7.3 Welder Identification. A welder identification system shall be employed such that records are available showing the person(s) welding each joint.

4.7.4 Welding Procedures. All welding including temporary attachments and their removal shall be performed in accordance with approved detailed written welding procedures. Welding procedures shall contain all essential and non-essential variables listed in ASME Section IX and shall contain the additional requirements of this specification, as applicable.

4.7.5 Alignment. Unless otherwise specified, alignment of sections shall be such that the maximum offset of the finished joint will not be greater than 1/8-inch or 1/4 T, whichever is less, where T is the thickness of the thinner base material. Alignment of sections at joints for single welded full-penetration groove welds shall be such that the maximum offset at any point shall not exceed 0.045 inch at the root side. All final dimensional requirements for the component or assembly shall be maintained.

4.7.6 Arc Strikes. Arc strikes on stainless steel surfaces shall be removed, verified by visual and penetrant examination, and weld repaired, if necessary. The final surface of weld repairs shall be inspected by liquid penetrant.

5. QUALITY ASSURANCE

5.1 Submittals. Submittal requirements shall apply to the Fabricator and the Fabricator's subcontractors. The Fabricator shall be responsible for all submittals including those of the Fabricator's subcontractors. If any changes are made to the submittals, the Fabricator shall send revisions to the Buyer.

5.1.1 Required Submittals. The following items shall be submitted to the Buyer for approval prior to use:

a. Bending and forming procedures

b. Heat treating procedures

c. Welding procedures (including repair procedures) and welding procedure performance qualifications

d. Nondestructive examination procedures and personnel certifications

e. Packaging procedure

5.2 Material Control. Material shall be controlled within the fabricator's shops under a quality assurance program which has been determined by survey/audit to meet material traceability and safety grade manufacturing practices as required by the Code of Federal Regulations 10 CFR 50, Appendix B, and 10 CFR, Part 21.

5.3 Inspection and Tests. All materials, part final surfaces, and welds (if any) shall be inspected for quality and cleanliness prior to the last operation which results in inaccessibility. Following such inspection, measures shall be taken to prevent the entry of soils into inaccessible areas during subsequent fabrication steps.

5.3.1 Liquid Penetrant Examination. All final part surfaces, except small inaccessible openings, shall be examined by the liquid penetrant method in accordance with E50YP22A, except that no cracking is permissible and linear indications shall not exceed 0.063 inch in length. Liquid penetrant materials shall be in accordance with E50YP22 or buyer approved equivalent. Provision shall be made to avoid the entrapment of liquid penetrant materials in any inaccessible areas.

5.3.2 Radiographic Examination. Radiographic examination shall be performed on all structural welds, if any are allowed as a repair, in accordance with the ASME Code, Article NG-5000 and acceptance criteria in accordance with Subarticle NG-5320. Acceptance standards and penetrameters shall be based on the final section thickness.

5.3.3 Ultrasonic Examination. Material shall be ultrasonically examination in accordance with ASME Code Subsection NG, paragraph NG-2540, or a buyer approved equivalent procedure.

6. PREPARATION FOR SHIPMENT

6.1 General Requirement. Components fabricated to this specification shall be prepared and packaged for shipment in such a manner that the components will not be damaged or lost by handling or environment during transit.

6.2 Procedure. The Fabricator shall package the product in accordance with Buyer approved procedures.

6.3 Identification. The component(s), when prepared for shipment, shall be identified by the purchase order number and other pertinent information in such a manner that the component(s) identity shall be maintained during shipment. When more than one component is included in a crate or package, the marking on the packaging shall indicate the identity and quantity of all parts.