GE Nuclear Energy

25A5690	SH NO. 1
REV. 2	

EIS IDENT: FAB SHROUD STABILIZER

REVISION STATUS SHEET

DOCUMENT TITLE FABRICATION OF SHROUD STABILIZER

LEGEND OR DESCRIPTION OF GROUPS

TYPE: FABRICATION SPECIFICATION

FMF: DRESDEN 2 AND 3

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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	CN02416 CHK BY: JL TROVATO ER MOHTASHEMI		

PRINTS TO

MADE BY	APPROVALS	GENERAL ELECTRIC COMPANY 175 CURTNER AVENUE
A. FORTIN 12/22/94	E.R. MOHTASHEMI 1/18/95	SAN JOSE CALIFORNIA 95125
CHKD BY: A. FORTIN 12/22/94	ISSUED JAN 18,1995 R. J. AHMANN	CONT ON SHEET 2

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 316, 316L, stainless steel type XM-19, and Ni-Cr-Fe alloy X-750 materials.

1.2 Definitions

Buyer - GE 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 (Rev. 10)	Arc Welding of Austenitic Stainless Steels
b.	P50YP211 (Rev. 1)	Cleaning and Cleanliness Control of Reactor System Components
c.	E50YP20 (Rev. 4)	Determination of Carbide Participation in Wrought Austenitic Stainless Steels
d.	E50YP11 (Rev. 3)	Examination for Intergranular Surface Attack
e.	E50YP22A (Rev. 3)	Liquid Penetrant Examination
f.	Y1010A3 (Rev. 0)	Shop Applied Practices
g.	P10JYP2 (Rev. 12)	Age Hardening of Ni-Cr-Fe Alloy X-750
h.	P16BYP3 (Rev. 6)	Chromium Alloy Coating "Electrolizing"

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. Deleted.

c. Section II, Material Specification, 1989 or later edition approved by NRC.

2.2.2 Deleted

a. Deleted

b. Deleted

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

g. ASTM A-412, Specificiation for Stainless and Heat Resisting Chromium-Nickel-Magenese Steel Plate, Sheet and Strip.

h. ASTM E-384, Standard Test Method for Microhardness of Materials.

I. ASTM A-336, Specification for Steel Forgings, Alloy, for Pressure And High-Temperature Parts.

j. ASTM A-751, Test Methods, Practices , and Terminology for Chemical Analysis of Steel Products.

k. ASTM E-8, Test Methods for Tension Testing Of Metallic Materials.

l. ASTM E-353, Test Methods For Chemical Analysis Of Stainless, Heat Resisting,Maraging, and other similar Chromium-Nickel-Iron Alloys.

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

2.2.5 American National Standard Institute (ANSI/ASME)

a. ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities, 1986 Edition.

b. ANSI/ASME N45.2.2 Packing, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants, 1978 Edition.

c. ANSI/ASME N45.2.13, Quality Assurance Requirement for Control of Procurement of Items and Services for Nuclear Power Plants, 1976 Edition.

2.3 Other Documents

a. BWROG-VIP, Core Shroud Repair Design Criteria, Latest revision.

b. Com Ed Technical Requirements document for Dresden/Quad Cities Core Shroud Repairs, NEC-12-4056, Rev 0.

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.

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, A-751, E-8, or E-353 as applicable.

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, 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 0.09 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 ± 25°F (metal temperature) and forced-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 ± 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, A-336, or A-240 type 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 ± 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 forming operations. In addition, after final machining materials will be re-solution annealed and sensitization tested per 3.2.2.2 with exception of; 1) Locking pins of sizes 0.19 and 0.50 inches diameter which are electrolized (hard chrome plated) after being centerless ground to size , and 2) The lower contact spacer, which must be trimmed to final dimension in acordance with site measurements. After trimming, the affected surface shall be polished with progressively finer grits to remove 0.003-0.004 inch of material.

Electrolizing shall be performed in accordance with P16BYP3A. A test sample shall be provided from the same material, same fabrication shop and the same process variables, prior to electrolizing. The sample shall be evaluated per paragraph 3.5.

A typical polishing process for the lower contact surface consists of; 1) Flap with a 60 grit flapper wheel, 2) Flap with a 80 grit flapper wheel, 3) Flap with a 3M or equivalent Level Cut Medium (LCM) grit polishing wheel, 4) Flap with a 3M or equivalent level cut fine wheel.

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

c. 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.

d. Minor cold straightening (up to 2 1/2% maximum outer fiber strain) may be performed after final solution anneal. Cold straightening over 1% strain shall be noted in the records package of the affected material or part.

3.2.2.2 Austenitic 300 SST Sensitization. All 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. Sensitization heat treatment shall be at 1250° ±25°F for one hour followed by 930° ± 25°F for twenty four hours. Successful completion of the sensitization testing shall be accepted as evidence of the correct solution heat treatment, if time and temperature charts are not available.

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 types 316 or 316L shall be R_B 92.

3.2.3 XM-19 Stainless Steel. Type XM-19 stainless steel shall be in accordance with ASTM A-479, A-182, A-336, A-412 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 500°F. As a vendor option to avoid distortion, the tie rods may be forced- air

cooled so that the metal temperature is below 500°F within 20 minutes of removal from the furnace. The solution anneal shall be performed after completion of final reduction, sizing, and straightening operations. Re-solution anneal of critical, highly stressed, machined areas such as tie rod threads need not involve the entire part, but can be limited to just the newly machined portions. The threaded portions of the tie rod will be re-solution annealed per following:
1- Induction heat will be applied at 7-8 kHz and temperature will be held at 1900-2000°F for 1 minute +10 seconds/-0 seconds.
2- Forced-air cooling will be applied directly on the threaded area for a minimum of 20 minutes and until the surface temperature less than 400°F is acheived.

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 E50YP20 or ASTM A-262 Practice E. Sensitization heat treatment shall be at 1250° ±25°F for one hour followed by 930° ± 25°F for twenty four hours. Successful completion of the sensitization testing shall be accepted as evidence of the correct solution heat treatment, if time and temperature charts are not available.

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_B100.

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 within the limits of paragraph 3.2.2.1d and 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. If the dimensions of the part permit, the hardness shall be measured with a test device specifically designed to perform Rockwell B measurements for all materials. (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 contaminants 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 contaminants. 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 by thermal cutting unless the process will be followed by solution heat treatment.

3.5 Metallographic and Microhardness Evaluation. Machined components that are not solution annealed after machining shall have metallographic and microhardness evaluation on test samples per requirements of 2.2.3h. Samples shall be provided from the same material, same fabrication shop and using the same process variables.

3.5.1 Cold Work Surface . The depth of cold work on the sample(s) shall be reported based upon any severely deformed, featureless surface layer plus near-surface cross-slip or curvature of twin boundaries and by microhardness readings. Microhardness measurements shall be made in series from the surface (first indication within 0.001 inch of the surface) to a sufficient depth to demonstrate the variation of the hardness as a function of depth below the surface. Hardness data shall be reported in microhardness units and also converted to Rockwell units.

3.5.2 Cold Work Depth. The total depth of the surface cold work on the sample(s), including the heavily deformed, featureless surface layer shall be determined by metallography and microhardness and shall not exceed:

	XM-19 and X-750	316 Locking Pins	316 Lower Contact Surface
Featureless Layer	0.0003 inch	None Allowed	None Allowed
Twin Region	0.003 inch	0.002 inch	0.003 inch
Total	0.003 inch	0.002 inch	0.003 inch

3.6 Deleted.

3.7 Repair. Minor surface grinding or machining 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 ensure that no unacceptable defects remain to demonstrate process capability.

d. Grinding or machining processes shall not introduce unacceptable surface coldwork or hardness in machining process qualification samples evaluated.

3.8 Deleted.

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 integral 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 Deleted.

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. Deleted.

d. Nondestructive examination procedures

e. Packaging procedure

f. Results of the metallographic and microhardness evaluation of fabrication induced surface cold work in samples evaluated, that are not solution annealed after final fabrication. Samples shall be provided from the same material , same fabrication shop and using the same process variables.

g. Sampling procedures used to produce process capability test samples and finished parts.

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 0.06 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 examined 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, in accordance with the document in Paragraph 2.2.5.b.

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 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.

Enclosure 3

GENE Fabrication Specification, 25A5690, Revision 2

Dresden 2 and 3 - Fabrication of Shroud Stabilizer