

ATTACHMENT 2

**GENE SPECIFICATION 25A5718, REVISION 0
SHROUD REPAIR HARDWARE
DESIGN SPECIFICATION
HATCH UNIT 2
MAY 1995**

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1. SCOPE

1.1 This document defines the design and performance requirements for stabilizers for the shroud to structurally replace welds H1 through H8. A sketch of the welds and their nomenclature is given in Figure 1. ASME code requirements are given in the document in Paragraph 2.1.1.d.

2. APPLICABLE DOCUMENTS

2.1 General Electric Documents. The following documents form a part of this specification to the extent specified herein.

2.1.1 Supporting Documents

- | | |
|---|----------|
| a. Determination of Carbide Precipitation in Wrought Austenitic Stainless Steel (Modified ASTM A262 Practice A) | E50YP20 |
| b. Examination for Intergranular Surface Attack | E50YP11 |
| c. Liquid Penetrant Examination | E50YP22A |
| d. Shroud Stabilizers Code Design Specification | 25A5717 |

2.1.2 Supplemental Documents. Documents under the following identities are to be used with this specification:

- | | |
|-------------------------|----------|
| a. Reactor Components | 383HA715 |
| b. Essential Components | 22A3041 |

2.2 Codes and Standards. The following documents of the latest issue (or specified issue) form a part of this specification to the extent specified herein.

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

- a. Section III, Appendices, 1989 Edition.
- b. Section III, Subsections NB and NG, 1989 Edition.



2.2.2 American Society for Testing and Materials (ASTM)

- a. ASTM A182, Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature.
- b. ASTM A240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- c. ASTM A262, Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels.
- d. ASTM A276, Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
- e. ASTM A479, Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
- f. ASTM A480, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- g. ASTM B637, Specification for Precipitation Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service.

2.3 Southern Nuclear Corporation Documents

- a. UFSAR, Hatch Unit 2, Rev. 13A.
- b. SCS Letter, File DCR 94-052, Log 01950048, January 30, 1995, "SCS Seismic Input for Unit 2 Core Shroud Repair".

2.4 BWR VIP Documents

- a. BWR VIP Core Shroud Repair Design Criteria, Revision 1, September 12, 1994.

3. GENERAL DEFINITION

3.1 The purpose of the shroud stabilizers is to structurally replace welds H1 through H8. Welds H1 through H8 are all of the circumferential welds in the shroud as well as the (H7) bimetallic attachment weld of the shroud to the shroud support and the weld (H8) of the shroud support cylinder to the shroud support plate. These welds were required to both vertically and horizontally support the core top guide, core support plate, and shroud head, and to prevent core flow bypass to the downcomer region. The core top guide and core support plate horizontally support the fuel assemblies and maintain the correct fuel channel spacing to permit control rod insertion.



4. REQUIREMENTS

4.1 Code

4.1.1 The Shroud Stabilizers are not classified as ASME Section III code components; however, material properties shall be obtained from the document in Paragraph 2.2.1.a. The nomenclature for stress intensity used in this document is the same as that in Paragraph 2.2.1.b. The Shroud Stabilizers shall meet the original construction requirements for the shroud.

4.1.2 The shroud repair shall be performed in accordance with the requirements of the document in Paragraph 2.4.a except as agreed to by GE Nuclear Energy and Southern Nuclear Operating Company.

4.2 Structural Criteria

4.2.1 All structural analysis shall be performed per the criteria given in the document in Paragraph 2.3.a. All of the load combinations given in Paragraph 4.3.5 shall be shown to satisfy the primary stress limits given in Table 4.2-12 of the document listed in Paragraph 2.3.a with values of SFmin as defined in Paragraph 4.3.6. The appropriate SFmin values have been incorporated into the allowable stress intensity values given in Paragraphs 4.2.1.1 and 4.2.1.2.

4.2.1.1 The primary stresses (P_m , P_l , and $P_b + P_l$) in the existing shroud, during normal and upset events, shall be shown to be less than S_m , $1.5S_m$, and $1.5S_m$ respectively. During emergency events, the allowable stresses are increased by a factor of 1.5 times the values for normal and upset events. During faulted events, the allowable stresses are increased by a factor of 2.0 times the values for normal and upset events.

4.2.1.2 The stresses (P_m , $P_m + P_b$, and $P_m + P_b + Q$) in the repair hardware, during normal and upset events, shall be shown to be less than S_m , $1.5S_m$, and $3.0S_m$ respectively. During emergency events, the allowable primary stresses are increased by a factor of 1.5 times the values for normal and upset events. During faulted events, the allowable primary stresses are increased by a factor of 2.0 times the values for normal and upset events. Secondary stresses are not limited during emergency and faulted events.

4.2.2 The values of S_m and S_y as well as any other required material property shall be obtained from the document in Paragraph 2.2.1.a, except for alloy X-750. The values of S_m and S_y for alloy X-750 at operating temperature are 47,500 psi and 92,300 psi respectively. If CMTRs are available, the value of S_m may be determined using the method in Appendix III of the document in Paragraph 2.2.1.a.

4.2.3 The maximum permanent deflection of any point on the shroud adjacent to either the H2 or the H3 weld shall be less than 2.1 inches divided by SFmin, during all of the load combinations specified in Paragraph 4.3.5. The maximum permanent deflection of any point on the shroud adjacent to either H6A or H6B shall be less than 0.75 inch divided by SFmin,



during all of the load combinations specified in Paragraph 4.3.5. The maximum transient elastic deflection during the seismic event adjacent to either H6A or H6B shall be less than 1.68 inch divided by SFmin specified in Paragraph 4.3.6.

4.3 Design Requirements

4.3.1 General. The shroud repair hardware shall be designed to horizontally support the top guide, core support plate, the fuel assemblies and the shroud head. The shroud repair shall be designed to limit upward displacement of the shroud. The shroud repair shall be designed for a life equal to the remaining design life of the plant plus possible life extension. The shroud repair shall be removable.

4.3.2 Spring Preload

4.3.2.1 Installation Preload. The 3.5 inch diameter tie rod nut shall be preloaded at installation to a minimum of 150 ft-lbs.

4.3.2.2 Preload Relaxation. The design shall consider a mechanical preload relaxation of 10% for the tie rods at beginning of life.

4.3.3 Environmental Conditions

4.3.3.1 Temperature. The design temperature for the repair hardware is 553 degrees F. The operating temperature is 528 degrees F. Operating temperature shall be used for emergency and fault evaluations.

4.3.3.2 Radiation. The maximum neutron radiation level at the shroud repair hardware is $3.2E10$ neutrons/cm²/sec, which will have no effect on material properties.

4.3.4 Physical Interfaces

4.3.4.1 The shroud repair hardware shall restrain the shroud during all of the load combinations in Paragraph 4.3.5. The allowable permanent motion is dependent on the safety significance of the portion of the shroud under consideration. The allowable permanent motion for those portions of the shroud, which affect control rod insertion, is given in Paragraph 4.2.3. For the remaining portion of the shroud below H3, the allowable permanent motion is determined such that the reflooding of the inside of the shroud up to two thirds of core height is assured. For the portion of the shroud above H2, the allowable motion is 4.0 inches, which assures that the core spray lines are not impacted by the shroud.

4.3.4.2 The shroud repair hardware must provide features which facilitate handling during installation. The upper and lower springs shall be movable without removing the tie rod and without welding to permit inspection of the reactor pressure vessel with GERIS 2000.



4.3.4.3 All parts shall be captured and held in place with a method that will last for the design life given in Paragraph 4.3.1.

4.3.5 Load Combinations. The load combinations that the shroud and shroud repair shall be analyzed for are given below.

Upset 1	OBE + Normal P + DW
Upset 2	Thermal Transient + DW
Emergency 1	DBE + Normal P + DW
Emergency 2	MS LOCA + DW
Emergency 3	1/2 SME + Normal P +DW
Faulted 1	DBE + MS LOCA + DW
Faulted 2	DBE + RL LOCA + DW
Faulted 3	1/2 SME + MS LOCA + DW
Faulted 4	1/2 SME + RL LOCA + DW

- OBE: Operating Basis Earthquake
- Normal P: Normal Operating Condition Pressure Differences
- DW: Dead Weight
- DBE: Design Basis Earthquake
- 1/2 SME: One Half the Seismic Margin Earthquake
- MS LOCA: Main Steam Line Loss of Coolant Accident
- RL LOCA: Recirculation Line Loss of Coolant Accident

The moment due to dead weight can be used to resist the recirculation line LOCA.

4.3.5.1 The pressure differences for these events are given in the below Table. The pressure inside the shroud is higher than outside the shroud and the pressure is higher below the core plate than above the core plate. These values all include increased core flow; and the uprated values include power uprate to 110%.

<u>Component</u>	<u>Normal Pressure</u>		<u>LOCA Pressure</u>	
	<u>Rated</u>	<u>Uprated</u>	<u>Rated</u>	<u>Uprated</u>
Core Plate	20.4 psi	19.9 psi	23.5 psi	23.5 psi
Shroud Head	8.0 psi	8.5 psi	29.0 psi	30.5 psi



4.3.5.2 A new seismic analysis based on the documents in Paragraph 2.3 shall be performed, which includes the shroud repair. The shroud repair shall function for the entire continuum from an uncracked shroud to a shroud with all horizontal welds (H1-H8) containing 360° through wall cracks. Therefore, multiple conditions must be analyzed for both the OBE and the DBE. At least the following shroud conditions shall be analyzed; an uncracked shroud with the installed repair, a shroud with a through wall 360 degree crack at any single weld (H1-H8) with the installed repair, and a shroud with all horizontal welds containing 360° through wall cracks.

The limiting seismic loads will be documented in a letter report for use in the stress analysis. The design report shall determine which conditions are the worst.

4.3.5.3 Two steady state thermal conditions shall be evaluated. The first is normal operation with the shroud at 540°F and the stabilizer at 528°F. The second condition is an upset transient (scram with loss of feedwater pumps) with the shroud at 433°F and the stabilizer at 300°F. This event shall be assumed to occur 10 times in 40 years of plant operation.

4.3.5.4 During the recirculation line LOCA, there is a force applied to the shroud between welds H4 and H5 of 25,000 lbs due to asymmetric pressures in the annulus between shroud and RPV. This force exists for sufficient time to be treated as a static force.

4.3.6 Required Safety Factors. The minimum safety factors (SF_{min}) shall be 2.25 for normal and upset, 1.5 for emergency, and 1.125 for faulted.

4.3.7 Vertical Shroud Displacement The shroud repair shall be designed so that there is no separation of 360 degree through wall cracking of the shroud welds during normal operation.

4.4 Materials. ASTM specification material is required for the shroud stabilizers. Certified material test results (CMTR) are required for all materials.

4.4.1 The stabilizer springs shall be made of nickel-chrome-iron alloy X-750 (UNS N07750-Modified). The cobalt content shall be limited to 0.10%. Alloy X-750 shall be purchased per ASTM B-637 and age hardened. Alloy X-750 shall be tested for intergranular attack (IGA) per E50YP11. In lieu of testing per E50YP11, finished components may incorporate the removal of a minimum of 0.030 inch of material from all surfaces of the original raw material form, after solution heat treatment.

4.4.2 The tie rod material shall be type XM-19 stainless steel in accordance with ASTM A-479, A-182 or A-240. The XM-19 carbon content shall not exceed 0.040%, and the material shall be annealed at 2000±50 degrees F followed by rapid cooling. XM-19 material shall be tested for sensitization in accordance with ASTM A-262 Practice E. XM-19 material shall be IGA tested in accordance with the requirements of E50YP11, unless a minimum of 0.030 inch of material is removed from all surfaces after final heat treatment.



4.4.3 Other parts of the shroud stabilizer may be made from austenitic stainless steel per ASTM A-182, A-240 or A-479 type 304, 304L, 316, or 316L material with a carbon content less than 0.020% and annealed at 1900 to 2100 degrees F, followed by quenching in circulating water to a temperature below 400 degrees F (or other approved alternate). Following solution heat treatment, the material shall be sensitization tested per E50YP20 (or approved alternative test method) and intergranular surface attack per E50YP11. The maximum hardness shall be RB90 for 304 and 304L. The maximum hardness shall be RB92 for 316 and 316L. Alternatively, other parts of the stabilizer assembly may be made from either X-750 material per paragraph 4.4.1 above, or XM-19 per paragraph 4.4.2 above.

4.5 Leakage Due to Repair. Zero leakage is not required. However, the design shall control the normal operating condition leakage to prevent cavitation of the jet pumps. The leakage after any required load combination shall be limited such that core flooding is assured.

4.6 Inspections. Liquid penetrant examination shall be performed on all final machined surfaces of all new hardware and on all structural welds per the document in Paragraph 2.1.1.c.

4.7 Fabrication

4.7.1 Welding Welding will not be used in this repair.

5.0 QUALITY ASSURANCE

5.1 The shroud repair hardware components are safety related as referenced in Paragraph 2.1.2.b, and design, fabrication installation and other construction activities shall be controlled per a QA Program, which satisfies 10CFR50 Appendix B, to assure safe and reliable components.

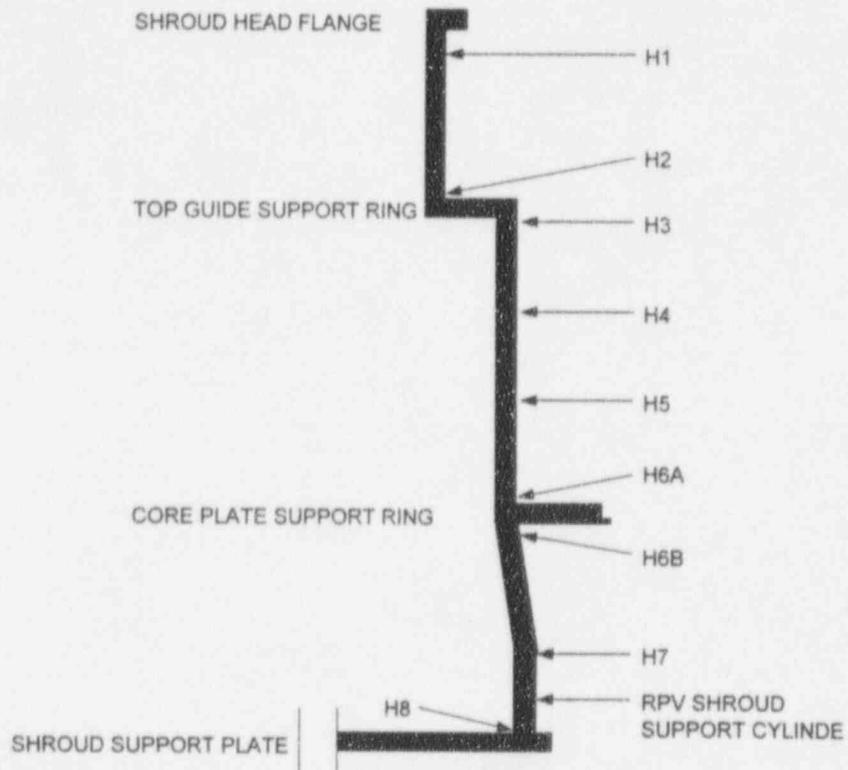


Figure 1. Horizontal Weld Location