GE Nuclear Energy

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25A5579 SH NO. 1
REV.A

EIS IDENT: SHROUD STABILIZER HARDWARE

REVISION STATUS SHEET

DOC TITLE SHROUD STABILIZER HARDWARE

LEGEND OR DESCRIPTION OF GROUPS

TYPE: DESIGN SPECIFICATION

FMF: PEACH BOTTOM 2 AND 3

MPL NO: PRODUCT SUMMARY SEC. 7

THIS ITEM IS OR CONTAINS A SAFETY RELATED ITEM YES X NO ☐ EQUIP CLASS CODE P

REVISION		I
A	RM-01386 SEP 12 1994	

PRINTS TO

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

1.1 This document defines the design and performance requirements for stabilizers for the core shroud which will functionally replace welds H1 through H7. A sketch of the welds and their nomenclature is given in Figure 1. All ASME Code requirements are given in the document of Paragraph 2.1.1.g. This specification herein contains those requirements that are not ASME Code requirements.

2. APPLICABLE DOCUMENTS

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

2.1.1 Supporting Documents

a.	Arc Welding of Austenitic Stainless Steel	P50YP102
b.	Sensitization Tests for Austenitic Stainless Steel, Modified ASTM A262 Practice E	E50YP13
c.	Determination of Carbide Precipitation in Wrought Austenitic Stainless Steel (Modified ASTM A262 Practice A)	E50YP20
d.	Examination for Intergranular Surface Attack	E50YP11
e.	Age Hardening of NI-CR-FE Alloy X750	P10JYP2
f.	Liquid Penetrant Examination	E50YP22
g.	Shroud Stabilizers	25A5580
h.	Reactor Vessel Thermal Cycles	729E762
i.	Seismic Analysis of Peach Bottom 2 Reactor Vessel and Internals	383HA691
j.	Reactor Internal Pressure Differences, Peach Bottom 2	257HA777
k.	Reactor Internal Pressure Differences, Peach Bottom 3	257HA776
l.	Peach Bottom 2,3 Power Rerate Analysis	NEDC-32230P

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

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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 IX, Welding and Brazing Qualifications, 1989 Edition.

c. Section III, Subsection NG, 1989 Edition.

d. Section XI, Rules for Inservice Inspection, 1980 Edition, Winter 1981 Addenda.

2.2.2 American Society for Testing and Materials (ASTM)

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

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

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

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

e. ASTM A-480, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

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

2.3 PECO Energy Documents

a. UFSAR, Peach Bottom Units 2 and 3.

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3. GENERAL DESCRIPTION

3.1 The purpose of the shroud stabilizers is to structurally replace welds H1 through H7. Welds H1 through H6 are all of the circumferential welds in the shroud, as well as the (H7) bimetallic attachment weld of the shroud to th shroud support. 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 into 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 stabilizer components are not classified as ASME Section III Code components. However, material properties shall be obtained from the document in Paragraph 2.2.1.a, and welding qualification shall be performed in accordance with the document in Paragraph 2.2.1.b. The nomenclature for stress intensity used in this document is the same as that used in the document of Paragraph 2.2.1.c.

4.2 Structural Criteria

4.2.1 All structural analysis shall be performed in accordance with the criteria given in the Peach Bottom UFSAR. All of the load combinations given in Paragraph 4.3.5 shall be shown to satisfy the primary stress limits given in Tables C.5.2 and C.5.6 of the Peach Bottom UFSAR, 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 (Pm, P1, and Pb + P1) in the existing shroud, during Normal and Upset events, shall be shown to be less than Sm, 1.5Sm, and 1.5Sm 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. Primary plus Secondary (P + Q) stresses for Normal and Upset events shall be less than 3.0 Sm

4.2.1.2 The stresses (Pm, Pm + Pb, and Pm + Pb + Q) in the repair hardware, during Normal and Upset events, shall be shown to be less than Sm, 1.5Sm, and 3.0Sm 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.

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4.2.2 The values of Sm and Sy as well as any other required material property shall be obtained from the document in Paragraph 2.2.1.a (ASME Code, Section III Appendices), except for alloy X-750. The values of Sm and Sy for alloy X-750 at operating temperature are 47,500 psi and 92,300 psi respectively. These values must be verified from the Certified Material Test Reports (CMTR's). The value of Sm must be determined using the method of Appendix III from the document of paragraph 2.2.1.a. If Certified Material Test Reports (CMTR's) are available, the value of Sm for XM-19, or for stainless steel 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 the H5 or H6 weld shall be less than 0.25 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 the H5 or H6 weld shall be less than 0.84 inch divided by SFmin specified in Paragraph 4.3.6. The allowable deflections are based on test data, and on Tables C.5.1 and C.5.5 of the Peach Bottom UFSAR.

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 prevent 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. All of the springs shall be installed with a preload due to bending deflection greater than the deflection resulting from the limiting design upset condition, exclusive of seismic events. The required installation spring bending preload is 0.04 inch for the upper springs and 0.01 inch for the lower springs.

4.3.2.2 Preload Relaxation. The design shall consider an End-of-Life preload relaxation of 5% for the upper springs near the H2 and H3 welds and a relaxation of 5% for the lower springs near the H5 and H6 welds.

4.3.3 Environmental Conditions

4.3.3.1 Temperature. The design temperature for the repair hardware is 550 degrees F. The operating temperature is 525 degrees F. Operating temperature shall be used for emergency and faulted evaluations.

4.3.3.2 Radiation. The maximum neutron radiation level (flux) at the shroud stabilizers in the shroud vessel annulus is 4.8E10 neutrons/cm^2/sec.

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 2.8 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, in order to permit inspection of the reactor pressure vessel with GERIS 2000.

4.3.4.3 The shroud repair hardware shall be designed and installed such that removal of jet pump inlet mixers can be performed without removal of any of the repair hardware.

4.3.4.4 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 from the Peach Bottom UFSAR. The limiting Upset event is a Design Basis Earthquake (DBE), plus Normal pressure differences, plus dead weight. The Emergency 1 event is a Maximum Credible Earthquake (MCE), plus Normal pressure differences, plus dead weight. The Emergency 2 event is a main steam line LOCA, plus dead weight. The Faulted event is a Maximum Credible Earthquake (MCE), plus a main steam line LOCA, plus dead weight. The combination of a recirculation line LOCA, plus MCE is not the limiting faulted event.

4.3.5.1 The pressure differences for these events are given in the table below. The pressure inside the shroud is higher than that outside of the shroud, and the pressure is higher below the core plate than above the core plate. These values include Power Rerate conditions based on 110% core flow, and 110% original power.

Component	Normal Pressure	LOCA Pressure
Core Plate	23.67 psi	30.0 psi
Shroud Head	9.41 psi	32.9 psi

4.3.5.2 A new seismic analysis based on the documents in Paragraph 2.3 shall be performed, which includes the shroud stabilizers. The shroud stabilizers shall function for the entire continuum from an uncracked shroud to a fully cracked shroud. Therefore, multiple conditions must be analyzed, for both the DBE and the MCE events. As a minimum, the following shroud conditions shall be analyzed: an uncracked shroud with the installed stabilizers, a shroud with a through wall 360 degree crack at the H7 weld with the installed stabilizers, and a shroud with a through wall 360 degree crack at the H6 weld with the installed stabilizers. The limiting seismic loads on the stablizer are given in the table below:

Component	DBE	MCE
Upper Spring	16,800 lb.	31,200 lb.
Lower Spring	33,400 lb.	89,600 lb.
Set of 4 Tie Rods (each)	76,400 lb.	121,000 lb.

4.3.5.3 Two steady state thermal conditions shall be evaluated. The first is Normal operation with the shroud at 539 degrees F, and the stabilizer assembly at 527 degrees F. The second condition is an Upset transient (scram with loss of feedwater pumps) with the shroud at 433 degrees F, and the stabilizer at 300 degrees F. The number of events is defined by 729E762 (document 2.1.1.h).

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

4.3.6 Required Safety Factors. The minimum safety factors (SFmin) shall be 2.25 for Normal and Upset events, 1.5 for Emergency events, and 1.125 for Faulted events. These are based on Table C.5.5 of the Peach Bottom UFSAR.

4.4 Materials. ASTM specification material is acceptable for the Shroud Repair. CMTRs are required for all material.

4.4.1 The springs shall be made of nickel-chrome-iron alloy X-750 (UNS N07750). The cobalt content shall be limited to a maximum of 0.10%. Alloy X-750 shall be purchased per ASTM B-637 and age hardened per P10JYP2. Alloy X-750 material shall be tested per E50YP11. In lieu of testing per E50YP11, all finished components may incorporate the removal, after solution heat treatment, of a minimum of 0.030 inches of material from all surfaces of the original raw material form.

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4.4.2 The tie rods may be made of either 304, 304L, 316, or 316L material with a maximum carbon content of 0.02%, and annealed at 1900 to 2100 degrees F followed by quenching in circulating water to a temperature below 400 degrees F. The tie rod material shall be tested per E50YP11 and E50YP20. The maximum hardness shall be RB90 for 304 and 304L. The maximum hardness shall be RB92 for 316 and 316L. XM-19 with a maximum carbon content of 0.04% may also be used for fabrication of the tie rods. XM-19 shall be annealed at 2,000 $\pm$ 25 degrees F, followed by rapid cooling, and shall be tested per E50YP13, or per ASTM A-262 Practice E.

4.4.3 Other parts shall be made of any of the materials listed in Paragraph 4.4. The filler material for any required weld buildups shall be Type 308L per P50YP102. All assembly welds shall satisfy P50YP102.

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 to 2/3 the height of the core is assured.

4.6 Inspections. Liquid penetrant examination shall be performed on all final machined surfaces of all stabilizer components, and on all structural welds in accordance with the requirements E50YP22A.

4.7 Fabrication

4.7.1 Welder and Weld Procedure Qualification. Welders and weld procedures shall be qualified per the document in Paragraph 2.2.1.b. Welder qualifications shall include limited access similar to the actual welds to be completed.

4.7.2 Root Pass. The root pass of all full penetration single sided stainless steel welded joints shall be made by the GTAW process. Protective gas back-purging is required for all full penetration single sided welded joints until a minimum of 3/16 inch of weld thickness is completed.

4.7.3 Weld Surface Finish. All welds shall have the final outer surface suitable for liquid penetrant examination. The final surface shall meet the hardness requirements of Paragraph 4.4.

5. QUALITY ASSURANCE

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

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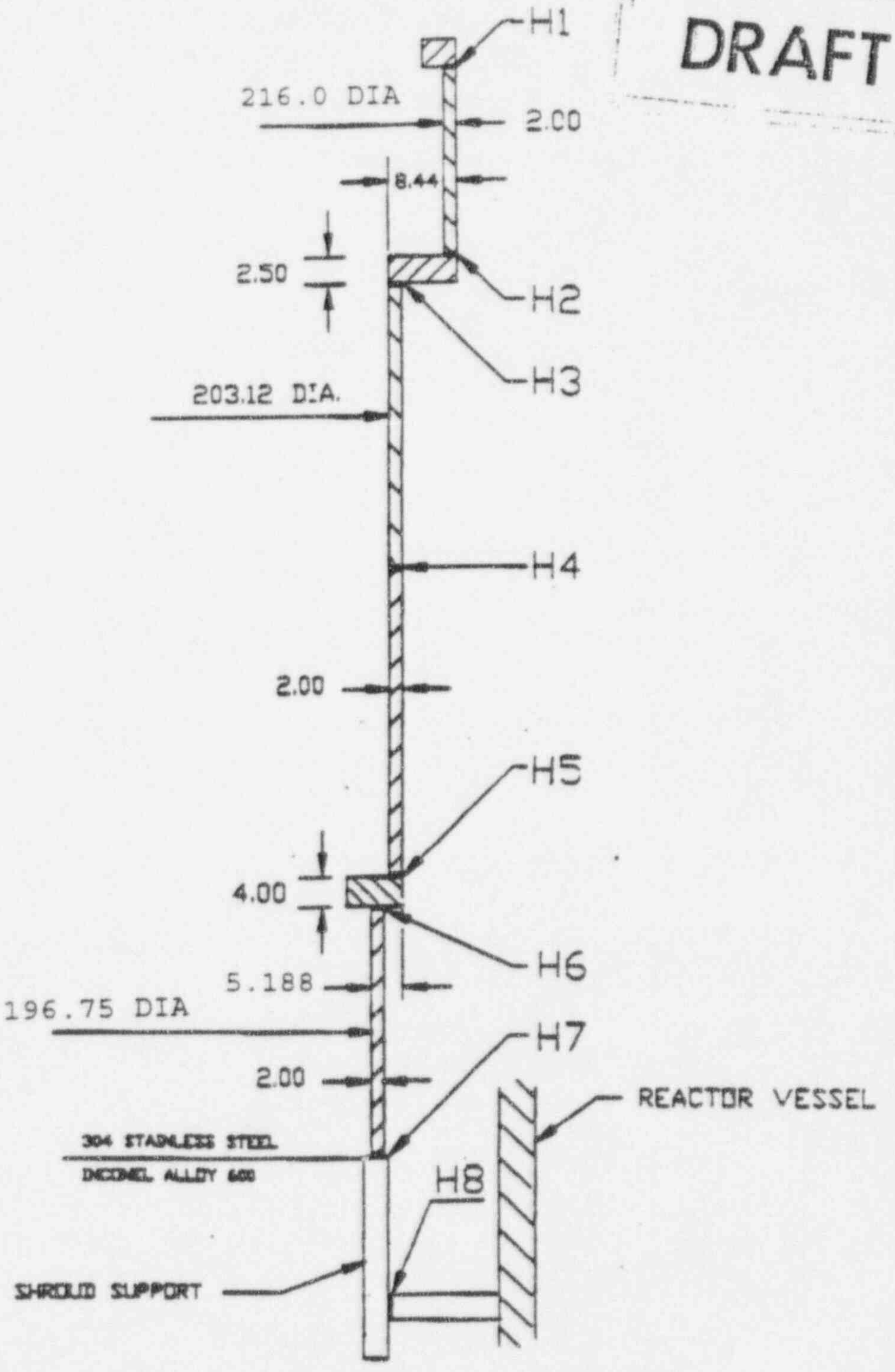

HORIZONTAL WELD LOCATIONS

FIGURE 1