HITACHI

GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

P.O. Box 780 M/C A-65
Wilmington, NC 28402-0780
USA

T 910.675.6192
F 910.362.6192
rick.kingston@ge.com

MFN 06-260, Supplement 8 Docket No. 52-010

March 30, 2009

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Supplemental Response to Portion of NRC Request for Additional Information Letter No. 219 Related to the ESBWR Design Certification Application - Nuclear Boiler System - RAI Number 5.2-36 S02**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) supplemental response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter No. 219 (Reference 1). The original RAI response to Reference 1 was submitted via Reference 2. GEH supplemental response to RAI Number 5.2-36 S02 is addressed in Enclosure 1. DCD markups associated with this response are provided in Enclosure 2.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

References:

1. MFN 08-560, Letter from U. S. Nuclear Regulatory Commission to Robert E. Brown, GEH, Request For Additional Information Letter No. 219 Related to the ESBWR Design Certification Application, June 30, 2008.
2. MFN 06-260, Supplement 7, Response to Portion of NRC Request for Additional Information Letter Number No. 219 Related to ESBWR Design Certification Application - Nuclear Boiler System - RAI Number 5.2-36 S02, September 22, 2008.

Enclosures:

1. Supplemental Response to Portion of NRC Request for Additional Information Letter No. 219 Related to ESBWR Design Certification Application – Nuclear Boiler System - RAI Number 5.2-36 S02.
2. Supplemental Response to Portion of NRC Request for Additional Information Letter No. 219 Related to ESBWR Design Certification Application – Nuclear Boiler System - RAI Number 5.2-36 S02 – DCD Markups.

cc:	AE Cubbage	USNRC (with enclosures)
	JG Head	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	eDRF Section	0000-0088-4790, Revision 1

Enclosure 1

MFN 06-260, Supplement 8

Supplemental Response to Portion of NRC Request for Additional Information Letter No. 219 Related to ESBWR Design Certification Application

Nuclear Boiler System

RAI Number 5.2-36 S02

NRC RAI 5.2-36 S02

The staff reviewed DCD Tier 2, Revision 5, Table 5.2-4. In order for the staff to complete its review of the ESBWR DCD, the staff requests that the applicant provide the following information and make the appropriate modifications to Table 5.2-4.

(a) For DPV Body, feedwater valves and feedwater disc, GEH listed SA-426 "Specification for Centrifugally Cast Ferric Alloy Steel Pipe for High Temperature Service," Gr CP22. The staff requests that GEH explain how it intends to use a cast pipe specification to make valve bodies and valve disc.

(b) References to SA-376 TP 304L and 316L should be TP304LN and TP 316LN to be consistent with SA-376 and Section II, Part D

(c) Under welding filler metals for P3, G3 base materials, the applicant lists SFA-5.23, FS8PO-ECF2-F2H2. The staff notes that this classification specifies that the welding flux is made solely from crushed slag or is a blend of crushed slag with unused (virgin) flux. The staff requests that GEH explain how a consistent weld metal chemistry will be maintained using crushed slag or a combination of crushed slag and unused flux rather than unused flux. In addition, neither submerged arc welding specification listed in Table 5.2-4 contains an 'N' designator for special requirements related to nuclear components.

(d) Note 4 of the table should be deleted. Part 52 has a process for the applicant to change materials after design certification.

GEH Supplemental Response

Regarding the questions on DCD Tier 2, Revision 5, Table 5.2-4:

(a) Listing material specification SA-426 Gr. CP22 against parts of the DPV is an unintended transcription. The intended fabrication material specification for the DPV body, feedwater valve body/bonnet and feedwater valve disc or seat ring material is a comparable 2.25% chrome cast alloy steel. The correct material specification and grade is SA-217, "Specification For Steel Castings, Martensitic Stainless And Alloy, For Pressure-Containing Parts, Suitable For High-Temperature Service," Grade WC9.

(b) The grade designations for specification SA-376 material, where listed in Table 5.2-4, will be corrected from TP-304L/316L to TP-304L<u>N</u>/316L<u>N</u>. Due to some material listings in the table, this change also affects the grades listed with specification SA-312 as shown in the accompanying markup.

(c) Based on further review, GEH will revise Table 5.2-4 to remove the use of weld filler metal that uses recycled flux, FS8P0-ECF2-F2H2.

The electrode classification EA3K is recommended by Lincoln Electric Company for P3G3 base material. An additional tensile strength range F9 was added to the table with the lowest diffusible hydrogen designator obtainable by the manufacturer.

The electrode classification EF2, a closer chemical composition to the P3G3 vessel material is recommended by ESAB. Two tensile strength ranges F8 and F9 are added to the table with the lowest diffusible hydrogen designator obtainable by the manufacturer.

Notes 5 and 6 were added to Table 5.2-4. Note 5 will apply to all beltline filler material. The composition requirements of DCD Tier 2 Table 5.3-1 are more restrictive than the composition requirements of SFA-5.23 "N" designation. Note 6 was added for SFA-5.23 material to implement the additional impact testing imposed by "N" designation.

(d) GEH agrees to delete Note 4 of Table 5.2-4. To allow components to be fabricated using the detailed information from the table, the following filler metals were added:

For Carbon Steel and Low Alloy Steel (P1G2): ER70S-6. This is also listed for P1G1 material.

Low Alloy Steel (P3G3):

- E9018-D1 as referenced by AWS for A533 Type B Class 1 plate.
- E8018-NM1 was recommended by a filler metal manufacturer.
- E9018M recommended by a vessel manufacturer qualifying welds per ASME Code Section III Subsection NB at greater than 24 hours PWHT.

Note 7 was added to the E9018 filler metals; therefore, the type of testing requirements are the same as E8018 filler metals.

Dissimilar metal combinations for the design of pressure retaining components were reviewed and note 8 was added to incorporate information from RAI 5.2-40 in addition to noting combinations between carbon and low alloy steels.

DCD Impact

DCD Revision 5, Tier 2, Table 5.2-4 will be revised per the above responses:

Items (a) and (b) – changed the material specifications, as noted in the attached markup.

Item (c) – added weld filler metal with notes 5 and 6, as noted in the attached markup.

Item (d) – deleted Note 4, added weld filler metal with notes 7 and 8, as noted in the attached markup.

Note: Changes to the DCD mark-up from the original response as submitted in GEH letter MFN 06-260, Supplement 7, dated September 22, 2008 are enclosed within boxes.

Enclosure 2

MFN 06-260, Supplement 8

Supplemental Response to Portion of NRC Request for Additional Information Letter No. 219 Related to ESBWR Design Certification Application

Nuclear Boiler System

RAI Number 5.2-36 S02

DCD Markups

Table 5.2-4

Reactor Coolant Pressure Boundary Materials

Component	Form	Material[1]	Specification[1] (ASTM/ASME)
Main Steam Isolation Valves (MSIVs)			
Valve Body	Cast	Carbon steel	SA352 Grade LCB
Cover	Forged	Carbon Steel	SA350 Grade LF2 Class 1
Poppet	Forged	Carbon Steel	SA350 Grade LF2 Class 1
Valve stem, guides[3]	Rod or Bar	Precipitation-hardened steel	SA564[2] Gr 630 or XM-13; SA479 Type XM-19 or 410 Condition 2
Body bolt	Bolting	Alloy steel	SA540 Gr B23 CL5
Hex nuts	Bolting Nuts	Alloy steel	SA194 Gr 7
Safety Relief and Depressurization Valves			
Body (SRV)	Forging or Casting	Carbon steel Carbon steel	SA350 Gr LF2 Class 1 SA352 Gr LCB
Body (DPV)	Forging or Casting	Stainless Steel Alloy Steel	SA182 or SA336, Gr F304L or F316L SA351 Gr CF3 or CF3A SA182 or SA336 Gr F22 SA217 Gr WC9~~SA426 Gr CP22~~
Bonnet (yoke)	Forging or Casting	Carbon steel Carbon steel	SA350 Gr LF2 Class 1 SA352 Gr LCB
Nozzle (seat)	Forging or Casting	Stainless steel Carbon steel	SA182 Gr F316 SA350 Gr LF2 Class 1
Body to bonnet stud	Bar/rod	Alloy steel	SA193 Gr B7
Body to bonnet nut	Bar/rod	Alloy steel	SA194 Gr 7
Disk	Forging or Casting	Stainless steel	SA182 or SA336 Gr F304L or F316L SA351 Gr CF3 or CF3A

Table 5.2-4

Reactor Coolant Pressure Boundary Materials

Component	Form	Material(1)	Specification(1) (ASTM/ASME)
Reactor Pressure Vessel			
Shells and Heads	Plate Forging	Mn-1/2 Mo-1/2 Ni Low Alloy Steel 3/4 Ni-1/2 Mo-Cr-V Low Alloy Steel	SA533/SA533M Type B, Class 1 SA508/SA508M Grade 3, Class 1
Shell and Head Flange	Forging	3/4Ni-1/2 Mo-Cr-V Low Alloy Steel	SA508/SA508M Grade 3, Class 1
Main Closure Bolting	Bolting	Low Alloy Steel	SA540/SA540M Grade B23 or B24, Class 3
Standard Flange Bolting	Bolting	Low Alloy Steel	SA193/SA193M Grade B7 or SA540/SA540M Grade B23, Class 3
Nozzles	Forging	3/4 Ni-1/2 Mo-Cr-V Low alloy steel	SA508/SA508M Grade 3, Class 1
Nozzle Safe Ends	Forging	Carbon Steel Low Alloy Steel	SA350/SA350M Grade LF2 Class 1 or SA508/SA508M Grade 1 SA508/SA508M Grade 3, Class 1
Drain Nozzles	Forging Seamless Pipe Bar	Cr-Ni-Mo Stainless steel	SA182/SA182M or SA336/SA336M Gr F304/F304L/F316/F316L; SA376/SA376M TP-304/304LN/316/316LN; SA479/SA479M 304/304L/316/316L

Table 5.2-4

Reactor Coolant Pressure Boundary Materials

Component	Form	Material(1)	Specification(1) (ASTM/ASME)
Instrumentation Nozzles	Forging Bar, Seamless Pipe Forging	Cr-Ni-Mo Stainless steel or Ni-Cr-Fe	SA182/SA182M or SA336/SA336M Grades F304/F304L/F316/F316L or Code Case N-580-1 with Base Material = SB-166, SB-167 or SB-564
Stub Tubes	Bar, Smls. Pipe Forging	Ni-Cr-Fe	Code Case N-580-1 with Base Material = SB-166, SB-167 or SB-564
Isolation Condenser			
Steam pipe	Seamless	Carbon steel	SA333 Grade 6
Steam pipe fittings	Forging or Fitting	Carbon Steel Carbon Steel	SA350 Grade LF2 Class 1 or SA508 Grade 1 SA420 Grade WPL-6
Valves	Forging or Casting	Carbon Steel Carbon Steel	SA350 Gr LF2 Class 1 SA352 Gr LCB
Disc	Forging Casting	Carbon Steel Carbon Steel Stainless Steel	SA350 Gr LF2 Class 1 SA352 Gr LCB SA351 Gr CF3 or CF3A
Valve Stem(3)	Rod or Bar	Precipitation-hardened Steel	SA564(2) Gr 630 or XM-13; SA479 Type XM-19 or 410 Condition 2
Condensate pipe	Seamless	Stainless steel	SA312 ~~or SA376~~ Grades TP-304/~~TP~~304L/304LN TP-316/~~TP~~316L/316LN or, SA376 Grades TP-304/304LN TP-316/316LN

Table 5.2-4

Reactor Coolant Pressure Boundary Materials

Component	Form	Material(1)	Specification(1) (ASTM/ASME)
Condensate pipe fittings	Forging or Fitting	Stainless Steel	SA182 or SA336 Grades F304/F304L/F316/F316L or SA403 Grades WP 304/304L/316/316L
Valves	Forging or Casting	Stainless Steel Stainless Steel	SA182 Gr F304, F304L, F316 or F316L; SA351 Gr CF3 or CF3A
Disc	Forging or Casting	Stainless Steel Stainless Steel	SA182 Gr F304, F304L, F316 or F316L; SA351 Gr CF3 or CF3A
Valve Stem(3)	Rod or Bar	Precipitation-Hardened Steel	SA564(2) Gr 630 or XM-13; SA479 Type XM-19 or 410 Condition 2
Feedwater			
Pipe	Seamless Forged & Bored	Low Alloy Low Alloy	SA335 Grade P22 SA369 Gr FP22
Fittings	Forging	Low Alloy	SA234 Gr WP22; SA336 Grade F22
Valves	Forging or Casting	Low Alloy Low Alloy	SA336 Gr F22 or ~~SA426 Gr CP22~~SA217 Gr WC9
Disc	Forging or Casting	Low Alloy Stainless Steel	SA336 Gr F22 or ~~SA426 Gr CP22~~SA217 Gr WC9 SA182 or SA336 Gr F304L or F316L SA351 Gr CF3 or CF3A
Valve Stems, Guides(3)	Bar, Rod	Low Alloy Stainless Steel	SA739 Gr B22 SA564(2) Gr 630, XM-13; SA479 Type XM-19 or Type 410 Condition 2

Table 5.2-4

Reactor Coolant Pressure Boundary Materials

Component	Form	Material(1)	Specification(1) (ASTM/ASME)
Valve Seat Rings	Forging or Casting	Low Alloy Stainless Steel Low Alloy	SA182 or SA336 Gr F22 SA182 Gr F304, F304L, F316 or F316L ~~SA426 Gr CP22~~SA217 Gr WC9
Reactor Water Cleanup/Shutdown Cooling			
Cleanup Piping	Seamless Pipe	Carbon steel	SA333 Grade 6
Fittings	Forging or Fitting	Carbon steel	SA350 Grade LF2 Class 1or SA508 Grade 1 SA420 Grade WPL-6
Valves	Forging or Casting	Carbon Steel Carbon Steel	SA350 Gr LF2 Class 1 SA352 Gr LCB
Disc	Forging Casting	Carbon Steel Carbon Steel Stainless Steel	SA350 Gr LF2 Class 1 SA352 Gr LCB SA351 Gr CF3 or CF3A
Valve Stem(3)	Rod or Bar	Precipitation-hardened Steel	SA564(2) Gr 630 or XM-13; SA479 Type XM-19 or 410 Condition 2
Drain Line Piping	Seamless Pipe	Stainless steel	SA312 ~~or SA376~~ Grades TP-304/~~TP~~304L/304LN TP-316/~~TP~~316L/316LN, or SA376 Grades TP-304/304LN TP-316/316LN
Fittings	Forging or Fitting	Stainless steel	SA182 or SA336 Grades F304/F304L/F316/F316L SA403 Grades WP 304/304L/316/316L
Valves	Forging or Casting	Stainless Steel Stainless Steel	SA182 Gr F304L or F316L SA351 Gr CF3 or CF3A

Table 5.2-4

Reactor Coolant Pressure Boundary Materials

Component	Form	Material[1]	Specification[1] (ASTM/ASME)
Disc	Forging or Casting	Stainless Steel Stainless Steel	SA182 Gr F304, F304L, F316 or F316L; SA351 Gr CF3 or CF3A
Valve Stem[3]	Rod or Bar	Precipitation-hardened Steel	SA564[2] Gr 630 or XM-13; SA479 Type XM-19 or 410 Condition 2
Gravity Driven Cooling			
Piping Downstream of Check Valves	Seamless Pipe	Stainless Steel	SA312 ~~or SA376~~ Grades TP-304/~~, TP~~304L/304LN~~,~~ TP-316/~~ or TP~~316L/316LN, or SA376 Grades TP-304/304LN, TP-316/316LN
Check Valves	Forging or Casting	Stainless Steel Stainless Steel	SA182 Gr F304, F304L, F316 or F316L; SA351 Gr CF3 or CF3A
Squib-activated Valves	Forging or Casting	Stainless Steel Stainless Steel	SA182 Gr F304, F304L, F316 or F316L; SA351 Gr CF3 or CF3A
Disc	Forging or Casting	Stainless Steel Stainless Steel	SA182 Gr F304, F304L, F316 or F316L; SA351 Gr CF3 or CF3A
Valve Stem, Guides[3]	Bar, Rod	Stainless Steel	SA564[2] Type 630 or XM-13; SA479 Type XM-19 or 410 Cond.-2
Valve Seat Ring	Forging or Casting	Stainless Steel Stainless Steel	SA564[2] Type 630 or XM-13; SA479 Type XM-19 or 410 Cond.-2 SA351 Gr CF3 or CF3A
Standby Liquid Control			
Piping	Seamless Pipe	Stainless Steel	SA312 Gr TP316L

Table 5.2-4

Reactor Coolant Pressure Boundary Materials

Welding Filler Metals

Base Material[8]	**Filler Metal Type**	**SFA Number**	**AWS Classification**~~(4)~~[5]
Carbon Steel P1, G1	Covered Electrodes or Filler Wire	SFA-5.1 SFA-5.18	E7018 ER70S-2 ER70S-3 ER70S-6
Carbon Steel and Low Alloy Steel P1, G2 (C, Mn, Si, Cb)	Covered Electrodes or Filler Wire	SFA-5.1 SFA-5.18 SFA-5.28	E7018 ER70S-2 ER70S-6 ER80S-D2
Low Alloy Steel P3, G1 (C, 1/2 Mo)	Covered Electrodes or Filler Wire	SFA-5.1 SFA-5.5 SFA-5.18 SFA-5.28	E7018 E8018-C3 ER70S-2 ER80S-D2
Low Alloy Steel P3, G3 (3/4 Ni, 1/2 Mo, 1/3 Cr, V) or (Mn, 1/2 Mo, 1/2 Ni)	Covered Electrodes or Filler Wire	SFA-5.5 SFA-5.1 SFA-5.28 SFA-5.18 SFA-5.23[6]	E8018-C3 E8018-NM1 E9018-D1[7] E9018M[7] E7018 ER80S-D2 ER70S-2 F8P0-EA3K-A3H2 F9P0-EA3K-A3H2 ~~FS8P0-ECF2-F2H2~~ F8P0-EF2-F2H4 F9P0-EF2-F2H4
Low Alloy Steel P5A, G1 (2-1/4 Cr, 1 Mo)	Covered Electrodes or Filler Wire	SFA-5.5 SFA-5.1 SFA-5.28 SFA-5.18	E9016-B3 E9018-B3 E7018 ER90S-B3 ER70S-2
(Deleted)			

Table 5.2-4

Reactor Coolant Pressure Boundary Materials

Welding Filler Metals			
Base Material (8)	**Filler Metal Type**	**SFA Number**	**AWS Classification** ~~(4)~~ (5)
Stainless Steel P8, G1	Covered Electrodes or Filler Wire	SFA-5.4 SFA-5.9	E308L-16 E309L-16 E316L-16 ER308L ER309L ER316L
Nickel Alloy P43	Filler Wire	SFA-5.14	ERNiCr-3

Notes:

(1) Carbon content of all RCPB wrought austenitic stainless steel (304/304L/304LN/316/316L/316LN) is 0.02% maximum.

(2) SA564 Type 630 or XM-13 material used for other than RCPB applications shall be in Condition H1100 or H1150, unless specifically approved by GEH. Where mechanically installed and replaceable parts requiring wear resistance (as substitutes for cobalt bearing alloys) require additional precipitation/age hardening, valve guides or other parts may be formed down to Condition H900 for Type 630 material and down to Condition H950 for Type XM-13 material, subject to demonstrated mechanical reliability.

(3) Items fabricated from these materials are wetted by reactor coolant, but are not required to be part of the design ASME Code pressure-boundary. Therefore, some of the specific material specifications or material specification grades identified under this category are not required to be listed in the ASME Code, Section II, Part D, Table 2A.

(4) ~~The filler materials specified are representative. Alternate filler metal specifications are acceptable provided the filler metal is qualified for use per Subsection 5.2.3.3 or 5.2.3.4.~~ Deleted

(5) Reference Table 5.3-1 and Subsection 5.3.1.5 for core beltline material compostion limits.

(6) Core beltline material shall require additional impact testing per SFA-5.23 "N" designation.

(7) Chemical analysis, soundness test, all weld metal tension test, impact test, fillet weld test and moisture test per SFA-5.5 required.

(8) Dissimilar metal welds between carbon/low alloy steel and stainless steel are made with a layer (or layers) of 309L/309MoL, followed by completion of the weld with either 308L, 316L, 309L or 309MoL. Alternatively, the welds may be completed with Nickel Alloy 82 for the entire weld. Dissimilar metal welds between nickel alloy and carbon/low alloy steel or stainless steel are performed using Nickel Alloy 82. Welds between carbon and low alloy steel may be made with the filler metals listed for either base material, except that partial penetration welds may also be made with Nickel Alloy 82.