



HITACHI

GE Hitachi Nuclear Energy

James C. Kinsey
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

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Subject: **Response to Portion of NRC Request for Additional
Information Letter No. 41 – Reactor Coolant Pressure
Boundary – RAI Numbers 5.2-36 S01 and 5.2-37 S01**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) originally transmitted via the Reference 1 letter and supplemented by NRC requests for clarification on November 7, 2006. The original responses to RAI Numbers 5.2-36 and 5.2-37 were transmitted to the NRC via Reference 2. RAI Numbers 5.2-36 S01 and 5.2-37 S01 are addressed in Enclosure 1.

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

Sincerely,

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 06-220, Letter from U.S. Nuclear Regulatory Commission to David Hinds Request for Additional Information Letter No. 41 Related to ESBWR Design Certification Application, July 10, 2006
2. MFN 06-260, Letter from David Hinds to the U.S. Nuclear Regulatory Commission, "Response to Portion of NRC Request for Additional Information Letter No. 41 Related to ESBWR Design Certification Application – Reactor Coolant Pressure Boundary Materials – RAI Numbers 5.2-36 through 5.2-49, August 7, 2006

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 41 Related to ESBWR Design Certification Application, Reactor Coolant Pressure Boundary, RAI Numbers 5.2-36 S01 and 5.2-37 S01

cc: AE Cubbage USNRC (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)
GB Stramback GEH/San Jose (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
eDRF 0000-0076-8816

Enclosure 1

MFN 06-260 Supplement 4

Response to Portion of NRC Request for

Additional Information Letter No. 41

Related to ESBWR Design Certification Application

Reactor Coolant Pressure Boundary

RAI Numbers 5.2-36 S01 and 5.2-37 S01

For historical purposes, the original text of RAI 5.2-36 and the GE response are included. The attachments (if any) are not included from the original response to avoid confusion.

NRC RAI 5.2-36:

SRP Section 5.2.3, Revision 2, July 1981 states that the specifications be reviewed for pressure-retaining ferritic materials, nonferrous metals and austenitic stainless steels, including weld materials, that are used for each component (e.g., vessels, piping, pumps, and valves) of the reactor coolant pressure boundary. DCD Tier 2, Table 5.2-1 is not complete because it does not list components in systems that are considered to be part of the reactor coolant pressure boundary (RCPB). There are inconsistencies in materials listed in DCD Tier 2 Tables 5.2-4 and 6.1-1 for the isolation condenser. Provide material type, specification and grade, for all pressure boundary materials, including weld material specifications and grades that make up the RCPB.

GE Response:

Based on the discussion topic, it is assumed reference to Table 5.2-1 in this RAI was intended to be Table 5.2-4. Table 5.2-4 will be corrected and expanded to include all RCPB components and materials, including weld metals.

Table 5.2-4 will be revised in the next DCD update. See attached draft revision.

NRC RAI 5.2-36 S01

In GE's response to RAI 5.2-36 (MFN 06-260), GE did not provide material specifications for isolation and check valves used in the Class 1 portion of the feedwater system. The staff requests the applicant to perform a complete review of the reactor coolant pressure boundary (RCPB) system and compare it to DCD, Tier 2, Revision 1, Table 5.2-4 and verify that all materials used as a pressure boundary for reactor coolant are included in Table 5.2-4.

GEH Response

The intent of DCD Tier 2, Revision 4, Table 5.2-4 is to provide an outline of the materials used for fabrication of components of the RCPB in accordance with SRP 5.2.3. A full table revision has been made to address the issues raised in this request.

Since the table should address RCPB materiel for all valves that are part of the RCPB, the valve specific listings for MSIVs and SRVs have been replaced with a generic Valves

listing of materiel. Similarly, the table addresses material specifications used under the headings of:

- Pipe and Fittings;
- Additional Fabricated Part Materiel;
- Pressure Vessel;
- Bolted Joint Materiel; and,
- Weld Filler Metals.

This table revision provides a list of material specifications to be used in the various portions of the RCPB including the reactor pressure vessel and its appurtenances, and the RCPB portion of each of the interfacing systems including the boundary valves. These systems and portions of systems are categorized as Quality Group A and built to ASME Code, Section III, Subsection NB (Class 1) requirements. Overlap with DCD Tier 2, Table 6.1-1, for Class 2 and 3 portions of the ESBWR design, have been deleted from Table 5.2-4 to remove potential conflicts and confusion.

The revision is necessary since many of the components of an actual ESBWR have not yet been procured, and a variety of suitable material specifications may be needed for each potential project depending on many factors affecting material availability. For example, with respect to the same functional component one project might use a valve forging of SA 266 Grade 2, or due to supply availability may instead use a valve casting of SA 352 Grade LCB. The DCD Table 5.2-4 revision addresses a range of suitable materiel that may be used in accordance with the ASME Code, rather than to list the component specific material specifications of a constructed unit FSAR document.

DCD Tier 2, Revision 4, Table 6.1-1 is being addressed separately under the response to RAI 6.1-2 Supplement 02. That response will address the overlap items in Table 6.1-1 that are designed and built in accordance with ASME Code, Section III, Subsection NB, and are covered by Table 5.2-4 material specification listings.

GEH believes that the revised Table 5.2-4 provides a more accurate and complete listing of RCPB material specifications that may be used in the construction of an ESBWR. The changes to Table 5.2-4 will be incorporated in the next revision of the DCD.

DCD Impact

DCD Tier 2, Table 5.2-4, will be completely revised as shown in the attached copy.

For historical purposes, the original text of RAI 5.2-37 and the GE response are included. The attachments (if any) are not included from the original response to avoid confusion.

NRC RAI 5.2-37

DCD Tier 2 Section 3E.2.2 states that SA 672 Gr. C70 is one of the carbon steels used in the ESBWR RCPB piping but this material is not listed in DCD Tier 2 Table 5.2-4 "Reactor Coolant Pressure Boundary Materials". Provide clarification.

GE Response

SA-672 Gr. C70 was listed in error in DCD Section 3E.2.2. This material is not used in the ESBWR reactor coolant pressure boundary. SA-672 Gr. C70 is rolled and welded pipe. All RCPB piping will be seamless.

DCD Section 3E.2.2 will be revised to delete reference to SA-672 Gr. C70 as follows:

3E.2.2 Carbon Steels and Associated Welds

The carbon steels used in the ESBWR reactor coolant pressure boundary piping are SA-106 Gr. B or SA-333 Gr. 6. The first specification covers seamless pipe and the second one pertains to both seamless and seam-welded pipe, although only seamless pipe will be used for ESBWR reactor coolant pressure boundary piping. The corresponding material specifications used for carbon steel flanges, fittings and forgings are equivalent to the piping specifications.

NRC RAI 5.2-37 S01

In GE's response to RAI 5.2-37 (MFN 06-260), GE stated that SA-106 Gr. B may be used in the RCPB but did not include the materials in the Table 5.2-4.

Provide correct materials specifications and Grades in Table 5.2-4.

GE Response

Refer to the response to RAI 5.2-36 Supplement 1, which deletes material specification SA-106 from Table 5.2-4 completely due to considerations for material toughness controls for the RCPB.

DCD Impact

No DCD changes will be made in response to this RAI.

Table 5.2-4
Reactor Coolant Pressure Boundary Materials
and Materials in Contact With Reactor Coolant

Component	Form	Material ¹	Material Specifications by ASME Code Designation
VALVES⁵			
Body, Bonnet/Cover, Disk/Wedge/Poppet	CASTING	Carbon Steel	SA-352 Gr. LCB or LCC; SA-487 ³ Gr. 16 Class A
		Stainless Steel	SA-217 Gr. CA15; SA-351 Gr. CF3, CF3M, CF8, CF8M, or CF3A; SA-487 ³ Gr. CA6NM
		Low Alloy	SA-217 Gr. WC9; SA-352 Gr LC1; SA-487 ³ Gr. 8
	FORGING	Carbon Steel	SA-350 – Gr. LF2 Class 1; SA-266 ³ Gr. 1, 2, 3 or 4
		Stainless Steel	SA-182 or SA-336 Gr. F304, F316, F304L or F316L;
		Low Alloy	SA-336 Gr. F21, F22 or F22V
Stem, Guides ⁴	BAR, ROD	Stainless	SA-564 ² Type 630 or XM-13; SA-479 Type XM-19, 410 Cond.-2, or 414 tempered/normalized-&-tempered
		Low Alloy	SA-739 Gr. B11 or B22
		Nickel Alloy	SB-637 UNS N07718
Seat Ring, Backseat	FORGING	Stainless	SA-564 ² Type 630 or XM-13; SA-479 Type XM-19, 410 Cond.-2, or 414 tempered/normalized-&-tempered
		Low Alloy	SA-182 or SA-336 Gr. F11, F12, F21 or F22
	CASTING	Stainless	SA-351 Gr. CF3, CF3M, CF8, CF8M, or CF3A; SA-487 ³ Gr. CA6NM
		Low Alloy	SA-426 Gr. CP21 or CP22 or CP11 or CP12 or CPCA15

Component	Form	Material ¹	Material Specifications by ASME Code Designation
PIPE AND FITTINGS⁵			
Large-Bore, Steam	SEAMLESS	Carbon Steel	SA-333 Gr. 6
		Stainless Steel	SA-213 or SA-312 – Grades TP 304, TP304L, TP 316, TP 316L; or SA-376 – Grades TP304, TP304LN, TP316, TP316LN
	FORGED-&-BORED	Stainless Steel	SA-430 Gr. FP316 or FP 316N
		Alloy Steel	SA-369 Gr. FP1, FP2, FP11, FP12, FP21 or FP 22
Small-Bore, Steam	SEAMLESS	Low Alloy Steel	SA-335 Gr. P21 or P22 or P11 or P12
		Stainless Steel	SA-213 or SA-312 – Grades TP 304, TP304L, TP 316, TP 316L; or SA-376 – Grades TP 304, TP304LN, TP 316, TP 316LN
Large-Bore, Condensate	SEAMLESS	Carbon Steel	SA-333 Gr. 6
		Stainless Steel	SA-213 or SA-312 – Grades TP 304, TP304L, TP 316, TP 316L; or SA-376 – Grades TP 304, TP304LN, TP 316, TP 316LN
		Low Alloy Steel	SA-335 Gr. P21 or P22 or P11 or P12
Small-Bore, Condensate	SEAMLESS	Carbon Steel	SA-333 Gr. 6
		Stainless Steel	SA-213 or SA-312 – Grades TP 304, TP304L, TP 316, TP 316L; or SA-376 – Grades TP 304, TP304LN, TP 316, TP 316LN
		Low Alloy Steel	SA-335 Gr. P21 or P22 or P11 or P12

Component	Form	Material ¹	Material Specifications by ASME Code Designation
PIPE AND FITTINGS (cont'd.)			
Large-Bore Fitting	FORGING	Carbon Steel	SA 266 Gr. 1, 2, 3 or 4; SA-350 Gr. LF2 Class 1; SA-420 Gr. WPL6; SA-508 Gr. 1
		Stainless Steel	SA-182 or SA 336 – Grades F304, F304L, F316 or F316L; SA-403 – Grades 304L, 316L or 316LN
		Low Alloy Steel	SA-234 Gr. WP9 or WP11 or WP12 or WP22
Small-Bore Fitting	FORGING	Carbon Steel	SA 266 Gr. 1, 2, 3 or 4; SA-350 Gr. LF2 Class 1; SA-420 Gr. WPL6; SA-508 Gr. 1
		Stainless Steel	SA-182 or SA 336 – Grades F304, F304L, F316 or F316L; SA-403 – Grades 304L, 316L or 316LN
		Low Alloy Steel	SA-234 Gr. WP9 or WP11 or WP12 or WP22
Flanges		Carbon Steel	SA-350 Gr. LF2 Class 1
		Stainless Steel	SA-182 or SA-336 Grades F304, F304L, F316 or F316L
		Alloy Steel	SA-336 Gr. F21, F22 or F22V
Spool Pieces	FORGING	Carbon Steel	SA-181
		Stainless Steel	SA-182 or SA-336 Grades F304, F304L, F316 or F316L
		Alloy Steel	SA-369 Gr. FP21 or FP22 or FP11 or FP12; SA-508 Gr. 3 Cl. 1
	CASTING	Carbon Steel	SA-660 Gr. WCA or WCB
		Stainless Steel	SA-426 Gr. CPCA15; SA-451 Gr. CPF3, CPF8, CPF3M or CPF8M

Component	Form	Material ¹	Material Specifications by ASME Code Designation
		Alloy Steel	SA-426 Gr. CP21, CP22, CP11 or CP12
Head-fitting/ Penetration Pipe	FORGING	Carbon Steel	SA-350 Gr. LF2 Class 1
ADDITIONAL FABRICATED PART MATERIEL ^{4, 5}			
		Carbon Steel	SA-321; SA-576; SA-675 Grades 45 through 70; SA-108; SA-434; SA-696 Gr B or C; SA-266 ³ Gr. 1 or 2; SA-727; SA-508 or SA-541 Gr1 or 1A; SA-285 Gr. A or B; SA-515 Gr. 60, 65 or 70; SA-516 Gr. 55, 60 or 70
		Stainless Steel	SA-240 Gr. 410, 410S, 429, 430, 304L, 316, 316L or XM-29; SA-705 Gr. XM13; SA-789 or SA 790 ≤ 0.50 max Cu; SA-182 – Gr. F6; or SA-336 – Gr. F6
		Low Alloy Steel	SA-387 Gr. 11, 12, 21, 22, or 91; SA-204 Gr. A, B, or C; SA-592 Gr. A; SA 508 Gr 22; SA-541 Gr. 22 or 22V; SA-737 Gr. B or C
		Nickel Alloy	SB-637 UNS N07718
PRESSURE VESSEL ⁵			
Shells and Heads	PLATE	Low Alloy Steel (Mn-1/2 Mo-1/2 Ni)	SA-533/SA-533M Grade B – Class 1
	FORGING	Low Alloy Steel (3/4 Ni-1/2 Mo-Cr-V)	SA-508/SA-508M Grade 3 – Class 1
Flanges, Shell and Head	FORGING	Low Alloy Steel (3/4 Ni-1/2 Mo-Cr-V)	SA-508/SA-508M Grade 3 – Class 1

Component	Form	Material ¹	Material Specifications by ASME Code Designation
Nozzles	FORGING	Low Alloy Steel (3/4 Ni-1/2 Mo-Cr-V)	SA-508/SA-508M Grade 3 – Class 1
Nozzle Safe Ends	FORGING	Carbon Steel	SA-350/SA-350M Gr. LF2 Cl. 1; SA-508/SA-508M Gr. 1
Drain Nozzles	FORGING	Cr-Ni-Mo Stainless Steel	SA-182/SA-182M or SA-336/SA-336M Grades F304, F304L, F316 or F316L; SA-376/SA-376M Gr TP304 or TP316; SA-479/SA-479M Type 304, 304L, 316 or 316L
Instrument Nozzles	FORGING	Cr-Ni-Mo Stainless Steel	SA-182/SA-182M or SA-336/SA-336M Grades F304, F304L, F316 or F316L
		Ni – Cr – Fe	Code Case N-580-1
Stub Tubes	FORGING	Ni – Cr – Fe	Code Case N-580-1
BOLTED JOINT MATERIAL⁵			
Pressure Vessel Main Closure	Stud	Low Alloy Steel	SA-540/SA-540M Gr B23 or B24 – Cl 3
Standard Flanges, Valve Body-to- Bonnet	Stud or Bolting	Alloy & Stainless Steels	SA-193 Gr B7, SA-354, SA-449
	Bolting Nuts	Carbon & Alloy Steels	SA-194

WELD FILLER METALS⁵			
Base Material	Filler Metal Type	SFA Number	AWS Classification
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 (C, Mn, Si, Cb) P1, G2	Covered Electrodes or Filler Wire	SFA-5.1 SFA-5.18 SFA-5.28	E7018 ER70S-2 ER80S-D2
Low-Alloy Steel P1, G3 (C, Mn, Si, V)	Covered Electrodes or Filler Wire	SFA-5.1 SFA-5.28	E7018 ER80S-D2
Low Alloy Steel P3, G1 (C, 1/2Mo)	Covered Electrodes or Filler Wire	SFA-5.1 SFA-5.18 SFA-5.28	E7018 ER70S-2 ER80S-D2
Low Alloy Steel P3, G2 (C, 1/2Mo)	Covered Electrodes or Filler Wire	SFA-5.5 SFA-5.18	E8018-C3 ER70S-2

Base Material	Filler Metal Type	SFA Number	AWS Classification
Low Alloy Steel P3, G3 (3/4Ni, 1/2Mo, 1/3Cr, V)	Covered Electrodes or Filler Wire	SFA-5.5 SFA-5.1 SFA-5.28 SFA-5.18	E8018-C3 E7018 ER80S-D2 ER70S-2
Low Alloy Steel P4, G1 (1Cr, 1/2Mo –to- 1 1/4Cr, 1/2Mo, Si)	Covered Electrodes or Filler Wire	SFA-5.5 SFA-5.23 SFA-5.28 SFA-5.29	E8018-B2 F8XX-EXXX-B2 ER70S-B2L ER80S-B2 E8XTX-B2
Low Alloy Steel P5A, G1 (2-1/4Cr, 1Mo)	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
Low Alloy Steel P5B, G1 (9Cr, 1Mo)	Covered Electrodes or Filler Wire	SFA-5.5 SFA-5.28	E801X-B8 E801X-B8L ER80S-B8
Low Alloy Steel P5B, G2 (9Cr, 1Mo, V)	Covered Electrodes or Filler Wire	SFA-5.5 SFA-5.28	E901X-B9 ER90S-B9

Base Material	Filler Metal Type	SFA Number	AWS Classification
Low Alloy Steel P5C, G1 (2-1/4Cr, 1Mo)	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
Low Alloy Steel P5C, G4 (2-1/4Cr, 1Mo)	Covered Electrodes or Filler Wire	SFA-5.5 SFA-5.28	E9016-B3 E9018-B3 ER90S-B3
Stainless Steel P6, G1	Covered Electrodes or Filler Wire	Note 6	
Stainless Steel P6, G2	Covered Electrodes or Filler Wire	Note 6	
Stainless Steel P6, G3	Covered Electrodes or Filler Wire	SFA-5.9 SFA-5.22	ER410 ER410NiMo E410TX-X E410NiMoTX-X
Stainless Steel P6, G4	Covered Electrodes or Filler Wire	SFA-5.9 SFA-5.22	ER410NiMo E410NiMo-TX-X
Stainless Steel P7, G1	Covered Electrodes or Filler Wire	Note 6	

Base Material	Filler Metal Type	SFA Number	AWS Classification
Stainless Steel P7, G2	Covered Electrodes or Filler Wire	Note 6	
Stainless Steel P8, G1	Covered Electrodes or Filler Wire	SFA-5.4 SFA-5.9	E308L-16 E309L-16 E316L-16 ER308L ER309L ER316L
Stainless Steel P8, G3	Note 6		
Stainless Steel P10H, G1	Note 6		
Nickel Alloy P43	Filler Wire	SFA-5.14	ERNiCr-3

- Note *: 1. Carbon content of all RCPB wrought austenitic stainless steel (304, 304L, 316, 316L) is 0.02% maximum.
2. SA 564 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. For this material, impact testing conditions and test acceptance criteria shall be as specified in the specification supplemental requirements or by GEH material procurement specification.
4. 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.
5. The table lists only the known and likely fabrication and welding material and is not intended to be complete, or exclusive of other material specifications or grades that the material supplier may choose to propose. Other material proposed for fabrication or welding is evaluated by GEH on the same bases of RCPB integrity requirements, if any, functional requirements of the fabrication, and compatibility with the reactor coolant chemistry and operating environment.
6. Welding filler metal is not listed for those groups for which welding is not anticipated to be a fabrication requirement. The material supplier may propose a weld filler metal and welding procedure for the material of this P-Number and Group-Number that is reviewed by GEH as per Note 5 above.