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MFN 06-260 Supplement 1

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 41 - Reactor Pressure Vessel and Nuclear Boiler System - RAI Numbers 5.2-41 S01 and 5.2-45 S01**

Enclosure 1 contains GE's response to the subject NRC RAIs originally transmitted via the Reference 1 letter and supplemented by NRC requests for clarification.

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

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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NRO

Reference:

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

Enclosures:

1. MFN 06-260 Supplement 1 - Response to Portion of NRC Request for Additional Information Letter No. 41 - Related to ESBWR Design Certification Application - Reactor Pressure Vessel and Nuclear Boiler System - RAI Numbers 5.2-41 S01 and 5.2-45 S01

cc:	AE Cubbage	USNRC (with enclosures)
	BE Brown	GE/Wilmington (with enclosures)
	GB Stramback	GE/San Jose (with enclosures)
	eDRF	0000-0068-2510 for RAI 5.2-41 S01
		0000-0068-4701 for RAI 5.2-45 S01

Enclosure 1

MFN 06-260 Supplement 1

Response to Portion of NRC Request for

Additional Information Letter No. 41

Related to ESBWR Design Certification Application

Reactor Pressure Vessel and Nuclear Boiler System

RAI Numbers 5.2-41 S01 and 5.2-45 S01

NRC RAI 5.2-41:

DCD Tier 2, Section 5.2.3.2.3 indicates that XM-13 is used in the RCPB. Provide a description of the components fabricated from XM-13, the basis for selection of XM-13, and any proposed thermal treatment. Include any history of its use in light water reactors (LWRs).

GE Response:

In actuality XM-13 is not used in the RCPB of ESBWR. Since compatibility of materials with reactor coolant was being discussed in Section 5.2.3.2.3, all alloys in contact with coolant were listed regardless of whether they were used for pressure boundary components or internals.

The only application of XM-13 is a single component in the control blades (if the pin/roller design is used). The component is a small diameter pin that holds the roller ball on the control blade wing. The original design for early BWRs used a cobalt base alloy for this component. In an effort to eliminate cobalt base alloys wherever practical, XM-13 was qualified as a replacement in the early 1980s. All GE-supplied control blades have used this alloy for this part since that time.

NRC RAI 5.2-41 S01:

In GE's response to RAI 5.2-41 (MFN 06-260), GE stated that XM-13 was qualified as a replacement for Cobalt based alloys in the early 1980's. Verify that since its qualification as a replacement in the early 1980's, there have been no degradation issues related to use of XM-13 in LWR's.

GE Response:

Throughout the period that the replacement material (SA/A-564 or SA/A-693) XM-13 control blade roller pins have been used in installed controlled blades, there have been no reported incidents resulting from XM-13 material degradation.

DCD Impact:

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

NRC RAI 5.2-45:

DCD Tier 2, Section 5.2.3.4.2 indicates that the ESBWR design meets the intent of RG 1.71. In order to assess the applicants alternative, please discuss the specific portions of RG 1.71 that the ESBWR design does not conform to and provide an explanation as to how the ESBWR alternative meets the intent of RG 1.71.

GE Response:

Regulatory Guide 1.71 deals with qualification of welders who perform welds with limited access. The Guide specifically requires that for welds performed with less than 12 to 14 inches of access in any direction from the joint, the welder performance qualification include a similar access restriction. However, the precise method for implementation of this guidance is open to interpretation and refinement. GE considers that the intent of the Regulatory Guide is that welds with restricted access be performed to the same level of quality as unrestricted welds, consistent with weld quality required by ASME Section III. As a way to practically achieve this objective (described in some detail in DCD Section 5.2.3.4.2), restricted access qualifications are required when access to a non-volumetrically examined production weld, (1) is less than 305 mm (~12 inches) in any direction, and (2) allows welding from one access direction only. Requalification is required if the production weld is more restricted than the welder's performance qualification. This position was previously approved for certification of the ABWR (See Reference 1 for RAI Response 5.2-44.). The rationale for this interpretation is as follows:

a. If a RCPB weld is subject to volumetric inspection, the inspection method and acceptance criteria will be according to ASME Section III, Subsection NB. If the weld passes this inspection, the weld quality is considered acceptable irrespective of the access restriction. Therefore the intent of the Regulatory Guide is met by inspection. The fabricator or installer must produce welds that satisfy the Code irrespective of any access restrictions.

b. The Regulatory Guide indicates restrictions of 12 to 14 inches. Since this is insufficiently definitive from a specification and quality assurance point of view, GE selected 12 inches as the defined limit.

c. Practically, even though a restriction may exist in one direction from the weld, this is not necessarily the only direction from which the welder may approach the weld. Therefore, if the welder can freely approach the weld from another direction with no access restrictions, the restricted access performance qualification is not required. It is further noted that in the ESBWR design, there are few, if any, RCPB welds that truly have restricted access. Additionally, much of the welding is performed with mechanized welding systems where physical access for a welder is not relevant to the ultimate weld quality.

NRC RAI 6.1-6:

Verify that the fabrication of ESF system materials follow the guidance provided in RG 1.71. If the guidance provided in RG 1.71 is not followed, provide a description of an alternative and provide a basis for using the proposed alternative.

GE Response:

Regulatory Guide 1.71 will be applied to ESF systems in the same manner as for RCPB systems. Please see response to RAI 5.2-45. The exclusion of two inch and smaller socket welds from restricted access qualification requirements is based on two main considerations. One is that socket welds are made as fillet welds, which are significantly easier to perform than groove welds, even under restricted access conditions. Secondly, a leak or failure of such a small line will not challenge the make-up water supply of the reactor system so safety is not affected. For ESBWR in particular, a survey of the current design shows only lines one inch and smaller are included in this category.

NRC RAI 5.2-45 S01:

In GE's response to RAI 5.2-45 (MFN 06-260), GE stated that the intent of the Regulatory Guide (RG) 1.71 (Dec 1973) is that welds with restricted access be performed to the same level of quality as unrestricted welds. Given that small diameter socket welds can be very challenging to weld in the restricted access position, provide a discussion of its alternative to exclude two-inch and smaller socket welds (as stated in GE's response to RAI 6.1-6 (MFN 06-365). The staff notes that the risk associated with the failure of two-inch and under socket welds does not reduce the need to produce original fabrication welds of good quality. DCD, Tier 2, Revision 1, Section 5.2.3.4.2 indicates that socket welds 50A and under are excluded. The staff assumes that 50A is actually 50DN or 2 NPS.

Provide a reference for 50A or revise the DCD to reflect a US or international standard for the applicable piping size. The staff notes that there is a history of unscheduled plant shutdowns from leaking socket welds that were a result of or partially a result of original fabrication welding defects. Given the history of socket weld failures, include a discussion on the use of socket welds given their failure rate and GEs attempt to reduce the number of socket welded joints in the ESBWR design.

GE Response:

The RAI supplement asks GE to "provide a discussion of its alternative to exclude two-inch and smaller socket welds." The referenced response to RAI 6.1-6 and the previous response to RAI 5.2-45 have been partially superceded by the DCD Tier 2, Revision 3, Subsection 5.2.3.4.2 discussion of Regulatory Guide 1.71 compliance. There is no exclusion of small-bore piping socket welds as stated in earlier versions of the DCD.

The RAI supplement asks GE to provide a reference for "50A." The reference for a pipe nominal size of 50A is from the Japanese Industrial Standard (JIS) system of metric measurement. The reference is intended to mean 50 mm or 2 inch nominal pipe size. The specific pipe dimensions differ slightly depending on the specific standard being applied (examples: ANSI B36.10, DIN 2448, or JIS G-2456, etc.). Since the dimension reference was contained in the same deleted text as discussed in the preceding paragraph, there is no impact to the current DCD revision.

The RAI supplement asks GE to provide "a discussion on the use of socket welds given their failure rate and GEs attempt to reduce the number of socket welded joints in the ESBWR design." In past domestic BWR plant discussion, much of the design, analysis and field assembly of small-bore connections was under the control of the prospective licensee's own engineering/construction staff or that of their authorized architect-engineer/constructor. Some of the incidents attributed to small-bore socket weld failure are due to the quality of welding. More were caused by designs using socket-welded small-bore pipe to support overly large and extended-cantilever loads subjected to flow vibration environments from the main process piping that resulted in cracking occurring in the heat affected zone of the branch pipe just beyond the socket weld. From lessons-learned experience, the issue is best addressed in the project piping design specifications through a set of pre-approved standard small-bore pipe run connections and branch attachment configurations. These may include socket-weld designs, but also designs that use butt welds or full-penetration welds, or use qualified mechanical connection methods in place of welds such as cryogenic shaped-memory metal fittings. Other parameters that would be addressed by the preplanned attachment configurations include (but are not limited to) pipe schedule and tolerance requirements, attachment weld designs and reinforcing welds, structural reinforcements, use of flexible connections to isolate vibration loads, and length limitations for unsupported and cantilevered loads.

In addition, most current licensed domestic nuclear power plants were designed prior to the wide availability of significant analytical methods and computing power. Because of past design tool limitations, small-bore piping was not designed and analyzed for all potential loads in the previous generation plant construction. Most small-bore pipe of the past generation of commercial nuclear power construction was field run and assembled. A piping stress analysis was included, when required by the ASME Code, as a calculation in the piping system as-built data report. The use of advanced computer-based design and analysis tools now available to each engineer permits the design and analysis of most ESBWR small-bore piping prior to construction.

The simplified design of the ESBWR does permit a reduction in the number of socket-welded connections. The elimination of the jet-pump type forced-recirculation system from the vessel also eliminates a large number of recirculation and jet-pump instrument small-bore connections from the recirculation piping and the reactor vessel. Many other connections were used for instrument, test, drain and vent connections on main process piping in the complex set of active emergency core cooling systems and engineered safety features of earlier BWR designs (Examples: residual heat removal system, low pressure core spray, high-pressure coolant injection, high-pressure core spray, reactor core isolation cooling, containment atmosphere dilution, or combustible gas control system). The replacement of most of these systems with simpler, passive systems in the ESBWR has reduced the number of process piping containment penetrations, eliminated the active safety-related pumps, eliminated many active safety-related valves with instrumented logic controls and actuator controls interconnections, and reduced the number of divisional cross-connected systems or system-to-system interconnections and associated vents/drains/instruments that cumulatively required large numbers of the small-bore connections.

Further, a reduction of small-bore socket-welded connections also supports the As Low as Reasonably Achievable (ALARA) philosophy of the ESBWR. The small gap that exists between the connecting pipe and the bottom of the socket of each joint forms a potential crud trap in contaminated systems. As noted in DCD Tier 2, Revision 3, Subsection 12.3.1.1.5, "Piping in radioactive systems such as the RWCU/SDC has butt-welded connections, rather than socket welds, to reduce crud traps." Specific instruction to implement this piping design requirement from the DCD is incorporated into the ESBWR project's design manual.

Finally, it is noted that a plan for piping vibration, thermal expansion and dynamic effects testing is outlined in DCD Tier 2, Revision 3, Subsection 3.9.2.1, that covers small-bore piping and is intended to confirm design adequacy with provisions to document and reconcile test acceptance criteria violations. And, as described in DCD Tier 2, Revision 3, Subsection 3.9.3, safety-related piping is designed in accordance with ASME Code Class 1, 2 or 3 requirements, respectively, including defined service condition loads and Code allowed stresses for structural integrity.

Thus, the overall design of the ESBWR is being developed based on guidelines that limit the use of small-bore socket-welded connections, which reduces the potential vulnerability of the design to the failure incidents that have occurred during the operation of past-generation constructed commercial nuclear plants.

DCD Impact:

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