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MFN 06-349 Supplement 1 Docket No. 52-010

May 8, 2007

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

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 56 – Safety Analysis – RAI Numbers 4.4-7 S01, 4.4-8 S01, 4.4-9 S01**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

D068

Reference:

1. MFN 06-316, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 56 Related to the ESBWR Design Certification Application*, September 7, 2006

Enclosures:

1. MFN 06-349 Supplement 1– Response to Portion of NRC Request for Additional Information Letter No. 56 – Related to ESBWR Design Certification Application – Loose Parts Monitoring System – RAI Numbers 4.4-7 S01, 4.4-8 S01, 4.4-9 S01

cc:

AE Cubbage	USNRC (with enclosures)
GB Stramback	GE/San Jose (with enclosures)
BE Brown	GE/ Wilmington (with enclosures)
eDRF	0067-6347

Enclosure 1

MFN 06-349 Supplement 1

Response to Portion of NRC Request for

Additional Information Letter No. 56

Related to ESBWR Design Certification Application

Loose Parts Monitoring System

RAI Numbers 4.4-7 S01, 4.4-8 S01, 4.4-9 S01

NRC RAI 4.4-7

Address how operating experience with loose parts monitoring systems (LPMS) was factored into the design of the ESBWR LPMS. Identify improvements and/or differences, if any, between the current LPMS design used in operating BWRs compared to design of the LPMS proposed for the ESBWR.

NRC RAI 4.4-8

In DCD Tier 2, Chapter 4, describe the sensitivity of the LPMS sensors in terms of its ability to detect the range of size, mass and kinetic energy of metallic parts, and the maximum distance from the sensor location up to which a part can be detected.

NRC RAI 4.4-9

The staff requests that ITAAC be provided for LPMS in ESBWR consistent with the ABWR ITAAC in DCD Tier 2, Chapter 4.

Original Combined GE Response to RAI 4.4-7, RAI 4.4-8, and RAI 4.4-9:

GE intends to delete the Loose Parts Monitoring System (LPMS) from the ESBWR Design currently described in DCD Tier 2 Subsection 4.4.5, and as a consequence the DCD Tier 2 Subsection 4.4.5 will be deleted. The basis for deleting the LMPS is discussed in the following paragraphs.

In a letter addressed to Mr. James Kenny, Chairman BWR Owners' Group (BWROG) dated January 25, 2001; the NRC approved the Loose Parts Monitoring System regulatory relaxations that were requested by the BWROG. The January 25, 2001 NRC approval letter and the associated safety evaluation that defines the basis for NRC acceptance of the topical report was enclosed in Reference 4.4-7.1.

The NRC Safety Evaluation conclusion section contained in Reference 4.4-7.1 states (in Section 4.0 first three paragraphs):

"In Topical Report NEDC-32975P, "Regulatory Relaxation for BWR Loose Parts Monitoring Systems," the BWROG reported on the effectiveness of the LPMS installed in some BWR plants and proposed eliminating the LPMS requirements. The BWROG stated that although loose parts have been detected on a few occasions: (1) the BWROG did not identify any BWR that was shutdown due to the impact of loose parts, (2) no LPMS detected a failed or weakened safety-related component, (3) licensees employ an aggressive foreign material exclusion program, and underwater inspection during refueling outages to ensure loose parts do not accumulate in the reactor vessel, (4) experience also shows that components left in the reactor system are retained in low flow regions, which do not pose as a safety problem, and (5) small metallic filings and other similar debris could contribute to fuel cladding damage, but the LPMS would not detect this class of debris and the industry has installed debris filters into the fuel support pieces which may reduce fuel cladding damage due to fretting."

"The staff finds that operating history does indicate that LPMS did detect weakened or degraded safety related components as well as damage to components due to loose parts

inadvertently left during maintenance or refueling. However, the LPMS in use are not reliable or sensitive enough to provide the safety benefits envisioned by RG 1.133. Loose parts can be detected by the normal plant process and monitoring systems and also through visual inspections. Also, operating history does not show a higher incidence or occurrence of damage to safety-related components in plants that have no LPMS installed. The staff concurs that the safety benefits of the LPMS do not appear to be commensurate with the cost of maintenance and the associated radiation exposure for plant personnel."

"Therefore the staff finds that Topical Report NEDC-32975P is acceptable for referencing in licensing applications to the extent specified and under the limitations delineated in this safety evaluation. The staff will not repeat its review of the matters described in the subject report when the report appears as a reference in licensing applications, except to ensure that the material presented applies to the specific plant involved."

Note: The ESBWR design incorporates debris filters. All fuel supplied by GNF has a filter at the bottom to prevent debris from entering the bundle. This supports the statement made in item (5) above.

Reference:

4.4-7.1 General Electric Nuclear Energy, "Regulatory Relaxation for BWR Loose Parts Monitoring Systems," BWR Owners Group Licensing Topical Report NEDC-32975P-A, February 2001

Affected Documents

DCD Tier2, Subsection 4.4.5 will be deleted. The basis for deleting the Loose Parts Monitoring System from the ESBWR design is as stated above.

NRC RAIs 4.4-7 S01, 4.4-8 S01, 4.4-9 S01

ESBWR design, as stated in MFN0 6-349, Response to RAI 4.4-7 through 4.4-9, is acceptable, the staff requests the applicant to provide the following supplemental information:

1. Discuss in detail:

(a) the design of ESBWR debris filter;

(b) maximum size of debris that can pass through the filter; and

(c) adverse impact on cladding and other components in the core by the debris that pass through the filter.

2. Provide an assessment of adverse impact on ESBWR safety related systems and components by the debris which originate downstream of the filter, for example, from the steam dryer. The safety assessment should address potential for physical damage and flow blockage, particularly, focusing on the ESBWR unique features, including potential for flow blockage of natural circulation and gravity driven flow lines. The response should include ESBWR components, but not limited to, the following:

a) Depressurization Valves (DPVs),

b) Main Steam Isolation Valves (MSIVs),

c) Isolation Condenser System (ICS) - tubes and valves,

d) Standby Liquid Control System (SLCS) - injection lines,

e) Gravity Driven Cooling System (GDCS) - injection lines and Valves,

f) Control Rod Drive (CRD) system.

Explain in detail and demonstrate that ESBWR can be safely operated without a LPMS. A systematic analysis of all systems and components in the RPV and the connected systems is required to justify the deletion of the LPMS.

GE Response to RAI 4.4-7 S01, RAI 4.4-8 S01, 4.4-9 S01

1) The GE12 debris filters are integrated into the lower tie plates of each fuel bundle. Water must pass through the flow holes before entering the fuel bundles. The debris filter assures objects larger than 0.112 inches in width are prevented from continuing past the filter. Objects small enough to pass through the filters would not be detectable by Loose Parts Monitoring Systems (LPMS).

2) GE expects licensees to employ a rigorous Foreign Materials Exclusion (FME) program to prevent external sources of loose parts. They also conduct underwater visual vessel internals inspections during outages to check the structural integrity of reactor components. This also provides opportunities to find loose parts in the vicinity of where inspections are performed.

The ESBWR design takes into consideration important aspects such as material selection and analysis for internal components to prevent failures, and uses proven design methods to fasten components. Also in accordance with RG 1.20, GE will instrument components during initial startup of the lead ESBWR plant as part of a program to measure Flow Induced Vibration (FIV) of critical components. The type and location of instrumentation is established by detailed evaluations of the RPV components using prior test data and analysis to determine susceptibility to FIV. This minimizes the opportunity for internal sources of loose parts in the RPV due to vibration.

The only two systems that provide fluid flow directly into the RPV during normal operation are the feedwater and CRD system. The feedwater system utilizes temporary strainers as precautionary measure to assure that loose parts that may have been left during the construction phase do not enter the RPV. These temporary strainers and any debris collected are removed after the first cycle. Also, the feedwater sparger inside the RPV provides a difficult path for large objects to pass through and enter into the RPV. Objects entering the feedwater spargers must pass through a 2-inch short radius elbow followed by a maximum 1.875 inch diameter sized nozzle to enter the RPV. Objects that are restricted within the feedwater spargers do not adversely affect the operation of the plant or the feedwater spargers. This minimizes the opportunity for loose parts to enter the RPV through the feedwater system.

For the CRD system, purge water flow enters from the bottom of the fine motion control rod drives (FMCRD) through a 1.25 inch line. This flow provides water to cool the internal parts of the drives during plant operation. Due to the restricted flow paths within the drive, it is only possible for small objects that would not be detectable by a loose parts monitoring system to enter the drive. Also, GE concurs with EPRI assessment that it is

unlikely for a loose part to enter into the Control Rod Drive (CRD) and restrict its operation. Topical Report NEDC-32975P-A Rev. 0 ("Regulatory Relaxation For BWR Loose Parts Monitoring Systems", February 2001), regarding regulatory relaxation for BWR LPMS reads, "The EPRI report also stated that loose parts do not, in general, affect CRD operation, because of the torturous path required for loose parts to enter the CRD guide tube. From the upper plenum, the clearance between the fuel channel and the top of the guide tube is small and movement of any loose parts would be counter to core flow. From the lower plenum, access to the CRD guide tube by metallic parts is effectively prevented by the integrity of the guide tube and the core flow patterns that exist in the fuel bundle and bypass regions. Any debris which enters a CRD guide tube is unlikely to have sufficient mechanical strength to interfere with the operation of the CRD."

GE does not expect loose parts to be an issue due to the previous explanations; however in the event of a loose part entering the vessel, GE believes the ESBWR design is capable of performing its safety-related functions. The plant has been designed with multiple Depressurization Valves (DPV) and Safety Relief Valves (SRV). In the event a DPV or SRV is restricted, the remaining DPVs and SRVs can accomplish the task of blow down. The plant has been designed with redundant Main Steam Isolation Valves (MSIV). If one of the series MSIVs becomes restricted, the remaining MSIV can accomplish the task of isolation. The Isolation Condenser System (ICS) has four independent trains. If one of the trains is restricted, the remaining three trains can accomplish the task of heat removal. The Standby Liquid Control (SLC) system has two independent trains. Each train has an injection line that branches into two sets of three injection nozzles within the core shroud. If one of the injection nozzles becomes restricted, the remaining eleven nozzles can accomplish boron injection. The Gravity-Driven Cooling System (GDCS) has four independent trains. If one of the trains is restricted, the remaining three trains can accomplish the task of supplying inventory for a Loss-of-Coolant-Accident (LOCA).

Design and testing are done appropriately to assure that loose parts are not generated internally. FME programs are performed to limit externally generated loose parts from entering the reactor coolant pressure boundary. Underwater in-vessel visual inspections are performed to detect cracking of components that can become potential loose parts. Additionally, with the redundancy in the design of the safety systems, GE believes that the ESBWR is capable of performing its safety-related functions without a LPMS.

DCD Impact

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