Enclosure 1

MFN 06-464, Supplement 10

Response to Portion of NRC Request for

Additional Information Letter No. 166

Related to ESBWR Design Certification Application

Mechanical Systems and Components

RAI Numbers 3.9-77 S02

NRC RAI 3.9-77

In accordance with Regulatory Guide 1.20, Revision 2, May 1976, and SRP-3.9.2, Draft Revision 3, April 1996, guidelines, differences between the valid prototype and the non-prototype reactors will have no significant effects on the vibratory response of any of the components. The applicant is requested to describe the modifications made to the vibration analysis of the ABWR Top Guide Assembly used to predict the response of ESBWR's Guide. Demonstrate that the FIV response of ESBWR's Guide is not significantly modified by the structural differences with the ABWR's. In particular, discuss the modifications made to account for the differences in any cutout patterns in the Guides' plate, their diameters, and their attachments to the Shroud, and the Chimney or the Shroud Head. This information is considered pertinent in determining whether or not the ESBWR reactor internals can be classified as non-prototype Category II, in accordance with Regulatory Guide 1.20, Revision 2, May 1976, and SRP 3.9.2, Draft Revision 3, April 1996, guidelines.

GE Response

This component has proven trouble free in past BWR designs, with various size cores, including the ABWR.

The design of the ESBWR Top Guide is made from a solid forging that is the same as the ABWR design in the arrangement and size of the cells. In addition, the overall thickness of the Top Guide is the same as the ABWR design. The ESBWR Top Guide does have a modestly larger overall diameter to accommodate the increased quantity of fuel assemblies and as a result, the ESBWR has a larger number of cells.

The Top Guide in both the ABWR and ESBWR is bolted into a larger structure. For the ABWR, the Top Guide is bolted to the shroud. For the ESBWR, the Top Guide is bolted between the shroud and chimney.

The flow across the Top Guide is limited to the by-pass flow between fuel assemblies. For the ESBWR the fluid velocities are lower than the ABWR, further reducing any potential for FIV.

DCD table 3L-4 identifies instrumentation that will be placed on the Top Guide to measure its lateral motion. This instrumentation will be the same as instrumentation placed on the Top Guide for the ABWR, as identified in DCD reference 3L-1.

DCD Impact

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

NRC RAI 3.9-77 S01

RAI 3.9-77 S01 Comment on response to RAI 3.9-77 (MFN 07- 207):

In its response to RAI 3.9-77, the applicant has not provided the engineering analysis or experimental evidence as requested in the RAI 3.9-77 and as required by Reg. Guide 1.20. In particular, an uninformative description of the ESBWR of the Guide Plate is given and it is only mentioned that the ABWR and ESBWR plates are connected to different components and the ESBWR plate has more cut outs and a larger diameter than the ABWR. Indeed, these are the issues that prompted the RAI. The ESBWR Guide plate supports in a cantilevered fashion a very long chimney on which the steam separators are attached. No long chimney (longer than either the shroud or separator components) exists in the ABWR between the Guide Plate and the Separators. Also, more of the Guide plate has been cutout in the ESBWR than in the ABWR, which may create greater stress concentration factors. Further, the fluid dynamic forces that will be transmitted to the Guide Plate will be different for the ESBWR: the fluid forces on the chimney do not exist in the ABWR and the steam separator unit is of a different design. The lateral motion of the guide plate is not of main interest; the dynamic stresses induced by dynamic deformation are of concern.

In accordance with Regulatory Guide 1.20, Revision 2, May 1976, and SRP-3.9.2, guidelines, show that the differences between the ABWR and the ESBWR Top Guide Plate will have no significant effects on the vibratory response. The applicant is requested to describe the modifications made to the analytical or experimental vibration analysis of the ABWR Top Guide Assembly used to predict the response of ESBWR's Top Guide Plate and demonstrate that the FIV response of ESBWR's top guide plate is not significantly modified by the structural and FIV loading differences with the ABWR's. If the information is not provided, then the ESBWR Guide Plate will be classified as a prototypic component, per Reg. Guide 1.20.

GEH Response

To calculate the FIV response of ESBWR Shroud/Chimney/Separator structure, measured pressure time histories in the ABWR RPV-Shroud annulus, were suitably scaled to define pressure time histories in the ESBWR RPV-Shroud/Chimney annulus. The scale factors were computed as the square of the ratio of ESBWR annulus fluid velocity to the corresponding value for the ABWR. Both ABWR shroud and ESBWR Shroud/Chimney structures were then analyzed under fluid forces resulting from the corresponding annulus pressure time histories to determine comparative responses of the Shroud/Chimney/Separator structure. During the prototype ABWR FIV test, the movement of the top guide was measured together with the shroud. The pressure time history was therefore further normalized such that the calculated ABWR response is

equal to the measured ABWR response. The highest zero-to-peak stress intensity calculated on the basis of these measurements was 10.8 MPa.

The ESBWR top guide is made from a solid forging that is the same as the ABWR design in the arrangement and size of the cells. Because the ESBWR is a forging, the stress concentration factors are smaller than those in the ABWR. Since the calculated ESBWR lateral load at the top guide is 2.00 times higher than that of the ABWR, the highest zero-to-peak stress intensity is 21.6 MPa and is much below the allowable value of 68.9 MPa.

Licensing Topical Report NEDE-33259P Revision 1, which has been issued, includes the above information.

DCD Impact

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

NRC RAI 3.9-77 S02

Provide the justification for extrapolating the stresses in the ESBWR top guide from stresses calculated in the ABWR, based on the guide plate lateral load results from the beam model analyses. In particular, comment on any differences in stress concentrations and stress patterns in the ABWR and ESBWR top guides, all of which would have to be the same or very similar in the ABWR and the ESBWR for the extrapolation to provide a reasonable estimate of the stress in the ESBWR top guide.

GEH Response

The scaled FIV Loads are now applied to the ESBWR specific geometry; as such there is no need to scale the stresses. The ESBWR 0 to peak stress intensity is below 5.0 MPa as compared with 10.8 for the ABWR and still well below the allowable value of 68.9 MPa. The scaling of the FIV Loads is based on the dynamic pressure ratios.

DCD Impact

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