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Subject: **Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application - Containment Design - RAI Numbers 6.2-11, 6.2-21, 6.2-26 and 6.2-27**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter. This completes GE's response to RAI Letter No. 18.

If you have any questions about the information provided here, please let me know.

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

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Enclosure:

1. MFN 06-284 - Response to NRC Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application - Containment Design - RAI Numbers 6.2-11, 6.2-21, 6.2-26 and 6.2-27

Reference:

1. MFN 06-113, Letter from U. S. Nuclear Regulatory Commission to Mr. David H. Hinds, *Request for Additional Information Letter No. 18 Related to ESBWR Design Certification Application,* April 24, 2006

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRFs 0056-6812, 0057-4114

ENCLOSURE 1

MFN 06-284

Response to NRC Request for

Additional Information Letter No. 18

Related to ESBWR Design Certification Application

Containment Design

RAI Numbers 6.2-11, 6.2-21, 6.2-26 and 6.2-27

NRC RAI 6.2-11

Provide the results of the evaluation(s) and compare to the design value(s). The DCD Section 6.2.1.1.4 indicates that the MSLB will not result in unacceptable results but it does not indicate if other LOCAs were evaluated to conclude this is the limiting case. Provide a discussion on how the limiting cases were identified, for both the drywell and wetwell. Address drywell results and, as appropriate, wetwell results.

GE Response

Among four design base LOCA break types analyzed for DCD, Feedwater Line (FWL) break results in the highest peak drywell (DW) pressure and Main Steam Line (MSL) break results in the lowest peak DW pressure. The peak pressure of GDCS Injection Line (GDL) or Bottom Drain Line (BDL) break falls between those of FWL and MSL breaks, as shown in Figure 6.2-11.1. DW temperatures are comparable for these 4 types of breaks, except that FWL and MSL cases have higher temperature between 800 and 1100 seconds, as shown in Figure 6.2-11.2. It is therefore adequate to analyze FWL and MSL break scenarios to provide diverse DW environmental conditions which envelope other break locations, for determining the minimum DW pressure and the pressure differential between WW and DW as consequence of inadvertent initiation of drywell spray. The results are tabulated below. An inadvertent drywell spray initiation during a MSLB resulted in a lower DW pressure. An inadvertent drywell spray initiation during a FWLB resulted in a higher WW to DW pressure differentials. The results are all within the design capability. An inadvertent drywell spray initiation during a normal operation was also analyzed and the results were inconsequential.

Results of three analyzed cases are summarized below:

	FWL Break	MSL Break	No Break
Drywell Spray Flow Rate (GPM)	2000	1000	2000
Spray initiation Time (sec. after break)	1300	1000	0
Minimum Drywell Pressure (psia)	25.3	17.5	14.9
Maximum Wetwell to Drywell ΔP (psid)	2.88	1.40	0.000028
Design Wetwell to Drywell ΔP (psid)	3.0	3.0	3.0

As described in the response to RAI 6.2-9, there is no credible event that can lead to significant depressurization of the Wetwell.

The second sentence of the last paragraph of DCD Section 6.2.1.1.4 will be revised to read:

"The Feed Water Line (FWL) and Main Steam Line (MSL) break scenarios provide diverse Drywell environmental conditions which envelope the other break locations. The results of the FWL and MSL break analyses show that the containment does not reach a negative pressure relative to the reactor building, and the maximum Wetwell-Drywell differential pressures are within the design capability."

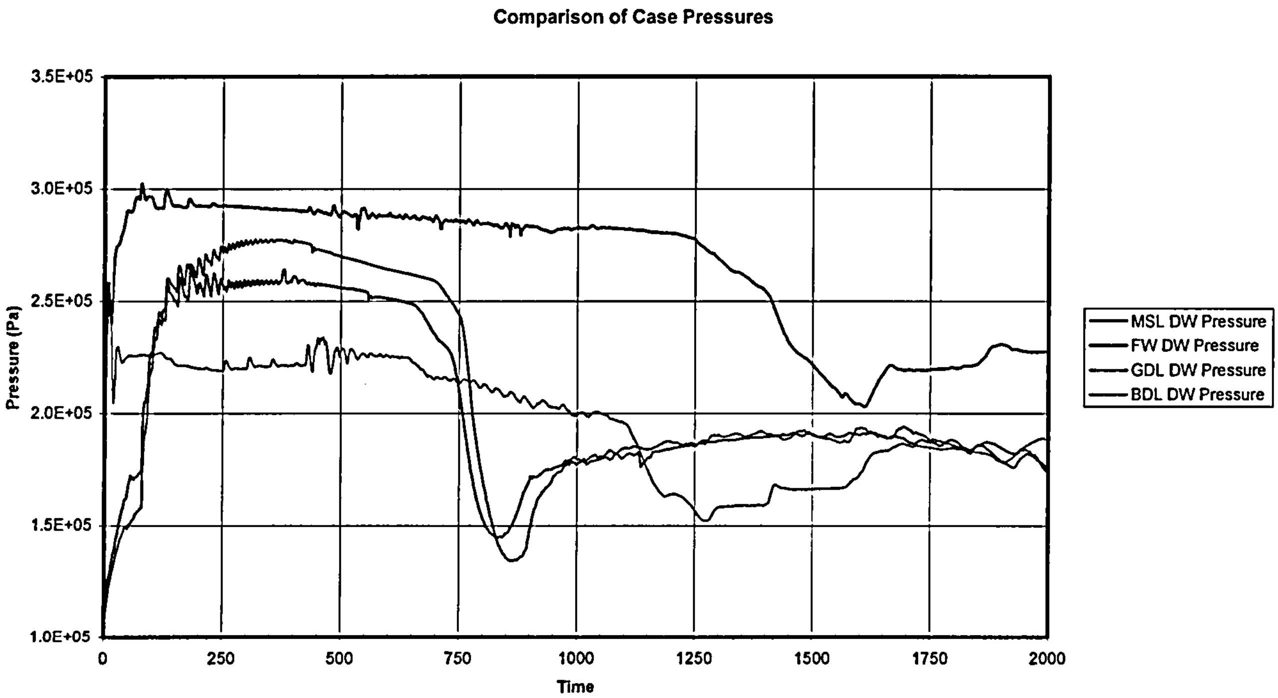

Figure 6.2-11.1 Drywell Pressure Responses of 4 LOCA Types

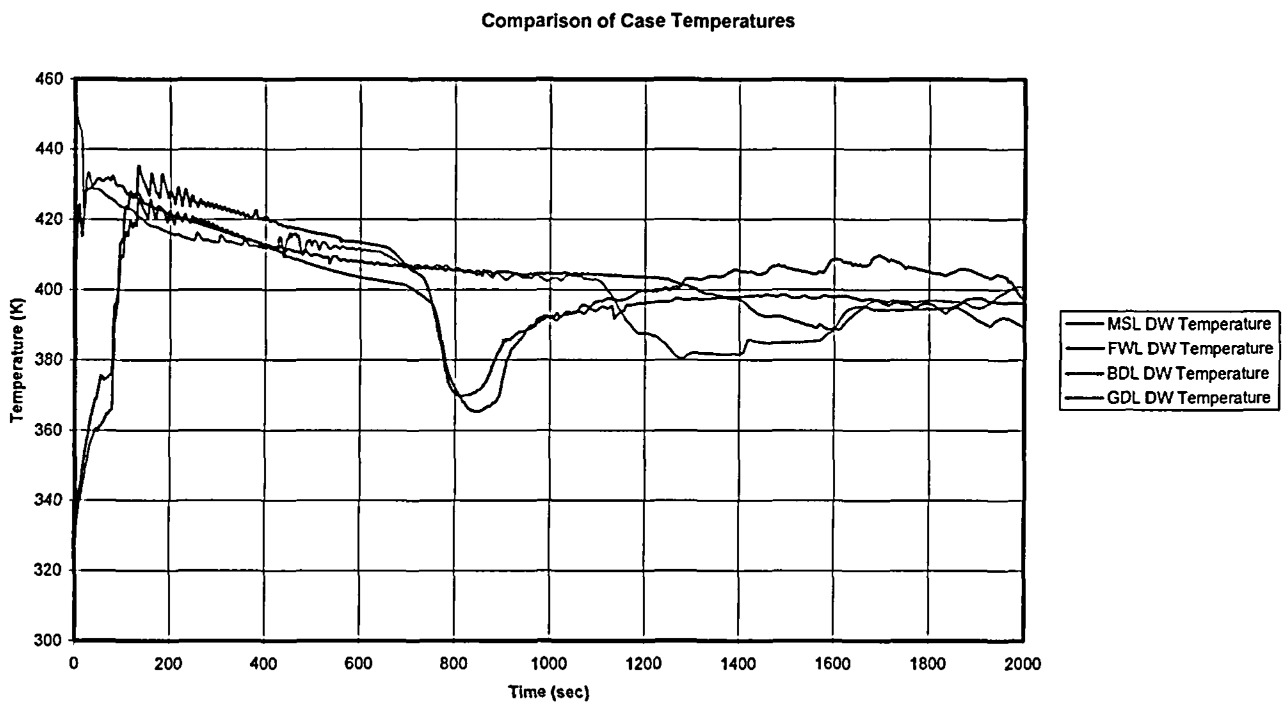

Figure 6.2-11.2 Drywell Temperature Responses of 4 LOCA Types

NRC RAI 6.2-21

Provide a description of and justification of the subsonic and sonic flow models used in vent flow calculations. The degree of entrainment assumed for the vent mixture should also be discussed and justified. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

DCD Tier 2 Section 6.2.1.2 states the Moody correlation is acceptable for use modeling critical flow. The analysis uses the Moody critical mass flux correlation to model the break flow. Where this model assumes instantaneous full critical velocity at the break, which is a highly conservative boundary condition.

The degree of entrainment is not a TRACG input, but is calculated by the TRACG interfacial shear model described in DCD Tier 2 Reference 6.2-5 (appended to DCD Tier 2 Section 6.2.9 in response to RAI 6.2-27).

DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation" will be appended with the following statement:

"The Moody critical mass flux correlation is used to model break flow. The TRACG interfacial shear model calculates the degree of entrainment for the vent mixture."

NRC RAI 6.2-26

For all vent flow paths, provide the flow conditions (subsonic or sonic) up to the time of peak pressure. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

GE Response

Prior to the time of peak pressure the vent flow is subsonic.

DCD Tier 2, Section 6.2.1.2.3, “Design Evaluation” will be appended with the above statement.

<u>NRC RAI 6.2-27</u>

Provide a detailed description of the method used to determine vent loss coefficients. Provide a tabulation of the vent paths for each subcompartment and the loss coefficients. Provide this information in DCD Tier 2, Section 6.2.1.2.3, "Design Evaluation." This information is necessary to evaluate ESBWR subcompartment loads per SRP 6.2.1.2 and RG 1.70, Section 6.2.1.2.

<u>GE Response</u>

The only vent flow path modeled is the annulus to drywell hydraulic connection, thus a table of vent flow paths is not provided.

As shown in the figure included with the response to RAI 6.2-23, the annulus to drywell hydraulic communication is modeled as an additional vessel elevation (Level 18). The hydraulic connection from the annulus to drywell is modeled as a flow area equal to the vertical gap between the top of the RSW and the drywell head base support structure (upper drywell ceiling). The gap is 0.365 m in height. Wall friction losses for the vent are calculated using methods described in the TRACG Model Description, DCD Reference 6.2-5 (appended to DCD Tier 2 Section 6.2.9 in response to RAI 6.2-27). The drywell airspace is not modeled as part of the annulus pressurization loads calculation since it is downstream of the vent restrictions and due to the fact that neglecting the drywell head volume will maximize the pressure response in the annulus.

In the current revision of the analysis the vent has a loss coefficient of zero applied to it. However, a 20% conservatism is taken in the pressures reported in the stress analysis. Thus it is expected that the results in the stress evaluation will continue to be bounding.

DCD Tier 2 Revision 3 will include an evaluation of annulus pressurization taking into account a form loss for the vent. The form loss used will be either the predefined form losses shown in the TRACG User's Manual Appendix C Section C.1.3 or will use a form loss calculated to accommodate the model's specific geometry. A statement will be provided either that the load definition applied is not impacted, or a new load definition will be applied.

DCD Tier 2, Section 6.2.1.2.3 should be appended to include: "Single phase wall friction losses are calculated using fits to Moody curves (Reference 6.2-5). Two phase wall friction losses are calculated using a modification of the Chisholm correlation (Reference 6.2-5)."

DCD Tier 2, Section 6.2.9 will be appended to include the Reference 6.2-5, the "TRACG Model Description," NEDE-32176P, Licensing Topical Report.