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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 80 - Containment Peak Pressure Analysis - RAI Numbers 6.2-140, 6.2-142, and 6.2-143**

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

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 06-419, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 80 Related to ESBWR Design Certification Application*, November 2, 2006

Enclosure:

1. MFN 07-311 - Response to Portion of NRC Request for Additional Information Letter No. 80 - Related to ESBWR Design Certification Application - Containment Systems - RAI Numbers 6.2-140, 6.2-142, and 6.2-143

cc:

AE Cubbage	USNRC (with enclosures)
BE Brown	GHNEA/Wilmington (with enclosures)
GB Stramback	GHNEA/San Jose (with enclosures)
eDRF	0000-0064-5590 for RAIs 6.2-140 and 6.2-143
	0000-0067-3663 for RAI 6.2-142

Enclosure 1

MFN 07-311

Response to Portion of NRC Request for

Additional Information Letter No. 80

Related to ESBWR Design Certification Application

Containment Systems

RAI Numbers 6.2-140, 6.2-142, and 6.2-143

NRC RAI 6.2-140:

For the bounding case, DCD, Tier 2, Revision 1, Figure 6.2-12 for the containment pressure shows a short term peak of 344 KPa and long-term peak pressure of 340 KPa at 72 hours, which is increasing. Please justify that the containment pressure does not exceed the design pressure of 414 KPa after 72 hours.

GHNEA Response:

The Passive Containment Cooling System (PCCS) is a passive engineered safety feature of the containment that will remove post loss-of-coolant accident (LOCA) decay heat from the containment for a minimum of 72 hours without operator action to maintain containment pressure and temperature within design limits. Beyond 72 hours, mitigating measures would be in place to keep the containment pressure and temperature within design. One of these measures consists of providing Isolation Condenser (IC)/PCC pool makeup for the PCCS to continue removing decay heat at a rate that will maintain the containment pressure and temperature within design limits. The analysis to determine the drywell pressure behavior for the main steamline break (MSLB) for the licensing bounding and nominal conditions including refill of the IC/PCC pool was performed utilizing the ESBWR TRACG code. The analysis results show that for licensing nominal conditions, the drywell pressure remains below the design pressure 413.7 KPa (60 psia) during the seven-day duration of the event. Under licensing bounding conditions, the results indicate that the drywell pressure remains at or below the design pressure for about 120 hours (five days) and increases to 430 KPa (62.4 psia), slightly above the design pressure by 16.3 KPa (2.4 psi) at the end of the seven-day period. The results for the bounding case are conservative. The decay heat and radiolytic gas generation were assumed not to change after the first four days, and these variables were kept constant for the remainder of the seven-day period (see Figure 6.2-140-1).

Additional evaluations were performed to support maintaining containment pressure values below design pressure for the bounding LOCA event for the entire long-term seven-day period. These evaluations determined that one measure to further reduce the containment pressure for a long-term seven-day period, and to assure that the licensing bounding case event remains below design pressure, was to reduce the impact of the non-condensable gases on containment pressure through the use of Passive Autocatalytic Recombiners (PARS). The impact of PARS is observed through an ESBWR TRACG analysis that considers the containment pressure behavior for the bounding case when the non-condensable gases are maintained at the 72-hour level (i.e., by assuming that the radiolytic gas production stops after 72 hours and comparing the results with those of a continuous radiolytic gas generation over the seven-day period). The results of the action of maintaining these non-condensable gases at the 72-hour level during the remainder of the seven-day period for the licensing bounding event indicate that the containment pressure remains below 395 KPa (57 psia), or 18.7 KPa (2.7 psi) below the design pressure, and that PARS is a measure that contributes to maintain the containment pressure below the design pressure during the MSLB seven-day period bounding case event (see Figure 6.2-140-2).

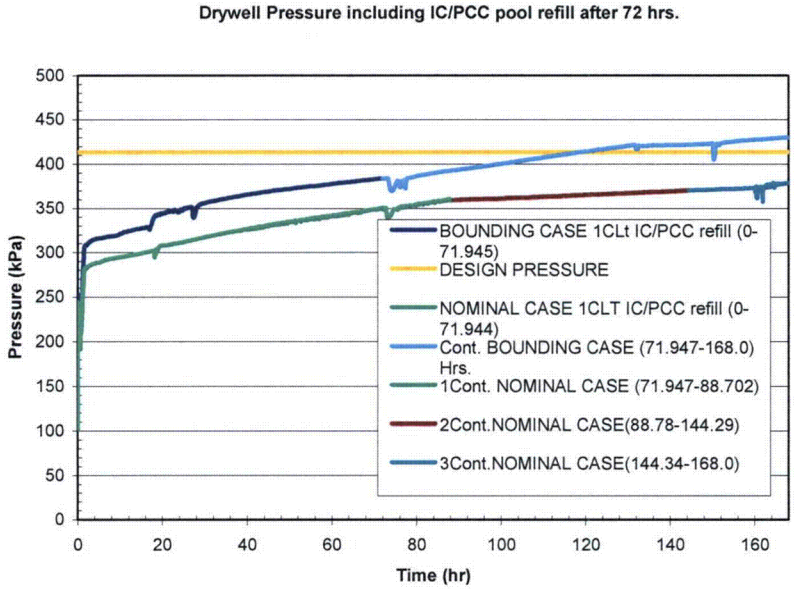

Figure 6.2-140-1. Post-LOCA Drywell Pressure for Seven-Day Period Bounding and Nominal Conditions, IC/PCC Pool Refill at 72 Hours

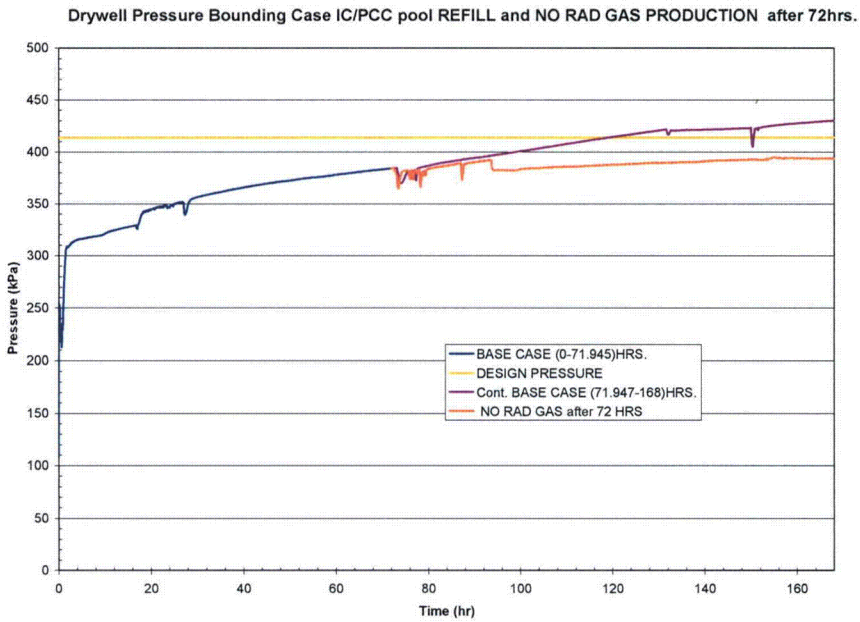

Figure 6.2-140-2. Post-LOCA Drywell Pressure for Seven-Day Period Bounding Conditions, IC/PCC Pool Refill at 72 Hours, No Radiolytic Gas Production after 72 Hours

DCD Impact:

DCD Tier 2, Section 6.2, will be expanded in DCD Tier 2, Revision 4, to capture the results of the current evaluations of the proposed IC/PCC pool refill at 72 hours and use of PARS to ensure no radiolytic gas production after 72 hours as measures to further maintain the post LOCA containment pressure values below design pressure for the entire seven-day period.

NRC RAI 6.2-142:

In response to NRC RAI 6.2-59, in Enclosure 1 to MFN-06-364 dated October 3, 2006, GE stated that "The ESBWR design uses 3 vacuum breakers. Assuming one vacuum breaker is out of service for the LOCA [loss-of-coolant accident] analyses, there should be 2 vacuum breakers available for the LOCA transient." Making 3 vacuum breakers available during a LOCA would appear to be more conservative considering that a higher rate of noncondensible flow from the wetwell to drywell would degrade the passive containment cooling system more than when only 2 vacuum breakers are available. Please explain this apparent nonconservative modeling of only 2 of 3 vacuum breakers available during a LOCA.

GHNEA Response:

The drywell-to-wetwell vacuum breakers open when the wetwell pressure exceeds the drywell pressure by a small amount (~3 kPa). Results show that vacuum breaker actuations take place during the first hour of the transient. During this period, the subcooled Gravity Driven Cooling System (GDCS) water entering the reactor pressure vessel absorbs most of the decay heat, reduces steam generation, and decreases the energy removed by the Passive Containment Cooling System (PCCS).

For the main steamline break (MSLB) with failure of one depressurization valve (DPV) at nominal conditions, vacuum breaker opening occurs twice at approximately 36 minutes into the transient. The vacuum breakers stay open for a short period of time (< 10 seconds). Vacuum breaker flow is shown in Figure 6.2-142-1.

For the feedwater line break (FWLB) with failure of one DPV at nominal conditions, vacuum breaker opening occurs repeated between 12 to 31 minutes into the transient. The vacuum breakers stay open for short periods of time (< 5 seconds). Vacuum breaker flow is shown in Figure 6.2-142-2.

During the GDCS injection period, some amount of non-condensable gases remains in the drywell annulus (see DCD Tier 2, Revision 3, Figures 6.2-9d1 and 6.2-10d1). When the vacuum breaker openings occur, non-condensable gases return from the wetwell to the drywell. With three vacuum breakers available, the flow of non-condensable gases from wetwell to the drywell is higher than it would be with only two vacuum breakers available. However, the impact of the higher concentration of non-condensable gases on the PCCS performance (heat removal capability) is expected to be very small. The impact is small because the decay heat load on the PCCS is small during the GDCS injection period, and also because the additional amount of non-condensable gases coming from the wetwell is mixed with the residual non-condensable gases remaining in the drywell annulus.

For all loss-of-coolant accident (LOCA) containment pressure evaluation cases reported in DCD Tier 2, Revision 3, Table 6.2-5, the steam flow into the drywell resumes and PCCS power approaches the decay heat curve within the first six hours of the transient. The total PCCS heat removal capacity becomes greater than the decay heat and remains greater for the duration of the 72-hour transient (see DCD Tier 2, Revision 3, Figures 6.2-9c1 and 6.2-10c1). Since the maximum drywell pressure occurs at the end of the 72-hour period, the short-term effect of one additional vacuum breaker opening early in the transient has no effect on the maximum drywell pressure.

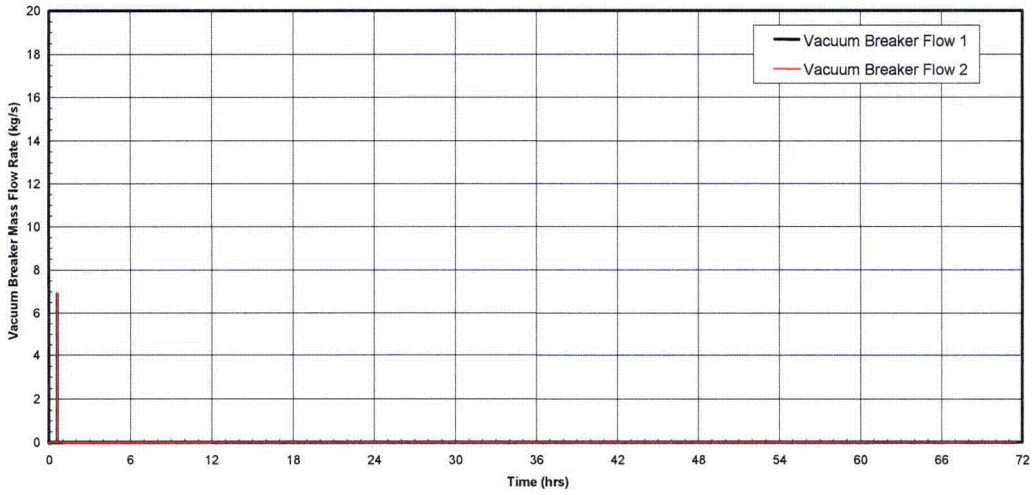

Figure 6.2-142-1. Vacuum Breaker Flow for Nominal MSLB Case

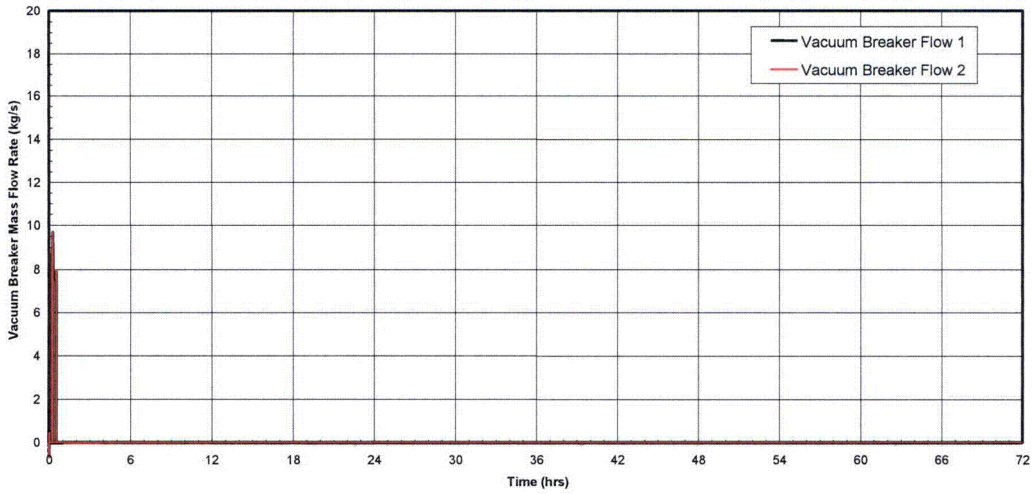

Figure 6.2-142-2. Vacuum Breaker Flow for Nominal FWLB Case

DCD Impact:

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

NRC RAI 6.2-143:

In response to NRC RAI 6.2-59, in Enclosure 1 to MFN-06-364 dated October 3, 2006, you provided the results of TRACG containment analyses for four accident cases: FWLB, MSLB, GDCS line break, and DBLB. These cases considered the nominal input values as given in Table 6.2-6, DCD Tier 2, Rev. 1. Of the four cases, the MSLB case resulted in the maximum drywell pressure. Please confirm that the MSLB case would give the maximum drywell pressure if bounding input values were considered.

GHNEA Response:

The results from the latest ESBWR TRACG containment analyses performed are already incorporated in DCD Tier 2, Revision 3, Section 6.2. These analyses consider bounding and nominal conditions for the main steamline break (MSLB) and feedwater line break (FWLB) accident cases, and nominal conditions for the Gravity Driven Cooling System (GDCS) injection line break (GDLB) and bottom drain line break (BDLB) accident cases. The results for MSLB, FWLB, GDLB, and BDLB accident cases under licensing nominal conditions show that a MSLB results in the maximum drywell pressure. The results also confirm that under licensing bounding conditions the MSLB shows the highest drywell pressure. These results are provided in DCD Tier 2, Revision 3, Table 6.2-5. Since DCD Tier 2, Revision 3, Section 6.2 already contains the results of the latest ESBWR TRACG containment analyses, no changes are required in response to this RAI.

DCD Impact:

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