

L. William Pearce  
Vice President724-682-5234  
Fax: 724-643-8069May 12, 2005  
L-05-079U. S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, DC 20555-0001

**Subject: Beaver Valley Power Station, Unit Nos. 1 and 2**  
**BV-1 Docket No. 50-334, License No. DPR-66**  
**BV-2 Docket No. 50-412, License No. NPF-73**  
**Responses to a Request for Additional Information in Support of License**  
**Amendment Request Nos. 317 and 190**

By letter dated March 28, 2005, the U.S. Nuclear Regulatory Commission (NRC) issued a request for additional information (RAI) relative to FirstEnergy Nuclear Operating Company (FENOC) license amendment requests 317 and 190 (Reference 1). These license amendment requests proposed changes that will revise the Beaver Valley Power Station Operating Licenses to permit each unit to be operated with an atmospheric containment design. Attachment A contains the FENOC responses to the RAI dated March 28, 2005.

During the development of the response to RAI item 6, an error was found in the design calculations supporting the original license amendment request submittal. Specifically, the sensitivity calculations indicated that a minimum value of quench spray flow was the limiting bias for the quench spray flow rate for cases determining the minimum low head safety injection pump available NPSH. However, the RAI response evaluation indicates that a maximum value yields more limiting results. The results still show substantial margin between the available and required NPSH. A detailed description of the correction, and its impact on the Licensing Report submitted in support of license amendment requests 317 and 190, is provided in the response to RAI item 6. Other sensitivity calculations were reviewed to confirm this was an isolated case and no other cases were affected.

The responses contained in this transmittal have no impact on the proposed Technical Specification changes, or the no significant hazards consideration, transmitted by Reference 1.

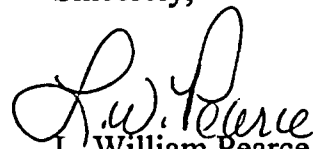
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Beaver Valley Power Station, Unit Nos. 1 and 2  
Responses to a Request for Additional Information in Support of License Amendment  
Request Nos. 317 and 190  
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No new commitments are contained in this submittal. If you have questions or require additional information, please contact Mr. Henry L. Hegrat, Supervisor - Licensing, at 330-315-6944.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 12, 2005.

Sincerely,



L. William Pearce

Attachments:

A. Responses to RAI dated March 28, 2005

Reference:

1. FENOC Letter L-04-073, License Amendment Requests 317 and 190, dated June 2, 2004.

c: Mr. T. G. Colburn, NRR Senior Project Manager  
Mr. P. C. Cataldo, NRC Sr. Resident Inspector  
Mr. S. J. Collins, NRC Region I Administrator  
Mr. D. A. Allard, Director BRP/DEP  
Mr. L. E. Ryan (BRP/DEP)

**REQUEST FOR ADDITIONAL INFORMATION (RAI)**  
**RELATED TO FIRSTENERGY NUCLEAR OPERATING COMPANY (FENOC)**  
**BEAVER VALLEY POWER STATION, UNIT NOS. 1 AND 2 (BVPS-1 AND 2)**  
**CONTAINMENT CONVERSION TO ATMOSPHERIC CONDITIONS**  
**DOCKET NOS. 50-334 AND 50-412**

By letter dated June 2, 2004, as supplemented February 11, 2005, FENOC (the licensee) proposed changes to BVPS-1 and 2 Technical Specifications (TSs) to allow operation of the containments at atmospheric conditions. The BVPS-1 and 2 containments are currently operated at subatmospheric conditions. In order for the Nuclear Regulatory Commission (NRC) staff to proceed with its review of the proposed change, the following information is needed. References to the February 11, 2005, RAI questions are underlined.

1. Describe the procedure and methods used to calculate the inadvertent spray event. Specify whether there has been any change in these methods for the containment conversion or the use of the MAAP-DBA computer code.

Response:

The procedure and method are the same as that used for the current plant design. The design inputs are simply revised to account for a Technical Specification change associated with conversion to an atmospheric containment.

The analysis demonstrates that the 8 psia minimum pressure requirement of the containment structural design is satisfied in the event of inadvertent quench spray during the most limiting normal operating conditions permitted by the Technical Specifications. The current plant and the atmospheric containment analysis are both hand calculations using ideal gas laws. Neither the current plant LOCTIC code nor the MAAP-DBA code is involved.

The analysis assumes the plant is operating at the maximum containment air temperature (105°F) and minimum containment air pressure (12.8 psia) permitted by the Technical Specifications when the quench sprays are inadvertently actuated. After inadvertent quench spray the final containment air temperature is assumed equal to the minimum Refueling Water Storage Tank (RWST) water temperature (45°F) permitted by the Technical Specifications. The containment volume reduction resulting from spraying RWST water is conservatively assumed to be zero. Using ideal gas laws the final containment air pressure is calculated based on those design inputs. The final containment air pressure is shown to be greater than the 8 psia minimum pressure requirement of the containment structural design.

Only one of the above Technical Specification values was changed for atmospheric containment. The minimum permitted containment air pressure was increased approximately 4 psi to 12.8 psia. The maximum containment air temperature and minimum RWST water temperature were not changed.

2. Do any of the emergency core cooling system (ECCS) or recirculation spray (RS) pumps currently take credit for operation with cavitation for some amount of time when required to mitigate a design-basis accident? A November 17, 1977, Duquesne Light report (Agencywide Documents Access and Management System, Legacy Library Accession No. 8710260129) describing changes to the BVPS-1 recirculation spray and low-head safety injection (LHSI) systems states (page 1-1) that the results of tests at reduced net positive suction head (NPSH) conditions provide the basis for the modifications described in the report. However, there have been several revisions to the NPSH analyses for BVPS-1 since this report.

Do the analyses done for the containment conversion, at current power or power uprate conditions, require credit for operation of LHSI or RS pumps in cavitation? If so, are the previous tests cited in the November 17, 1977, report (which references an earlier September 9, 1977, report) still applicable?

Please provide curves of available Net Positive Suction Head (NPSH) as a function of time for the limiting sequences. Also provide the required NPSH values used in the analyses.

Response:

In the analyses supporting License Amendment Request (LAR) 317 (Unit No. 1) and 190 (Unit No. 2), none of the ECCS or spray pumps take credit for operation in a cavitation mode for any period of time. The NPSH requirements are met for all scenarios investigated at all times following startup of the pumps. This is consistent with the current licensing basis analysis.

The November 17, 1977 report referred to NPSH tests, which were performed in 1977 for both the RS and LHSI pumps for BVPS-1. These tests established that the pumps could satisfactorily operate with lower NPSH requirements than the original vendor recommendations. The testing and results were based on industry standards for defining the NPSH required to avoid cavitation (i.e., 3% reduction in TDH). None of these pumps has been replaced at BVPS-1 and the test results remain applicable. While the calculation of available NPSH has been revised several times since 1977, the acceptance criteria for required NPSH has not changed.

The required NPSH values are discussed on page 4-18 of Enclosure 2 of the LAR. Figures 4-14 and 4-15 of Enclosure 2 of the LAR provide the curves of available NPSH versus time for the limiting sequences.

**3. Response to RAI 2.**

**(a) The response to RAI 2 states:**

**The confirmation of the interface between these two models [Westinghouse-1979 and MAAP-DBA] includes the ECCS recirculation time and the recirculation temperature and the steam generator (SG) depressurization points (pressure and time). It is confirmed that the 1979 Model uses an earlier switchover time, a hotter recirculation temperature, and a quicker SG depressurization than predicted by MAAP-DBA.**

**Since the earlier switchover time, the hotter recirculation temperature and the quicker depressurization are more conservative, why does the fact that the value of these parameters is more conservative with the Westinghouse-1979 model demonstrate the acceptability of MAAP-DBA?**

Response:

Prior to 3600 seconds, Westinghouse-1979 model mass and energy releases are used directly as the boundary condition input to the MAAP-DBA analysis. Included in these releases are conservative assumptions such as an early switchover time, a hot recirculation temperature, and a quick depressurization down to atmospheric conditions within 3600 seconds. Once the MAAP-DBA calculations are completed it is confirmed that these assumptions remain valid, otherwise the Westinghouse-1979 model mass and energy releases would be redone adjusting these assumptions to bound the containment response if the containment analysis calculated a more restrictive set of conditions. The purpose of this particular response to RAI 2 was not to demonstrate the acceptability of MAAP-DBA, but to reconfirm that the Westinghouse-1979 model mass and energy releases used a bounding set of assumptions based upon containment results during the first 3600 seconds of the postulated event.

**(b) Provide the following information in order for the NRC staff to perform an independent analysis of the mass and energy release from a loss of coolant accident (LOCA) after 1 hour for an NPSH analysis.**

Response:

The following responses are based on the limiting case for maximum sump temperature (Case 6L –DEPS LOCA) at switchover to cold leg recirculation for BVPS-1 except those questions applicable to general methodology.

**1) refueling water storage tank (RWST) capacity and temperature**

Response:

RWST Capacity - 430,500 gallons minimum usable volume  
RWST temperature – 65°F.

**2) break size, location and discharge coefficient**

Response:

Break Size –full Double Ended Rupture (DER) 31” Diameter  
Break Location – Reactor Coolant Pump (RCP) suction piping  
Discharge coefficient – 1.0

**3) flow rates or pump curves for pumps operating during the injection and recirculation phases**

Response:

Table 1 provides the Safety Injection (SI) injected flow and no spillage for the specific case that is based on the use of minimum safeguards assumptions.

<b>Table 1</b>			
<b>Safety Injection Flows</b>			
<b>Pressure (psia)</b>	<b>HHSI (gpm)</b>	<b>LHSI (gpm)</b>	<b>Total (gpm)</b>
14.7	450.1	3375.4	3825.5
34.7	448.3	3116.0	3564.3
64.7	445.0	2686.0	3131.0
114.7	440.5	1786.0	2226.5
164.7	435.4	280.8	716.2
214.7	430.0	0.0	430.0
414.7	407.4	0.0	407.4
614.7	383.7	0.0	383.7
814.7	359.0	0.0	359.0
1014.7	332.9	0.0	332.9

**Injection Phase**

SI data points – Minimum Safeguards has one high head/SI pump and, one low head/Residual Heat Removal (RHR) pump. No spill is assumed. See Table 3.1-2 in Enclosure 2 of the LAR.

Recirculation Phase

For recirculation phase, a constant value of 3072 gpm was used as discussed in Table 3.1-2 of Enclosure 2 of the LAR.

**4) time until recirculation**

Response:

Switchover time for cold leg recirculation is 2900 seconds (Case 6L Maximum Sump Temperature).

**5) earliest time to switch to simultaneous injection (does this affect NPSH)?**

Response:

Switchover time for simultaneous injection – 6 hours. This does not affect NPSH for either the Low Head Safety Injection pumps (LHSI) or High Head Safety Injection (HHSI) pumps for either unit. The pump flow rates during simultaneous injection are essentially the same as during cold leg injection so there is no change in the NPSH required or friction losses upstream of the pump suctions. Containment sump temperatures and levels are also unaffected by the change to simultaneous injection.

**6) decay heat curve and multiplier**

Response:

The Westinghouse LOCA Mass & Energy (M&E) that are based on the WCAP-10325-P-A model used the 1979 ANS 5.1 decay heat with 2 sigma uncertainty applied. This model is described in Section 2.4 of WCAP-10325-P-A and Enclosure 2 of the LAR contains a table of decay heat fractions (i.e., Table 3.1-12 (Part 1)). This decay heat curve was used in the MAAP-DBA calculations after the first 3600 seconds for the entire transient.

**7) all pumped injection head flow curves (plus uncertainty on head and flow)**

Response:

See response to question 3(b) 3). The SI flow curves are calculated including consideration of uncertainties.

**8) accumulator temperature**

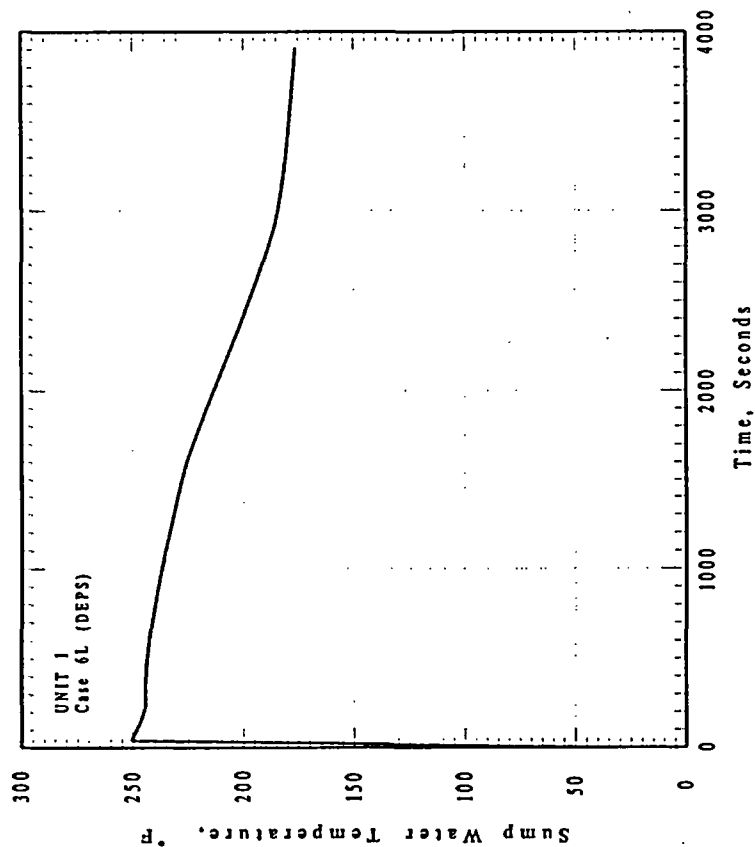
Response:

The assumed accumulator temperature of 105°F is based on the maximum allowable containment air temperature per the Technical Specifications. This temperature is identified in Table 3.1-1 of Enclosure 2 of the LAR.

**9) sump temperature versus time**

Response:

**Figure 1: Sump water temperature history for BVPS-1 Case 6L.**



Plot Date: 10/15/2010 10:51:50 AM. Plot Name: BVPS-1 Case 6L (DEPS). Plot File: BVPS-1 Case 6L (DEPS). Plot Title: Sump Water Temperature History for BVPS-1 Case 6L (DEPS).

**10) Was superheat of the primary steam by the steam generator secondaries included in the calculations? If not, please explain.**

Response:

As noted in Section 3.1.5.3 of Enclosure 2 of the LAR, the FROTH code does produce super-heated steam. Steam releases in Reflood and post-Froth (i.e. Epitome) are limited to dry saturated steam. At 3600 seconds, all of the steam generator secondary energy, core stored energy and the Reactor Coolant System (RCS) metal energy above 14.7 psia, 212°F has been removed. The additional stored energy in the upper elliptical head, upper shell, and miscellaneous upper internals is released at a constant rate over the next 6 hours. Thus, no energy sources are available post 3600 seconds to drive steam to super-heat conditions.

**11) Was entrainment of liquid into the SGs simulated along with the attendant additional steam source to the containment? If not, please explain.**

Response:

Yes, entrainment of liquid into the steam generators is modeled. WCAP-8264-P-A, which is the basis for the WCAP-10325-P-A model, describes the FROTH code in Section II-D starting on page II-1-19. This description includes the calculation of the two-phase mixture that enters into the SG primary tubes.

**12) Please describe how the mixing in the ECC injection sections was modeled. Was the break placed upstream or down stream of the ECC injection nozzle and please justify the chosen configuration?**

Response:

A break in the RCS pump suction piping is by definition downstream of the injection section when the direction of the break flow is considered. Thus, steam condensation can occur in both the intact cold legs and the cold leg section of the faulted loop. The ECCS steam/water mixing model is described in WCAP-10325-P-A, Sections 2.2.1.2, 2.2.1.3, 2.2.1.4, and 2.2.1.5 and again in Section 3.1.5.2 of Enclosure 2 of the LAR.

**13) Did the analysis include injection of the nitrogen into the containment?**

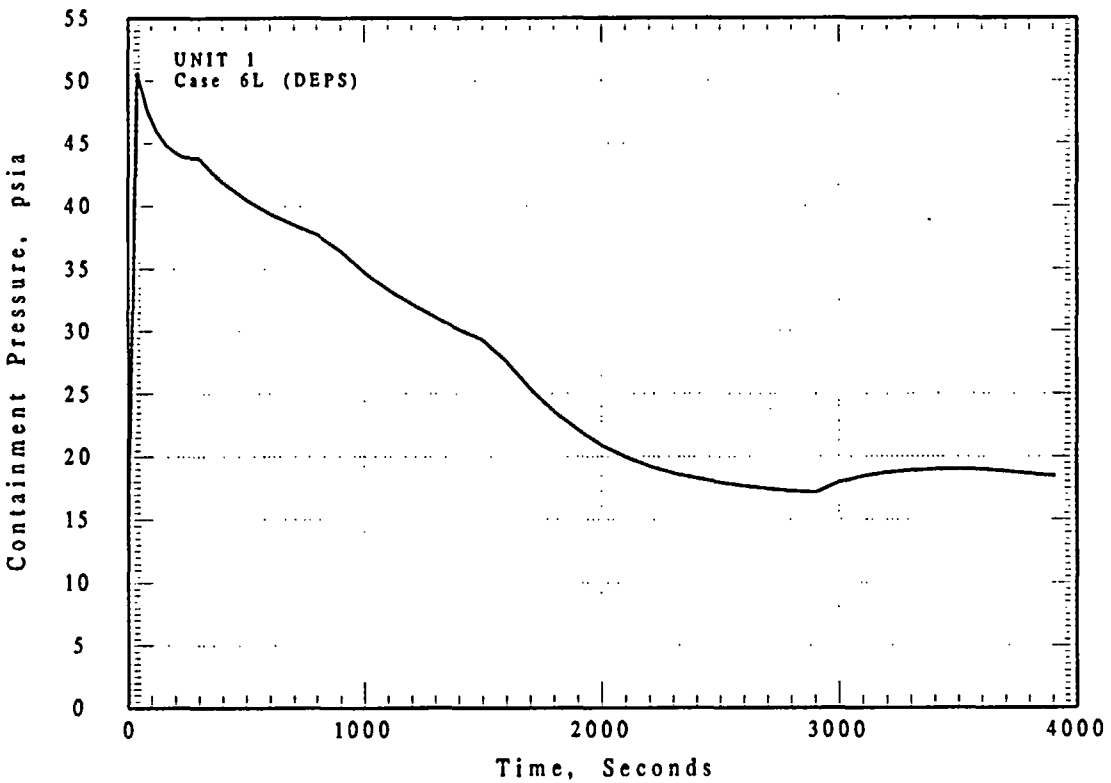
Response:

Yes, injection of accumulator nitrogen is included in the analysis.

#### 14) Containment pressure as a function of time

**Response:**

**Figure 2: Containment pressure history for BVPS-1 Case 6L.**



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5 SOURCE GCL FILE IS BE80K000(HMMFAT\_02-04R4 RV.[PHUI MRUNS]CHSEGL\_RSG.MIX.MST GCL)

Table 2 is provided to facilitate the confirmatory assessment of the long term mass and energy histories from a LOCA after 1 hour.

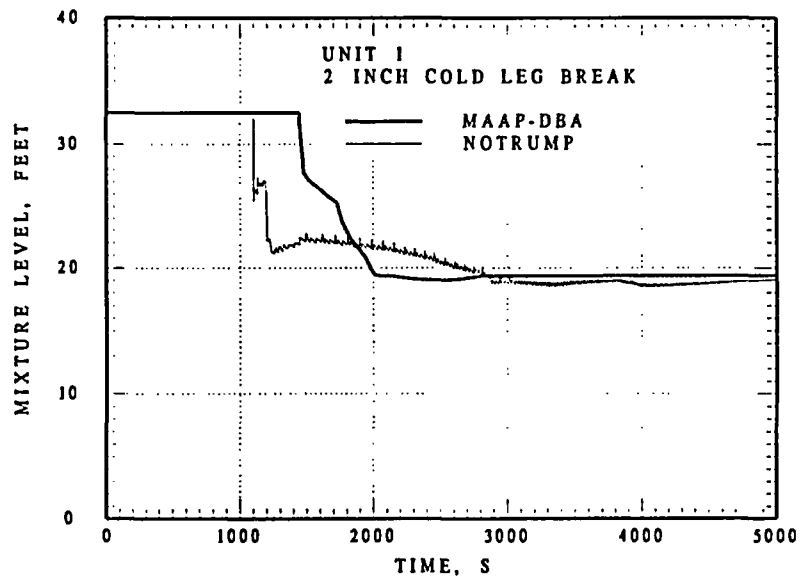
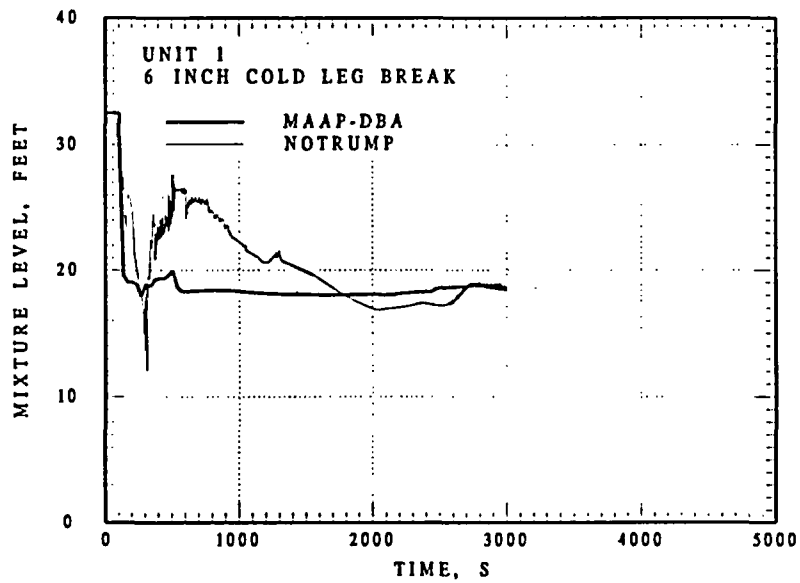
Table 2 CASE 6L Mass And Energy Release Histories After One Hour		
Time (Hour)	Mass Release Rate (lb/sec)	Energy Release Rate (BTU/sec)
1.0	408	1.109E5
1.5	408	9.406E4
2.0	408	8.844E4
2.5	408	8.568E4
3.0	408	8.341E4
3.5	408	8.144E4
4.0	408	7.945E4
4.5	408	7.778E4
5.0	408	7.628E4
5.5	408	7.480E4
6.0	408	7.228E4

4. Response to RAI 20. Provide a Figure 2 comparing the MAAP-DBA and NOTRUMP mixture levels for a 2-inch and a 6-inch break.

Response:

Figure 3, which is a revision of RAI 20 Figure 2 (part (d)), provides the comparison of the Reactor Pressure Vessel (RPV) downcomer water levels as calculated by NOTRUMP and MAAP-DBA for 2-inch and 6-inch leg breaks. The comparison figure presents the mixture level whereas the previous RAI 20 Figure 2 presented the MAAP-DBA collapsed water level for the RPV downcomer. The level information supplements the fundamental information presented for the mass and energy benchmark in the LAR that presents the integral mass and energy release histories predicted by the two computer codes. The mass and energy release histories are the information used by the small and intermediate break LOCA containment analyses.

**Figure 3: Comparison of downcomer mixture level histories for 2 and 6 inch diameter breaks.**



FAI GRAPHICS, V5.1. (c) 2003. USER:HAUSER. PLOT MADE AT 07:05:04 ON 29-MAY-2005 PAGE: 1

2 SOURCE GCL FILE IS SESOCK300(MANMFA)\_C2-C4R6 BV.DBA.U.I.M.RUNS)MIX\_LEVEL GCL-2:

**5. Response to RAI 20. Explain why the limiting recirculation pump available NPSH conditions are calculated for the small-break LOCA rather than the large-break LOCA. This does not appear to have been the case with previous BVPS-1 and 2 NPSH calculations?**

Response:

Table 3, included in the response to RAI 20, shows the limiting cases for RS pump NPSH for BVPS-1 and BVPS-2. For BVPS-1, the limiting case for the inside RS pumps (IRS) is a double-ended hot leg break (DEHL). This is consistent with the current BVPS-1 calculations. For the BVPS-1 outside RS pumps (ORS), the limiting case is an intermediate 12 inch hot leg break. The current calculations show the limiting case to be a Double Ended Hot Leg (DEHL) break. Sensitivity analyses performed in 1977 using the LOCTIC code showed that the NPSH results for intermediate size breaks was very close to the DEHL break. In the case of the ORS pumps, the DEHL case was only 0.1 feet more limiting than intermediate size breaks. Changes in the methodology as discussed below contribute to this change in the limiting break size.

For BVPS-2, the limiting case for the RS NPSH is listed in Table 3 as a 3 inch break. The current calculations evaluate the limiting case to be a large break. The BVPS-2 RS NPSH analysis does not include credit for containment pressure. Therefore, the analysis is primarily dependent on the sump water level when the RS pumps start.

The MAAP-DBA analyses of available NPSH for the RS pumps uses a multi-node model as described in Section 4 of Enclosure 2 of the LAR. This model provides for a more detailed accounting of the water holdup inside containment than the current single node LOCTIC model. This detailed accounting may impact the sump level at startup of the RS pumps. This is particularly significant for smaller breaks since the inventory of spillage from the RCS break is reduced relative to larger breaks. The MAAP-DBA analysis also incorporates a non-uniform spray distribution pattern. This is not included in the current licensing basis analysis. This spray pattern biases more spray toward the center of containment where there is a higher potential for water holdup in the refueling cavity. The non-uniform spray distribution is a conservative feature in the MAAP-DBA analysis and is based on test data from the Carolina Virginia Test Reactor (CVTR) test facility. This biasing of spray distribution results in additional holdup during the initial part of the transient, which affects the sump level when the RS pumps start and therefore the available NPSH.

The changes in the limiting case for BVPS-1 and BVPS-2 RS NPSH are primarily driven by the changes in methodology as discussed above.

6. **Table 4-3, Enclosure 2:** (a) In calculating available NPSH, please explain why a maximum containment volume is used for the LHSI pumps and a minimum volume for the RS pumps. (b) Similarly, please explain the application of maximum and minimum values for the Hi-Hi quench spray setpoint, start delay for quench spray, quench spray flow rate, start delay for recirculation spray, heat exchanger (HX) UA, recirculating spray flow rate and HX cooling water temperature. Provide physical explanation, if possible.

Response:

A sensitivity analysis was performed to establish the limiting direction of bias for each of the input parameters listed in Table 4-3 of Enclosure 2 of the LAR that were important for a particular attribute. For example, when examining the sensitivity for RS and LHSI pump NPSH, the following input parameters were each evaluated individually to determine the limiting value; containment volume, containment initial pressure, containment initial temperature, containment initial relative humidity, paint thickness and conductivity, spray droplet size, cooling water flow and temperature, RS heat exchanger performance, Quench and RS spray flow rates and spray initiation setpoint. The biases listed in Table 4-3 of Enclosure 2 of the LAR reflect the results of these sensitivity studies.

In the case of containment volume, the results for both RS and LHSI are relatively insensitive to changing from the minimum to the maximum value. As discussed in a previous response to question 9 in the December 14, 2004 RAI, the RS NPSH analysis is more sensitive to the rate of depressurization because of the dependency on the relative rate of pressure reduction between the containment atmosphere and the containment sump vapor pressure. A minimum volume also causes the spray pump start setpoint to be reached earlier at which time the sump inventory is lower. Because of these effects, a minimum volume, and resulting lower air mass, causes a higher depressurization rate and a lower sump level and results in more limiting results.

In the case of the LHSI, the minimum NPSH occurs at switchover from injection to recirculation mode of safety injection. At this point in the transient, the containment pressure still provides an important contribution to the available NPSH; however, neither the pressure nor the containment sump temperature is changing much. Therefore, it is the absolute value of the pressure which governs and the lowest pressure occurs by using the maximum containment volume.

The RS NPSH is essentially insensitive to the Hi-Hi quench spray (containment isolation phase B (CIB)) setpoint. For BVPS-1 large breaks (DEHL and 12 inch hot leg) are limiting for IRS and ORS pumps. These large breaks result in very rapid containment pressurization that quickly reaches and exceeds the CIB setpoint. The variation in the CIB setpoint bias is small compared to the rapid change in containment pressure such that it does not result in a significant change in the timing of spray system initiation. The sensitivity study for large LOCA demonstrated a slight variation in the containment

overpressure and sump water temperature (but not sump inventory) that resulted in less than a few tenths of a foot of NPSH variation for the CIB bias. The maximum CIB bias produced the slightly smaller NPSH result for the RS pumps. For BVPS-2 a small break (3 inch hot leg) was found to be limiting. For BVPS-2 the containment pressure and sump water temperature are not included in the determination of the available NPSH for the RS pumps. Only sump inventory expressed as the elevation difference relative to the pump impeller and system head losses are included in the NPSH result. The bias in the CIB setpoint as applied for the large break scenarios has been reevaluated for this BVPS-2 small break LOCA case. Recognizing that sump inventory controls the NPSH determined for BVPS-2, and that a 3 inch diameter break would result in a slower rate of containment pressurization than a large break, the limiting RS NPSH sequence was rerun with the CIB setpoint biased to its minimum value as-is the case for the LHSI NPSH assessment for BVPS-1. The minimum CIB setpoint resulted in slightly less sump inventory being accumulated in containment due to the break flow prior to when the spray systems were initiated. This resulted in a very small reduction (less than a tenth of a foot) such that the minimum available RS NPSH determined for BVPS-2 remained the same at 15.1 feet.

The LHSI NPSH is virtually insensitive to the CIB setpoint bias. This is due to the fact the large breaks are limiting for LHSI NPSH and during large break scenarios, the CIB setpoint is reached quickly and therefore does not significantly affect the timing of the quench spray (QS) startup. Therefore, there are no significant changes in the sump inventory or temperature at the time of switchover to LHSI recirculation.

A minimum start delay for QS is conservative for the RS NPSH calculations since this is associated with higher pump performance (reduced piping fill time) and therefore higher QS flow rates. This also starts containment depressurization sooner, which slightly reduces containment overpressure available to the RS pumps. For LHSI NPSH, a maximum start delay is conservative since this is associated with minimum pump performance and will reduce amount of QS delivered to the sump relative to SI flows, which are heated in the RCS. This has the effect of a slight increase in sump temperature at switchover.

For RS NPSH, a higher QS flow rate is conservative because it increases the containment depressurization rate, which reduces the containment overpressure available. For LHSI, a minimum QS flow is indicated in Table 4-3 of Enclosure 2 of the LAR, but the table should indicate a maximum QS flow for LHSI NPSH. The higher QS flow, and the increased containment depressurization rate it produces, results in a reduced containment pressure when the LHSI pump starts. The LHSI NPSH cases (6L-DEPS MIN SI and 7L-DEPS MAX SI) reported in Table 4-23 of Enclosure 2 of the LAR were re-run using the maximum QS flow rate and the corresponding minimum QS delay time. The results for these revised runs for the minimum available LHSI NPSH were 25.67 feet for CASE6L and 27.83 feet for CASE7L. These values are less than the corresponding values reported in Table 4-23 of Enclosure 2 of the LAR for these two sequences but these revised results provide significant margin relative to the required LHSI NPSH of 10.6 feet. The use of the maximum QS flow rate rather than the minimum flow rate will

also impact the detailed shape of the time history of the available LHSI NPSH presented in Figure 4-14 of Enclosure 2 of the LAR. The available LHSI NPSH time history will start just prior to 3000 seconds and rise to the initial (minimum) value when the maximum QS flow rate is used.

A minimum RS start delay is more limiting for RS NPSH because the pump starts sooner and there is less inventory in the sump. For LHSI, a longer delay is limiting because there is less time available for the RS system to remove heat from the containment and sump which leads to a higher sump temperature at switchover.

For RS pump NPSH, a higher RS flow is limiting because higher spray flow reduces the containment pressure faster. Also at higher RS flow, the pump suction losses are higher and NPSH required is higher and thus more limiting. For LHSI, lower RS spray flow reduces the heat removal capability of the system which increases the sump temperature at switchover to recirculation mode.

As discussed in the response to question 9 of the previous set of RAIs, a higher heat removal rate (i.e., higher UA and lower service water temperature) is more limiting for RS NPSH because the transient effect of reducing containment pressure faster than the sump temperature leads to a drop in available overpressure and NPSH. Higher heat removal reduces the RS spray temperature and leads to faster depressurization. The transient effect can be seen on Figure 4-14 of Enclosure 2 of the LAR. For LHSI NPSH, maximizing sump temperature is the dominant effect since the containment has been depressurized when recirculation mode is reached. Minimizing RS heat removal capabilities (i.e., minimum UA and maximum cooling water temperature) maximizes the sump temperature.

**7. Response to RAI 26: Provide results of a sensitivity of containment peak pressure and temperature to the model of the energy exchange between the water on the containment floor and the containment atmosphere.**

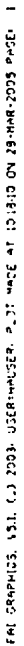
Response:

The containment peak pressure results from large LOCA sequences. For BVPS-1 the peak pressure occurs for Case 8L (DEHL) as reported in Table 4-16 of Enclosure 2 of the LAR and for BVPS-2 the peak pressure occurs for Case 3L (DEHL) as reported in Table 4-17 of Enclosure 2 of the LAR. The containment peak temperature results from main steam line break (MSLB) sequences. For BVPS-1 the limiting temperature presented in Enclosure 2 of LAR occurs for Case 3M as reported in Figure 4-8 of Enclosure 2 of the LAR and for BVPS-2 it occurs for Case 16M as reported in Figure 4-13 of Enclosure 2 of the LAR.

The sensitivity of the results for these four sequences to this energy exchange model was investigated by running each sequence with this model turned off in the MAAP-DBA code. As expected, the peak values for these sequences are not sensitive to this heat exchange model. The containment peak pressures for the large LOCA sequences as summarized in Table 3 are seen to be unchanged when the heat exchange between the water pool and containment atmosphere is turned off. The containment gas temperature for the MSLB sequences are compared in Figures 4 and 5. The short-term temperature values are not sensitive to this heat exchange value. A small impact of this heat exchange process is displayed in the longer term.

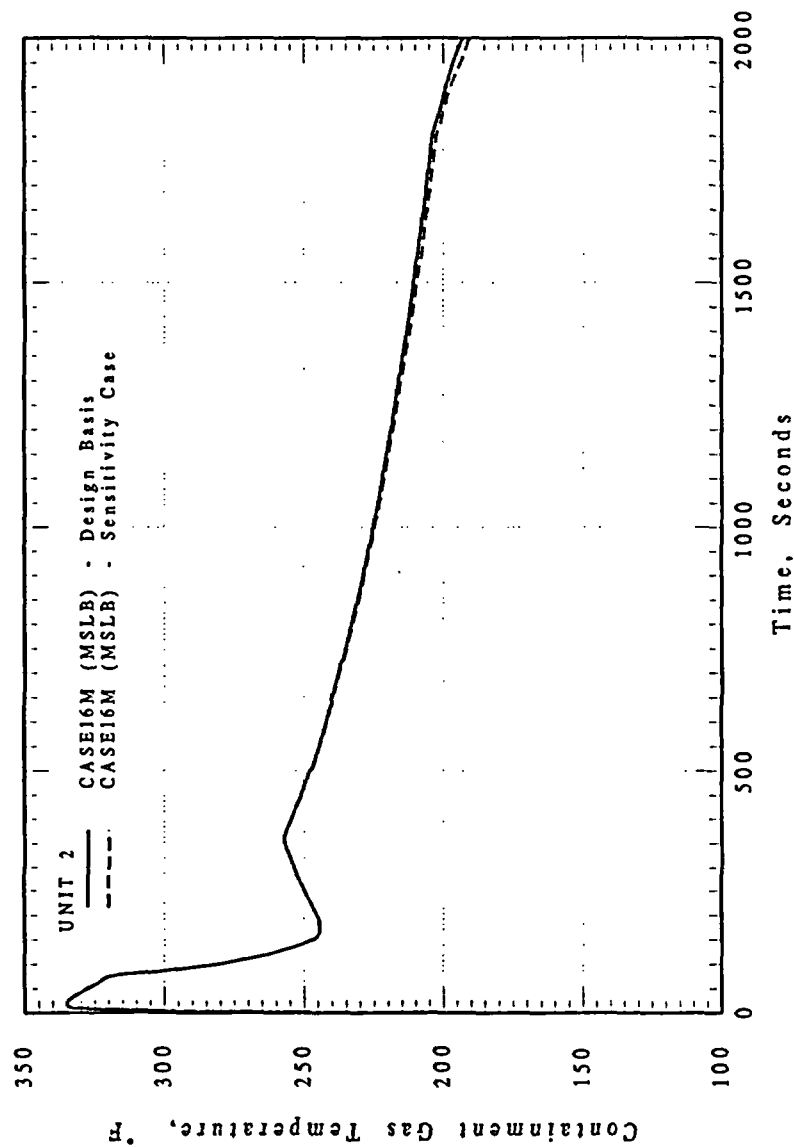
<b>Table 3</b>		
<b>BVPS-1 and BVPS-2 Containment Peak Pressure - Comparison of Design Basis And Sensitivity Study</b>		
	<b>Containment Peak Pressure (PSIG)</b>	
	<b>BVPS-1</b>	<b>BVPS-2</b>
<b>Design Basis<sup>(1)</sup></b>	<b>43.3</b>	<b>44.9</b>
<b>Sensitivity Study<sup>(2)</sup></b>	<b>43.3</b>	<b>44.9</b>
<b>(1) Model for heat exchange between water pool on containment floor and containment gas space turned on.</b>		
<b>(2) Model for heat exchange between water pool on containment floor and containment gas space turned off.</b>		

### **sensitivity study.**



16 SOURCE GPL FILE IS S8SDKA300-THMMHFAI\_02-04RE.PV.DNA U.S.RAI.2)FIGURE\_1.GCL 6

Figure 5: BVPS-2 containment gas temperature -comparison of design basis and sensitivity study.



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SOURCE GEL FILE IS \\S10VAD100\HMH\TAL\02-0596 BV\_DRA\U25.PML\2FIGURE.2 GCL13

**8. Table 4-3, Enclosure 2: (a) for several containment analysis input values (e.g., initial containment pressure, initial containment temperature and service water temperature), the value used in the safety analysis is the same as the TS value. How is measurement uncertainty accounted for? (b) How is measurement uncertainty accounted for in the values of safety analysis input parameters that are not in the TSs (e.g., RWST temperature, recirculation spray heat exchanger flow rate, quench spray flow rate)?**

Response:

- (a) For those input values which appear in the Technical Specifications as analysis values, the uncertainty will be accounted for in the surveillance limits. For the types of parameters specifically listed, the parameters are monitored on a log in accordance with the Technical Specification surveillance frequency. The log limits will be adjusted from the analysis limits to account for the measurement uncertainty based on the specific instrumentation, calibration tolerance and frequency, etc.
- (b) The process is similar for inputs which are not in the Technical Specifications. Surveillance limits are adjusted to account for uncertainties where appropriate. The RWST temperature limits are actually in the Technical Specifications. The cooling water flow to the recirculation spray heat exchanger is measured in an operational surveillance test and the limits are adjusted to account for measurement uncertainty. In the case of recirculation and quench spray flow rates, the analysis input values are taken from system flow calculations which are based on minimum acceptable pump performance and conservative system loss factors. The pumps are tested in accordance with the In-service Testing (IST) program and the surveillance limits are based on either the minimum performance assumed in the safety analyses or ASME XI limits, whichever is more limiting. The surveillance tests for these pumps do not account for measurement uncertainty. The need to address measurement uncertainty for these pumps is identified in the BVPS Corrective Action program.

**9. Table 4-3, Enclosure 2: The value of accumulator pressure used in the mass and energy release analyses is less than the range of TS values. Explain why this is conservative.**

**Response:**

Previous NRC RAI No. 17 requested, "Verify that all parameters covered by technical specifications are at conservative technical specifications limit for the mass and energy release calculations." FENOC Letter L-05-006, dated February 11, 2005, responded to this question and stated that the low pressure value of 575 psia (560 psig) was lower than the current TS values and therefore was conservative.

This new RAI requests a basis for the statement that the low pressure value is conservative. This statement is based on plant sensitivity studies that have shown that the assumption of minimum accumulator gas pressure results in increased mass and energy releases. This is due to extending the blowdown phase since the accumulator injection rate is reduced with a lower initial gas pressure. A longer blowdown phase results in a larger release of mass and energy to the containment.