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Designated Original

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July 6, 2006
L-06-114

U. 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
Additional Information in Support of License Amendment Request Nos. 302 and 173 (Unit No. 1 TAC No. MC4645/Unit No. 2 TAC No. MC4646)

On October 4, 2004, FirstEnergy Nuclear Operating Company (FENOC) submitted License Amendment Request (LAR) Nos. 302 and 173 by letter L-04-125 (Reference 1). This submittal requested an Extended Power Uprate (EPU) for Beaver Valley Power Station (BVPS) Unit Nos. 1 and 2 and is known as the EPU LAR.

NRC review of the EPU LAR indicated that additional analysis relative to post-LOCA long term core cooling transients was necessary. Attachment 1 of this submittal provides requested information that pertains to the post-LOCA long term core cooling transients under the proposed EPU conditions.

The supplemental information provided by this transmittal has no impact on either the proposed Technical Specification changes or the no significant hazards consideration transmitted by Reference 1.

No new regulatory commitments are contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Gregory A. Dunn, Manager – FENOC Fleet Licensing, at (330) 315-7243.

A001

Process per
T. Colburn

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 6, 2006.

Sincerely,

James H. Lash

Attachments:
1. Additional Information: Long Term Core Cooling Transients for Proposed EPU Conditions (BVPS-1 and 2)

References:
1. FENOC Letter L-04-125, License Amendment Request Nos. 302 and 173, dated October 4, 2004.

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

Attachment 1 of L-06-114

Additional Information: Long Term Core Cooling Transients for Proposed EPU Conditions (BVPS-1 & 2)

NRC Request:
NRC review of the EPU LAR indicated that additional analysis relative to post-LOCA long term core cooling transients under the proposed EPU conditions was necessary.

Based on the NRC staff's review of the licensee's SBLOCA and post-LOCA long term cooling analysis, the NRC staff concludes that the Westinghouse NOTRUMP SBLOCA methodology and post-LOCA long term cooling evaluation, is acceptable for use for BVPS-1 and 2 in demonstrating compliance with the requirements of 10 CFR 50.46(b), under the proposed EPU conditions. The acceptability is contingent upon submission of additional analyses to show that small breaks can be cooled down to an RCS pressure of 120 psia, with a failure of one of the atmospheric dump valves. Or, show that for those breaks which cannot be depressurized below RCS pressure of 120 psia in order to flush the core that the RCS can be shown to refill and re-establish subcooled natural circulation. The necessary operator actions to facilitate a successful control of boric acid would also need to be included in the EOPs. If the RCS is shown to remain above 120 psia and boil for an extended time beyond the 6-hr. switch time, then additional EOP cautions or guidance would be needed to preclude the operators from an inadvertently rapid depressurizing with high concentrations of boric acid in the RCS.

Response:

To address the concerns associated with Reactor Coolant System (RCS) smaller break sizes, cold leg break analysis of 1.5-inch and 1.1-inch was performed to determine the timing associated with system cooldown and depressurization to 120 psia and 350°F.

The capacity of the BVPS steam generator (SG) Atmospheric Relief Valve (ARV), or atmospheric dump valve, is dependent on operating pressure and the installed piping configuration. The ARV capacities, per valve, are 356,300 lb/hr (@ 1050 psia)* for BVPS-1 and 235,000 lb/hr (@1040 psia) for BVPS-2. There is one ARV on each of the three (3) steam headers at both units. Each unit also has an additional Residual Heat Removal (RHR) atmospheric steam release valve which is connected to all three steam headers. The capacity of the RHR valve is 251,800 lb/hr (@1050 psia)* for BVPS-1 and 480,000 lb/hr (@ 1040 psia) for BVPS- 2. The failure of the RHR atmospheric steam release valve for BVPS-2 is the limiting case for this analysis, based on the total relief capacity with a limiting single failure. Therefore, the limiting steam relief capacity for both units is bounded by the total relief capacity of the three BVPS-2 ARVs with the assumed failure being the RHR valve. Credit for an additional High Head Safety Injection (HHSI) charging pump was not taken in this analysis.

*Note: The BVPS-1 capacity values for the ARVs and the RHR valve reported above are lower than those previously reported in response to RAI E.18 (Reference 1). Corrections were necessary to the BVPS-1 valve capacity values to account for system friction losses. However, this analysis is unaffected since the BVPS-2 valve capacities were the limiting case and were utilized in this analysis.

The RCS pressure condition of 120 psia was chosen since boric acid and water are miscible at the corresponding saturation temperature and, at that head, the Residual Heat Removal (RHR) pumps will start to deliver significant flow. The hot leg recirculation alignments are briefly summarized below:

BVPS-1 Hot Leg Recirculation Safety Injection (SI) Alignment:

1. The Low Head Safety Injection (LHSI) pumps are aligned to the hot legs and the HHSI pumps remain aligned to the cold legs during the hot leg recirculation phase.

BVPS-2 Hot Leg Recirculation SI Alignment:

1. If there is no Motor Operated Valve (MOV) failure, all SI is aligned to the hot leg.

2. If there is an MOV failure, the HHSI pumps are aligned to the hot legs and the LHSI pumps remain aligned to the cold legs during the hot leg recirculation phase.

Since LHSI hot leg recirculation is required for flushing flow in two of the three alignments, timely cooldown and depressurization are required to ensure that adequate flushing flow can be delivered at the designated hot leg switchover time. A summary of the BVPS EPU long term cooling post-LOCA boric acid control strategy for various size breaks is shown in Table 1. The boric acid solubility limit of 29.27 wt.% was assumed in all of the precipitation analyses. Figures F-6 and F-7, previously provided in RAI response F.6 (Reference 2), provide the results (including core flushing) of the limiting 6-inch break analysis for boric acid precipitation for BVPS-1 and 2, respectively.

The 1.5-inch cold leg break RCS cooldown and depressurization results are presented in Figure-1 and Figure-2. Figure-1 demonstrates the system response to the 1.5-inch cold leg break assuming that only the steam generator ARVs are utilized to perform the cooldown and depressurization function. As can be seen, the RCS temperature condition was achieved at approximately 14,000 seconds (3.89 hours) into the transient or 2.89 hours following the initiation of the RCS cooldown and depressurization. At 6 hours (5 hours after initiation of cooldown) the RCS had only depressurized to approximately 130 psia; therefore, in order to demonstrate acceptable depressurization to the desired RCS pressure of 120 psia, opening of the Pressurizer Power Operated Relief Valves (PORVs) is required. Figure-2 presents the same information assuming that three Pressurizer PORVs opened at 18,100 seconds (5.03 hours) to demonstrate that RCS depressurization can be achieved. As can be seen, RCS pressure can be reduced to below 120 psia approximately 600 seconds (10 minutes) after opening all three Pressurizer PORVs. The choice of 18,100 seconds to accelerate RCS depressurization using the PORVs was rather arbitrary and could have been commenced much earlier. It should be noted that even with the SG ARVs discharging and all three Pressurizer PORVs open, the RCS pressure stabilizes at approximately 110 psia under this analysis scenario. This is because the operable SG ADVs and PORVs are either under or close to critical flow conditions. If this were not the case, such as assuming either the BVPS-1 or BVPS-2 valve capacities with no failures, or assuming the availability of the condenser steam dump system, the RCS would be depressurized long before boric acid precipitation is a concern. Even under these circumstances, because of the high volume flow rates in the main steam system, RCS pressure will be slow to respond. This further reinforces the argument that no abrupt depressurization events can occur through either the ADVs or Pressurizer PORVs, thus RCS temperature remains high, promoting a very high boric acid solubility limit.

The 1.1-inch cold leg break cooldown and depressurization simulation results can be found in Figure-3 through Figure-5. From Figure-3, the desired RCS pressure/temperature conditions are not met for this simulation; however, for this break size and assumed conditions, the RCS refills sufficiently (Figure-4) such that natural circulation flow is re-established (Figure-5).

In summary, the cooldown capability of BVPS-1 and 2, in terms of primary temperature, is not limited by the SG ARVs as the desired RCS temperatures can be achieved approximately 2.5 hours after cooldown initiation. However, in order to achieve the desired RCS pressure conditions of 120 psia, another form of primary pressure reduction is required. This is most easily achieved by utilizing the Pressurizer PORVs.

No specific time is included in the Emergency Operating Procedures (EOPs) at which the RCS cooldown and depressurization steps must commence. However, the operators are trained to step through the EOPs in a timely and accurate manner. The analysis documented herein consistently assumes that this process starts one hour into the transient. Note that via extensive use of the BVPS-1 and 2 plant simulators for various size Small Break Loss of Coolant Accident (SBLOCA) events, the operations staff typically commences this activity within ½ hour following the start of the event, and therefore revising the EOPs is not deemed necessary.

Table 1 BVPS EPU - Long Term Cooling Post-LOCA Boric Acid Control Strategy

BREAK SIZE	SCENARIO	ANALYSIS
1.0 ft^2 0.8 ft^2 0.6 ft^2 8.0 in. 6.0 in.	Large or Intermediate Breaks: Breaks of this size will depressurize to RHR cut-in pressure without operator action.	Large Break Mixing Volume Analysis and Large Break Boric Acid Analysis
4.0 in. 2.0 in. 1.8 in. 1.5 in.	Small Breaks: For breaks of this size, operators will take action to depressurize RCS to LHSI cut-in pressure before boric acid atmospheric solubility limit is reached.	Small Break Boric Acid Analysis and Depressurization/ Cooldown Analysis
1.4 in. 1.3 in. 1.2 in. 1.1 in.	Very Small Breaks: Natural circulation is lost but regained before boric acid atmospheric solubility limit is reached.	Small Break Depressurization Analysis - Natural circulation will keep the core diluted.
1.0 in. 0.9 in. 0.8 in. 0.7 in. 0.6 in. 0.5 in.	Very Small Breaks: Natural circulation is not lost.	
0.375 in. - Charging Flow Makeup Capacity		

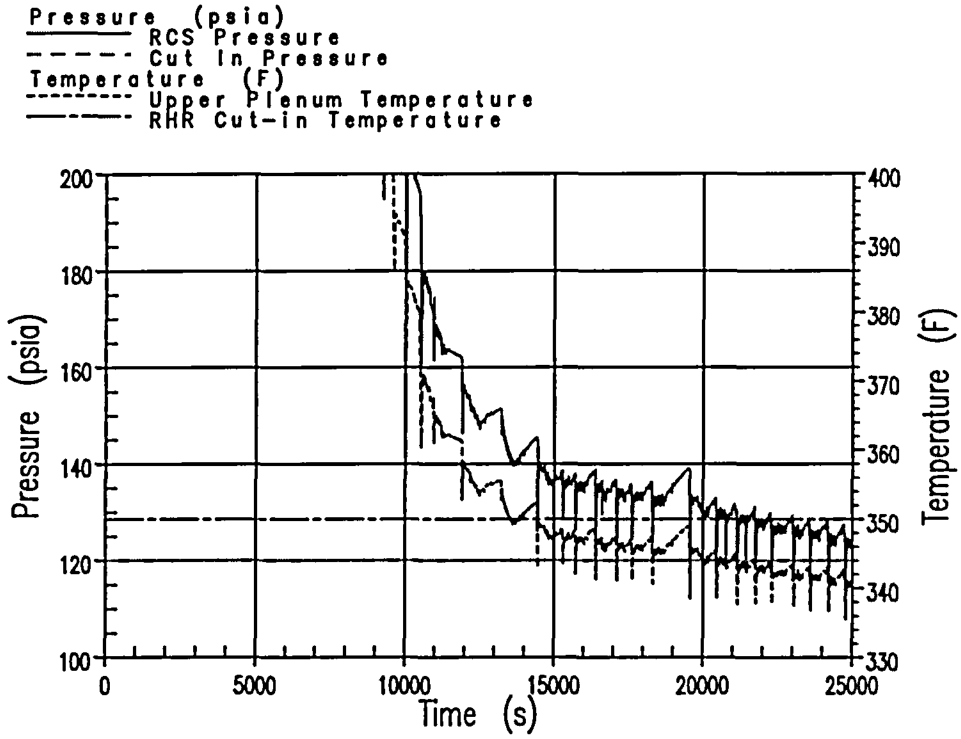

Figure-1 BVPS-2 1.5-Inch Break, RCS Pressure/Temperature Response, ARVs Only

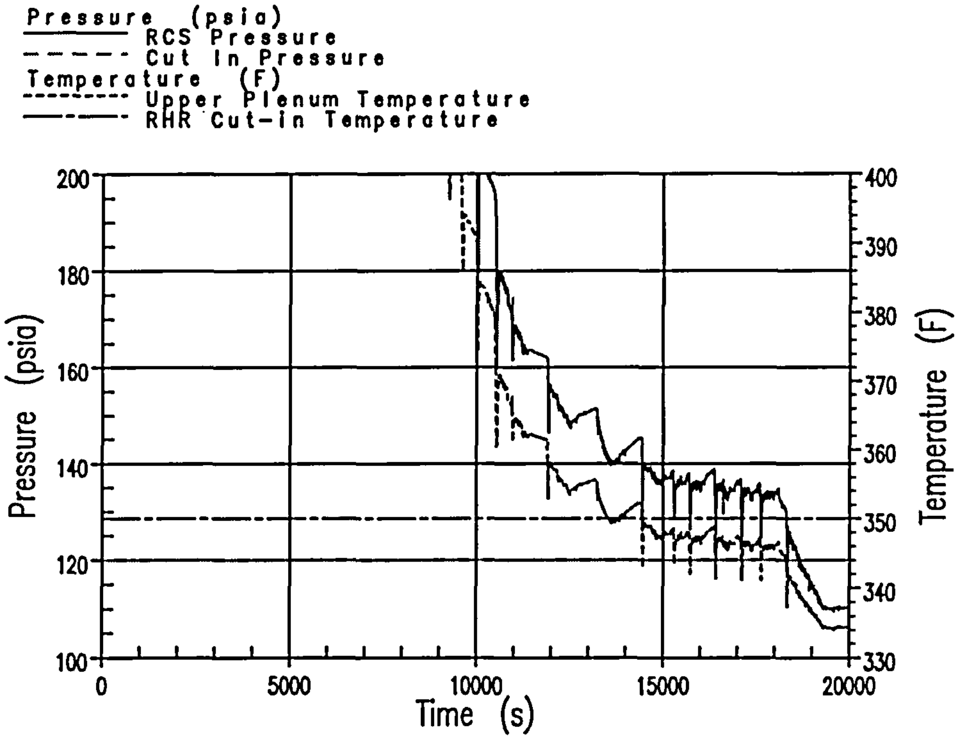

Figure-2 BVPS-2 1.5-Inch Break, RCS Pressure/Temperature Response, ARVs + Pressurizer PORVs (Open at 18100 seconds)

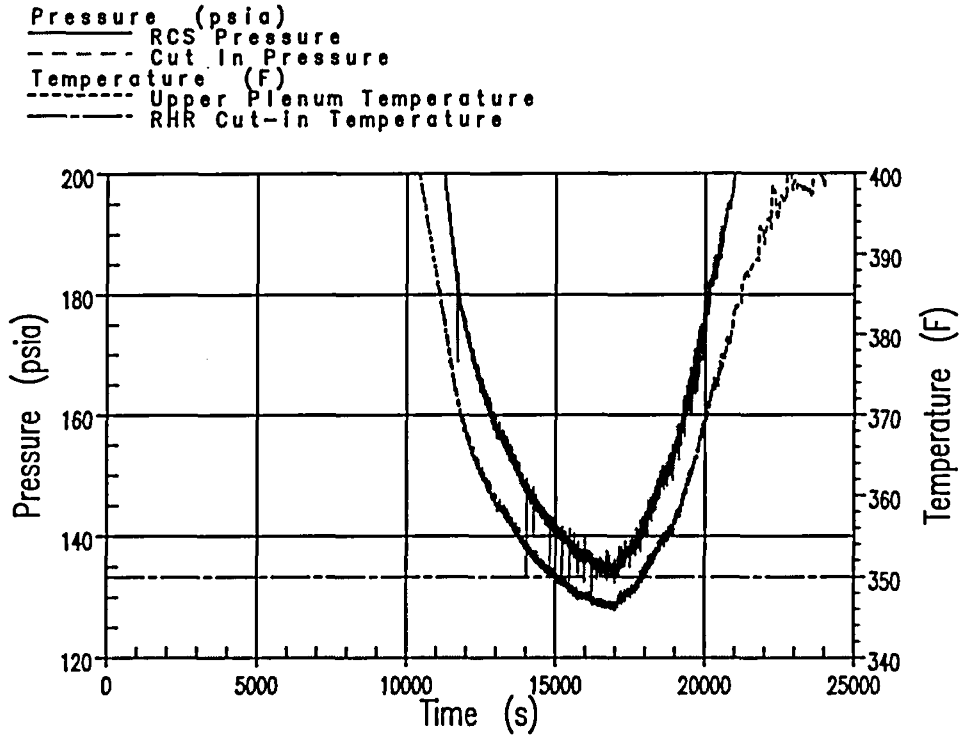

Figure-3 BVPS-2 1.1-Inch Break, RCS Pressure/Temperature Response, ARVs Only

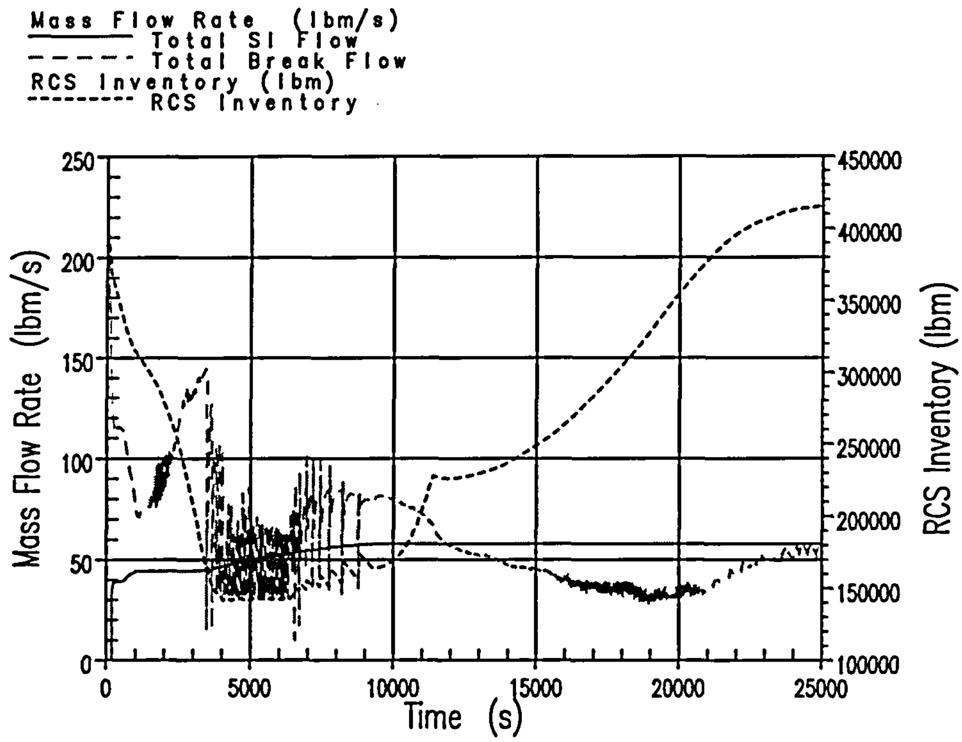

Figure-4 BVPS-2 1.1-Inch Break, Break Flow and Total ECCS Flow/Total RCS Mass

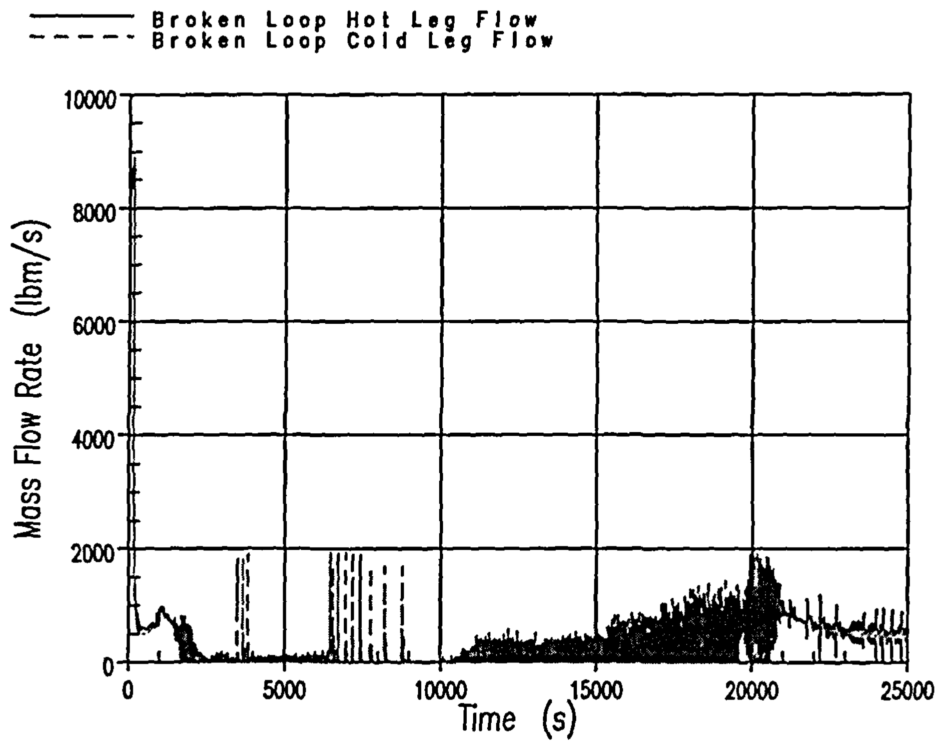

Figure-5 **BVPS-2 1.1-Inch Break, Broken Loop Hot/Cold Leg Flows**

References:

1. FENOC Letter L-05-112, "Beaver Valley Power Station, Units Nos. 1 and 2, BV-1 Docket No. 50-334, License No. DPR-66 BV-2 Docket No. 50-412, License No. DPR-73 Responses to a Request for Additional Information in Support of License Amendment Request Nos. 302 and 173," dated 7/8/05.

2. FENOC Letter L-05-169, "Beaver Valley Power Station, Units 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 (RAI dated Sept. 30, 2005) in Support of License Amendment Request Nos. 302 and 173," dated 11/21/05.