FENOC
FirstEnergy Nuclear Operating Company

Beaver Valley Power Station
P.O. Box 4
Shippingport, PA 15077

Peter P. Sena III
Site Vice President

724-682-5234
Fax: 724-643-8069

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L-08-350

10 CFR 50.90

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
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
Response to Request for Supplemental Information Regarding Containment Spray Additive System License Amendment Request (TAC Nos. MD9734 and MD9735)

By letter dated October 24, 2008, the NRC requested that supplemental information be provided to support their review of the subject license amendment request dated September 24, 2008 (L-08-236) for Beaver Valley Power Station, Unit No. 2. The attachment to this submittal contains the requested information.

There are no regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-761-6071.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 10, 2008.

Sincerely,

Peter P. Sena III

Attachment: Supplemental Information Needed for the Spray Additive System Amendment Request

A001
NRR

cc: NRC Region I Administrator
NRC Senior Resident Inspector
NRR Project Manager
Director BRP/DEP
Nuclear Safety Specialist (BRP/DEP)

SUPPLEMENTAL INFORMATION NEEDED FOR THE SPRAY ADDITIVE SYSTEM AMENDMENT REQUEST FIRSTENERGY NUCLEAR OPERATING COMPANY FIRSTENERGY NUCLEAR GENERATION CORP. BEAVER VALLEY POWER STATION, UNIT NOS. 1 AND 2 DOCKET NOS. 50-334 AND 50-412

The following supplemental information is provided in response to a letter dated October 24, 2008, in which the NRC requested supplemental information to support the review of license amendment request dated September 24, 2008 (L-08-236). Information requested by the NRC is denoted by bold text and is followed by the FENOC response.

1. **To provide the NRC staff with reasonable assurance that changing the buffer from sodium hydroxide (NaOH) to sodium tetraborate (STB) will reduce the amounts of Generic Safety Issue-191 chemical precipitates, the NRC staff requires more information. Show that changing the buffer from NaOH to STB will result in reduced chemical effects, and provide the calculated quantity of chemical precipitates, by species, before and after the proposed change. Use "NRC STAFF REVIEW CONSIDERATIONS FOR BUFFER CHANGES," (Agencywide Documents and Access Management System (ADAMS) Accession No. ML0712803501) as guidance.**

   FENOC Response:

   Table 1 provides the calculated quantities of chemical precipitates with the current sodium hydroxide buffer and the precipitates with the proposed change to sodium tetraborate. The quantities were calculated for a reactor coolant system loop cross-over leg break and a reactor vessel nozzle break using the WCAP-16530-NP, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191" spreadsheet model.

Table 1
Calculated Chemical Precipitate Quantities

BREAK	BUFFER	$NaAlSi_3O_8$ kg	AlOOH kg
LOOP	Sodium Hydroxide	320.9	0
LOOP	Sodium Tetraborate	115.3	0
NOZZLE	Sodium Hydroxide	86.1	52.5
NOZZLE	Sodium Tetraborate	83.8	6.2

The values in Table 1 are based on the current BVPS-2 post-LOCA debris load. As discussed in FENOC Letter L-08-257, "Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors" - Request for Extension of Completion Date for Corrective Actions (TAC Nos. MC4665 and MC4666)," dated August 28, 2008, some insulation modifications will be required during the next scheduled refueling outage (2R14, fall 2009) which will reduce the current debris load.

2. **To provide the NRC staff with reasonable assurance that the sump pH will remain greater than 7 over the period of 30 days post-loss-of-coolant accident (LOCA), the licensee is requested to provide the information below: (Refer to Calvert Cliff's license amendment request for examples of calculations, ADAMS Accession No. ML082480671)**

   i. **Provide time dependant values of strong acid concentrations in the sump for a period of 30 days post-LOCA.**

   FENOC Response:

   The strong acids of concern are hydrochloric acid resulting from cable degradation in high radiation fields, and nitric acid generated due to radiolysis of the containment sump water. The maximum quantity of these acids generated during the 30-day duration post-LOCA was calculated to be 3946.5 gm-moles. This quantity was based on the 30-day integrated dose values from a LOCA with conservative volumes of cable insulation and sump water. A time-dependant analysis at other times was not performed. A 10% margin on the acid production was utilized in the analysis. The calculated minimum sump water pH and the associated required mass of sodium tetraborate decahydrate (NaTB) incorporate the 30-day acid production. The calculated minimum pH at initiation of the recirculation mode assumes no acid production prior to that point in time.

   ii. **Describe the analysis methodology used to determine the pH in the sump water during a period of 30 days post-LOCA. Include detailed calculations of time dependant pH values in the sump during a 30-day period post-LOCA to demonstrate that the pH remains greater than 7 throughout this time period.**

   FENOC Response:

   As indicated in Table 2, the equilibrium sump pH was determined at three (3) time intervals post-LOCA:

Table 2
pH, Water Volumes, and Boron Concentrations

Event	pH	Source	Volume (liters)	Concentration (ppm)	Concentration (gm-moles/liter)	Vol. x Conc. (gm-moles)
Start of Recirculation* (no acid contribution)	7.47	RWST**	1182847	2600	0.240518	284496
		RCS***	189356	2400	0.222017	42040
		Accumulators	91067	2600	0.240518	21903
End of Quench Spray (no acid contribution)	7.07	RWST	3280051	2600	0.240518	788911
		RCS	189356	2400	0.222017	42040
		Accumulators	91067	2600	0.240518	21903
End of 30 Days (full acid contribution)	7.00	RWST	3280051	2600	0.240518	788911
		RCS	189356	2400	0.222017	42040
		Accumulators	91067	2600	0.240518	21903

* Mass of water in the reactor vessel included in pH analysis
** Refueling Water Storage Tank
*** Reactor Coolant System

The licensing amendment request addresses the use of sodium tetraborate decahydrate (NaTB) stored in six wire mesh baskets located on the containment floor as the post-LOCA buffering agent. Following the initiation of quench spray, boric acid solution from the refueling water storage tank with a pH of 4.6 (minimum pH) is sprayed into containment. As a result of this change, the BVPS-2 quench spray would consist only of a boric acid solution with a spray pH as low as 4.6. As indicated in Standard Review Plan (SRP), Section 6.5.2, Revision 2, "Containment Spray as a Fission Product Cleanup System," fresh sprays (sprays with no dissolved iodine) are effective at scrubbing elemental iodine and thus a spray additive is unnecessary during the initial injection phase when the spray solution is being drawn from the refueling water storage tank. As described in the SRP, research has shown that elemental iodine can be scrubbed from the atmosphere with borated water, even at low pH. In accordance with the current licensing basis, the dose analysis need not address iodine re-evolution if sump water pH of 7 or greater is achieved well within 16 hours after the LOCA and is maintained for the duration of the accident. The 16-hour period is based on NUREG/CR 5732, "Iodine Chemical Forms in LWR Severe Accidents – Final Report," April 1992.

The NaTB modification conforms to these aspects of the current licensing basis.

As this water collects on the containment floor, the borated water dissolves the NaTB. Mixing is achieved as the solution is continuously recirculated by the emergency core cooling system (ECCS) and the recirculation spray system (RSS) pumps following the recirculation actuation signal. This provides for continued iodine retention effectiveness of the sump water and minimizes the occurrence of chloride and caustic induced stress corrosion cracking of systems and components exposed to the fluid.

The raw titration data sets for NaTB/boric acid systems and NaOH/boric acid systems presented in WCAP-16596-NP, Revision 0, July 2006, "Evaluation of Alternative Emergency Core Cooling System Buffering Agents," were analyzed, and a correlation relating total boron concentration to free base was developed for solution pHs. As the specification for NaTB indicated that the NaTB equivalence had a range of 99% to 105%, it was conservatively assumed that the NaTB/boric acid titrations were performed with 105% NaTB while the mass of NaTB required to maintain the sump pH ≥ 7.0 was calculated under the assumption that the NaTB equivalence was 99%. Parametric variation of the NaTB equivalency in the titration data indicated that the best fit to the data was with the 99% to 100% equivalency assumption.

In determining the mass (and volume) of NaTB required to be stored in the baskets, the maximum borated water source volumes and concentrations provided in Table 2 were used as well as the 30-day acid production plus margin. The conservatively calculated minimum NaTB weight was approximately 13,980 lbs. (with a corresponding volume of 292 ft^3 at a minimum density of 48 lbs/ft^3) to maintain the minimum pH ≥ 7.0.

Also of concern was the maximum long-term pH if the minimum borated water source volumes and concentrations and maximum effective NaTB (105%) were used. Table 3 below provides the minimum volume and concentration of borated sources.

Table 3
Minimum Volume and Concentration of Borated Sources

Source	Volume (liters)	Concentration (ppm)
RWST	3,252,254	2400
RCS	189,356	0
Accumulators	78,325	2300

In evaluating the ability of NaTB to rapidly dissolve and to achieve pHs ≥ 7.0 in time to avoid iodine re-evolution due to peroxide formation from radiolysis, WCAP-16596-NP compares the dissolution times of NaTB to tri-sodium phosphate (TSP), which has already been licensed for use in this application at other facilities, and reports that the NaTB has a dissolving rate per gram that is higher than TSP and that NaTB is more effective in raising solution pH in boric acid solutions (at pHs < 7.5) per gram than TSP.

Assuming that all the NaTB (105%) is dissolved at the start of ECCS recirculation and the baskets are filled to capacity with full densification, the maximum pH for the minimum borated source case is 8.27 with no acid addition.

iii. If a computer program was used, describe the code and provide the input and output data of the program.

FENOC Response:

No computer code was used to develop the pH and NaTB masses discussed above.