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Timothy G. Mitchell
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2CAN020802

February 19, 2008

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: License Amendment Request
Replacement of Containment Sump Buffer
Request for Additional Information
Arkansas Nuclear One – Unit 2
Docket No. 50-368
License No. NPF-6

Dear Sir or Madam:

By letter dated October 5, 2007 (2CAN100703), Entergy submitted a license amendment request to replace the containment buffer at Arkansas Nuclear One, Unit 2. By letter dated December 13, 2007 (2CNA120702), the NRC issued a request for additional information (RAI) requesting the information within 30 days. On February 5, 2007, a conversation was held with the NRR project manager requesting additional time to finalize calculations necessary to support the additional information requested. The response to the RAI is provided in the attachment to this submittal.

There are no new commitments contained in this submittal. If you need any additional information, please contact Natalie Mosher at 479-858-4635.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 19, 2008.

Sincerely,

B. Berryman for T. Mitchell
B. Berryman
TGM/nbm

Attachment

A001
NRR

cc: Mr. Elmo E. Collins
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

NRC Senior Resident Inspector
Arkansas Nuclear One
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U. S. Nuclear Regulatory Commission
Attn: Mr. Alan B. Wang
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Washington, DC 20555-0001

Mr. Bernard R. Bevill
Director Division of Radiation
Control and Emergency Management
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P.O. Box 1437
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Attachment to

2CAN020802

Request for Additional Information
Related to Replacement of Containment Sump Buffer

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Related to Replacement of Containment Sump Buffer

To minimize the conversion of ionic iodine to elemental iodine in the sump, the pH of the sump water should be maintained above a pH of 7 for a period of 30 days after a loss-of-coolant accident (LOCA). During this period, strong acids (hydrochloric and nitric acid) are being generated. Hydrochloric acid is formed from the decomposition of cable insulation, and nitric acid is formed from the irradiation of the environment existing in containment. If the pH of the sump water is not controlled, the pH value may drop below 7. To maintain a pH above the value of 7, a buffer should be added to the sump water.

1. **To demonstrate that the pH in the sump remains >7 over the period of 30 days post-LOCA, the licensee is requested to provide the following information:**

   - **Identify all sources of post-LOCA strong acid generation in containment and time-dependant values of strong acid concentrations in the sump for a period of 30 days post-LOCA.**

     The two sources of strong acid generation are the chloride-bearing cable jacketing exposed to the containment atmosphere and the irradiation of the sump water. In calculating the amount of cable in containment, scheduled cables were included whether in a tray, conduit, embed, or other enclosure. This is considered conservative due to the shielding effect of the enclosures. Also, the weight of chloride-bearing cable jacketing was assumed to be equal to the weight of the non-conducting cable material. This is conservative since it includes the insulating material which is not exposed due to being covered by the cable jacketing. Therefore, the weight of cable jacketing exposed to the containment atmosphere is considered conservative. The cable jacketing amount of 44,704 pounds could generate 3473.6 moles of hydrochloric acid, and the irradiation of the sump water could generate 147.1 moles of nitric acid for a total of 3620.7 moles of acid generated.

   - **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 basic throughout this time period.**

     The analysis was performed using a spreadsheet and the ANO sump level calculation (Calculation 90-E-0100-04) to determine the sump pH transient post-LOCA associated with the determined amount of sodium tetraborate (NaTB) dissolved during a specified time interval. The methodology consisted of the following:

     - The minimum amount of NaTB required to reach a pH of 7.0 was determined. The maximum mass of NaTB was assumed to be the maximum possible amount that the existing sump buffer baskets could hold using a maximum density of 56 lb/ft^3.

     - The conditions to minimize and maximize the sump pH transients were determined. In order to minimize the sump pH transient, maximum water volumes for the refueling water tank (RWT), boric acid make-up (BAM) tank, and the safety injection tanks (SITs) at the maximum boron concentrations were utilized. The minimum RWT and reactor coolant system (RCS) contributing sump volumes and the minimum boron concentration were used to maximize the sump pH transient.

- The volumes of water released into the sump at the specified times for the minimum sump pH were determined using the RWT and BAM flow rates and assuming the SITs were instantaneously released into the sump post-LOCA. The same method was used to determine the minimum water volumes versus time for the maximum sump pH case using the RWT flow rate and assuming the RCS inventory was promptly released into the sump solution. The sump height versus time was generated, and then the sump height was translated into an average area of basket submerged and the amount of NaTB dissolved during each time interval.

- Finally, the minimum and maximum sump pH transients were generated using the NaTB concentration as a function of time. The final sump boron concentration was used to determine the corresponding pH.

Minimum sump pH conditions
The minimum sump pH transient was determined using a combination of minimum NaTB mass, maximum mass of the RWT (503,300 gal at 3000ppm), BAM (23,400 gal at 6125 ppm), and SIT (47,875 gal at 3000 ppm) water sources for dilution of the NaTB. This results in a maximum sump boron concentration of 3248 ppm and a total sump mass of 4,643,899 lbs.

Sump water mass and sump water height for minimum sump pH
The amount of water released into the sump at the specified time for the RWT and BAM was determined by multiplying the flow rate by the time interval. The contents of the RWT were gradually added to the containment sump via the containment spray system and safety injection system (high-pressure safety injection and low-pressure safety injection).

The contents of the SITs were assumed to promptly release into the containment at time zero. These calculated volumes were then used to determine a corresponding sump mass, volume, height, and equivalent sump level.

Dissolution rate and dissolved NaTB mass for minimum sump pH
The average rate of dissolution for the three baskets was calculated by multiplying the averaged submerged basket area by the NaTB dissolution rate of 1.014 lb/ft^2-min for the specified time interval. The area of the submerged basket was determined by multiplying the calculated height of basket submerged by the number of sides exposed to the sump solution and by the length of the basket. The bottom of the basket is 0.42 ft from the containment floor and was accounted for in the submerged basket height. The total basket height is 4.5 ft; therefore, once the calculated sump water level reached 4.92 ft, the baskets were completely submerged. The average dissolution rate was then used to calculate a summed mass amount of NaTB dissolved for each time interval.

NaTB concentration and boron solution concentration for minimum sump pH
The dissolved mass of NaTB and the calculated sump volume at each time interval was used to generate the NaTB concentration transient. The minimum sump water mass was used to determine the maximum sump boron concentration. This accounted for the hold-up volumes of the wetted surfaces and the vapor and the containment system spray droplets suspended from the sump solution. This was the most conservative case since it maximized the sump boron concentration.

Determination of required NaTB amount to achieve pH > 7.0

For the minimum required amount of NaTB of 15,000 lbs the calculation yields an equilibrium pH of 7.104 (see Table 1 below). The calculation was performed for a sufficient amount of time to allow for the dissolution of the NaTB resulting in an equilibrium state. The 15,000 lbs of NaTB at a density of 48.7 lb/ft^3 corresponds to a volume of 308 ft^3 as specified in the ANO-2 Technical Specifications (TS). The basket minimal fill level (administrative limit) of 4.1 ft corresponds to a NaTB volume of 443 ft^3 (21,561 lbs at a density of 48.7 lb/ft^3). The basket minimal fill level is currently administratively controlled in a site procedure which will be revised to accommodate the NaTB. The completely dissolved 21,561 lbs of NaTB yields a sump solution pH of 7.285 at around 75 minutes.

Table 1
Sump pH for ANO-2 TS
(15,000 lbs NaTB)

Time (min.)	Minimum Sump pH
60	7.116
125	7.114
192	7.112
217	7.111
242	7.110
767	7.104
7167	7.104
14333	7.104
29167	7.104
43200	7.104

Effects of Acid Generation

As stated in the first bullet, a total of 3620.7 moles of acid could be generated post-LOCA. It was assumed that one mole of NaTB would neutralize one mole of acid generated, thus consuming 3044 lbs of NaTB by neutralization after acid generation.

The effect on sump pH from acid generation was obtained by applying the total 30-day quantity of acids generated to the total NaTB which was dissolved into the sump solution. The minimum amount of NaTB after acid generation was calculated to be 18517 lbs (21561 lbs – 3044 lbs) resulting in a final pH of 7.202 for the administrative basket minimal fill level. In addition, the pH remains above 7.0 as shown in Table 2 below for the ANO-2 TS limit with acid generation.

Table 2
Sump pH for ANO-2 TS with Acid Generation
(15,000 lbs – 3044 lbs = 11,956 lbs NaTB)

Time (min.)	Minimum Sump pH
60	7.012
125	7.010
192	7.008
217	7.007
242	7.006
767	7.000
7167	7.000
14333	7.000
29167	7.000
43200	7.000

Accounting for strong acid generation in the sump pH calculation is a revision to the ANO licensing basis. The minimum margin available to a steady state pH value of 7 is offset by the conservative assumption of cable material assumed exposed to the containment environment. Additionally, Entergy will continue to administratively control the amount of NaTB in containment to a higher value than required by ANO-2 TS ensuring a steady state pH of > 7.

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

  No computer codes were utilized.