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INDIANA MICHIGAN POWER

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
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Donald C. Cook Nuclear Plant Units 1
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
TECHNICAL SPECIFICATION CHANGE REQUEST
SPRAY ADDITIVE TANK MAXIMUM VOLUME AND SODIUM HYDROXIDE CONCENTRATION
(TAC NO. MB0908)

References:
1) Letter from R. P. Powers (I&M) to U.S. Nuclear Regulatory Commission (NRC) Document Control Desk, "Technical Specification Change Request. Spray Additive Tank Maximum Volume and Sodium Hydroxide Concentration," submittal C0101-05, dated January 2, 2001.

2) Letter from U.S. NRC, to R. P. Powers "Request for Additional Information, 'Technical Specification Change Request. Spray Additive Tank Maximum Volume and Sodium Hydroxide Concentration,' (TAC No. MB0908)," dated February 7, 2001.

In Reference 1, Indiana Michigan Power Company (I&M), the Licensee for Donald C. Cook Nuclear Plant Unit 1, proposed to amend Appendix A, Technical Specifications (T/S), of Facility Operating License DPR-58. I&M proposed to change the limiting condition for operation (LCO) of T/S 3/4.6.2.2.a, "Spray Additive System," to specify a maximum allowed contained volume and sodium hydroxide (NaOH) concentration for the spray additive tank. In Reference 2, the Nuclear Regulatory Commission requested additional information related to the proposed license amendment. The requested information is provided in

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Attachment 1 to this letter. Attachment 2 identifies new commitments made in this letter.

I&M has determined that the evaluation of significant hazards considerations for the proposed license amendment, documented in Attachment 4 to Reference 1, is not affected by the information provided in this letter.

Should you have any questions, please contact Mr. Ronald W. Gaston, Manager of Regulatory Affairs, at (616) 697-5020.

Sincerely,

M. W. Rencheck
Vice President Nuclear Engineering

Attachments

\dmb

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ATTACHMENT 1 TO C0301-06

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Indiana Michigan Power Company (I&M), the Licensee for Donald C. Cook Nuclear Plant (CNP) Unit 1, provides the following information in response to Nuclear Regulatory Commission (NRC) letter, "Request for Additional Information, 'Technical Specification Change Request Spray Additive Tank Maximum Volume and Sodium Hydroxide Concentration,' (TAC No. MB0908)," dated February 7, 2001.

NRC Question 1

"The submittal provided a statement that you determined the maximum allowed contained volume and sodium hydroxide concentration for the spray additive tank to support a bounding calculation of the maximum pH value for the containment spray solution and for the water contained in the containment recirculation sump under postulated accident conditions. You indicated that the analyses performed using the proposed Unit 1 maximum volume and sodium hydroxide concentrations verified that the acceptance criteria were satisfied for loss-of-coolant-accident (LOCA) events. However, the analyses were not provided for review, nor was a description of how the conclusion was reached.

In order to begin our review, Nuclear Regulatory Commission (NRC) staff requests that you describe in detail and justify the analyses performed, the assumptions made in the analyses, and the results of the analyses."

I&M Response

The proposed license amendment adds upper limits to the Unit 1 Technical Specifications (T/S) for the contained volume and for the sodium hydroxide (NaOH) concentration in the spray additive tank (SAT). The upper limits that are specified in the proposed amendment are the values used in a bounding analysis that determined pH values for containment spray during the injection and recirculation phases of an accident. In this analysis, the pH of the containment spray and containment recirculation sump water were determined from the volume and chemical properties of the constituent water sources for those accident scenarios in which the containment spray system (CTS) actuates. The analysis considered the times and events in the accident sequence at which there can be significant changes in the parameters affecting the containment spray pH. The analysis also considered various postulated failure scenarios that could occur during the accident sequence. Where a range of values exists for a given parameter, the value used was that which provided the most conservative results for the specific condition or scenario under consideration. Consistent with discussions held with members of the NRC staff, I&M has provided the requested additional detail in a summary of the analysis. This summary is provided below.

The accidents analyzed were a large break LOCA, a main steam line break (MSLB), and a small break LOCA because these are the accidents that result in CTS operation. Six different events in the accident sequence were considered in the analysis: start of the injection phase, end of injection phase, start of recirculation phase, SAT isolation, three hours after start of the recirculation phase, and completion of ice melting in the ice condenser. These conditions were chosen because they constitute points in the accident sequence at which there can be significant changes in the parameters that affect the pH of the containment spray. The analysis considered eight different single failure scenarios that were considered to be credible during the postulated sequence of events.

The pH of the containment spray and containment recirculation sump water were determined from the quantity and chemical properties of the constituent water sources. For the LOCA cases, these sources are the reactor coolant system (RCS), the accumulators, the refueling water storage tank (RWST) via the emergency core cooling system and CTS, the SAT via the CTS, and the ice melt from the ice condenser. The delivered water volumes assumed in the analysis were 314,000 to 385,400 gallons from the RWST, 27,556 to 29,051 gallons from the four accumulators, 78,523 to 97,576 gallons from the RCS, and 871 to 3637 gallons from the SAT. The SAT deliverable volumes were calculated from initial SAT contained volumes of 4000 and 4600 gallons as specified in the existing Unit 2 T/S and the proposed Unit 1 T/S. The calculation accounts for automatic and manual SAT isolation in determining the deliverable volumes. For the MSLB cases, the mass of water released from the secondary system, 152,000 lbs., is used in lieu of the RCS and accumulator volumes.

The chemicals and concentration values used in the analyses were: the boric acid in the RWST and accumulators (2400 to 2600 ppm boron, consistent with existing T/S 3.5.1 and 3.5.5 limits), the boric acid in the RCS (0 to 2600 ppm boron, based on bounding credible operating conditions), the NaOH in the SAT (30 to 34 weight-percent, consistent with the existing Unit 2 T/S 3.6.2.2 limits and proposed Unit 1 T/S 3.6.2.2 limits) and the sodium tetraborate in the ice condenser ice. The sodium tetraborate is a chemical buffer with a nominal pH of 9.3. Since the sodium tetraborate is beneficial in achieving the desired recirculation sump pH of 7.6 to 9.5 in both minimum and maximum pH analyses, all pH analysis cases use a value of 2.2 million pounds for the ice mass, which is less than that allowed by T/S 3.6.5.1 requirements, the minimum concentration of 1800 ppm boron allowed by T/S 3.6.5.1, and the minimum ice melt rates calculated by the CNP recirculation sump inventory analyses.

The minimum and maximum spray additive flow rates were determined in a separate calculation at the four conditions that define the flow from the SAT: start of injection phase, end of injection phase, start of the recirculation phase, and SAT isolation. Assuming theoretical maximum performance of the eductors during the LOCA and MSLB, the spray additive flow rates were calculated to range from 23 to 64 gpm. Supplemental calculations were performed demonstrating that the minimum pH requirements remain satisfied with the eductor performance

degraded 25% from the ideal performance. This eductor performance corresponds to the minimum flow rate specified by the Bases for T/S 3/4.6.2.2.2 surveillance requirements.

In the maximum pH cases, the maximum NaOH concentration in the SAT and the maximum spray additive flow rates were assumed. The maximum pH cases also assumed the minimum boric acid concentrations and volumes in the RWST, accumulators, and RCS. Similarly, the minimum pH cases use minimum spray additive concentration and flow rates with maximum boric acid concentrations and volumes.

As detailed below, the pH values determined by the analyses support the existing post LOCA hydrogen evaluation, the post-LOCA radiological dose calculations, the T/S Bases concerning the post-LOCA evolution of iodine and chloride and caustic stress corrosion, and component environmental qualification requirements. The pH analyses determined that:

- The current post-LOCA hydrogen generation evaluation remains valid. With one exception, the containment spray pH profile used in the hydrogen generation evaluation is greater than the calculated maximum post-LOCA containment spray pH profile. The one exception is that a maximum spray pH of 12.9 may occur during a large break or small break LOCA if the recirculation phase starts before the SAT is isolated. However, the period during which the spray pH is 12.9 is expected to be no more than 4 minutes, since isolation of the SAT in the recirculation phase is procedurally required, operators are trained to perform this isolation within 4 minutes of CTS pump restart, and their ability to do so has been validated on the CNP simulator in accordance with approved validation procedures. In comparison, the hydrogen generation evaluation assumes that a maximum spray pH of 12.6 exists for 83 minutes. Therefore, there is a four-minute interval in which the pH analysis peak value exceeds the hydrogen generation input value. However, the hydrogen evaluation input value of 12.6 greatly exceeds the pH analysis result (a pH of 10 or less) for 79 minutes. Therefore, the effect on hydrogen generation of a pH profile of 12.6 for 83 minutes bounds the effect of the calculated pH profile of 12.9 for four minutes and 10 or less for 79 minutes.

- In the LOCA cases, the pH of the recirculation sump after the start of the recirculation phase will be greater than or equal to 7.0. This satisfies the pH requirement imposed by post-LOCA radiological dose calculations.

- In the LOCA cases, the pH of the recirculation sump will be 7.6 to 9.5 three hours after the start of the recirculation phase and thereafter. This satisfies the Bases for T/S 3/4.1.2, "Boration Systems," and 3/4.5.5, " Refueling Water Storage Tank." This pH band minimizes the evolution of iodine and minimizes the effect of chloride and caustic stress corrosion on mechanical systems and components.

- The pH ranges and durations determined by the containment spray and recirculation sump pH analyses fall within the values used for evaluating the environmental qualification of class IE

equipment inside containment that are required for mitigating the consequences of an accident. Additional detail is provided in the response to Question 6.

NRC Question 2

"Your Updated Final Safety Analysis Report (UFSAR), Section 6.3.1, 'Design Bases - Containment Heat Removal Systems,' states the following:

'(Unit 1 only)

The Containment Spray System is designed to deliver sufficient sodium hydroxide solution which, when mixed with water from the Refueling Water Storage Tank (RWST) which contains approximately 1.5% by weight boric acid (2000 ppm Boron), reactor coolant system water and the melted ice, gives a final spray water pH of approximately 9.3 after the spray additive sodium hydroxide (NaOH) tank is emptied.'

Does your bounding calculation assume 2,000 ppm of boron as stated in the UFSAR or does it use between 2,400 ppm and 2,600 ppm as stated in Technical Specification 3/4.5.5.b? Explain the discrepancy between the UFSAR and the Technical Specification? What is the range of pH in the injection mode using your bounding calculation? Justify your results."

I&M Response

The bounding calculation assumes 2,400 ppm to 2,600 ppm as stated in T/S 3/4.5.5.b. The 2,000 ppm value noted above was outdated. This was identified in March 2000, and a change to Section 6.3.1 of the UFSAR has been approved to provide a single description for both Unit 1 and Unit 2. The description reads as follows:

> "The Containment Spray System is designed to deliver sufficient sodium hydroxide solution which, when mixed with water from the Refueling Water Storage Tank which contains approximately 1.5% by weight boric acid (2400 to 2600 ppm Boron), accumulator water, reactor coolant system water and the melted ice, results in the solution recirculated within containment after a LOCA having a pH in the range of 7.6 to 9.5. The performance of the Containment Spray System for iodine removal with a single Containment Spray Pump operating adequately fulfills the requirement of 10 CFR 100 as described in Chapter 14."

This change is to be included in the next UFSAR update transmitted to the NRC pursuant to 10 CFR 50.71(e)(4).

The bounding calculation determined that the containment spray generally has a pH in the range of 7.0 to 10.0 during both injection and recirculation modes. In some MSLB minimum pH cases, the containment spray pH will decrease below 7.0 to a minimum value of 4.5 because the SAT is

isolated before the switchover from injection to recirculation resulting in a containment spray of pure RWST water. In these cases, the spray pH returns to the range of 7.0 to 10.0 when the switchover to recirculation is completed. During recirculation, the containment spray pH may briefly be as high as 12.9 immediately after the switchover to recirculation. In these cases, the spray pH returns to the range of 7.0 to 10.0 when the control room operators manually isolate the SAT. However, the period during which the spray pH is 12.9 is expected to be no more than 4 minutes, since isolation of the SAT in the recirculation phase is procedurally required, operators are trained to perform this isolation within 4 minutes of CTS pump restart, and their ability to do so has been validated.

NRC Question 3

"Your Updated Final Safety Analysis Report (UFSAR), Section 6.3.1, 'Design Bases - Containment Heat Removal Systems,' states the following:

'(Unit 1 only)

The Containment Spray System is designed to deliver sufficient sodium hydroxide solution which, when mixed with water from the Refueling Water Storage Tank (RWST) which contains approximately 1.5% by weight boric acid (2000 ppm Boron), reactor coolant system water and the melted ice, gives a final spray water pH of approximately 9.3 after the spray additive sodium hydroxide (NaOH) tank is emptied.'

'(Unit 2 only)

The Containment Spray System is designed to deliver sufficient sodium hydroxide solution which, when mixed with water from the Refueling Water Storage Tank (RWST) which contains approximately 1.5% by weight boric acid (2400 to 2600 ppm Boron), accumulator water, reactor coolant system water and the melted ice, results in the solution recirculated within containment after a LOCA having a pH in the range of 7.6 to 9.5.'

According to the UFSAR, the Unit 1 analysis does not take into account the accumulator water and the Unit 2 analysis does. Does your bounding calculation for Unit 1 take the accumulator water into account? If not, justify."

I&M Response

As described in the response to Question 2, a change to Section 6.3.1 of the UFSAR has been approved to provide a single description for both Units 1 and 2. Consistent with that description, the bounding calculation accounts for the water in the accumulators.

NRC Question 4

"In your submittal, you stated that 'to facilitate the pH analyses of the LOCA events, the calculations performed assumed the Unit 2 maximum values that are now proposed for Unit 1.'

Unit 2 UFSAR Section 6.3.2, 'System Design - System Description - Spray Additive Tank,' states the following: 'The tank contains sufficient sodium hydroxide solution to ensure that, when mixed with the refueling water, accumulator water, reactor coolant and melted ice in the containment sump, the solution recirculated within containment after a LOCA has a pH between 7.6 and 9.5.'

Unit 2 Technical Specification (TS) Bases 3/4.6.2.2, 'Spray Additive System,' states the following: 'The limits on NaOH volume and concentration ensure a pH value of between 8.5 and 11.0 for solution recirculated within containment after a LOCA.'

Unit 2 Technical Specification (TS) Bases 3/4.5.5, 'Refueling Water Storage Tank,' states the following: 'The limits on contained water volume and boron concentration of the RWST also ensure a pH value of between 7.6 and 9.5 for the solution recirculated within containment after a LOCA.'

Explain the differences in these Unit 2 UFSAR and TS bases. Since the Unit 1 bounding analysis uses the same values as Unit 2, does the Unit 1 bounding analysis ensure a pH between 8.5 and 11.0 or 7.6 and 9.5 for the solution recirculated within containment after a LOCA? Explain."

I&M Response

The pH value in the above stated Unit 2 T/S Bases 3/4.6.2.2 was outdated. I&M identified the outdated value and revised Unit 2 T/S Bases 3/4.6.2.2 in accordance with 10 CFR 50.59. The revised Bases page is to be included in the next T/S Bases update transmitted to the NRC.

The bounding analysis ensures a pH value of between 7.6 and 9.5 for the solution recirculated within containment after a LOCA. This is consistent with Section 6.3.1 of the UFSAR, and the revised T/S Bases.

NRC Question 5

"Your Updated Final Safety Analysis Report (UFSAR), Section 6.3.2, 'System Design - System Description,' states the following:

'During the time period that NaOH solution is added to the spray flow, 26 gpm (approximate) is diverted from the Containment Spray Pump discharge and used as motive water for the eductor.

The eductor draws 38 gpm (approximate) {Unit 1 only} and between 23 and 64 gpm {Unit 2 only} from the spray additive tank which produces a solution in the recirculation sump suitable for iodine retention.'

Explain how the bounding calculation pH range is between 7.6 and 9.5 for the solution recirculated within containment after a LOCA for Unit 1 and Unit 2 yet the eductor draws different flow rates from the spray additive tank for Unit 1 and Unit 2. What assumptions were made? Justify."

I&M Response

Section 6.3.2 of the UFSAR has been changed to provide a single description for both Units 1 and 2. The description reads as follows:

> "During the time period that NaOH solution is added to the spray flow, 26 gpm (approximate) is diverted from the Containment Spray Pump discharge and used as motive water for the eductor. The eductor draws between 23 and 64 GPM (approximate) from the spray additive tank which produces a solution in the recirculation sump suitable for iodine retention."

The range of 23 to 64 gpm was used for SAT flow in the bounding calculation. Other assumptions used in the bounding calculation are described in the response to Question 1.

NRC Question 6

"In your submittal, you stated that "the proposed upper limit on volume and concentration for the spray additive tank, also, supports a bounding equipment qualification (EQ) calculation of pH during the LOCA and main steam line break (MSLB) events. What is the pH range for the bounding EQ calculation? Does this pH range bound the chemical effects for injection phase and recirculation phase?"

I&M Response

The class IE equipment inside containment that is required for mitigating the consequences of an accident has been evaluated for exposure to containment spray with following pH values:

Long Term Spray pH

The pH range used to environmentally qualify equipment for long-term exposure is 7.0 to 10.0. The exposure duration used to environmentally qualify equipment for this pH range is based on the long term required operating time for the specific equipment.

Short Term Maximum Spray pH

The maximum pH range used to environmentally qualify equipment for short-term exposure is 10.0 to 12.9. The exposure duration used to environmentally qualify equipment for this pH value is 10 minutes.

Short Term Minimum Spray pH

The minimum pH range used to environmentally qualify equipment for short-term exposure is 4.3 to 7.0. The exposure duration used to environmentally qualify equipment for this pH value is 60 minutes.

These pH values and durations bound the pH ranges and durations determined by the containment spray and recirculation sump pH analysis.

ATTACHMENT 2 TO C0301-06

COMMITMENTS

The following table identifies those actions committed to by Indiana Michigan Power company (I&M) in this document. Any other actions discussed in this submittal represent intended or planned actions by I&M. They are described to the Nuclear Regulatory Commission (NRC) for the NRC's information and are not regulatory commitments.

Commitment	Date
The revised page for Unit 2 T/S Bases 3/4.6.2.2 will be included in the next T/S Bases update transmitted to the NRC.	June 15, 2001