WOLF CREEK
NUCLEAR OPERATING CORPORATION

Russell A. Smith
Site Vice President and Chief Nuclear Operating Officer

March 26, 2014

WO 14-0032

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Reference:
1) Letter ET 13-0023, dated August 13, 2013, from J. P. Broschak, WCNOC, to USNRC
2) Letter dated December 13, 2013, from C. F. Lyon, USNRC, to M. W. Sunseri, WCNOC, "Wolf Creek Generating Station – Request for Additional Information Re: Transition to Westinghouse Core Design and Safety Analysis (TAC NO. MF2574)"
3) Letter ET 14-0003, dated January 28, 2014, from J. P. Broschak, WCNOC, to USNRC

Subject: Docket No. 50-482: Supplemental Information for Response to Request for Additional Information Regarding License Amendment Request for the Transition to Westinghouse Core Design and Safety Analysis

Gentlemen:

Reference 1 provided the Wolf Creek Nuclear Operating Corporation (WCNOC) application to revise the Technical Specifications to support transition to the Westinghouse core design and safety analysis methodologies. The amendment request included revising the Wolf Creek Generating Station (WCGS) licensing basis by adopting the Alternative Source Term radiological analysis methodology in accordance with 10 CFR 50.67, "Accident source term." Reference 2 provided a Nuclear Regulatory Commission (NRC) request for additional information related to the application. Reference 3 provided WCNOC's response to the request for additional information. The response to question ESGB-RAI-1 indicated that a plant-specific sump pH calculation would be performed to determine the effect of the post Loss-of-Coolant Accident acidic sources with the details and results to be provided in a supplement to the request for additional information. The Attachment provides supplemental information associated to question ESGB-RAI-1.

The additional information does not expand the scope of the application and does not impact the no significant hazards consideration determination presented in Reference 1.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," a copy of this submittal is being provided to the designated Kansas State official.

A001
NRR

There are no regulatory commitments contained in this submittal. If you have any questions concerning this matter, please contact me at (620) 364-4156, or Mr. Michael J. Westman at (620) 364-4009.

Sincerely

Russell A. Smith

RAS/rlt

Attachment

cc: T. A. Conley (KDHE), w/a
M. L. Dapas (NRC), w/a
C. F. Lyon (NRC), w/a
N. F. O'Keefe (NRC), w/a
Senior Resident Inspector (NRC), w/a

STATE OF KANSAS)
) SS
COUNTY OF COFFEY)

Russell A. Smith, of lawful age, being first duly sworn upon oath says that he is Site Vice President and Chief Nuclear Operating Officer of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the contents thereof; that he has executed the same for and on behalf of said Corporation with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By [signature]
Russell A. Smith
Site Vice President and Chief Nuclear Operating Officer

SUBSCRIBED and sworn to before me this 26th day of March, 2014.

STATE OF KANSAS NOTARY PUBLIC
RHONDA L. TIEMEYER
My Appointment Expires
January 11, 2018

Rhonda L. Tiemeyer
Notary Public

Expiration Date January 11, 2018

Response to Request for Additional Information

Reference 1 provided Wolf Creek Nuclear Operating Corporation's (WCNOC) application to revise the Technical Specifications to support transition to the Westinghouse core design and safety analysis methodologies. The amendment request included revising the Wolf Creek Generating Station (WCGS) licensing basis by adopting the Alternative Source Term radiological analysis methodology in accordance with 10 CFR 50.67, "Accident source term." Reference 2 provided a Nuclear Regulatory Commission (NRC) request for additional information related to the application. Reference 3 provided WCNOC's response to the request for additional information. The response to question ESGB-RAI-1 indicated that a plant-specific sump pH calculation would be performed to determine the effect of the post Loss-of-Coolant Accident (LOCA) acidic sources with the details and results to be provided in a supplement to the request for additional information. The specific NRC question is provided in italics.

2. <u>ESGB-RAI-1</u>

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

Response: As discussed in Section 4.4.2 of Enclosure VI to Reference 1, the containment sump pH calculation did not include consideration of acid generation (nitric acid produced by the irradiation of water and air or hydrochloric acid produced by the radiolysis of chlorine bearing materials) as they were considered secondary effects. In Section 4.4.2 of Enclosure VI to Reference 1, WCNOC indicated that it was expected that the effect of acid generation on sump pH would decrease the pH value less than 0.1 pH units based on a comparison of Byron Station information and the conclusion reached by the NRC in the safety evaluation for Amendment No. 147 for the Byron Station and Amendment No. 140 for the Braidwood Station (Reference 4). In Reference 3, WCNOC indicated that a plant-specific sump pH calculation would be performed to determine the effect of post-LOCA acidic sources. Provided below are the specific details and results of this calculation.

<u>Methodology</u>

In order to calculate the minimum sump pH, the maximum amount of boric acid from the various sources of borated water that enter the containment sump and the strong acids that are generated from the effects of radiolysis post-LOCA combined with a minimum amount of caustic from the spray additive tank (SAT) will yield a minimum pH value. The concentrations of these substances are used to compute the value of the sump pH as a function of time using verified titration curve data for aqueous solutions of boric acid and sodium hydroxide.

The current licensing basis (CLB) for the WCGS sump pH calculation (EN-03-W, Rev.2, "18 Months Fuel Cycle, Cycle 4 Specific Boron – pH Calculations for TSA 20038-001, Rev. 3") forms the basis of existing Updated Safety Analysis Report (USAR) Figure 6.5-5. Two scenarios are analyzed: both containment spray trains operating with one NaOH eductor in service, and both containment spray trains operating with both NaOH eductors in service.

No computer codes were used in the CLB calculation. To determine the pH in this calculation, NaOH and H_3BO_3 molarities were first calculated and then used with Oak Ridge National Laboratory (ORNL) titration curve data to determine the pH of the spray and sump solutions during the injection and recirculation phases of Emergency Core Cooling System (ECCS) operation. The CLB calculation did not consider the effects of the generation of strong acids inside containment post-LOCA.

Westinghouse has subsequently performed an independent calculation (CN-SEE-1-13-10, Rev. 1, "Wolf Creek Sump pH,") to update the conclusions of the CLB calculation for the transition to the Westinghouse Core Design and Safety Analysis methodologies. The Westinghouse calculation used pH data for boric acid/sodium hydroxide solutions from verified titration curve data for aqueous solutions of boric acid and sodium hydroxide. A revision of this calculation was performed in response to this RAI question (ESGB-RAI-1) and the effect of strong acid generation on the post-LOCA sump pH was considered. In accordance with the guidance of NUREG/CR-5950, "Iodine Evolution and pH Control," the mass of nitric acid that is generated by the radiolysis of air and water inside containment and the mass of hydrochloric acid that is generated by the radiolysis of Hypalon® electrical cable insulation inside containment were calculated. The amount of hydriodic acid that is generated from iodine released inside containment was judged to be negligible and was not considered in the sump pH calculation.

The masses (moles) of the strong acids that are generated inside containment post-LOCA were assumed to instantaneously be neutralized by a molar equivalent of NaOH, which reduced the net mass of NaOH that was available to neutralize the boric acid injected from the Reactor Coolant System (RCS), accumulators and refueling water storage tank (RWST). The net effect of the neutralization of all acid species in the sump by the NaOH from the SAT determined the equilibrium sump pH.

Assumptions and Inputs

Among the various assumptions that were made in the sump pH calculation is that of effective mixing of the water inventory in the sump. This is a valid assumption because of the long term operation of the Containment Spray System and the uniform dispersion of spray over the containment cross section. With respect to the generation of strong acids inside containment, the gaseous hydrochloric acid produced by electric cable insulation radiolysis was conservatively assumed to be instantly dissolved in the sump water, and the hydrochloric acid generated from the radiolysis of cable insulation and nitric acid generated by the irradiation of containment sump water and air was assumed to fully dissociate in the sump water. At the completion of the injection and mixing of all chemical species (acids and sodium hydroxide) inside containment post-LOCA, it was assumed that there would be no further change in the sump liquid inventory and, consequently, that there would be no further change in the calculated sump pH endpoint over the 30 day post-LOCA period.

The minimum long-term sump pH in the revised Westinghouse calculation uses the following conservative bases:

1. Maximum RWST and safety injection (SI) accumulator Technical Specification 3.5.1, "Accumulators," and 3.5.4, "Refueling Water Storage Tank (RWST)," boron concentration of 2500 ppm.

2. A conservatively high RCS boron concentration of 1900 ppm in the CLB, and 1980 ppm in the Westinghouse calculation. Given that the RCS is only approximately 15% of the sump fluid, this difference in boron concentration is a small effect.

3. The SAT is assumed to contain the Technical Specification 3.6.7, "Spray Additive System," minimum 28% by weight NaOH solution.

4. The mass of Hypalon® electrical cable insulation inside containment is 50,000 lb_m.

5. The 30-day integrated containment doses inside containment (beta and gamma sources) to which the Hypalon® insulation is exposed post-LOCA were derived from the plant-specific report for the Environmental Qualification of Safety-Related Electrical Equipment.

6. The maximum sump liquid mass is approximately 4.1×10^6 lb_m, which corresponds to a liquid volume of 1.87×10^6 liters.

While the Technical Specification 3.6.7 SAT minimum contained volume is 4340 gallons, the CLB analysis assumed a conservative minimum delivered volume of only 2960 gallons. The Westinghouse calculation used an adjusted delivered volume of 2752 gallons, which accounted for the neutralization of the strong acid generated inside containment post-LOCA.

Results and Conclusions

The Westinghouse calculation determined a long-term sump pH of 8.7, while the CLB calculation determined a minimum value of 8.6. The slightly higher pH in the Westinghouse calculation is attributed to the use of a different boron/NaOH/pH correlation. In either case, the results show that the sump pH remains above the CLB value of 8.5 and well above the NRC-required value of 7.0 after the minimum amount of NaOH is injected into the sump.

In the CLB calculation, the limiting system alignment of both containment spray trains operating with one NaOH eductor in service results in a sump pH of 7 in approximately 15 minutes, with the final long-term pH of 8.6 in approximately 80 minutes. The less limiting case of both Containment Spray trains operating with both NaOH supplies in service results in a sump pH of 7 in approximately 11 minutes, with the final long-term pH of 8.6 in approximately 45 minutes. For the Westinghouse calculation, the limiting system alignment of both containment spray trains operating with one NaOH eductor in service results in a sump pH of 7 in approximately 11 minutes, with the final long-term pH of 8.7 in approximately 70 minutes. The less limiting case of both containment spray trains operating with both NaOH supplies in service results in a sump pH of 7 in approximately 9 minutes, with the final long-term pH of 8.7 in approximately 35 minutes.

Figure 4-1 shows that the acceptance criteria of sump pH > 8.5 (minimum) is met for one or two containment spray eductors in service, considering also the generation of strong acids inside containment post-LOCA, consistent with the guidance of NUREG/CR-5950.

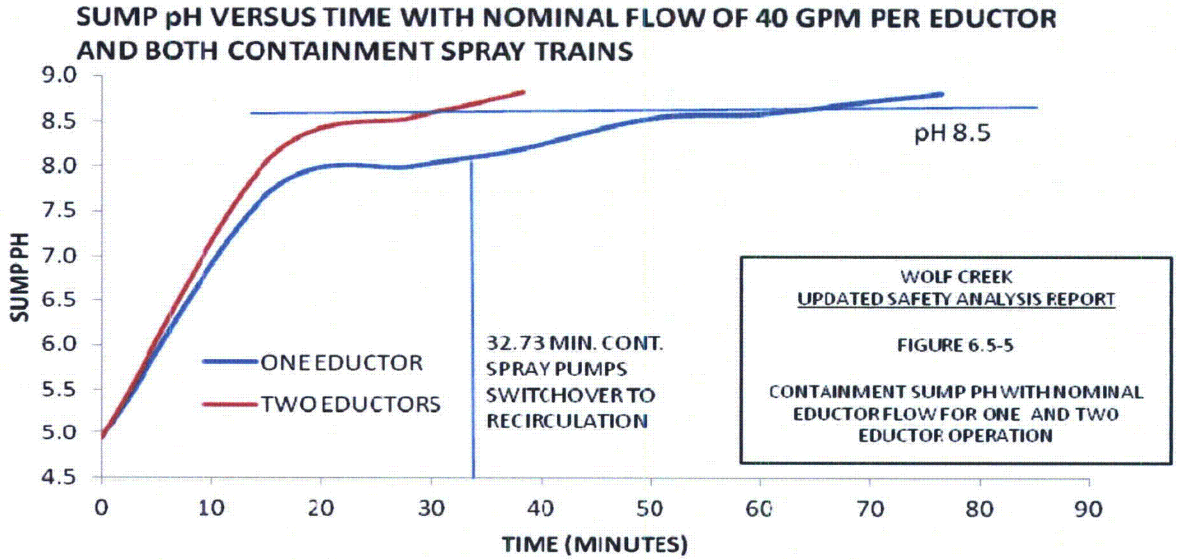

Figure 4-1 Containment Sump pH versus Time

References:

1. WCNOC Letter ET 13-0023, "License Amendment Request for the Transition to Westinghouse Core Design and Safety Analysis," August 13, 2013. ADAMS package Accession No. ML13247A075.

2. Letter from C. F. Lyon, USNRC, to M. W. Sunseri, WCNOC, "Wolf Creek Generating Station – Request for Additional Information Re: Transition to Westinghouse Core Design and Safety Analysis (TAC NO. MF2574)," December 13, 2013. ADAMS Accession No. ML13345B335.

3. WCNOC Letter ET 14-0003, "Response to Request for Additional Information Regarding License Amendment Request for the Transition to Westinghouse Core Design and Safety Analysis," January 28, 2014. ADAMS Accession No. ML14035A224.

4. Letter from R. F. Kuntz, USNRC, to C. M. Crane, Exelon Generation Company, "Byron Station, Unit Nos. 1 and 2, and Braidwood Station, Unit Nos. 1 and 2 – Issuance of Amendment Re: Alternative Source Term (TAC NOS. MC6221, MC6222, MC6223, and MC6224)," September 8, 2006. ADAMS Accession No. ML062340420.