UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 23, 2021

ANO Site Vice President
Arkansas Nuclear One
Entergy Operations, Inc.
N-TSB-58
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 1 - ISSUANCE OF AMENDMENT NO. 272 RE: REPLACEMENT OF REACTOR BUILDING SPRAY SODIUM HYDROXIDE ADDITIVE WITH A PASSIVE REACTOR BUILDING SUMP BUFFERING AGENT (EPID L-2020-LLA-0036)

Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment No. 272 to Renewed Facility Operating License No. DPR-51 for Arkansas Nuclear One, Unit 1 (ANO-1). The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated February 24, 2020, as supplemented by letters dated July 21, 2020, August 27, 2020, October 1, 2020, and February 22, 2021.

The amendment modifies ANO-1 TS 3.3.6, “Engineered Safeguards Actuation System (ESAS) Manual Initiation,” and TS 3.6.6, “Spray Additive System.” Specifically, the amendment replaces the current reactor building spray sodium hydroxide additive with a passive reactor building sump buffering agent, sodium tetraborate decahydrate.

A copy of the related Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission's monthly *Federal Register* notice.

Sincerely,

/RA/

Thomas J. Wengert, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures:
1. Amendment No. 272 to DPR-51
2. Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

ENTERGY OPERATIONS, INC.

DOCKET NO. 50-313

ARKANSAS NUCLEAR ONE, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 272
Renewed License No. DPR-51

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Entergy Operations, Inc. (the licensee), dated February 24, 2020, as supplemented by letters dated July 21, 2020, August 27, 2020, October 1, 2020, and February 22, 2021, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.c.(2) of Renewed Facility Operating License No. DPR-51 is hereby amended to read as follows:

    (2) <u>Technical Specifications</u>

    The Technical Specifications contained in Appendix A, as revised through Amendment No. 272, are hereby incorporated in the renewed license. EOI shall operate the facility in accordance with the Technical Specifications.

3. This amendment is effective as of its date of issuance and shall be implemented prior to startup from refueling outage 1R29 (spring 2021), coincident with the plant modifications associated with this license amendment to be performed in 1R29.

FOR THE NUCLEAR REGULATORY COMMISSION

Jennifer L. Dixon-Herrity

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Date: 2021.03.23 13:42:32 -04'00'

Jennifer L. Dixon-Herrity, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to Renewed Facility
Operating License No. DPR-51
and the Technical Specifications

Date of Issuance: March 23, 2021

ATTACHMENT TO LICENSE AMENDMENT NO. 272

RENEWED FACILITY OPERATING LICENSE NO. DPR-51

ARKANSAS NUCLEAR ONE, UNIT 1

DOCKET NO. 50-313

Replace the following pages of Renewed Facility Operating License No. DPR-51 and the Appendix A, Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Renewed Facility Operating License

REMOVE	INSERT
3	3

Technical Specifications

REMOVE	INSERT
3.3.6-1	3.3.6-1
3.6.6-1	3.6.6-1
3.6.6-2	--------

(5) EOI, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components;

(6) EOI, pursuant to the Act and 10 CFR Parts 30 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

c. This renewed license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

EOI is authorized to operate the facility at steady state reactor core power levels not in excess of 2568 megawatts thermal.

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 272, are hereby incorporated in the renewed license. EOI shall operate the facility in accordance with the Technical Specifications.

(3) Safety Analysis Report

The licensee's SAR supplement submitted pursuant to 10 CFR 54.21(d), as revised on March 14, 2001, describes certain future inspection activities to be completed before the period of extended operation. The licensee shall complete these activities no later than May 20, 2014.

(4) Physical Protection

EOI shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification, and safeguards contingency plans, including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contains Safeguards Information protected under 10 CFR 73.21, is entitled: "Arkansas Nuclear One Physical Security Plan, Training and Qualifications Plan, and Safeguards Contingency Plan," as submitted on May 4, 2006.

3.3 INSTRUMENTATION

3.3.6 Engineered Safeguards Actuation System (ESAS) Manual Initiation

LCO 3.3.6 Two manual initiation channels of each one of the ESAS Functions below shall be OPERABLE:

a. High Pressure Injection (channels 1 and 2);

b. Low Pressure Injection (channels 3 and 4);

c. Reactor Building (RB) Cooling (channels 5 and 6); and

d. RB Spray (channels 7 and 8).

APPLICABILITY: MODES 1 and 2,
MODES 3 and 4 when associated engineered safeguards equipment is required to be OPERABLE.

ACTIONS

--NOTE--
Separate Condition entry is allowed for each Function.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more ESAS Functions with one channel inoperable.	A.1 Restore channel to OPERABLE status.	72 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. <u>AND</u> B.2 --------------NOTE------------- LCO 3.0.4.a is not applicable when entering Mode 4. ------------------------------------- Be in MODE 4.	6 hours 12 hours

3.6 REACTOR BUILDING SYSTEMS

3.6.6 Reactor Building (RB) Sump Buffering Agent

LCO 3.6.6 The RB Sump Buffering Agent shall be OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. RB Sump Buffering Agent inoperable.	A.1 Restore RB Sump Buffering Agent to OPERABLE status.	72 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.6.1	Verify the summed volume of sodium tetraborate (NaTB) decahydrate contained within the RB Sump Buffering Agent baskets is ≥ 308 ft^3.	In accordance with the Surveillance Frequency Control Program
SR 3.6.6.2	Verify a sample from each RB Sump Buffering Agent basket provides adequate pH adjustment of borated water.	In accordance with the Surveillance Frequency Control Program

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 272 TO

RENEWED FACILITY OPERATING LICENSE NO. DPR-51

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 1

DOCKET NO. 50-313

1.0 INTRODUCTION

By letter dated February 24, 2020 (Reference 1), as supplemented by letters dated July 21, 2020, August 27, 2020, October 1, 2020, and February 22, 2021 (References 2, 3, 4, and 5, respectively), Entergy Operations, Inc. (the licensee) submitted a license amendment request (LAR) to modify the Technical Specifications (TSs) for Arkansas Nuclear One, Unit 1 (ANO-1).

The amendment would revise the TSs to replace references to sodium hydroxide (NaOH) with references to sodium tetraborate (NaTB) decahydrate as the reactor building sump pH buffer chemical. The revised TSs would have the same purpose of maintaining effective iodine removal by preventing the sump fluid pH from becoming acidic following a loss-of-coolant accident (LOCA).

The new NaTB decahydrate additive would continue to support control of the post-accident RB sump pH and maintain effective iodine removal from the RB atmosphere, which is currently provided by the NaOH additive.

The supplemental letters dated July 21, 2020, August 27, 2020, October 1, 2020, and February 22, 2021, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the U.S. Nuclear Regulatory Commission (NRC, the Commission) staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on May 19, 2020 (85 FR 29984).

Enclosure 2

2.0 REGULATORY EVALUATION

2.1 Proposed Technical Specification Changes

The modification would require changes to the ANO-1 TSs to establish requirements for the new RB sump buffering agent and to delete the requirements for the NaOH spray additive.

TS 3.3.6, "Engineered Safeguards Actuation System (ESAS) Manual Initiation," Limiting Condition for Operation (LCO) 3.3.6.e requires that the spray additive channels of the ESAS are operable in Modes 1 and 2. TS 3.6.6 "Spray Additive System," requires the system to be operable in Modes 1 and 2. The spray additive tank and two associated flow paths are required to be operable.

The licensee proposed to delete LCO 3.3.6.e and to revise TS 3.6.6 to provide requirements consistent with the proposed new RB sump buffering agent, NaTB decahydrate. Consistent with the current TSs, the proposed new RB sump buffering agent would be required to be operable in Modes 1 and 2 and, if inoperable, would be required to be restored to an operable status within 72 hours, followed by plant shutdown to Mode 3 if not restored within the allotted 72-hour period. The operability requirements are established in the proposed revision to TS 3.6.6 by establishing two surveillance requirements (SRs):

1. Verifying that the summed volume of NaTB decahydrate contained within the RB sump buffering agent baskets is greater than or equal to 308 cubic feet at a frequency established by the Surveillance Frequency Control Program (SFCP) and

2. Verifying that a sample from each RB sump buffering agent basket provides adequate pH adjustment of borated water at a frequency established by the SFCP.

The elimination of the current NaOH spray additive system would also require a change to ANO-1 TS 3.3.6 to delete references to the NaOH spray additive system. Because the new NaTB decahydrate buffering agent is a passive system and requires no actuation signal, reference to this system within TS 3.3.6 would not be necessary.

The licensee's proposed TS revisions are summarized below. The proposed TS page markups are provided with the licensee's letters dated February 24, 2020, October 1, 2020, and February 22, 2021.

2.1.1 Proposed Deletion of LCO 3.3.6.e

LCO 3.3.6.e currently requires that the ESAS spray additive channels (9 and 10) be operable for manual actuation. LCO 3.3.6.e would be deleted by the licensee's proposed change.

2.1.2 Proposed Revision to TS 3.6.6

The licensee's proposed revisions to ANO-1 TS 3.6.6 would change the title of TS 3.6.6 from "Spray Additive System" to "Reactor Building (RB) Sump Buffering Agent" and would contain the requirements for the new RB sump buffering agent (NaTB decahydrate).

2.1.3 Proposed Revision to LCO 3.6.6

The licensee proposed that ANO-1 LCO 3.6.6 be revised to reflect the new name of the TS, "RB Sump Buffering Agent."

2.1.4 Proposed Revision to LCO 3.6.6 Condition A and Required Action A.1

The licensee requested that Condition A and its associated Required Action A.1 be reworded to reflect the RB sump buffering agent instead of the spray additive system, which would reflect the change in the name of TS 3.6.6.

2.1.5 Proposed Revision to SR 3.6.6.1

The licensee proposed that SR 3.6.6.1 be revised to require verification of the minimum volume of NaTB decahydrate to be contained in the RB sump buffering agent baskets. The requirement for spray additive system valve position verification would be deleted. SR 3.6.6.1, as revised, would require the licensee to verify the summed volume of NaTB decahydrate contained within the RB sump buffering agent baskets is at least 308 cubic feet.

2.1.6 Proposed Revision to SR 3.6.6.2

The licensee proposed that SR 3.6.6.2 be revised to eliminate the requirement for verification of the minimum volume of NaOH solution and to replace it with a requirement to verify a sample from each RB sump buffering agent basket provides adequate pH adjustment of borated water.

2.1.7 Proposed Deletion of SR 3.6.6.3

The licensee proposed to delete SR 3.6.6.3, which verifies that the concentration of NaOH within the spray additive tank is within a specific acceptance band.

2.1.8 Proposed Deletion of SR 3.6.6.4

The licensee proposed to delete SR 3.6.6.4, which verifies that automatic valves in the flow path for the spray additive system actuate to the correct position on an actual or simulated actuation signal.

The procedures for the proposed SRs are described in a revision to TS Bases Section B 3.6.6. The frequency of the proposed SRs would continue to be in accordance with the SFCP.

2.2 REGULATORY REQUIREMENTS

The regulatory requirements and guidance documents that the NRC staff used in its review of the LAR are listed below.

2.2.1 Regulatory Requirements

The regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.36(a)(1) require an applicant for an operating license to include in the application proposed TSs in accordance with the requirements of 10 CFR 50.36. The applicant must include in the application a "summary statement of the bases or reasons for such specifications, other than those covering administrative controls." However, per 10 CFR 50.36(a)(1), these technical specification bases "shall not become part of the technical specifications."

The regulations in 10 CFR 50.36(b) state, in part, that:

> Each license authorizing operation of a . . . utilization facility . . . will include technical specifications. The technical specifications will be derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to [10 CFR] 50.34 ["Contents of applications; technical information"]. The Commission may include such additional technical specifications as the Commission finds appropriate.

The categories of items required to be in the TSs are provided in 10 CFR 50.36(c). As required by 10 CFR 50.36(c)(2)(i), the TSs will include LCOs, which are the lowest functional capability or performance levels of equipment required for safe operation of the facility. In accordance with 10 CFR 50.36(c)(2)(i), when an LCO of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the TSs until the condition can be met. The criteria for inclusion of LCOs in the TSs are given in the 10 CFR 50.36(c)(2)(ii).

The regulations at 10 CFR 50.36(c)(3) require TSs to include items in the category of SRs, which are "requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that [LCOs] will be met."

The regulations in 10 CFR 50.44, "Combustible gas control for nuclear power reactors," relate to the requirement for plants to have the capability for ensuring a mixed atmosphere so that the concentration of combustible gasses in the RB is below a level that would support combustion or detonation that could cause loss of RB integrity.

The regulations in 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," contain requirements for a system to limit the temperature of the fuel and provide long-term cooling following a LOCA.

The regulations in 10 CFR 50.49, "Environmental qualification of electric equipment important to safety for nuclear power plants," require qualification of electrical equipment with respect to environmental conditions at the location where the equipment must perform its safety function.

The alternative source term (AST) LOCA radiological analysis requirements are in 10 CFR 50.67, "Accident source term," which provides the requirements for evaluation of consequences of applicable design-basis accidents (DBAs). The regulations in 10 CFR 50.67 state, in part, that:

> (2) The NRC may issue the amendment only if the applicant's analysis demonstrates with reasonable assurance that:
>
> (i) An individual located at any point on the boundary of the exclusion area for any 2-hour period following the onset of the postulated fission product release, would not receive a radiation dose in excess of 0.25 Sv [Sievert] (25 rem [roentgen equivalent man]) total effective dose equivalent (TEDE).
>
> (ii) An individual located at any point on the outer boundary of the low population zone, who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage), would not receive a radiation dose in excess of 0.25 Sv (25 rem) total effective dose equivalent (TEDE).
>
> (iii) Adequate radiation protection is provided to permit access to and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 0.05 Sv (5 rem) total effective dose equivalent (TEDE) for the duration of the accident.

The following General Design Criteria (GDC) of Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants," apply to this LAR:[1]

GDC 19, "Control room," states, in part, that*:*

> A control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions, including loss-of-coolant accidents. Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem [(0.05 Sv)] whole body, or its equivalent to any part of the body, for the duration of the accident. Equipment at appropriate locations outside the control room shall be provided (1) with a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and (2) with a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures.

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[1] As noted in Section 4.1, "Applicable Regulatory Requirements/Criteria," of the LAR, ANO-1 was initially licensed to the GDC proposed by the Atomic Energy Commission (AEC) in 1967. However, the ANO-1 Safety Analysis Report provides a comparison to the GDC published as Appendix A to 10 CFR Part 50 in 1971.

> . . . holders of operating licenses using an alternative source term under [10 CFR] 50.67, shall meet the requirements of this criterion, except that with regard to control room access and occupancy, adequate radiation protection shall be provided to ensure that radiation exposures shall not exceed 0.05 Sv (5 rem) (TEDE) as defined in [10 CFR] 50.2 for the duration of the accident.

GDC 14, “Reactor coolant pressure boundary,” states that the reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

GDC 38, “Containment heat removal,” states that a system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.

GDC 41, “Containment atmosphere cleanup,” states, in part, that:

> Systems to control fission products . . . shall be provided as necessary to reduce . . . the concentration . . . of fission products released to the environment following postulated accidents . . . .

2.2.2 Guidance

Regulatory Guide (RG) 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors” (Reference 6), provides the methodology for analyzing the radiological consequences of several DBAs to show compliance with 10 CFR 50.67. Regulatory Guide 1.183 provides guidance to licensees on an acceptable application of AST (also known as the accident source term) submittals, including acceptable radiological analysis assumptions for use in conjunction with the accepted AST. The guidance in RG 1.183 states that the analyses should consider iodine re-evolution if the RB sump liquid pH is not maintained at 7.0 or greater.

NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition” (SRP), Section 6.5.2, “Containment Spray as a Fission Product Cleanup System,” Revision 4 (Reference 7), provides an acceptable model for the reduction of airborne radioactivity, including guidance for determining the fission product removal effectiveness of the RB spray and additive (or pH control) systems.

SRP Section 15.0.1, “Radiological Consequence Analyses Using Alternative Source Terms,” Revision 0 (Reference 8), provides guidance to the NRC staff for the review of AST amendment requests. The guidance in SRP Section 15.0.1 states that the NRC reviewer should evaluate the proposed change against the guidance in RG 1.183.

SRP Branch Technical Position (BTP) 6-1, “pH for Emergency Coolant Water for Pressurized Water Reactors” (Reference 9), provides the background and the basis used in establishing the minimum value of 7.0 pH in post-accident containment sprays in pressurized-water reactors (PWRs).

2.2.3 Previous NRC Approvals

The NRC approved Amendment No. 238 for ANO-1 by letter dated October 21, 2009 (Reference 10), which used an AST methodology for analyzing the radiological consequences of the DBAs using the regulatory guidance in RG 1.183.

In an NRC safety evaluation dated December 24, 2013 (Reference 11), the NRC staff approved a revision to the LOCA analysis results.

The NRC staff also considered relevant information in the ANO-1 Safety Analysis Report, which describes the DBAs and evaluation of their radiological consequences for ANO-1.

3.0 TECHNICAL EVALUATION

3.1 System Design and Operation

Currently, ANO-1 uses an NaOH additive in the RB spray to reduce the amount of radioiodine released during a postulated DBA LOCA. According to the guidance in NUREG-1465, “Accident Source Terms for Light-Water Nuclear Power Plants” (Reference 12), iodine released from the damaged core to the containment after a LOCA is composed of 95 percent cesium iodide, which is a highly ionized salt and soluble in water. The function of the NaOH additive is to maintain the pH of the containment sump water in the basic range (i.e., above 7.0). A basic pH minimizes the conversion of water-soluble cesium iodine to elemental iodine, which can be re-evolved as a gas into containment and potentially released to the atmosphere. The guidance in NUREG/CR-5950, “Iodine Evolution and pH Control” (Reference 13), describes acids and bases in containment and their relationship to iodine chemical forms and evolution.

The ANO-1 NaOH RB spray additive system acts to reduce the iodine fission product inventory in the RB atmosphere resulting from a DBA. The RB spray system supports the spray additive system iodine removal function by providing a distribution mechanism for the solution.

The current RB spray and spray additive systems perform no function during normal operations. In the event of a LOCA, the spray additive system will be automatically actuated upon an RB high-high pressure signal by the ESAS. Actuation of the spray additive system opens the NaOH isolation valves, which are powered from independent electrical buses. When the valves are open, the NaOH solution is ready to be introduced into the RB spray system headers.

Radioiodine in its various forms is the fission product of primary concern in the evaluation of the dose consequences of an accident. It is absorbed by a spray solution from the RB atmosphere. The spray solution is adjusted to an alkaline pH that promotes iodine hydrolysis, in which iodine is converted to nonvolatile forms. Because of its stability when exposed to radiation and elevated temperature, NaOH is the spray additive currently utilized at ANO-1.

In this LAR, the licensee proposed using baskets of soluble NaTB decahydrate on the containment floor, rather than NaOH from an active spray system, to maintain a basic sump pH during a postulated DBA LOCA. The NRC staff evaluated the ability of the proposed pH control method to maintain a sump pH of at least 7.0 for 30 days post-DBA LOCA. The guidance in SRP Section 6.5.2 and RG 1.183 (Appendix A) identify a pH of 7 as the value below which molecular iodine should be assumed to evolve from the sump water. The NRC staff also evaluated the changes to TS 3.6.6, which currently describes the NaOH spray additive requirements but would be modified to contain the requirements related to the NaTB decahydrate baskets.

Efforts to resolve Generic Safety Issue (GSI)-191, "Assessment of Debris Accumulation on PWR Sump Performance," have also shown that the sump pH buffer affects the type and amount of chemical precipitates that may form in postulated post-LOCA recirculating water. Chemical precipitates are a result of interaction between materials in containment (e.g., insulation and metallic materials) and the sump fluid, and they could degrade the performance of the emergency core cooling system (ECCS) by contributing to blockage of sump strainers and fuel assemblies, and a loss of heat transfer. Studies of these "chemical effects" have included both NaTB and NaOH. Topical Report WCAP-16530-NP-A, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191," dated March 2008 (Reference 14), provides additional references for GSI-191 chemical effects testing and evaluation.

In addition, the pH of the sump fluid may affect corrosion of ECCS components. To reduce the likelihood of stress corrosion cracking (SCC) in austenitic stainless steel, SRP BTP 6-1 provides a minimum pH criterion of 7.0 and states that the likelihood of SCC decreases with increasing pH between 7.0 and 9.5. It also notes that aluminum corrosion and the associated hydrogen gas evolution should be considered for pH greater than 7.5.

The proposed modifications, using NaTB decahydrate agent, will have three baskets seismically secured to the lowest floor of the RB. The new NaTB decahydrate buffering agent is a passive system and requires no actuation signal, and the system can deliver NaTB decahydrate by a passive method. Each NaTB decahydrate basket is designed to contain approximately 162 cubic feet of NaTB decahydrate when filled to the maximum volume of the basket.

Initial loading of the NaTB decahydrate baskets is determined based on weight. When the baskets are filled, the level of each basket is documented for reference in evaluating volume. Subsequent periodic surveillances will verify the NaTB decahydrate volume in each basket. The licensee performed calculations to determine the amount of NaTB decahydrate required to adjust the pH of the RB sump solution to a value of greater than 7.0.

3.2 Alternative Source Term LOCA Radiological Analysis

The NRC staff reviewed the regulatory and technical bases, as related to the radiological consequences of DBAs, performed by the licensee in support of its proposed license amendment. The NRC staff also reviewed the assumptions, inputs, and methods used by the licensee to assess the impacts of the proposed license amendment.

The LOCA analysis is the only DBA that credits removal of radioactivity from the containment using sprays. After a LOCA, a variety of different chemical species are released from the postulated damaged core. One of them is radioactive iodine. This iodine, when released to the outside environment, would significantly contribute to radiation doses. It is, therefore, essential to keep it confined within the plant's containment.

According to guidance in NUREG-1465, iodine is released from the core in three different chemical forms. In an aqueous environment, iodine is expected to dissolve in water pools or plate out on wet surfaces in ionic form as iodide. Subsequently, iodine behavior within containment depends on the time and pH of the water solutions. Because of the presence of other dissolved fission products, radiolysis is expected to occur and lower the pH of the water pools. Control of the pH in the water helps keep dissolved iodine from converting to elemental iodine and being released to the containment atmosphere. At a higher pH, conversion to elemental form is lower and at pH greater than 7 it becomes negligibly small. The relationship between the rate of conversion and pH is specified in Figure 3.1 of NUREG/CR-5950.

Per Section 3.4, "Iodine Generation and Offsite Dose," of the enclosure to the LAR, the current licensing basis for ANO-1 credits the AST, in accordance with RG 1.183, for evaluating the radiological consequences of a LOCA. RG 1.183, Appendix A, Regulatory Position 2, states that:

> If the sump or suppression pool pH is controlled at values of 7 or greater, the chemical form of radioiodine released to the containment should be assumed to be 95% cesium iodide (CsI), 4.85 percent elemental iodine, and 0.15 percent organic iodide. Iodine species, including those from iodine re-evolution, for sump or suppression pool pH values less than 7 will be evaluated on a case-by-case basis. Evaluations of pH should consider the effect of acids and bases created during the LOCA event, e.g., radiolysis products. With the exception of elemental and organic iodine and noble gases, fission products should be assumed to be in particulate form.

The licensee proposed to eliminate the use of NaOH as an additive to containment spray in conjunction with the adoption of NaTB decahydrate to maintain a sump water pH of greater than 7.0 at the time of sump water recirculation.

The NRC staff reviewed the licensee's calculations evaluating the pH as described in Section 3.3 of this safety evaluation. Consistent with RG 1.183, Appendix A, Regulatory Position 2, the licensee's evaluations of sump pH considered the effect of acids and bases created during the LOCA event, such as hydrochloric acid resulting from cable degradation in high radiation fields, and nitric acid generated due to radiolysis of the RB air and sump water. Based upon the licensee's statements that the pH is maintained at a pH of greater than 7.0 at the time of sump water recirculation, and the NRC staff's review of the licensee's statements, the NRC staff finds that the proposed changes do not impact the licensee's consistency with RG 1.183, Appendix A, Regulatory Position 2 in the licensee's LOCA radiological analyses.

The NRC staff reviewed the impact of the proposed changes on the licensee's LOCA analysis compliance with RG 1.183, Regulatory Position 5.1.2, "Credit for Engineered Safety Features." The guidance in RG 1.183, Regulatory Position 5.1.2, states, in part, that credit may be taken for accident mitigation features that are required to be operable by TSs. After the proposed change, TS LCO 3.6.6 would continue to require the credited buffering agent to be operable. To be considered operable, the volume and concentration of the NaTB decahydrate must be sufficient to raise the long-term sump pH to a level conducive to iodine retention. Based upon the continued operability requirement for an RB system to deliver a buffering agent to control pH, the NRC staff finds that the licensee's LOCA radiological analysis continues to be consistent with the guidance in RG 1.183, Regulatory Position 5.1.2.

3.3 Containment Sump pH Buffer Proposed Change

In the LAR, the licensee proposed that three stainless steel baskets containing NaTB decahydrate be secured to the lowest floor of the RB to adjust the post-LOCA sump pH. As modified, SR 3.6.6.1 would require the baskets to contain a summed volume of at least

308 cubic feet of NaTB decahydrate. The licensee stated that this volume of buffering agent will be adequate to adjust the post LOCA pH of the RB sump water to at least 7.0. Additionally, the licensee provided calculations showing that the pH will remain above 7.0 over the 30-day post-LOCA time period. The licensee calculated the resultant pH for three scenarios based on different amounts of buffer in the baskets in containment. These scenarios correspond to the proposed minimum amount of NaTB decahydrate required by the TS, a case with a larger amount of NaTB decahydrate expected to be the administrative limit, and a case with the maximum amount of NaTB decahydrate that could be fit in the baskets (i.e., the maximum pH case).

These scenarios considered the multiple sources of borated water, as well as minimum and maximum concentrations of boric acid in the sources. The boron concentration used in the core flood tanks and borated water storage tank were the TS maximum and minimum limits. Since there are no TS limits for the reactor coolant system (RCS) and makeup and storage tank (M&ST), the licensee assumed a value of zero for the maximum pH case and a value of 1800 parts per million (ppm) for the other two cases. The licensee's supplemental letter dated August 27, 2020, provided the basis for the 1800 ppm value (i.e., reload analyses) and the sensitivity of pH to the RCS and M&ST boron concentrations. The sensitivity calculations showed that increasing the boron concentration from 1800 to 3600 ppm resulted in a pH decrease of 0.15, 0.04, and 0.04 at 10 minutes; recirculation; and 30 days, respectively.

The licensee's analysis of the sump fluid pH also included the effect of strong acids (i.e., hydrochloric and nitric) generated in the postulated post-LOCA environment. The licensee's calculation of the acid quantities is based on relationships provided in NUREG/CR-5950. The licensee made conservative assumptions in estimating the amount of chlorine-containing cable material to include in the hydrochloric acid calculation. For example, all cable is included in the calculation whether or not it is located in a conduit or another enclosure that provides shielding, the entire mass of jacketing and filler is included, and the filler material is assumed to contain chlorine. The licensee's supplemental letter dated August 27, 2020, included information about how strong acids are treated in determining the sump pH.

The NRC staff performed an audit (Reference 15) of the licensee's calculation and analyses to determine if the proposed amount of buffer (NaTB decahydrate) is sufficient to prevent iodine re-evolution by raising the pH to at least 7.0 prior to the beginning of recirculation and maintaining it above 7.0 for the 30-day post-LOCA period. The audit activities are summarized in an audit report (Reference 16) and address the licensee's pH calculation methodology, assumptions, inputs, and calculations. The NRC staff's evaluation included estimating the amounts of nitric and hydrochloric acids predicted to form in the post-LOCA environment.

The NRC staff found the licensee's boron concentration input values reasonable because they are based on conservative use of TS limits and in the case of the RCS and M&ST, approximately equal to the maximum value determined from reload analyses. The NRC staff found the licensee's calculation of strong acids to be reasonable based on the conservative assumptions of the quantity of source material and the use of relationships in NUREG/CR-5950 for radiation dose and acid generation. In addition, the NRC staff considered it conservative to add all of the strong acid before all of the NaTB decahydrate is dissolved and available to buffer the pH.

As part of its review, the NRC staff performed confirmatory hand calculations of the pH at the onset of recirculation, the impact of strong acids on the sump pH, and whether the pH of the sump would remain above 7.0 for at least 30 days following the postulated LOCA. Based on this evaluation, the NRC staff concluded that the proposed quantity of NaTB decahydrate would be sufficient to ensure that the sump pH would be at least 7.0 prior to onset of recirculation and remain above 7 for the 30-day post-LOCA period to prevent re-evolution of elemental radioiodine. Therefore, the NRC staff finds that the proposed changes meet 10 CFR 50.67 for evaluating DBA consequences and GDC 41 as it relates to pH control for preventing post-LOCA iodine re-evolution.

The NRC staff also determined that the form of storage of the NaTB decahydrate would make it readily available following a LOCA to perform its pH buffering function. This is based on the baskets being located on the lowest floor in the reactor building where they will be submerged early in the event, and on the solubility of NaTB decahydrate at the temperature of the sump fluid, which decreases to about 120 degrees Fahrenheit after 30 days following a LOCA. The solubility of NaTB decahydrate is about 30 grams per liter at 70 degrees Fahrenheit, and about 525 grams per liter at 212 degrees Fahrenheit as stated in *Lange's Handbook of Chemistry* (Reference 17). Dissolving all of the NaTB decahydrate required by the TS into the sump water results in a concentration of about 3.6 grams per liter. Therefore, the NRC staff concludes that the solubility of NaTB decahydrate is high enough to fully dissolve in the post-LOCA sump fluid with margin.

3.4 Emergency Core Cooling System Strainer Blockage

Section 3.3, "Environmental Qualification," of the enclosure to the LAR addresses the effect of the pH buffer change on the potential for ECCS strainer blockage due to formation of chemical precipitates in the sump fluid (i.e., chemical effects). The licensee considered the current chemical precipitate evaluation bounding and did not perform a new evaluation for the proposed NaTB decahydrate buffer. This is based on the use of the referenced WCAP-16530-NP-A methodology for the pH buffer and chemical effects source materials. The licensee concluded that the amount of chemical precipitate would not increase because no new source materials would be introduced, and because the methodology does not predict more chemical effects from NaTB decahydrate than it predicts from NaOH. The baskets are made from stainless steel, which does not contribute to chemical effects.

The NRC staff evaluated the licensee's existing ANO-1 chemical effects evaluation for the conditions proposed in the LAR. The chemical precipitates calculated for ANO-1 with the WCAP-16530-NP-A methodology are the result of aluminum corrosion. Because NaTB decahydrate has a lower pH profile than NaOH, the predicted amount of aluminum corrosion and corresponding chemical precipitates would decrease with the buffer change. In addition, no chemical effects source materials are being added to containment, and there are no chemical effects resulting specifically from NaTB decahydrate. Therefore, the NRC staff finds that the proposed changes meet 10 CFR 50.46 as they relate to the ANO-1 chemical effects evaluation.

3.5 Corrosion

Section 3.6, "Corrosion Rates," of the enclosure to the LAR states that maintaining a slightly basic pH will reduce corrosion rates of most materials in the RB such as metallic structural members and components. As described in this section, the licensee used a pH of 10.5 to evaluate aluminum corrosion and hydrogen generation, and that the upper pH limit for NaOH (the current buffer chemical) is 9.0 at the maximum NaOH concentration. Corrosion of aluminum increases with pH in the basic range, making higher pH more corrosive. The licensee's maximum calculated pH for the NaTB decahydrate cases is 8.24. Based on NaTB decahydrate having a lower pH than is used in its corrosion calculations, the licensee stated that "no increase in corrosion rates is expected."

The NRC staff evaluated the LAR to determine if the proposed RB sump pH will be in a range that does not cause SCC of austenitic stainless-steel components or an increase in the corrosion rate of aluminum. The licensee's pH calculations and the NRC staff's corresponding evaluation, which are discussed above in Section 3.3, indicate that after a short period of time (e.g., 10 minutes), the post-LOCA RB sump pH will remain above 7.0 and well below 9.

For austenitic stainless steel, the criteria in the SRP BTP 6-1 guidance are that, for a low probability of SCC, the pH should be 7.0 or greater, and that an increasing pH in the 7.0 to 9.5 range increases the assurance that SCC will not occur. For aluminum, SRP BTP 6-1 includes a criterion that for pH greater than 7.5, consideration of hydrogen generation from aluminum corrosion should be considered. As described in Section 3.6 of the enclosure to the LAR, the licensee used a pH of 10.5 to evaluate aluminum corrosion and hydrogen generation.

Based on the sump pH range predicted for NaTB decahydrate buffer, and because the licensee's corrosion calculations for NaOH buffer are bounding for NaTB decahydrate, the NRC staff finds that the proposed NaTB decahydrate pH buffer changes are acceptable with respect to SCC of austenitic stainless steel at lower pH, and corrosion of aluminum at higher pH. Therefore, the NRC staff finds that the proposed use of NaTB decahydrate meets GDC 14 with respect to assuring the low probability of abnormal leakage or failure of the reactor coolant pressure boundary and safety-related structures.

3.6 Passive Additive System Design

Section 2.4, "Description of the Proposed Change," of the enclosure to the LAR indicates that in the current RB spray design, the spray additive system will be automatically actuated upon an RB high-high pressure signal by the ESAS in a LOCA. The new NaTB decahydrate buffering agent is a passive system and requires no actuation signal. The system can deliver NaTB decahydrate by a passive method.

Section 3.0, "Technical Evaluation," of the enclosure to the LAR indicates that in the proposed modifications, all three baskets of NaTB decahydrate will be submerged by the minimum post-LOCA flood inventory. The borated water from the RCS, core flood tanks, and borated water storage tank will be collected on the RB floor, and the NaTB decahydrate in the baskets will be dissolved in the water. The mixed solution is continuously recirculated by the ECCS following the recirculation actuation signal.

Section 2.4 of the enclosure to the LAR indicates that the current TS 3.6.6 requirements governing the operability of the NaOH additive system would be replaced with requirements governing a new RB sump buffering agent, NaTB decahydrate. The elimination of the current NaOH additive system also requires a change to ANO-1 TS 3.3.6 to remove references to the NaOH spray additive system. Because the new NaTB decahydrate buffering agent is a passive system and requires no actuation signal, reference to this system within TS 3.3.6 would not be necessary.

The NRC staff finds the proposed design modifications acceptable, because the submerged NaTB decahydrate baskets can dissolve required additive passively in the RB sump in the recirculation phase of a LOCA. Based on the above, the NRC staff finds the proposed changes to TS 3.3.6 regarding the elimination of spray additives actuation acceptable, because of the removal of automatic actuation of spray additive in the current RB spray system design.

3.7 Containment Free Volume, Heat Sink, and Fluid Inventory

Section 3.1, "Evaluation of Containment Free Volume, Heat Sink, and Fluid Inventory," of the enclosure to the LAR states:

> The installation of large stainless-steel baskets filled with NaTB decahydrate results in a minor decrease in RB net free volume and an increase in the available heat sinks in the RB. The additional heat sinks and the reduction in net free volume were evaluated and determined to have negligible impact on the RB peak pressure and temperature calculations for LOCAs as well as the RB post-LOCA flood level. Subsequently, the installation and use of NaTB decahydrate baskets do not affect the post-accident RB pressure and temperature profiles used for environmental qualification analyses.
>
> Elimination of the NaOH spray additive inventory would reduce the post-accident RB sump fluid inventory very slightly. RB water level and net free volume have been evaluated. Available net positive suction head (NPSH) calculated for the pumps taking suction from the RB sump (low head safety injection pumps and RB spray pumps) is slightly reduced but remains within acceptable limits. Similarly, plant hydraulic models and component erosive wear calculations remain unchanged. Acids generated during long-term core cooling increased insignificantly. Post-accident radiological doses with respect to applicable accident analyses were not affected by the decreased water inventory.

To verify the above, the NRC staff performed a regulatory audit as described in the audit plan, which included a review of the calculations in the following areas:

- Spray Pump NPSH
- Water Level in Containment
- Containment Net Free Internal Volume
- DBA Reanalysis
- RB Surface Areas for the Heat Sink and Hydrogen Generation Calculations
- Alternate Buffer Evaluation
- Maximum RB Sump Level

The NRC staff audited the "DBA Reanalysis" calculation concerning containment analysis and noted only a small change in containment free volume. The current licensing basis containment analysis remains unchanged. The licensee's calculation "Containment Net Free Internal Volume" indicated a decrease of containment free volume of 600 cubic feet as a result of the proposed system modification. The decrease in free volume is small compared to the containment free volume of 1.8 x 10^6 cubic feet for the containment analysis. Further, the increase in heat sink surface area resulting from the proposed system modification serves to offset the decrease of containment free volume. Therefore, the NRC staff concludes that a containment reanalysis is not necessary. The current licensing basis of containment pressure and temperature profiles remains unchanged. The post-accident RB pressure and temperature profiles used for environmental qualification analyses remain unchanged. The current licensing bases relative to GDC 38 on containment heat removal and 10 CFR 50.49 on environmental qualification remain unchanged.

In addition, the NRC staff audited the calculations concerning “Water Level in Containment,” “Spray Pump NPSH,” and “Maximum RB Sump Level,” and verified that elimination of the NaOH spray additive inventory would reduce the post-accident RB sump fluid inventory very slightly. The RB water level available NPSH calculated for the pumps taking suction from the RB sump (low head safety injection pumps and RB spray pumps) is slightly reduced but remains within acceptable limits.

Based on the audit, the NRC staff verified that the current licensing bases for containment analysis, pressure and temperature profiles being used for environmental qualification, and the NPSH for pumps being used for the LOCA recirculation phase remain unchanged.

3.8 Hydrogen Generation

Section 3.7, “Hydrogen Generation,” of the enclosure to the LAR states, in part, that ANO-1 hydrogen generation is associated with the following four different mechanisms: (1) metal-water reaction with fuel cladding; (2) entrained hydrogen in RCS water; (3) radiolytic decomposition of water; and (4) reaction of sump water with materials susceptible to corrosion (i.e., aluminum, copper, and zinc). The metal-water reaction with fuel cladding would be unchanged along with the volume of RCS water that would release hydrogen. Additionally, hydrogen that is generated due to radiolysis is not affected because hydrogen generation assumptions are based on bounding radiation levels that are not changed using the proposed buffering agent. The corrosion mechanism is based on a fixed quantity of materials that oxidizes to produce hydrogen. The amount of this material is unchanged by the application of the proposed buffering agent and is conservatively based on a pH of 10.5, which bounds the long-term pH achieved with the use of NaTB decahydrate. Thus, the assumed hydrogen generation remains unchanged.

The scope of the NRC staff audit also included a review of the licensee’s calculations in the following areas:

- Containment Building Hydrogen
- RB Surface Areas for the Heat Sink and Hydrogen Generation Calculations

Based on the audit of the above calculations, the NRC staff verified the statements in Section 3.7 of the enclosure to the LAR that the hydrogen generation resulting from the use of NaTB decahydrate would remain unchanged and, therefore, the current licensing bases relative to 10 CFR 50.44 on combustible gas control would remain unchanged.

3.9 NRC Staff Evaluation of Proposed Technical Specification Changes

The NRC staff evaluated the licensee’s application to determine if the proposed changes are consistent with the regulations, guidance, and licensing information discussed in Section 2.2 of this safety evaluation.

3.9.1 Proposed Deletion of LCO 3.3.6.e

The licensee requested that LCO 3.3.6.e for ESAS spray additive channels (9 and 10) be deleted. The licensee stated that the change from an active to passive buffer system is an enhancement. With the passive system, the active components in LCO 3.3.6.e are no longer required. The NRC staff finds that the deletion of LCO 3.3.6.e is acceptable because the components associated with the LCO will not be required to fulfill any safety function once the buffering agent is installed in the RB sump.

3.9.2 Proposed Revision to TS 3.6.6

The licensee requested that TS 3.6.6 be renamed from “Spray Additive System” to “RB Sump Buffering Agent.” The licensee stated that the buffering agent will replace the function of the spray additive system and is required to be operable as verified by revised SRs 3.6.6.1 and 3.6.6.2, discussed below. The proposed applicability for the TS would be Modes 1 and 2, which is the same as the current applicability for the “Spray Additive System.” The NRC staff reviewed the ability of the NaTB decahydrate RB sump buffering agent to perform the required safety functions of the NaOH spray additive system and determined that the new system will perform sufficiently to buffer sump pH. Because both the RB sump buffering agent and the spray additive system acceptably perform the required safety functions, it is acceptable to replace one with the other.

3.9.3 Proposed Change to LCO 3.6.6

The licensee proposed that LCO 3.6.6 be changed to reflect the new name of the TS, “RB Sump Buffering Agent.” Because the RB sump buffering agent replaces the spray additive system and the RB sump buffering agent adequately performs the required safety functions, the NRC staff finds the change acceptable.

3.9.4 Proposed Revision to LCO 3.6.6 Condition A and Required Action A.1

The licensee requested that Condition A and its associated Required Action A.1 be reworded to reflect “RB Sump Buffering Agent” instead of “Spray Additive System.” This corresponds to the proposed change in the name of the TS. Since the RB sump buffering agent performs the same function as the spray additive system, the change in nomenclature is acceptable. If the RB sump buffering agent is inoperable, the required action is to restore the buffering agent to operable. There is no change to the required action other than to the name of the system. The completion time (CT) for Required Action A.1 is 72 hours and remains unchanged from the CT for the spray additive system. Because the systems were found to perform similarly, retention of the CT of 72 hours is acceptable.

The occurrence of a LOCA within the CT of 72 hours is very unlikely making this CT an acceptable period to return the system to operable. Condition B and its associated Required Action B.1 are unchanged. Condition B requires that the unit be placed in Mode 3 within 6 hours if Required Action A.1 is not met. Maintaining the required action and CT from the current TS is acceptable because the RB sump buffering agent performs similarly to the spray additive system. The licensee stated that 6 hours is adequate time to reach Mode 3 from full power operation based on operating experience. The NRC staff also confirmed that these CTs are consistent with the Standard Technical Specifications (STS) in NUREG-1430, “Standard Technical Specifications, Babcock and Wilcox Plants,” Revision 4.0, Volume 1, “Specifications” (Reference 18). The STS are based on a plant with the spray additive system. Maintaining these CTs for the RB sump buffering agent provides reasonable assurance that the sump pool pH will be adequately controlled during a postulated accident.

3.9.5 Proposed Revision to SR 3.6.6.1

The licensee proposed to revise SR 3.6.6.1 to establish a requirement to verify the minimum volume of NaTB decahydrate contained in the RB sump buffering agent baskets. The required minimum content of the baskets is 308 cubic feet of NaTB decahydrate. The proposed requirement would replace the spray additive system requirement to verify that the system valves are in the correct position. Since the new buffering agent is passive, no valves are required to maintain a specific position or actuate to a different position for the system to perform its safety function. Therefore, a requirement to verify valve position is not needed. Verifying the minimum amount of NaTB decahydrate in the RB sump buffering agent baskets (combined with the requirements of SR 3.6.6.2, discussed below), provides assurance that the pH of the sump and the removal of iodine from the containment atmosphere will remain within the assumptions in the analyses. Therefore, the NRC staff concludes that the proposed changes to SR 3.6.6.1 are acceptable. The frequency for the surveillance is unchanged and is determined in accordance with the SFCP.

3.9.6 Proposed Revision to SR 3.6.6.2

The licensee proposed to revise SR 3.6.6.2 to eliminate the requirement to verify the minimum volume of NaOH solution and to replace it with a requirement to verify that samples from each RB sump buffering agent basket would provide adequate pH adjustment of borated water. The licensee provided the methodology for performing the dissolution and pH validation test in the LAR in a markup for the TS Bases for TS 3.6.6. The frequency for the surveillance is unchanged and is determined in accordance with the SFCP. The NRC staff concludes that the proposed change to SR 3.6.6.2 is acceptable because it verifies that the RB sump buffering agent will adequately control the pH of the post-LOCA sump pool.

3.9.7 Proposed Deletion of SR 3.6.6.3

The licensee proposed to delete SR 3.6.6.3, which verifies that the concentration of NaOH in the spray additive tank is within a specific acceptance band. The NRC staff concludes that the deletion of SR 3.6.6.3 is acceptable because SRs 3.6.6.1 and 3.6.6.2 are adequate to ensure that LCO 3.6.6 is met. The spray additive system is being retired and the tank and its contents will no longer be required.

3.9.8 Proposed Deletion of SR 3.6.6.4

The licensee proposed to delete SR 3.6.6.4, which verifies that automatic valves in the flow path for the spray additive system actuate to the correct position on an actual or simulated actuation signal. The NRC staff concludes that the deletion of SR 3.6.6.4 is acceptable because SRs 3.6.6.1 and 3.6.6.2 are adequate to ensure that LCO 3.6.6 is met. The spray additive system is being retired and the associated flowpath and valves will not be required.

3.9.9 Summary of NRC Staff Evaluation of Proposed TS Changes

The NRC staff finds that the proposed deletion of LCO 3.3.6.e for the RB spray ESAS channels is acceptable because the RB sump buffering agent is a passive system that does not require any actuation to perform its safety function. Once the RB sump buffering agent is installed, the spray additive system is no longer required.

Several changes to TS 3.6.6 are proposed to allow for the replacement of the spray additive system with the RB sump buffering agent. The revisions are necessary to establish requirements for the new sump buffering system. Since the RB sump buffering agent completely replaces the spray additive system, it is acceptable to delete all requirements for the spray additive system. The proposed changes to TS 3.6.6 establish requirements that ensure that the RB sump buffering agent will meet the LCO and, therefore, perform its safety functions as defined in the analyses.

The proposed revisions to SRs 3.6.6.1 and 3.6.6.2 will provide adequate assurance that LCO 3.6.6 will be met. The SRs 3.6.6.3 and 3.6.6.4 for the spray additive system are no longer required and will be deleted.

The NRC staff reviewed the proposed TS changes to ensure that the TS required amount of NaTB decahydrate is sufficient to maintain the sump pH greater than 7.0 during a DBA LOCA and that requirements for periodic inspection and sampling of the buffer provide reasonable assurance that it will function as required.

The NRC staff determined that the proposed TS changes to TS 3.6.6 are acceptable as NaTB decahydrate will serve as an adequate buffer for post-DBA LOCA sump pH control. Additionally, the NRC staff finds it acceptable to maintain a combined volume of at least 308 cubic feet of NaTB decahydrate, as this volume of buffer will be adequate to maintain the sump pH greater than 7.0, as discussed in the NRC staff's technical evaluation above. The proposed SRs provide for periodic testing of the NaTB decahydrate stored in containment to confirm that the NaTB decahydrate buffering capabilities are within its design limits. Therefore, the NRC staff concludes that the proposed changes meet 10 CFR 50.36 with respect to incorporating the use of NaTB decahydrate into the TSs and, thus, are acceptable.

3.10 NRC Staff Technical Evaluation Conclusion

With the proposed changes, the licensee's LOCA radiological analyses will continue to be consistent with RG 1.183, Appendix A, Regulatory Position 2 and Regulatory Position 5.1.2 and, therefore, the results of these analyses will not change. Therefore, the licensee's DBA LOCA radiological consequences analyses, after implementing the proposed change, will continue to meet the guidance in RG 1.183, and the postulated consequences will continue to meet the dose acceptance criteria in 10 CFR 50.67 and RG 1.183, Regulatory Position 4.4 and are, therefore, acceptable to the NRC staff.

As described above, the NRC staff reviewed the assumptions, inputs, and methods used by the licensee to assess the radiological impacts of the RB sump pH control system buffer change at ANO-1. The NRC staff finds that the licensee used analysis methods and assumptions consistent with the conservative regulatory requirements and guidance identified in Section 2.0 above. The NRC staff finds, with reasonable assurance, that the licensee's estimates of the exclusion area boundary, low population zone, and control room doses will continue to comply with these criteria. Therefore, the proposed building emergency sump pH control system buffer change at ANO-1 is acceptable with respect to the radiological consequences of postulated DBAs.

The NRC staff reviewed the LAR and the licensee's post-DBA LOCA sump pH calculation, assumptions, and methodology, and finds that the change from NaOH injection to NaTB decahydrate baskets stored in containment will provide reasonable assurance that the post-DBA LOCA sump pH will reach at least 7.0 by the onset of recirculation and maintain this pH for the 30-day post-LOCA period. The NRC staff also performed independent calculations to evaluate the post-LOCA sump pH behavior using the specified amount of NaTB decahydrate. The proposed TS requirement to maintain at least 308 cubic feet of NaTB decahydrate in baskets in containment provides reasonable assurance that a pH of at least 7.0 will be reached by onset of recirculation mode and will be maintained for the 30-day period following a DBA LOCA. In addition, the post-LOCA pH range is consistent with BTP 6-1 as it relates to limiting the likelihood of SCC of components in containment. The NRC staff also finds that the change from NaOH to NaTB decahydrate as the pH buffering agent is acceptable as it relates to post-LOCA generation of chemical precipitates that could contribute to ECCS suction strainer blockage.

Based on the above, the NRC staff concludes that the proposed change in sump pH buffering agent from NaOH to NaTB decahydrate is acceptable with respect to meeting the following: 10 CFR 50.67 and GDCs 19 and 41 for DBA consequences and pH control for preventing iodine re-evolution, 10 CFR 50.46 for preventing ECCS strainer blockage by chemical effects, GDCs 14 and 41 for limiting the likelihood of SCC, and 10 CFR 50.36 for incorporating the changes into the TS.

Moreover, based on the evaluation above, the NRC staff concludes that the requirements of GDC 38 for containment heat removal, 10 CFR 50.44 for hydrogen generation, and 10 CFR 50.49 for environmental qualification will continue to be met. The proposed changes are also acceptable from a radiological consequence review because they do not have an impact on the current licensing basis LOCA analysis as discussed above in Section 3.1.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Arkansas State official was notified of the proposed issuance of the amendment on January 13, 2021. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes requirements with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20 and changes SRs. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration published in the *Federal Register* on May 19, 2020 (85 FR 29984), and there has been no public comment on such finding. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. Gaston, R., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "License Amendment Request, Replacement of Reactor Building Spray Sodium Hydroxide Additive with a Passive Reactor Building Sump Buffering Agent Sodium Tetraborate," dated February 24, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20056D591).

2. Gaston, R., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Supplemental Information Related to License Amendment Request to Replacement of Reactor Building Spray Sodium Hydroxide Additive with a Passive Reactor Building Sump Buffering Agent Sodium Tetraborate," dated July 21, 2020 (ADAMS Accession No. ML20203M182).

3. Gaston, R., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Additional Information Related to License Amendment Request to Replace the Reactor Building Spray Sodium Hydroxide Additive with a Passive Reactor Building Sump Buffering Agent Sodium Tetraborate," dated August 27, 2020 (ADAMS Accession No. ML20240A207).

4. Gaston, R., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Modification of Surveillance Requirement Related to License Amendment Request to Replace the Reactor Building Spray Sodium Hydroxide Additive with a Passive Reactor Building Sump Buffering Agent Sodium Tetraborate," dated October 1, 2020 (ADAMS Accession No. ML20275A200).

5. Gaston, R., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "Supplement Related to License Amendment Request to Replace the Reactor Building Spray Sodium Hydroxide Additive with a Passive Reactor Building Sump Buffering Agent Sodium Tetraborate," dated February 22, 2021 (ADAMS Accession No. ML21053A417).

6. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," Revision 0, dated July 2000 (ADAMS Accession No. ML003716792).

7. U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition" (SRP), Section 6.5.2, "Containment Spray as a Fission Product Cleanup System," Revision 4, dated March 2007 (ADAMS Accession No. ML070190178).

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Date: March 23, 2021

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 1 - ISSUANCE OF AMENDMENT NO. 272 RE: REPLACEMENT OF REACTOR BUILDING SPRAY SODIUM HYDROXIDE ADDITIVE WITH A PASSIVE REACTOR BUILDING SUMP BUFFERING AGENT (EPID L-2020-LLA-0036) DATED MARCH 23, 2021

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