



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

January 13, 2009

Vice President, Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT NO. 1 - ISSUANCE OF AMENDMENT RE:
SODIUM HYDROXIDE TANK CONCENTRATION (TAC NO. MD9535)

Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 234 to Renewed Facility Operating License No. DPR-51 for Arkansas Nuclear One, Unit No. 1. The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated July 30, 2008, as supplemented by letter dated October 2, 2008.

The amendment revises the current TS 3.6.6.3 surveillance requirements for sodium hydroxide (NaOH) concentration. Specifically, the amendment changes the surveillance requirements of the NaOH tank solution concentration from between 5.0 percent and 16.5 percent to between 6.0 percent and 8.5 percent.

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

Sincerely,

A handwritten signature in cursive script that reads "Alan Wang".

Alan B. Wang, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures: 1. Amendment No. 234 to DPR-51
2. Safety Evaluation

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

ENERGY OPERATIONS, INC.

DOCKET NO. 50-313

ARKANSAS NUCLEAR ONE, UNIT NO. 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 234
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 July 30, 2008, as supplemented by letter dated October 2, 2008, 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 license 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.

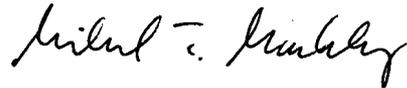
2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-51 is hereby amended to read as follows:

- (2) Technical Specifications

- The Technical Specifications contained in Appendix A, as revised through Amendment No. 234, are hereby incorporated in the renewed license. EOI shall operate the facility in accordance with the Technical Specifications.

3. The license amendment is effective as of its date of issuance and shall be implemented within 90 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Michael T. Markley, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Date of Issuance: January 13, 2009

ATTACHMENT TO LICENSE AMENDMENT NO. 234
RENEWED FACILITY OPERATING LICENSE NO. DPR-51
DOCKET NO. 50-313

Replace the following pages of the Renewed Facility Operating License No. DPR-51 and 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.

Operating License

REMOVE

License Page 3

INSERT

License Page 3

Technical Specifications

REMOVE

3.6.6.1
3.6.6.2

INSERT

3.6.6.1
-

- (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. 234, 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.

3.6 REACTOR BUILDING SYSTEMS

3.6.6 Spray Additive System

LCO 3.6.6 The Spray Additive System shall be OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Spray Additive System inoperable.	A.1 Restore Spray Additive System 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 each Spray Additive System manual, power operated, and automatic valve in the flow path that is not locked, sealed, or otherwise secured in position is in the correct position.	31 days
SR 3.6.6.2 Verify sodium hydroxide tank solution volume is ≥ 9000 gallons.	184 days
SR 3.6.6.3 Verify sodium hydroxide tank solution concentration is > 6.0 wt% and < 8.5 wt.% NaOH.	184 days
SR 3.6.6.4 Verify each Spray Additive System automatic valve in the flow path actuates to the correct position on an actual or simulated actuation signal.	18 months



UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 234 TO

RENEWED FACILITY OPERATING LICENSE NO. DPR-51

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT NO. 1

DOCKET NO. 50-313

1.0 INTRODUCTION

By application dated July 30, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML082130343), to the U.S. Nuclear Regulatory Commission (NRC), as supplemented by letter dated October 2, 2008 (ADAMS Accession No. ML082770149), Entergy Operations, Inc. (the licensee), requested changes to the Technical Specifications (TSs) for Arkansas Nuclear One, Unit No. 1 (ANO-1). The supplement dated October 2, 2008, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on November 4, 2008 (73 FR 65694).

The proposed amendment will revise the current TS 3.6.6.3 surveillance requirements for sodium hydroxide (NaOH). Specifically, the amendment changes the surveillance requirements of the NaOH tank solution concentration from between 5.0 weight (wt.) percent and 16.5 wt. percent to between 6.0 wt. percent and 8.5 wt. percent.

The licensee has proposed this amendment to improve sump performance until the potential chemical effects associated with NaOH issue is resolved as part of the Generic Safety Issue (GSI)-191, "Assessment of Debris Accumulation on PWR Sump Performance." The NRC and the nuclear industry jointly sponsored Integrated Chemical Effects Tests (ICET) to investigate potential chemical effects in representative post-loss-of-coolant accident (LOCA) containment environments. The ICET series was conducted by Los Alamos National Laboratory (LANL), at the University of New Mexico. ICET #1 represented an NaOH environment and showed that chemical precipitates were generated following corrosion of insulation and metallic materials. Aluminum oxyhydroxide forms after the corrosion of aluminum. The corrosion of aluminum increases with increased pH.

ANO-1's proposed license amendment would decrease the maximum amount of NaOH in containment, which would reduce the post-LOCA sump maximum pH and in turn reduce the corrosion of aluminum and formation of aluminum-based precipitates. Thus, the reduction in the

maximum NaOH concentration will have a beneficial effect on total mass of chemical precipitate generated, reducing the potential impact of chemically formed precipitates on the sump strainer and improving sump performance. The licensee's approach to resolving potential chemical effects associated with NaOH is a part of the GSI-191 resolution process which is still under NRC staff review. With regard to this amendment, while the proposed change will be beneficial to the operation of the emergency core cooling system (ECCS) post-LOCA, ANO-1's current licensing basis requires NaOH control for pH control.

2.0 REGULATORY EVALUATION

The containment sump (also known as the emergency recirculation sump) is part of the emergency core cooling system (ECCS). In accordance with the regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," every nuclear power plant is required to have an ECCS to mitigate a design-basis accident. The regulations in 10 CFR 50.46(a)(1)(i) states, in part, that each "pressurized light-water nuclear power reactor ... must be provided with an [ECCS] that must be designed so that its calculated cooling performance following postulated [LOCAs] conforms to the criteria set forth in paragraph (b) of this section." The regulations in 10 CFR 50.46(b)(5), "Long-term cooling," state "[a]fter any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core."

Under LOCA conditions, buffering agents are added to the pool of water in the containment building to increase the coolant pH to greater than 7.0. The buffering agent is needed to reduce the release of iodine fission products from the coolant pool to the containment atmosphere as iodine gas. Thus, pH control is necessary for dose control limitations. In 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criteria (GDC) 41, "Containment atmosphere cleanup," applies to fission product control. GDC 41 states, in part, that

Systems to control fission products, hydrogen, oxygen, and other substances which may be released into the reactor containment shall be provided as necessary to reduce, consistent with the functioning of other associated systems, the concentration and quality of fission products released to the environment following postulated accidents . . .

In addition, the NRC staff utilized the following regulatory guidance in performing this review:

- U.S. Nuclear Regulatory Commission, "Containment Spray as a Fission Product Cleanup System," NUREG-0800, Revision 4, March 2007 (ADAMS Accession No. ML053080202), Section 6.5.2, which states, in part, that long-term iodine retention may be assumed only when the equilibrium sump solution pH, after mixing and dilution with the primary coolant and ECCS injection, is above 7.
- U.S. Nuclear Regulatory Commission, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," Regulatory Guide 1.82, Revision 3, November 2003 (ADAMS Accession No. ML033140347), Section 1.1.2, which states, in part, that debris that could accumulate on the sump screen should be minimized.

3.0 TECHNICAL EVALUATION

Post-LOCA containment pool buffering is primarily required to control the radiological consequences of an accident by reducing the release of iodine fission products from the pool to the containment atmosphere as molecular iodine. Maintaining a pH above 7 prevents significant amounts of iodine, released from failed fuel and dissolved in the recirculation water, from converting to a volatile molecular iodine form and evolving into the containment atmosphere. The pH of the sump water in ANO-1 is controlled by the NaOH buffer which is formed by the addition of NaOH to the boric acid dissolved in the sump water after an LOCA. However, current understanding of the sump chemistry has indicated that NaOH inside containment forms aluminum-based precipitates. These precipitates, when generated in significant quantities, may impede the flow of fluid through the strainers in the sump. To reduce the potential for strainer blockage by chemical precipitates, the licensee proposes to reduce the quantity of NaOH in containment to establish a sump pH range that still ensures iodine retention, but is less caustic and generates less chemical precipitates than the pH range created by the current amount of NaOH. As noted earlier, ANO-1's current licensing basis only requires NaOH control for pH control.

The current ANO-1 TS requires the concentration of NaOH to be between 5.0 wt. percent and 16.5 wt. percent. The maximum pH for this concentration range is 10.5. The proposed TS would change the concentration of NaOH to be between 6.0 wt. percent and 8.5 wt. percent. The proposed change in the range of concentration would have a maximum pH of 9.0.

By letter dated October 1, 2008, the NRC staff requested the licensee to provide the following additional information:

1. the maximum concentration of strong acid concentrations in the sump for a period of 30 days post-LOCA,
2. describe the methodology used to determine the pH in the sump water during the period of 30 days post-LOCA, and
3. describe the computer code used for the analysis and provide the inputs and outputs of the program.

In the Entergy letter dated October 2, 2008, the licensee stated that the maximum strong acids generated are cable-generated hydrochloric acid ($1.52E-3$ moles per liter) and sump generated nitric acid ($5.85E-5$ moles per liter). The licensee used the computer program MULTEQ-REDOX, Version 2.24, to calculate the pH post-LOCA. The program inputs include the borated water storage tank (Boron), the core flood tanks (Boron), the reactor coolant system (Boron), the NaOH tank (NaOH) and the strong acids generated. The program calculated that a NaOH tank concentration value of 5.53 wt. percent will result in an equilibrium sump water pH of at least 7.0. Based on the above, the NRC staff has concluded that the proposed NaOH tank solution of between 6.0 wt. percent and 8.5 wt. percent will assure that the pH remains greater than 7.0 over the period of 30 days post-LOCA. The new NaOH limits are bounded by the previous limits and are greater than the minimum required NaOH concentration to maintain the sump pH greater than 7.0. The NRC staff, therefore concludes that revising the ANO-1 TS to change the concentration limits required in the NaOH tank will provide acceptable containment sump

buffering such that the sump pH will be maintained in an acceptable range under LOCA conditions.

In the NRC letter dated October 1, 2008, the NRC staff also requested the licensee to show that the reduction in maximum NaOH concentration will result in reduced chemical effects and provide the calculated quantity of chemical precipitates, by species, before and after the proposed change. In the Entergy letter dated October 2, 2008, the licensee performed analysis using the model in WCAP-16530-NP, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191," for the existing pH range and the proposed pH range. This analysis was performed using conservative values for boron concentration and water volume, in order to establish the maximum possible pH. The licensee's analysis determined that the quantity of aluminum oxyhydroxide can be reduced by approximately 60 percent by reducing the concentration of NaOH to assure a maximum pH of 9.0 as opposed to the current maximum of 10.5.

The NRC staff's evaluation concluded that the proper buffering, to maintain a final sump pH greater than 7.0 in the case of a LOCA, will be provided by the new reduced concentrations of NaOH to be added by the spray additive. Based on the above, the NRC staff finds that the proposed change to the NaOH concentration limits in the NaOH tank is acceptable. In addition, based on the licensee's analysis, the NRC staff has concluded that changing the NaOH concentration limits to reduce the maximum pH will reduce the quantity of precipitates produced, which will be beneficial to the operability of sump strainers post-LOCA.

4.0 STATE CONSULTATION

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

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. 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, and there has been no public comment on such finding published November 4, 2008 (73 FR 65694). 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) 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.

Principal Contributor: E. Wong
A. Wang

January 13, 2009

Vice President, Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT NO. 1 - ISSUANCE OF AMENDMENT RE:
SODIUM HYDROXIDE TANK CONCENTRATION (TAC NO. MD9535)

Dear Sir or Madam:

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Sincerely,

/RA/

Alan B. Wang, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures: 1. Amendment No. 234 to DPR-51
2. Safety Evaluation

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ADAMS Accession Nos.: ML083050176 *See previous concurrence **SE input memo

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