

October 2, 2007

Mr. Michael Balduzzi
Sr. Vice President, Regional Operations NE
Entergy Nuclear Operations, Inc.
440 Hamilton Avenue
White Plains, NY 10601

SUBJECT: PALISADES NUCLEAR PLANT - ISSUANCE OF AMENDMENT RE:
REPLACEMENT OF CONTAINMENT SUMP BUFFER (TAC NO. MD5893)

Dear Mr. Balduzzi:

The Commission has issued the enclosed Amendment No. 227 to Renewed Facility Operating License No. DPR-20 for the Palisades Nuclear Plant. The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated June 29, 2007, as supplemented by letter dated August 20, 2007.

The amendment revises the TSs to replace references to trisodium phosphate (TSP) with sodium tetraborate decahydrate (STB). Specifically, the changes revise TS Limiting Condition for Operation (LCO) 3.5.5, to reflect the weight requirements for STB. Surveillance Requirements (SR) 3.5.5.1 and SR 3.5.5.2 are revised to reflect the change from TSP to STB. The title of the TS section is changed from "Trisodium Phosphate" to "Containment Sump Buffering Agent and Weight Requirements."

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

Sincerely,

/RA/

Mahesh L. Chawla, Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosures:

1. Amendment No. 227 to DPR-20
2. Safety Evaluation

cc w/encls: See next page

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*Per Memo dated September 6, 2007

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ENTERGY NUCLEAR OPERATIONS, INC.

DOCKET NO. 50-255

PALISADES NUCLEAR PLANT

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 227
Renewed License No. DPR-20

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Entergy Nuclear Operations, Inc. (the licensee), dated June 29, 2007, as supplemented by letter dated August 20, 2007, 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;
 - 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 the license amendment and Paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-20 is hereby amended to read as follows:

The Technical Specifications contained in Appendix A, as revised through Amendment No. 227, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. ENO shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of issuance and shall be implemented during the 2007 refueling outage, prior to Mode 3 entry following refueling.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Travis L. Tate, Acting Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment: Changes to the Renewed Facility Operating License
and Technical Specifications

Date of Issuance: October 2, 2007

ATTACHMENT TO LICENSE AMENDMENT NO. 227

RENEWED FACILITY OPERATING LICENSE NO. DPR-20

DOCKET NO. 50-255

Replace the following page of the Renewed Facility Operating License No. DPR-20 with the attached revised page. The changed area is identified by a marginal line.

REMOVE

INSERT

Page 3

Page 3

Replace the following pages of 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.

REMOVE

INSERT

Table of Contents page ii
3.5.5-1

Table of Contents page ii
3.5.5-1

- (1) Pursuant to Section 104b of the Act, as amended, and 10 CFR Part 50, "Licensing of Production and Utilization Facilities," (a) ENP to possess and use, and (b) ENO to possess, use and operate, the facility as a utilization facility at the designated location in Van Buren County, Michigan, in accordance with the procedures and limitation set forth in this license;
 - (2) ENO, pursuant to the Act and 10 CFR Parts 40 and 70, to receive, possess, and use source and special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Updated Final Safety Analysis Report, as supplemented and amended;
 - (3) ENO, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use byproduct, source, and special nuclear material as sealed sources for reactor startup, reactor instrumentation, radiation monitoring equipment calibration, and fission detectors in amounts as required;
 - (4) ENO, 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 for sample analysis or instrument calibration, or associated with radioactive apparatus or components; and
 - (5) ENO, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operations of the facility.
- C. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations in 10 CFR Chapter I and is subject to all applicable provisions of the Act; 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) ENO is authorized to operate the facility at steady-state reactor core power levels not in excess of 2565.4 Megawatts thermal (100 percent rated power) in accordance with the conditions specified herein.
 - (2) The Technical Specifications contained in Appendix A, as revised through Amendment No. 227, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. ENO shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.
 - (3) ENO shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report for the facility and as approved in the SERs dated 09/01/78, 03/19/80, 02/10/81, 05/26/83, 07/12/85, 01/29/86, 12/03/87, and 05/19/89 and subject to the following provisions:

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 227 TO

RENEWED FACILITY OPERATING LICENSE NO. DPR-20

ENERGY NUCLEAR OPERATIONS, INC.

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

1.0 INTRODUCTION

By application dated June 29, 2007 (Agencywide Documents Access and Management System (ADAMS), Accession No. ML071830385), as supplemented by letter dated August 20, 2007 (ADAMS Accession No. ML072320392), Entergy Nuclear Operations, Inc., (the licensee), requested changes to the Technical Specifications (TSs) for the Palisades Nuclear Plant (PNP). The proposed changes would revise the TSs to replace references to trisodium phosphate (TSP) with sodium tetraborate decahydrate (STB). Specifically, the proposed changes would revise TS Limiting Condition for Operation (LCO) 3.5.5, to reflect the weight requirements for STB. Surveillance Requirements (SR) 3.5.5.1 and SR 3.5.5.2 would be revised to reflect the change from TSP to STB. The title of the TS section would also be changed from "Trisodium Phosphate" to "Containment Sump Buffering Agent and Weight Requirements."

The licensee's supplement dated August 20, 2007, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the Nuclear Regulatory Commission (NRC) staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on July 10, 2007 (72 FR 37544).

2.0 REGULATORY EVALUATION

The NRC staff review addresses the impact of the proposed change from TSP to STB on containment sump performance, especially potential chemical effects impact on sump screen blockage and head loss.

The containment sump (also known as the emergency recirculation sump) is part of the emergency core cooling system (ECCS). Every nuclear power plant is required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46, to have an ECCS to mitigate a design-basis accident. Paragraph 50.46(a) of 10 CFR 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 loss-of-coolant accidents (LOCA) conforms to the criteria set forth in paragraph (b) of this section." Paragraph 50.46(b)(5) of 10 CFR, "Long-term cooling," states "After 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.”

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

- NUREG-0800, Section 6.5.2, “Containment Spray as a Fission Product Cleanup System,” which states, in part, that long-term iodine retention may be assumed only when the equilibrium sump solution potential of hydrogen (pH), after mixing and dilution with the primary coolant and ECCS injection, is above seven.
- Regulatory Guide 1.82, Revision 3, “Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident,” Section 1.1.2, which states, in part, that debris that could accumulate on the sump screen should be minimized.

3.0 TECHNICAL EVALUATION

This proposed amendment removes TSP from containment. Current PNP containment materials include sources of phosphate (from the TSP) and calcium (from calcium silicate pipe insulation, marinite fiber board, and concrete). The combination of these materials is expected to form a calcium phosphate precipitate in a post-LOCA containment pool. NRC and the nuclear industry jointly sponsored Integrated Chemical Effects Tests (ICET) to investigate potential chemical effects in representative post-LOCA containment environments. The ICET series was conducted by Los Alamos National Laboratory (LANL), at the University of New Mexico. ICET #3 showed that the presence of calcium silicate (cal-sil) insulation and TSP in a simulated post-LOCA containment pool rapidly formed a calcium phosphate precipitate. NRC Information Notice (IN) 2005-26, “Results of Chemical Effects Head Loss Tests in a Simulated PWR [pressurized water reactor] Sump Pool Environment,” along with NRC IN 2005-26, Supplement 1, “Additional Results of Chemical Effects Tests in a Simulated PWR Sump Pool Environment,” discussed results from NRC sponsored head loss testing at Argonne National Laboratory (ANL). These ANL test results showed that substantial head loss can occur if sufficient calcium phosphate is produced in a simulated post-LOCA containment pool and is transported to a pre-existing bed on the containment sump screen. Therefore, this amendment proposes to remove TSP from containment.

Post-LOCA containment pool buffering is primarily required to reduce the release of iodine fission products from the pool to the containment atmosphere as iodine gas, in order to control the radiological consequences of the accident. Maintaining a pH above seven prevents significant amounts of iodine, released from fuel failures and dissolved in the recirculation water, from converting to a volatile form and evolving into the containment atmosphere. Since the ability to control pH in a post-LOCA containment pool is affected by removal of TSP, the licensee proposes to use STB as the new buffering agent.

The method of introducing the buffer material to the post-LOCA environment is the same for STB as it is for TSP. The existing 20 TSP baskets would be used to hold the STB. The licensee confirmed that the baskets are adequately sized to hold the required amount of STB. The minimum and maximum amounts of STB were determined by the licensee. Their analyses included consideration of minimum and maximum quantities of boron and borated water and the time-dependent post-LOCA sump temperature. The analyses also included radiolysis of air and

water, radiolysis of chloride bearing electrical cable insulation and jacketing, and spilled reactor core inventory. The licensee determined that the minimum amount of STB required to maintain the minimum sump pH of 7.0 is greater than or equal to 8,186 lbs. The licensee determined that the maximum amount of STB that will keep the pH less than or equal to 8.0 is less than or equal to 10,553 lbs. A detailed evaluation to confirm the licensee's pH calculations was performed by the NRC staff as part of its review of the PNP license amendment request to adopt the alternate source term methodology. The NRC staff reviewed the licensee's methodology, assumptions, and performed hand calculations to verify the resulting pH value after 30 days following a LOCA. The NRC staff's independent verification demonstrated the containment sump pH would remain above seven for at least 30 days with the quantities of STB described above.

The NRC staff reviewed the licensee's regulatory and technical analyses related to the impact of the proposed change from TSP to STB on containment sump performance, particularly the potential impact from chemical effects on sump screen blockage and head-loss aspects of design-basis accidents. The licensee's evaluation determined that STB is an acceptable alternative to TSP based on industry testing of buffers outlined in WCAP-16596-NP, "Evaluation of Alternative Emergency Core Cooling System Buffering Agents," and through plant-specific application of the chemical model developed in WCAP-16530-NP, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support [Generic Safety Issue] GSI-191." Under the existing TSP conditions, the model predicts approximately 5,500 kg of chemical precipitates. For the proposed STB condition using conservative values for pH, temperature, and quantities of contributing materials, the model predicts approximately 4,400 kg of chemical precipitates. Based on the WCAP-16530-NP model, the switch from TSP to STB results in a reduction in the mass of predicted chemical precipitates of approximately 1,100 kg. In addition the switch to STB eliminates the formation of calcium phosphate precipitates which have been shown to have severe head-loss implications at early stages of a simulated post-LOCA event (see NRC IN 2005-26).

The model still predicts a significant loading of chemical precipitates with STB buffer, however, the predicted species are aluminum-based rather than the calcium phosphate precipitates generated with TSP buffer. Calcium phosphate forms very early in the event because of the rapid dissolution of calcium. Aluminum-based precipitates are expected to form later in the event, when there is greater net positive suction head (NPSH) margin available to accommodate the debris. That is, there is less demand on the ECCS pumps at the time that the aluminum-based precipitates form. For example, NRC sample calculations (ADAMS Accession No. ML061510478) indicate the NPSH margin increases by more than 20 feet during the time from the initiation of recirculation to 24 hours after a large-break LOCA. The NRC staff finds that changing buffer materials from TSP to STB at PNP will result in an improved situation from a chemical effects standpoint. Although the buffer change will have a beneficial result on chemical precipitate generation, the licensee will still need to demonstrate acceptable ECCS performance under the proposed STB conditions in order to fully resolve GSI-191 for PNP.

4.0 SUMMARY

Based on verification calculations, the NRC staff finds that replacing the TSP containment sump buffer with STB in the quantities specified by the licensee will provide acceptable containment sump buffering such that the sump pH will be maintained in an acceptable range under LOCA conditions.

Although potential chemical effects exist with the use of STB in the PNP containment, the NRC staff determined that chemical effects at PNP will be of lower quantity and will be delayed to a more favorable time with STB compared to TSP. Based on the proper buffering to be provided by STB in the quantities specified and the relative reduction in the mass of chemical precipitates in the case of a LOCA, the NRC staff finds that the replacement of TSP with STB in the quantities specified is acceptable.

The NRC staff will review the licensee's approach to resolve potential chemical effects associated with STB as part of the GSI-191 resolution process.

5.0 STATE CONSULTATION

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

6.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to the 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 (72 FR 37544). 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.

7.0 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: Matthew G. Yoder, NRR

Date: October 2, 2007

Palisades Plant

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