February 1, 2004

Thomas L. Williamson
Director, Nuclear Safety and Regulatory Affairs
Maine Yankee Atomic Power Company
321 Old Ferry Road
Wiscasset, ME 04578-4922

SUBJECT: EXEMPTION FROM 10 CFR 72.212 AND 72.214 FOR DRY SPENT FUEL STORAGE ACTIVITIES

Dear Mr. Williamson:

This is in response to your letter dated October 2, 2003, as supplemented October 21, 2003, requesting an exemption from 10 CFR 72.212(a), 72.212(b)(2)(i), 72.212(b)(7) and 10 CFR 72.214, pursuant to 10 CFR 72.7. In your letter you requested an exemption from the requirements in Certificate of Compliance (CoC) No. 1015, Amendment 2, Appendix B, Section B 3.4.2.6, for the NAC-UMS dry spent fuel storage system. This exemption would relieve Maine Yankee Atomic Power Company (MYAPC) from the requirement to maintain a coefficient of friction on the independent spent fuel storage installation (ISFSI) pad surface of at least 0.5.

We understand that you requested the exemption to regain compliance with CoC No. 1015, Amendment 2, following discovery of a winter icing condition at MYAPC's ISFSI which created an indeterminate coefficient of friction between the vertical concrete casks and the ISFSI pad surface. MYAPC determined that a specific coefficient of friction is unnecessary.

The U.S. Nuclear Regulatory Commission (NRC) staff performed a safety evaluation of the proposed exemption. The staff reviewed the evaluations provided by MYAPC and has reasonable assurance that the site specific design earthquake will not result in significant sliding of the NAC-UMS vertical concrete casks. To gain additional assurance that icing conditions will have no adverse effects on the dry storage system, the staff evaluated the magnitude of the impact load between two colliding vertical concrete casks. The staff determined that the impact load would be far less severe than that encountered in a tip-over accident for which the NAC-UMS system has been demonstrated to be structurally adequate. The enclosed safety evaluation concludes that the requested changes will not pose an increased risk to public health and safety. Accordingly, the exemption will be effective immediately.

The NRC staff evaluated the public health and safety and environmental impacts of the proposed exemption and determined that granting the exemption would not result in any significant impacts. For this action, an Environmental Assessment and Finding of No Significant Impact have been prepared and published in the Federal Register (69 FR 4543, January 30, 2004). A copy of the Federal Register Notice was provided to you by letter dated January 23, 2004. Based on the foregoing considerations, the staff has determined that granting the proposed exemption from specific provisions of 10 CFR 72.212(a)(2), 72.212(b)(2)(i), 72.212(b)(7), and 10 CFR 72.214 is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest.

Specifically, this exemption relieves MYAPC from the requirement to maintain a coefficient of friction on the ISFSI pad surface of at least 0.5. The elimination of a required coefficient of friction value will not significantly impact the quality of the human environment. Therefore, the NRC staff has concluded that the proposed changes will not pose an increased risk to public health and safety.

If you have any questions, please contact me or Stephen O'Connor of my staff at 301-415-8500. Any future correspondence related to this action should reference Docket 72-30 and TAC No. L23658.

Sincerely,

/RA/
Larry W. Camper, Deputy Director
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Docket Nos.: 72-30, 72-1015, and 50-309

Enclosure: Safety Evaluation

cc: Mailing List

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* - see previous concurrence

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ENCLOSURE

SAFETY EVALUATION REPORT
Docket No. 72-30
Maine Yankee Atomic Power Station
Independent Spent Fuel Storage Installation

1.0 Summary

By letter dated October 2, 2003, as supplemented on October 21, 2003, Maine Yankee Atomic Power Company (MYAPC) requested an exemption from U.S. Nuclear Regulatory Commission (NRC) requirements to maintain a specific coefficient of friction (COF) on the independent spent fuel storage installation (ISFSI) pad. Specifically, Certificate of Compliance (CoC) No.1015, Technical Specification 3.4.2.6, for the NAC-UMS storage system requires that a COF of at least 0.5 be maintained on the ISFSI pad surface. However, MYAPC requested an exemption to this requirement due to winter icing conditions which may cause a significant reduction in this COF.

The NRC has evaluated the technical issues associated with this exemption and concluded in the discussion below that the proposed exemption does not pose an increased risk to public health and safety.

2.0 Discussion

2.1 Maine Yankee Evaluation

During the 2002-2003 winter, MYAPC discovered that the surface area between the NAC-UMS vertical concrete casks (VCCs) and the ISFSI pads had a significant covering of ice (approximately 80 - 95 percent of the surface). The design basis for the NAC-UMS VCC at the Maine Yankee ISFSI did not specifically address the ice formation between the bottom of the VCC and the pad during storage operations. The icing condition created a different operating parameter than those presented in the NAC-UMS Final Safety Analysis Report (FSAR). In the exemption request, MYAPC presented an evaluation of the VCC sliding performance under icing conditions.

Top-of-Pad Earthquake Acceleration Levels
Technical Specification 3.4.2.3 in CoC No. 1015, specifies the design basis earthquake acceleration levels at the top surface of the concrete ISFSI pad: horizontal acceleration in each of the two orthogonal directions at 0.38g and corresponding vertical at 0.253g. The earthquake levels were established, without specific reference to a free-field control ground motion, by analyzing seismic stability of the loaded VCC with a margin of 1.1 against sliding, given that the COF between the VCC and ISFSI pad surface be at least 0.5.

Using soil-structural interaction analyses, MYAPC considered the site specific design earthquake control motion anchored at 0.18g, rather than the 10 CFR 72.102 (a)(2) standardized design earthquake of 0.25g, to calculate the top-of-pad earthquake motion levels of 0.231g horizontal and 0.155g vertical. These accelerations, which are less severe than the

respective allowables of 0.38g and 0.253g, correspond to a minimum COF value of 0.266, in lieu of 0.5, for maintaining VCC seismic stability against sliding.

VCC Sliding Estimates

In the exemption request, MYAPC described a number of scenarios of ice formation between the VCC bottom and ISFSI pad surface with varied effective COF values. A ridge of ice formed on the pad around the outer perimeter of the VCC, coupled with the frozen bond between the VCC and the pad, is considered to provide sufficient resistance to inhibit sliding during the design earthquake. As the effective COF degrades and falls below certain thresholds, following melt of the ice ridge, the VCC is expected to undergo some lateral displacement during earthquakes. A condition of base isolation, which introduces no inertia force and, thus, no residual relative displacement to the VCC, is realized should the effective COF approach zero. To determine the magnitude of VCC sliding, MYAPC used three approaches: (1) application of Seismic Qualifications Utility Group (SQUG) seismic experience database and processes (Ref. 1), (2) application of a Sandia study (Ref. 2) on the Private Fuel Storage facility, and (3) a practical, intuitive evaluation. MYAPC estimated the magnitude of VCC sliding to be up to about 12 inches for the design earthquake.

Effects of VCC Sliding

The licensee determined that the design earthquake would not cause a VCC tip-over or impact accident. This was based on an evaluation of four NAC-UMS storage systems on a single 31-ft square ISFSI pad. At a center-to-center spacing of 15 ft between the VCCs, two VCCs will have to slide toward each other for greater than 3'-8" before impact. A lateral movement in excess of 7 feet is necessary to translate the center of gravity of a loaded VCC over the free edge of a storage pad to result in a tip-over accident.

2.2 Staff Safety Evaluation

VCC Sliding

The structural evaluation guideline, per NUREG-1536 (Ref. 3), states that the applicant should demonstrate that no tip-over or drop will result from an earthquake. In addition, impact between storage systems should either be precluded, or should be considered an accident event for which the storage systems must be shown to be structurally adequate. Technical Specification 3.4.2.6 in CoC No. 1015 requires Maine Yankee to conduct physical testing to demonstrate that the coefficient of friction on the ISFSI pad surface is at least 0.5. This COF is sufficiently large to ensure that individual VCC will not slide and will move integrally with the ISFSI pad during the design earthquake to preclude VCC impacts. For icing conditions with significantly reduced effective COF, the staff notes that sliding of the VCC can be tolerated if either it is within predetermined limits or, in the unlikely event of VCC impacts, the storage systems can be shown structurally adequate.

The staff reviewed MYAPC's VCC sliding estimates for a variety of icing conditions for which there exist considerable uncertainty about effective COF values. The staff notes that not all the database and approaches used are strictly applicable to icing conditions. In the case of the calculated relative displacements by Sandia, no basis was provided for extrapolating the results at a COF of 0.2 for application to a bounding icing condition of a nearly frictionless pad surface. Thus, although the site specific design earthquake of 0.18 g had been thought unlikely to cause large VCC sliding, the staff, nevertheless, assumed that the VCCs would impact each other and evaluated the NAC-UMS structural performance as discussed below.

Impact Velocity and Impact Loads on Storage System

In addition to reviewing the licensee's evaluation, the staff considered the effects of two storage systems impacting one another. The staff used the relative velocity of a VCC with respect to the pad motion as the basis to demonstrate that mechanical loads acting on the storage systems during VCC impacts are far less severe than those associated with a VCC tip-over accident. This is done by recognizing that the damage potential of an impact load, commonly known as the g-load level, can more appropriately be characterized by an impulse, that is defined as the product of a force and the time duration over which it acts. By equating the impulse to the change in momentum, the g-load level can be considered proportional to the velocity of the impacting body, provided that the body mass and impact time duration remain constant. For the VCC impact and tip-over accidents, that involve the impact of the VCC with another massive concrete body, the applicable g-load levels will depend, respectively, on the relative velocity between the two VCCs moving toward each other and the rotational velocity of a tipping VCC before impacting the ISFSI pad.

Estimated G-Load Levels for VCC Impact

The NAC-UMS storage system has been shown structurally adequate for the tip-over accident occurring on the storage pad. Section 11.2.15.1 of the FSAR shows peak decelerations of 35.3 g and 37.6 g for the PWR Classes 1 and 2 canisters, respectively. For the bounding deceleration of 37.6 g, the corresponding impact velocity is 166.3 in/sec at the center of gravity of the loaded VCC. In Calculation Package 08196.16-SG-6 (Ref. 4), MYAPC reported a peak ground displacement of 6.44 in. for the design earthquake anchored at a peak ground acceleration of 0.18g. The peak ground velocity was calculated to be 8.64 in/sec, in accordance with the licensing basis of the NUREG/CR-0098 method (Ref. 5) for developing site specific design response spectra. Considering soil-structure interaction effects, which amplify the top-of-pad motion to 0.231g from 0.18g, by a factor of 1.28 (0.231/0.18 = 1.28), the staff applied the same amplification factor to estimate a peak velocity of 11.1 in/sec (8.64 x 1.28 = 11.1) for the ISFSI pad. Since the peak VCC velocity relative to the pad is likely to be no more than twice the peak velocity of the pad, the staff further assumed conservatively that the maximum relative velocity between two VCCs to be four times the peak pad velocity at 44.4 in/sec (11.1 x 4 = 44.4). Assuming that the same impulse duration for NAC-UMS impact applies also to the VCC tip-over accident, the peak g-load for the VCC impact is estimated to be 10.04g (44.4/166.3 x 37.6 = 10.04). This load is far less severe than the 37.6 g for which the NAC-UMS storage system has been demonstrated to be structurally adequate for the Maine Yankee site.

3.0 Conclusion

The staff reviewed the evaluations provided by MYAPC in the exemption request, as supplemented, to allow deviation from the ISFSI pad COF requirement of 0.5. The staff has reasonable assurance that the site specific design earthquake will not result in significant sliding of the NAC-UMS storage system. To gain additional assurance that icing conditions will have no adverse effects on the storage system, the staff evaluated the magnitude of the impact load between two colliding VCCs. The staff determined that the impact load would be far less severe than that encountered in a tip-over accident for which the NAC-UMS system has been demonstrated structurally adequate. On this basis, the staff concludes that the proposed exemption does not pose an increased risk to public health and safety.

References

1. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Power Plant Equipment," Revision 2, corrected February 14, 1992, Seismic Qualification Utility Group.

2. "Seismic Analysis Report on HI-STORM 100 Casks at Private Fuel Storage Facility, Revision 1," V.K. Luk, et al, Sandia National Laboratories, Albuquerque, NM, March 31, 2002.

3. "Standard Review Plan for Dry Cask Storage Systems," NUREG-1536, U. S. Nuclear Regulatory Commission, January 1997.

4. Calculation Package 08196.16-SG-6, "NUREG-0098 Artificial Time History (Soil)," Maine Yankee ISFSI, Maine Yankee Atomic Power Company, October 2000.

5. "Development of Criteria for Seismic Review of Selected Nuclear Power Plants," N.M. Newmark and W.J. Hall, NUREG/CR-0098, May 1978.