UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

February 25, 2022

Mr. Daniel H. Dorman
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SAFETY EVALUATION FOR HOLTEC LICENSING TOPICAL REPORT HI-2200750, REVISION 0, "HOLTEC SPENT FUEL POOL HEAT UP CALCULATION METHODOLOGY"

Dear Mr. Dorman:

During the 692nd meeting of the Advisory Committee on Reactor Safeguards (ACRS), February 2-4, 2022, we completed our review of Holtec International's (Holtec's) licensing topical report HI-2200750, Revision 0, "Holtec Spent Fuel Pool Heat Up Calculation Methodology," and the associated staff draft safety evaluation (SE). Our Accident Analyses - Thermal Hydraulic Subcommittee reviewed this topic on January 20, 2022. During these meetings, we had the benefit of discussions with the staff and representatives from Holtec. We also had the benefit of the referenced documents.

CONCLUSIONS AND RECOMMENDATIONS

1. The methodology documented in HI-2200750, Revision 0, when used with the four limitations and conditions in the staff draft SE report, is a technically-sound approach for calculating peak fuel clad temperature during postulated beyond-design-basis draining events in spent fuel pools.

2. The conservative assumptions in Holtec's methodology, supported by detailed staff analysis using independent methods, compensates for limited experimental data.

3. The credibility assessment framework documented in NUREG/KM-0013 used by the staff, increases rigor, enhancing confidence in the evaluation. Its use should be encouraged for other reviews.

4. The staff draft SE report should be issued.

BACKGROUND

As stated by Holtec during our January 20, 2022, subcommittee meeting, their methodology provides an approach to determine the best overall spent fuel pool arrangement to reduce the risk of a "zirconium fire" after permanent defueling. During a postulated beyond-design-basis

drain down event of a spent fuel pool, the cladding of the fuel assemblies heats up due to the loss of water in the pool. If the zirconium alloy cladding temperature exceeds a certain value, there is the possibility of a self-sustained exothermic oxidation reaction with air. The Holtec methodology uses transient thermal analysis for a proposed spent fuel loading arrangement to confirm that the peak fuel temperature does not exceed the allowed limit within the prescribed time. In addition to potential safety benefits, the Holtec method offers possible economic benefits during decommissioning. Prior to any fuel movement, other regulatory requirements and commitments, such as those associated with criticality or aircraft impact, are reviewed for compliance.

DISCUSSION

The staff applied the acceptance criteria from NUREG-1738 that the spent fuel peak temperature remains below 900°C for at least 10 hours following a complete drain down of the SFP. Based on analysis of experimental data, NUREG-1738 concludes that the 900°C provides an acceptable limit to prevent self-sustained fuel oxidation in an air environment. The 10-hour criterion allows for time to implement mitigation actions.

The Holtec calculational methodology was reviewed using Section 15.0.2 of the Standard Review Plan (SRP), NUREG-0800. In addition, the staff followed a structured format based on the credibility assessment framework documented in NUREG/KM-0013. The credibility framework was used by the staff to extract all the steps from the SRP and evaluate compliance.

There are insufficient experimental data to use standard statistical methods to validate Holtec's methodology. To compensate, the staff conclusions were based on the methodology's conservative assumptions and were supported by detailed analysis using independent tools and novel methods. Conservative assumptions include neglecting air flow and axial heat loss through the fuel top and bottom. These assumptions, if credited, would result in lower fuel temperatures; this adds confidence on the adequacy of the proposed methodology.

The staff draft SE report contains four limitations and conditions, which impose penalties or methodology restrictions to account for uncertainties in the methodology. These limitations help ensure the overall conservatism of the methodology.

The staff review was thorough and supports their conclusion that "there is reasonable assurance that this method will conservativity or accurately predict the PCT [peak cladding temperature] following spent fuel pool drain down." Our review of Holtec's submission and the staff draft SE report confirms this conclusion.

SUMMARY

The methodology documented in HI-2200750, Revision 0, when used with the four limitations and conditions in the staff draft SE report, is a technically-sound approach for calculating peak fuel clad temperature during postulated beyond-design-basis draining events in spent fuel pools. The conservative assumptions in Holtec's methodology, supported by detailed staff analysis using independent methods, compensates for limited experimental data. The credibility

assessment framework documented in NUREG/KM-0013 used by the staff increases rigor, enhancing confidence in the evaluation. Its use should be encouraged for other reviews. The staff draft SE report should be issued.

We are not requesting a formal response from the staff to this letter report.

Sincerely,

Signed by Rempe, Joy
on 02/25/22

Joy L. Rempe
Chairman

REFERENCES

1. Holtec International, HI-2200750, Revision 0, “Holtec Spent Fuel Pool Heat Up Calculation Methodology,” September 29, 2020 – initial submittal (October 30, 2020 – resubmittal) (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML20280A525 (Non-Publicly Available) and ML20280A524 (Publicly Available)).

2. U.S. Nuclear Regulatory Commission (NRC), Draft Safety Evaluation for “Holtec Spent Fuel Pool Heat Up Calculation Methodology,” Revision 0, September 16, 2021 (ADAMS Accession No. ML21313A370 (Non-Publicly Available)).

3. NRC, NUREG-1738, “Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants,” 2001 (ADAMS Accession No. ML010430066)”.

4. NRC, NUREG-0800, Section 15.0.2, “Review of Transient and Accident Analysis Methods,” December 2005 (ADAMS Accession No. ML053550265).

5. NRC, Regulatory Guide 1.203, “Transient and Accident Analysis Methods,” December 2005 (ADAMS Accession No. ML053500170).

6. Kaizer, J. S., Heller, A. K., and Oberkampf, W. L., “Scientific computer simulation review,” Reliability Engineering and System Safety 138: 210-218, 2015.

7. NRC, NUREG/KM-0013, “Credibility Assessment Framework for Critical Boiling Transition Models: A generic safety case to determine the credibility of critical heat flux and critical power models,” Draft for Comment (ADAMS Accession No. ML19073A249).

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