SAFETY EVALUATION REPORT
NAC INTERNATIONAL, INC.
MAGNASTOR® STORAGE SYSTEM
DOCKET NO. 72-1031
AMENDMENT NO. 8

Summary

By application dated September 12, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18257A079), as supplemented on November 11, 2018 (ADAMS Accession No. ML18331A180), June 14, 2019 (ADAMS Accession No.ML19171A269), and July 16, 2019 (ADAMS Accession No. ML19199A151), the cask vendor, NAC International, Inc. (NAC, or applicant) submitted a request to the NRC in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 72.244 to amend Certificate of Compliance (CoC) No. 1031. NAC requested the NRC to delete Technical Specification (TS) A5.6 and revise the maximum pellet diameter in TS, Appendix B, Table B2-3 from 0.325 inches to 0.3255 inches to authorize the CE16H1 hybrid fuel assembly. This amended CoC, when codified through rulemaking, will be denoted as Amendment No. 8 to CoC No. 1031. This safety evaluation report documents the U.S. Nuclear Regulatory Commission (NRC) staff's review and evaluation of Amendment No. 8 for CoC No. 1031 for the Modular Advanced Generation Nuclear All-purpose STORage (MAGNASTOR®) spent fuel dry cask storage system.

The NRC staff determined that the areas of review that are not affected by this revision include: general information, principal design criteria, structural, confinement, shielding, materials, operating procedures, acceptance test and maintenance program, radiation protection, accident analyses, and quality assurance; therefore, only the thermal, criticality and TS evaluations are provided.

The NRC staff reviewed the amendment request using guidance in NUREG-1536, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility, Final Report," Rev. 1, dated July 2010. For the reasons stated below and based on the statements and representations in NAC's application, as supplemented, and the conditions specified in the CoC and TSs, the staff concludes that the requested changes meet the requirements of 10 CFR Part 72.

4.0 THERMAL EVALUATION

The applicant submitted for review and approval License Amendment Request No. 8 to revise the CoC for the MAGNASTOR® cask storage system to delete TS A5.6, "Special Requirements for the First System Placed in Service." In support of its application, NAC provided data from a purpose-built test apparatus that simulates the heat transfer characteristics of the MAGNASTOR® cask storage system to validate the MAGNASTOR® thermal analysis.

Using the design information of the test apparatus as described in the Calculation Package No. 71160-3161, "Validation of [computational fluid dynamics (CFD)] Mass Air Flow Calculations for MAGNASTOR Systems with Sandia Thermal Test Program," NAC developed a two-dimensional (2-D) CFD model to perform the air mass flow analysis and compared the predicted results with test data. Comparisons with measured data shows that the air mass flow rate is predicted very well, and component temperatures were overpredicted for the reasons stated below. Based on the comparisons of predicted results versus measurements, the applicant concluded this would validate MAGNASTOR® thermal analysis because the comparison shows the thermal analysis

would tend to overpredict temperatures. Based on the 2-D analysis and results, the applicant concluded TS 5.6 requirements for validation of the heat transfer characteristics and thermal performance had been satisfied and therefore, TS A5.6 could be removed from the CoC.

The staff reviewed the applicant's thermal models used in the analyses. The staff checked the code input in the calculation package (Calculation Package No. 71160-3161, Rev. Nos. 0 and 1) and confirmed that the proper material properties and boundary conditions were used (with specific limitations regarding the applicant-developed 2-D model, such as the three-dimensional (3-D) effects that are not included in the applied boundary conditions at each end of the test apparatus). The staff verified that the applicant's selected code models and assumptions were adequate for the flow and heat transfer characteristics prevailing in the test apparatus geometry and analyzed conditions. The drawings of the test apparatus were also consulted to verify that adequate geometry dimensions were translated to the analysis model. The material properties presented in the calculation package were reviewed to verify that they were appropriately referenced and used. The staff also reviewed the analysis model to ensure that the applicant used an adequate mesh to properly capture the heat transfer characteristics of the test apparatus. The staff finds the applicant's test apparatus and developed analysis model acceptable because the test apparatus mimics the thermal-hydraulic characteristics of the MAGNASTOR® cask storage system. Therefore, the staff concludes that the applicant's analysis models and results from the test apparatus support the NRC staff's action to revise the CoC and delete TS A5.6 as requested.

The staff reviewed and evaluated the applicant's analysis and results and concluded that the applicant's thermal model adequately validates the thermal analysis regarding air mass flow rate predictions. Based on the comparison provided by NAC, the predicted air mass flow rates can be used to validate the MAGNASTOR® thermal analysis. Comparisons of calculated component temperatures with the measurements show that the applicant's analysis model slightly overpredicts the temperature of the aluminum plate and overpredicts the temperature of the liner plate. This can be attributed mostly to the fact that the applicant's analysis model is a 2-D representation of the test apparatus. The staff believes the model lacks 3-D details such as heat transfer losses at each end of the test apparatus. A 3-D representation of the test apparatus would result in a better comparison. However, the objective of the test is to obtain data to validate predictions of air mass flow rate. As indicated above, predicted air mass flow rates compare very well with measurements. Therefore, based on the validation results, the staff finds the applicant's request to remove TS A5.6 from the CoC acceptable.

4.1 Evaluation Findings

F4.1 The staff reviewed the application and concludes that the proposed change to TS A5.6 is in compliance with 10 CFR Part 72, and that the applicable design and acceptance criteria have been satisfied. The NRC staff evaluation of the TS change provides reasonable assurance that the MAGNASTOR® cask storage system will continue to provide safe storage of spent nuclear fuel. This conclusion is reached on the basis of a review that considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.

6.0 CRITICALITY EVALUATION

In support of its request to revise the maximum pellet diameter in TS, Appendix B, Table B2-3 from 0.325 inches to 0.3255 inches to authorize the storage of hybrid fuel assembly CE16H1, NAC provided information demonstrating that the larger pellet diameter was evaluated by NAC

and that, with the larger pellet diameter, the MAGNASTOR® cask storage system meets the criticality requirements in 10 CFR Part 72.

NAC discussed that, in the criticality evaluation for its application for approval (ADAMS Accession No. ML091030364), it grouped the proposed inventory of allowable spent fuel assemblies into generic fuel types and established bounding values on the key parameters for each generic type. Any fuel assembly that meets all the characteristics of a fuel assembly hybrid group can safely be loaded into the MAGNASTOR® cask storage system.

NAC provided portions of NAC Calculation 71160-6001, Revision 0, "NewGen Transfer and Storage Criticality Analysis," which evaluates changes to moderator density, guide/instrument tube thicknesses and diameter, and pellet diameter. Cases 2 and 4 from Table 6.7.2-3 show the effect on reactivity of changing pellet diameter, whereas the other 6 cases show changes to the other aforementioned items. The maximum pellet diameter evaluated in Table 6.7.2-3, "PWR Lattice Parameter Reactivity Study (Increased Variance)" in its submittal dated July 16, 2019, was 0.3255 in. (0.8268 cm) for case 2 and the minimum pellet diameter evaluated was 0.3245 in. (0.82423 cm) for case 4. The k_{eff} for case 2 is 0.87710 and the k_{eff} for case 4 is 0.87731. NAC determined that the system k_{eff} with this larger diameter pellet is statistically the same as the system k_{eff} with the nominal pellet diameter, which therefore has no effect on the criticality safety of the MAGNASTOR® cask storage system.

The staff reviewed the FSAR and agrees that the proposed change to the pellet diameter will not result in statistically significant changes to the MAGNASTOR® cask storage system k_{eff}. The staff also agrees with the results of the NAC criticality analysis in the FSAR and NAC's conclusion that this change does not affect the ability of the MAGNASTOR® cask storage system to meet the criticality safety requirements in 10 CFR Part 72.

6.1 Findings

F6.1 The proposed change to the maximum pellet diameter continues to ensure that the MAGNASTOR® cask storage system is designed to be subcritical under all credible conditions.

13.0 TECHNICAL SPECIFICATIONS AND OPERATING CONTROLS AND LIMITS EVALUATION

NAC requested the NRC to delete TS A5.6 and revise the maximum pellet diameter in TS, Appendix B, Table B2-3 from 0.325 inches to 0.3255 inches to authorize the storage of the CE16H1 hybrid fuel assembly. Both of these proposed changes were evaluated in the previous sections of this safety evaluation report and found to be acceptable. Based on the NRC staff's evaluation in Chapters 4 and 6 above, the NRC finds that the proposed changes to the TSs are acceptable.

13.1 Evaluation Findings

F13.1 The staff concludes that the conditions for use for the MAGNASTOR® cask storage system identify necessary TSs to satisfy 10 CFR Part 72 and that the applicable acceptance criteria have been satisfied. The proposed TSs provide reasonable assurance that the MAGNASTOR® cask storage system will allow safe storage of spent fuel. This finding is based on the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted practices.

Issued with Certificate of Compliance No. 1031, Amendment No. 8,
on February 20, 2020.