Non-Proprietary Request for Additional Information
Docket No. 72-1031
Certificate of Compliance No. 1031
Model No. MAGNASTOR® Storage System
Amendment No. 10

By letter dated December 9, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19345E594), as supplemented on May 13, 2020 (ADAMS Accession No. ML20143A102), NAC International (NAC) submitted an application for Amendment No. 10 to the Model No. MAGNASTOR® storage cask. The application proposes to add a new metal storage overpack (MSO). This request for additional information identifies information needed by the U.S. Nuclear Regulatory Commission (NRC) staff in connection with its review of the application. The requested information is listed by chapter number and title in the applicant's safety analysis report (SAR). The NRC staff used NUREG-2215, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility — Final Report," in its review of the application.

Each question describes information needed by the staff for it to complete its review of the application and to determine whether the applicant has demonstrated compliance with regulatory requirements.

Structural Evaluation

3-1 Clarify how the effects of material nonlinearities (e.g., strain rate and triaxiality) are accounted for in the structural integrity evaluation of the MSO pedestal assembly and transportable storage container (TSC) when subjected to a 24-inch drop accident.

Based on the LS-DYNA finite element models provided with the SAR and the evaluation of the 24-inch drop presented in Calculation Package No. 30082-2604, "Evaluation of the MAGNASTOR® Metal Storage Overpack for a 24-inch Drop," it is not clear to the staff if these material nonlinearities have been accounted for in the plastic analysis of the MSO pedestal assembly or the finite element models supporting the plastic analysis. In the finite element models of the 24-inch drop provided to the staff, it appears that strain rate effects and triaxiality of failing components have not been incorporated into the analysis. For the piecewise linear plasticity material model used for the pedestal components, the option to account for strain rate effects by scaling the yield stress was chosen. However, the curve for the scaling factor does not appear to have been defined. The staff is concerned that higher g-loads could be experienced by the TSC and the structural integrity of the pedestal could be diminished when incorporating these material properties. Since the structural evaluation of the TSC in the drop is based on a comparison of the g-loads to the design TSC g-loads, the staff's concern is related to confinement. And since the deformations in the pedestal affect the geometry of the MSO air inlets, the staff's concern also relates to the thermal performance of the cask. The staff requests clarification of how these material nonlinearities are addressed and that the simulations, calculations, and the SAR be updated as necessary.

This information is needed to determine compliance with the regulatory requirements in 10 CFR 72.236(l).

3-2 Clarify the geometry of the MSO pedestal and the g-loads experienced by the TSC as a result of the 24-inch drop scenario.

LS-DYNA simulations of the 24-inch drop scenario show the TSC striking the MSO pedestal. The simulations show the part labeled “SHORT support rail,” which is green in Figure 3-1 below and apparently unlabeled in the drawings but shown in detail AA-AA on sheet 4 of Drawing No. 71160-565, “MSO Body, Lid, and Details,” rotating and engaging the inner liner (shown in red). The clearance between the inner “SHORT support rail” and the inner liner according to the drawings is

(proprietary information removed)

The staff is concerned that this extra clearance allows the pedestal to absorb more of the impact energy in the model than it would in the real drop. The “SHORT support rail“ should “lock up” with the inner liner earlier in the simulation, this would increase the stiffness and allow for an “anvil and hammer” effect, which would increase the g-loads on the TSC. The staff also notes that several parts of the top portion of the MSO (e.g., the trunnions) are “ghosting through” (i.e., unrealistically passing through with no resistance) outer portions of the MSO. Though as this behavior occurs at the top of the model, the staff accepts that it may not impact the area of concern at the bottom of the model. The staff requests clarification of the MSO pedestal geometry, clarification of the g-loads experienced by the TSC in the drop scenario, and that the LS-DYNA models that simulate drop events, the calculations, and the FSAR be updated as necessary.

(Proprietary figure removed)

Figure 3-1, “SHORT Support Rail in LS-DYNA Heavy Drop Model”

This information is needed to determine compliance with the regulatory requirements in 10 CFR 72.236(l).

3-3 Justify the assumption that the MSO will behave as a cantilever beam when determining the natural frequency of the MSO in Appendix A to Calculation Package No. 30082-2605, "Tip-Over Analysis for the MAGNASTOR Metal Storage Overpack (MSO)."

The stress analysis for the non-mechanistic tip-over provided on page 30 of the calculation package considers the MSO to be a simply supported beam with a triangular loading applied when striking the pad. However, this calculation applies a dynamic load factor that is derived from the natural frequency of the MSO calculated in Appendix A, which assumes a cantilever beam behavior. The staff notes that the LS-DYNA model that simulates tip-over produces the largest accelerations when the bottom lip of the MSO and tip of the MSO are in contact with the pad, resembling more closely a simply supported beam. Looking at Figure 6.1.5-1 of Calculation Package 30082-2605, the staff believes that the dynamic load factor determined from assuming a cantilever beam behavior may be non-conservative when a simply supported beam assumption appears to be more appropriate for the boundary conditions of the MSO when striking the pad. The staff requests justification of the assumption of cantilever beam behavior in the tip-over stress analysis and that the calculations and FSAR be updated with the appropriate dynamics load factor as necessary.

This information is needed to determine compliance with the regulatory requirements in 10 CFR 72.236(l).

Thermal Evaluation

4.1 If the casks will be situated outside on a concrete pad, demonstrate that low-speed wind does not adversely impact the fuel peak clad temperature or other components important to safety such that the components exceed their allowable temperature limits described in the SAR.
In the response to request for supplemental information "Submission of a Responses to the NRCs Request for Supplemental Information for the NAC International MAGNASTOR® Cask System Amendment No. 10" (ADAMS Accession No. ML20143A102), the applicant states that it does not expect any negative thermal performance effects due to low wind speed even though this new cask design has traditional inlets and nontraditional outlet vents. These non-traditional outlet vents are circular and encompass the entire perimeter of the upper cask. However, the staff notes that because of a larger number of outlet vents that encompass the entire circumference, air exiting the outlet vents could encounter a larger resistance to the air flow compared to the traditional discrete design. Any justification that this outlet design does not impact the cask thermal performance needs to be supported by adequate analysis. The staff needs this information to have assurance predicted temperatures remain below the allowable limits described in the SAR, during long term storage. 10 CFR Part 72 regulations require that the spent fuel cladding must be protected during storage against degradation that leads to gross ruptures or the fuel must be otherwise confined such that degradation of the fuel during storage will not pose operational safety problems with respect to its removal from storage. The above is accomplished by keeping the cladding temperature below 400°C for the entire duration of the licensed storage period. Currently the SAR shows that for normal conditions of storage,

predicted peak cladding temperature (PCT) is about 15°C below the allowable limit. Based on the information provided in the SAR regarding the unique design of the MSO outlet vent, the staff can't determine whether the increase in PCT (due to a potential reduction in air flow because of low speed wind) can be accommodated by the margin shown in the SAR. Therefore, the staff does not have reasonable assurance the spent fuel cladding would be protected from degradation during the entire licensed period for normal storage.

This information is needed to determine compliance with the regulatory requirements in 10 CFR 72.236(b) and 72.236(f).

4-2 Demonstrate that MAGNASTOR® MSO used inside an independent spent fuel storage installation (ISFSI) building or an enclosure will not result in temperatures exceeding the criteria specified in the SAR.

In the response to request for supplemental information "Submission of a Responses to the NRCs Request for Supplemental Information for the NAC International MAGNASTOR® Cask System Amendment No. 10" (ADAMS Accession No. ML20143A102), the applicant stated that it has determined that this cask design is most likely going to be used inside an ISFSI building or enclosure. The applicant also stated that casks inside a building are not susceptible to any sustained low wind speeds because it is an indoor ISFSI and not directly exposed to any environmental wind conditions. If the applicant seeks approval of the building/enclosure or if the building has a significant impact on the design, the application should provide a demonstration of safety, which may include thermal models, calculations, and analysis results that demonstrate predicted temperatures would be below any applicable temperature limits for this configuration. Commensurate with the safety significance, the SAR should also provide a description of the building or enclosure surrounding the MSO and its effect in the MSO heat rejection capabilities. Boundary conditions should be properly applied on all external walls of the ISFSI building or enclosure. Update the SAR as appropriate.

The staff needs this information to make sure that MAGNASTOR® MSO situated inside an ISFSI building or an enclosure will not result in temperatures exceeding the criteria specified in the FSAR.

This information is needed to determine compliance with the regulatory requirements in 10 CFR 72.236(b) and 72.236(f).

Shielding Evaluation

5-1 See Enclosure 2. The entire question contains proprietary information.

5-2 See Enclosure 2. The entire question contains proprietary information.

Materials Evaluation

8-1 Clarify the fracture toughness testing requirements and acceptance criteria for the procured structural steels for the MSO and provide a technical basis for any criteria that deviates from the design code.

SAR Tables 1.3-5 and 2.1-1 state that all steel materials shall meet applicable requirements in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, and that the design code of the MSO is ASME B&PV Code, Section III, Division 1, Subsection NF. ASME B&PV NF-2300 includes testing requirements and acceptance criteria for procured steels to verify that the steels were produced with adequate toughness. However, the staff notes that some of the fracture toughness testing requirements and acceptance criteria for the MSO structural steels do not appear to be defined in the SAR, while other test requirements appear to be inconsistent with the ASME B&PV code.

SAR Section 8.1.1, "Fracture Toughness," does not include a description of the toughness testing and acceptance criteria for many of the MSO components, such as the bottom weldment and inner and outer liners. In addition, the basis provided for not requiring fracture toughness testing of the MSO trunnion steels (the MSO handling is limited to temperatures of 0°F and above) does not appear to be consistent with ASME Code. The staff notes that ASME B&PV Code, Section III, Division 1, Subsection NF-2300 includes materials that do not require testing; however, it is not clear how the trunnion steels meet the ASME B&PV Code exception criteria.

In order to complete its review, the staff requires information on the fracture toughness testing and acceptance criteria for the procured MSO steels and a technical basis for any criteria that deviates from the design code.

This information is needed to determine compliance with the regulatory requirements in 72.146(a), 72.234(a), and 72.236(b).

8-2 Provide a copy of the NS-3 shielding material fabrication specification per SAR licensing Drawing No. 71160-565, Revision 0P and describe the qualification activities for the installation (mixing/pouring) process that demonstrates that it will prevent or sufficiently minimize gaps and voids to ensure shielding performance, with no requirement for testing of the MSO for shielding effectiveness.

SAR Section 8.7.2 stated that the NS-3 shielding material is installed by pouring the material into the annulus formed by the MSO inner and outer shells and the cavity of the MSO lid and that the installation of the material utilizes a process that minimizes gaps and voids in the installed material. Consequently, no shop or field testing of the MSO for gamma or neutron shielding effectiveness is required or performed.

The staff requests additional information on the details of the fabrication specification and the qualification activities that were performed to demonstrate that the specification will minimize or ensure the absence of voids and gaps, without the need for subsequent shielding performance tests. Such qualification details may include, but are not necessarily limited to, shielding effectiveness tests that were performed on NS-3 material fabricated over the ranges of processing variables allowed under the specification.

This information is required to ensure compliance with 10 CFR 72.146(a) and 72.236(d).

Material Observations:

8-1 The description for item 6, shielding material, in the bill of materials on licensing Drawing No. 71160-565 sheet 1 of 9 refers to note 13, however note 13 does not describe the shielding material. Note 12 describes shielding material.

The staff observed that all descriptions that refer to drawing notes are incorrect for the following items: 22, 26, 28, 33 and 49.

8-2 SAR licensing Drawing No. 71160-565, sheet 2 of 9, Detail D-D. The weld symbol for welding item 5 gussets to item 7 bottom weldment shows a 0.5-inch weld. However, the staff does not recognize whether this weld symbol is a groove (square) or fillet weld.

8-3 SAR licensing Drawing No. 71160-565, sheet 4 of 9, View U-U. The weld symbol for welding item 12 stand to item 14 base plate shows a ¼-inch weld, every 4 inches. However, the staff does not recognize whether this weld symbol is a groove (square) or fillet weld.