Non-Proprietary Request for Additional Information
Docket No. 71-9356
Certificate of Compliance No. 9356
Model No. MAGNATRAN Package
Amendment No. 3

By letter dated December 28, 2020 (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML21005A014), NAC International (NAC) submitted an application for a revision to Certificate of Compliance No. 9356 for the Model No. MAGNATRAN transport package. The application, which includes Revision 20C of the safety analysis report (SAR) includes a request for moderator exclusion pursuant to Title 10 of the *Code of Federal Regulations* 71.55(c), to treat high burnup fuel as undamaged fuel, when these fuel assemblies meet the definition of undamaged fuel, and removal of content restrictions when using moderator exclusion and transporting high burnup fuel.

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 SAR. The NRC staff used NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material: 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.

2. Structural Evaluation

2-1 Provide responses to the following questions related to Section 2.11.4, "Side Drop Evaluation," of the SAR, Revision 20C:

(a) Describe how the maximum stresses were calculated in the table shown on page 2.11.4-2 of the SAR, Revision 20C, and

(b) Justify the use of a dynamic load factor (DLF) of 1.75.

In Section 2.11.4, "Side Drop Evaluation," of the SAR, Revision 0 (Reference 2.1), the applicant provided the table for the maximum stress in the fuel rods based on the design basis acceleration of 60g for cask side drop, as shown below:

Calculated Maximum Stress in the Fuel Rods (SAR, Revision 0)

Fuel Rod	Maximum Stress (ksi)	Factor of Safety
CE14×14	37.1	1.88
WE15×15	48.1	1.45
WE17×17	46.3	1.50

Note: Allowable Stress = Yield Strength = 69.6 ksi at 752°F

In the SAR, Revision 20C, the applicant recalculated and reduced the maximum stress using an acceleration of 45.5g for cask side drop and a factor of 1.25, which is based on a guidance provided in Section 2.3.3 of NUREG-2224 (Reference 2.2), as shown below:

Calculated Maximum Stress in the Fuel Rods (Table in SAR, Revision 20C)			
Fuel Assembly Type	Maximum Stress (ksi)	Maximum Stress (ksi) with DLF=1.75	Factor of Safety
CE14×14	29.2	51.1	1.36
WE15×15	35.5	62.1	1.12
WE17×17	34.5	60.4	1.15
Note: Allowable Stress = Yield Strength = 69.6 ksi @ 752°F			

The applicant stated that the maximum stresses were recalculated by applying a maximum acceleration of 45.5g for cask side drop and a factor of 1.25 to the rod moment of inertia based on a suggestion in Section 2.3.3 of NUREG-2224. However, in Section 2.11.1, "PWR [pressurized-water reactor] Fuel Rod Evaluation," it states that there were two finite element (FE) models (ANSYS and LS-DYNA) for the PWR fuel rod evaluations, where the ANSYS FE model used elastic material properties and the LS-DYNA model used bilinear material properties. The staff is not clear how the acceleration of 45.5g and the factor of 1.25 were applied to the calculations for rigidity (E and I) and maximum stresses. The SAR, Revision 20C does not provide detailed information that explains the reduction in maximum stress values from Revision 0. Describe how the maximum stresses were calculated to arrive at the values in Revision 20C.

In addition, the applicant used a DLF of 1.75 to calculate the factor of safety (FS). However, Section 2.3.5.2 of NUREG-2224 (Reference 2.2) provides guidance to use a DLF of 2.0 to account for uncertainties involved in natural frequency, load duration, and load time history shape, which depend on the physical characteristics of the fuel assembly, the rod, and the cask. The staff recalculated a FS using the DLF of 2.0 and found that the FS for the fuel rod assembly (WE 15x15) is less than 1.0, indicating that there would be a concern with the safety of the fuel rods.

Provide the technical justification for using a DLF of 1.75 and not using the DLF of 2.0 recommended in NUREG-2224.

This information is needed to determine compliance with 10 CFR 71.73(c)(1).

References:

2.1 NAC International, MAGNATRAN Safety Analysis Report, Revision 0, USNRC Docket Number 71-9356, April 2019.

2.2 NUREG-2224, Dry Storage and Transportation of High Burnup Spent Nuclear Fuel (Final Report), Office of Nuclear Material Safety and Safeguards, November 2020.

4. Containment Evaluation

4-1 Clarify the penultimate sentence in the last paragraph of Section 4, "Containment," on page 4-1 of the application to describe that leak testing the entire containment boundary, rather than the containment boundary seals, specifically to the American National

Standards Institute (ANSI) N14.5-1997[1] leaktight criterion assures that the containment does not leak.

Section 4. "Containment," of the application describes that the leakage testing of the containment boundary seals assures that the containment doesn't leak. That statement is inconsistent with the statement in Section 6.1.1, "Design Features," of the application that states, "Based on a no credible leakage TSC [transportable storage canister] boundary and a leaktight transport cask boundary, moderator is not present in the TSC while it is being transported.," which necessitates a leaktight transportation package boundary to provide reasonable assurance that moderator is excluded in the TSC. That statement in Section 4 of the application on leakage testing the containment boundary seals is also inconstant with the another statement that is in Section 4, "Containment," of the safety analysis report (SAR) that states, "The containment boundary is tested to ANSI N14.5-1997…[]," (e.g. bottom inner forging, inner shell, top forging, cask lid, lid metal inner O-ring, cover plate, and cover plate metal inner O-ring). Also, ANSI N14.5-1997 describes that the entire containment boundary should be leak tested during a fabrication leakage rate test, and the containment boundary seals should also be tested during the periodic, and pre-shipment leakage rate tests. In addition, Section 6.4.1, "Configuration/Discussion," of the application describes that the MAGNATRAN system is designed with two independent boundaries, one of which is the entire transport cask, not only the containment boundary seals. The penultimate sentence in the last paragraph of Section 4 of the application also appears starting on page 1.3-8 of the application, and as the first sentence of the second paragraph in Section 5(a)(2) of the Certificate of Compliance (CoC), and therefore should also be clarified in each of the locations.

This information is necessary to determine compliance with 10 CFR 71.51(a)(1) and (2), and 71.55(c).

Reference:

1. American National Standards Institute ANSI N14.5, *American National Standard for Radioactive Materials - Leakage Tests on Packages for Shipment*, New York, NY, 1997.

4-2 Clarify Section 6.1.1, "Design Features," of the application to also address the leakage tests described in Section 8.1.4 of the application, in addition to Section 8.2.2 of the application that is already described in the application.

Section 6.1.1, "Design Features," of the application states that, "Containment boundary integrity is checked via leakage tests described in Section 8.2.2." However, the fabrication leakage rate test is described in Section 8.1.4 of the SAR, in addition to the maintenance, periodic, and pre-shipment leakage rate tests are described in Section 8.2.2 of the application.

This information is necessary to determine compliance with 10 CFR 71.51(a)(1) and (2), and 71.55(c).

5. Shielding Evaluation

5-1 It is not clear that removing restrictions on the placement of high burnup fuel within the TSC in the proposed amendment does not impact the ability of the MAGNATRAN package to meet the regulatory requirements of 10 CFR 71.47.

The contents include high burnup spent fuel (maximum assembly average burnup exceeding 45 GWd/MTU) for both PWR and boiling-water reactor (BWR) up to a maximum assembly average burnup of 60 GWd/MTU. In revisions 0, 1 and 2, of the CoC, the PWR fuel contents contained a condition that “All fuel with burnup >45,000 MWd/MTU is treated as damaged fuel and is placed into damaged fuel cans” and BWR fuel was limited to a maximum burnup of 45,000 MWd/MTU. Therefore, any limitations for damaged fuel (i.e., additional cool time) and for the remaining package contents when damaged fuel is present also apply to high burnup fuel, regardless of the actual condition of the high burnup fuel. It is not clear from the information submitted in the consolidated application and subsequent supplements[1] for Revision 1 of the application, that fuel with a burnup greater than 45,000 MWd/MTU was considered for placement in all fuel assembly locations and not just in the damaged fuel locations. The evaluation to support elimination of this condition (i.e., stating that previous revisions included high burnup fuel in all fuel locations) was not given in the Revision 20C of the application. It was not clear to NRC staff whether previous analyses bound the new fuel loading of placing high burnup fuels in any location of TSC in order to meet the regulatory requirements for dose rates in 10 CFR 71.47.

This information is needed to determine compliance with 10 CFR 71.47.

7. Package Operations

7-1 Provide details for the methodology and acceptance criteria for the condition assessment of MAGNATRAN TSCs that demonstrate that TSCs that may have experienced aging-related degradation during prior storage are capable of excluding water during all conditions of transportation.

Section 7.1.2 of the application (Loading of Contents) described that TSCs containing spent nuclear fuel that are to be retrieved from storage for off-site transport in the MAGNATRAN transport cask will be evaluated to ensure that the specific TSC stored in the storage overpack, which may have been subject to 10 CFR 72 normal, off-normal, accident and natural phenomena events, retains its ability to satisfy functional and performance requirements of the MAGNATRAN packaging certified content conditions.

The application also states that dry storage systems that have been maintained in an aging management program (AMP) will include a system specific review and an assessment of this AMP information record will be conducted as part of the off-site transport evaluation to ensure that the MAGNATRAN packaging certified content conditions are validated. The application states that the TSCs containing spent nuclear fuel and experiencing only normal or off-normal events during storage will be evaluated for potential corrosion and cracking at the welds and any damage caused by removal of the TSC from the storage overpack.

However, the application does not include any specific details on how to determine whether a TSC that has been in storage and subject to aging mechanisms, is

[1] See consolidated application dated July 1, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19186A385), as supplemented on July 15, 2019 (ADAMS Accession No. ML19203A252), and August 7, 2019 (ADAMS Accession No. ML19221B591)

capable of excluding water during a transportation accident. It is not clear to the staff what parameters will be evaluated, the methods used to characterize those parameters, or the acceptance criteria that will be used to make this determination.

The staff also notes that an evaluation of AMP records can provide valuable information to inform the assessment; however, such a program is still undefined. As a result, the reliance on a future, undefined, AMP for storage provides only a limited basis to demonstrate that TSCs are free of aging-related degradation effects (e.g., corrosion and cracking) such that TSCs can maintain moderator exclusion.

This information is needed to determine compliance with 10 CFR 71.55(c), 10 CFR 71.85(a) and 10 CFR 71.87(b).

7-2 Revise the operating procedures to provide instructions for opening the package when it is transported using moderator exclusion to ensure that the package is not placed in a pool.

NAC proposed revisions to the contents for shipments containing moderator exclusion that would increase the maximum enrichment to 5 weight percent uranium-235, obviate the use of burnup credit, and other changes to the contents, which, consistent with moderator exclusion, have not been evaluated for an optimally moderated package. However, it is not clear from the package operations chapter, how a licensee receiving the package would know whether the contents were packaged using moderator exclusion or not. One cannot rely on the fact that any shipment of spent fuel from a storage general licensee would not be transported to a licensee that has a pool for opening the package, in the event that the spent fuel inside the canister would need to be repackaged for future storage or disposal.

This information is needed to determine compliance with 10 CFR 71.89.

8. Acceptance Tests and Maintenance Program

8-1 Either revise Chapter 8 to state that all TSCs containing spent fuel (whether loaded from storage, or loaded with spent fuel on-site prior to transport) are leak tested in accordance with Section 10.1.3 of the MAGNASTOR SAR, Revision 9 (ADAMS Accession No. ML17293A085) or revise the MAGNATRAN SAR to incorporate TSC leak testing requirements.

MAGNATRAN packages that are transported using moderator exclusion rely on the TSC entire confinement boundary as a special design feature in addition to the MAGNATRAN containment boundary that both together prevent a single packing error from permitting water in-leakage into the TSC and allowing contact with the fissile material, as required by 10 CFR 71.55(c). However, it is not clear in the MAGNATRAN SAR that TSCs, which are loaded and not placed into storage (load and go scenario), have the same leak test requirements at fabrication as TSCs that are loaded and placed into storage under the CoC No. 1031 for the MAGNASTOR storage system. Section 8.1.4 of the MAGNATRAN SAR only includes fabrication leak test requirements for MAGNATRAN containment boundary and does not include leak testing of the TSC shell weldment after completion of the TSC shell seam and shell to bottom plate weld, the TSC composite closure lid, and the TSC vent and drain port inner port covers and welds, which are included in the MAGNASTOR leak testing requirements.

This information is needed to determine compliance with 10 CFR 71.55(c).