

TN EAGLE STC Package

RAIs - NRC Meeting
NRC Docket No.71-9382

September 9, 2022



Agenda

1. RAI 8-1
2. RAI 8-2
3. RAIs 8-3 and 2-1
4. RAI 9-3
5. Leak Test

Objectives

Understand the requirements for level of detail in the SAR Operating Instructions for:

- Preparation of package for transport and receipt of package. (RAI 8-1)
- Verifying the condition of the DSC prior or during transfer from the HSM into the transportation package. (RAI 8-2)
- Lifting and handling of package without impact limiters at a licensee site. (RAI 8-3 and 2-1)

Discuss taking exception to performing a hydrostatic pressure test for each package prior to first use. (RAI 9-3)

Discuss an alternative to leak testing a thick-walled containment vessel that is provided in ISO 12807 - Safe transport of radioactive materials - Leakage testing on packages. (Not related to RAIs)

RAI 8-1

Provide procedures for controlling the radiation level limits on unloading operations and procedures for addressing situations when surface contamination and radiation surveys are too high.

Step 6 in Section 8.2.1 of the operating procedures states: *“Verify that the cask surface removable contamination levels meet the requirements of 49 CFR 173.443.”* Step 7 of the same section states: *“Perform a radiation survey of the cask to verify compliance with 10 CFR 71.47.”* However, there are no procedures associated with controlling radiation level limits and addressing situations when contamination and radiation levels exceed regulatory limits. RG 7.7, “Administrative Guide for Verifying Compliance with Packaging Requirements for Shipping and Receiving of Radioactive Material” Section 4.0, “Receiving and Opening a Package,” contains an approach that the staff considers acceptable for meeting the requirements associated with receipt of radioactive material in 10 CFR Part 71 and 10 CFR Part 20. In addition, NUREG/CR-4775, “Guide for Preparing Operating Procedures for Shipping Packages,” may contain useful information.

This information is needed for a user to be able to comply with 10 CFR 71.89 and 10 CFR 20.1906.

RAI 8-1

Previously approved transportation SAR have included only the statement to measure contamination levels and external radiation levels as a routine operational requirement prior to shipping and upon receipt of package.

The package can not be released for shipping until the contamination and external radiation limits comply with the requirements in 49 CFR 173.441 and 173.443. Additional guidance in RG 7.4 could be added to 8.1.3 Preparation for Transport to address situations where limits are exceeded.

Excessive levels discovered after shipment during receipt inspections will be addressed using guidance in RG 7.4. This guidance could be added to the SAR 8.2.1 Receipt of Package from Carrier.

Detailed actions taken to determine the cause cannot be anticipated. Therefore, remedial actions will depend on each situation, and cannot be specified in the SAR Operating Instructions.

The guidance in RG 7.4 and remedial or corrective actions have not been included in SAR operating instructions for previously approved package designs.

RAI 8-2

Provide justification that a review of DSC loading reports provides adequate information to verify that the DSC was not damaged during the insertion or extraction process. Alternatively, provide an inspection process to verify that the DSC is in unimpaired physical condition. Provide qualitative acceptance criteria to verify the performance of the DSC shell to the original design requirements for safety functions and that package is unimpaired physical condition.

Section 8.4.1, "DSC Evaluation for Transport," Step 6, states that, "for DSCs being stored under the initial 10 CFR 72 licensed period, the loading reports were reviewed to ensure the DSC was not damaged during the insertion or extraction process and that, if necessary, appropriate evaluations were performed to verify the performance of the DSC shell to the original design requirements for safety functions."

NUREG 2216, Section 8.1.1.1, "Preparation for Loading," states in part, to "verify that the application describes the procedures for package loading preparations sequentially in the order of performance, and ensure that the procedure descriptions, at a minimum, assure... the package is in unimpaired physical condition."

10 CFR 71.87, "Routine determinations" states, in part, that, "before each shipment of licensed material, the licensee shall ensure that the package with its contents satisfies the applicable requirements of this part and of the license. The licensee shall determine that... (b) The package is in unimpaired physical condition except for superficial defects such as marks or dents"

The NRC staff was unable to determine whether the loading procedures provided an adequate level of inspection and acceptance criteria to make the determination that the package is in unimpaired physical condition except for superficial defects such as marks or dents.

RAI 8-2

Scratching of the DSC shell in area of contact with HSM rails is expected from insertion and removal. The scratching observed from experienced with RWC is superficial.

Experience with accessing any damage due to insertion and removal of DSC is limited since no DSC have been transferred to a transportation package..

Detailed inspection procedures and acceptance criteria were intended to be part of the more detailed Operations Manual and site storage system specific procedures for removal of the DSC from the HSM.

There is a possibility that methods used for aging management inspections could be adapted for use during the transfer of DSC from the HSM to the transportation package.

RAIs 8-3 & 2-1

8-3

Revise the operating procedures to include steps for lifting a package without impact limiters during its transit from the point of origin to destination.

In addition to either a drop analysis or commitment for a single failure proof lifting device (see item 2-1, above), lifting the package without the package's impact limiters is a safety significant operation during transport.

This information is needed to determine compliance with 10 CFR 71.35(c).

RAIs 8-3 & 2-1

2-1

In Appendix 2.11.1, “TN EAGLE Cask NCT [normal conditions of transport] Evaluation,” the applicant stated that the weight of the impact limiters was not included for the lifting condition. Since the impact limiters are part of the packaging, clarify why this weight was not included.

If the TN Eagle-STC package is lifted without impact limiters either at an NRC- licensed facility or during transport, provide either a revised cask drop analysis without the impact limiters installed, or a commitment to utilize a single failure proof handling system and describe associated single failure proof design features. These additional analyses, or design features, ensure that if the package is lifted either during preparation, shipment, or receipt, that the package is maintained within its design configuration. Note that lifts at an NRC facility licensed under 10 CFR Part 50 or 10 CFR Part 72 would also be evaluated under the provisions of 10 CFR 50.59 or 10 CFR 72.48, accordingly.

Section 8.1.3 indicates that impact limiters are not installed during cask lifting operations. Specifically, “Step 3. Using an appropriately sized lift beam and rigging, engage the outer ends of the cask body with slings in a basket configuration. Step 4. Lift the cask out of the transfer skid and place it in the transport frame on the conveyance. Step 5. Install the transport frame tie-down straps. Step 6. Install the impact limiters on the cask...”

Additionally, a cask lift height restriction should be established to ensure the package without its impact limiters is not lifted to a height greater than that for which a drop evaluation has been performed, or alternatively has been deemed incredible by utilizing a single failure proof handling system. This operational restriction ensures that the package is handled within the limitations of its design.

The NRC staff was unable to determine whether a failure of a lifting system would impair the ability of the package to meet the requirements of 10 CFR Part 71 in the event of a drop event when the impact limiters are not installed.

This information is necessary to determine compliance with 10 CFR 71.47, 10 CFR 71.51(a) and 10 CFR 71.55(b).

RAIs 8-3 & 2-1

Package shell can only be lifted without the impact limiters attached. In Appendix 2.11.1 the weight of the impact limiters is not included for this lift to demonstrate that the package is capable of being handled in this manner.

For any intermodal transfer of the package during 10 CFR Part 71 transportation, the transport frame will be lifted with package secured to the transport frame and impact limiters installed.

Lifts of the package without impact limiters installed will be done only at an NRC licensed facility and these lifts be done using rigging plans that comply with conditions in the 10 CFR Part 50 or 10 CFR Part 72 license. Rigging and handling procedures prior to transport and during receipt are not considered within the scope of 10 CFR Part 71 requirements.

Chapter 8 introductory paragraph will be revised to add an explanation that handling without impact limiters will only be done at a 10 CFR Part 50 or 10 CFR Part 72 licensed facility.

Specifying a limit for the height of lifts without impact limiters would require additional structural evaluations that may be done for the licensee rigging plan. This evaluation is not be included in the Part 71 SAR.

Use of single failure proof rigging equipment and cranes depends on conditions in the 10 CFR Part 50 or 10 CFR Part 72 license for lifting heavy loads.

RAI 9-3

Revise Section, 9.1.3, “Structural and Pressure Tests,” to include pressure tests for each fabricated cask assembly, rather than first cask assembly (any model) fabricated to the design provided in the applicable drawings for package approval. Revise Section 9.1.3 to include ASME B&PV Code, Section III, Subsection NB, Paragraph NB-6100, and NB-6400 with NB-6200.

Section, 9.1.3, “Structural and Pressure Tests,” states that, “A pressure test shall be performed on the first cask assembly (any model) fabricated to the design provided in the applicable drawings for package approval. Any change to the design that could impact the structural performance will require a new pressure test. The test pressure is between 20.0 and 25.0 psig and held for a minimum of 10 minutes. All visible joints and surfaces shall be visually examined for possible leakage after application of the pressure. The test shall be performed in accordance with ASME B&PV Code, Section III, Subsection NB, Paragraph NB-6200 [1].”

Section 4.2, “Containment under Normal Condition of Transport,” indicates that, “The maximum normal operating pressure is calculated in Chapter 3 to be 83.4 kPa(12.1 psig) and the analyses in Chapter 2 demonstrate that the TN Eagle Cask effectively maintains containment leak-tight integrity with a cavity pressure of 83.4 kPa (12.1 psig).”

Since the normal operating pressure has been determined to be 12.1 psig, a pressure test of the containment system is required in accordance with 10 CFR 71.85(c). The regulations in 10 CFR 71.85(c) requires this test be performed for “any packaging” not the “first cask assembly (any model) fabricated to the design provided in the applicable drawings for package approval.” While a testing of the first cask assembly fabricated may show adequacy of the initial design, continued testing is necessary to demonstrated continued adequacy of fabrication of that design.

The hydrostatic pressure test shall be performed in accordance with all applicable portions of ASME B&PV Code, Section III, Subsection NB, Paragraph NB-6000. Inclusion of the paragraphs NB-6100, and NB-6400 with NB-6200 ensure that adequacy of the test with appropriate general requirements and gauges.

This information is needed to comply with 10 CFR 71.85(c).

RAI 9-3

Hydrostatic pressure test to be performed only on the first fabricated cask was also challenged by the French Regulatory body but they have finally approved this approach using the following reasoning:

- Large design margins for structural strength between the max allowable working pressure calculation and the max design pressure for the thick wall forged body
- ASME code is followed for the strength criteria, but that these pressure tests are usually not mandatory for transport casks.

Evidence of large margins also present in the NRC application for approval of package design:

- As per Section 2.5.3 the MNOP is 12.1 psig and due to atmospheric pressure changes the internal pressure can be up to 159.9 kPa=23.192 psi. The cask, as per the same section, is designed for NCT (for the load combinations that include the "Reduced External Pressure") for 210 kPa=30 psi.
- As per Section 2.6.4, for the accident fire case Table 3-12 required an internal pressure of 13.3 psig. The structural analysis is performed for 130 psi.
- In the SAR we don't report the margin for each individual load case, but rather for the load combinations required by Reg. Guide 7.8. The minimum margin for NCT is 1.1% for the load combination that includes the 1ft drop (Table 2.11.1-4 Case 5B). For HAC the minimum margin is 4% for the load combinations with 30ft drop. For the fire accident HAC the margin is 275% (Table 2.11.2-3).
- Table 15 of CALC-TNEAGLE01-0209 R0 shows that for just the internal pressure of 30 psi the design margin is 1608%. The analysis is linear so margin can be proportioned to whatever internal pressure we required.

Leak test

9.1.4

Leakage Tests

1. Leakage tests shall be performed on the cask containment boundary prior to first use. The fabrication verification leakage test can be separated into the following four tests:

- Base metal integrity to evaluate the material of the cask body, primary lid, ram access cover plate, and the lid port plug,
- Lid port plug seal integrity,
- Primary lid inner seal integrity, and
- Ram access cover plate inner seal integrity.

a) This testing shall be performed in accordance with written procedures and conform to the requirements of ANSI N14.5 [3]. These tests are usually performed using the helium mass spectrometer method. Alternative methods are acceptable, provided they conform to ANSI N14.5 [3] and the required sensitivity is achieved.

b) Personnel performing the tests shall be qualified and certified in leakage testing in accordance with SNT-TC-1A [2].

c) The acceptance criterion requires each component to be individually leak tight, that is, the leakage rate must be less than $1\text{E-}7$ ref-cm³/sec with a sensitivity of $5\text{E-}8$ ref-cm³/sec, or better.

d) The cask body test shall be performed without the bottom closure plate, bottom ring, shielding rings, top handling ring, or associated fasteners installed.

e) The primary lid test shall be performed without the lid spacer or associated fasteners installed.

Leak test

- **French ASN / IRSN accepted that the thick-walled forged containment vessel need not be tested based on explanatory note E.7.1.3 in ISO 12807, Safe transport of radioactive materials - Leakage testing on packages**
- **ISO 12807, E. 7. 1.3 Fabrication verification**
Parts of the containment vessel for which evidence can be given that the leakage rate is negligible need not be tested, for example thick-walled vessels.
- *“Evidence that leakage rate is negligible”*
 - TN Eagle is thick-walled forged shell that is 4 to 6 inches thick.
 - Monobloc forged body, no welding, no trunnion connections.
 - In the case of forged ingot used to manufacture the forged body the zone likely to get discontinuities are discarded. The fabrication procedure indicates that : “The sufficient discards shall be made from top and bottom ends to ensure that only sound metal enters the completed forging”.
 - In addition to the discard measure, the forming process used is going to flatten any potential discontinuities. They are going to be parallel to the surface do not lead to indication oriented in the through-wall direction.
 - Forged body 100% MT and UT of surface with no indication (circumferential nor radial), with a recording level below 5mm (Quality Class 3) .
 - EN 10228-3, Non-destructive testing of steel forgings, Part 3: Ultrasonic testing of ferritic or martensitic steel forgings
 - EN 10228-1, Non-destructive testing of steel forgings, Part 1: Magnetic particle inspection



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RAI 9-3 (3/3)

ONPS get IRSN approval (see below in French) to perform this test only on the first cask:

9. FABRICATION, UTILISATION ET MAINTENANCE DU COLIS

Le requérant définit des opérations de vérification de la conformité des emballages à l'issue de leur fabrication, que l'IRSN considère acceptables. Il s'est par ailleurs engagé à contrôler les enveloppes de confinement d'un exemplaire d'emballage soumises à la pression maximale des conditions accidentelles de transport, en application du paragraphe 501 a) de de la réglementation. **L'IRSN considère cet engagement acceptable.**

Les opérations d'utilisation et de maintenance de l'emballage présentées dans le dossier de sûreté, complétées par un engagement du requérant relatif aux opérations de serrage visant à assurer un serrage uniforme, sont satisfaisantes.

IRSN

6/8

Le requérant définit des opérations de vérification de la conformité des emballages à l'issue de leur fabrication, que IRSN considère acceptables. Il s'est par ailleurs engagé à contrôler les enveloppes de confinement d'un exemplaire d'emballage soumises à la pression maximale des conditions accidentelles de transport, en application du paragraphe 501 a) de la réglementation. L'IRSN considère cet engagement acceptable.

Les opérations d'utilisation et de maintenance de l'emballage présentées dans le dossier de sûreté, complètes par un engagement du requérant relative aux opérations de serrage visant à assurer un serrage uniforme, sont satisfaisantes.

The applicant shall define operations to verify the conformity of the packaging at the end of its manufacture, which IRSN considers to be acceptable. It also undertook to control the containment envelopes of a packing copy subjected to the maximum pressure of the accidental conditions of carriage, pursuant to paragraph 501 (a) of the Regulations. IRSN considers this commitment acceptable.

The operations for the use and maintenance of the packaging in the safety file, supplemented by an undertaking by the applicant relating to the tightening operations to ensure uniform tightening, are satisfactory.