Request for Additional Information
for the
Model No. OPTIMUS-H Package
Docket No. 71-9392

This request for additional information (RAI) identifies information needed by the staff in connection with its review of the NAC International Model No. OPTIMUS-H package.

CHAPTER 1 GENERAL INFORMATION

1.1 Provide tolerances for all Important to Safety (ITS) components on the licensing drawings so that the "as-built" package can be verified as being manufactured in accordance with the analyzed design.

All tolerances that support analyses for all ITS components in the application shall be placed on the licensing drawings so that the staff can assess whether the results of the analyses including structural, shielding, and thermal analyses are valid. Tolerances for non-ITS components shall also be included, if they have a potential to impact any ITS component performance.

This information is required to determine compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) 71.33(a)(5), 71.71(c)(7), 71.73(c)(1), and 71.73(c)(3).

1.2 Categorize all components listed in the Bill of Materials on the licensing drawings following the guidance of NUREG/CR-6407. Clarify their safety classification and acceptance criteria (if applicable) used to characterize the components.

All components, including components serving as the containment boundary, should have their safety category indicated on the Bill of Materials, according to NUREG/CR-6407, "Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety," (i.e., Category A, B, or C for components important to safety; or not important to safety).

This information is required to determine compliance with 10 CFR 71.33(a)(5).

CHAPTER 2 STRUCTURAL AND MATERIALS EVALUATION

2.1 Indicate the respective densities of the foam material in Figures 2.2-1 and 2.2-1 of safety analysis report (SAR) 21A. Clarify what is meant by end foam and side/corner foam.

The staff needs this information to confirm that the properties of the foam in the impact limiter are appropriately captured in the LS-DYNA numerical model for impact simulation under different drop scenarios.

This information is required to determine compliance with 10 CFR 71.71 and 71.73.

2.2 PROPRIETARY

2.3 PROPRIETARY

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2.7 Clarify whether the statements (quoted below) from the fifth paragraph of Section 2.3.1, "Fabrication," are meant to apply to all welds for the CCV, the impact limiter shells, and the shield insert assemblies (SIAs); or whether the statements in this paragraph are meant to apply only to CCV welds. If these statements apply only to the CCV welds, address whether changes to this section of the application are needed to address the requirements for qualification of welding procedures and personnel for fabrication of welded joints for impact limiter shells and SIAs.

The fifth paragraph of Section 2.3.1, "Fabrication," states: "*All welding is performed in accordance with a written welding procedure specification (WPS) that is qualified in accordance with the applicable requirements of the ASME Code. All personnel performing welding are qualified to use the welding procedure, and their qualifications are documented in accordance with the applicable requirements of Section IX of the ASME Code*."

The application should identify any established codes or standards proposed for use in the fabrication of ITS packaging components. The staff reviews the applicable codes or standards that are proposed for use in the qualification of welding procedures and personnel for fabrication of welded joints for impact limiter shells and SIAs to confirm that they are suitable for this purpose.

This information is required to determine compliance with 10 CFR 71.31(c), 71.35(a), 71.51(a), and 71.55(b), (d), and (e).

2.8 The itemized requests below pertain to the second paragraph under the header, "Fabrication Tests and Examinations" in Section 2.3.2, "Examination."

a. Clarify whether the statements in the first sentence regarding visual (VT) examination and liquid penetrant (PT) examination of welded joints pertain to surface and visual exams for all ITS welded joints for ITS components or just for certain welded joints for specific components. If the scope of the statements are limited to just certain welded joints for specific components, or if the statement needs to be revised based on the issues identified below, please address whether any revisions to the application are needed.

b. Clarify whether the statements in the third sentence regarding the performance weld examinations in accordance with the applicable requirements of the ASME BPVC are applicable to all ITS welded joints for the CCV, impact limiter shells, and the SIAs. If the scope of the statements is not applicable certain impact

limiter and SIA welds, or if the statement needs to be revised based on the issues identified below, please address whether any revisions to the application are needed.

With respect to the first sentence of the paragraph cited in part a of this RAI, the staff noted that not all welds depicted in the drawings are shown to require PT for surface exams and VT exams. For example, the drawings show that some of the carbon steel SIA welds require magnetic particle (MT) and VT exams, some of the SIA welds do not show any non-destructive examination (NDE) requirement, and none of welds depicted in the impact limiter drawings show any NDE requirement.

With respect to the third sentence of the paragraph cited in part b of this RAI, the staff noted that the CCV drawings adequately specify the applicable ASME BPVC requirements for NDE of the containment welds; however, the impact limiter and SIA drawings do not specify any codes or standards for NDE of these welds, and (as addressed above) many of the welds depicted in the SIA and impact limiter drawings do not show any NDE requirement.

The staff needs to confirm the scope of the NDE, including NDE methods, and use of NDE codes and standards, for ensuring weld integrity for ITS packaging components.

This information is required to determine compliance with 10 CFR 71.31(c), 71.35(a), 71.51(a), and 71.55(b), (d), and (e).

2.9 The itemized requests below pertain to NDE examinations of the ductile cast iron OSV body and lid.

a. Address whether revisions are needed in the application to address the apparent discrepancy between Section 2.3.2 and Section 8.1.6, as cited below.

b. Section 8.1.6 does not specify any codes or standards for surface examinations of the OSV castings, and there are no OSV NDE codes or standards specified in the OSV drawings. Address whether any revision to Section 8.1.6 is needed to address codes and standards for surface exams of the OSV castings.

The second sentence of the fourth paragraph under the heading, “Fabrication Tests and Examinations” in Section 2.3.2 states that “all accessible internal and external surfaces of the OSV body and lid, except threaded surfaces, shall be examined for surface discontinuities using PT or magnetic particle (MT) methods in accordance with the requirements of Section 8.1.6.”

However, the fifth and sixth sentences of the second paragraph under Section 8.1.6, “Shielding Tests” states that MT surface examination methods are to be used; these sentences do not specify PT surface exams.

The staff needs to confirm the scope of the NDE, including NDE methods, and use of NDE codes and standards, for ensuring the integrity of ITS packaging components.

This information is required to determine compliance with 10 CFR 71.31(c), 71.35(a), 71.51(a), and 71.55(b), (d), and (e).

2.10 Address whether revisions are needed in the drawings to address the issues cited below.

- There is a statement in Section 8.1.2, “Weld Examinations,” that “all packaging welds shall be examined to the requirements of the general arrangement drawings in Section 1.3.” The staff observed that the drawings for the impact limiters and SIAs do not include NDE requirements for any impact limiter welds and certain SIA welds. Further, there are no NDE codes or standards specified on the impact limiter and SIA drawings.

- Note 12 in the OSV body drawing and Note 6 in the OSV lid drawing notes includes an incidental mention of MT exams for the castings, but the drawings do not specify UT exams of the castings as discussed in Section 8.1.6. The OSV drawings also do not specify any NDE codes or standards.

- The impact limiter and SIA drawings do not specify any codes or standards for qualification of welding procedures and personnel.

The staff needs to confirm the scope of the NDE, including NDE methods, and use of NDE codes and standards, for ensuring the integrity of ITS packaging components. The staff also needs to confirm that any applicable codes or standards that are proposed for use in the qualification of welding procedures and personnel for fabrication of welded joints for impact limiter shells and SIAs are suitable for this purpose.

This information is required to determine compliance with 10 CFR 71.31(c), 71.35(a), 71.51(a), and 71.55(b), (d), and (e).

2.11 The itemized requests below pertain to the coating used for the ductile cast iron OSV surfaces and the carbon steel SIA surfaces. The staff’s basis for the questions is provided after the statement of the questions.

a. Identify the safety classification of the coating (ITS vs. NITS). If the safety classification of the coating is NITS, identify whether failure or degradation of the coating could adversely affect the safety functions of the OSV or SIA.

b. Clarify whether the function of the coating is just for corrosion protection of the OSV and SIA surfaces or whether it is used for additional design functions such as heat rejection.

c. If the coating is also used for heat rejection, clarify whether the emissivity data provided in Section 3.2 for the ductile cast iron OSV is applicable to the coated surface or the uncoated ductile cast iron surface.

d. If the coating is not used for heat rejection, please address whether the potential impact of the coating on the emissivity of the ductile cast iron surface was

considered in the thermal evaluation. If not considered (e.g., potential beneficial impact conservatively discounted), address why it did not need to be considered in the thermal evaluation.

e. Provide the allowable service temperatures for the coating based on manufacturer or supplier product specifications (or other specification, as applicable).

f. Address whether the maximum and minimum temperatures of the coated components for NCT and HAC based on the Chapter 3 thermal analyses are within the bounds of the allowable service temperatures for the coating.

g. Address whether the chemical properties of the coating were considered, or whether they need to be considered, in the analyses of the potential for flammable gas reactions documented in Section 4.5. If the coating properties do not need to be considered in these analyses, please address why they do not need to be considered.

h. Address whether the manufacturer or supplier specifications for coating properties are verified through qualification testing to ensure that the coating has the properties needed to adequately perform its required design functions for the required service conditions.

i. Describe the qualification testing requirements (e.g., thermal testing, resistance to chemical reactions, abrasion testing, resistance to radiation damage, etc.) for assuring the required coating performance, including no adverse effects on overall package safety performance, under the required service conditions. If the qualification testing requirements are based on certain consensus codes or standards (e.g., ASTM, ASME, etc.) please provide a reference for the applicable code or standard.

j. Describe the NDE requirements for assuring that the coating has been adequately applied and adequately adheres to the OSV and SIA surfaces, such that these components are acceptable for placement into service. For example, acceptance examinations may include visual examinations and associated visual acceptance criteria to ensure coating integrity on OSV and SIA components that are to be placed into service. If the acceptance examinations are based on certain consensus codes or standards (e.g., ASTM, ASME, etc.) please provide a reference for the applicable code or standard.

k. Address whether any application SAR changes are needed to address the above-requested information.

The application includes limited information on the coating material and its use for protecting the OSV and SIA components against corrosion. The application identifies the

coating compound and the metallic component surfaces to which it is applied. The application also generally identifies that the coating is commonly used for similar nuclear applications, is highly resistant to chemical reactions, and has very good abrasion resistance.

However, except for corrosion protection, the application does not identify the safety classification or the scope of the design functions of the coating. The application also does not identify the potential impact of the coating on the package thermal analyses, nor does it address whether it is credited for heat rejection in the thermal analyses. The application does not address whether the coating was considered (or whether it needs to be considered) in the analyses of the potential for flammable gas reactions documented in Section 4.5. The application does not include any manufacturer or supplier data on the properties of the coating or describe how the data was considered in the package safety analyses. The application also does not address qualification testing of the coating to ensure the coating can adequately perform its intended functions under its required service conditions, all well as for ensuring that the coating does not adversely affect the safety performance of the package (e.g., tests to ensure the coating does not contribute to adverse chemical reactions for NCT and HAC). The application also does not describe NDE that is performed for acceptance of coated components to ensure that the coating has been properly applied and adequately adheres to the component surfaces such that the coated components are acceptable for placement into service. The application also does not reference any consensus standards for the use of the coating, nor does it reference any consensus standards addressing qualification testing and acceptance examinations for coated components. Therefore, the staff is requesting this information, as itemized above.

In order to ensure that the coating used for the ductile cast iron OSV surfaces and carbon steel SIA surfaces can adequately perform its required functions for the required service conditions, the staff needs to ensure that the information in the application adequately describes the safety classification, design functions, properties, product specifications, qualification testing, acceptance examinations, and maintenance examinations of the coating for use on the coated components consistent with the guidance in Section 7.4.9 of NUREG-2216. This includes reviewing the information requested above and verifying that the information demonstrates that coating can adequately perform as required to support the safety functions of the coated OSV and SIA components under the required service conditions.

This information is required to determine compliance with 10 CFR 71.35(a) and 10 CFR 71.43(d).

2.12 The itemized requests below pertain to the chemical and physical form of the non-compliant TRU waste contents, as described in Section 1.2.2.1.

Explain the physical form of the radioactive material for the non-compliant TRU waste. Specifically, address which of the following is applicable:

(a) The radioisotopes are located on the exterior of the aerosol cans and lecture bottles (e.g., fixed contamination on the exteriors of the containers);

(b) The radioisotopes or are absorbed into the cylindrical structure of the cans and lecture bottles; or

(c) The radioisotopes are mixed in with the compressed gas, liquefied propellants, or the unknown contents, of the aerosol cans and lecture bottles.

Address whether any revisions to this section of the application are needed to clarify this issue.

Address whether revisions to the application are needed to address the following apparent discrepancy:

> The second paragraph of Section 1.2.2.1 (TRU Waste) states that acceptable non-compliant TRU waste is subdivided into three sub-types of TRU waste drums: Content 1-2A: Drums "containing aerosol cans with compressed gas propellant"; Content 1-2B: Drums "containing aerosol cans with liquified gas propellant or unknown propellants"; Content 1-2C: Drums "containing standard DOT 3E lecture bottles".
>
> The third paragraph in this section states that the quantity of non-compliant TRU waste items permitted in the contents is limited to assure CCV internal pressure does not exceed design internal pressure loads for NCT and HAC and to prevent combustible gas mixtures. It also states that it conservatively assumes all aerosol cans or standard DOT 3E lecture bottles are ruptured, implying that non-ruptured (sealed) aerosol cans and lecture bottles are acceptable for non-compliant TRU waste contents.

However, Item 5 under the heading, "Loading and Shipping Restrictions" in this section states that "*Explosives, corrosives, non-radioactive pyrophorics, and sealed items containing compressed and/or flammable gas (e.g., aerosol cans, lecture bottles, etc.) are prohibited*." (Emphasis added.)

Therefore, this section of the application seems to indicate that non-compliant TRU waste literally consists of the aerosol cans and lecture bottles with compressed gas or liquified gas propellant (or even unknown contents). However, Item 5 under "Loading and Shipping Restrictions" seems to indicate that aerosol cans and lecture bottles containing compressed and/or flammable gases are prohibited.

The staff needs to ensure that the application provides an adequate description of the chemical and physical form of the package contents.

This information is required to verify that the application adequately describes the chemical and physical form of contents of the package and thus determine compliance with 10 CFR 71.33(b).

CHAPTER 3 THERMAL EVALUATION

3.1 Perform thermal evaluations with two packages inside an International Standards Organization (ISO) Container under the HAC fire.

The applicant stated, in SAR Section 3.3, that the initial conditions used for the HAC thermal evaluation are the NCT evaluation with two packages in an ISO container, which results in the highest packaging temperatures (see SAR Table 3.3-8) for initial conditions of the HAC evaluation, and consequently, the highest peak temperatures during the fire transient. The applicant also said a conservative approach was used by assuming the package is outside the ISO container and exposed directly to the fire during the fire transient analysis (see FSAR Table 3.4-2).

The staff finds that the HAC thermal evaluation with assumption, that the package is outside the ISO container and exposed directly to the fire during both 30-minute fire transient and post-fire cooldown, is only conservative for the 30-minute fire transient but may not be conservative for the post-fire cooldown in which the period is much longer than the 30 minutes and the heat removal from the package to the ambient could be hindered by the ISO container.

The applicant needs to verify the presented HAC thermal evaluation with the package outside an ISO container is bounding for overall HAC fire analysis. The applicant may verify the bounding analysis through comparison by assuming the package is inside the ISO container for both 30-minute fire and post-fire cooldown.

This information is required to determine compliance with 10 CFR 71.73(c)(4).

3.2 PROPRIETARY

3.3 Correct typos in item (a) thru item (d) and suggest revising “fuel waste” to “irradiated fuel waste” or “IFW” in item (e) thru item (m) below for consistency.

Based on SAR Table 3.1-1, only transuranic (TRU) waste with content heat of 50 W/200 W is permissible for open transport and closed transport (e.g., ISO container) and irradiated fuel waste with content heat of 1,500 W is only permitted for open transport. The following typos need to be corrected in SAR Revision 22A:

a) Figure 3.3-14 NCT Steady-State Temperatures ~~ILW~~ TRU waste (200 W, He) - 2 Packages in ISO container (page 3-ii).
b) “To evaluate multiple packages being shipped in an ISO container, an additional model is used to evaluate two packages inside a 20-ft ISO container, each containing ~~ILW contents~~ TRU waste”
c) Figure 3.3-14 NCT Steady-State Temperatures – ~~ILW~~ TRU waste (200 W, He) — 2 Packages in ISO container (page 3.3-33)
d) ~~TRU waste~~ IFW/CCV Fill Gas (average) in Figure 3.4-9

It is suggested to revise “fuel waste” to “irradiated fuel waste” or “IFW” (as shown with underlines below) in SAR Rev. 22A to avoid confusion and distinguish from TRU waste:

Page 3-ii:

e) Figure 3.3-4 Exploded View of the CCV with Modeled Irradiated Fuel Waste
f) Figure 3.3-15 NCT Steady-State Temperatures Irradiated Fuel Waste (1,500 W, He)
g) Figure 3.3-16 CCV Lid Temperatures, NCT, Irradiated Fuel Waste, 1,500 W Heat Flux

h) Figure 3.3-17 OSV Lid Temperatures, NCT, Irradiated Fuel Waste, 1,500 W Heat Flux

i) Table 3.3-9 Maximum Temperatures for NCT, Irradiated Fuel Waste (page 3-iv)

j) Per the requirements of 10 CFR 71.71(c)(1), the package with TRU waste or irradiated fuel waste is evaluated for NCT, as presented in Section 3.3 (page 3.1-2)

k) Revise Fuel Waste to Irradiated Fuel Waste or IFW in Tables 3.1-1, 3.1-3, 3.1-4, 3.3-9, and 3.4-3

l) Revise Fuel Waste to Irradiated Fuel Waste or IFW in Figures 3.3-4, 3.3-15, 3.3-16, and 3.3-17

m) Revise fuel waste to irradiated fuel waste or IFW (pages 3.3-3, 3.3-4, 3.3-6, 3.3-7, 3.3-22, 3.3-29, 3.3-37, 3.3-38, 3.4-1, 3.4-5, 3.4-6, 3.4-8, 3.4-9, 3.5-4, and 3.5-5)

Beside the items above, the applicant should check the entire application (e.g., SAR) for consistency.

This information is required to determine compliance with 10 CFR 71.33(b).

3.4 PROPRIETARY

CHAPTER 4 CONTAINMENT EVALUATION

4.1 Provide information that demonstrate the inerting process will be effective and reliable to ensure no flammable and explosive reactions during transport of the package.

In accordance with NUREG-2216, “Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material,” the application needs to ensure that hydrogen and other flammable gases make up less than 5% by volume of the total gas inventory, or lower if warranted by the flammable gas, within any confined volume.

The applicant stated, in SAR Section 4.5.2, that prior to each shipment of transuranic (TRU) waste with a total heat load exceeding 50 W and irradiated fuel waste (IFW), the inerting is used to reduce the quantity of oxygen inside the cask containment vessel (CCV) below the threshold at which a flammable gas mixture can develop in the CCV during the shipping period.

The applicant needs to demonstrate the inerting process (e.g., nitrogen as the inert gas), proposed in the application, is effective and reliable through the questions below:

(a) Explain how the inerting process will prevent the development of flammable gas mixtures in any confined area of the package throughout the entire transport period.

(b) Perform a detailed evaluation or analysis to demonstrate that there are no flammable gas mixtures (considering the worst-case concentrations of hydrogen or any other flammable gases, and oxygen) during shipment.

(c) Provide a detailed configuration of the secondary container and explain the features that will allow the inert gas (e.g., nitrogen) be introduced effectively through the port, e.g., injection path, port orientation, to the innermost packaging or other confined areas within the containment system of the package.

(d) Demonstrate that the inert gas either effectively occupies the containment cavity or is in uniform concentration through the cavity. Discuss how the concentrations of combustible gases would be quantitatively analyzed.

An inerting test on a full-scale OPTIMUS-H package will justify the effectiveness of the inerting process.

This information is required to determine compliance with 10 CFR 71.43(d).

4.2 Provide information on questions (a), (b) and (c) regarding the CCV assembly with the optional drain port (if designed).

The applicant stated, in SAR Section 2.1.1.1, that the CCV assembly may include an optional drainage feature to facilitate wet loading operations. The optional drainage feature includes a drain port in the CCV lid, through which a drain tube assembly is inserted and guided through a drain tube support weldment to a counterbored hole (e.g., sump) in the CCV bottom plate.

(a) Clarify whether a CCV assembly with the optional drain port is only used for wet loading or for both dry and wet loadings and a CCV assembly without drain port is only used for dry loading?

(b) If a CCV assembly with the drainage feature were designed for both dry and wet loadings, describe the operation procedure (i.e., operational steps) that is followed by the users to switch to the dry loading after use for the wet loading.

The applicant described, in SAR Attachment 7.5-3, the procedure used for determination of the flammable gas concentration and the shipping time, and stated, in step #3 (Determine release rates for each confinement region), that for one boundary, the effective release rate (T_{eff}). is equal to the release rate (RR) of the vent on the secondary container.

(c) Clarify whether the RR from the drain port (if designed) needs to be accounted for a CCV assembly with the drain port when calculating the flammable gas concentration?

This information is required to determine compliance with 10 CFR 71.33 and 71.43(d).

4.3 Provide a table in the application to summarize all leakage rate tests performed on the OPTIMUS-H package and (b) clarify whether ANSI N14.5 (American National Standard for Radioactive Materials – Leakage Tests on Packages for Shipment) or another standard, is used in the leakage rate tests.

The applicant described the leakage rate tests in SAR Section 4.4, 7.1.3 and 8.2.2. The applicant needs to provide a table in SAR Chapter 7 or Chapter 8 to summarize the fabrication, pre-shipment, maintenance, and periodic leakage rate tests for clarification. Information provided in the table should include, but is not limited to, leakage test criteria, test sensitivity, test methods, test frequency, and containment components that are subject to testing for each of fabrication, pre-shipment, maintenance, and periodic leakage rate tests.

Clarify whether ANSI N14.5 (a consensus standard), or another standard, is used in these leakage rate tests mentioned in item (a). If ANSI N14.5 is used, clarify whether the leakage rate testing procedures are approved by personnel whose qualifications and certifications in the non-destructive method of leak testing include certification by a nationally recognized society at a level appropriate to the writing and/or review of leakage rate testing procedures (e.g., an American Society of Non-destructive Testing (ASNT) Level III in leak testing) as noted in Section 8.8, “Quality Assurance,” of ANSI N14.5. An ASNT Level III in leak testing can be of great value in the design of a high reliability, economical leak testing program that includes selection of methods, equipment, and generation of procedures.

This information is required to determine compliance with 10 CFR 71.51.

4.4 Ensure use of the vacuum grease will not degrade the containment effectiveness of the CCV lid and CCV port cover O-ring seals.

The applicant stated, in step 26 of SAR Section 7.1.1, “Coat the exposed surfaces of the CCV lid and CCV port cover O-ring seals with the vacuum grease prior to assembling the package to minimize deterioration or cracking of the seal during use.”

Provide information of the vacuum grease to ensure that use of the grease will not degrade the containment effectiveness of the CCV lid and CCV port cover O-ring seals which are containment seals important to safety. Use of lubricant (grease) could minimize friction effect and avoid harmful abrasion on the O-rings but may cause premature failure of the O-rings or cause chemical or other reactions at higher temperatures under NCT and HAC.

This information is required to determine compliance with 10 CFR 43(d) and 71.51.