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AEM 12-02

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Mark D. Lombard, Director
Document Control Desk
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety and Safeguards
US Nuclear Regulatory Commission
Washington, DC

Subject: GEH Response to Request for Information for Continued use of the Model No. 2000 Package, Certificate of Compliance No. 9228, Docket 71-9228, TAC LA0129

Reference: 1) NRC Request for Information, M. D. Lombard to D. R. Krause, 7/23/12
2) GEH Response Extension Request, D. R. Krause to P. Saverot, 8/21/12
3) GEH Request for Extension for RAI Response, D.R. Krause to P. Saverot, 9/20/12
4) NRC Confirmatory Action Letter, NMSS-2012-001, 9/21/12

Dear Mr. Lombard:

GE Hitachi Nuclear Energy herein provides the information requested (Reference 1) and requests a revision to CoC 9228 to incorporate a minor modification to the liner drawing referenced and condition 5(a)(ix).

GEH understands that there has been a difference of opinion between the NRC understanding of the use of the liner and the GEH understanding. GEH believed the use of the lid to be optional; however, the NRC did not. The current lid does not fit the GE2000 package. Its design was carried over from an earlier model package, but no lid was ever really intended for use during the recent shipments. GEH here by commits that future shipment using the shielding liner as shielding will include a lid and a lid that fits will be fabricated for use with the package. A drawing change is required to incorporate the revised lid and drawing into the certificate of compliance.

The responses to the RAIs (Reference 1) are provided in Attachment 1. The details and justification of the drawing changes and requested modification to the COC are contained in Attachment 2. A revised drawing is provided as Attachment 3.

The GE2000 package has been subjected to many reviews and approvals by the NRC and has been used for 35 years of without significant incident before this current situation was identified. With the clarification of the shielded liner lid issue, there appears no reason to consider suspension of the CoC for this package.

If you have any additional questions please contact me at 925-862-4344.

Sincerely,

Digitally signed by Anthony McFadden
Date: 2012.10.10 12:32:14 -07'00'

Anthony E. McFadden, Manager
Vallecitos Nuclear Center

Commitments: 1) Model 2000 shipments requiring the optional liner for shielding, require the use of the liner lid.
2) Pre-shipment engineering evaluations will be amended to look for streaming paths.

Attachments: 1) GEH RAI Responses
2) CoC Amendment Request Details
3) Revised drawing number 129D4922

Cc: P. Saverot, USNRC NMSS SFS&T

Attachment 1

Request for Information
For the Model No. 2000 package
Docket No. 71-9228
Use of Inner Shield Liner

1. ***Provide the following information regarding the determination made by users to insert the inner shield liner without the shield lid:***

a. Clarify if the inner shield lid is credited in the package analysis for normal conditions of transport (NCT) and hypothetical accident conditions (HAC).

GEH Response:

NEDO-31581, Rev. 1 on page 5-2 and in Table 5.1.1 (October 2000) indicates that the liner was included in those shielding demonstrations; however, it is clear in the document that these are demonstrations and not all inclusive evaluations. NEDO-32318, July 1994, did not include the liner in the shielding demonstrations. Both documents discuss limitations in being able to exactly model every potential shipment configuration and indicate a pre-shipment engineering evaluation is required and that the pre-shipment survey measurements will determine compliance with transportation regulations.

b. Discuss why the inner shield lid specified in CoC Condition No.5(a)(3)(ix) does not fit and was not intended for use in the package.

GEH Response:

The liner, including its lid were originally designed for and used in the GE-1600 cask. When the GE-1600 was retired and replaced by the GE-2000 (of similar size), the liner and lid were thought to be compatible and applicable to continued use. Early in the use of the GE-2000 it was identified that the lid would not fit due to interference from the lifting fixture and by the addition of a rack in the bottom to assist with drainage following underwater loading.

The fact that the lid did not fit was not cause for concern since it was identified as an optional component and the understanding was that the liner could be used without the lid. NEDO-32318, August 2000, Rev.1 further supports this position based on the statements of Section 2.11.5 as follows: *"The Maximum Contents weight of the 2000 Transport Package, as defined in Section 2.2, is 5,450 pounds. Maximum Contents may consist of the liner, liner lid, a rack, material/contents, <u>or any combination of these.</u> Table 2.197 shows several credible combinations of Maximum content components."* Table 2.197 shows options with and without the liner lid.

Pre-shipment engineering evaluations are performed prior to loading the cask for shipment and had the lid been considered important for a proposed shipment, a new one could have been fabricated with a modified lifting fixture and fit to accommodate the drying rack. As stated in the SAR, the binding requirement is that the shipment has to meet the regulatory transportation limits.

c. Discuss the reasons for specifying the inner shield liner in the design drawings provided to NRC for approval and for continuing to specify it in subsequent certificate renewals.

GEH Response:

As indicated, GE understood the liner to be optional and that included an optional use of the lid (NEDO-32318, Section 2.11.5). Additionally the following extract from NEDO-32318, August 2000, Rev. 1, and Page 426 supports this position: *"Dose rates from a shipment of radionuclides are determined by many variables. Some of the variables are: physical form and configuration, thicknesses of container shields,*
irradiation time, operating power (neutron flux), decay time, composition of hardware

(or target material), and so forth. For this reason, defining a maximum source load for the container is conditional. Two significant limits which are practical for assuring public safety are the criticality mass limit for SNM and the maximum heat load to prevent structural failure. The normal condition quantity limits and dose rate limits are defined by the transportation regulations, and compliance with these limits is demonstrated for each particular load. Accident condition dose rates are a function of geometry changes in the load and/or shielding. Major changes are prevented by the structural integrity of the container. Typically, the controlling dose rate limit is the two-meter limit of 10 mR/hr. Barring loss of shielding, the accident case geometry does not result in the limiting dose rate of 1,000 mR/hr at one meter from the surface of the container."

Based on the GEH understanding of the package requirements there appeared to be no reason to change the certificate and in fact if a proposed shipment required the liner lid for shielding, a new one could have been fabricated.

d. Discuss how the use or non-use of the inner shield is communicated to the users of the package.

GEH Response:

As stated above, GEH previously understood the liner to be optional and that the liner can be used without the lid. When users requested use of the package with the liner including the lid, GEH advised them that the lid was not available. The potential user then made their own decision as to whether the package is adequate for their proposed use.

In addition, the operating procedures in Chapter 7 require the user to do a pre-shipment engineering evaluation and this provides confidence that the shipment will meet regulatory requirements when packaged and surveyed for shipment. Therefore there are several safeguards in place.

e. Discuss also if there are any specifications or notes in the supporting application (including drawing 129D4922) that indicate that the shield liner is permitted to be used without the shield lid. In a conversation with NRC staff on May 22, 2012, (ML12164A774), GEH stated that the optional lead liner depicted in drawing 129D4922 is partially used, without the shield lid component. GEH stated that the inner shield lid does not fit inside the package and was not intended for use in this package. However, the shielding calculations that form the licensing basis for shipments of contents below 600 Watts, in Condition No. 5(b)(1)(ii) of the CoC, for NCT and HAC, assume that the lead liner is inserted in the package in its entirety (NEDO-31581Rev. 1 Pages 5-2 and 5-14).
This information is required by the staff to determine compliance with the requirements of 10 CFR 71.95 and 10 CFR 71.107.

GEH Response:

The statement that GEH stated that the lid did not fit and was not intended for use in this package should have included the wording "because of the interference from the lifting device on this specific part and the drainage rack in the cask".

GEH considers that there are several references that would indicate that the liner and the liner lid are different components and that the liner could be used independent of the lid. The most obvious one is the fact that these components are noted as "optional" and identified as a "class C" component meaning they are not safety related. See also Section 2.11.5 in the SAR. Clearly there is ambiguity related to precisely what the requirement is regarding the liner and the liner lid.

The calculations that are described as forming the basis for the contents of 5(b)(1)(ii) are intended as demonstration that the cask is capable of handling the range of materials authorized and is not specific or all inclusive. The SAR indicates that predicting exact conditions of shipment in the package is very difficult and therefore the pre-shipment engineering calculations and pre-shipment survey are very important in assuring that regulatory limits are met. So the conditions in the SAR demonstration are not represented to be all possible cases but a reasonable representation of cases.

It is also important to note, that Figure 5.1 – Normal Condition Shield Analysis Geometry, that the measurement points are noted on the diagram and these are the points used for reporting the results of the shielding analysis in the SAR and the past pre-shipment engineering evaluations. They are representative of the package performance but not all inclusive. The pre-shipment survey is more representative of the actual radiation dose rate from the package and this is the reason the importance of the pre-shipment survey is stressed.

2. Provide the following information regarding the optional use of the inner shield liner (any or all components) for the package as described in CoC Condition No.5(a)(3)(ix):

a. Discuss the procedure that describes the use of this component for the users of the package, including the applicable criteria when deciding that an "optional" component becomes necessary for the package.

GEH Response:

Chapter 7 of the SAR does not include any specific instructions regarding the use of the liner or the liner lid. One of the GEH procedures incorporated into Chapter 7 includes shielding in the definition of packaging; and baskets, holder, spacer, spider, etc. are considered typical terms used to describe mechanisms which restrain or support the contents to prevent movement during transport. Such items are considered part of the packaging and are supplemental to the basic description in the package certificate. This is consistent with the previous GEH determination that these are optional components.

The SAR provides instructions to complete a pre-shipment engineering evaluation of the proposed shipment. This engineering evaluation looks at a number of parameters including shielding. The purpose of the engineering evaluation is to determine if the proposed configuration for the shipment would most likely meet regulatory requirements and in cases where necessary identify changes in the shielding, shoring or other protective measures as appropriate. In addition a pre-shipment radiation survey is required.

b. State if any shipments of contents described in Condition No. 5(b)(1)(i) and 5(b)(1(ii) of the CoC have been performed in an horizontal configuration, and discuss how modifications can be made to the lid to fit in this configuration, as required by Condition No. 16 of the CoC. CoC Condition No. 5(a)(3)(ix) states that the lead liner is an optional component of the package. However, the Safety Evaluation Report (SER), Rev. 0, issued by NRC staff, references drawing 129D4922 and appears to credit it in the original safety approval. The lead liner is discussed in NEDO-31581 Rev. 1, "Model 2000, Radioactive Material Transport Package," in Section 1.2.1 and illustrated on Figure 1.2.3.
This information is required by the staff to determine compliance with the requirements of 10 CFR 71.95 and 10 CFR 71.107.

GEH Response:

GEH confirms that shipments in the horizontal configuration have been made and all were made without the lid on the liner. Condition 16 of the COC requiring the liner use for shipments in the horizontal configuration was added on May 26, 2005. It appears that horizontal-configuration-shipments were made in 2008 and 2005, and possibly some in the 1990s. There is no indication that the radiation limits for the shipments exceeded regulatory limits.

GEH understands that the NRC believes that when the liner is specified it means the lid and the liner, however, this is not the understanding or practice of those using the package historically. The liner body and liner lid were seen as optional components and therefore the liner could be used without the lid. There was a good technical reason for this in the horizontal shipping configuration because the cask bottom was only steel and needed the lead in the liner to reduce the dose rate out of the bottom of the package which faced toward the rear of the vehicle.

With regard to modifications to the current lid, there do not appear to be any options for modification because not only does the lifting fixture interfere but also the thickness is too great to accommodate the drainage platform under the liner. A new lid is being fabricated for use with all future shipments using the lead liner as shielding.

The February 23, 2012 shipment is the first time in 35 years that there has been a perceived problem associated with the package shielding. It is GEHs opinion that the February 23, 2012 shipment was compliant with the CoC and all transport requirements.

3. Provide the following information regarding the HAC performance of the package when not using the inner shield liner, or when using it without the shield lid:

a. Justify that allowable sources below 600 Watts will meet HAC regulatory dose rate limits without the liner as a required component, and in a partial configuration with no shield lid, for contents described in Condition No. 5(b)(1)(ii) of the CoC. Staff performed preliminary analyses that indicate that 60Co sources (from 100 to 600 Watts) could exceed HAC dose rate limits without the additional shielding provided by the liner. In addition, staff noticed that the area between the top of the liner and the lid is the location where the greatest streaming effects are observed.

GEH Response:

For contents described in Condition No. 5(b)(1)(ii) of the CoC below 600 watts, for the HAC case where a 1.08E5 Ci Co-60 source shipped without the liner and liner lid, the dose at one meter from the overpack is greater than 1 R/hr when applying the HAC source described in NEDO-31581 Rev. 1. For combinations of isotopes with loadings of 600 watts and below, a pre-shipment evaluation is necessary to determine if the liner is necessary to meet the HAC regulatory dose rate limits. The NRC staff observation regarding the area of maximum streaming is consistent with the GEH observations during the pre-shipment survey and the investigation of these RAIs. These streaming paths were not evaluated in previous evaluations which used the dose points consistent with those in NEDO-31581 Rev. 1 (Figure 5.1). Radiation surveys performed immediately when the cask was removed from the loading pool found the elevated dose location from the GE2000 cask and corrective measures were employed before the shipment was made. GEH has plans to amend our pre-shipment engineering evaluations to look for excessive streaming in future shipments.

For the case in which the liner is present without the lid, (i.e., the HAC case where a 1.08E5 Ci Co-60 source shipped without the liner lid), the dose at one meter from the overpack is less than 1 R/hr when applying the HAC source as described in NEDO-31581 Rev. 1.

b. Justify that the shield liner installed in a configuration with and without the shield lid will maintain its configuration under HAC, as credited in application. The package licensing basis used finite element analyses (FEA) and a ¼ scale drop testing for the 30 ft drop test. However, the optional liner does not appear to have been considered in the FEA or scaled drop testing. It also appears that the shield liner could be subject to buckling and failure in a configuration without the shield lid. The liner consists of lead held together with a 0.38" stainless steel shell.

GEH Response:

In the context of the SAR (NEDO-31581) and related certification drawings, an ANSYS finite element model (Reference NRC SFPO ISG-21) was generated to evaluate the stresses of the optional liner. The model includes the GE2000 cask body with lead shield and lid, optional liner without lid, and dummy contents that represents the shoring materials and source payload. The mass of the optional liner and dummy contents is equivalent to the maximum payload weight of 5,450 lb (NEDO-31581, Table 2.10.1.1.

The solid model of the GE 2000 cask was generated from the provided drawings and design input. The 3D (half-symmetry) solid model was generated using Autodesk Inventor, which was imported into ANSYS Workbench Design Modeler. The solid model is shown in Figure 3b-1. The finite element mesh was generated using the ANSYS Workbench Mechanical interface. The finite element model is presented in Figure 3b-2. Boundary conditions are shown in Figure 3b-3.

Two drop configurations are considered to evaluate the worst case loading to the optional liner. When the liner lid is not present, the HAC side drop may impose maximum hoop stresses in the liner shell due to the inertial load

applied by the lead. Similarly, during the end drop the interior shell of the liner may experience maximum stresses when resisting movement of the lead column.

For the side drop, symmetry boundary conditions are applied to the cut plane of the half-model and the side bottom edge of cask is fixed. The side acceleration of 133g is applied in the +X direction to simulate the inertial load experienced during the HAC side drop (NEDO-31581, p 2-97). Similarly, for the end drop, symmetry boundary conditions are applied to the cut plane of the half-model and the bottom surface of the cask is fixed to simulate end drop conditions. The end acceleration of 133g is applied in the +Z direction to simulate the inertial load experienced during the HAC end drop. All analyses are performed under ambient temperature conditions.

Figures 3b-4 and 3b-5 show the results of the drop analyses. For the side drop the total stress intensity occurs at the edge of the bottom shell. To evaluate the stress across the shell, the linearized section is defined. As the tabulated data shows the total stress intensity across the liner shell is less than the yield strength of 304 stainless steel (30,000 psi). The total stress shown in figure 3b-5 also shows the stresses during the end drop are acceptable. Therefore, the structural integrity of the optional liner during HAC drop conditions is acceptable.

Figure 3b-1. GE 2000 Cask Solid Model.

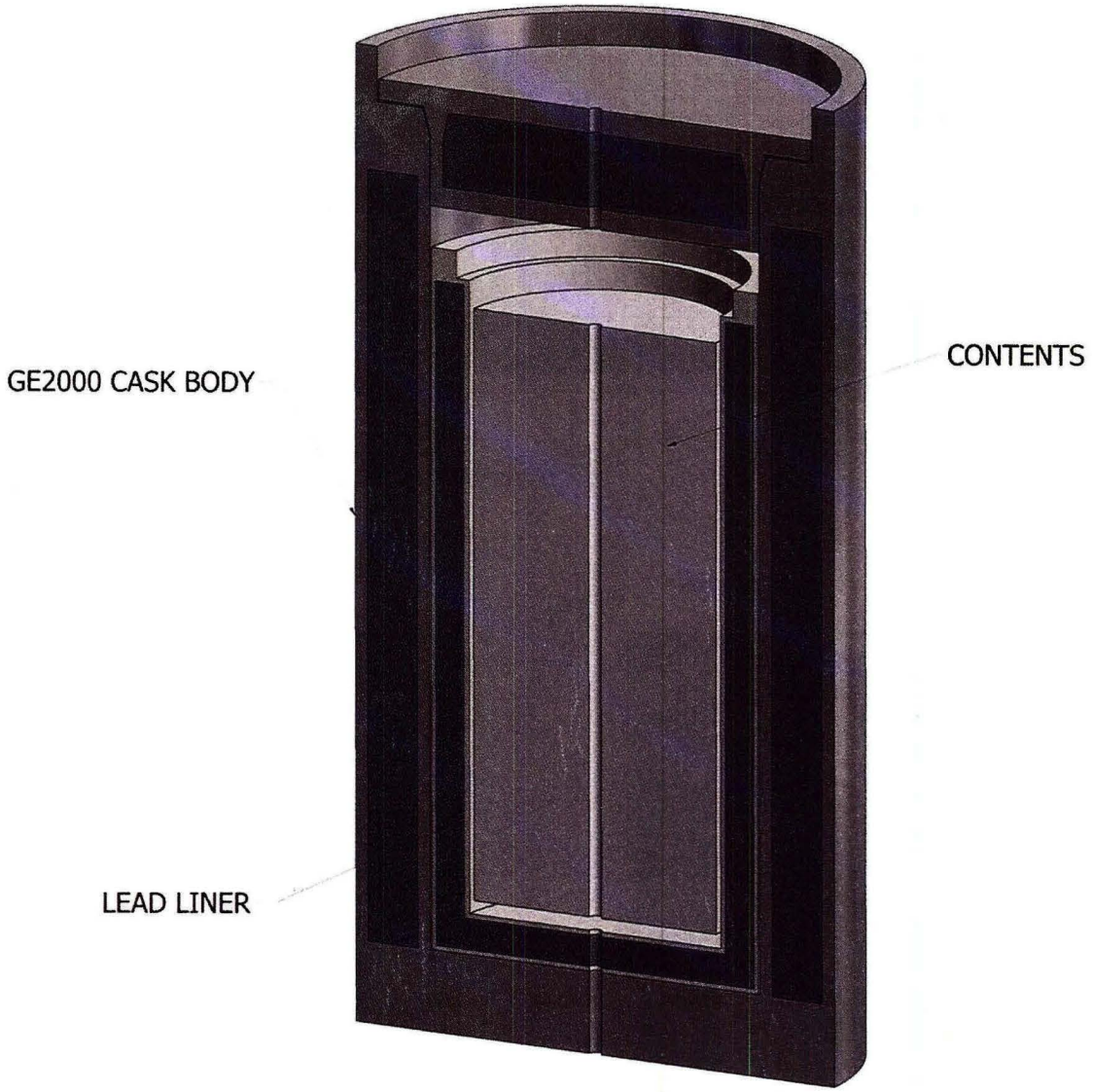
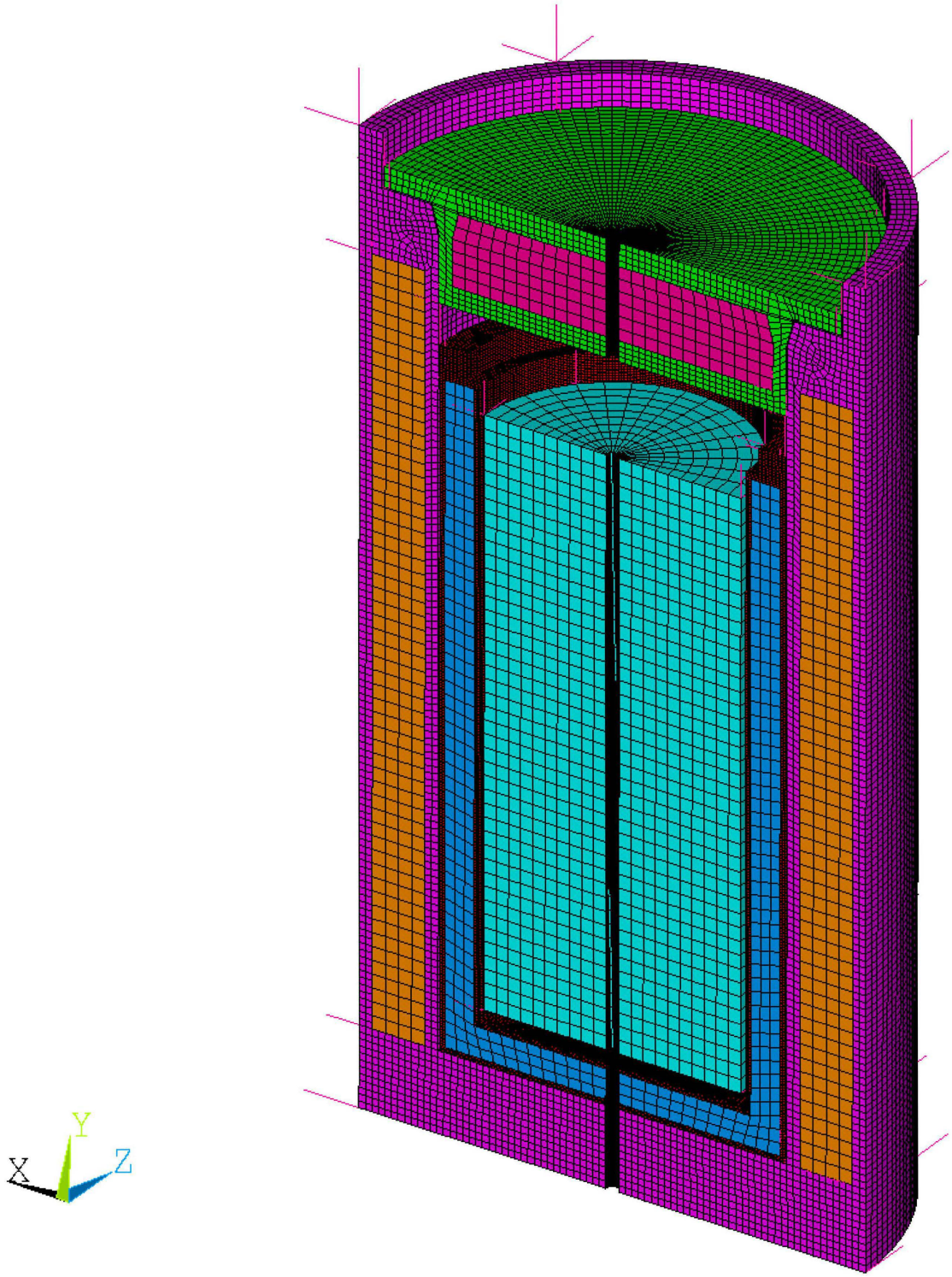


Figure 3b-2. GE 2000 Cask Finite Element Model.



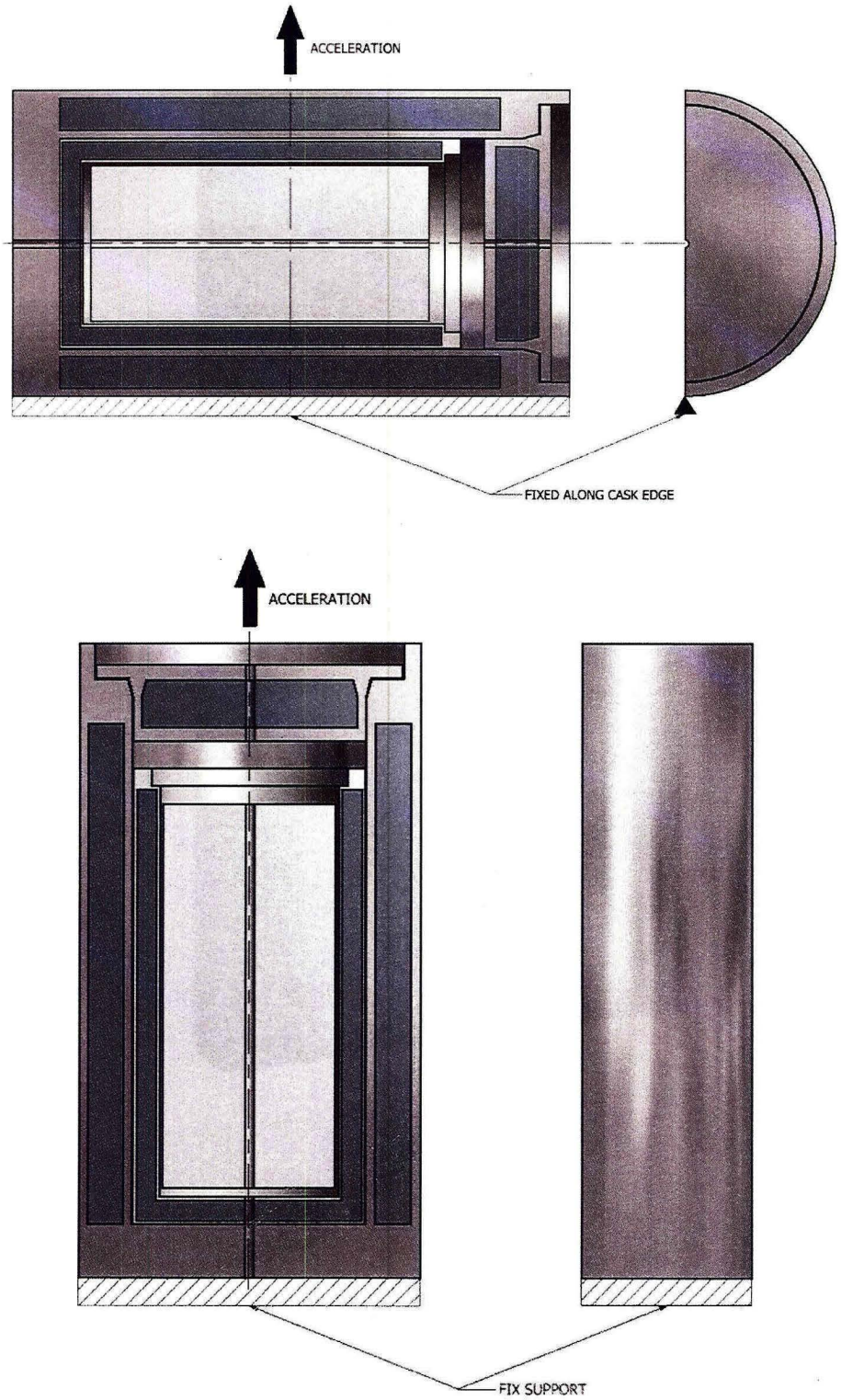
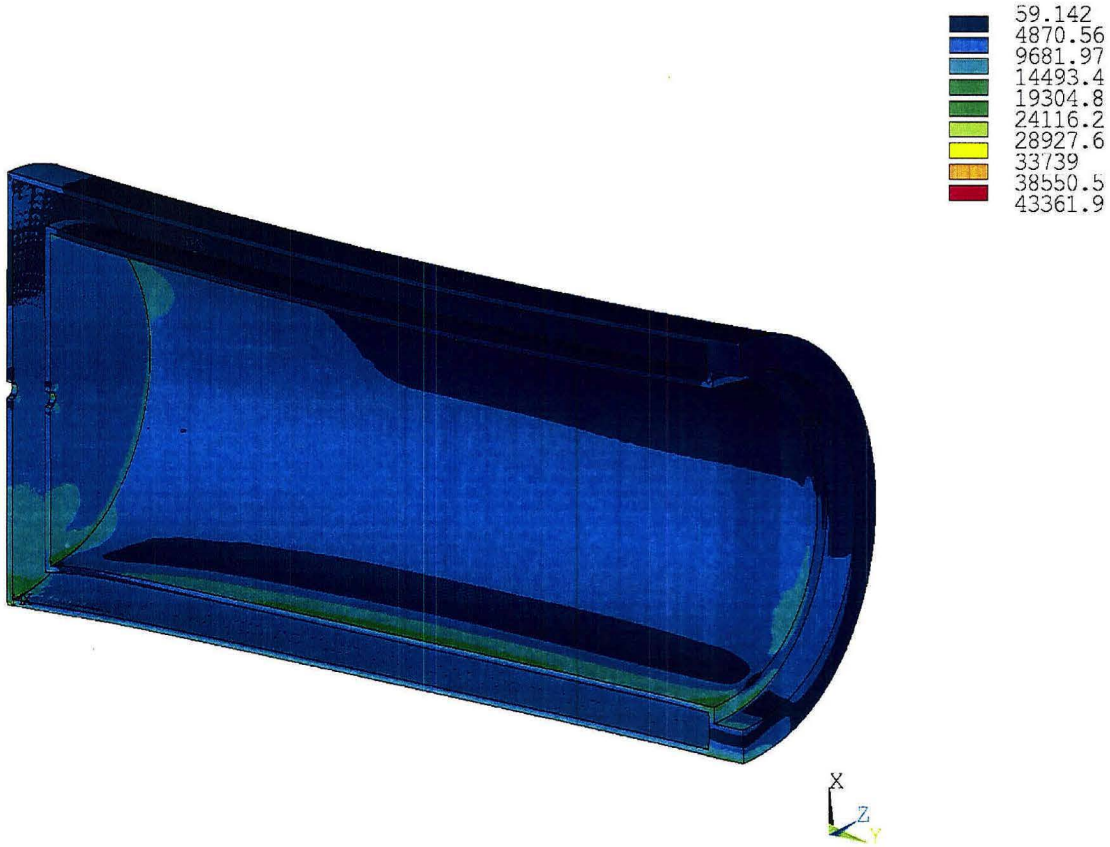


Figure 3b-3 . GE 2000 Model Boundary Conditions

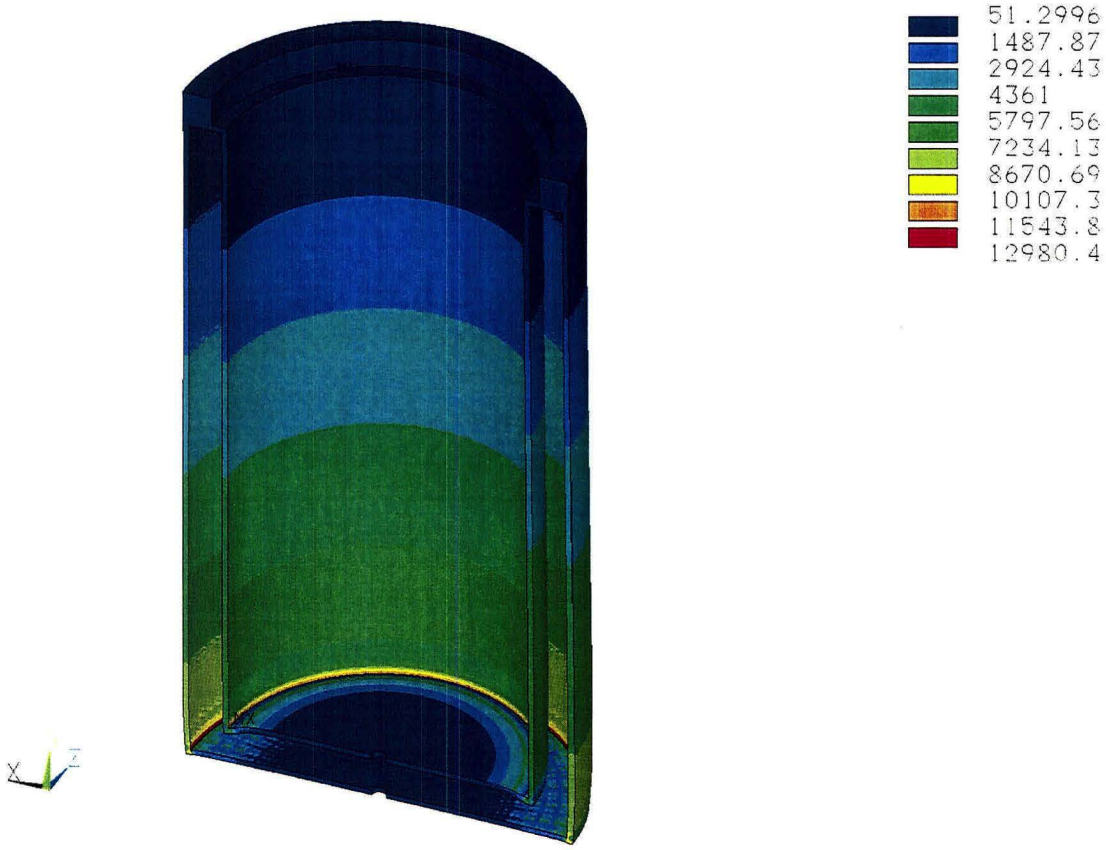
Figure 3b-4. Optional Liner Stress Intensity (psi) Side Drop



Section Stress Across Shell

Path (inches)	Total Stress (psi)
0.0000	23709
0.0188	22491
0.0375	21398
0.0563	20432
0.0750	19595
0.0938	18892
0.1125	18331
0.1313	17919
0.1500	17657
0.1688	17537
0.1875	17538
0.2063	16457
0.2250	15269
0.2438	14356
0.2625	14952
0.2813	15628
0.3000	16362
0.3188	17150
0.3375	17995
0.3563	18903
0.3750	19883

Figure 3b-5. Optional Liner Stress Intensity (psi) HAC End Drop.



c. Evaluate the possibility of the source getting lodged in the gap between the liner body and the lid of the cask after HAC and calculate resultant dose rates. When the optional lead liner (drawing 129D4922, Rev. 2) is used in a configuration without a lid, it appears that sources may no longer be contained within the liner bounds after HAC because of a gap of multiple inches between the shield liner body and the structural lid of the package.

GEH Response:

For the configuration when both the liner and liner lid are used, the source will not be able to be lodged in the gap between the liner body and the lid of the cask. The HAC peak dose is less than 1 R/hr at one meter from the overpack surface when the liner and lid are both used.

For the HAC case where a 1.08E5 Ci Co-60 source shipped without the liner lid, the dose at one meter from the overpack is less than 1 R/hr when applying the HAC source described in NEDO-31581 Rev. 1. While the dose without the liner lid is less than the HAC dose limit, the dose increases by an order of magnitude when the liner lid is not used.

d. Justify whether streaming affects should be analyzed in both the NCT and HAC evaluations for the package. Streaming effects are not accounted for in the shielding calculations that form the licensing basis, as documented in NEDO-31581 Rev. 1, "Model 2000, Radioactive Material Transport Package," page 5-8, for shipments of contents below 600 Watts for Condition No. 5(b)(1)(ii) of the CoC, and in NEDO-32318, "Model 2000, Radioactive Material Transport Package, 2000 Watts Decay Heat Upgrade, Safety Analysis Report," page 5-7, for contents between 600 and 2,000 Watts. The events at the Clinton Nuclear Generating Station, where unexpected high dose rates were observed, thus requiring the package to be shipped in a closed configuration, demonstrate that streaming paths with sources in elevated positions may produce higher than expected dose rates.

GEH Response:

The prior evaluation did not specifically look for streaming effects. However, a shipment specific HAC analysis should consider the impact of streaming paths for contents considering shoring, source geometry and other factors. GEH plans to amend our procedures for pre-shipment evaluations per Chapter 5 of NUREG-1609. The update will include looking for streaming paths so that they are understood with respect to source configuration. The procedure will also be updated to consider the transport package shielding review and recommendations from NUREG-1609 and NUREG-6802.

In the case at the Clinton Nuclear Generating Station, it is important to note that the pre-shipment survey found the problem before the shipment was placed in public transit in accordance with site practices.

e. Discuss the effects of lead slump in the main package shielding on the HAC dose rates in the shielding analyses. Lead slump does not appear to be accounted for in the analyses for HAC conditions; however, Page 2-106 of NEDO-31581 Rev. 1, "Model 2000, Radioactive Material Transport Package" indicates that this effect is analyzed in the HAC structural analyses.
This information is required by the staff to determine compliance with the requirements of 10 CFR 71.51(a)(2), 10 CFR 71.73, and 10 CFR 71.47.

GEH Response:

Lead slump is conservatively calculated using classic methods and assuming the cask lead shield column is unsupported by the steel inner and outer shells. The response of the lead shield is determined by multiplying the shield weight by the HAC end drop acceleration of 133g. Therefore, the worst case lead slump is (Reference NRC SFPO ISG-21):

$y_{max} = \frac{P}{k} = 0.046$ in.

where

$P = W \times g = 1.2462 \times 10^6$ lb

$W = V \times \rho = 9{,}370.2$ lb, weight of lead shield

$V = A \times h = 22{,}870.8$ in³, volume of lead shield

$A = \pi(r_o^2 - r_i^2)$, cross-sectional area of lead shield

$r_o = 18.25$ in, outside radius of lead shield

$r_i = 14.25$ in, inside radius of lead shield

$h = 56$ in, height of lead column

$\rho = 0.4097$ lb/in³, density of lead

$g = 133$ g, end drop acceleration

$k = \frac{A \times G}{h} = 2.71 \times 10^6$ lb/in, effective stiffness of the lead shield

$G = \frac{E}{3(1-2\nu)} = 3.72 \times 10^6$ psi, bulk modulus of lead

$E = 2.23 \times 10^6$ psi, modulus of elasticity of lead at 100°

$\nu = 0.4$ = Pission's ratio for lead

The calculation shows that the maximum lead slump is small for an unsupported lead shield. With the lead fully supported by the inner and outer shells of the cask, the actual lead slump is significantly smaller. The lead slump is bounded by conservatism built into the shielding analysis. Therefore, no further shielding analysis is required.

4. Provide the following information regarding the NCT performance of the package when not using the inner shield liner, or when using it without the shield lid:

a. Justify that allowable sources below 600 Watts will meet NCT regulatory dose rate limits without the liner as a required component, and in a partial configuration with no shield lid for contents described in Condition No. 5(b)(1)(ii) of the CoC. The shielding calculations for NCT that form the licensing basis for shipments of contents below 600 Watts for Condition No. 5(b)(1)(ii) of the CoC appear to credit the "optional" lead liner (Reference NEDO- 31581 Rev. 1, "Model 2000, Radioactive Material Transport Package,"page 5-2).

GEH Response:

For the NCT case, if 1.08E5 Ci Co-60 source is shipped with the liner but without the liner lid, the dose at the overpack on contact has the potential of exceeding the dose rate limits when applying the NCT source described in NEDO-31581 Rev. 1.

For the NCT case where a 1.08E5 Ci Co-60 source shipped without the liner and liner lid, the dose on contact on the overpack exceeds the dose rate limits when applying the NCT source described in NEDO-31581 Rev. 1. For combinations of isotopes with loadings of 600 watts and below, it has been GEH practice to require that a pre-shipment evaluation be used to determine if the liner is necessary to meet the NCT regulatory dose rate limits.

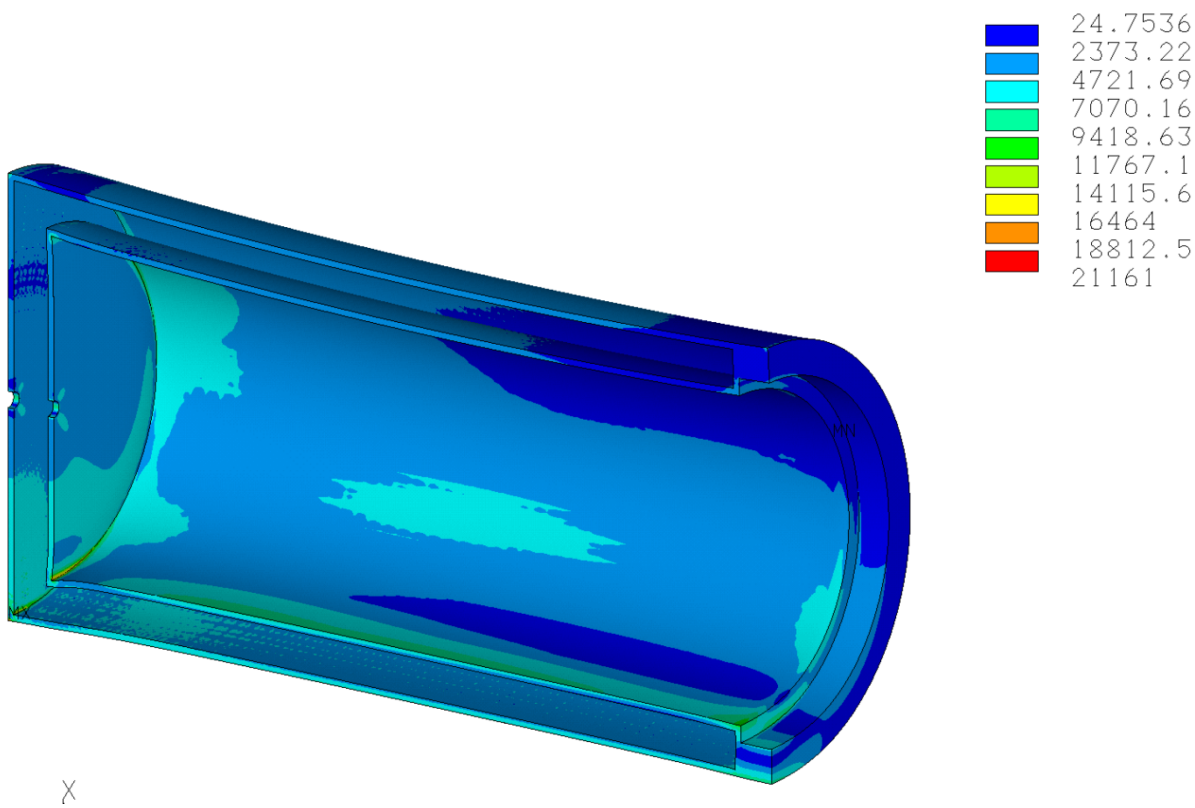
GEH does perform a pre-shipment evaluation for all shipments of isotopes that are specific for the shipment being made and takes corrective action where the calculations indicate that regulatory requirements would not be met.

b. Provide the structural analysis of the optional lead liner for NCT conditions.
This information is required by the staff to determine compliance with the requirements of 10 CFR 71.47 and 10 CFR 71.71.

GEH Response:

In the context of the SAR (NEDO-31581, Section 2.6.7, p 2-69) and ANSYS finite element model presented in the response to RAI 3b, an acceleration of 69g is applied simultaneously in the +X and +Z directions. This inertial load bounds all NCT drop conditions. Results of the analysis are presented in Figure 4b-1. As the figure shows the peak stress intensity in the liner is less than the yield strength of 304 stainless steel (30,000 psi). Therefore, the structural integrity of the optional liner during NCT drop conditions is acceptable.

Figure 4b-1. GE 2000 Cask NCT Drop Analysis Stress Intensity (psi) Results.
ORIGINAL CERTIFICATION BASIS



5. The shielding calculations that form the licensing basis for shipments of contents below 600 Watts for Condition No. 5(b)(1)(ii) of the CoC assume a cylindrical geometry during NCT (Section 5.4.2 of NEDO-31581 Rev. 1, "Model 2000, Radioactive Material Transport Package," page 5-14).

a. Provide additional information justifying that this cylindrical geometry, including any assumed self-shielding, is bounding under NCT for any and all other geometries allowed arrangements of the authorized contents.

GEH Response:

The pre-shipment evaluation for NCT considers the actual shipped source geometry or a conservative geometry for the source orientation. The self-shielding and cylindrical geometry of the source is case-specific as it is further discussed in Section 5.4.3 of NEDO-31581 Rev. 1 which states, "These loading limits are for the geometry and material cases analyzed only and are the Curie or mass limits which comply with the regulatory dose rate limits only". The pre-shipment shielding evaluation verifies that the specific shipment source geometry is bounded by the geometry discussed in Section 5.4.3 of the SAR.

b. Provide a structural justification demonstrating that the sources remain shored so that there is no deviation from this "cylindrical" geometry, or justify that other possible geometry will meet regulatory dose rate limits.
This information is required by the staff to determine compliance with the requirements of 10 CFR 71.51 and 10 CFR 71.71.

GEH Response:

Compliance with the SAR and the dose rate limits is determined as part of the pre-shipment evaluation. The pre-shipment evaluation considers conservative source geometry with respect to shielding orientation of the actual shipped source configuration. Feasible changes in the source geometry and orientation are considered as part of the HAC evaluation.

6. Clarify the procedure used to convert source activity to source decay heat for contents below 600 Watts. Explain how package's users perform this conversion and how consistency is ensured for each use of the package. Expressing content's limits in terms of decay heat (Watts) may be ambiguous and, unless the procedure for converting an activity to watts is consistent, will not result in an adequate estimation of shielding capability. For example, the procedure for calculating the decay heat from the activity is described on page 5-14 of NEDO-32318, "Model 2000, Radioactive Material Transport Package, 2000 Watts Decay Heat Upgrade, Safety Analysis Report." For Co-60 this procedure includes the gamma energies and one third of the beta energy. Other ways to perform this conversion is to use the published Q value of the reaction, or to only account for the gamma energy and neglect the beta. This procedure can be more complicated for other nuclides with radioactive daughter isotopes. This document states on page 5-15: "The presentation of the activity equivalence to 2000 watts can be misinterpreted if it is not clear whether the activity refers only to the parent isotope or to the combined activity of the parent plus the daughter." The SAR for contents below 600 Watts is documented in a different document, NEDO-31581, and is silent on instructing users on how to perform this conversion. The staff also notes that there are no operating procedures that instruct users on how this conversion is to be done.
This information is required by the staff to determine compliance with the requirements of 10 CFR 71.107.

GEH Response:

A pre-shipment evaluation is required for each shipment. The estimated isotopic activities of the source are used as inputs to the radiological shielding evaluation. Compliance with the decay heat and dose rate is evaluated separately. ORIGEN2 and / or ORIGEN ARP are used to determine the decay heat for the approved type and form of the material.

For contents below 600 watts, source decay heat is not the limiting basis for the Package's shielding, containment or structural capability.

7. Justify how specific basket configurations are determined and installed by users of the package for contents above 600 Watts. Justify that undefined basket configurations will not result in dose rates exceeding NCT and HAC dose limits Table 1.1 of NEDO-32318, "Model 2000, Radioactive Material Transport Package, 2000 Watts Decay Heat Upgrade, Safety Analysis Report" shows specific basket configurations that are to be used for various contents when shipping 600-2000 Watts of contents for Condition No. 5(b)(1)(ii) of the CoC. These are not currently included as requirements of the CoC or within the associated operating procedures.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.47, 10 CFR 71.71 and 10 CFR 71.73.

GEH Response:

Contents with greater than 600 Watts of heat present a wide variety of materials, configurations; and handling requirements at facilities. These materials may include activated parts, relatively low activity sources and other materials that are greater than Class A material. An analysis following the process described in Chapter 7 of the SAR must be followed to safely accommodate this range of materials. GEH Vallecitos Operations follow Pre-shipment Evaluation Procedure, No. 130P010 Rev. 3 and later, along with the R-99 form. This process requires that a competent person compares the proposed shipment to previously analyzed shipments. These comparisons result in either shipments that are bounded by previous analysis or those that need additional specific analysis. For bounded shipments, the rational for use of previous analysis is documented. In cases where additional analysis are required, then analysis using procedures developed for that discipline (radiological, thermal, mechanical…) are followed. In both cases the results are reviewed by an independent person for completeness.

The configuration for materials that have a heat load of greater than 600 watts may require shoring in excess of that in other shipments. Because of the low amount of heat, the thermal and mechanical analyses are generally limited in scope. The dose analysis take into account such factors as reasonably expected configuration changes during accident conditions. In all cases, the as presented and as received packages undergo survey to assure that applicable dose limits are met.

8. Justify that specific nuclides are bounding for all radionuclides (neutron and gamma sources) that can be shipped. The licensing basis for contents in Condition No. 5(b)(1)(ii) of the CoC is not specific to any radionuclide; however, the shielding analysis performed below 600 watts (Page 5-15 of NEDO-31581 Rev. 1 "Model 2000, Radioactive Material Transport Package") is limited to Cobalt-60, Cesium-137, Zirconium-95/Niobium-95, and Hafnium-181. For contents between 600 and 2000 Watts, the shielding analysis is limited to Cesium-137, Cobalt-60, Hafnium-181, Iridium-192, Strontium/Yttrium-90, and Zirconium/Niobium-95 (Page 5-1 of NEDO-32318, "Model 2000, Radioactive Material Transport Package, 2000 Watts Decay Heat Upgrade, Safety Analysis Report").
This information is required by the staff to determine compliance with the requirements of 10 CFR 71.33(b).

GEH Response:

The pre-shipment evaluation applies an estimated or conservative isotopic activity of the source to confirm that the shipment is bounded by the respective SAR and the licensing shipping shielding and decay heat limits.

9. Provide an analysis to justify that all contents of the package specified under Condition No. 5(b)(1)(ii) of the CoC with shoring/carrier racks meet HAC conditions. Also provide the procedure for shoring, or for using the carrier racks, that is consistent with what was analyzed.
Condition No. 13 of of the CoC, Rev. 5, states: "Appropriate carrier racks or shoring must be provided to minimize movement of contents during accident conditions of transport." It does not appear that carrier racks or shoring devices were considered in the finite element analyses or scaled drop testing.
This information is required by the staff to determine compliance with the requirements of 10 CFR 71.73.

GEH Response:

In the context of the SAR (NEDO-31581), the package is defined as the GE2000 cask, carrier rack(s), and optional lead liner as addressed previously in the responses to RAI's 3b and 4b. The carrier rack is a light weight structure designed to safely transfer source material from the reactor environment, into the GE2000 cask for transport, and hot cell operations at the GEH Vallectos Nuclear Center. The carrier rack is design to facility shoring of the source materials and is not anticipated to survive HAC conditions. The shielding analysis presented

in the SAR, Section 5.2, justifies this claim since the source is assumed to collapse into a sphere located at the inner wall of the liner cavity.
Through finite element analysis and ¼-scale drop tests GEH demonstrated that the GE2000 package meets the requirements in 10 CFR 71.71 and 71.73. The maximum contents weight is limited 5,450 lb. The majority of the contents weight is comprised of the lead liner with lid. Approximately 1000 pounds is available for the carrier racks, secondary containers and source materials. However, the carrier source rack plus contents is less than 100 pounds. Because the relative mass of the carrier rack and source material is small when compared to the mass of the GE2000 cask and optional liner, the inertial effect on the carrier rack is small. Therefore, the inertial loads applied to the contents during NCT are not anticipated to challenge the structural integrity of the structure. Furthermore, the shielding analysis supports the claim that the carrier rack is not required to survive the HAC drop events. Therefore, no further analysis is required.

Attachment 2

1) Drawing 129D4922 is modified to Revision 3 for incorporation into Condition 5. (a) (ix). The new drawing is included as Attachment 3.

The new lid design eliminated the lifting bail and replaces it with removable anchors in the top. In addition the amount of the plug that protrudes out the top of the liner has been reduced; however, the amount of lead shielding has been retained by allowing the plug to extend further into the liner cavity.

2) GEH is requesting that the wording to Condition 5. (a) (ix) be modified to make clear that when the liner is used for shielding that the lid must also be used. The proposed language is as follow:

When the optional lead liner is used as required shielding, it must be constructed and assembled with both the liner and the lid in accordance with General Electric Company Drawing No. 129D4922, Rev. 3.

Attachment 3

New Drawing # 129D4922