UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 7, 2019

Mr. Franz Hilbert
DAHER NUCLEAR TECHNOLOGIES GmbH
Margarete-von-Wrangell-Straße 7
D-63457 Hanau – GERMANY

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE MODEL NO. DN-30 PACKAGE

Dear Mr. Hilbert:

By letter dated August 2, 2018, you submitted an application for Certificate of Compliance No. 9362, Revision No. 0, for the Model No. DN30 package. Your application was accepted for review on October 4, 2018, when staff received your responses to our request for supplemental information dated September 29, 2018.

The staff has determined that further information is needed to complete its technical review. The information requested is listed in the enclosure to this letter. We request you provide this information by May 8, 2019.

Please reference Docket No. 71-9362 and EPID - L-2018-NEW-0003 in future correspondence related to this licensing action. If you have any questions regarding this matter, please contact me at 301-415-7505.

Sincerely,

/RA Ilka Berrios Acting for/

Pierre Saverot, Project Manager
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9362
EPID No. L-2018-NEW-0003

Enclosure:
Request for Additional Information

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE MODEL NO. DN-30 PACKAGE DOCUMENT DATE: March 7, 2019

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Request for Additional Information
DAHER NUCLEAR TECHNOLOGIES GmbH
Docket No. 71-9362
Model No. DN-30 Package

By letter dated August 2, 2018, Daher Nuclear Technologies, GmbH, submitted an application for Certificate of Compliance No. 9362, Revision No. 0, for the Model No. DN-30 package.

The U.S. Nuclear Regulatory Commission (NRC) staff (the staff) issued a request for supplemental information dated September 29, 2018, for which responses were received on October 4, 2018.

This request for additional information (RAI) identifies information needed by the staff in connection with its review of the application.

Each individual RAI describes information needed by the staff to complete its review of the application and to determine whether the applicant has demonstrated compliance with the regulatory requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71.

CHAPTER 1 GENERAL INFORMATION

1-1 Provide a discussion in the application to describe and ensure that the loaded 30B cylinder is in a safe condition for transport within the DN-30 PSP.

Section 1.7.4 of the application states that the filling of the 30B cylinder with UF_6 is described in site-specific operating handbooks. Although specific procedural details may be included in user handbooks, the application should provide assurance that the loaded 30B cylinder is in a safe condition for transport. Items to address include:

- The 30B cylinder should be filled, handled, and undergo testing per procedures that, at a minimum, follow USEC-651 "Uranium Hexafluoride: A Manual of Good Handling Practices" (or equivalent).
- Inspection of the 30B cylinder as described in USEC 651 (or equivalent), ANSI N14.1, and ISO 7195 to ensure there are no deposits at the valve and plug.
- Weighing the 30B cylinder to ensure it has not been overfilled and, in addition, has sufficient ullage.
- Prior to shipment, the 30B cylinder is to be cooled such that the vapor pressure is below atmospheric pressure and the entire UF6 content is solid.

This information is needed to determine compliance with 10 CFR 71.43(f), and 71.55.

1-2 Remove from the application all statements pertaining to any equivalency of materials or their possible substitution.

Staff has always been opposed to vague wording, such as "equivalent" or "similar," in safety analysis reports. What is "equivalent" to one applicant may not be "equivalent" for another applicant. All materials must have specified characteristics in accordance with recognized Codes and Standards, particularly for "important to safety" components. Defining equivalency by some critical characteristics meeting or exceeding those specified for the designated material is not acceptable for staff because it does not provide the means to determine how equivalency will be confirmed.

Therefore, these equivalency statements could lead to an incorrect conclusion that something other than the unique material specified in the licensing drawings could be used. Staff noticed that there was a list of materials that could be substituted to those on the licensing drawings according to Section 5.2 of the Manufacturing Specifications, Document (0023-SPZ-2016-001). As such, any packaging component which does not comply with the licensing drawings, referenced in the certificate, is not acceptable for shipment.

This information is needed to determine compliance with 10 CFR 71.43.

1-3 Provide (i) Codes and Standards comparable to those used in the U.S. for the international Codes and Standards quoted in the application, and (ii) additional Codes and Standards as those that were provided in another UF_6 transport package application.

The applicant used international Codes and Standards. However, not all of them are either described nor comparable to those used in the U.S. Examples of such Codes and Standards that may be used are in IAEA 2012, Certificate EN10204, ISO 7195, and Steel Codes.

Also, the applicant did not discuss the DN30 overpack with respect to the ASME Codes, while the staff notes that another UF_6 package application discussed in detail the acceptance criteria with respect to both ASME Section V and Section III (Subsection NF) in its maintenance chapter. The applicant needs to include such a discussion in its application.

This information is needed to determine compliance with 10 CFR 71.43(d) and 71.43(f).

Chapter 2 STRUCTURAL AND MATERIALS REVIEW:

2-1 Clarify and justify the assumptions made in the characterization of UF_6 contents with respect to LS-DYNA hypothetical accident conditions (HAC) drop simulations of the DN30 Package.

For HAC drops simulated in LS-DYNA, the applicant assumed that the UF_6 in the 30B cylinder remains a single solid piece. In addition, the material properties assigned to the contents are not those of normal concrete but are similar to “reinforced” concrete; however, according to picture 4 of the drop test program (document 0023-BDI-2015-002), the contents are described as being partially loose and with large fissures.

Provide a justification for the following:

a) The assumption that the UF_6 material is always bonded to the 30B cylinder. If the contents are one solid piece and detach from the 30B cylinder during any of the simulated drops, it could cause internal damage to the 30B cylinder and/or valve plug. Drop simulations should be re-examined in this instance.

b) The UF_6 material is modeled as one large piece during the drop simulations. Clarify if vibrations incident to transport could potentially "break up" or fracture the UF_6 material, prior to a drop. In such a case, large pieces of UF_6 should be modeled during drop simulations.

c) The use of "reinforced" concrete material properties for the UF_6. Large inelastic deformations can occur in the UF_6 material based on this material model, allowing energy to be absorbed into the UF_6 rather than the surrounding containment boundary and potentially imposing less structural demand on the containment boundary (30B cylinder). Assuming more realistic (i.e., more brittle) material properties for the UF_6 could potentially cause more damage to the containment boundary.

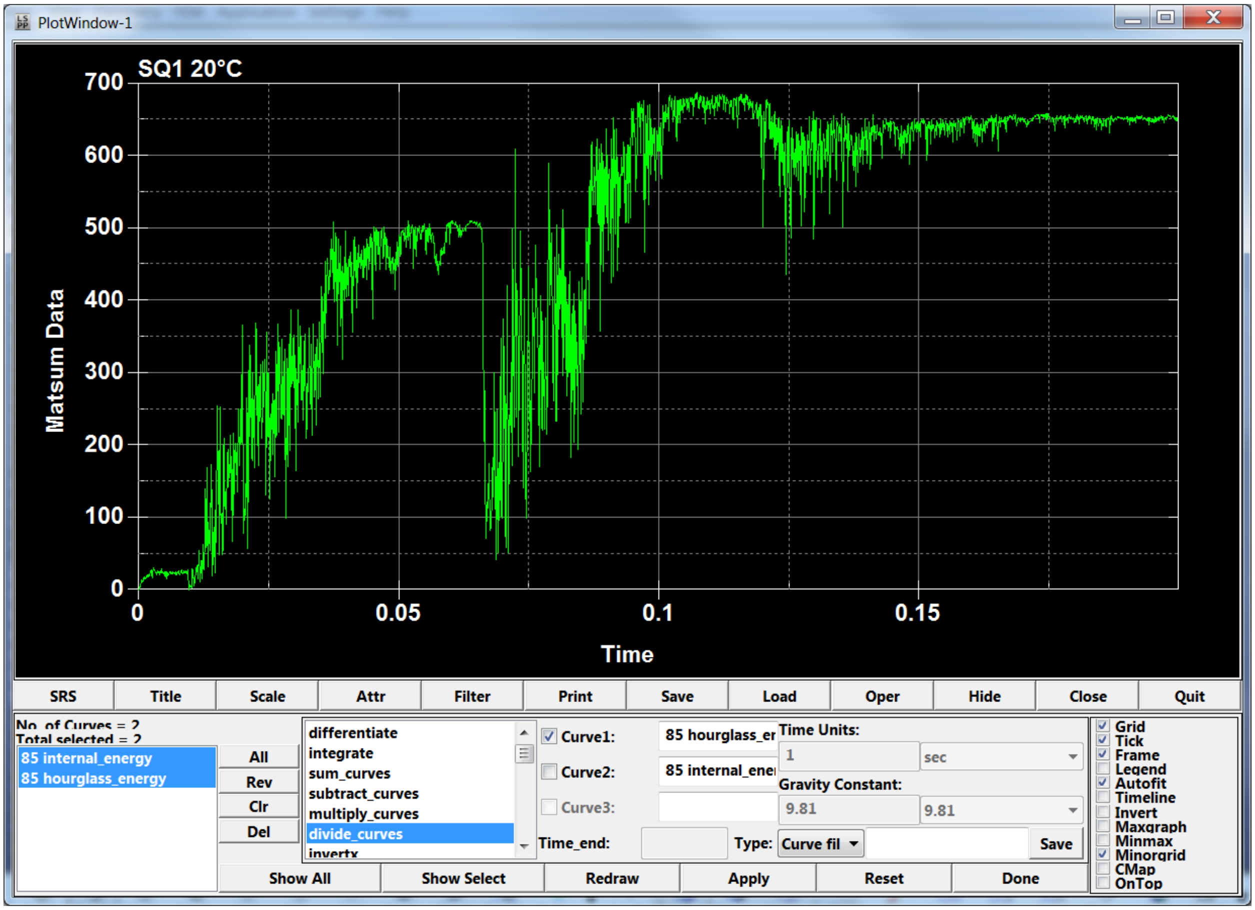
Confirm the modeling of the contents and update the LS-DYNA drop simulations as necessary.

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

2-2 Justify the ratio of hourglass energy to internal energy observed for certain parts of the DN30 during drop simulations in LS-DYNA.

As stated by the applicant, the ratio of hourglass energy to internal energy should be kept to a ratio of 10% or less, as hourglass energy indicates a nonphysical part of internal energy. This, in turn, implies that deformations and overall physical behavior of a part may not be realistic during LS-DYNA simulations.

For drop sequence SQ1, the plug of the 30B cylinder (part 85 in LS-DYNA) observes very large amounts of hourglass energy relative to the internal energy of the part as seen in the graphic below. Other parts, such as the protective case surrounding the valve (part 56 in LS-DYNA), and parts 92-103, also observe large amounts of hour glassing energy.



Parts 92-103 represent the closure devices (mortise and tenon design) used to keep both halves of the Protective Structural Packaging (PSP) together and have been idealized as solid steel blocks in LS-DYNA. A more refined analysis is conducted on these closure devices that takes account of the actual geometry elsewhere in the application and uses raw LS-DYNA output.

The design of the closure devices and other parts of the package should be re-examined and updated. Staff also notes that large ratios of hour glassing energy to internal energy are not confined to just the sequence SQ1 or to just the parts mentioned above, as other drop sequences and parts exhibit this behavior.

It was noted that the applicant compared the energy of a particular part to the overall energy of the package to justify large ratios of hour glassing energy. While the energy of a part may be very small relative to the energy of the package as a whole, realistic behavior of that part (which hour glassing energy helps describe), such as the plug or valve of the 30B cylinder, is critical. Other parts of the package which do not make up the containment boundary should also be examined for hour glassing as unrealistic behavior of these parts can influence those that are part of the containment boundary.

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

2-3 Clarify how a safety factor of 3 is met with respect to yielding for the lifting lugs of the DN30 package.

Section 2.2.1.2.3.1 of the application analyses the stresses found in the lifting lugs (part 211) which reach a utilization of 87.6% of the shear stress capacity in Table 24. 10 CFR 71.45(a) states that a factor of 3 is needed with respect to yielding, which would indicate that a utilization of 33.3% or less of the shear capacity of the lifting lug is required.

Clarify how a factor 3 with respect to yielding is achieved and update the application as necessary.

This information is needed by the staff to determine compliance with 10 CFR 71.45(a).

2-4 Clarify the weld symbol terminology indicated on drawing 0023-ZFZ-1000-002.

Drawing 0023-ZFZ-1000-002 has 14 different types of welds tabulated. Each weld symbol has an “a” or a “z” associated with it as well as a numerical pair of values at the tails of the weld symbols such as “135/141”.

It is unclear if these values are weld deposit thickness or some other fabrication terminology. Place this clarifying terminology on the licensing drawings.

This information is needed by the staff to determine compliance with 10 CFR 71.33(a)(5).

2-5 Clarify the weld used to attach the lifting lug to the front plate of the foot.

Section 2.2.1.2.3.1 of the application analyses the stresses found in the lifting lugs (part 211). The calculations assume that a full penetration butt weld attaches the lifting lug to the front plate (part 101) of the foot.

Drawing 0023-ZFZ-1110-210 indicates that the lifting lug is welded according to weld seam type SN13 which is not a full penetration butt weld. Clarify the weld used at this location and update the drawings and/or the calculations as necessary.

This information is needed by the staff to determine compliance with 10 CFR 71.33(a)(5) and 71.45(a).

2-6 Clarify how tie-down devices are able to withstand 2 times the weight of the package in the vertical direction, 5 times the weight of the package in the lateral direction, and 10 times the weight of the package in the axial direction.

Section 2.2.1.3 indicates that the tie downs are designed for only 2 times the load in the axial, lateral, and vertical direction rather than 5 times the weight of the package in the lateral direction and 10 times the weight of the package in the axial direction as per 10 CFR 71.45(b)(1).

In addition, it appears that Figure 5 shows the package loaded laterally by axial loads, while the axial direction of the package appears to be loaded in the lateral direction which is contrary to Figures 18 and 19 in the application.

This information is needed by the staff to determine compliance with 10 CFR 71.45(b)(1).

2-7 Justify the amount of torque specified for the pins that secure the closure system of the PSP portion of the package.

Document 0023-HA-2015-001-Rev2 indicates that a tightening torque of 80 Nm is called for by each of the 6 pins that secure the closure system of the PSP. It is unclear how these values were determined, and how fatigue effects during NCT will not loosen the bolts.

This information is needed by the staff to determine compliance with 10 CFR 71.43(c).

2-8 Justify the mechanical properties used to characterize substitute materials in lieu of those called for in the licensing drawings.

Table 2 of document 0023-SPZ-2016-001 indicates that materials used to construct the PSP portion of the package can be substituted for other materials; however, as said in RAI 1-2, it is unclear what criteria applies to the substitute materials chosen.

Staff does not accept equivalency of materials because the applicant cannot clarify how yield strength, ductility, stress-strain curves, and strain rate for substitute materials meet or exceed those of the materials called for on the licensing drawings. Also, the applicant has not considered the differences in materials in any FEM analyses, nor updated the application accordingly.

This information is needed by the staff to determine compliance with 10 CFR 71.33(a)(5).

2-9 Describe the condition of the 30B cylinder after the HAC fire given the preexisting inelastic deformations in the 30B cylinder from the previous drop tests.

Several of the drop tests sequences examined (such as sequence 3) indicate that the 30B cylinder undergoes inelastic deformations. It is unclear what the condition of the 30B cylinder is after the HAC fire, given these preexisting inelastic deformations were not accounted for during the HAC analysis.

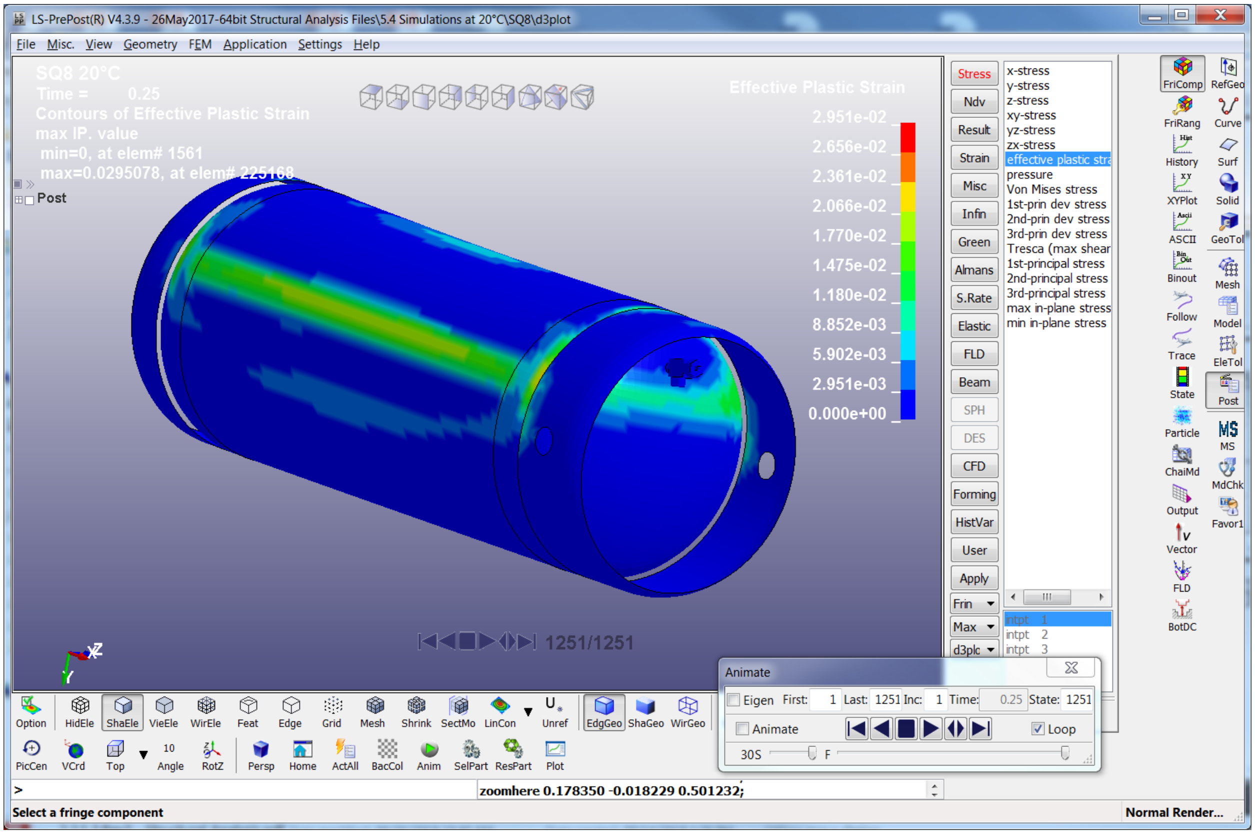
This information is needed by the staff to determine compliance with 10 CFR 71.73(c)(4).

2-10 Justify the use of tied contacts in LS-DYNA drop simulations to represent welds in the package.

The image below displays the inelastic deformations observed in the 30B cylinder after Sequence 8 has terminated. The applicant states that a fine mesh would be required to model the welds between parts such as those in the 30B cylinder but would be too time consuming. Instead, tied contacts have been used. From the picture below, the canister appears to have inelastic deformations, in the main body of the cylinder, which do not carry at all into the adjoining/protruding flange which, if welded, should experience very similar inelastic demands where the 2 parts meet.

The parts appear to be too separated from each other and do not appear to be transmitting forces correctly. The valve at the end of the cylinder appears to be in a zone of inelastic deformation; yet, it is unclear how the valve behaves as a result. Staff is concerned that the containment boundary (valve) may not be free of inelastic deformation as desired. Similar behavior has been noted for the 30 B cylinder in other sequences.

The applicant shall verify that the tied contact assumption is valid when compared to welds that have been modeled as the rest of the 30B cylinder (with a mesh).



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

2-11 Clarify how dimensional changes in the package due to thermal expansion were incorporated into the LS-DYNA simulations and resulting stress/strain outputs.

From the application and LS-DYNA models, it is clear that changes in material properties as a function of temperature were incorporated; however, the physical dimensions of the package do not appear to have changed with temperature (-40°C, and 60°C) as simulated.

Describe how the package behaves for simulated drop tests in LS-DYNA for NCT and HAC given gap and dimensional changes associated with temperature. Staff is concerned that additional stresses and/or strains in the package may not be fully captured as a result.

This information is needed by the staff to determine compliance with 10 CFR 71.71(c)(1)&(c)(2), 10 CFR 71.73(b), and 10 CFR 71.73(c)(1).

2-12 Describe the design criteria used to characterize the materials of the DN30 in the inelastic range.

Relatively large inelastic strains (0.449) have been observed in the package as a result of drop test simulations for HAC, as observed in figure 5-254 of document 0023-BSH-2016-001-Appendix-2.2.1.3-Rev3. It is unclear from the documentation or material models from LS-DYNA when the uniform elongation of any of the materials of construction in the package would be exceeded.

In such a case, additional material properties such as triaxiality and failure strains should be specified in the LS-DYNA models as the current analysis do not appear to permit material failure/erosion, and thus potential part failure.

The design criteria (if any) used to design the package in the inelastic range and avoid exceeding uniform strains should be provided and/or clarified.

This information is needed by the staff to determine compliance with 10 CFR 71.33(a)(5).

2-13 Describe the condition of the package after the compression test under normal conditions of transport.

This information is needed by the staff to determine compliance with 10 CFR 71.71(c)(9).

2-14 Provide measured data for the material properties used in the safety analyses or provide the basis and the justification for using estimated properties that were not based on testing.

The applicant provided both measured (from material testing conducted) and estimated (or assumed) values for material properties used in the safety analyses. The applicant should use measured material properties or provide a basis or a justification for all estimated material properties. The estimated material data include, but are not limited to:

- UF_6 properties: mechanical tests were performed using a solid block of iron concrete to simulate solid UF_6; thermal conductivity, specific heat capacity, and density were estimated.

- In Section 2.1.1.2 (30B cylinder) and Section 2.1.1.3 (DN30 PSP), staff notes that the material standard physical properties were estimated.

- Intumescent material: staff notes that chemistry information was not provided.

This information is needed to determine compliance with 10 CFR 71.43(d) and 71.43(f).

2-15 Provide detailed thermal effects of the packaging materials on other functional (e.g., structural integrity) requirements.

The application did not provide detailed thermal effects of materials on all functional requirements of the package. The applicant needs to provide a basis and a justification for thermal effects: degradation of mechanical properties, degradation of integrity, alteration of materials, and thermal expansion.

The operating parameters and materials with incomplete thermal effects include, but are not limited to TFE (packing and pat cap gasket), EPDM (gasket), Polyamide (thermal plug), Polyester or Nylon (lifting sling), Florinate (lubricant), plug, valve and mantle, coating or paint for corrosion protection, seals, foam at a temperature above 250°C.

This information is needed to determine compliance with 10 CFR 71.43(d) and 71.43(f).

2-16 Provide a quantitative basis for the non-quantifiable terms frequently used to describe the material properties used in the safety analysis. Provide a justification that the qualitative basis used in the safety analysis is sufficient.

The applicant frequently used non-quantifiable terms to describe the safety basis for the materials properties used. The applicant needs to provide an adequate justification that qualitative bases are sufficient for the safety analyses.

Qualitative bases include, but are not limited to (i) "Significant" contribution from U-234 to heat generation, (ii) "Periodic" inspection in Section 1.8.2, with a frequency that is not provided, (iii) "no specifics" such as yield stress, fracture stress or ultimate stress, in mechanical properties, (iv) in Section 2.1.1.4, Table 14, the effect of content fracture on dose rate, the qualitative consequence with design modifications in Section 2.1.4, e.g., "considerable" or "negligible," "more robust,"; "much better" in thermal properties with silicon in Section 2.1.4.2.10.2, (v) "Small" deformation in Section 2.2.1.5.1.5.1.2.2; surface crack is not expected in Section 2.2.1.5.1.5.1.2.2., (vi) Measurement error in page 198, deceleration increases "slightly" in page 209, "excessive" coating degradation, etc.

This information is needed to determine compliance with 10 CFR 71.43(d) and 71.43(f).

Chapter 3 THERMAL REVIEW

3-1 Provide deviations of the fire test conditions, from the fire test conditions required by 10 CFR 71, in Section 2.2.2.2.1.4, "Deviations of the test conditions from the test conditions required by [IAEA 2012]," of the application.

The applicant provided deviations of the fire test conditions from the test conditions required by IAEA 2012; however, the applicant did not provide the deviations of the test conditions from the test conditions required by 10 CFR 71.73(c)(4).

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

3-2 Provide justification that the emissivity and absorptivity values in Table 54, "Heat transfer by radiation at the surface of the DN30 package," meet the requirements of 10 CFR 71.73(c)(4).

Table 54 of the application presents the emissivity and absorptivity values used during the fire phase of the HAC analysis as 0.72. The application did discuss how the chosen value meets the required values in 10 CFR 71.73(c)(4). 10 CFR 71.73(c)(4) describes that, "Exposure of the specimen fully engulfed, except for a simple support system, in a hydrocarbon fuel/air fire of sufficient extent, and in sufficiently quiescent ambient conditions, to provide an average emissivity coefficient of at least 0.9, […]."

Title 10 of the *Code of Federal Regulations* (10 CFR) 71.73(c)(4) also describes that, "For purposes of calculation, the surface absorptivity coefficient must be either that value which the package may be expected to possess if exposed to the fire specified or 0.8, whichever is greater."

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

3-3 Provide justification for the convection equations in Section 2.2.2.3.2.4.3, "Convection," of the application.

Section 2.2.2.3.2.4.3 of the application describes that, for the convective heat transfer for NCT as well as the post-fire phase of HAC, the formula $Nu = 0.13*(Pr*Gr)^{1/3}$ is used. Also, Section 2.2.2.3.2.4.3 of the application describes that for the convective heat transfer for the fire phase of HAC, the equation $Nu = 0.036*Pr^{1/3}*Re^{0.8}$ from IAEA SSG-26, "Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)," 728.31 is used.

From IAEA SSG-26 728.31, the convective heat transfer correlation for NCT is for vertical planes and has not been shown to be applicable to the DN30 PSP geometry. The convective heat transfer correlation for HAC has also not been justified to be applicable to the DN30 PSP geometry.

NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Material," describes in Section 3.5.3.1, "Evaluation by analysis," staff should ensure that for each thermal analysis the appropriate expressions are used for conductive, convective, and radiative heat transfer among package components and from the surfaces of the package to the environment.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73(c)(4).

3-4 Provide justification for the pool fire gas velocity in Section 2.2.2.3.2.4.3, "Convection," of the application.

Section 2.2.2.3.2.4.3 of the application states that the pool fire gas velocity is assumed to be 7.5 m/s. No justification was provided for this value.

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

3-5 Provide evaluations of thermal stresses caused by constrained interfaces among package components resulting from temperature gradients and differential thermal expansion during normal conditions of transport (NCT) and hypothetical accident conditions (HAC).

The evaluations should include the maximum stresses as well as cyclic stresses during the service life of the package for NCT. For HAC, the maximum thermal stresses can occur either during or after the fire.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73(c)(4).

3-6 Provide justification for the 30B cylinder maximum admissible temperature limit for empty, partially full, and full 30B cylinders during HAC in comparison to the value in ANSI N14.1 and the UF_6 melting point. In addition, address the consequence of melted UF_6 contents.

Table 46, “Admissible component temperatures of the package DN30,” of the application states that the admissible temperature of the 30B cylinder shell is 400 °C (752 °F), and the valve and plug thread is 183°C (361°F) during HAC. ANSI N14.1, “American National Standard for Nuclear Materials - Uranium Hexafluoride – Packagings for Transport,” includes a design temperature of 250°F (121°C) (see Section 5.1.1, “Design Conditions,” Table 1, “UF_6 cylinder design conditions”). ANSI N14.1 is referenced in Section 1.3.1.3, “Permissible conditions for repeated use,” of the application.

The calculated temperatures of the 30B cylinder mantle (124°C) and valve (122°C) for an empty 30B cylinder in Table 58, “Maximum temperatures at the DN30 package loaded with an empty, partially filled and filled 30B cylinder,” of the application exceed the ANSI N14.1 maximum allowable temperature. The calculated temperatures of the partially filled 30B cylinder (50%) do not exceed 121°C. However, a lower fill percentage of a partially filled 30B cylinder may cause the 30B cylinder mantle or valve to exceed 121°C.

In addition, the melting point of UF_6 is 147°F (64°C), the calculated temperatures of the 30B cylinder, valve, and plug exceed the melting point of UF_6 in Table 58 of the application. The consequence, if any, of melted UF_6 contents during HAC has not been addressed in the application.

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

3-7 Provide clarification to Section 2.2.2.3.4.2, “Results with solar insolation,” of the application regarding the maximum 30B temperature with constant insolation during NCT.

Section 2.2.2.3.4.2 of the application describes, “For the case of constant insolation over 24 hours with 100% of the insolation the maximum temperatures reached are 52°C for the 30B cylinder and its components. However, in Table 57, “Temperatures at the DN30 package loaded with a filled 30B cylinder under RCT and NCT,” the maximum temperature for the 30B cylinder and its components reaches 58°C with constant insolation over 24 hours.

This information is needed to determine compliance with 10 CFR 71.71.

3-8 Provide a NCT thermal analysis of a DN30 package loaded with a partially filled 30B cylinder or provide justification that the thermal analysis during NCT with a filled 30B cylinder is the most limiting condition.

Table 57, “Temperatures at the DN30 package loaded with a filled 30B cylinder under RCT and NCT,” of the application provides results with a filled 30B cylinder under NCT; however, Table 58, “Maximum temperatures at the DN30 package loaded with an empty, partially filled and filled 30B cylinder,” of the application provides maximum temperatures with a partially filled, and filled 30B cylinder under HAC. Table 58 demonstrates that the highest temperatures are for a partially filled 30B cylinder, and the lowest temperatures are for a filled 30B cylinder.

This information is needed to determine compliance with 10 CFR 71.71.

3-9 Provide confirmation that the maximum normal operating pressure (MNOP) during NCT has no effect on the DN30 PSP.

Section 2.2.2.4.1, “Ambient temperatures and pressures,” of the application describes that, “Pressures which are likely to be encountered during RCT and NCT have no effect on the results of the thermal analysis.” Section 1.2.8, “Maximum normal operating pressure,” of the application states, “The maximum normal operating pressure for the DN30 package is defined as the pressure at the triple point of UF6.”; however, the applicant did not specify if the DN30 PSP is capable of maintaining a pressure during NCT, or if there is a design pressure limit for the DN30 PSP.

This information is needed to determine compliance with 10 CFR 71.71.

3-10 Provide confirmation of the maximum allowable internal pressure of the 30B cylinder and address the discrepancy in maximum pressure during HAC.

The applicant described, in Section 2.2.1.5.3.1, “Internal pressure,” that the maximum allowable internal pressure of the 30B cylinder is 2.14 MPa (314 psig); however, Section 9.7, “Pressure build-up in the 30B cylinder,” of Appendix 2.2.2.3, “Thermal Analysis,” describes the maximum allowable internal pressure of 1.38 MPa that the 30B cylinder is designed for according to [ISO 7195] and [ANSI N14.1] and the temperature is only slightly above the maximum design temperature of 121°C (250°F).

The design pressure of the 30B cylinder is specified in ANSI N14.1, “American National Standard, for Nuclear Materials – Uranium Hexafluoride – Packagings for Transport,” which is equal to 200 psig (1.38 MPa) at 250 °F (121 °C).

In addition, the maximum pressure in Section 2.2.1.5.3.1, “Internal Pressure,” of the application is <u>approximately 0.8 MPa</u> during the thermal test; however, Section 2.2.2.4.2, “Rupture of the containment system,” of the application describes, “In section 9.7 of Appendix 2.2.2.3 (Thermal Analysis) a maximum pressure of <u>0.75 MPa</u> within the 30B cylinder during the thermal test (for a temperature of 125°C) is evaluated.”

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

3-11 Provide justification to show that the DN30 PSP components are not degraded at -40°C (-40°F).

The applicant specified in Section 1.2.7, “Lowest Transport Temperature for which the Package is Designed,” of the application that the components were good to -40°C (-40°F). However, no justification was provided for that statement. The staff is specifically interested in any potential degradation of the polyisocyanurate rigid (PIR) foam, intumescent material Promaseal-PL®, and MICROTHERM®.

This information is needed to determine compliance with 10 CFR 71.71(c)(2).

Chapter 4 CONTAINMENT REVIEW

4-1 Provide details of the leakage rate tests in the Operations and Maintenance sections of the application.

Page 245/296 of 0023-BSH-2016-002-Rev0 indicated that the containment would have a design standard leakage rate of 1E-4 Pa m3/sec. However, there was no discussion as to the type of leakage rate test (e.g., fabrication, pre-shipment), test methodology, standard for performing the test, or qualifications for those performing the test.

This information is needed to determine compliance with 10 CFR 71.37(b), and 71.43(f).

4-2 Clarify in the application the leakage test methodology (e.g., pulling vacuum with helium inside 30B cylinder), the leakage rate of the 30B cylinder prior to physical testing (if performed), and the extent of the 30B cylinder (e.g., welds, valve, plug) that was leakage tested after the six drop and thermal tests.

Details associated with the leakage rate tests after the hypothetical accident condition test were not discussed; for example, it was not clear which components (e.g., valve, plug, welds) were leak tested after the hypothetical accident condition test. This information is needed to understand the relevance of the leakage rate test results.

This information is needed to determine compliance with 10 CFR 71.37(b), and 71.43(f).

CHAPTER 6 CRITICALITY REVIEW

6-1 Provide the references cited in Section 6.3.1 of Appendix 2.2.5, Rev. 1 regarding hydrogenated uranium residues.

The applicant refers to references [MILIN 2016], [CONNOR 2013], [BEGUE 2013], and [REZGUI 2013] as part of their discussion regarding the amount of moderator present in the DN30 package. Notably, the H/U ratio of 11 appears to be higher than what is typically used in other UF_6 analyses performed by the NRC, since the transportable form of UF_6 is typically a solid and have H/U ratios lower than 0.1.

Also, the statement in Section 6.3.2, near the bottom of Page 23 of the appendix, indicated that these studies are "very contradictory". Staff needs to review these references to determine if they are reasonable assumptions to use to determine the subcriticality of the DN30 transport package.

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

6-2 Provide additional justification for the amount of water ingress calculated in Section 6.7 of Appendix 2.2.5, Rev.1 and the applicability of these calculations to Section 10.2.1 of the appendix.

The applicant's discussion in Section 6.7 indicated a very small quantity of water ingress (i.e., 2.55 grams) when the DN30 package is assumed to be submerged under HAC. For UF_6 packages, the size of a cylinder breach is the primary determining factor for water ingress. For small in-leakages of water, cylinders tend to be self-sealing by uranic breakdown products, however, for larger in-leakages of water, this may not be true.

It is unclear to staff exactly how this value of water ingress is used in the criticality safety analysis. Moderation levels within the DN30 package are of concern regarding the subcriticality of this package under HAC, where a larger breach in the cylinder may be possible.

This information is needed to determine compliance with 10 CFR 71.55(b)(2), 71.55(g), and 71.73(a)(5).

6-3 Provide additional justification that the validation cases used for the DN30 transportation package are adequate for the proposed contents.

The validation cases used by the applicant in Section 5.2 of Appendix 2.2.5, Rev. 1 of the SAR are drawn from a single benchmark set, LEU-COMP-THERM-033, which includes enrichments between 2 and 3 wt% ^{235}U. There is no discussion of trends in the bias or extrapolation to the maximum enrichment of 5 wt% as requested by the applicant.

This level of extrapolation is well beyond what is provided by the experimental data, exceeds the commonly accepted guidelines of ISG-21, and does not address what is outlined as adequate in NUREG/CR-6361, NUREG/CR-6698, and ANSI/ANS-8.24-2017. The validation should consider the linear trend in the bias and the uncertainties in the bias.

This information is needed to determine compliance with 10 CFR 71.31(a)(2) and 71.35(a).

6-4 Provide additional justification for assuming at least 20 cm of water reflection for a single DN30 transportation package in isolation.

Section 7 of Appendix 2.2.5, Rev. 1 states that at least 20 cm of water reflection is used for all calculation models in accordance with [ADR 2017] section 6.4.11.9 and [IAEA 2012] para. 681. The typical practice for transportation packages is to assume 12 inches (30 cm) for full water reflection.

Although the reactivity difference may not be significant, given that some of the cases evaluated by the applicant approach the k_{eff} limit of 0.95, assuming less than full water reflection may not provide an adequate safety margin given the above information requested regarding code validation.

This information is needed to determine compliance with 10 CFR 71.55(e)(3).

6-5 Clarify the most reactive UF_6 fill levels in the DN30 transportation package.

Section 7.3.1 of Appendix 2.5.5, Rev.1 states that a completely filled 30B cylinder (i.e., 60.7%) is more reactive than a partially filled cylinder. Contrary to that statement, the calculation model in Section 7.3.2 indicates that the FILL2 configuration is more reactive than a completely filled cylinder, even though the quantity of UF_6 is less than the maximum allowable mass of 2277 kg of UF_6.

This information is needed to determine compliance with 10 CFR 71.55(e)(1).

CHAPTER 7 OPERATING PROCEDURES

7-1 Provide non-proprietary appendices for the DN-30 package handling instruction and test instructions.

The following appendices have been submitted as proprietary:

- “Handling Instruction No. 0023-HA-2015-001-Rev 2,”
- “Periodical Inspections of DN30 PSP, Test Instruction 0023-PA-2015-015-Rev 1,” and,
- “Inspection Criteria and Maintenance of the DN30 PSP, Test Instruction, 0023-PA-2015-016-Rev 1.

These documents include procedures, tests, and maintenance programs that are described in Chapter 7, “Operating Procedure Review,” and Chapter 8, “Acceptance Tests and Maintenance Program Review,” of NUREG-1609, “Standard Review Plan for Transportation Packages for Radioactive Material.” This information is a requirement in a Certificate of Compliance and, therefore, should not be proprietary.

This information is needed to determine compliance with 10 CFR 71.31(c), 71.35(c), 71.37(b), 71.87, 71.89.

7-2 Clarify that as part of the DN-30 inspections prior to each use, items inspected will be replaced if inspection shows excessive wear or any defects.

Step L.8 “Inspections” on page 17/33 of 0023-HA-2015-001-Rev2 indicates that an inspection will “check the presence” of the DN-30 gasket (top half), thermal plugs, pads, etc. However, the explanation should specify that these items will be replaced if the inspection shows excessive wear and defects.

This information is needed to determine compliance with 10 CFR 71.41, 71.87(b).

7-3 Provide detailed procedures/operations to ensure there is no air (with moisture)/water exchange with the 30B cylinder (e.g., vessel, valve or plug).

The application includes statements regarding the potential formation of fluorides and other uranium compounds. If leaktightness is not ensured, moisture or water may intrude continuously and thus react with fissile materials, corrode steel, or form deposits.

This information is needed to determine compliance with 10 CFR 71.43(d) and 71.43(f).