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

SAFETY EVALUATION REPORT

Docket No. 71-9342
Model No. Versa-Pac
Certificate of Compliance No. 71-9342
Revision 13

Summary

By application dated March 16, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18151B048), as supplemented on November 26, 2018 (ADAMS Accession No. ML18330A091), Daher-TLI, (Transport Logistics International, Inc. [TLI] or the applicant) requested revision to Certificate of Compliance No. 9342, for the Model No. Versa-Pac package.

A summary of the requested changes to the safety analysis report (SAR) referenced in the certificate of compliance (CoC) in this application is listed below:

- Addition of new UF_6 contents to be transported in 1S and 2S cylinders,
- Authorize a new allowable enrichment of 1.25 wt.% U-235 for general loading content,
- Allowance for air transport of the package and addition of air transport limits,
- Removal of VP-55HC terminology and changed to state VP-55 with 5-inch pipe configuration throughout SAR and CoC,
- New licensing drawings for VP-55 and VP-110,
- Increased payload weight from 250 pounds to 350 pounds for the VP-55 based on new drop test results, and
- Rewrite of Section 3.0 to update analysis from antiquated code to a modern finite element analysis code.

The staff used the guidance in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," as well as associated interim staff guidance documents to perform the review of the proposed package changes. Based on the statements and representations in the application, as supplemented, and the conditions listed in the following chapters, the staff concludes that the package meets the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71.

EVALUATION

1.0 GENERAL INFORMATION

1.1 Packaging Description

The Model No. Versa-Pac packaging consists of two designs, i.e., the Model No. VP-55, a 55 gallon drum, and the Model No. VP-110, a 110 gallon version, both use a bolted closure ring, standard carbon steel lugs, 5/8-inch diameter American Society for Testing and Materials (ASTM), A429 bolts and nuts, and a closed-cell rubber lid gasket. For this revision, the applicant is requesting the use of the ASTM A429 bolts and nuts on both designs (formerly used ASTM A307 bolts and nuts).

Both drums use vertical stiffeners fabricated from 1-1/4 inch carbon steel square tubing, two inner liners of rolled 16-gauge carbon steel insulated by ceramic fiber blanket which encase the vertical tubing, and a 1/4-inch carbon steel reinforcing plate on the bottom.

The package's inner container is insulated (thermal protection) with layers of ceramic fiber blanket around the containment area with rigid polyurethane foam disks on the top and bottom. A 1/2-inch-thick fiberglass ring is used as a thermal break, which is fit in between the steel components with twelve 1/2-inch bolts connecting the structural members to the fiberglass.

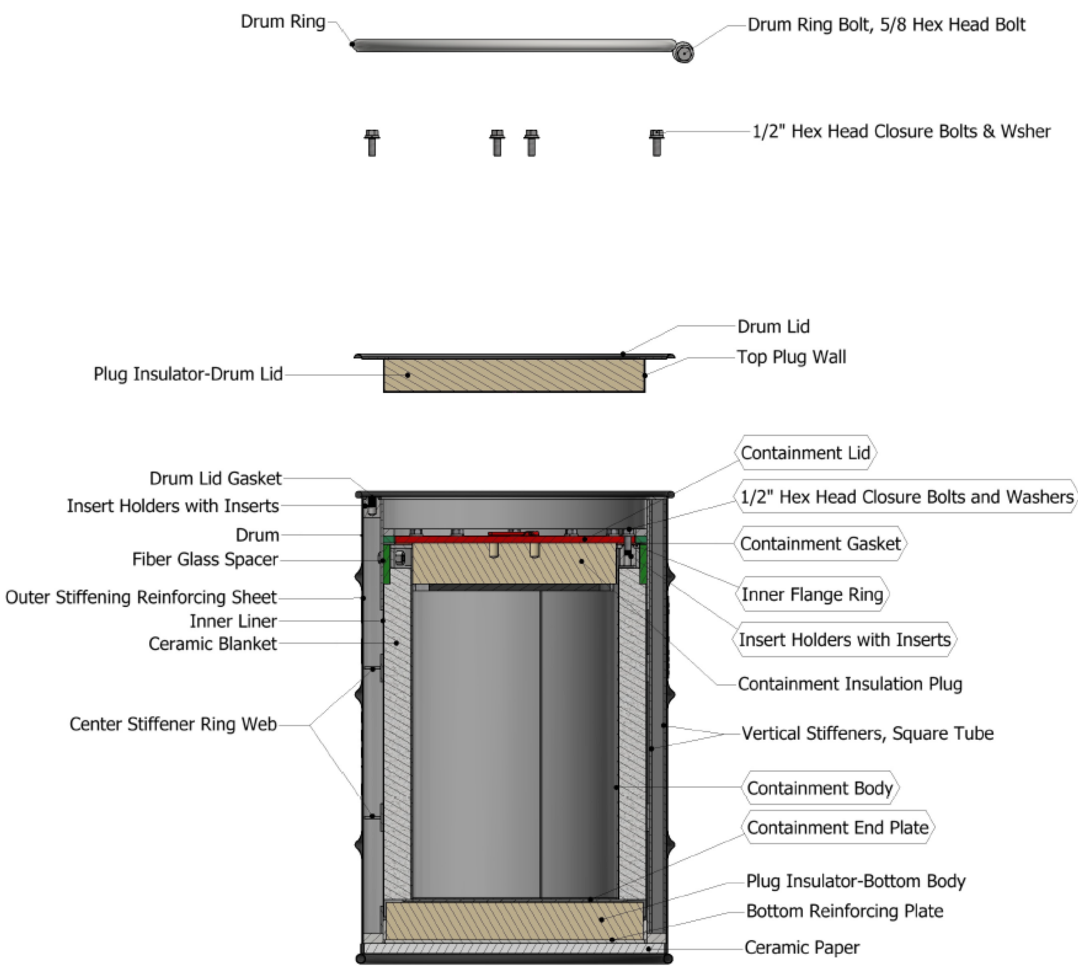

Figure 1: Versa-Pac Component (SAR Figure 1-1)

The containment boundary of the package is defined as the payload vessel with its associated welds, payload vessel high temperature heat resistant silicone coated fiberglass gasket, payload vessel blind flanges, and reinforcing ring. The payload vessel is comprised of a 10 gauge carbon steel sheet for the body and bottom. The upper end of the vessel is fitted with a 1/4-inch inner carbon steel flange ring with a 1/2-inch-thick carbon steel blind flange. The vessel has three circumferential welds (two at the flange, one at the base) and one longitudinal weld. A 1/8-inch high temperature, heat resistant silicone coated fiberglass gasket is used between the steel flange ring and blind flange. The payload vessel blind flange is secured with twelve 1/2-inch bolts.

In addition to the above listed changes, the applicant requested removal of the term VP-55HC throughout the SAR and CoC for the use of the 5-inch pipe as a separate configuration of the VP-55 model.

1.1.1 Model No. VP-55/VP-55 with 5-inch Pipe

The overall outer dimensions of the 55-gallon drum are 23-3/16 inches outer diameter by 34-3/4 inches in height to the top of the outer drum bolt ring. The drum cover is reinforced by a 10-gauge thick 22-3/8-inch outer diameter by 18-3/8-inch inner diameter plate, and four 1/2-inch bolts. As requested in this revision, the exterior skin of the packaging is a UN1A2/Y425/S carbon steel material (formerly UN1A2/X400/S carbon steel).

1.1.2 Model No. VP-110

The overall outer dimensions of the 110-gallon drum are 30-7/16 inches (outer diameter) by 42-3/4 inches in height to the top of the outer drum bolt ring. The drum cover is reinforced by a 10-gauge 29-3/4-inch outer diameter by 27-1/4-inch inner diameter ring. The exterior skin of the packaging is a UN1A2/Y409/S carbon steel material.

1.2 Contents

The Versa-Pac standard configuration shipping packages, model numbers VP-55 and VP-110, have been designed to transport Type A normal form, fissile materials limited to U-235 masses based on the loading limits in Table 1 (SAR Table 1-1, CoC, Table 2).

The applicant is requesting a new allowable enrichment of 1.25 wt.% U-235 and the addition of uranium hexafluoride (UF_6) in 1S and 2S cylinders be added as allowable contents of the Versa-Pac.

Under the changes listed in this amendment, the VP-55 can ship American National Standards Institute (ANSI) N14.1 compliant 1S and 2S cylinders filled with UF_6 based on the U-235 limits provided in Table 3 (SAR Table 1-1B and CoC Table 4) of this safety evaluation report (SER) for enrichment less than or equal to (≤) 20 wt.%. Quantities of cylinders greater than the limits stated in Table 3, or combinations of 1S and 2S cylinders in a single package (e.g., one 1S cylinders and two 2S cylinders) are allowed if the total U-235 quantity meets the fissile limit, for the maximum enrichment, established in Table 1 of this SER. For example, for two cylinders with enrichments of 5 wt.% and 15 wt.%, respectively, the U-235 mass limit is based on the 20 wt.% limit.

Table 1: U-235 Loading Table for VP-55 and VP-110 Standard Configuration (SAR Table 1-1)

Weight Percent U-235	U-235 Mass Limit (g)	
	Ground/Vessel	Air
≤ 100%	350	350
≤ 20%	410	410
≤ 10%	470	470
≤ 5%	580	580
≤ 1.25%	2,000	--

Table 2: U-235 Loading Table for the VP-55 with 5-inch Pipe (SAR Table 1-1A)

Weight Percent U-235	U-235 Mass Limit (g)	
	Ground/Vessel	Air
≤ 100%	695	395
≤ 20%	1,215	495
≤ 10%	1,605	590
≤ 5%	1,065	790

Table 3: 1S/2S Cylinder Limits for the VP-55 (up to 20 wt. % U-235) (SAR Tables 1-1B, CoC Table 4)

Cylinder Type	Mass UF_6 per VP-55 (lb./g)	Weight percent U-235	Number of Cylinders	U-235 Mass Limit per VP-55 (g)
1S	7.0 / 3,175	≤ 20	7	429.8
2S	9.8 / 4,445	≤ 20	2	600.8

Table 4: 1S/2S Cylinder Limits for the VP-55 with 5-inch Pipe (up to 100 wt.% U-235) (SAR Tables 1-1C, CoC Table 5)

Cylinder Type	Mass UF_6 per VP-55 (lb./g)	Weight percent U-235 (e is enrichment)	Number of Cylinders	U-235 Mass Limit per VP-55 (g)
1S	1.0 / 454	20 < e ≤ 100	1 *	306
2S	4.9 / 2,223	20 < e ≤ 100	1	1497

* Limited to one cylinder based on fit inside of the VP-55 cavity with the required 2-inch thick foam liner.

Also, ANSI N14.1 compliant 1S and 2S cylinders filled with UF_6 with U-235 enrichments up to 100% can be shipped in the VP-55 with 5-inch pipe configuration based on the limits provided in Table 4 (SAR Tables 1-1C, CoC Table 5) of this SER. For this configuration, each 1S or 2S cylinder is loaded into a 5-inch pipe and the 5-inch pipes are loaded into the VP-55 prior to shipment. Each shipment of the VP-55 with 5-inch pipe content type may only contain either a 1S cylinder or 2S cylinder.

For any shipments of 1S and 2S cylinders, TLI must use a foam insert to provide thermal protection for the cylinder. The minimum foam insert thickness, circumferentially between the 1S/2S cylinders and the cavity wall of the Versa-Pac shall be 2 inches. Cribbing or dunnage[1] may be used inside the foam insert to restrict movement of the contents during transport, providing a snug fit for the 1S/2S cylinders or multiple 5-inch pipes.

The maximum payload capacity for the VP-55 is 350 pounds. The maximum payload capacity for the VP-110 is 260 pounds.

---

[1] Any additional dunnage/cribbing are considered contents of the VP-55 package in this configuration.

1.3 Drawings

Daher-TLI submitted 2 new drawings showing the approved transport configurations for the proposed changes.

The new drawings showing the transport packaging include:

VP-55-LD, Rev. 0 (sheets 1 and 2) 55 Gallon Versa-Pac Shipping Container

VP-110-LD, Rev. 0 (sheets 1 and 2) 110 Gallon Versa-Pac Shipping Container

2.0 STRUCTURAL AND MATERIALS EVALUATION

The objective of this NRC structural and materials evaluation is to verify that the applicant has adequately evaluated the structural performance of the package (packaging together with contents) and demonstrated that it meets the regulations in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material".

This safety evaluation focuses on revision 10 of the SAR as described in the application. The VP-55 version of the package has changed slightly, while the VP-110 version of the package has not changed. From a dimensional point of view, the VP-55 overall dimensions and materials of construction are very nearly identical to the previous revisions (8 and 9); however, the VP-55 package can now weigh up to 750 lb. (previously 645 lb.). The applicant also requested the allowance of air transport of fissile material for both the VP-55 and VP-110. The 5-inch pipe located within the inner container is unchanged relative to the last revision. The 5-inch pipe maintains geometric configuration of the fissile contents and the containment boundary is unchanged.

The applicant updated material specifications for both the licensing drawings and the SAR.

The applicant provided an additional description of the Champion[2] package which is similar to the Versa-Pac and was used for physical testing to demonstrate that the Versa-Pac could withstand the rigors of water immersion.

A notable change in the design of the package deals with the outer barrel which is used for handling. The barrel used in SAR revision 10 for the VP-55 is no longer a UN1A2/X400/S barrel with a 16-gauge body, bottom and cover, but is now a UN1A2/Y425/S barrel. These steel barrels are typically made of ASTM A36 steel, according to the applicant, although this is not guaranteed. The outer barrel does absorb impact energy during normal conditions of transport (NCT) and hypothetical accident conditions (HAC) drop tests. The energy absorbed depends on the yield strength and ductility of the material used to construct the barrel. While these two parameters are important with respect to energy absorption, the staff believes that an argument of reasonable assurance can still be made for the package, despite not having a clear material grade associated with the barrel. The rationale is that the skin of the outer drum does not absorb a large portion of the impact energy, and because the remaining inner containers and steel frame exhibited little to no damage during the drop tests, a margin of redundancy still exists in the package.

---

[2] Century Industries Champion Type B package – Due to similarities between this package and the Versa-Pac, tests involving the Century Industries Champion, although not directly applicable, are used to support the safety basis of the Versa-Pac design as supplemented by further analysis and tests.

The applicant re-qualified the package by performing the drop tests performed previously and described in previous revisions of the SAR for the (now) heavier package, with the exception of the slap down scenario. In this case, the applicant argued that the dynamic crush test was more challenging to the closure system that affixes the lid to the barrel than the slap down scenario which was not performed.

Specifically, the applicant states that the package absorbs 30% more energy during the dynamic crush test when compared to the slap down scenario. The applicant states that the package rebounds in a slap down scenario, indicating that not all of the energy observed in the drop is directed into the package, as observed in the dynamic crush test where no rebound occurs. Thus, the applicant claims that the dynamic crush test bounds the slap down scenario. The staff believes that there could be more force directed into the lid of the package in a slap down scenario than the dynamic crush test; however, the staff believes that reasonable assurance of the structural performance of the package has been demonstrated because:

1) The results of the slap-down scenario for the lighter 640 lb. package (roughly 15% lighter than the 750 lb. package) showed no closure system failure and the package was not breached and remained intact.
2) The dynamic crush test of the 750 lb. package did not see any rebound and directly challenged the closure system with 30% more energy than the slap down scenario.
3) Was evaluated for other drop orientations and puncture tests and maintains criticality safety as discussed in chapter 6 of this SER.
4) Additional residual redundancy and ductility in the closure system, as the components of the closure system exist, was demonstrated as it did not fail or separate from the package during the drop tests. This is also the case for the inner structure and barrels of the system, which provide additional redundancy.

With respect to NCT, the changes to the package involved re-evaluating the packages ability to withstand the drop tests described above. That is, the additional weight and material property changes of the drums will not affect the package’s ability to withstand the drop tests cited for NCT. As a result, the staff reviewed the structural performance of the packaging under the NCT prescribed in 10 CFR 71.71 and concludes that there will be no substantial reduction in the effectiveness of the packaging that would prevent it from satisfying the requirements of 10 CFR 71.55(d)(2) which state that the package contents is not substantially altered.

With respect to HAC, the changes to the package involved re-evaluating the packages ability to withstand the drop tests described above. That is, the additional weight and material property changes of the drums will not affect the package’s ability to withstand the drop tests cited for HAC. As a result, staff reviewed the structural performance of the packaging under the HAC required by 10 CFR 71.73 and concludes that the packaging has adequate structural integrity to satisfy the subcriticality requirements of 10 CFR 71.55(e) for a fissile material package.

The applicant states that, with regards to air transport, all contents are ejected into a bounding configuration. Thus, the staff reviewed the structural performance of the packaging under the air transport accident conditions for fissile material required by 10 CFR 71.55(f) and concludes that the packaging has adequate structural integrity to satisfy the subcriticality requirements of 10 CFR 71.55(f) for air transport of fissile material.

2.1 Materials Evaluation

Daher-TLI submitted an application for amendment to Model No. Versa-Pac, consolidated into revision 10 of the SAR. The staff has provided a brief package material description and evaluated SAR revision 10 material changes to the VP-55 configuration, as follows.

The applicant identified the following material changes: The barrel used for the VP-55 is now a UN1A2/Y425/S barrel rather than a UN1A2/X400/S barrel. The new contents for the Versa-Pac include an additional enrichment (1.25 wt. %) and UF_6 in 1S/2S cylinders. In addition, the SAR now allows for air transport of the Versa-Pac.

The applicant provided the package description in SAR Section 2. The Versa-Pac is a drum type package that features a nested containment, an inner container is positioned inside a 55-gallon or 110-gallon drum. The Versa-Pac is used with pails, pipe containers, poly bottles, and a variety of smaller containers, inserts and vessels. The new UF_6 cylinder contents are shipped in the 55-gallon drum configuration (VP-55).

The applicant states that fabrication records show that the drum reinforcing ring, backing bars, and stiffening rings fabricated from ASTM A1011 Grade 36, which is the sheet form of ASTM A36 steel. The nominal yield strength for ASTM A36 steel is 36000 psi. Note 12 was added to the Versa-Pac licensing drawings to specify that the material specification for ASTM A1011 components should be Grade 36 at a minimum. The applicant states that In regard to the drum material properties, typically carbon steel equates to ASTM A36 steel. In addition, the applicant states that the drum is classified as a Category C item per NUREG/CR-6407, which states: “When used as an outer shell, the drum provides support for the contents in both normal and accident conditions.

The staff notes that research of other fabrication drawings for UN1A2/Y425/S drum material specifies the use of carbon steel to ASTM A1008 and ASTM A568 both similar to ASTM A1011. These specifications are for sheet, high-strength, low-alloy, carbon steel. In addition, the Model Versa-Pac design utilizes the minimum drum designation UN1A2/Y425/S (fabricated, tested and UN certified) then adds carbon steel stiffeners, ceramic fiber insulation, polyurethane foam, fiberglass, neoprene rubber, and an inner carbon steel containment body. Further, the staff finds that the mechanical properties of the materials used for the UN1A2/Y425/S are similar to those previously reviewed and approved, ASTM A36 steel, and sufficient for the conditions of the cask required by 10 CFR Part 71 during NCT and HAC.

The applicant stated the following: ANSI N14.1 compliant 1S and 2S nickel alloy cylinders filled with UF_6 and U-235 enrichments up to 100% can be shipped in the VP-55 with 5-inch pipe configuration. Each 1S or 2S cylinder is loaded into a 5-inch pipe and the pipes are loaded into the VP-55 drum prior to shipment. The applicant stated that the potential of hydrofluoric (HF) acid contamination is minimal. Prior to loading into the Versa-Pac, all 1S/2S cylinders are cleaned to be free of chemical contamination. Each 1S/2S cylinder is packed along with proper shoring/cribbing to prevent shifting to limit contact with the containment area and to support the cylinders during NCT and HAC events. The applicant stated that the in-leakage of water into the payload cavity which holds the UF_6 material and thus potential generation of HF acid is not a credible event because of the small mass of the cylinders and the support of the cylinders within the package, however, in the event of cylinder surface HF contamination, the applicant stated that the corrosion of the Versa-Pac packaging components would not result in the release of fissile material.

The staff notes that the mechanical and thermal material properties used to evaluate the Versa-Pac performance are provided in SAR Table 2-3 and SAR Section 3.2.1, respectively, and were previously approved. The staff notes that the Versa-Pac package is a nested transportation container fabricated to previously approved consensus codes, that is, American Welding Society (AWS), American Society of Mechanical Engineers (ASME), and ASTM specification number(s) for the material(s) used. The staff notes that neutron and gamma shields are not required for the Versa-Pac payloads.

The staff has determined that there is no chemical, galvanic, and other reactions during NCT since the internal environment of the Versa-Pac has insufficient moisture to create a galvanic cell during transportation. Visual inspections of the payload cavity, performed in in accordance with procedures as provided in SAR Section 7.1.1, provide reasonable assurance against any considerable corrosion. The UF_6 cylinders are cleaned and packaged as described above and fabricated from nickel which is considered a suitable material for its high resistance to corrosion. In addition, for HF acid to form, UF_6 must escape or water vapor must penetrate the UF_6 cylinders at the threaded joint/solder between the valve and cylinder, which the staff considers to be an unreasonable event. Packages constructed of similar materials containing UF_6 cylinders have been previously approved and successfully transported. The staff notes that no radiolytic reactions are expected based on a payload decay heat of less than 11.4 watts.
The staff notes, for HAC, the applicant bounded the package materials by assuming complete failure of the Versa-Pac packaging with UF_6 cylinders exposed to fire.

2.2 Evaluation Findings

Based on review of the statements and representations in the application, the NRC concludes that the package has been adequately described and evaluated to demonstrate that it satisfies the structural integrity requirements of 10 CFR Part 71.

Based on the review of the statements and representations in the application, the NRC staff concludes that the materials used in the transportation package design have been adequately described and evaluated for potential chemical, galvanic, and other reactions and that the package meets the requirements of 10 CFR Part 71.

3.0 THERMAL EVALUATION

The objective of this review is to verify that the thermal performance of the package design has been adequately evaluated for the thermal tests specified under NCT and HAC, and that the package design meets the thermal performance requirements of 10 CFR Part 71. This application was also reviewed to determine whether the package fulfills the acceptance criteria listed in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material."

3.1 Description of Thermal Design

3.1.1 Design Features

In SAR Sections 1.1 and 1.2, the applicant describes the Versa-Pac packaging components and their design functions. The Versa-Pac is a drum type package consisting of two standard configuration shipping models. Principal design of the Versa-Pac packaging maintains the use of an inner container positioned inside a 55-gallon (VP-55) or 110-gallon drum (VP-110). The Versa-Pac is used directly or in conjunction with pails, pipe containers, poly bottles, and a variety of smaller containers, inserts and vessels. The standard configuration shipping packages have been designed to transport Type A fissile materials limited to U-235 masses based on the loading limits in Table 1 of this SER.

The applicant further describes the thermal design features of the Versa-Pac in SAR Section 3.1. The VP-55 consists of a containment body centered within the insulated 55-gallon drum. The payload cavity is protected from water intrusion with a gasketed lid which is closed with bolts. Under the containment lid, there is a 3-inch-thick polyurethane insulation plug for added thermal insulation. Exterior to the containment lid, the 55-gallon drum lid is modified with a steel encapsulated polyurethane insulation plug and is closed with bolts and a standard drum ring. A gasket at the drum lid’s stiffening ring provides a third barrier against water in-leakage.

A 1/2-inch-thick fiberglass ring and fiberglass spacers are used as thermal breaks at the payload cavity flange. The thermal break is sandwiched between the steel components and limits the heat transfer to the payload cavity through the steel flange components. There are no moving parts to the thermal break, and its functionality is maintained as long as it separates the steel components top stiffening ring, from the connection ring. The volume between the inner liner of the 55-gallon drum and the containment body is filled with ceramic blanket insulation, called “Cerablanket”. Furthermore, the bottom of the containment body is insulated with polyurethane foam and the gap between the bottom reinforcing plate and the drum bottom is filled with sheets of ceramic paper, which is similar to the Cerablanket product but is different in density. The specifications for the ceramic blanket and paper products, and for the polyurethane foam are presented in SAR Appendices 1.4.3 and 1.4.4.

The containment boundary of the package is defined as the payload vessel which is comprised of a 10-gauge carbon steel sheet for the body and bottom. The payload containment area of the 55-gallon version has an inside diameter of 15 inches in diameter and is 23-1/8 inches in length. The applicant states, in SAR Section 3.1, that the basic design of the VP-110 is identical to that of the VP-55 with the exception of the larger exterior and payload cavity diameters. The 110-gallon version consists of a 10-gauge containment body, with payload cavity dimensions of 21 inches in diameter and is 29-3/4 inches in length. The thickness of the walls and insulation remain the same as that of the VP-55. Additionally, the applicant states that the payload decay heat in the VP-110 is the same as that of the VP-55, but because it is larger in size, the volumetric decay heat load is less than that of the VP-55. Therefore, the applicant uses the VP-55 analysis to bound the VP-110. The staff agrees with this and reviewed the VP-55 analysis for this thermal evaluation. The staff finds that the applicant addressed the Versa-Pac overall and thermal insulating component dimensions in SAR Table 3-1.

The Versa-Pac outer drum is not a sealed system. There are four, 1/4-inch holes in the outer drum between the insulation and containment boundary inner container that are used to vent gases that may be produced from sublimation of the insulating foam in the outer drum during a fire event. There are no pressure relief systems for the inner container (containment boundary) in either of the VP-55 or VP-110 configurations.

An additional configuration features a 5-inch steel pipe inner container which fits inside the VP-55 payload vessel to facilitate transport of greater quantities of U-235, and is fully described in SAR Appendix 1.4.6. The VP-55 with 5-inch pipe configuration is designed to transport Type A fissile materials limited to U-235 masses based on the loading limits in Table 2 of this SER.

An added content for the VP-55 is ANSI N14.1 compliant 1S and 2S cylinders filled with UF_6. The VP-55 can ship 1S or 2S UF_6 cylinders based on the 20 wt.% U-235 limits provided in Table 3 of this SER. Also, ANSI N14.1 compliant 1S and 2S cylinders filled with UF_6 with U-235 enrichments up to 100% can be shipped in the VP-55 with the 5-inch pipe configuration based on the limits also provided in Table 4 of this SER. For this configuration, each 1S or 2S cylinder is loaded into a 5-inch pipe and the 5-inch pipes are loaded into the VP-55 prior to shipment. The 5-inch pipe container is held in place during transport by a “birdcage” device and is defined as the containment boundary when using this configuration. Each shipment of the VP-55 with 5-inch pipe content type may only contain either a 1S cylinder or 2S cylinder.

To transport 1S/2S cylinders, the inner cavity of the VP-55 must be lined with a minimum 2-inch-thick polyethylene foam liner with a minimum foam density of 9 lbs/ft^3.

SAR Appendix 3.5.2 documents the thermal analysis of the 1S/2S UF_6 cylinders in the VP-55.

3.1.2 Content’s Decay Heat

For both the VP-55 and VP-110 configurations, the decay heat for the payload is limited to 11.4 watts. For configurations including 1S/2S cylinders, contents will not be greater than an A_2 quantity of any uranium isotope; therefore, there will not be a significant amount of decay heat from the contents.

3.1.3 Summary Tables of Temperatures

The staff reviewed the NCT and HAC summary tables of package component temperatures. The applicant presents the steady state thermal evaluation results and maximum allowable temperatures for components under NCT in SAR Table 3.2. The components include the containment body, containment end plate, containment insulation plug, gasket, containment lid, drum, drum lid and gasket, package surface, and air volume.

The applicant presents the transient thermal evaluation results and maximum allowable temperatures for components under HAC in SAR Table 3.3. The components include the containment body, containment plug bottom surface, containment cavity surface, gasket, containment lid, drum and drum lid, inner flange, and air volume. For HAC, the applicant presented the maximum temperature of the components reached, and the time at which that occurred. During HAC, the inner cavity stays below 600°F; therefore, it can be predicted that the contents will remain in solid form because the radioactive content is a stable solid that does not undergo a change of state below 600 °F.

Summary temperatures of key components for the VP-55 1S/2S UF_6 cylinder configuration under NCT and HAC are presented in SAR Tables 3-16 and 3-17, respectively. In this configuration, the inner cavity temperature reaches a maximum temperature of 243 °F during HAC.

The temperatures are consistently presented throughout the SAR for both NCT and HAC and all components remain below their material property limits, as listed in SAR Tables 3.2, 3.3 and 3.10.

3.1.4 Summary Tables of Maximum Pressures

Per SAR Section 3.1.4, the Versa-Pac outer drum is not a sealed system; therefore the maximum NCT and HAC operating pressures are near atmospheric and no summary tables are presented.

The staff reviewed the design features, design criteria, and content decay heat of the Versa-Pac package. Based on the information provided in the SAR and responses to the staff's request for additional information (ADAMS Accession No. ML18270A093) regarding these items, the staff determined that the SAR is consistent with the guidance provided in Section 3.5.1 (Description of the Thermal Design) of NUREG-1609, therefore, the staff concludes that the description of the thermal design is acceptable.

3.2 Material Properties and Component Specifications

3.2.1 Material Properties

Thermal properties, such as thermal conductivity, thermal diffusivity, density, specific heat, and emissivity for package materials, are provided in SAR Section 3.2.1. Specifically, thermal properties are provided for ASTM A36 carbon steel, series 525 fiberglass used for the thermal break, Cerablanket used as an insulating material, dry air, polyurethane foam, and gasket materials. The staff finds these properties acceptable.

Staff also reviewed the material properties of the polyethylene foam used as a liner to the inner surface of the inner cavity for package configurations with 1S/2S cylinder, which were provided in SAR Section 3.5.2.2, and found them acceptable as well. The thermal properties used by the applicant for the analysis of the package were appropriate for the materials specified and for the conditions of the cask required by 10 CFR Part 71 during NCT and HAC.

3.2.2 Component Specifications

In SAR Section 3.2.2, the applicant provided component specifications for components relevant to the thermal analysis, including the 55-gallon drum overpack and insulation, inner cavity, drum gaskets and the ceramic insulation material, polyurethane foam, and fiberglass thermal breaks. The maximum allowable service temperatures under NCT and HAC for these materials and components are specified in SAR Table 3.10 and are appropriate for each package component. Staff verified that the minimum allowable service temperature for all components is less than or equal to -40 °F.

3.3 Thermal Evaluation under NCT

Staff reviewed the thermal evaluation which is described in SAR Section 3.3. The NCT thermal evaluation of the 1S/2S cylinder configuration is provided in SAR Section 3.5.2.3. The applicant performed a steady-state heat transfer analysis using a quarter symmetry finite element model of the package in ANSYS 17.1. Staff reviewed the methods and element types used in the model and determined that they were correctly applied, and also confirmed that appropriate element types, thermal properties, and assumptions for heat sources were used.

The boundary conditions for the NCT thermal evaluation tests are described in SAR Section 3.3. Boundary conditions for the 1S/2S configuration are provided in SAR Section 3.5.2.3. Staff reviewed these boundary conditions to ensure the required temperature and thermal conditions were correctly applied.

For the standard package configuration, the applicant analyzed four NCT cases that included different combinations of ambient temperatures, solar insolation, and internal heat generation to determine the bounding configuration. The maximum interior temperature of the package in the standard configuration is identified in Case I, which includes solar insolation, natural convection, and an ambient temperature of 100 °F.

3.3.1 Heat and Cold

Staff reviewed the analysis in SAR Section 3.3.1, through which the applicant demonstrated that the effectiveness of the Versa-Pac design is not reduced significantly when subjected to NCT tests. The applicant performed a steady-state analysis using the Versa-Pac thermal model with a uniform heat flux to distribute the given 12 hours of total insolation value over 24 hours. Four NCT cases were analyzed using a combination of ambient temperatures (100 °F and -40 °F), solar insolation, convection, emissivity, and internal heat generations.

The NCT evaluation results presented in SAR Section 3.3.1.1, show that with a 100 °F ambient in still air and shade (Case II), a maximum accessible surface temperature of 102 °F is observed on the drum which meets the 122 °F limit specified in 10 CFR 71.43(g) for nonexclusive use shipment.

In SAR Table 3.13, the applicant presents the maximum calculated temperatures for the Versa-Pac components under NCT. The maximum temperature of the package is seen in the inner cavity in Case I at 232 °F. Per SAR Table 3-10, the NCT temperature limit for the inner cavity in the standard configuration is 600 °F. The staff concludes that the applicant's calculated maximum temperatures are below the material temperature limits and finds that there are no changes in material conditions or properties that would degrade the heat-transfer capability or structural performance of the package as discussed in the Structural section of this SER.

For the 1S/2S cylinder configuration, the applicant assumed NCT Case I from the standard configuration analysis bounds all other NCT cases, and, therefore, the applicant performed a steady state NCT Case I analysis to study the maximum temperature in the interior surface of the added foam liner. The NCT results for the evaluation of the 1S/2S Cylinder package configuration are provided in SAR Table 3-19. The maximum inner cavity temperature is 138 °F, which is below the 250 °F temperature limit as defined in SAR Table 3-10.

3.3.2 Maximum Normal Operating Pressure

The Versa-Pac is not a sealed system, the function of the payload cavity gaskets is to prevent dispersal of contents; therefore, the maximum normal operating pressure is near atmospheric pressure.

3.4 Thermal Evaluation under HAC

The applicant's HAC thermal analyses address three sequential phases including the pre-fire, fire, and post-fire conditions. The Versa-Pac must survive the HAC thermal analysis such that the structural integrity is sufficient for the criticality control credited in Section 6 of this SER.

3.4.1 Initial Conditions

In SAR Section 3.4.1, the applicant describes the initial conditions for the transient thermal HAC analysis and the HAC model geometry, which is the same as that used in the NCT analysis.

The temperature results from the hottest NCT thermal analysis (Case I) are used as the initial conditions of the package for the HAC analysis.

Damage from the mechanical tests was not simulated; however, local reductions in wall thickness were shown in the drop tests to be limited to the outer 1-1/2-inch of the package. Since this portion of the package quickly attains the temperature of the fire, a local reduction is not expected to influence the temperature of the contents. Further, observation of the test article after drop testing showed no rupture of the drum or inner support structure, hence no charring or burning of the packaging foam will occur under HAC (Appendix 2.13.7).

The applicant references SAR Section 2 to describe the geometric changes and deformations of the drum exteriors after the NCT and HAC drop and crush impact tests. These deformations are minimal and the applicant does not include these deformations in the HAC thermal analysis model. The staff finds this acceptable because the polyurethane foam insulation in the package is a stiff material and does not suffer substantial volumetric reduction from these structural tests in addition to the fact that there is no damage to the inner liner during these tests.

Even if the surrounding sheet metal of the package exterior has deformed and there is local damage to the exterior of the 55-gallon drum, nearly all of the polyurethane foam thickness remains after impact. Thus, the localized damage of the 55-gallon drum does not significantly affect the thermal results. The staff has reasonable assurance that the deformations will not significantly impact the thermal results due to the substantial thermal margin and redundancy in layers of materials in this package.

For the 1S/2S cylinder configuration, the results of NCT thermal analysis Case I are used as the initial conditions for the HAC analysis.

3.4.2 Fire Test Conditions

For the HAC thermal analysis, the applicant performed a transient thermal analysis on the VP-55 quarter model simulating exposure to a fully engulfing fire at 1475 °F with forced convection and an emissivity of 0.9 for a period of 30 minutes which aligns with the requirements in 10 CFR 71.73. The applicant followed this phase of the analysis with a 7.5 hour cool down period to ensure the package components reach their maximum temperature. The staff confirmed the forced convection coefficient and reviewed all input and output files of the thermal HAC analysis. This includes SAR Figure 3-12 depicts that the HAC fire evaluation is conducted in a horizontal position for maximum fire exposure of the package with internal heat generation due to the content decay heat of 11.4W with the appropriate fire boundary conditions applied to the exterior surface, as described above.

At the end of the 30-minute fire, the applicant ensures that the package remains in the horizontal position and is subjected to full insolation, an ambient temperature of 100 °F, and natural convection during post-fire cool-down.

The same conditions are used in the thermal analysis of the 1S/2S cylinder configuration.

The staff concludes that the methods used for this analysis are properly applied, all assumptions in the modeling of heat sources and heat transfer paths are clearly stated and justified, and that the required temperature and thermal boundary conditions are correctly applied.

3.4.3 Maximum Temperatures and Pressure

The results of the HAC temperature evaluation are documented in temperature-time history plots, temperature contours and values in SAR Table 3-14. Package component maximum temperatures are listed in SAR Table 3-14, including the time at which they occurred, either during the 30-minute fire or during the steady-state cool down process. SAR Figures 3-14 and 3-15 are time history plots of package component and containment component temperatures. The maximum temperature at the containment region during the HAC fire event is 498 °F which is seen at the inner flange. The containment inner cavity surface remains below 386 °F and the internal air volume remains below 350 °F. Staff finds that all components remain below their maximum thermal design temperature limits listed in SAR Tables 3-3 and 3-10.

The maximum inner cavity temperature of 386 °F, seen in the package during the standard configuration HAC analysis, is too high for the 1S/2S cylinder configuration, per ANSI N14.1, "Uranium Hexafluoride - Packaging for Transport", which provides a design temperature limit of 250 °F for these configurations. Therefore, the applicant performed a HAC analysis to determine the minimum thickness of the extra polyethylene foam liner used in the 1S/2S cylinder configuration to bring the interior surface temperature to the acceptable range of below 250 °F. The applicant performed a foam thickness study to predict that 2-inch thick foam would reduce the cavity surface temperature to the acceptable range, and then performed a HAC analysis of the entire package configuration with 2-inch thick interior liner. The applicant presents maximum component temperatures in SAR Table 3-20 which shows that with 2-inch thick foam added to this configuration, the foam liner inner surface temperature, representative of the inner cavity maximum temperature, is 243 °F which staff finds to be acceptable compared to the limit set in ANSI N14.1. Staff finds that all other components remain below their temperature limits in this configuration.

The Versa-Pac is not a sealed system, the function of the payload cavity gaskets is to prevent dispersal of contents; therefore, the maximum pressure is near atmospheric pressure.

3.4.4 Maximum Thermal Stresses

The applicant uses a fire test performed for a similar package, the Century Champion Type B package, which is provided in SAR Appendix 3.5.4, to demonstrate the performance of the Versa-Pac with respect to thermal stresses. The applicant performs a design comparison and states that both packages share the same basic structural components including ceramic fiber blanket insulation and polyurethane foam in the top and bottom portions of the container, among other similarities. The Century Champion package was subjected to a 30-minute 1350 °F fully engulfing fire, and the applicant provides a summary of the results in SAR Section 3.5.4.4. Additional fuel was added to the fire and allowed to burn for an additional 14 minutes, for a total of 44 minutes, to compensate for the low flame temperature. It was found that the structural components did not show failure or fatigue at the conclusion of the thermal test, and there were no seam or closure separations in the package, demonstrating that the steel and metallic components maintained their structural capabilities. The staff agrees with the applicant that these observations are directly applicable to the Versa-Pac, since the outer structure designs are identical; therefore, the staff finds that the Versa-Pac is not anticipated to be subjected to thermal stresses beyond limits of the materials of the package during the HAC analysis.

3.4.5 Accident Conditions for Fissile Material Packages for Air Transport

In SAR Section 3.4.5, the applicant states the criticality analysis for Versa-Pac packages transported by air assume ejection of all contents from the packaging into a bounding configuration and therefore no thermal analyses are performed for Versa-Pac shipments via air transfer. The regulations in 10 CFR 71.55(f)(1)(iv) states the fire test for fissile material packages to be transported by air must be 60 minutes rather than 30 minutes. Staff asked the applicant to justify not having a thermal analysis for air transport shipments in the staff's request for additional information, comment T1-1. In the response, the applicant states that the Versa-Pac is a Type A(F) package limited to Type A quantities of radioactive material; therefore, the applicant states that a full release of material from the packaging in HAC is not a concern in terms of the radiological consequences and, as discussed in Chapter 6, the applicant shows that package is subcritical. Staff agrees with this, therefore the 60 minute fire test described in 10 CFR 71.55(f)(1)(iv) is not necessary. Additionally, the applicant addresses the criticality concerns pertinent to the requirement of 10 CFR 71.55(f)(1) in SAR Section 6.7, which staff discusses and approves in the criticality section of this SER.

The staff reviewed the applicant's analysis of the package during HAC. Based on the information proved in the SAR regarding the HAC analysis, the staff determined that the SAR is consistent with the guidance provided in Section 3.5.5 (Thermal Evaluation under Hypothetical Accident Conditions) of NUREG-1609. Therefore, the staff concludes that the HAC analysis is acceptable.

3.5 Evaluation Findings

The staff reviewed the package description and evaluation and found reasonable assurance that they satisfy the thermal requirements of 10 CFR Part 71. The staff reviewed the material properties and component specifications used in the thermal evaluation and found reasonable assurance that they are sufficient to provide a basis for evaluation of the package against the thermal requirements of 10 CFR Part 71. The staff reviewed the methods used in the thermal evaluation and found reasonable assurance that they are described in sufficient detail to permit an independent review of the package thermal design. Therefore, the staff finds that the thermal performance of the package has been adequately evaluated during normal and hypothetical accident transportation conditions and meets the thermal requirements in 10 CFR Part 71.

4.0 CONTAINMENT

The objective of this review is to verify that the package design satisfies the containment requirements of 10 CFR Part 71 under NCT and HAC.

4.1 Description of the Containment System

For the two Versa-Pac Type A(F) models, the VP-55 and the VP-110, the containment boundary is unchanged and is defined as the inner containment body with its associated welds, the containment end plate, the 1/2-inch thick containment closure plate, the inner flange ring, the silicone-coated fiberglass gasket, the 1/2-inch blind flange, the insert holders with inserts, and the1/2-inch bolts. These components are illustrated in SAR Figure 1-1, "Versa-Pac Component Illustration," of the application.

4.2 General Considerations for a Type A Fissile Package

The staff confirmed that SAR Chapter 7 describes that for the Versa-Pac package, as a Type A(F) package, the contents are always limited to be less than or equal to an A_2 quantity, calculated per the guidance in 10 CFR Part 71 Appendix A, and that all radioisotopes in the contents shall be included in the A_2 calculation, including uranium isotopes: U-233, U-234, and U-236.

SAR Section 4.2, "Containment under Normal Conditions of Transport," is unchanged. SAR Section 2.0 shows that there is no loss or dispersal of radioactive material under NCT. As discussed below, SAR Section 6.0 shows that the contents within the 5-inch pipe remain subcritical during NCT.

SAR Section 4.3, "Containment Requirements under Hypothetical Accident Conditions," is unchanged. The applicant described in SAR Section 1.4.6.1, "VP-55 with 5-inch Pipe Packaging Description," that when the 5-inch pipe is utilized in the VP-55, the 5-inch pipe is used for geometric confinement of the fissile material contents. The applicant also described that although all radioactive material is confined inside the pipe during all transport conditions, the containment boundary of the package is always the inner vessel of the Versa-Pac. Appendix 2.13.6, "Performance Test Report for the VP-55HC 5-Inch Pipe Container," includes TR-20000-102 Rev. 0, "5-Inch Pipe Container Drop Test Report," (ADAMS Accession No. ML15296A561) which showed that after three drop tests (slap down, end drop, and center of gravity over top corner) of the 5-inch pipe used as an inner vessel in the Versa-Pac VP-55-2R onto an unyielding surface from a height of 30 feet, there was no appreciable damage to the 5-inch pipe and no loss of contents. As discussed below, SAR Section 6.0 shows that the contents within the 5-inch pipe remain subcritical during HAC.

SAR Sections 4.2 and 4.3 were also unchanged stating that the package is not a sealed system and therefore the pressure is maintained near atmospheric pressure during NCT and HAC. The applicant addressed, in their response to the staff's request for additional information, response C4-1, (ADAMS Accession No. ML18330A091), the potential pressure rise in the 5-inch pipe during the package heat-up due to the HAC fire exposure. The applicant demonstrated that the maximum pressure inside the 5-inch pipe, due to the increase in temperature, was well below the working pressure rating of the standard 5-inch schedule 40 pipe and manufactured pipe cap. The applicant also showed that there is adequate margin of safety when comparing the membrane plus bending stress to the stress intensity at 500 °F for the 5-inch pipe ASTM A36 steel. Therefore, the applicant concluded and the staff accepts that the 5-inch pipe will retain the contents during the fire accident.

Therefore, the staff concludes there is no loss or dispersal of material under NCT, and the contents maintain its geometry for criticality under NCT and HAC.

4.3 Evaluation Findings

Based on review of the statements and representations in the application, the staff concludes that the containment design has been adequately described and evaluated and that the package design meets the containment requirements of 10 CFR Part 71.

5.0 SHIELDING EVALUATION

There were no changes that affected the package's criticality evaluations.

6.0 CRITICALITY EVALUATION

The objective of this review is to verify the Versa-Pac transportation package design meets the criticality safety requirements of 10 CFR Part 71.

Staff reviewed the information in the SAR and verified that all the information was consistent, as well as all of the descriptions, figures, drawings, and tables were sufficient to support an evaluation of the changes proposed in this revision. The changes affecting the criticality safety of the Versa-Pac package are the addition of a new allowable enrichment (1.25 wt.% U-235), the addition of 1S and 2S UF_6 cylinders as allowable contents, and the use of air transport when shipping the Versa-Pac package. The purpose of this review is to determine whether the proposed changes to the Versa-Pac continue to meet the criticality safety requirements of 10 CFR Part 71.

6.1 Description of the Criticality Design

The design of the Versa-Pac relies on the use of favorable geometry, primarily the diameter of the payload vessel, as well as spacing and array configuration. No neutron absorbing materials are used in the package design. All configurations transportable in the Versa-Pac assume optimum moderation by polyethylene that bounds other hydrogenated materials. The mass of U-235 is limited in each standard payload configuration based on the maximum enrichment to be transported as specified in SAR Table 6.1-1.

Building on the applicant's previous analyses of the VP-55HC configuration, this designation was replaced with VP-55 and specifies when the 5-inch pipe configuration is utilized. For the VP-55 with the 5-inch pipe container configuration, criticality safety relies on the 5-inch pipe, and the applicant analyzed several different array configurations in order to maximize the interaction between packages. The mass limits for this configuration are specified in SAR Table 6.1-2, based on the enrichment of the payload.

For the 1S/2S UF_6 cylinder configuration, criticality control relies on the geometry of the cylinder within the Versa-Pac package. Several array configurations were analyzed, and the most reactive configurations were used to determine the payloads for 1S and 2S cylinders, which are limited by mass per ANSI N14.1-2012, and are shown in the SAR Table 6.1-3.

6.2 Contents

As requested by the applicant in this revision, the contents to be added to the Versa-Pac include a new allowable enrichment of 1.25 wt.% U-235 and the addition of UF_6 contained in 1S and 2S cylinders as allowable contents.

6.3 General Considerations

The applicant evaluated the Versa-Pac with the new contents and provided additional calculations using the SCALE 6.1.3 code that was also used in the previous analysis. Both the software version and the 44-Group Standard Cross Section Library are appropriate for these new contents, are used appropriately, and staff finds them to be acceptable for this application. The benchmark evaluation is unchanged from previous revisions and remains adequate to perform these analyses.

The Versa-Pac model is unchanged from the previous VP-55 and VP-110 package dimensions, with new CAD drawings provided, and the applicant listed the Versa-Pac dimensions important to criticality safety in Table 6-3 and cited nominal dimensions and the corresponding conservatisms used for modeling the dimensions, such as a smaller drum radius, reduced vessel wall thickness, reduced insulation, etc., in order to bound the nominal drum design.

The applicant evaluated the new enrichment of 1.25 wt.% U-235 and its mass limits, and performed calculations similar to the other enrichment limits previously approved. As shown in SAR Table 6.1-4, in all instances, the enrichment of 1.25 wt.% U-235 was bounded by the previous analyses for both NCT and HAC.

The applicant also evaluated the new 1S/2S UF_6 cylinder configurations and performed calculations to demonstrate maximum system reactivity for various enrichments and cylinder loading in the Versa-Pac. As shown in Tables 6.1-7, 6.1-8, and 6.1-9, the maximum calculated k_{eff} for both a single package, and the applicant's NCT and HAC evaluations for arrays of packages, are all well within the upper subcritical limit of 0.94 for the Versa-Pac.

The applicant did not change the criticality safety index (CSI) calculations from the previously approved revision and only changed the VP-55HC designation. Therefore, the staff finds that the CSIs remain unchanged for the VP-55 with 5-inch Pipe Configuration, and for enrichments up to 10 wt.% U-235, the CSI is 0.7, and for greater than 10 wt.% U-235 up to 100 wt.% U-235 the CSI is 1.0. For the 1S/2S cylinder contents in the VP-55, the CSI is 1.0.

6.4 Air Transport

The applicant requested air transport of fissile material as part of this revision. As noted by the applicant, the Versa-Pac packaging was not subjected to the expanded accident conditions specified in 10 CFR 71.55(f). Rather, the applicant assumed that for an air transport accident, all the fissile contents are ejected from the Versa-Pac packaging and reconfigure to form an optimally moderated sphere of fissile material closely reflected by 20 cm of water. NRC staff considers this a conservative assumption and a worst possible case configuration of the fissile material since none of the packaging material is used in the analysis, the fissile material assumes the most reactive geometry possible, and optimally moderates the resulting spherical masses.

In order to bound the allowable contents of the Versa-Pac (both the VP-55 and VP-110 packages) listed in SAR Section 6.1.1, the applicant assumed that the fissile contents are uranium metal at a density of 19.05 g/cc, and the moderating material to be high density polyethylene (HDPE) as described in SAR Section 6.2.1. The applicant performed parametric and sensitivity studies of the H/U-235 ratios to perform their analysis. Staff evaluated the resulting studies and finds that the assumptions used by the applicant are conservative and represent the most reactive configuration of the fissile material.

Staff reviewed the calculations and the studies performed on the various enrichments and masses of U-235 allowed in the Versa-Pac. For the VP-55 with a 5-inch pipe container configuration, the applicant performed additional calculations to analyze the H/U-235 ratio of the various allowable enrichments and masses, and the applicant used the resulting maximum reactivity cases to limit the maximum U-235 mass allowed for air shipment as summarized in SAR Section 6.7.2. Staff reviewed the applicant's calculations and analysis and compared them to the minimum critical masses of uranium metal spheres for varying enrichments as reported in LA-10860-MS, "Critical Dimensions of Systems Containing U-235, Pu-239, and U-233" and the minimum critical masses for optimally moderated H/X UO_2F_2 systems for the UF_6 materials, as reported in ORNL/TM-12292, "Estimated Critical Conditions for UO_2F_2-H_2O Systems in Fully Water-Reflected Spherical Geometry". Staff found that the applicant's analysis was in agreement with these references, and with the conservatisms introduced by the applicant's analysis, that the resulting analysis show the contents remain subcritical to meet the air transportation requirements of 10 CFR Part 71.

For the VP-55 and VP-110 configurations, the ground transportation mass limits listed in SAR Section 6.1.1 were found by staff to be bounding for air transportation of those materials since the resulting masses were less than those determined to be safe for the VP-55 with 5-inch pipe analysis. In response to the staff's request for additional information (ADAMS Accession No. ML18330A091) regarding the air transport of 1S and 2S cylinders in the VP-55, the applicant revised SAR Table 6.1-3 to explicitly list the air transport limits for the 1S/2S contents. In addition, the applicant revised SAR Tables 1-1B and 1-1C to match these changes.

6.5 Evaluation Findings

The staff reviewed the criticality safety analysis provided in the SAR following the guidance of NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," during the criticality safety review of the proposed revision to the Versa-Pac package. Based on the statements and representations contained in the SAR, the response to the staff's request for additional information, and the additional calculations and analysis provided by the applicant, the staff concludes that the Versa-Pac transportation package continues to meet the criticality safety requirements of 10 CFR Part 71.

7.0 PACKAGE OPERATIONS

The purpose of this evaluation is to verify that the proposed changes to the operating controls and procedures of the Versa-Pac transport package meet the requirements of 10 CFR Part 71.

The applicant revised the operations procedures to include loading and handling the 1S/2S UF_6 cylinder contents. The staff reviewed the new operating procedures.

Based on review of the statements and representations in the application and conditions imposed in the CoC for the Versa-Pac transport package, the staff concludes that the revised operating controls and procedures for the package to accommodate the new contents meet the requirements of 10 CFR Part 71, and that these controls and procedures are adequate to ensure the safe use of the package.

8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM REVIEW

Chapter 8 of the application identifies the acceptance tests and maintenance programs to be conducted on the Model Versa-Pac package and verifies its compliance with the requirements of 10 CFR Part 71.

The staff reviewed and evaluated the revised acceptance tests. Based on the statements and representations in the application, the staff concluded that the revised acceptance tests meet the requirements of 10 CFR Part 71, and that they are adequate to assure the package will be constructed in a manner consistent with its evaluation for approval. Further, the certificate is conditioned to specify that the package must be prepared for shipment and operated in accordance with the Acceptance Tests and Maintenance Procedures in Section 8 of the application.

9.0 CONDITIONS

The staff made editorial changes to improve the readability of the CoC. The CoC includes the following condition(s) of approval:

Condition No. 3.b., “Title and Identification of Report or Application,” has been updated to reflect the consolidated application submitted by Daher-TLI.

Condition No. 5(a)(1), “Model No.,” has been updated to remove mention of the Model No. VP-55HC configuration.

Condition No. 5(a)(2), “Description,” has been updated to:

- reflect the removal of the Model No. VP-55HC,
- describe the new package description for the UF_6 in 1S or 2S cylinders,
- reflect the use of new materials used in each package (e.g., UN1A2/Y425/S as new exterior package skin), and
- revise Table 1 - Weights and Dimensions to reflect a new packaging outer diameter and small editorial changes.

Condition No. 5(a)(3), “Drawings,” has been updated to include reference to the new drawings for the VP-55/VP-55 with 5-inch pipe and VP-110 packages.

Condition No. 5.(b)(1), “Type and form of material,” has been updated to include details of the UF_6 loaded into ANSI N14.1 compliant 1S or 2S cylinders authorized for shipment and clarify that the TRISO coated fuel is C/SIC/C and not C/SIS/C.

Condition No. 5.(b)(2), “Maximum quantity of material per package,” has been updated to include:

- new provisions for air transportation for both the VP-55/VP-55 with 5-inch pipe and VP-110 models,
- new restrictions with use of the 1S/2S cylinders,
- revised ground/vessel transport loading mass limits for the new allowable enrichment of 1.25 wt.% U-235, and
- an updated net weight of the authorized contents shall not exceed 350 lbs for the Model No. VP-55.

Condition No. 5.(c), “Criticality Safety Index (CSI),” has been updated to reflect removal of the VP-55HC model.

Condition No. 7, has been updated to reflect authorization for air transport, with stated restrictions and limits.

The references section has been updated to include this request and associated supplements.

10.0 CONCLUSIONS

Based on the statements and representations contained in the application, as supplemented, and the conditions listed above, the staff concludes that the design has been adequately described and evaluated, and the Model No. Versa-Pac package meets the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9342, Revision No. 13, for the Model No. Versa-Pac.