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

SAFETY EVALUATION REPORT

Docket No. 71-9798
Model No. D2G Power Unit Shipping Container
Certificate of Compliance No. 9798
Revision No. 0

TABLE OF CONTENTS

SUMMARY

By application dated September 29, 2020, the Department of Energy, Division of Naval Reactors, requested that the Nuclear Regulatory Commission (NRC) review and concur with the Model No. D2G Power Unit Shipping Container (PUSC) package as a Type B(F) package for the transport of unirradiated Uranium-235 (U-235). The NRC previously reviewed the D2G PUSC for transport of D2G shipboard, D2W Prototype, and D2W shipboard power units under Certificate of Compliance (CoC) USA/6441/B(U)F. The applicant allowed the original CoC USA/6441/B(U)F to expire. However, the applicant recently identified the need to transport the D2W power unit in the D2G PUSC package.

The NRC staff (the staff) reviewed the application using the guidance in NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material." Based on the statements and representations in the application and the conditions listed in the certificate of compliance (CoC), the staff concludes that the package meets the requirements of 10 CFR Part 71.

1.0 GENERAL INFORMATION

1.1 Packaging

The D2G PUSC consisted of three main components: the barrel assembly, the upper cover, and the lower cover. The applicant manufactured these components from steel plates, steel forgings or both. The D2G PUSC measured approximately 31 feet long and 10 feet-8 inches wide at its widest point. The D2G PUSC provided physical protection for the D2W power unit during loading, transport, transfer and unloading operations. A structural barrier provided protection against structural damage, and a sealed enclosure precluded contact with dirt or other objectional contaminants. The applicant used a shipping ring to retain the D2W power unit in the D2G PUSC. Eight studs secured the power unit shipping ring to the core barrel upper ring. Control drive mechanisms restrained control rod motion within the power unit. The D2G PUSC weighed approximately 230,000 pounds when loaded with a D2W power unit.

1.2 Drawings

The applicant constructed the package in accordance with the drawings contained in safety analysis report for packaging (SARP) Appendix A.1.3.3. The staff confirmed that the drawings are in accordance with NUREG/CR-5502, "Engineering Drawings for 10 CFR Part 71 Package Approvals," and provide an adequate description of the materials and fabrication requirements. Therefore, the staff finds the drawings to be acceptable.

1.3 Contents

The content consisted of a single D2W power unit. The individual components of a D2W power unit included a core barrel, unirradiated uranium fuel assemblies enriched in the U-235 isotope with all design control rods and mechanisms installed, a closure head and associated hardware. The staff finds the contents are adequately described.

1.4 Evaluation Findings

Based on a review of the statements and representations in the application, the staff concludes that the package has been adequately described to meet the requirements of 10 CFR Part 71.

2.0 STRUCTURAL

The applicant submitted an application containing additional structural analyses and design information for the D2W power unit in the D2G PUSC to demonstrate the structural adequacy of the package under both normal conditions of transport (NCT) and hypothetical accident conditions (HAC) as required by 10 CFR Part 71. The staff reviewed the application, which is an addendum to the SARP, WAPD-DP(CH)-1133 (Reference 1), for the D2W power unit in the D2G power unit shipping container transportation package, to verify that the structural performance of the package meets the requirements of 10 CFR Part 71.

2.1 Structural Design

2.1.1 Overview

The applicant designed seven principal structural components to transport the D2W power unit in the D2G PUSC package: PUSC assembly, fuel cell assemblies, control rod assemblies, CDM assemblies, core barrel assemblies, closure head assembly as well as shipping ring and lifting flange components. The applicant provided the component configuration of the package in SARP Figure A1-2 in Chapter A1 and detailed package descriptions (i.e., weight, dimensions, material types, etc.) in SARP Section A1.2 and Section A2.1. The applicant identified the major important-to-safety (ITS) components of the package, as well as detailed information to demonstrate compliance with 10 CFR 71.33(a) and 71.107(a), in the package general assembly drawings provided with the application. The staff reviewed the structural descriptions and drawings for completeness and accuracy. The staff finds that the geometry, dimensions, materials, components, notes, and fabrication details were adequately incorporated into the SARP.

2.1.2 Design Criteria

The applicant evaluated the D2W power unit in the D2G PUSC package using design criteria which are similar to the design criteria in References 1 and 2 that were previously used for D2G PUSC package evaluations. The applicant used the closed-form solutions and method of finite element (FE) analysis to evaluate the package. The applicant performed linear elastic analyses for NCT and bilinear elastic-plastic analyses for HAC. Based on a review of the design criteria presented in SARP Section A2.1.2, the staff finds that the structural design criteria for the D2W power unit in the D2G PUSC package are adequate to evaluate the structural integrity of the package for meeting the 10 CFR 71 NCT and HAC requirements.

2.1.3 Weights and Centers of Gravity

The applicant provided the nominal weights and the center of gravity (CG) locations for the D2W power unit components in the D2G PUSC package in SARP Tables A2.1-2 and A2.1-3. The applicant used these weights and CG locations in the structural evaluations demonstrating that the 10 CFR 71 NCT and HAC requirements are satisfied. The staff finds that the applicant provided information that adequately described the weights and determined the CG locations.

2.2 Fabrication and Examination

The applicant fabricated and examined components for shipping the D2W power unit in the D2G PUSC package in accordance with the engineering design drawings in SARP Chapter A1 and SARP Chapter A9. In addition, the applicant fabricated and examined those components in accordance with the Naval Nuclear Propulsion Program (NNPP) standards as discussed References 1 and 2 which were previously reviewed and accepted by the staff. After reviewing the statements and drawings, the staff finds that the applicant provided adequate information to describe the fabrication and examination requirements.

2.3 General Standards for All Packages

2.3.1 Minimum Package Size

Drawing R-126361 in SARP Appendix A1.3.2 illustrated that the smallest overall dimension of the D2G PUSC transportation package approximately 10 feet which is larger than the minimum requirement of 4.0 inches. The staff finds that the application meets the 10 CFR 71.43(a) regulatory requirement.

2.3.2 Tamper Indicating Feature

The applicant employed security seals with the D2W power unit in the D2G PUSC package at the following locations: two seals between the upper cover barrel, two seals between the lower cover and barrel, and one seal at each of three nozzle viewing port covers. Examination of the security seals at each package closure joint and viewing port cover allowed the applicant to determine if the package had or had not been opened. The staff finds that the application meets the 10 CFR 71.43(b) regulatory requirement.

2.3.3 Positive Closure

As discussed in SARP Chapter A7, the applicant fastened the D2W power unit in the D2G PUSC package with 24 upper cover cap-screws and 12 lower cover cap-screws. The applicant securely tightened them using installation torque in conjunction with lockwire. The applicant utilized these screws to maintain positive closure and to prevent inadvertently opening the package. The staff finds that the application meets the 10 CFR 71.43(c) regulatory requirement.

2.4 Lifting and Tie-down Standards for All Packages

The applicant stated that the D2W power unit in the D2G PUSC package satisfied the 10 CFR 71.45(a) and 71.45(b) requirements for lifting devices and tie-down standards respectively through a combination of technical evaluations and operating procedure compliance. The applicant previously provided technical evaluations in Reference 1 that demonstrated how some D2G PUSC package components (e.g., lifting attachments) satisfied the 10 CFR 71.45(a) and 71.45(b) requirements. The staff previously reviewed and accepted these technical evaluations. For lifting and tie-down components that could not be designed to satisfy the 10 CFR 71.45(a) and 71.45(b) requirements, the applicant committed to rendering them inoperable during transit, in accordance with 10 CFR 71.87(h), through strict compliance with operating procedures. The staff reviewed SARP chapter A7 and determined that the applicant incorporated adequate instructions to render lifting and tie-down components inoperable during transit. Therefore, the staff finds that the application meets the 10 CFR 71.45(a) and 71.45(b) regulatory requirements.

2.5 Normal Conditions of Transport

The applicant evaluated the D2W power unit in the D2G PUSC package for NCT as required by 10 CFR 71.71. The applicant analyzed the D2W power unit in the D2G PUSC using closed form solutions, a computer program developed by the Navy to evaluate transportation packages, and the results of the previous structural analyses in Reference 1 to demonstrate compliance with the 10 CFR 71.71 regulatory requirements for NCT.

2.5.1 Heat

The applicant performed thermal evaluations of the D2W power unit in the D2G PUSC package to demonstrate structural design adequacy of the package for the temperatures specified in 10 CFR 71.71(c)(1). The applicant provided detailed thermal evaluations and their results in SARP Chapter A3. The applicant also briefly summarized the thermal analysis in SARP Section A2.6.1.

2.5.1.1 Pressures and Temperatures

The applicant calculated the maximum component temperature as well as maximum operating pressure for NCT in SARP Sections A3.4.2 and A3.4.4 respectively. The results of the evaluations showed that the maximum temperature will not damage the D2G PUSC components and the maximum D2G PUSC pressure will not result in loss of radioactive material.

2.5.1.2 Stress Calculations and Comparison with Allowable Stresses

In Reference 1, the applicant calculated a minimum factor of safety (FS) of 23 for the structural components of the D2G PUSC package under combined pressure and thermal loading conditions. In the SARP submitted with this application, the applicant calculated a FS of 19. The applicant attributed the difference to a slight increase of internal pressure. The applicant concluded that the stresses in structural components of the D2W power unit in the D2G PUSC under combined pressure and thermal loading conditions are acceptable because of the large calculated FS of 19. After reviewing the applicant's FS calculation, the staff finds that the application meets the 10 CFR 71.71(c)(1) regulatory requirement.

2.5.2 Cold

The applicant performed a thermal evaluation for the D2W power unit in the D2G PUSC package under the cold NCT conditions (i.e., -40°F in still air and shade) in SARP Chapter A3. As shown in Section A3.2 of SARP Chapter A3, the valve sealing elements and the silicon rubber container gaskets in the D2G PUSC package are stable in temperatures between -40ºF and 200ºF. In addition, the applicant stated in Section A1.2.5 of SARP Chapter A1 that the package may only be shipped when the temperature is greater than or equal to 20ºF. As a result, the applicant concluded that significant stresses are not developed due to thermal contraction. After reviewing the thermal evaluation, staff finds that the D2W power unit in the D2G PUSC package satisfies the 10 CFR 71.71(c)(2) regulatory requirement.

2.5.3 Reduced External Pressure

The applicant evaluated the impact of a reduction in atmospheric pressure from 14.7 psia to 3.5 psia. The applicant stated in Section A3.4.4 of SARP Chapter A3 that the maximum internal

pressure under NCT is 16.9 psig. The applicant calculated an equivalent internal pressure of 28.1 psig due to an external pressure reduction from 14.7 psia to 3.5 psia [16.9 + (14.7 - 3.5) = 28.1].

The applicant previously calculated a minimum FS of 22 for the package components under 14.5 psig in Reference 1. Since the components are in an elastic stress range during a pressure increase from 14.5 psig to 28.1 psig, the applicant recalculated a minimum FS of 10 under 28.1 psig using a linear relationship. Since the FS of 10 is larger than 1, the applicant concluded that the structural component stresses for the D2W power unit in the D2G PUSC package under a reduced external pressure of 3.5 psia are acceptable.

The staff reviewed the applicant's results in SARP Table A2.6-2. The staff confirmed that the effects of an external pressure reduction from 14.7 psia to 3.5 psia, is negligible. Therefore, the staff finds that the application meets the 10 CFR 71.71(c)(3) regulatory requirement.

2.5.4 Increased External Pressure

The applicant stated that the effect of an external pressure of 20 psia is considered negligible for the D2W power unit in the D2G PUSC package. The applicant reached that conclusion based on the results of structural analyses under NCT presented in SARP Section A2.6.7. In SARP Section A2.6.7, the applicant demonstrated the structural integrity of the D2W power unit in the D2G PUSC package under a loading case of 21.7 psig. Therefore, the staff found the statement acceptable. The staff finds that the application meets the 10 CFR 71.71(c)(4) regulatory requirement.

2.5.5 Vibration

The applicant stated that the effects of vibration are considered negligible for the D2W power unit in the D2G PUSC package. After calculating the natural frequency of the package, the applicant found that this frequency exceeded the vibration frequencies expected during NCT by a significant margin. The staff reviewed the frequency calculation. Because the package's natural frequency is greater than the forcing frequency, staff found that there will not be significant dynamic amplification of vibrations; therefore, the possibility of resonance and subsequent elevated stress conditions is not credible. In addition, to support their assertion that the effects of vibration are negligible, the applicant pointed to the fact that this package has an extensive service history without any significant vibration induced issues. After reviewing the application, the staff finds that the regulatory 10 CFR 71.71(c)(5) requirement for normal vibration incidents during transportation is met.

2.5.6 Water Spray

The applicant stated that the outer layer of the D2G PUSC package is designed to be fabricated entirely with steel materials. In addition, the D2G PUSC package is designed to be leak-tight to gas as described in Reference 1. The applicant determined that the water spray test has no adverse effect on the package. Since the water spray test is primarily intended for packaging constructed of material that either absorbs water or is softened by water, the staff concluded, after reviewing the evaluation, that the rationale for the applicant's determination is acceptable. The staff finds that the application satisfies the 10 CFR 71.71(c)(6) regulatory requirement.

2.5.7 NCT Free Drop

The applicant evaluated the D2W power unit in the D2G PUSC package to meet the 10 CFR 71.71 free drop requirements. The applicant only considered a side drop orientation through a height of one foot onto a flat, essentially unyielding, horizontal surface in the analysis. The applicant asserted that an end drop orientation was not credible because the D2G PUSC package is shipped in the horizontal orientation and any attempt to re-orient it requires a multi-ton crane, therefore, the applicant only evaluated a side drop orientation.

The applicant based the side drop analysis on the results of the NCT free drop analysis which was previously reviewed in Reference 1 and accepted by the staff. In Reference 1, the applicant used a classical solution in conjunction with the Navy's computer program to evaluate the equations of dynamic motion for the package via explicit time integration.

The applicant calculated the side-drop accelerations using the computer program as discussed in SARP Appendix A2.12.2 and in Reference 1. The applicant identified that the upper cover cap-screws are the components most susceptible to failure under accident loads. The applicant evaluated the cap-screws and showed the analytical results in SARP Table A2.6.3. The applicant calculated a maximum combined cap-screw stress that was significantly less than the yield and ultimate strength of the cap-screw material. After reviewing the analysis results, the staff finds that the D2W power unit in the D2G PUSC package meets the 10 CFR 71.71(c)(7) regulatory requirement.

2.5.8 Corner Drop

The applicant stated that this condition is not applicable to the D2W power unit in the D2G PUSC package because 10 CFR 71.71(c)(8) requires this test for fiberboard, wood, or fissile material rectangular packages not exceeding 110 lb. and fiberboard, wood, or fissile material cylindrical packages not exceeding 220 lb. Since the weight of the D2W power unit in the D2G PUSC package exceeds 220 lb., the staff finds that the 10 CFR 71.71(c)(8) regulatory requirement is not applicable to the D2W power unit in the D2G PUSC package.

2.5.9 Compression

The applicant stated that this condition is not applicable to the D2W power unit in the D2G PUSC package because 10 CFR 71.71(c)(9) only requires this test for a package weighing up to 11,000 lbs. Since the weight of the D2W power unit in the D2G PUSC package exceeds 11,000 lbs., the staff finds that the 10 CFR 71.71(c)(9) regulatory requirements are not applicable to the D2W power unit in the D2G PUSC package.

2.5.10 Penetration

The applicant stated that the D2W power unit in the D2G PUSC package meets the 10 CFR 71.71(c)(10) requirement. The staff determined that the applicant previously evaluated penetration of the top cover (the thinnest PUSC component) and provided the results of the evaluation in Reference 1. The results showed no penetration occurred. Because the evaluation was previously reviewed and accepted, the staff finds that the D2W power unit in the D2G PUSC package satisfies the 10 CFR 71.71(c)(10) regulatory requirement.

2.6 Hypothetical Accident Conditions

The applicant evaluated the D2W power unit in the D2G PUSC package for the HAC free drop, crush, puncture, thermal, and water immersion conditions as required by 10 CFR 71.73. The applicant analyzed the D2W power unit in the D2G PUSC using the FE analysis computer programs (ABAQUS and ANSYS) and closed-form solutions to demonstrate compliance with the 10 CFR 71.73 HAC regulatory requirements.

2.6.1 30-foot Free Drop

Per the 10 CFR 71.73(c)(1) requirement, the applicant needed to demonstrate structural adequacy by a 30-foot free drop onto a flat, unyielding, horizontal surface in a position for which maximum damage is expected. To determine the orientation that produced the maximum damage, the applicant evaluated the D2W power unit in the D2G PUSC for impact orientations in which the package strikes the impact surface on its bottom, end, and side. The applicant considered four drop configurations: end drop, side drop, corner drop, and oblique drop.

The applicant provided the results of the evaluation for the D2W power unit structural components in SARP Appendix A2.12.9. The results showed that the closure head and control drive mechanisms remain in place in the power unit. In addition, the results showed that, although the core barrel and the fuel cell assemblies plastically deform, these components experienced only localized deformations and remained essentially intact with no loss of radioactive material under the 10 CFR 71.73 “drop” event.

The staff reviewed the modeling methodologies, results of the ABAQUS FE analyses, and comparisons with the allowable stresses. Based on a review of the application and independent calculations, the staff finds that the application satisfies the 10 CFR 71.73(c)(1) regulatory requirement.

2.6.2 Crush

The applicant stated that the dynamic crush test specified in 10 CFR Part 71.73(c)(2) is not required for the D2W power unit in the D2G PUSC package. Per 10 CFR Part 71.73(c)(2), a dynamic crush test is performed on packages with a mass not greater than 1,100 lb. by positioning the specimen on a flat, essentially unyielding, horizontal surface such that the package suffers the maximum damage from an 1,100 lb. mass dropped 30 feet onto the package. However, the weight of the D2W power unit in the D2G PUSC package exceeds 1,100 lb. Therefore, the staff finds that the 10 CFR 71.73(c)(2) regulatory requirement is not applicable to the D2W power unit in the D2G PUSC package.

2.6.3 Puncture

The applicant evaluated the D2W power unit in the D2G PUSC package against the 10 CFR Part 71.73(c)(3) requirements using the closed-form solutions in SARP Appendix A2.12.10. The 10 CFR Part 71.73(c)(3) requirements specified that the package undergo a free drop, through a distance of 40 inches in a position for which maximum damage is expected, onto the upper end of a solid, vertical, cylindrical, mild steel bar mounted on an essentially unyielding, horizontal surface. The regulations specified that the pin must be 6 inches in diameter, and that it must have a horizontal top with its edge rounded to a radius of not more than 0.25 inch. The regulations also specified the long axis of the bar must be vertical with a length that causes

maximum damage to the package, but not less than 8 inches long. SARP Table A2.12.10-1 summarized the puncture results as following:

(a) PUSC Lower Cover - the pin will buckle,
(b) Core Barrell Side Wall - the pin will buckle,
(c) Core Barrell Nozzle Opening - the pin will buckle,
(d) Clamping Ring (Horizontal) - the pin will buckle, and
(e) PUSC Upper Cover (Vertical) - the pin will buckle.

The evaluation results demonstrated that the pin buckles before shearing any package structural components or causing a package configuration change that would affect the containment capability of the package. The staff reviewed the evaluations and determined that the D2W power unit in the D2G PUSC package has the structural strength and design adequacy to withstand the 10 CFR 71.73(c)(3) “puncture” event. Therefore, the staff finds that the application satisfies the 10 CFR 71.73(c)(3) regulatory requirement.

2.6.4 Thermal

The applicant described thermal evaluations of the D2W power unit in the D2G PUSC transportation package under HAC in SARP Chapter A3. The staff’s detailed findings on the applicant’s thermal evaluations are provided in Section 3 of this safety evaluation report (SER). The applicant briefly summarized the SARP Chapter A3 thermal evaluation results in SARP Section A2.7.4. The results showed that:

(a) no structural parts melted,
(b) no degradation of the containment system sealing capability occurred,
(c) all calculated stresses are less than the allowable stresses,
(d) the fire condition does not affect package safety, and
(e) there is no loss of radioactive material.

The staff reviewed the evaluations presented by the applicant and found them acceptable. Additional detailed reviews and safety evaluations by the staff on the applicant’s thermal evaluations are provided in Section 3 of this SER. The staff finds that the application satisfies the 10 CFR 71.73(c)(4) regulatory requirement.

2.6.5 Immersion – Fissile

The applicant stated that the D2W power unit in the D2G PUSC package satisfies the 10 CFR 71.73(c)(5) regulatory requirement which states that packages transporting fissile material subject to 10 CFR Part 71.55 must be evaluated for immersion under a head of water of at least three feet in the attitude for which maximum leakage is expected if the criticality analysis has not assumed water in-leakage. The applicant stated that SARP Chapter A6 provided a criticality evaluation that demonstrates subcriticality under the assumption that the PUSC allows in-leakage of water. The staff’s detailed findings on the applicant’s criticality evaluations are provided in Section 6 of this SER. Therefore, the staff finds that the application satisfies the 10 CFR 71.73(c)(5) regulatory requirement.

2.6.6 Immersion - All Packages

The 10 CFR Part 71.73(c)(6) requirements stated that a separate, undamaged specimen must be subjected to water pressure equivalent to immersion under a head of water of at least 50 feet

(equivalent pressure of 21.7 psig) for a period of 8 hours. To satisfy these requirements, the applicant considered two principal accident scenarios for the D2W power unit in the D2G PUSC package under the 21.7 psig external pressure: buckling of the D2G PUSC package, and induced stresses in the D2G PUSC package. For the buckling evaluation, the applicant divided the D2G PUSC package into five regions: the lower cover, three locations of the upper covers, and the PUSC barrel. The applicant used the same method of evaluation for the current analyses as those used in Reference 1.

SARP Table A2.7.2 provided the lengths, radii, and thickness of the PUSC package regions for the buckling analysis. The table also showed the analytical results. The minimum critical buckling stresses in SARP Table A2.7.2 demonstrated that there is no buckling concern associated with the immersion accident for the PUSC package because the package buckling stresses are significantly greater than the external pressure of 21.7 psig.

The applicant also calculated the stresses due to a differential pressure across the walls of the PUSC package using the same method of evaluation in Reference 1. SARP Table A2.7.3 showed that the induced stresses from the external pressure are significantly lower than the yield strength of the material. These results demonstrated that there is no excessive stress concern associated with the immersion accident for the PUSC package.

The staff reviewed the buckling analysis and the stress calculation results. Staff determined that the D2G PUSC package has the structural strength and design adequacy under the immersion accident condition of a head of water of at least 50 feet (equivalent pressure of 21.7 psig). Therefore, the staff finds that the application satisfies the 10 CFR 71.73(c)(6) regulatory requirements.

2.6.7 Deep Water Immersion Test -Special Requirements for Type B Packages Containing More Than 10^5 A_2

The applicant asserted that the D2W power unit in the D2G PUSC package satisfies the regulatory requirements of 10 CFR 71.61 which state that a Type B package containing more than 10^5 A_2 must be designed so that its undamaged containment system can withstand an external water pressure of 290 psi for a period of not less than one hour without collapse, buckling, or in-leakage of water. The applicant showed in SARP Table A2.7.4 that the package contains less than 10^5 A_2. After reviewing the table, the staff finds that the application satisfies the 10 CFR 71.61 regulatory requirements.

2.6.8 Summary of Damage

The applicant stated in SARP Section A2.7.8 that the analytical results reported in SARP Sections A2.7.1 through A2.7.7 demonstrated that structural damages due to the HAC did not diminish the package's ability to maintain the containment boundary of the D2W power unit in the D2G PUSC package. The applicant stated that only the side drop caused significant fuel rearrangement or control rod motion; however, the analysis showed that the fuel cladding remained intact and unyielded during the side drop. The staff reviewed the evaluations and their results as presented in SARP Sections A2.7.1 through A2.7.7. The staff determined that the applicant's damage assessments are acceptable. Therefore, the staff finds that the application satisfies the 10 CFR 71.73 regulatory requirements.

2.7 Accident Conditions for Air Transport of Plutonium

The staff reviewed the application and determined that the application did not seek approval for air transport of plutonium. Therefore, the staff finds that the accident evaluations defined in 10 CFR 71.74 are not applicable to the D2W power unit in the D2G PUSC package.

2.8 Accident Conditions for Fissile Materials for Air Transport

The staff reviewed the application and determined that the application did not seek approval for air transport of fissile materials. Therefore, the staff finds that the accident evaluations defined in 10 CFR 71.55(f) are not applicable to the D2W power unit in the D2G PUSC package.

2.9 Special Form

The staff reviewed the application and determined that this section is not applicable to the D2W power unit in the D2G PUSC package because the radioactive materials presented for transport are not special form sources, therefore, the 10 CFR 71.75 requirements are not applicable.

2.10 Fuel

For the D2W power unit, the applicant relied on the fuel cladding to provide the primary containment boundary for nuclear fuel. The structural evaluations provided in SARP Sections A2.6 and A2.7 in Chapter A2 as well as the thermal evaluations provided in Chapter A3 demonstrated that cladding integrity is maintained under NCT and HAC. In addition, SARP Chapter A4 provided a description of the fuel cladding and addressed the containment performance of the cladding under NCT and HAC.

The staff reviewed the structural evaluation results in SARP Sections A2.6 and A2.7. Additional safety evaluations with respect to the fuel cladding integrity are provided in Sections 3 and 4 of this SER. Based upon the information provided, the staff finds that the fuel cladding is not vulnerable to failure (rupture or breach) under a 30-foot drop accident event when transporting the D2W power unit in the D2G PUSC package.

2.11 Evaluation Findings

Based on a review of the statements and representations in the application, the staff finds that the structural design has been adequately described and evaluated and that the D2W power unit in the D2G PUSC transportation package has adequate structural integrity to meet the structural requirements of 10 CFR Part 71.

2.12 References

1. WAPD-DP(CH)-1133 – Safety Analysis Report for Packaging (SARP); AEC Manual Chapter 0529 Evaluation; D2G Power Unit Shipping Container with D2W Prototype Power Unit, Westinghouse Electric Corporation for the U.S. Atomic Energy Commission, 1973

2. WAPD-DP(CH)-1466 – D2W Project; Safety Analysis Report for Packaging for the D2G Power Unit Shipping Container and D2W Power Unit; Westinghouse Electric Corporation for the U.S. Atomic Energy Commission, 1974

3.0 THERMAL

The staff reviewed the D2G PUSC transportation package application to verify that the thermal performance of the package has been adequately evaluated for the tests specified under NCT and HAC and that the package design satisfies the thermal requirements of 10 CFR Part 71. The application was also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 3 of NUREG-2216, “Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material.”

3.1 Description of Thermal Design

3.1.1 Design Features

The applicant designed and fabricated this Type B package, which was previously reviewed and certified for transport, in accordance with the SARP drawings, Naval specifications, and the Naval QA program. According to the application, the D2G PUSC packaging consisted of the steel barrel assembly, steel upper cover, steel lower cover, and steel shipping ring. Shipping ring, bolts, and studs retained the D2W power unit in the D2G PUSC assembly.

3.1.2 Content’s Decay Heat

The applicant stated that the contents included a single D2W power unit consisting of a core barrel, unirradiated fuel assemblies, closure head, and various mechanisms and hardware. The SARP chapter A3 indicated that no internal heat generation is considered because the content’s unirradiated fuel does not generate decay heat.

3.1.3 Summary of Temperatures

The applicant noted that the temperatures associated with cladding and the package’s structural components remain below their allowable temperatures during NCT and HAC. The applicant indicated that, per 10 CFR 71.43(g), the maximum temperature of the accessible package surfaces at hot normal conditions was lower than the 185°F allowable accessible surface temperature for exclusive use transport.

Although it was noted in the SARP chapter A2 that seals associated with pressure relief valves and between bolted sections have a -40°C allowable temperature, the applicant committed to instituting operational controls such that the package would be shipped when ambient temperatures are above the lowest service temperature of 20°F. Staff notes that this administrative operational control is a condition of the CoC.

The applicant indicated that maximum package temperatures were below the cladding and package metal allowable temperatures after the 30 minute HAC fire. Although seal temperatures were above allowable temperatures following the HAC fire, the applicant stated that this would not prevent the package from meeting 10 CFR Part 71 containment requirements because the integrity of the containment boundary is maintained; therefore, the staff finds this acceptable because cladding temperature is well below melting temperature.

3.1.4 Summary of Maximum Pressures

The applicant stated in the SARP chapters A2 and A3 that the package is shipped dry and slightly pressurized with an inert gas. The applicant utilized pressure relief valves as part of the

package to maintain package internal pressures within set limits; the applicant indicated in the SARP chapter A2 that there is no continuous venting. The applicant also stated that, even if the pressure relief valves open, there is no loss of radioactive material because the cladding integrity is maintained during NCT and HAC.

The applicant indicated that the Maximum Normal Operating Pressure (MNOP) was based on the initial inert gas pressure setpoint and the assumption that the pressure relief valves would fail to function. The applicant stated that the package stresses at MNOP conditions were bounded by the allowable stresses that occur during the pressure related HAC test described in the SARP chapter A2. Therefore, the staff determined that stresses in the D2G PUSC at MNOP are acceptable and would not impact package functions.

3.2 Material Properties and Component Specifications

The applicant included values associated with the package material thermal properties, including thermal conductivity, specific heat, and thermal diffusivity in the SARP. As noted earlier, the package and its properties were previously reviewed by the staff and found to be acceptable.

3.3 Thermal Evaluation under Normal Conditions of Transport

The applicant noted that the thermal results of the previously approved S-6213 PUSC analysis were used to determine the maximum temperature of the D2G PUSC because the S-6213 PUSC design and its thermal model were applicable and bounded the D2G PUSC. The applicant based the original thermal analysis on an energy balance of the package surface that accounted for convection heat transfer, radiation heat transfer, and insolation.

The steady-state thermal calculation for hot NCT assumed a 100°F ambient temperature with the peak insolation value defined in 10 CFR 71.71(c) for curved surfaces. The package temperatures provided by the applicant at normal conditions (hot and cold) demonstrated that the content, as well as PUSC valves, seals, and metal components, remain within their allowable temperature range; however, with regard to transport in cold temperatures, the applicant stated in the SARP chapter A2 that the package would only be shipped when temperatures are above the low service temperature of 20°F.

As described in Section 3.1.4 above, the applicant designed the D2G PUSC to withstand the MNOP stresses. Likewise, as noted in Section 3.1.3, the package met the exclusive use shipment requirement of 10 CFR 71.43(g) because the maximum package surface temperature was less than 185°F. In the SARP chapter A2, the applicant identified that there was no significant differential thermal expansion or contraction between package components because there is no decay heat and the package's components are of similar material.

3.4 Thermal Evaluation under Hypothetical Accident Conditions

The applicant based the HAC thermal analysis on a lumped mass analytical approach. The applicant assumed that the temperature of the lumped mass is spatially uniform at any point in the transient and then solved the differential equations associated with the lumped masses; the applicant used this method in the SARP for the previously approved S-6213 PUSC. The applicant based the initial conditions on the results from the hot normal condition (with insolation) thermal analysis. The applicant noted in the SARP that the HAC fire thermal analysis considered the potential effect of a cover being separated from the package during the

fire. The results indicated that the package's structural component temperatures due to the fire were below their melting point. Although package seals were above their allowable temperatures during the HAC fire, the applicant identified no significant impacts as discussed below.

As explained in the SARP chapter A3, the applicant based the package pressure during the HAC fire on the Ideal Gas Law; inputs included the package's temperature during the accident, cold NCT temperature, and the inert gas setpoint pressure during loading. The calculated pressure assumed that the pressure control valves failed to open at high pressure. The SARP indicated that the package pressure could unseat the seals and slightly separate bolted joints. However, the SARP chapter A2 indicated that the maximum fuel temperature was below the melting point for the fresh fuel's metallic cladding. Consequently, the applicant asserted that there would be no degradation of containment integrity, and therefore, that there would be no release from the package. The applicant also indicated in the SARP chapter A2 that there were no significant effects due to thermal expansion under HAC.

3.5 Evaluation Findings

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

4.0 CONTAINMENT

4.1 Description of the Containment System

The D2G PUSC packaging consisted of the barrel assembly, upper cover, lower cover, and shipping ring. The shipping ring, bolts, and studs retained the D2W power unit (i.e., the contents) in the PUSC assembly. The applicant designed and fabricated this Type B package, which was previously reviewed and certified for transport, in accordance with the drawings contained in the SARP, Naval specifications, and the Naval QA program.

The contents included unirradiated fuel that generates negligible decay heat. The D2G PUSC provided no containment function; rather, the fuel cladding and its weldments formed the containment boundary. The SARP chapters A2 and A4 indicated that the integrated fuel and cladding arrangement is robust and that there are no penetrations. Likewise, the SARP indicated that the cladding undergoes numerous visual and dimensional examinations as well as volumetric inspections to ensure manufacturing specifications are met.

Although the D2G PUSC is not the containment boundary, the applicant indicated that it does surround the fuel and confines the content during NCT and potential accident conditions. Therefore, the SARP discussed the design features and the performance of the D2G PUSC. For example, the SARP chapter A3 noted that the D2G PUSC includes pressure relief valves to ensure that the package internal pressure remains within operational setpoints. The SARP chapter A3 stated that the package includes seals which are associated with the pressure relief valves and the bolted joints between package components. However, the applicant noted that the containment function of the package does not rely on the performance of the seals or pressure relief valves.

The SARP Acceptance Test chapter stated that the D2G PUSC undergoes acceptance tests during fabrication, including weld inspections, pressure tests and leakage tests; in addition, the

SARP Maintenance chapter stated that the package undergoes a leakage rate test if criteria are met during periodic inspections. In addition to the presence of security seals, the SARP indicated that the package includes screws and fasteners that are torqued to secure package closure and prevent the package from being unintentionally opened. Finally, the SARP chapters A2 and A3 stated that the package is shipped dry with an inert gas which indicates that potential reactions with the fuel or radiolysis are not significant issues.

4.2 Containment under Normal Conditions of Transport

The applicant stated that the cladding containment boundary is not affected by high or low pressures within the package during NCT. Although the package has pressure relief valves to maintain package internal pressures within operating limits, the SARP chapter A2 indicated there is no continuous venting. Likewise, the SARP chapter A3 noted that, even if the pressure relief valves open, there is no loss of radioactive material because the integrity of the containment boundary is maintained. The SARP chapters A2 and A3 noted there would be no damage to the PUSC that would result in loss of content and no loss of containment boundary integrity during NCT; therefore, the staff finds that the applicant has demonstrated compliance with 10 CFR 71.43(f) and 71.51 because there would be no release of radioactive contents.

4.3 Containment under Hypothetical Accident Conditions

The applicant stated that the cladding containment boundary is not affected by high or low pressures within the package during HAC. According to the SARP chapters A2 and A3, the content remains contained within the package with no loss of radioactive material even if pressure relief valve seals are damaged during the HAC fire because the maximum fuel temperature remains well below the unirradiated fuel cladding's melting temperature during the fire; therefore, the staff finds that the applicant has demonstrated compliance with 10 CFR 71.51 because there would be no structural concern or degradation of the containment boundary.

4.4 Evaluation Findings

Based on a 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

The staff reviewed the application and determined that a shielding evaluation is not needed because the content is unirradiated.

6.0 CRITICALITY

6.1 Review Objectives

The D2G PUSC is a fresh fuel transportation package that is designed to transport the D2W power unit. Although it is designated as a 96-BF(U) package, this package is only used to transport unirradiated fissile material; therefore, it is treated as a type AF package in this application. The objective of this review is to verify that the D2G PUSC package meets the criticality safety requirements of 10 CFR Part 71. The staff reviewed the application following the guidance provided in NUREG-2216, "Standard Review Plan for Transportation Packages for

Spent Fuel and Radioactive Material." This SER section documents the staff's evaluation of the criticality safety design of the package.

6.2 Criticality Design Description

The applicant designed the package to transport fresh fuel. The package consisted of a fuel basket and an overpack. The overpack provided protection for the content under NCT and HAC as prescribed in 10 CFR 71.71 and 71.73 respectively. The applicant provided drawings for the various components of the packaging design. The principal criticality safety design features of the package included limits on the quantity of fissile material per package and neutron poison materials in various forms.

The staff reviewed the package design description which includes the packaging and the proposed content. The staff determined that the applicant sufficiently described the package design for the staff to evaluate the criticality safety of the package under NCT and HAC. On this basis, the staff finds that the package description is acceptable and meets the 10 CFR 71.33 regulatory requirement.

6.3 Fissile Material Contents

The applicant designed the D2G PUSC to transport one D2W power unit and control elements with different fissile and neutron poison materials loads for different fuel modules. The applicant provided specifications for the fissile materials, control materials, and neutron poison materials that are essential to assure criticality safety. After reviewing the fissile material content description, the staff found that the description was specific and detailed enough for the staff to review the criticality safety analysis. On this basis, the staff finds that the fissile material content description is acceptable and meets the 10 CFR 71.33(b) requirement.

6.4 General Criticality Evaluation Considerations

The applicant developed the criticality safety analysis models based on the structural layout and dimensions of the D2W package to accurately represent the geometric dimensions of the contents and the packaging system. The applicant took the material property data used in the evaluation from American Society of Mechanical Engineers (ASME), American Society of Testing and Materials (ASTM), and NNPP documents. Based on its review of the parametric studies performed by the applicant for the various assembly types, the staff confirmed that the applicant used the most reactive D2W fuel module types with the most reactive fuel load configuration in its criticality safety calculations.

The applicant demonstrated the maximum reactivity of the D2G PUSC by sensitivity studies with respect to various parameters that are important to criticality safety and assumptions for the single package as loaded with flooded conditions, a single package under NCT, and a single package under HAC. Based on its criticality calculations and the method prescribed in 10 CFR 71.59, the applicant determined the criticality safety index (CSI) for the D2G PUSC package is 100.

6.5 Single Package Evaluation

For the single package evaluation, the applicant evaluated various flooded and damaged conditions in accordance with the applicable 10 CFR 71.55 regulatory requirements. The applicant calculated a maximum k_{eff}, with all biases and uncertainties included, less than 0.95

for the package under NCT and HAC. In Appendix A2.12.6 of Chapter A2, the applicant identified that the core may shift due to plastic deformation of the package under HAC. The applicant discussed the criticality model for the package under HAC in Section A6.3.1 of SARP Chapter A6. Within this subsection, the applicant identified that the interstitial water gaps resulting from the potential plastic deformation of the package, which were provided in Tables A6.3-4 and A6.3-5, were modeled to bound the gaps determined in the structural analyses as discussed in Appendix A2.12.6 of SARP Chapter A2.

The applicant calculated the k_{eff} value of the package under NCT assuming that the package is flooded and fully reflected with water. The applicant also included in the model potential plastic deformation of the package as determined by the structural analyses. The analysis result showed that k_{eff} value is below 0.95. Since this is consistent with the acceptance criterion provided in NUREG-2216, the staff determined that the package design meets the 10 CFR 71.55(b), (d) and (e) regulatory requirements.

6.6 Package Array Evaluation Under NCT

The applicant did not perform criticality safety analysis for an array of packages under NCT because only one package can be transported at any time as an exclusive use shipment. The staff finds that this is consistent with the 10 CFR 71.59 regulatory requirements because the size of the array is a single package.

6.7 Package Array Evaluation Under HAC

The applicant did not perform a criticality safety analysis for an array of packages under HAC because only one package can be transported in any time as an exclusive use shipment. The staff found that this is consistent with the regulatory requirements of 10 CFR 71.59 because the size of the array is a single package.

6.8 Criticality Safety Index

Following the regulations in 10 CFR 71.59, the applicant calculated the criticality safety index (CSI) for the package. Because a single package under both NCT and HAC is demonstrated to be subcritical, the number “N” is 0.5 and CSI=50/N following the method prescribed in 10 CFR 71.59(b). Therefore, the applicant determined that the CSI for this package is 100 (CSI=50/0.5=100).

The staff reviewed the applicant’s CSI value determination and found that the applicant followed the method prescribed in 10 CFR 71.59(a) and 71.59(b) for determining the CSI for the package. Because the CSI is 100, the package must be transported in exclusive transport mode per the 10 CFR 71.59(c)(3) regulatory requirement.

6.9 Computer Code and Cross Sections

The applicant used a transport theory-based computer code, named MC21, that the Navy developed internally for its specific applications. The computer code used a Monte Carlo solution method to solve the neutron transport equation. The staff reviewed the description of the computer code and found it acceptable because the code has been extensively validated as discussed in section 6.10 of this SER.

The applicant developed its own cross section library based on the combination of ENDF/B-VII, JEFF-3.1 and JENDL-4.0. The staff found this acceptable because it is a common practice for criticality safety analysts to utilize cross sections from multiple data sources to supplement the main cross sections for some elements. On this basis, the staff finds that the cross sections used by the applicant are appropriate and acceptable.

6.10 Computer Code and Cross Sections

The applicant provided an extensive benchmark evaluation using two sets of critical experiments. One set consisted of 135 critical experiments selected from the International Criticality Safety Benchmark Evaluation Project (ICSBEP) Handbook and the other set consisted of 200 naval mockups, prototypes, and shipboard cores. The applicant determined the bias and uncertainties associated with the code and cross sections via code benchmarking.

The staff reviewed the applicant's code benchmarking analyses and finds that the method employed is consistent with the recommendations in American Nuclear Society 8.1 and meets the acceptance criterion of NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material" for criticality safety analysis code benchmarking. In particular, the second set provided experiments that are very relevant in terms of area of applicability. On this basis, the staff finds that the applicant's code benchmarking analysis is appropriate and acceptable.

6.11 Evaluation Finding

Since the resulting k_{eff} values for the evaluated system under both NCT and HAC were confirmed through the applicant's analysis to be less than 0.95, the staff concluded that the Model D2G PUSC containing a full load of D2W fuel modules under the conditions listed in the Certificate of Compliance meets the criticality safety requirements in 10 CFR Part 71.

7.0 MATERIALS EVALUATION

7.1 Codes and Standards

The applicant largely adopted military standards, including those of the NNPP, to design the packaging. Additionally, the applicant adopted codes and standards from the American Society of Mechanical Engineers Boiler & Pressure Vessel Code (ASME BPVC) (Section III) and ASTM International. The staff finds the codes and standards acceptable because the use of military standards, as well as industry consensus codes and standards, is consistent with the guidance in NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material."

7.2 Weld Design and Inspection

The applicant fabricated welds, including full penetration welds, in accordance with military codes and ASME BPVC (Section III). In addition, the applicant examined and tested all welds using liquid penetration, magnetic particle, ultrasonic, radiography examinations and leakage tests as appropriate. The staff finds the welding criteria acceptable because military standards, as well as industry consensus codes and standards, provide adequate controls for the fabrication, examination, and testing of welds.

7.3 Mechanical Properties

The Bill of Materials referenced ASTM standard materials, U.S Military Standard grades, and ASME BPVC materials for low carbon steel, stainless steel, and nickel-based alloys. The staff reviewed the mechanical properties used in the structural analyses and confirmed that they are consistent with the standards for materials listed above. In addition, the staff confirmed that appropriate testing was performed to ensure that structural materials have sufficient fracture toughness. Therefore, the staff finds the mechanical properties acceptable.

7.4 Thermal Properties of Materials

The staff confirmed that the material properties used in the thermal analyses are consistent with values in the ASME BPVC, military standards, and ASTM standards. The applicant demonstrated that material melting points are sufficiently high for the intended application. In addition, the applicant provided test data that demonstrated the silicon elastomer seals are thermally stable. Therefore, the staff finds the thermal properties to be acceptable.

7.5 Corrosion Resistance

The staff reviewed the package design to confirm that adverse chemical and galvanic reactions of the contents, as well as between the contents and packaging materials, are adequately precluded. The staff noted that the package design included coatings of all materials that may be susceptible to corrosion. In addition, the applicant conducted visual inspections to verify the absence of any degradation phenomena associated with the contents and the packaging materials. Also, the applicant used lubricants that conform to military standards to ensure that no adverse reactions occurred between the lubricant and the material lubricated. Therefore, based on the staff's review of the package design, the applicant's controls for preventing adverse reactions, and the visual inspection results, the staff finds that the applicant adequately addressed the potential for corrosive reactions to adversely affect the performance of the package.

7.6 Evaluation and Finding

Based on a review of the statements and representations in the application for the Navy D2G PUSC, the staff finds that the applicant adequately described and evaluated the materials performance of the package, and the materials are acceptable. Therefore, the staff concludes that the package meets the materials requirements of 10 CFR Part 71.

8.0 PACKAGE OPERATIONS

The objective of this review is to verify that the operating controls and procedures meet the requirements of 10 CFR Part 71 and are adequate to assure that the package will be operated in a manner consistent with its evaluation for approval.

8.1 Package Loading

The applicant specified that the package user employ procedures for loading the contents. The applicant required the package user's procedures to cover operations such as handling the package, inspecting components (seals, plugs, etc.) and replacing components which showed signs of deterioration. The applicant also provided toque values for bolts, screws, etc. that the package user needed to install. In addition, the applicant identified special instructions to be

incorporated into the package user's procedures. After reviewing the package loading instructions, the staff finds that they are appropriate and adequate for the purposes of ensuring the package is operated in a manner consistent with the package analyses in the application.

8.2 Package Unloading

The applicant specified that the package user employ procedures for unloading the contents. The applicant required the package user's procedures to cover operations such as receipt inspection, handling the package, venting the package, inspecting components (seals, plugs, etc.) and replacing components which showed signs of deterioration. The applicant also provided toque values for replacement components (e.g., bolts or plugs) that the package user might need to replace as well as administrative controls to prevent package lifting and tie down points from being used for this purpose during transit because the lifting and tie down points did not meet the requirements of 10 CFR 71.45(a) and 10 CFR 71.45(b). In addition, the applicant identified special instructions to be incorporated into the package user's procedures. After reviewing the package unloading instructions, the staff finds that they are appropriate and adequate for the purposes of ensuring the package is operated in a manner consistent with the package analyses in the application.

8.3 Preparation of Empty Package for Transport

The applicant required the package user to check the package internals for foreign objects, inspect seals and replace seals which showed signs of deterioration. The applicant also provided toque values for installing bolts after seal replacement. The applicant directed the package user to install both a security seal and hardware fastening the PUSC to the railcar conveyance as well as to confirm the presence of both the security seal and the hardware that fastened the PUSC to the railcar conveyance prior to shipment. In addition, since a PUSC might not be transported for some time after being loaded, the applicant also directed the package user to pressurize the PUSC with nitrogen and to monitor the amount of nitrogen in the PUSC using a pressure gauge. After reviewing the package unloading instructions, the staff finds that they are appropriate and adequate for the purposes of ensuring the package is operated in a manner consistent with the package analyses in the application.

8.4 Evaluation Findings

Based on the statements and representations contained in the application, the staff finds that the operations have been adequately described and evaluated, and the Model No. D2G PUSC package meets the requirements of 10 CFR Part 71.

9.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM REVIEW

The applicant provided acceptance testing information to demonstrate that each packaging is fabricated consistent with the package evaluation in SARP chapters A2 through A6, and maintenance information to assure that the package maintains its ability to meet the regulatory requirements throughout its service life.

9.1 Acceptance Tests

The applicant performed non-destructive examinations of welds (e.g., magnetic particle). The applicant also required the following tests be performed to confirm that components met the necessary acceptance criteria: pressure tests, evacuation tests, pressure relief tests, leakage

tests and purging tests. Because some components are fabricated from brittle material, the applicant identified on which components Charpy V-notch testing would be performed as well as the acceptance criteria. For components excepted from Charpy V-notch testing, the applicant performed other tests to confirm the components would function as intended. In addition, the applicant utilized stress relief techniques on welds associated with brittle materials. After reviewing the acceptance tests and acceptance criteria, the staff finds that they are appropriate and adequate for the purposes of ensuring the package is fabricated in a manner consistent with the package analyses in the application.

9.2 Maintenance Program

The applicant specified that O-rings, sealing surfaces and threaded components are examined during all handling operations. The applicant committed to performing magnetic particle tests on both the PUSC lift lug base material and welds every third loaded shipment. The applicant also identified the repair procedures to be employed if the magnetic particle tests identified flaws requiring rework. The applicant stated that pressure relief valves would be periodically tested. The applicant specified the conditions that would require leak test performance, provided the leak test methodology and the steps to be performed if the leak test failed. In addition to providing remediation steps if a leak test failed, the applicant also maintained the option of utilizing a continuous nitrogen supply. After reviewing the maintenance programs, the staff finds that these maintenance programs provide adequate assurance that the package will continue to meet the regulatory requirements over the course of its service life in a manner that is consistent with the package analyses in the application.

9.3 Evaluation Findings

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. D2G PUSC package meets the requirements of 10 CFR Part 71.

CONDITIONS

In addition to the authorized contents listed in Section 1.2 and the drawings listed in Section 1.4 of this SER, the CoC includes the following conditions of approval:

Condition No. 6: Shipment of D2W power units in the D2G PUSC is limited to a lowest service temperature of 20°F. The package must not be shipped unless the forecast minimum temperature for the period of the shipment is greater than this lower service temperature.

Condition No. 7: The package shall be prepared for shipment and operated in accordance with the Operating Procedures in Chapter 7.0 of the application, and each packaging shall be tested and maintained in accordance with the Acceptance Tests and Maintenance Program in Chapter 8.0 of the application.

Condition No. 8: Air transport of a D2G PUSC loaded with fissile material is not authorized.

Condition No. 9: Expiration date: June 30, 2026.

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. D2G PUSC package meets the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9798, Revision No. 0
on {{date:long}}.