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Technical Review Report for the Mound 1KW Package Safety Analysis Report for Packaging Waiver for the Use of Modified Primary Containment Vessel (PCV)

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Disclaimer

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Technical Review Report
for the
Mound 1KW Package
Safety Analysis Report for Packaging
Waiver for the Use of Modified Primary Containment Vessel (PCV)
R1033-0064-ES-00

Docket 08-03-9516

LLNL-TR-405706

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Packaging and Transportation Safety Group
Lawrence Livermore National Laboratory

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Overview

This Technical Review Report (TRR) documents the review, performed by the Lawrence Livermore National Laboratory (LLNL) staff, at the request of the U.S. Department of Energy (DOE), on the *Waiver for the Use of Modified Primary Containment Vessels (PCV)*.[1] The waiver is to be used to support a limited number of shipments of fuel for the Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) Project in support of the National Aeronautics and Space Administration's (NASA's) Mars Science Laboratory (MSL) mission. Under the waiver, an inventory of existing national security PCVs will be converted to standard PCVs. Both types of PCVs are currently approved for use by the Office of Nuclear Energy. LLNL has previously reviewed the national security PCVs under *Mound 1KW Package Safety Analysis Report for Packaging, Addendum No. 1, Revision c*, dated June 2007 (Addendum 1).[2] The safety analysis of the package is documented in the *Safety Analysis Report for Packaging (SARP) for the Mound 1KW Package* (i.e., the Mound 1KW SARP, or the SARP) where the standard PCVs have been reviewed by LLNL.[3] The Mound 1KW Package is certified by DOE Certificate of Compliance (CoC)[4] number USA/9516/B(U)F-85 for the transportation of Type B quantities of plutonium heat source material. The waiver requests an exemption, claiming safety equivalent to the requirements specified in 10 CFR 71.12, *Specific Exemptions*,[5] and will lead to a letter amendment to the CoC.

Under the waiver, the Office of Radioisotope Power Systems, NE-34, is seeking an exemption from 10 CFR 71.19(d)(1), *Previously Approved Package*,[5] which states:

> "(d) NRC will approve modifications to the design and authorized contents of a Type B package, or a fissile material package, previously approved by NRC, provided—
> (1) The modifications of a Type B package are not significant with respect to the design, operating characteristics, or safe performance of the containment system, when the package is subjected to the tests specified in §§ 71.71 and 71.73…"

The LLNL staff had previously reviewed a request from Idaho National Laboratory (INL) to reconfigure national security PCVs to standard PCVs.[6,7] With a nominal 50% reduction in both the height and the volume, the LLNL staff initially deemed the modifications to be *significant*, which would not be allowed under the provisions of 10 CFR 71.19(d)(1)—see above. As a follow-up, the DOE requested additional clarification from the Nuclear Regulatory Commission (NRC). The NRC concluded that the reconfiguration would be a new *fabrication*, and that an exemption to the regulations would be required to allow its use,[8] as per the requirements specified in 10 CFR 71.19(c)(1), *Previously Approved Package*:

> "(c) A Type B(U) package, a Type B(M) package, or a fissile material package previously approved by the NRC with the designation "-85" in the identification number of the NRC CoC, may be used under the general license of §71.17 with the following additional conditions:

(1) Fabrication of the package must be satisfactorily completed by December 31, 2006, as demonstrated by application of its model number in accordance with 71.85(c)…"

Although the preferred approach toward the resolution of this issue would be for the applicant to submit an updated SARP, the applicant has stated that the process of updating the Model Mound 1KW Package SARP is a work that is in progress, but that the updated SARP is not yet ready for submittal. The applicant has to provide a submittal, proving that the package meets the "-96" requirements of International Atomic Energy Agency (IAEA) Safety Standards Series No. TS-R-1,[9] in order to fabricate approved packagings after December 31, 2006. The applicant has further stated that all other packaging features, as described in the currently approved Model Mound 1KW Package SARP,[3] remain unchanged.

This report documents the LLNL review of the waiver request.[1] The specific review for each SARP Chapter is documented below.

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Chapter 1: General Information

This section of the TRR covers the review of the General Information, Chapter 1. The applicant requests a waiver for the reconfiguration of the longer national security PCVs to the standard PCVs as is described in the subsequent paragraphs.

Description of the Waiver

NE-34, Radioisotope Power Systems, Office of Nuclear Energy, proposes a modification of the existing national security PCVs (Drawing No. R1033-0069-ED-00) [Figure 1] to the specifications of the standard PCVs (Drawing No. R1033-0019-ED-01) [Figure 2] to meet the shipping requirements of NE-34. The standard PCVs and the national security PCVs are essentially identical in design except that the standard PCV is 5.75 inches in length and the national security PCV is 11.16 inches in length.

Steps to reconfigure the longer PCVs to the standard length PCVs would include machining the weld joint, machining a new cutting groove, and updating the laser etching on the can and lid. The existing weld, attaching the bottom lid to the body is not altered. The modification is to an approved design already accepted under the current SARP for the Model Mound 1KW Package. Drawings for the PCVs call for laser-marking the Drawing Number and Serial Number on the inside and outside of the body, in addition to laser marking the vessel lid. The parts will have to be laser-marked once again since the modified PCVs will now conform to a different Drawing Number and have different Serial Numbers.

Traceability will have to be provided back to the Quality Assurance (QA) records for materials, welding, etc., since the Drawing Numbers and Serial Numbers will have changed in the modification process. The listing of Hardware Numbers and Serial Numbers, shown in Attachment 4 (PCF-07-4738), Mound 1 KW Package Containment Vessel Hardware Serial Numbers, of Addendum 1 (R1033-0064-ES-00), Revision c,[2] to the SARP will have to be updated.

Basis for Relief

NE-34 manufactured a number of components for the Model Mound 1KW Packaging during the fall of 2006, based on projected program needs. NE-34 envisioned a multi-year need for taller PCVs to support a national security program. Subsequently, a sizeable quantity of Russian fuel

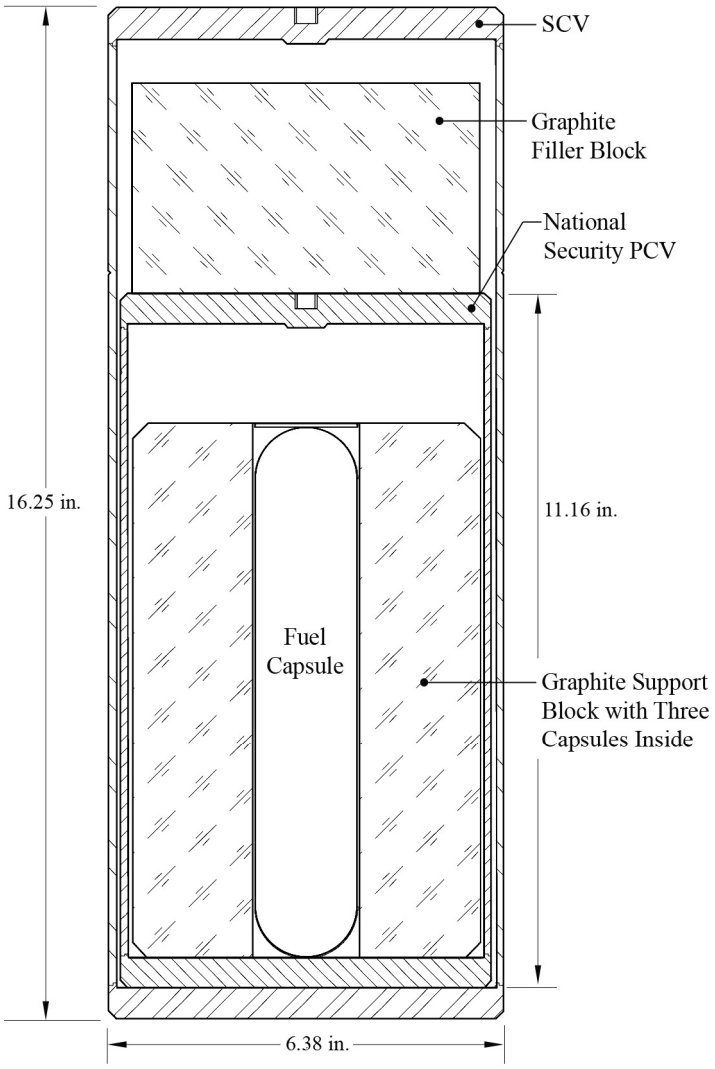

Figure 1. Fueled Capsule Assembly Payload [Showing the National Security PCV] (Figure 1.2.3-3 in Reference 2 of this TRR).

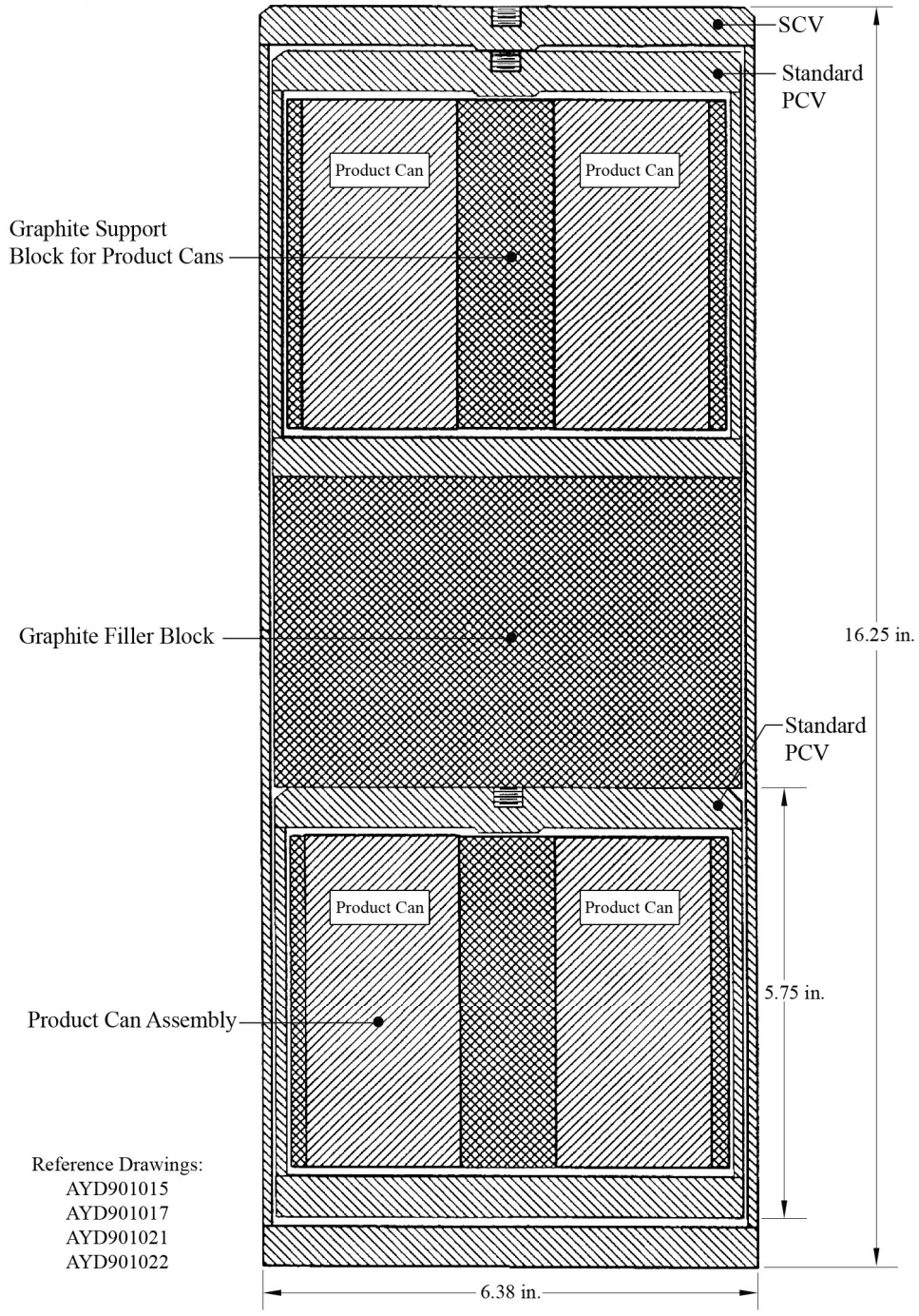

Figure 2. Product Can Containment Assembly [Showing the Standard PCV] (Figure 1.5 in Reference 3 of this TRR).

was made available for shipment, and the shipment required nearly all of the standard PCVs in the inventory. These standard PCVs had originally been slated to be used to ship fuel for the Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) Project in support of National Aeronautics and Space Administration's (NASA) Mars Science Laboratory (MSL) mission. Although standard PCVs are no longer available for this shipment, changes in the national security program have resulted in the availability of national security PCVs remaining in the NE-34 inventory. These taller PCVs can enable NE-34 to make a May 2008 shipment once they have been modified to the standard PCV size. Authorization to reconfigure a number of the taller PCVs would provide improved support to DOE programs using the Model Mound 1 KW Package, as well as provide more efficient use of DOE hardware. The taller PCVs were also available because of the ability to ship three, Fuel Clad Assemblies (FCAs), rather than two, per taller PCV for a separate program.

Description of Fuel in the Radioisotope Thermoelectric Generator

The General Purpose Heat Source (GPHS) Fueled Clad Assemblies for the MMRTG Project are limited to 255 watts per PCV with up to eight (8) Fueled Clad Assemblies per PCV. The GPHS Fueled Clad Assemblies consist of a plutonium dioxide fuel pellet in a roughly one-inch cube, clad in an iridium capsule. The plutonium dioxide isotopic composition is given in the table below.

Plutonium Initial Isotopic Limits

	^{236}Pu (ppm)	^{238}Pu (wt %)	^{239}Pu+ ^{241}Pu (wt %)	other ΣPu (wt %)	^{241}Am (wt %)	^{237}Np (wt %)	U (wt %)	ΣTh (wt %)
Source Specification	≤2.0	74–90	25.5–8.4	≤4.0	≤0.3	≤1.0	≤10	≤0.5

Findings

Based on the review of the information, statements, and representations in the waiver request, the staff has concluded that there should be no safety-related issues associated with the granting of this request.

Conditions of Approval

Because there should be no safety-related issues associated with the granting of this request, the staff recommends that this request be approved under the provision of 10 CFR 71.12,[5] i.e.,

> "On application of any interested person or on its own initiative, the Commission may grant any exemption from the requirements of the regulations in this part that it determines is authorized by law and will not endanger life or property nor the common sense and security."

The staff further recommends that the request be granted for a limited time, only. The staff also recommends that the applicant be required to submit an updated SARP for the Model Mound 1KW Package—within a pre-specified time frame—an updated SARP that demonstrates full compliance with the current regulations specified in 10 CFR 71. The staff finally recommends that, because, all three (3) of the above recommendations can be invoked through the issuance of

a letter amendment to the CoC, no additional conditions of approval need to be added to the existing CoC[4] for the approval of this request. However, the Conditions of Approval in Chapters 7 and 9 must also be fulfilled.

Chapter 2: Structural Evaluation

This section covers the assessment of the Structural Evaluation information provided in Chapter 2.

Findings

Based on the review of the information, statements, and representations in the waiver request, the staff has concluded that there should be no safety-related issues associated with the granting of this request.

Conditions of Approval

The staff has concluded that no additional structurally-related conditions of approval need to be added to the existing CoC[4] for the approval of this request.

Chapter 3: Thermal Evaluation

This section covers the assessment of the Thermal Evaluation information provided in Chapter 3.

Findings

Based on the review of the information, statements, and representations in the waiver request, the staff has concluded that there should be no safety-related issues associated with the granting of this request.

Conditions of Approval

The staff has concluded that no additional thermally-related conditions of approval need to be added to the existing CoC[4] for the approval of this request.

Chapter 4: Containment Evaluation

This section covers the assessment of the Containment Evaluation information provided in Chapter 4.

Findings

The Model Mound 1KW Package was originally certified under the requirements of 10 CFR 71 (1983),[10] and later recertified under the requirements of 10 CFR 71 (1996).[11] As a consequence, the Mound 1KW Package includes a double-containment system, as was required by the earlier regulatory requirements for plutonium oxide shipments. Since the applicant has not requested any relief from the double-containment requirements of 10 CFR 71.63 (1983) and/or 10 CFR 71.63 (1996), the older, double-containment requirements for plutonium oxide shipments are still applicable. Based on the review of the information, statements, and representations in the waiver request, the staff has concluded that there should be no safety-related issues associated with the granting of this request.

Conditions of Approval
The staff has concluded that no additional containment-related conditions of approval need to be added to the existing CoC[4] for the approval of this request.

Chapter 5: Shielding Evaluation

This section covers the assessment of the Shielding Evaluation information provided in Chapter 5.

Findings
Based on the review of the information, statements, and representations in the waiver request, the staff has concluded that there should be no safety-related issues associated with the granting of this request.

Conditions of Approval
The staff has concluded that no additional shielding-related conditions of approval need to be added to the existing CoC[4] for the approval of this request.

Chapter 6: Criticality Evaluation

This section covers the assessment of the Criticality Evaluation information provided in Chapter 6.

Findings
Based on the review of the information, statements, and representations in the waiver request, the staff has concluded that there should be no safety-related issues associated with the granting of this request.

Conditions of Approval
The staff has concluded that no additional criticality-related conditions of approval need to be added to the existing CoC[4] for the approval of this request.

Chapter 7: Operating Procedures Review

This section covers the assessment of the Operating Procedures information provided in Chapter 7.

Findings
Based on the review of the information, statements, and representations in the waiver request, the staff has concluded that there should be no safety-related issues associated with the granting of this request.

Conditions of Approval
A procedure must be written to describe the conversion of the national security PCVs, manufactured prior to December 31, 2006 per Drawing Number R1033-0069-ED-00, to the standard PCVs described in Drawing Number R1033-0019-ED-01. The staff has concluded that no additional operating procedure-related conditions of approval need to be added to the existing CoC[4] for the approval of this request.

Chapter 8: Acceptance Tests and Maintenance Program Review

This section covers the assessment of the Acceptance Tests and Maintenance Program information provided in Chapter 8.

Findings

Based on the review of the information, statements, and representations in the waiver request, the staff has concluded that there should be no safety-related issues associated with the granting of this request.

Conditions of Approval

The staff has concluded that no additional acceptance test- or maintenance program-related conditions of approval need to be added to the existing CoC[4] for the approval of this request.

Chapter 9: Quality Assurance Review

This section covers the assessment of the Quality Assurance information provided in Chapter 9.

Findings

Based on a review of the information, statements and representations in the waiver request, the staff concludes that the Quality Assurance program has been adequately described, and meets the quality assurance requirements of Subpart H of 10 CFR 71. Package-specific requirements are adequate to assure the package is designed, fabricated, assembled, tested, used, maintained, modified, and repaired in a manner consistent with its evaluation.

Conditions of Approval

Traceability will have to be provided back to the Quality Assurance (QA) records for materials, welding, etc. since the Drawing Numbers and Serial Numbers will change in the modification process. The listing of Hardware Numbers and Serial Numbers shown in Attachment 4 (PCF-07-4738), Mound 1 KW Package Containment Vessel Hardware Serial Numbers, of Addendum 1 (R1033-0064-ES-00), Revision c,[2] to the SARP will have to be updated. The staff has concluded that no additional quality assurance-related conditions of approval need to be added to the existing CoC[4] for the approval of this request.

References

[1[*Waiver for the Use of Modified Primary Containment Vessels (PCV)*, NE-34, Letter from Owen Lowe, Office of Nuclear Energy, to Dae Chung, Office of Environmental Management, EM-60, April 3, 2008.

[2] *Mound 1KW Package Safety Analysis Report for Packaging, Addendum No. 1, Revision c*, R1033-0064-ES-00, June 2007.

[3] *Safety Analysis Report for Packaging for the Mound 1KW Package*, USA/9516/B(U)F-85 (DOE), MLM-MU-91-64-001, Revision 7c, February 2006.

[4] U.S. Department of Energy Certificate of Compliance, USA/9516/B (U) F-85 (DOE), Revision 14, August 14, 2007.

[5] *Packaging and Transportation of Radioactive Material*, Code of Federal Regulations, Title 10 Part 71, Washington, DC (January 2006).

[6] *Request to Modify ALTB PCV Cans to Standard PCV Cans*, E-mail attachment, Dirk Cairns-Gallimore to James Shuler, October 31, 2007. *Review of Request to Modify ALTB PCV "Cans" to Standard PCV "Cans"*, Lawrence Livermore National Laboratory, November 2, 2007.

[7] *Review of Request to Modify ALTB PCV "Cans" to Standard PCV "Cans"*, Lawrence Livermore National Laboratory, November 2, 2007.

[8] *Your Help on Two Questions*, E-mail from Robert Nelson, Nuclear Regulatory Commission, to James Shuler, EM-60, March 26, 2008.

[9] *Regulations for the Safe Transport of Radioactive Material—2005 Edition—Requirements*, IAEA Safety Standards Series, No. TS-R-1, International Atomic Energy Agency, Vienna, Austria (2005).

[10] Title 10—Energy, Chapter I—Nuclear Regulatory Commission, *Final Rule: 10 CFR Part 71—Packaging of Radioactive Material for Transportation and Transportation of Radioactive Material Under Certain Conditions; Compatibility with IAEA Regulations*, 48 F.R. 35600, pp. 35600 – 35627, August 5, 1983.

[11] Nuclear Regulatory Commission, 10 CFR Part 71, *Compatibility with International Atomic Energy Agency (IAEA), Final Rule*, 60 F.R. 50248, pp. 50248–50289, September 28, 1995.