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DOE Packaging Certification Program

**Safety Evaluation Report
for
Amendment of Certificate of Compliance No. 9975
Model 9975 Package Design**

Docket No. 21-22-9975

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Date: 2021.04.21 15:26:00 -04'00'

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This Safety Evaluation Report (SER) documents the U.S. Department of Energy (DOE) Packaging Certification Program's (PCP's) independent review of an Addendum to the Safety Analysis Report for Packaging (SARP) submitted by the Savannah River Operations Office (SR) for amendment of DOE Certificate of Compliance (CoC) Number 9975 for the Model 9975 package design.

Evaluation

By email ^[1] dated March 23, 2021, the DOE CoC 9975 certificate holder, SR, requested an amendment of the CoC to authorize Gallium (Ga) as a permissible impurity for Plutonium (Pu) contents. A similar amendment was authorized by the DOE Headquarters Certifying Official (HCO) for the Model 9980 (CoC No 9980 Rev. 4, Docket 20-45-9980).

The SR request is supported by an addendum ^[2] to the SARP, prepared for SR by the Savannah River National Laboratory (SRNL). This addendum demonstrates the inclusion of Ga in the Pu contents does not negatively impact the safety basis in the SARP. Below is a summary of the DOE PCP staff's independent review of the addendum.

Chapter 1: General Information

Addendum Table 1.2, *Content Envelopes*, was revised to include a footnote 'kk' for the non-radioactive Ga material in oxide and metal Pu contents (i.e., impurities) up to 3080 grams of Gallium.

DOE PCP staff concurs with the change to the Content Envelop description in Table 1.2 and concurs that the information clarifies Ga as a permissible impurity for oxide and metal Pu contents. Staff also concurs that the mass limit for Ga of 3080 grams is consistent with the impurity limits for Pu and/or Uranium bearing contents as described in the 3013 Standard. ^[3]

Chapter 2: Structural Evaluation

DOE PCP staff concurs that the presence of Ga does not alter the evaluations of chemical and galvanic reactions in the SARP and concurs that the inclusion of Ga in the oxide and metal Pu contents does not impact the structural performance of the package.

Chapter 3: Thermal Evaluation

DOE PCP staff concurs that the oxide and metal Pu content with Ga present will remain solid and not melt. Staff also concurs that the current melting limit for Pu metal in the SARP is 752°F (SARP Table 3.5 - *Constitutive Properties of Packaging Materials*), which is from the lowest melting point Pu eutectic with Fe and Ga (as described in the DOE 3013 Standard). Since the peak temperature for any contents is 580°F (SARP Table 3.15 - *Effect of a Full-Circle Radial Gap in the Celotex Insulation in the HAC-Fire Event*, which occurs post-HAC- fire with Pu oxide), there is a large margin between the maximum Pu Content temperature and the Pu-Ga-Fe eutectic temperature.

Staff concludes that the presence of Ga as an impurity in the oxide and metal Pu contents does not adversely impact the existing thermal evaluation or conclusions in the SARP.

Chapter 4: Containment Evaluation

DOE PCP staff concurs that an addendum to the Containment Evaluation in the SARP is not required because the inclusion of Ga in the oxide and metal Pu contents does not increase the radioactivity of the contents.

Chapter 5: Shielding Evaluation

DOE PCP staff concurs that no changes were needed to the Shielding Evaluation in the SARP since Ga does not have a neutron yield via the α -n reaction and the applicant's shielding evaluation replaced any Ga (non-radioactive material) present with radioactive material for bounding calculated results. Staff concurs with the clarification that Ga is an allowable impurity in oxide and metal Pu contents and does not impact the shielding evaluation results reported for oxide and metal Pu contents in the SARP.

Chapter 6: Criticality Evaluation

Increasing percentages of Ga within Pu metal or oxide contents leads to a decrease in fissionable material density and thus a decrease in k-effective. Furthermore, Ga has a significant neutron capture cross-section. Thus, no limit on Ga below the 3080-gram impurity limit for 3013 stabilized contents is necessary.

DOE PCP staff concurs that the inclusion of Ga would have no negative impact upon the Criticality Evaluation in the SARP.

Chapter 7: Operating Procedures, Chapter 8: Acceptance Tests and Maintenance Program, and Chapter 9: Quality Assurance

DOE PCP staff concurs that the inclusion of Ga as an impurity up to 3080 grams in oxide and metal Pu contents does not impact the Operating Procedures, Acceptance Test & Maintenance Program, or Quality Assurance of the package and that no addendum is needed to these chapters of the SARP.

Based on the statements and representations contained in the addendum, DOE PCP staff independently confirmed by document review that the package design has been adequately described and evaluated in this addendum to the SARP. Therefore, staff has reasonable assurance that the regulatory requirements of 10 CFR Part 71, have been met and recommends amendment of the CoC by the DOE HCO.

Conditions of Approval

The following changes to the CoC are required to implement the modifications evaluated in this SER.

- Section 5(b)(1), *Type and Form of Material*: Table 1, *Content Envelopes*
 - Add footnote “kk” to Impurities (2 places).
 - Add “kk Gallium may be present in stabilized oxide and metal plutonium

contents up to the combined 3013 impurity limit of 3080 grams as described in footnote t unless a lower impurity limit applies to the content envelope.” to *Table 1 – Table Notes*.

- Section 5(d), Conditions: Revise (13) to “Revision 14 of this certificate may be used until April 30, 2022 for DOE domestic shipments of 9975-96 packages or for international shipments to the USA when endorsed by DOT Competent Authority Certification (certificate).”
- Section 5(e), Supplements – Add (10) Safety Analysis Report For Packaging Model 9975, Addendum, Gallium Content Clarification, S-SARA-G-00022, Revision 0, March 2021.”

Conclusion

Based on the statements and representations contained in the addendum and the conditions listed above, DOE PCP staff concludes that the package design has been adequately described and evaluated and the Model 9975 continues to meet the requirements of 10 CFR Part 71.

References

- [1] *9975 Addendum*, Email, Maxcine Maxted to Shuler, March 23, 2021.
- [2] *Safety Analysis Report For Packaging Model 9975, Addendum, Gallium Content Clarification*, S-SARA-G-00022, Revision 0, March 2021
- [3] *Stabilization, Packaging, and Storage of Plutonium-Bearing Materials*, DOE-STD-3013-2018.