Department of Energy
Washington, DC 20585

SEP 2 6 2013

MEMORANDUM FOR WILLIAM E. KILMARTIN
DIRECTOR, PROGRAM SUPPORT DIVISION
OFFICE OF FISSILE MATERIALS DISPOSITION

FROM: STEPHEN C. O'CONNOR
HEADQUARTERS CERTIFYING OFFICIAL
DIRECTOR, OFFICE OF PACKAGING AND TRANSPORTATION

SUBJECT: Authorization for Air Transport of EU in Powdered Metal Form in the ES-3100 Packaging, Docket 13-37-9315

Your request dated May 9, 2013, for air transport of up to eleven ES-3100 shipping containers to transport enriched uranium (EU) metal alloy powder is approved with the conditions specified in this Letter of Authorization and Department of Energy (DOE) Certificate of Compliance (CoC) Number 9315, Revision 5. Your request for this transport has been reviewed and approved based on the attached Safety Evaluation Report. The shipper must meet all conditions of the DOE CoC and the additional conditions listed below:

- The EU-metal alloy powder is uranium/molybdenum alloy (U/Mo) with about 8 wt% Mo, and a nominal enrichment of 19.75%.
- The EU metal alloy powder shall be packaged in Teflon bottles and each Teflon bottle shall be placed in a metal convenience can.
- Each single Teflon bottle contains no more than 4 kg of U/Mo alloy (0.73 kg U-235) and no more than three Teflon bottles can be shipped in a single ES-3100 package, i.e., no more than 12 kg of U/Mo metal allow powder (net weight) per ES-3100 package.
- The Criticality Safety Index shall be based on Table 1.3 of the CoC under the category of broken metal. The 0.73 kg U-235 limit does not include the non-uranium portion of the alloy that must be treated as U-235.
- For air shipment of highly enriched uranium in powdered metal form in the ES-3100 package, the Teflon bottle, the metal convenience can, and the containment vessel shall be inerted with argon gas of high purity (> 99%) and with low moisture (< 5 ppm moisture).

This authorization expires on August 30, 2014.

If you have any questions, please call me at (301) 903-7854, or Dr. James M. Shuler of my staff at (301) 903-5513.

Attachment

cc w/att.:
Kenneth E. Sanders, NA-261
Yung Liu, ANL
Jeff Arbital, Y-12

Safety Evaluation Report for Letter Amendment Request to Ship EU in Powdered Metal Form in the ES-3100 Package

Docket No. 13-37-9315

Prepared by: _____ Date: 9/26/13

James M. Shuler
Manager, DOE Packaging Certification Program
Office of Packaging and Transportation

Approved by: _____ Date: SEP 26, 2013

Stephen C. O'Connor
Headquarters Certifying Official
Director, Office of Packaging and Transportation

SUMMARY

The National Nuclear Security Administration (NNSA), Office of Defense Nuclear Nonproliferation (NA-20) submitted a letter[1] dated May 9, 2013, requesting that the Department of Energy (DOE) issue a Letter Amendment to the Certificate of Compliance (CoC) Number 9315, Rev 5., Package Identification No. USA/9315/B(U)F-96(DOE),for the Model ES-3100.

In this letter, NA-20 requested a special authorization for a one-time shipment of enriched uranium (EU) in a powdered metal alloy form by air transport mode. The shipment will consist of up to eleven (11) ES-3100 packages carrying EU metal alloy powder. The EU metal alloy powder is uranium/molybdenum alloy (U/Mo) with a nominal U-235 enrichment of 19.75%, and about 8 wt.% Mo. The EU metal alloy powder will be packaged in Teflon bottles; up to three (3) Teflon bottles can be shipped in a single ES-3100 package, and each single Teflon bottle shall contain no more than 4 kg of U/Mo alloy (0.73 kg U-235). In total, a maximum of 12 kg of EU metal alloy powder can be shipped per ES-3100 package, which equates 11.04 kg of uranium with 2.18 kg U-235 per package. The existing criticality analyses in the Safety Analysis Report for Packaging (SARP)[2] only analyzed small quantities of EU metal and alloy powder in a single ES-3100 package for air transport; therefore, the letter amendment requests includes additional criticality safety analysis results[3] for EU metal alloy powder. For pyrophoricity considerations, the Teflon bottles are sealed with argon cover gas and the bottles are placed in metal convenience cans prior to loading into the ES-3100 containment vessel (CV), which are also inerted with argon gas before closure the CV.

On the basis of the statements and representations in the request for Letter Amendment and the additional criticality safety analysis results, and the DOE Packaging Certification Program (PCP) staff's confirmatory evaluation as summarized in this Safety Evaluation Review Report (SER), PCP staff finds that the request for a single air shipment of eleven (11) ES-3100 packages with up to 12 kg EU metal alloy powder per package acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

PCP has concluded that the following two (2) conditions of approval are needed pursuant to the approval of the request for Letter Amendment, as follows:

1. *For air shipment of highly enriched uranium in powdered metal form in the ES-3100 package, the Teflon bottles, the metal convenience cans and the containment vessel shall be inerted with argon of high purity (>99%) and with low moisture (<5 ppm moisture).*

2. *Each single Teflon bottle contains no more than 4 kg of U/Mo alloy (0.73 kg U-235) and no more than three Teflon bottles can be shipped in a single ES-3100 package.*

1. GENERAL INFORMATION AND DRAWINGS

Detailed packaging descriptions, drawings and contents can be found in the SARP. The components of the packaging include a drum enhanced by impact-limiting and thermal-insulating materials, neutron-absorbing materials, and a CV inside the drum. The payload in the CV is contained in Teflon bottles placed in convenience cans to prevent contamination of the interior surface of the CV.

The content in the request for Letter Amendment is covered in Table 1.3b of the SARP under content category of "HEU metal or alloy."

Criticality Safety Index

On the basis of the results of the criticality safety analysis presented in Reference 3, PCP staff has confirmed, using the procedure in 10 CFR 71.59(b), that the Criticality Safety Index (CSI) values are 0.0, 0.4, 0.8, 2.0, and 3.2 for the ES-3100 package with EU metal alloy powder and with the loading limits listed in Tables 1.3 and 1.3b of the SARP.

Radiation Level and Transport Index

PCP staff has confirmed that the radiation transport index (TI) for the EU metal alloy powder content is less than 4.9, the TI calculated for 24 kg HEU oxide, which is less than 10, the TI limit in 10 CFR 71.47(a) for non exclusive use shipment. The actual TI of the ES-3100 package will be determined by measurement prior to shipment.

On the basis of the statements and representations in the request for Letter Amendment and the SARP Revision 0 with Page Change 4, and the PCP staff's confirmatory evaluation, the PCP staff finds the general information and drawings of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

Evaluations of design and performance of the package for safety and regulatory compliance in structural, thermal, containment, shielding, criticality safety, operating procedures, acceptance tests and maintenance, and quality assurance are provided in the remaining sections of this SER.

2. STRUCTURAL

2.1 Discussion

PCP staff performed a review of the structural design and performance of the ES-3100 package for air transport of the EU metal alloy powder packed in Teflon bottles, as described in the request for Letter Amendment. The PCP staff also reviewed the material compatibility between the EU metal alloy powder and the packaging components.

2.2 Structural Evaluation

The amount of EU metal alloy powder for air transport is no greater than 12 kg per package, which is bounded by the radioactive content weight limit of 35.2 kg of the ES-3100 HEU

package. Therefore, the structural evaluation in the original SARP remains valid. The enhanced structural tests described in 10 CFR 71.55(f)(1) and (2) for air transport of fissile material packages were not conducted for the ES-3100 package, which means the condition of the package following the tests cannot be determined. Therefore, worst-case assumptions regarding the geometric arrangement of the package and contents were made for criticality analysis, taking into account all moderating and structural components of the packaging (See Chapter 6 of this SER). This is consistent with the anticipated results in the mechanical and thermal tests specified in 10 CFR 71.55(f)(1) and (2).

For air transport, IAEA TS-R-1, Paragraph 618, requires that packages maintain integrity of containment when exposed to ambient temperatures ranging from -40°C (-40 °F) to +55°C (131°F), and Paragraph 619 requires that packages be capable of withstanding, without leakage, an internal pressure that produces a pressure differential of not less than maximum normal operating pressure (MNOP) plus 95 kPa (13.78 psi). The condition for calculating MNOP for air transport is an ambient temperature of 55°C (131°F) in still air without solar insolation (IAEA TS-G-1.1, Paragraph 619.3). The calculated MNOP for air transport is 198.43 kPa (28.78 psi) at an ambient temperature of 55°C (131°F) and a CV temperature of 63.4°C (146.11°F). The CV was then evaluated at a pressure differential of 293.43 kPa (42.56 psi), and the results show that the structural integrity of the CV can be maintained.[2]

The EU metal alloy powder is packed in Teflon bottles, and the Teflon bottles are placed in convenience cans; therefore, there is no material incompatibility between the contents and the packaging components.

2.3 Conclusion

On the basis of the statements and representations in the request for Letter Amendment, the SARP Revision 0 with Page Change 4, and the PCP staff's confirmatory evaluation, the PCP staff finds the structural design and performance of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

3. THERMAL

3.1 Discussion

The PCP staff performed a review of the thermal design and performance of the ES-3100 package for air transport of the EU metal alloy powder packed in Teflon bottles, as described in the request for Letter Amendment. The PCP staff also reviewed Appendix 1.3.8 "Pyrophoricity of Uranium Metal" of the ES-3100 SARP. The review and evaluation was focused on the potential pyrophoricity of ultrafine uranium metal powders for air shipment.

3.2 Thermal Evaluation

The content of the air shipment is EU metal alloy powder. The EU powder is U/Mo alloy with a nominal U-235 enrichment of 19.75%, and about 8 wt.% Mo. This shipment will use Teflon bottles to contain the fine EU metal alloy powder with up to 4 kg in each Teflon bottle placed inside a convenience can. The Teflon bottles, the metal convenience cans and the CV are to be inerted using argon cover gas.

Fine uranium powder can ignite easily. Moreover, spontaneous ignition of fine uranium powders is possible under water and even in a moist argon atmosphere (See page 534 in *Handbook of Non-Ferrous Metal Powders: Technologies and Applications*, O.D. Neikov et. al., 2009). Appendix 1.3.8 of the SARP on page 1-188 addresses this issue of pyrophoricity of fine uranium powders by inerting with a high-purity (>99%) argon cover gas containing low moisture (< 5 ppm moisture). The PCP staff reviewed the information in the aforementioned handbook and verified an acceptable inerting method.

3.3 Conclusion

On the basis of the statements and representations in the request for Letter Amendment, the SARP Revision 0 with Page Change 4, and the PCP staff's confirmatory evaluation, the PCP staff finds the thermal design and performance of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

The PCP staff concluded that the following condition of approval is needed pursuant to the approval of the request for Letter Amendment:

"For air shipment of highly enriched uranium in powdered metal form in the ES-3100 package, the Teflon bottles, the metal convenience cans and the containment vessel shall be inerted with argon of high purity (>99%) and with low moisture (<5 ppm moisture)."

4. CONTAINMENT

4.1 Discussion

The PCP staff performed a review of the containment design and performance of the ES-3100 package for air transport of the EU metal alloy powder packed in Teflon bottles, as described in the request for Letter Amendment. The PCP staff also reviewed Appendix 1.3.8 "Pyrophoricity of Uranium Metal" of the ES-3100 SARP. The review and evaluation was focused on the pyrophoricity of uranium metal powders in the presence of water (vapor).

4.2 Containment Evaluation

Appendix 1.3.8 of the SARP concludes that the thermal stability criterion as formulated (Equation 7, page 1-184, and associated discussion in the appendix) is satisfied for the ES-3100 package for temperatures at or above the ambient condition of T0. However, the ambient temperature for air transport within the cargo holds may be well below T0, depending on the altitude of the aircraft, e.g., -56.5°C at 36000 ft (11 km) [International Organization for Standardization, Standard Atmosphere, ISO 2533:1975]. For these lower temperatures (but above 0°C) and basing on the assumptions used in the appendix (relative humidity 100% at T0), liquid water may form by condensation on the internal material surfaces of the package including the U metal particles. The reaction of U metal particles with liquid water film on their surfaces at temperatures below 300K has not been included in the stability analysis presented in Appendix 1.3.8.

The reaction of uranium metal with anoxic liquid water (i.e., free of dissolved oxygen) below 350°C forms uranium dioxide (UO_2) and H_2 [C.H. Delegard and A.J. Schmidt, "Uranium Metal Reaction Behavior in Water, Sludge, and Grout Matrices," PNNL-17815, 2008]. The UO_2 layer formed is not protective as it tends to spall off after a short time. The activation energy of the reaction rate of U metal with anoxic liquid water is 68.2 kJ/mol, which is significantly smaller than 95.5 kJ/mol — the activation energy of the reaction rate of U metal with unsaturated water vapor in Appendix 1.3.8. The difference in reaction rates becomes more significant as temperature decreases. The impact on thermal stability of the package arising from the potential presence of liquid water has not been addressed in Appendix 1.3.8. However, the potential presence of liquid water within the package is only relevant for low temperature environment such as during air transport. These issues can be mitigated by inerting the CV with argon of high purity (>99%) and with low moisture (<5 ppm moisture).

4.3 Conclusion

On the basis of the statements and representations in the request for Letter Amendment, the SARP Revision 0 with Page Change 4, and the PCP staff's confirmatory evaluation, the PCP staff finds the containment design and performance of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

PCP concluded that the following condition of approval is needed pursuant to the approval of the request for Letter Amendment:

"For air shipment of highly enriched uranium in powdered metal form in the ES-3100 package, the Teflon bottles, the metal convenience cans and the containment vessel shall be inerted with argon of high purity (>99%) and with low moisture (<5 ppm moisture)."

5. SHIELDING

5.1 Discussion

The PCP staff performed a review of the shielding design and performance of the ES-3100 package for air transport of the EU metal alloy powder packed in Teflon bottles, as described in the request for Letter Amendment. The amount of EU metal alloy powder for air transport is no greater than 12 kg, which is bounded by the radioactive content weight limit of 35.2 kg of the ES-3100 HEU package. Therefore, the shielding evaluation in the original SARP remains valid.

5.2 Conclusion

On the basis of the statements and representations in the request for Letter Amendment and the SARP Revision 0 with Page Change 4, and the PCP staff's confirmatory evaluation, the PCP staff finds the shielding design and performance of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

6. CRITICALITY

6.1 Discussion

PCP staff performed a review of the criticality design and performance of the ES-3100 package for air transport of the EU metal alloy powder packed in Teflon bottles, as described in Reference 3 of this SER, and the ES-3100 SARP. The PCP staff also performed Monte Carlo analyses to independently confirm the criticality safety under the most reactive conditions during normal conditions of transport (NCT) and hypothetical accident conditions (HAC) for the shipment.

6.2 Package Description

The ES-3100 package design includes a stainless steel CV inside a 30-gallon outer drum (See Figures 1.1 and 1.2 of the SARP). The EU metal alloy powder is packed in Teflon bottles and placed in metal convenience cans. The package includes two features intended for criticality control: neutron absorber that surrounds the CV and can spacers placed between convenience cans, both filled with alumina borated cement. The drawings included in the SARP provide the dimensions of the relevant packaging components. Chapter 2 of the SARP provides material specifications for the packaging components.

Descriptions of the ES-3100 package design features include identification of packaging materials, densities and compositions of packaging materials, and the fissile/fissionable material forms, masses, and isotopic compositions of the payloads. The PCP staff confirmed that criticality-related information in the SARP is complete and representative of the actual materials specified for the ES-3100 package.

Contents

The contents of the ES-3100 package include various forms of uranium metal, uranium alloys, uranium oxides, uranyl nitrate hydrate, uranium compounds, and unirradiated TRIGA fuel elements (See Tables 1.3, 1.3a, and 1.3b of the SARP for loading limits). The content for the proposed shipment in the request for Letter Amendment consists of up to eleven (11) ES-3100 shipping packages carrying enriched uranium/molybdenum metal alloy in powder form. Approximately 12 kg of alloy will be shipped per ES-3100. This equates to approximately 11.04 kg of uranium with approximately 2.18 kg of U-235 per ES-3100 for the stated 19.75% U-235 enrichment in the uranium.

Content in the form of EU metal alloy powder requires a separate analysis because certain assumptions used to derive limits for other forms of HEU metal, such as broken pieces, are not applicable to EU metal alloy powder.

Reference 3 of this SER lists the results of criticality safety calculations for the proposed U/Mo metal alloy powder content. The PCP staff confirmed that the models used in those criticality calculations are consistent with the drawings and the detailed package description given in the SARP.

6.3 Criticality Models

The single package, NCT and HAC array calculations for the proposed uranium metal alloy powder were based on detailed KENO V.a models of the ES-3100 package and payload and on a variety of array configurations.

The Standard Composition Library and the 238GROUPNDF5 nuclear data library in the SCALE code package were used for all KENO V.a calculations in Reference 3 and the confirmatory analyses. Section 6.8 in Reference 3 summarizes the determination of the minimum k_{safe} value. The lowest k_{safe} value determined from the validation is 0.925. Therefore, any configurations of ES-3100 packages with $k_{eff} + 2\sigma < k_{safe}$ are deemed subcritical. All calculations incorporated sufficient neutron histories to ensure statistical uncertainty (σ) less than 0.002 and adequate convergence. The PCP staff concurs that the benchmark experiments and corresponding bias value are applicable and conservative as applied to the ES-3100 package.

6.4 Summary of Reference 3 Criticality Analysis and Staff's Confirmatory Evaluation

6.4.1 Evaluation of a Single Package under NCT and HAC

The analyses in Section 6.4 of Reference 3 show that maximum reactivity occurs for a fully flooded, reflected package; therefore, the single package analysis is based on a fully flooded, reflected package. Reference 3 provided analysis for both a fully flooded, reflected containment vessel and a fully flooded, reflected package.

Table 6-1 of this SER shows the maximum $k_{eff} + 2\sigma$ reactivity results listed in Appendix 6.9.6 of Reference 3 and the staff's confirmatory analyses for EU metal alloy powder in the single package configuration. Single package configurations with uranium enrichments less than or equal to 80 wt.% and uranium mass less than or equal to 24105 g resulted in acceptable $k_{eff} + 2\sigma$ values that are below the k_{safe} limit of 0.925. Therefore, the ES-3100 single package containing EU metal alloy powder with the loading limits listed in Table 1.3 of the SARP is subcritical and satisfies the requirements of 10 CFR 71.55(b) related to a flooded single package. In particular, the proposed EU U/Mo powder shipment described in Reference 1 is subcritical and satisfies the requirements of 10 CFR 71.55(b) related to a flooded single package.

6.4.2 Evaluation of Undamaged Package Arrays (NCT)

The NCT undamaged package array models for the EU metal alloy powder corresponded to CSI values of 0.0, 0.4, 0.8, 2.0 and 3.2, with no can spacers. The analyses in Reference 3 show that maximum reactivity occurs in an array of ES-3100 packages when the containment vessel is flooded and the packaging is dry, referring to a configuration in which: (a) the neutron poison of the body weldment liner inner cavity and the impact absorbing insulation are dry, (b) recesses of the package external to the containment vessel do not contain any residual moisture, and (c) the interstitial space between packages in the array does not contain any residual moisture. The NCT array configurations are based on a flooded containment vessel and dry packaging to maximize the k_{eff} of the array.

Table 6.1 of this SER shows the maximum $k_{eff} + 2\sigma$ reactivity results listed in Table 6.9.6-11 of Reference 3 and the staff's confirmatory analyses for the proposed EU metal alloy powder under NCT. The NCT arrays resulted in acceptable $k_{eff} + 2\sigma$ values that are below the k_{safe} limit of

0.925. Therefore, the ES-3100 package containing EU metal alloy powder with the loading limits listed in Table 1.3 of the SARP is subcritical and satisfies the requirements of 10 CFR 71.55(d) and 10 CFR 71.59(a)(1). In particular, the proposed EU U/Mo powder shipment described in Reference 1 is subcritical and satisfies the requirements of 10 CFR 71.55(d) and 10 CFR 71.59(a)(1).

Table 6.1 Summary of Reference 3 Criticality Analysis and the PCP Staff's Confirmatory Analysis

Case	Content	Case Reference 3	Maximum $k_{eff} + 2\sigma$[(a)]	
			Reference 3	Staff
Single Package				
S1	EU powder[(b)]	cvr3cha_25_1_5_15	0.92249	0.92007
NCT Array				
N1	EU powder[(b)]	nciabmt11_4_1_5_3	0.92133	0.92329
N2	EU powder[(b)]	nciabmt11_6_1_3_3	0.91515	0.91398
HAC Array				
H1	EU powder[(b)]	hciabmt12_4_1_5_3	0.92476	0.92386
H1	EU powder[(b)]	hciabmt12_6_1_3_3	0.91274	0.91412

a) Upper subcritical limit k_{safe} value is 0.925.
b) HEU turnings, fines and powder

6.4.3 Evaluation of damaged package arrays (HAC)

The HAC damaged package array model for the EU metal alloy powder also corresponded to CSI values of 0.0, 0.4, 0.8, 2.0 and 3.2, with no can spacers. Each package had a flooded containment vessel and dry packaging to maximize the k_{eff} of the array. Table 6.1 shows the maximum $k_{eff} + 2\sigma$ reactivity results listed in Table 6.9.6-11 of Reference 3 and the staff's confirmatory analyses for EU metal alloy powder under HAC. The HAC arrays resulted in acceptable $k_{eff} + 2\sigma$ values that are below the k_{safe} limit of 0.925. Therefore, the ES-3100 package containing EU metal alloy powder with the loading limits listed in Table 1.3 of the SARP is subcritical and satisfies the requirements of 10 CFR 71.55(e) and the HAC-related requirements of 10 CFR 71.59(a)(2). In particular, the proposed EU U/Mo powder shipment described in Reference 1 is subcritical and satisfies the requirements of 10 CFR 71.55(e) and the HAC-related requirements of 10 CFR 71.59(a)(2).

6.4.4 Air Transport of EU Metal Alloy Powder

Reference 1 requested authorization to ship EU in powdered metal alloy form by air transport mode. Approximately 12 kg of alloy would be shipped in each ES-3100 package. This corresponds to approximately 2.18 kg of U-235 per ES-3100 package. The six air transport models described in Section 6.3.1.4 of the SARP assume 7 kg of U-235 mixed with packaging materials and do not take any credit for the physical form of the payload. The proposed shipment described in Reference 1 falls within the existing criticality safety envelope for air transport and does not require any additional evaluation (see Sections 6.3.1.4 and 6.7 of the SARP). Therefore, the ES-3100 package with the EU U/Mo powder content described in

Reference 1 is subcritical and satisfies the requirements of 10 CFR 71.55(f) related to air transport.

6.5 CSI for Nuclear Criticality Control

Based on the NCT/HAC array analyses, CSI values of 0.0, 0.4, 0.8, 2.0 and 3.2 are appropriate for the ES-3100 package with EU metal alloy powder and with the loading limits listed in Tables 1.3 and 1.3b of the SARP.

6.6 Conclusion

On the basis of the statements and representations in the request for Letter Amendment and Reference 3 of this SER, the SARP Revision 0 with Page Change 4 and the PCP staff's confirmatory evaluation, the PCP staff finds the nuclear criticality safety design of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

The PCP staff concluded that the following condition of approval is needed pursuant to the approval of the request for Letter Amendment:

"Each single Teflon bottle contains no more than 4 kg of U/Mo alloy (0.73 kg U-235) and no more than three Teflon bottles can be shipped per ES-3100 package."

7. PACKAGE OPERATIONS

7.1 Discussion

The PCP staff performed a review of the package operations of the ES-3100 package for air transport of the EU metal alloy powder packed in Teflon bottles, as described in the request for Letter Amendment. The PCP staff finds no issues related to package operations that need to be addressed relative to this request except pyrophoricity of fine uranium metal alloy powders (see Section 3 of this SER for details).

7.2 Conclusion

On the basis of the statements and representations in the request for Letter Amendment, the SARP Revision 0 with Page Change 4, and the PCP staff's confirmatory evaluation, the PCP staff finds the package operations of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

The PCP staff concluded that the following condition of approval is needed pursuant to the approval of the request for Letter Amendment:

"For air shipment of highly enriched uranium in powdered metal form in the ES-3100 package, the Teflon bottles, the metal convenience cans and the containment vessel shall be inerted with argon of high purity (>99%) and with low moisture (<5 ppm moisture)."

8. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

8.1 Discussion

The PCP staff performed a review of the acceptance tests and maintenance program of the ES-3100 package for air transport of the EU metal alloy powder packed in Teflon bottles, as described in the request for Letter Amendment. The PCP staff finds no issues related to acceptance tests and maintenance program that need to be addressed relative to this request.

8.2 Conclusion

On the basis of the statements and representations in the request for Letter Amendment and the SARP Revision 0 with Page Change 4, and the PCP staff's confirmatory evaluation, the PCP staff finds the acceptance tests and maintenance program of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

9. QUALITY ASSURANCE

9.1 Discussion

The PCP staff performed a review of the quality assurance of the ES-3100 package for air transport of the EU metal alloy powder packed in Teflon bottles, as described in the request for Letter Amendment. The PCP staff finds no quality assurance-related issues that need to be addressed relative to this request.

9.2 Conclusion

On the basis of the statements and representations in the request for Letter Amendment and the SARP Revision 0 with Page Change 4, and the PCP staff's confirmatory evaluation, the PCP staff finds the quality assurance of the ES-3100 package acceptable for air transport of EU metal alloy powder in Teflon bottles, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

References

1. Request for Letter Amendment to Ship HEU in Powdered Metal Form in the ES-3100 Package, Docket 13-20-9315, CoC USA/9315/B(U)F-96 (DOE), submitted to James M. Shuler, Manager of Packaging Certification Program, Office of Packaging and Transportation of Department of Energy, by the National Nuclear Security Administration (NNSA), Office of Defense Nuclear Nonproliferation (NA-20), May 9, 2013.
2. Safety Analysis Report for Packaging for Model ES-3100 Package with Bulk HEU Contents, SP-PKG-801940-A001 Rev. 0, Page Change 4, Babcock & Wilcox Technical Services Y-12, LLC, Y-12 National Security Complex, January 10, 2013.
3. SP-PKG-801940-A0001, Rev. 0, Letter Amendment Calculations, ES-3100 HEU SARP Chapter 6 Criticality Evaluation, April 18, 2013.