



Safety Evaluation Report for Certificate of Compliance No. 9315 Amendment for the Model ES-3100

Docket No. 24-07-9315

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This Safety Evaluation Report (SER) documents the U.S. Department of Energy (DOE) Packaging Certification Program (PCP) independent technical review of the application submitted by the Y-12 Field Office (YFO – formerly the National Nuclear Security Administration Production Office [NPO]) for amendment and renewal of DOE Certificate of Compliance (CoC) Number 9315 for the Model ES-3100 package design. This package is needed to support the mission of the National Nuclear Security Administration (NNSA).

Evaluation

By memorandum ^[1] dated December 4, 2023, NPO (now YFO) requested an amendment of DOE CoC 9315 (Revision 19) to authorize non-safety related changes to drawings and specifications for fabrication and acceptance of new ES-3100 packaging. NPO submitted Revision 4 (draft) of the Y-12 Safety Analysis Report for Packaging (SARP) ^[2] as the safety basis document (application) in support of the request.

SARP Revision 4 (draft) identified six changes in its “Revision Log”, as follows:

- Incorporated minor editorial changes
- Added provisions in the SARP to support procurement of Packcrete (thermal insulating and impact limiting material) for ES-3100 production units including updated drawings noted in Appendices 1.3.1 and 1.3.7 as well as updated specifications in Appendices 1.3.2, 1.3.3, 1.3.5, and 1.3.9 through 1.3.12.
- Clarified that Type B(U) packages, transported by air, shall not contain activities greater than 3000 A₂ as specified in IAEA SSR-6, paragraph 433.
- Incorporated latest revision of the example leak test procedures provided in Appendices 7.5.2 and 8.3.1.
- Updated references to reflect current regulatory and DOE directive requirements.
- Updated references to the current Packaging and Transportation Quality Assurance Program Plan (QAP-Y-91-273860-1 001 17).

DOE PCP staff completed their independent technical review of the proposed SARP changes on June 20, 2024 ^[3] and had no technical comments but did identify four errors (Q1.1 through Q1.4) on several certificate drawings and component specifications in need of correction.

YFO submitted Revision 4 (approved) of the SARP on August 21, 2024 ^[4], with corrections to the certificate drawings and component specifications. Staff confirmed the corrections were properly implemented in the SARP. YFO submitted an additional request on December 12, 2024 ^[5], to renew the CoC for 5-years to expedite an extension to the DOT certificate for use of the package for import/export.

The table below describes the SARP Revision 4 (approved) drawing and component specification changes, the applicant’s justification for the changes, and DOE PCP staff’s review and evaluation of the changes. This table addresses the 2nd bullet in the list of “Revision Log” changes.

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SARP Reference (current revision)	Description of the changes in SARP Rev 4 (approved)	Applicant's Justification	DOE PCP Staff Review & Evaluation
SARP Appendix 1.3.1 Drawing DD-M2E801580A037 000, Revisions K (3 sheets) and L (3 sheets), <i>ES-3100 Shipping Package, Consolidated Assembly Drawing.</i>	Revision K 1) Sheet 1 revised to add the containment vessel O-ring specification (SPC-M801580 0002) in Note 13 for both O-rings (inner and outer Find Nos. 12 and 13). 2) Sheet 2 revised to add reference to drawing part DD-M2E801580A002-01, Body Weldment, since an alternate fabrication option has been added to weld the drum flat cover to the double head reinforced drum (DD-M2E801580A002 Detail E), and an alternate fabrication option has been added to use flared bevel groove weld in lieu of the seal welds and the 1/8-inch weld wire (Find No. 3) on both end of the ES-3100 double open end reinforced drum body (DD-M2E801580A004 Detail D). 3) Sheet 2 revised to add reference to drawing part DD-M2E801580A003-01, Inner Liner Weldment, for an alternate fabrication option for the lower inner ring of the drum inner liner. 4) Sheet 2 revised to lower the tolerance for the overall height of DD-M2E801580A008-01, Top Plug Weldment, from 5.28 -0.33 to 5.28 -0.43 inches. Revision L 1) Sheet 2 revised to correct the “weld all around” symbol at longitudinal weld in Section B-B for the Inner Liner Weldment (DD-M2E801580A003-01) in response to DOE Q1.3.	These changes do not affect design features, requirements, or specifications shown on the drawing, or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs they changes do not affect the design and performance of the packaging.

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SARP Reference (current revision)	Description of the changes in SARP Rev 4 (approved)	Applicant's Justification	DOE PCP Staff Review & Evaluation
SARP Appendix 1.3.2 SPC JS-YMN3-801580-A002 000, Revision 6, <i>ES-3100 Drum Assembly</i>	- Deleted CMTR exemption for the drum arc weld studs from Section 3.2.2.1 to be consistent with Quality Category B requirements (Tables 9.1 and 9.2 of the SARP) and Section F of the Receipt Inspection Checklist. - Added Section 3.5.2 to clarify government furnished testing provisions in this specification. - Corrected an error in Section I, which cited ASME BPVC, Sect. III instead of Sect. VIII for the drum assembly fabrication. - Corrected tolerance errors in the Receipt Inspection Checklist (RIC), for the entry "MODIFIED ANGLE MIN THICKNESS", that contradict Drawing DD-M2E801580A003.	These changes are administrative and do not affect design features, requirements, or specifications shown on the ES-3100 certification drawing or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs the changes do not affect the design and performance of the packaging.
SARP Appendix 1.3.3 SPC JS-YMN3-801580-A001 000, Revisions 10, 11, and 12, <i>ES-3100 Containment Vessel</i>	Revision 10 - Removed the requirement to use Y-12's leak testing tooling in Sections 3.7.7 and 3.7.8. - Corrected a typographical error in Section 4.1.1, Step f, that incorrectly referenced Section 3.4.10 instead of Section 3.7 for leak testing. - Clarified warranty and liability provisions in Attachment D. Revision 11: Removed the "machined" option as an acceptable fabrication method of CV body assembly in response to DOE Q.1.4. Revision 12: Corrected Sections 3.2.1.3, 3.4.2.2, and 3.7.8 to implement the Revision 11 change per DOE follow-up comment to Q1.4.	These administrative changes do not affect design features, requirements, or specifications shown on the ES-3100 certification drawing or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs the changes do not affect the design and performance of the packaging.

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SARP Reference (current revision)	Description of the changes in SARP Rev 4 (approved)	Applicant's Justification	DOE PCP Staff Review & Evaluation
SARP Appendix 1.3.5 Equipment Specification SPC JS-YMN3-801580-A005 000, Revision 9, <i>Casting</i> <i>Catalog No. 277-4</i> <i>Neutron Absorber for</i> <i>the ES-3100 Shipping</i> <i>Package</i>	1) Corrected the method used to determine the B-10 isotopic content in B₄C powder to be mass spectrometry, given that this property cannot be determined by gravimetric analysis. 2) Incorporated the PGNA testing requirements, in Section 3.3 and Form D, in accordance with the methodology specified in SARP Sects. 6.3.2 and 6.9.3.3.	These changes are procurement-related administrative modifications and do not affect design features, requirements, or specifications shown on the ES-3100 certification drawing or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs the changes do not affect the design and performance of the packaging.
SARP Appendix 1.3.7 Drawing DD-M2E801580A002 000, Revisions D, E, and F, <i>ES-3100 Shipping</i> <i>Package Bold Weldment</i>	1) Revision D: Changed the Corporate name for the Cat. No. 277-4 neutron-absorbing material. 2) Revision E: Added a weld option, i.e. using bevel groove weld together with fillet weld to attach the drum flat cover to the double head reinforced drum, and then inspected by VT, in lieu of the fillet weld. 3) Revision F: Corrected Note 8 to reference the specification for casting Kaolite (JS-YMN3-801580-A003) in response to DOE Q1.2. 4) Revision F: Corrected the “Material” description for Find No 10 on the Parts List to include Packcrete in response to DOE Q1.1	Corporate name change does not affect design features, requirements, or specifications shown on the drawing or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs that using a bevel groove weld together with fillet weld increases the strength of the weld joint, in comparison to fillet weld, and does not affect the design and performance of the packaging.

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SARP Reference (current revision)	Description of the changes in SARP Rev 4 (approved)	Applicant's Justification	DOE PCP Staff Review & Evaluation
SARP Appendix 1.3.7 Drawing DD-M2E801580A003 000, Revisions C and D (2 sheets), <i>ES-3100 Shipping Package, Inner Liner Weldment</i>	1) Revision C: Sheet 2, Section G-G (DD-M2E801580A003-06 Lower Inner Ring) added an alternate fabrication option for the lower inner ring (Find No. 6) of the drum inner liner, i.e. by welding two pieces together instead of one piece. 2) Revision D: Sheet 2, corrected the “weld all around” symbol at longitudinal welds in Sections K-K (DD-M2E801580A003-05 Lower Outer Ring), G-G (DD-M2E801580A003-06 Lower Inner Ring), and E-E (DD-M2E801580A003-03 Upper Outer Ring) in response to DOE Q1.3.	These changes do not affect design features, requirements, or specifications shown on the drawing, or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs the alternate fabrication option and the welding method does not affect the design and performance of the packaging.
SARP Appendix 1.3.7 Drawing DD-M2E801580A004 000, Revision D, <i>ES-3100 Shipping Package, Double Open Head Reinforced Drum</i>	1) Added an alternate fabrication option using flared bevel groove weld in lieu of the seal weld and the 1/8-inch weld wire (Find No. 3) on both ends of the ES-3100 double open end reinforced drum body.	This change does not affect design features, requirements, or specifications shown on the drawing, or condition of approval in the CoC.	Staff reviewed this change and justification and concurs that using flared bevel groove weld in lieu of a seal weld on both ends of the drum body does not affect the design and performance of the part.

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SARP Reference (current revision)	Description of the changes in SARP Rev 4 (approved)	Applicant's Justification	DOE PCP Staff Review & Evaluation
SARP Appendix 1.3.7 Drawing DD-M2E801580A008 000, Revision E, <i>ES-3100 Shipping Package, Top Plug Weldment</i>	1) Revised Detail A to increase the tolerance for a radius height to 0.41-inch ± 0.09-inch. 2) Revised Detail A to add an internal diameter range of 12.83-inches, -0.37 or $+0.20$ inch for the top and bottom of the Plug Rim (DD-M2E801580A008-04) and hence make the dimensions R.56, R.62 and .77 reference dimensions. 3) Revised to add an option of applying an additional internal surfacing weld to the bottom side of the Top Sheet (DD-M2E801580A008-02) for straightening, in the case that welding of the Top Sheet to the Plug Rim (DD-M2E801580A008-04) is near the bulge limit of 0.34-inch.	These changes do not affect design features, requirements, or specifications shown on the drawing, and or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs the changes do not affect the design and performance of the packaging.
SARP Appendix 1.3.7 Drawing DD-M2E801580A011 000, Revision J, <i>ES-3100 Shipping Package Containment Vessel Assembly</i>	1) The "Part or Identifying No." column entry in Parts List for Find No. 2, Containment Vessel Body Assembly, was revised to delete "...OR COMPANY APPROVED EQUAL." Change is to support the removal of Sect. 5.(d), Condition (20), in the CoC 9315, Rev. 18.	Administrative change does not affect design features, requirements, or specifications shown on the ES-3100 certification drawing or conditional of approval in the CoC.	Staff reviewed this change and justification and concurs the change does not affect the design and performance of the packaging.

SARP Reference (current revision)	Description of the changes in SARP Rev 4 (approved)	Applicant's Justification	DOE PCP Staff Review & Evaluation
SARP Appendix 1.3.7 Drawing DD-M2E801580A012 000, Revisions E and F (2 sheets), <i>ES-3100 Shipping Package Containment Vessel Body Assembly</i>	Revision E 1) "Description" column entry in the Parts List for Find No. 3 on Drawing DD-M2E801580A012 is revised, from "Containment vessel formed or machined body" to "CV pipe body 5IPS SCH40". The purpose of the change is to eliminate the option of machining the CV body from a solid billet of 304L stainless steel. This change is to support the removal of Sect. 5.(d), Condition (20), in the CoC 9315, Rev. 18. 2) Geometric dimensioning and tolerancing (GD&T) control associated with the CV body assembly top flange revised to correct the datum precedence in the feature control frame. 3) GD&T control associated with containment vessel inner O-ring groove was revised to correct the feature control frame for consistency with the requirements of the outer O-ring groove GD&T controls. Revision F 1) Removed the provision for an entirely machined CV body fabrication option from Note 11 in response to DOE Q1.4.	These changes do not affect design features, requirements, or specifications shown on the ES-3100 certification drawing or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs the changes do not affect the design and performance of the packaging.
SARP Appendix 1.3.9 Equipment Specification SPC M801580-0002 000, Revisions 4 and 5, <i>ES-3100 Ethylene Propylene Diene Monomer (EPDM) Containment Vessel O-rings</i>	1) Revision 4: updates the revisions of the documents in the "Procedure or Form" list in Section 4.6 as "latest". Adds a requirement for providing copy of the "Procedure and Forms" during the proposal phase. 2) Revision 5 change: updates Section 4.6 to use a generic numbering scheme for the Commercial Grade Survey (CGS) number and adds a new JDS procedure, <i>MP-ENG-QF-8.3-17-01 Manufacturing Plan</i>, in place of <i>ENG-16-01 Manufacturing Plan</i>.	These changes are procurement-related administrative modifications, and do not affect a design features, requirements, or specifications shown on the ES-3100 certification drawing or condition of approval in the CoC.	Staff reviewed the changes and justification and concurs the changes do not affect the design and performance the packaging.

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SARP Appendix 1.3.10 SPC M801580-0004, Revision 1, <i>ES-3100 Heavy Can Spacer Assemblies</i>	1) Section 2.2 added references to DD-M80 1580-0050 for CAT 277-0 and CAT 277-4 verification standards, and SOW-801580-0009 for PGNAA testing to incorporate the PGNAA testing requirements in Section 3.3 in accordance with the methodology specified in SARP Sections 6.3.2 and 6.9.3.3. 2) Section 4.2.1 revised so the casting forms are consistent with SARP Appendix 1.3.5. 3) Sections 3.5 and 4.3 updated the technical evaluation and approval procedures to a CGD plan.	These changes do not affect design features, requirements, or specifications shown on the drawing, or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs these changes do not affect the design and performance the packaging.
SARP Appendix 1.3.11 SPC M801794-0003 000, Revision 1, <i>Packcrete Preliminary Lot Qualification</i>	1) Section 5.4.1 revised to add sampling plans and procedures for inspection by attributes, i.e. bulk density and particle size distribution acceptance criteria, in accordance with ASQ/ANSI Z1.4, Table II-A.	This change is procurement-related administrative modification, which does not affect a design feature, requirement, or specification shown on the ES-3100 certification drawing or condition of approval in the CoC.	Staff reviewed this change and justification and concurs this change does not affect the design and performance the packaging.

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SARP Appendix 1.3.12 SPC M801580-0003 000, Revision 1, <i>ES-3100 Packcrete</i> <i>Final Lot Qualification</i> <i>and Production</i> <i>Processing</i>	1) Section 7.7.4 revised to increase the furnace temperature tolerance for consistency with the requirements in SARP Appendix 1.3.11, Section 6.2.6. 2) Section 5.4.1 revised the Vermiculite Acceptance Criteria to reference SARP Appendix 1.3.11, Section 5.4.1 since the bulk density of procured vermiculite has been expanded, and sampling plans and procedures for inspection by attributes, i.e. bulk density and particle size distribution acceptance criteria, in accordance with ASQ/ANSI Z1.4, Table II-A, have been added. 3) Section 9 deleted the requirement of measuring the elastic modulus and Poisson's ratio for the Packcrete material in its scope of testing and clarified that Supplier will only be creating pipes for the Dynamic Impact Crush Strength test.	These changes are administrative and do not affect a design feature, requirement, or specification shown on the ES-3100 certification drawing or condition of approval in the CoC.	Staff reviewed these changes and justification and concurs these changes do not affect the design and performance the packaging.

DOE PCP staff confirmed by document review that the drawing and specification changes were implemented in the text of SARP Revision 4 (approved).

In addition to the drawings listed in the table above, DOE PCP staff reviewed the minor changes to all drawings revised as shown in Appendix 1.3.7, *ES-3100 Design Drawings*, based on the following Engineering Change notices ^[6]:

- EC 801580-0050 – update drawing formats to current (Y-12) drawing requirements with SSC and Quality grading added to the Parts List,
- EC 801580-0053 – DD M2E8011580A031 Rev. G revised to remove faulty datums in zones B5 and G5 and remove the engineering hoist ring in the CV, and
- EC 801580-0054 - DD M2E8011580A010 Rev. G revised to remove the data plate for the Pu configuration of the package (DOE CoC 9867 for Pu shipments terminated in May of 2022). Add “or 304 SST” material for 16 gauge sheet metal for the data plates and modify Note 5 to allow for laser etching as an option for the data plate characters and symbols.

Staff confirmed these additional minor drawing revisions do not affect the performance of the packaging.

With respect to the additional non-editorial changes in the “Revision Log”, DOE PCP staff confirmed:

- SARP Section 1.2.2 was revised to add the condition “Contents to be transported by air are limited to ≤ 3000 A₂, per SSR-6 (Rev 1, 2018 Edition), *Classification as Type B(U), Type B(M) or Type C package*, paragraph 433 (step c). Note – “Type C package” is not addressed in 10 CFR Part 71.
- SARP Appendices 7.5.2 and 8.3.1 were updated to provide examples of the current preshipment (air) and fabrication, periodic, and maintenance (helium) leakage test procedures.
- SARP Appendices 1.3.13, 2.12.1, 3.5.5, 4.5.3, 5.5.4, 6.9.12, 7.5.3, 8.3.2, and 9.4.1 were updated/corrected to reflect the chapter references to the current regulations, standards, and directives, as appropriate.
 - SOW 801580-0009 000 01, *Statement of Work PGNA Testing of ES-3100 Neutron Absorber*, Consolidated Nuclear Security, LLC, Y-12 National Security Complex, September 2022, added to references in Appendix 6.9.12.
- SARP Chapter 9 was revised throughout for clarifications consistent with the current *Packaging and Transportation Quality Assurance Program Plan* (QAP-Y-91-273860-1 001 17), approved by the DOE and NNSA Certifying Officials (https://rampac.energy.gov/docs/default-source/qa/approval_0019_r4.pdf).
 - Section 9.3.7 *Control of Purchased Material, Equipment, and Services*, was revised to add the clause “... Unacceptable conditions or deficiencies that are

identified during the supplier evaluation must be addressed and resolved.”
Transportation Quality Assurance Program Plan (QAP-Y-91-273860-1 001 17).

Based on the statements and representations in the SARP Revision 4 (approved), and PCP staff’s confirmatory evaluation described in this SER, staff finds this amendment and renewal request to the packaging design acceptable and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met subject to the Conditions in the CoC.

Conditions of Approval

The following changes to CoC Rev 19 are required to implement changes evaluated in this SER.

- 3(2) Title and identification of report or application: replace with “Safety Analysis Report for Packaging (SARP) Y-12 National Security Complex, Model ES-3100 Package with Bulk HEU Contents, SP-PKG-801940-A001, Revision 4, dated August 15, 2024, as supplemented [see 5(e)].”
- 5(a)(2) Packaging Description, Option to use the ARG-US radiofrequency identification (RFID) system: Correct typo from “... 8 in.ches” to “... 8 inches”).
- 5(a)(3) Drawings: Revise the list (revisions) per SARP Rev 4, Appendices 1.3.1 (Package Certification Drawing) and 1.3.7 (ES-3100 Design Drawings).
- 5(b) Contents,
 - Page 5 of 15, 1st paragraph: Revise from “... § 71.88.” to “... 10 CFR 71.88).
 - Radioactive/Fissile Constituents, (b): Add text “For air transport, package contents must not exceed 3,000 A₂, per IAEA SSR-6 2018 Edition, para 433(c), with a maximum transuranic concentration of 40.0 µg/gU, and plutonium meeting 10 CFR 71.88 requirements.”
- 5(b) Contents, Radioactive/Fissile Constituents, Table 1.3b Notes: Add text “For air transport, package contents must not exceed 3,000 A₂, per IAEA SSR-6 2018 Edition, para 433(c), with a maximum transuranic concentration of 40.0 µg/gU, and plutonium meeting 10 CFR 71.88 requirements.”
- 5(d) Conditions:
 - (12) Revise to “... packaging-specific Quality Assurance requirements of Chapter 9 of SARP, Revision 4, as supplemented.” (replace Rev 3 with Rev 4)
 - (13) Revise to “Revision 19 of the certificate may be used until July 31, 2025.”
 - (20) Replace with “Reserved” (The option to allow machining the CV body from a solid billet of stainless steel was removed from the SARP, drawing, and component specification.)
- 6(b) Expiration Date, revise to “July 31, 2030.” (renewal)

Conclusion

Based on the statements and representations contained in SARP Revision 4 (approved), and the conditions listed above, DOE PCP staff concludes that the package design has been adequately described and evaluated, and the Model ES-3100 package continues to meet the requirements of 10 CFR Part 71.

References

- [1] *Request for Review of Revision 4 of the ES-3100 Safety Analysis Report for Packaging by the U.S. Department of Energy Packaging Certification Program*, Memorandum, Teresa M. Robbins to Julia C. Shenk, December 4, 2023.
- [2] *Safety Analysis Report for Packaging, Y-12 National Security Complex, Model ES-3100 Package with Bulk HEU Contents*, SP-PKG-801940-A001 000 04, Draft-Issued for Approval, June 29, 2023.
- [3] *Technical Review Complete*, Memorandum, Julia C. Shenk to Sol Arroyo-Sola, June 20, 2024.
- [4] *Safety Analysis Report for Packaging, Y-12 National Security Complex, Model ES-3100 Package with Bulk HEU Contents*, SP-PKG-801940-A001 000 04, Approved, August 15, 2024.
- [5] FW: Request for 5-Year Renewal of ES-3100 CoC, Email Mary Hitson to Julia Shenk, December 12, 2024.
- [6] RE: [External] RE: Drawings (Docket 24-07-9315), Email Stan Thomas to Lawrence Gelder, October 16, 2024 (ECs 801580-0050, 801580-0053, and 801580-0054 attached).