71-9315

BWXT Y-12
Protecting America's Future

June 1, 2005

CCN-013704
COR-BWXT-5/31/2005-80255

Mr. Shawn Williams
U. S. Nuclear Regulatory Commission
Mail Stop: O13D13
Washington, D.C. 20555-0001

RE: Draft Input for the ES-3100 Certificate of Compliance, Docket No. 71-9315

Dear Mr. Williams:

Please find attached input for the ES-3100 shipping package Certificate of Compliance. This input is consistent with the current application (Safety Analysis Report, Y/LF-717, Revision 0, dated February 25, 2005), and has been formatted in accordance with the structure of an NRC CoC (Sections 5 - end). The CoC text is an electronic file in MS Word software. If you would like any of this material modified or if BWXT Y-12 can be of any further assistance, please let me know.

If you have any questions, please contact me at (865) 576-8254 or George Singleton at (865) 241-3854.

Very truly yours,

J. Arbital

Jeffrey G. Arbital
Containers Program Manager

JGA:slc

Attachment: As stated

cc: E. D. Ragos, NNSA YSO
J. M. Shuler, DOE EM-24
D. R. Tousley, DOE NA-26

NMSS01

CERTIFICATE OF COMPLIANCE

USA/9315/B(U)F-96, Revision 0
Docket No. 71-9315

5.(a) Packaging

(1) Model No.: ES-3100

(2) Description

A shipping container for unirradiated uranium of any enrichment.

The packaging consists of: (1) a stainless steel drum assembly with a bolted lid, encapsulated Thermal Ceramics, Inc. Kaolite 1600™ insulation, encapsulated Thermo Electron Corporation Catalog 277-4 neutron absorber; and, (2) a stainless steel, flat bottom, containment vessel with a flat lid, single-nut closure device, and double O-ring seal.

(i) Drum Assembly

The drum body and lid are fabricated from 16-guage (0.0598-inch thick) type 304 or 304L stainless steel. The inside diameter of the drum is 18.25 inches with an overall height of 43.5 inches including the cover and bottom. The outside diameter of the drum (including the chimes) is 19.37 inches. The drum bottom is a 12-gauge (0.105-inch thick) type 304 or 304L stainless steel arched panel that is welded to the drum. The drum used in the ES-3100 is fabricated in accordance with the dimensional requirements of MIL-D-6054F and modified as shown on Drawing M2E801580A004. Material, fabrication, and quality control criteria are generally equivalent to those imposed for a DOT Specification 17C drum. Weld studs are attached to the upper face of the internal flange. The drum body seams are welded. Welding procedures qualification and welders certification to these qualified procedures are conducted in accordance with Sect. IX of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

The drum has four 0.313-inch diameter holes equally spaced around the circumference about 1.50 inches from the top rim to relieve pressure in the drum in the event of a thermal accident. Plastic plugs are placed into these holes from the outside to prevent leakage of water into the drum during handling and storage. The drum external surface includes a data plate, trefoil data plate, and two lugs for use with tamper-indicating devices. The two plates are electrochemically etched and permanently affixed to the exterior of the drum body.

The removable drum top plug assembly is 14.37 inches in diameter and 5.28 inches in height at the center. The skin is made from 16 gauge (0.0598-inches thick) type 304 or 304L stainless steel and is filled with Kaolite 1600™. The removable drum lid is attached to the drum body by a flange with eight silicon bronze, 5/8-11-UNC-2B hex-head nuts (C65100, American Society for

Testing and Materials [ASTM] F-467) with stainless-steel washers. These nuts are tightened onto the weld studs (type 304 or 304L stainless steel, 5/8-11-UNC-2A, ASTM A-493 or F-593) to 30 ±5 foot-pounds of torque with no sequence specified.

An inner liner is attached to the drum by an internal flange (angle) that is welded to both the drum and liner. The cavity created by the inner liner for placement of a containment vessel is a three-tier volume. The uppermost tier accommodates the top plug and has an inside diameter of 14.77 inches and is 5.22 inches deep. The second tier accommodates the containment vessel flange and has an inside diameter of 8.60 inches and is 2.20 inches deep. The third tier accommodates the containment vessel body and has an inside diameter of 6.24 inches and is 30.83 inches deep.

The volume formed between the drum and the attached inner liner is filled with an inorganic, castable refractory material made by Thermal Ceramics, Inc. (Kaolite 1600™), which acts as both thermal insulation and an impact limiting material. Kaolite 1600™ is nonflammable and will not undergo chemical decomposition at temperatures below 2300°F.

A second volume is formed in the liner and runs the full length of the third tier liner (30.83 inches). This volume is an annulus approximately 1.12 inches thick. This annulus is filled with a cast, refractory, neutron absorbing material (Thermo Electron Corporation Catalog No. 277-4).

The drum assembly also contains three silicone rubber pads. The first pad is placed on the bottom of the drum cavity to support the containment vessel bottom during transport. The second pad is placed on top of the containment vessel lid during transport. The third pad is placed on the top shelf of the second-tier liner to cushion the top plug during transport.

No tie-down devices are integral to the package, nor can any features be used for these purposes. The ES-3100 package is designed to be shipped in accordance with the safe-secure trailer/safeguards transporter (SST/SGT) requirements of the DOE Office of Secure Transportation (OST).

(ii) Containment Vessel

A single containment vessel forms the containment boundary in the ES-3100 shipping package. The ES-3100 containment boundary consists of the containment vessel body, lid assembly, and inner O-ring.

The containment vessel of the ES-3100 package is a pressure vessel that is designed, fabricated, examined, and tested in accordance with the ASME Boiler and Pressure Vessel Code, Sect. III, Division I, Subsection NB. The ES-3100 containment vessel body is fabricated from type 304L stainless steel.

The containment vessel lid assembly, which completes the containment boundary structure, consists of a sealing lid, closure nut, and external retaining ring. The containment vessel sealing lid is machined from type 304

stainless steel with final material properties in accordance with ASME SA-479. The containment vessel closure nut is machined from a Nitronic 60 stainless-steel bar with material properties in accordance with ASME SA-479. These two components are held together using a Smally WSM-400-S02 external retaining ring made from type 302 stainless steel.

The sealing lid has an attachment point for a 3/8-16 swivel hoist ring bolt, a leak-check port to test seal integrity between the O-rings, and notches along the perimeter to engage two dowel pins. The swivel hoist ring is only intended for use only during loading and unloading operations, and will be removed for shipment. The lid assembly, with the O-rings in place on the containment vessel body, is joined together by tightening the closure nut and sealing lid assembly to a torque of 120±5 foot-pounds.

The O-rings on the containment vessel are fabricated from ethylene propylene (compound specification ASTM D2000, M3BA712A14B13F17). The double O-ring seal permits assembly verification leak testing of the containment vessel by measuring the leak rate from the volume between the inner and outer O-rings. The leak test port between the O-rings facilitates a pressure rise or drop leakage test following assembly or 10 CFR 71 compliance testing. This leak test port is sealed during transport using a threaded brass plug (with a standard fluorocarbon rubber O-ring).

The inside diameter of the containment vessel is 5.06 inches and wall thickness is 0.10 inches (excluding the flange). The nominal thickness of the flat bottom is 0.25 inch. The usable height inside the containment vessel is 31.0 inches. The overall height of the containment vessel without the swivel hoist ring is 32.40 inches. The containment vessel drawing number, drawing revision, and serial number are electroetched onto the side of the containment vessel body, as well as onto the top of the sealing lid and the closure nut. No penetrations, connections, or fittings through the containment boundary exist.

MAXIMUM GROSS WEIGHT 420 pounds (190.5 kg).

(3) Drawings

The Model No. ES-3100 Shipping Package is constructed in accordance with the following BWXT Y-12, L.L.C. Drawing Nos.:

M2E801580A001	Sheet 1	Rev. B	Drum Assembly
M2E801580A002	Sheet 1	Rev. B	Body Weldment
M2E801580A003	Sheets 1, 2	Rev. B	Inner Liner Weldment
M2E801580A004	Sheet 1	Rev. B	Double Open Head Reinforced Drum
M2E801580A005	Sheet 1	Rev. B	Misc. Details
M2E801580A006	Sheet 1	Rev. B	Drum Lid Weldment
M2E801580A007	Sheet 1	Rev. B	18.25" Diameter Drum Lid
M2E801580A008	Sheet 1	Rev. B	Top Plug Weldment
M2E801580A009	Sheet 1	Rev. C	Pad Details
M2E801580A010	Sheet 1	Rev. B	Data Plate Details
M2E801580A011	Sheet 1	Rev. C	Containment Vessel Assembly

M2E801580A012	Sheets 1, 2	Rev. C	Containment Vessel Body Assembly
M2E801580A013	Sheet 1	Rev. B	Containment Vessel O-ring Details
M2E801580A014	Sheet 1	Rev. B	Containment Vessel Lid Assembly
M2E801580A015	Sheet 1	Rev. C	Containment Vessel Sealing Lid
M2E801580A016	Sheet 1	Rev. B	Containment Vessel Closure Nut
M2E801580A026	Sheet 1	Rev. B	Heavy Can Spacer Assembly
M2E801580A031	Sheet 1	Rev. B	Main Assembly

5.(b) Contents

The package content is defined as the HEU fissile material, the convenience cans and can spacers, and the associated packing materials (plastic bags, pads, tape, etc.) inside the ES-3100 containment vessel.

(1) Type and form of material

(i) Unirradiated uranium as solid metal and alloy.

(ii) Unirradiated uranium as oxide. The HEU oxide content in the ES-3100 package includes UO_2, UO_3, and U_3O_8. The physical form of all contents is dense, loose powder which may contain clumps, and pellets. Moisture content in oxide is limited to 3 weight percent water.

(iii) Unirradiated solid uranyl nitrate in the form of uranyl nitrate crystals, [$UO_2(NO_3)\bullet xH_2O$, where x is ≤ 6].

(2) Maximum quantity of material per package and criticality safety transport index

Convenience cans constructed of stainless steel or tin-plated carbon steel are used to hold contents inside the containment vessel. The convenience cans must have an outer diameter of less than 5 inches and a maximum height of 10 inches. Any combination of these convenience cans will be allowed in a single package, as long as the total height of the stack-up (including spacers, if required) does not exceed the inside working height of the containment vessel (31 inches). Silicone rubber pads may be placed between the convenience cans to reduce vibration. Some contents require the use of spacers between convenience cans for criticality safety. The ES-3100 spacers are thin-walled stainless-steel cans filled with neutron absorbing material (drawing M2E801580A026).

The weight of the contents, including radioactive material, convenience cans, can lift attachments, polyethylene bags, spacers, and other material in the containment vessel shall not exceed 90 pounds.

(i) For the material described in 5(b)(1)(i), the concentration limits of uranium and other transuranic constituents shall be the following:

Isotope	Concentration Limit
^{232}U	0.040 μg/gU[a]
^{233}U	0.006 g/gU[b]
^{234}U	0.02 g/gU
^{235}U	1.00 g/gU
^{236}U	0.40 g/gU
^{238}U	1.00 g/gU
Transuranics (except Np)	40.0 μg/gU
Np	0.003 g/gU

a. μg/gU 10^{-6} grams per gram of total uranium
b. g/gU grams per gram of total uranium

The material described in 5(b)(1)(i) may be in the form of solid geometric shapes. Solid shapes may include the following:

1. Spheres having a diameter no larger than 3.24 inches (maximum of two spheres per convenience can)

2. Cylinders having a diameter no larger than 3.24 inches (maximum of one cylinder per convenience can)

3. Square bars having a cross section no larger than 2.29 inches x 2.29 inches (maximum of one bar per convenience can)

4. Slugs having dimensions of 1.5 inches diameter x 2 inches tall (maximum of 10 slugs per convenience can)

HEU bulk metal and alloy contents not covered by the geometric shapes category specified above will be in the broken metal category.

Mass loading limits for metal and alloy (geometric shapes and broken metal) are in Table 1.

Table 1: Loading Limits for Metal and Alloy

Metal or Alloy Description		Enrichment	CSI	With Spacers ^{235}U (kg)[a]	No Spacers ^{235}U (kg)
Solid HEU metal or alloy (specified geometric shapes)	Spheres	≤ 100%	0.0	32.938	16.946
	Cylinders	≤ 100%	0.0	18.000	12.000
	Sq. Bars	≤ 100%	0.0	30.000	18.000
	Slugs	> 80%	0.0	16.342	Spacer req'd
	Slugs	≤ 80%	0.0	26.213	Spacer req'd
Broken HEU metal or alloy		> 95%, ≤ 100%	0.0	2.774	Spacer req'd
			0.4	5.548	Spacer req'd
			0.8	8.323	Spacer req'd
			2.0	11.097	Spacer req'd
		> 90%, ≤ 95%	0.0	2.637	Spacer req'd
			0.4	5.274	Spacer req'd
			0.8	10.549	Spacer req'd
			2.0	16.703	Spacer req'd
		> 80%, ≤ 90%	0.0	2.500	Spacer req'd
			0.4	7.500	Spacer req'd
			0.8	10.000	Spacer req'd
			2.0	15.834	Spacer req'd
		> 70%, ≤ 80%	0.0	2.225	2.225
			0.4	8.900	4.450
			0.8	18.542	14.092
			2.0	23.734	18.542
		> 60%, ≤ 70%	0.0	5.848	1.949
			0.4	12.346	7.797
			0.8	20.793	16.245
			2.0	24.692	24.692
		≤ 60%	0.0	11.153 kgU	5.576 kgU
			0.4	29.743 kgU	17.660 kgU
			0.8	35.320 kgU	35.320 kgU
			2.0	35.320 kgU	35.320 kgU

a. Spacers are cans containing neutron absorbing material as described in drawing M2E801580A026.

(ii) For the material described in 5(b)(1)(ii), the mass limit shall be 24 kg of oxide with a CSI of 0. No spacers are required in the containment vessel. The maximum overall uranium isotopic concentrations for all oxide contents are:

Isotope	Concentration Limit
^{232}U	0.040 μg/gU[a]
^{233}U	200 μg/gU
^{234}U	0.02 g/gU[b]
^{235}U	0.977 g/gU[c]
^{236}U	0.40 g/gU
^{238}U	0.80 g/gU
Transuranics	40.0 μg/gU

a. μg/gU 10^{-6} grams per gram of total uranium
b. g/gU grams per gram of total uranium
c. ^{235}U must be greater than 0.20 g/gU

(iii) For the material described in 5(b)(1)(iii), the mass limit shall be 24 kg of uranyl nitrate crystals with a CSI of 0. The form of uranyl nitrate crystal shall be $UO_2(NO_3)\bullet xH_2O$ [where x is ≤ 6]. No spacers are required in the containment vessel. The maximum overall uranium isotopic concentrations for all uranyl nitrate crystal contents are:

Isotope	Concentration Limit
^{232}U	0.040 μg/gU[a]
^{233}U	0.006 g/gU[b]
^{234}U	0.02 g/gU
^{235}U	1.00 g/gU[c]
^{236}U	0.40 g/gU
^{238}U	1.00 g/gU
Transuranics (except Np)	40.0 μg/gU
Np	0.003 g/gU

a. μg/gU 10^{-6} grams per gram of total uranium
b. g/gU grams per gram of total uranium
c. ^{235}U must be greater than 0.20 g/gU

6. The vent holes on the outer steel drum shall be capped closed during transport and storage to preclude entry of rain water into the insulation cavity of the drum.

7. Content forms may not be mixed in a single ES-3100 containment vessel.

8. HEU fissile material to be shipped in the ES-3100 package must be placed in stainless-steel or tin-plated carbon steel convenience cans. Any closure on the convenience can is allowed.

9. Any combination of convenience can sizes is allowed in a single package, as long as the total height of the can stack (including silicone rubber pads and spacers, if required) does not exceed the inside working height of the containment vessel (31 inches).

10. Empty convenience cans and/or stainless-steel scrubbers may be used to fill the void space in the containment vessel for smaller fissile loads. In situations where empty convenience cans are shipped in the package, they must be placed on top of the loaded cans, and a minimum 0.125-inch-diameter hole must be placed through the lid of each empty can.

11. In configurations not requiring spacers for criticality control, spacer cans may be used to fill void space if placed on top of loaded cans in the containment vessel.

12. HEU broken metal loading is further restricted to sizes with a specific surface area not greater than 1.00 square centimeter per gram or a piece weight not less than 50 grams. Furthermore, foils, turnings, and wires are not permitted for shipment.

13. Where spacers are required for a shipment, the quantity of fissile material in any convenience can shall not exceed one-third of the mass loading limit for that content.

14. The contents may be bagged or wrapped in polyethylene, and the convenience cans may also be wrapped in polyethylene to further reduce the possibility of contamination.

15. The amount of hydrogen in a containment vessel is limited to the most restrictive of the following options:

    (a) The total amount of hydrogen contained in both the package content (including absorbed moisture or hydration molecules of the fissile content) and the water if the containment vessel were to flood shall not exceed an average density of 0.1117 gram per cubic centimeter inside the free volume of the containment vessel not occupied by dry package content.

    (b) The mass of hydrogenous material (i.e., polyethylene bagging, silicone rubber, etc.) used inside the ES-3100 containment vessel is limited to 500 grams. In addition, if convenience cans having a diameter greater than 4.25 inches are used, no hydrogenous material may be used inside the containment vessel.

16. The maximum content heat load shall not exceed 0.40 watts.

17. In addition to the requirements of Subpart G of 10 CFR Part 71:

    (a) Each package shall be operated and prepared for shipment in accordance with Chapter 7 of the application.

    (b) Each package shall be acceptance tested and maintained in accordance with Chapter 8 of the application.

18. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.12.

19. Expiration date:

REFERENCES

BWXT Y-12, L.L.C. application dated February 25, 2005.

FOR THE NUCLEAR REGULATORY COMMISSION