CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE		PAGES
9204	20	71-9204	USA/9204/B(U)F-96	1	OF	5

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. ISSUED TO *(Name and Address)*

Energy*Solutions* Services, Inc.
Suite 100, Center Point II
100 Center Point Circle
Columbia, SC 29210

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Energy*Solutions* application dated January 24, 2011, as supplemented.

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model No.: 10-160B

(2) Description

A cylindrical carbon steel and lead shielded shipping package, designed to transport radioactive waste material. The package is transported in the upright position and is equipped with steel encased, rigid polyurethane foam impact limiters on the top and bottom. The package has approximate dimensions, shielding, and weight as follows:

Package height	88 inches
Package outer diameter	78-1/2 inches
Package cavity height	77 inches
Package cavity diameter	68 inches
Overall package height, with impact limiters	130 inches
Overall package diameter, with impact limiters	102 inches
Lead shielding thickness	1-7/8 inches
Gross weight (packaging and contents)	72,000 lbs
Maximum total weight of contents, shoring, secondary containers, and optional shield insert	14,250 lbs

5.(a)(2) Description (Continued)

The packaging body consists of a 1-1/8-inch thick carbon steel (ASME SA516 or SA537) inner shell, a 1-7/8-inch thick lead gamma shield, and a 2-inch thick carbon steel outer shell (ASME SA516). The inner and outer shells are welded to a 5-1/2-inch thick carbon steel bottom plate. The packaging cavity has an optional 11-gage stainless steel liner. A 12-gage stainless steel thermal shield surrounds the cask outer shell in the region between the impact limiters. The impact limiters are secured to each other around the cask by eight ratchet binders.

The packaging lid is a 5-1/2-inch thick carbon steel plate, and has a 31-inch diameter opening equipped with a secondary lid. The primary lid is sealed with a double elastomer O-ring and 24 equally spaced 1-3/4-inch diameter bolts. The secondary lid is 46 inches in diameter, is centered within the primary lid, and is sealed to the primary lid by a double elastomer O-ring and 12 equally spaced 1-3/4-inch diameter bolts. The space between the double O-ring seals is provided with a test port for leak testing the primary and secondary lid seals.

The secondary lid is protected by a thermal shield which consists of two polished stainless steel plates separated by a thin air gap. The thermal shield is attached to the secondary lid lifting lugs with hitch-pins. The optional drain and vent ports are sealed with a plug and an O-ring seal.

The package is equipped with four tie-down lugs welded to the cask outer shell. Two lifting lugs and two redundant lifting lugs are removed during transport. The lid is equipped with three lifting lugs which are covered by the top impact limiter and rain cover during transport.

An optional carbon steel shield insert may be used within the cask cavity for contents as specified in Condition No. 5(b)(1)(i) through (v). For contents specified in Condition No. 5(b)(1)(vi), a source insert shall be used. The source insert design weight is 8,000 lbs; it has side walls consisting of 6.0-inch thick lead, sandwiched between an inner 8 inches nominal SCH 40 steel pipe and an outer 24.0-inch SCH 60 steel pipe. The bottom of the source insert also consists of lead supported by a 0.75-inch thick steel base plate. The lid includes a steel encased lead plug, steel bolting plate and flat silicone rubber gasket.

(3) Drawings

The packaging is constructed and assembled in accordance with Energy*Solutions* Drawing No. C-110-D-29003-010, sheets 1 through 5, Rev. 16.

The Secondary Lid Thermal Shield is constructed in accordance with Energy*Solutions* Drawing No. DWG-CSK-12CV01-EG-0002-01, Rev. 3.

An optional shield insert is constructed in accordance with Chem-Nuclear Systems Drawing No. C-119-B-0018, Rev. 2.

The Source Insert Assembly is constructed in accordance with Energy*Solutions* Drawing No. C-038-145083-004, Rev.0.

The Source Insert Steel Cribbing is constructed in accordance with Energy*Solutions* Drawing No. C-038-145083-005, Rev. 0.

5.(b) Contents

(1) Type and form of material

(i) Byproduct, source, and special nuclear material, non-fissile or fissile-excepted, as special form, or non-special form in the form of process solids or resins, either dewatered, solid, or solidified waste in secondary containers; or

(ii) Dewatered, solid or solidified transuranic-containing wastes (TRU), fissile or non-fissile or fissile-excepted, in secondary containers; or

(iii) Plutonium-239 (Pu-239) as Pu-Be neutron sources meeting the requirements of special form sources; or

(iv) Neutron activated metals or metal-oxides in solid form in secondary containers; or

(v) Miscellaneous radioactive solid waste materials, including special form materials and powdered solids, in secondary containers.

(vi) Byproduct material as Co-60 loaded into the source insert.

(2) Maximum quantity of material per package

(i) The maximum quantity of radioactive materials must be the lesser of the quantity determined by the methodology described in Attachment 1 to Chapter No. 7 of the application or 3000 A_2, except for contents specified in Condition No. 5(b)(1)(vi) for which the limit is 10,000 Ci of Co-60.

(ii) Fissile contents must be limited to the fissile gram equivalent of 325 grams of Pu-239, as determined using the conversion factors in Table 9.1.3, in Chapter No. 4, Appendix 4.10.2, of the application. Plutonium content exceeding 0.74 TBq (20 Ci) must be in solid form.

(iii) TRU exceeding the fissile limits of 10 CFR 71.15 must not be machine-compacted and must have no more than 1% by weight of special reflectors and no more than 25% by volume of hydrogenous material.

(iv) Neutron sources as described in 5(b)(1)(iii) are limited to a maximum emission rate of 1.1E+8 n/sec.

(v) Maximum decay heat: 200 watts.

(vi) Maximum weight of contents: 14,500 pounds including shoring, secondary containers, and either optional shield insert or mandatory source insert. The contents of the source insert have a maximum weight of 500 pounds.

(vii) Explosives, corrosives, non-radioactive pyrophorics, and compressed gases are prohibited. Pyrophoric radionuclides may be present only in residual amounts less than 1 weight percent.

(viii) The total amount of potentially volatile organic compounds present in the headspace of a secondary container is restricted to 500 parts per million.

(ix) Powdered solid radioactive materials shall not include radioactive forms of combustible metal hydrides or combustible elemental metals, i.e., magnesium, titanium, sodium, potassium, lithium, zirconium, hafnium, calcium, zinc, plutonium, uranium and thorium, or combustible non-metals, i.e., phosphorus.

(x) Powdered solids contents with neutron emitters are not permitted.

5.(c) Criticality Safety Index 0.0

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

(a) The package must be prepared for shipment and operated in accordance with the Operating Procedures of Chapter No. 7 of the application.

(b) Each packaging must meet the Acceptance Tests and Maintenance Program of Chapter No. 8 of the application.

7. Transport by air of fissile material is not authorized.

8. Flammable gas (hydrogen) concentration is limited to less than 5% in volume. For contents other than TRU waste, inerting is not allowed to limit the concentration of flammable gases. For TRU waste, compliance with the 5% hydrogen concentration limit is determined by the methods discussed in Appendix 4.10.2 of the application. For contents with a radioactivity concentration not exceeding that for Low Specific Activity material, the hydrogen concentration can be assumed to be less than 5% provided the package is shipped within 10 days of preparation, or within 10 days after venting of drums or other secondary containers.

9. Payload containers authorized for shipment of TRU waste are the 30-gallon and the 55-gallon drums. TRU waste characteristics are determined and limited in accordance with Appendix 4.10.2 of the application.

10. The non-homogeneity of the package contents may lead to elevated levels of radiation on the package surfaces. Radiation surveys must be performed to obtain measurements from all surfaces of the package, and from the outer surfaces of the vehicle enclosure, unless process knowledge or survey history indicates that elevated radiation levels are not likely to be encountered.

11. Appropriate devices or measures must secure contents in the secondary container, if necessary.

12. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.

13. Expiration date: October 31, 2015.

REFERENCES

Energy*Solutions* application dated January 24, 2011.

Supplements dated April 6, September 9, and October 28, 2011; July 20, July 26 and August 10, 2012.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Michael D. Waters, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Date: August 23 , 2012.

SAFETY EVALUATION REPORT
Docket No. 71-9204
Model No. 10-160B
Certificate of Compliance No. 9204
Revision No. 20

SUMMARY

By application dated July 20, 2012, supplemented July 26 and August 10, 2012, Energy*Solutions* requested an amendment to Certificate of Compliance (CoC) No. 9204 to incorporate the addition of a thermal shield as an integral component of the package.

The applicant found that, under an Hypothetical Accident Condition (HAC) of a puncture test followed by a thermal test, the sheet metal covering the hollow region of the impact limiters may rupture and provide a direct heat path to the secondary lid and the baseplate of the package, thus exposing the seals to unacceptable temperatures and eventually leading to a loss of containment for the package. Therefore, a thermal shield plate has been attached to the secondary lid in order to protect the seals.

Revision 19 of the CoC was granted under the provisions of Title 10 Code of Federal Regulations (10 CFR) 71.41(c). The regulation in 10 CFR 71.41(c) states that the NRC may authorize a package using environmental and test conditions different from those specified in either 10 CFR 71.71, "Normal Conditions of Transport" and 10 CFR 71.73, "Hypothetical Accident Conditions," if the controls proposed by the shipper are demonstrated to be adequate to provide the equivalent level of safety.

In order to demonstrate compliance with the requirements of 10 CFR 71.41(a) for this self-identified design issue and to add the thermal shield to all packages prior to each Type B shipment, Energy*Solutions* provided a revision to the consolidated safety analysis report, Revision No. 4, and updated drawings as supporting information to this amendment request.

NRC staff reviewed the applicant's request and found that the addition of the thermal shield allows the package to meet the requirements of 10 CFR Part 71.

1.0 GENERAL INFORMATION

1.1 Package Description

There are no changes to the Model No. 10-160B package as described in the January 24, 2011, application other than (i) the addition of the thermal shield, and (ii) a limitation of the weight of the contents to 14,250 lbs from 14,500 lbs in previous revisions of the CoC.

The thermal shield protects the secondary lid. The thermal shield, consisting of two polished stainless-steel plates separated by a thin air gap, provides an additional air gap above the secondary lid. The thermal shield is attached to the secondary lid lifting lugs with hitch-pins.

1.2 Licensing Drawings

The staff reviewed Licensing Drawing No. DWG-CSK-12CV01-EG-0002, Rev. 3 for the secondary lid thermal shield and Energy*Solutions* Drawing No. C-110-D-29003-010, sheets 1 through 5, Rev. 16, for the packaging itself, and determined that the submitted drawings are adequate.

1.3 Findings

The staff concludes that the information presented in this section of the application provides an adequate basis for the evaluation of the Model No. 10-160B package against 10 CFR Part 71 requirements for each technical discipline.

2.0 STRUCTURAL EVALUATION

The staff reviewed the application to verify that the addition of the thermal shield did not change the results of the previously approved structural analysis.

2.1 Structural Evaluation

The staff reviewed the structural evaluation of the deformation and/or damage to the shield in a scenario of a puncture bar going through the top hollow portion of the impact limiter's sheet-metal cover and contacting the thermal shield and the secondary lid bolts. The applicant showed that, although (i) the puncture bar causes minor damage to the central portion of the shield, and (ii) the shield plates may deform all the way to the lid with only minor damage, the top and bottom plates remain intact over most of their surface area and, as such, provide adequate thermal resistance during the thermal test. In addition, the applicant demonstrated that the secondary lid bolts remain covered by the thermal shield under this scenario.

The applicant also evaluated a scenario of a rod striking the bolt-head, assuming that the thermal shield does not provide any cover to the bolts. Even if the secondary lid comes into contact with the primary lid, the rod does not cause any damage to the lid. Further, the applicant demonstrated that a shear-out of the bolt head is not even possible in a scenario of a rod, inclined at a 27°angle from the lid surface to cause the maximum shear load onto the bolt head: the bolt shear strength is greater than that of the rod, i.e., 216,450 lbs versus 156,420 lbs. The staff reviewed the information provided and determined that the puncture bar will not cause any damage to the bolts even under this scenario.

2.2 Materials Evaluation

The thermal shield is made of ASTM A240 Type 304 austenitic stainless steel plates joined by ASTM A276 Type 304 sectioned pipes. The staff has confirmed that the material properties are acceptable. The staff notes that the minimum ASTM elongation strain at rupture for ASTM A276 Type 304 is 35%, while the finite element analysis (FEA) of the sectioned piping predicts a 40% strain, in the plastic regime following a puncture test. The FEA strain is reported in terms of true stress and strain, while the ASTM specification requires a minimum engineering strain. As such, the equivalent minimum engineering strain of the ASTM A276 Type 304 will be sufficient to prevent rupture of the sectioned pipes of the thermal shield during a puncture test.

Staff also noted a typographical error related to the schedule of the pipe used for the optional shield insert: the inner 8 inches SCH 60 steel pipe for the insert is in fact a SCH 40 pipe.

2.3 Findings

The structural analyses and calculations that were submitted for the addition of the thermal shield in this amendment request, have adequately confirmed that the design of the thermal shield is acceptable and in compliance with the requirements of 10 CFR Part 71.

3.0 THERMAL EVALUATION

The addition of a thermal shield to the secondary lid of the package reduces the heat load on the package body during an HAC fire event and allows the seal temperatures to be kept below their maximum allowable temperature limits. The applicant performed a 2-D thermal evaluation, predicted a maximum O-ring seal temperature of 375°F when considering a scenario in which the puncture bar impacts the thermal shield, and concluded that the package is in compliance with 10 CFR 71.51.

3.1 Thermal Evaluation

In order to protect the containment seals during an HAC thermal event, a thermal shield, consisting of two stainless steel plates covering the entire secondary lid surface (the plate and the bolts) and separated by a thin air gap, was installed onto the secondary lid of the package. The thermal shield bottom plate is insulated with air-pocket from the “outside” surface of the secondary lid. Seven pipe stubs are welded to the thermal shield plates to act as stand-offs providing an additional air gap above the secondary lid. A 0.104 inch thick fire shield, with a 0.156 inch thick air gap between the shield and the outer structural shell of the packaging, also covers the exposed portion of the body of the packaging.

3.2 Modeling

The 200-watt internal heat load is applied as a constant heat flux over the exposed inner surface of the secondary lid using a 2-D finite element model ANSYS code that includes only the secondary lid. The total insolation is modeled to be 400 gcal/cm^2 for a 12-hour period for curved surfaces during the post-fire cooldown, according to 10 CFR 71.71. The ambient temperature is set up as 1475°F during the 30-min fire transient and 100°F during post-fire cool-down. For radiation heat transfer between the thermal shield and the environment, an emissivity of 0.9 is specified for the 30-minute fire transient, and a calculated emissivity of 0.7347 is used during post-fire cool down. Heat transfer is enhanced from the ambient fire to the thermal shield by forced convection during the 30-minute fire transient and is reduced from the thermal shield to the ambient air by natural convection during the cool-down period. The proposed thermal model is acceptable for predicting the secondary lid seal temperatures.

The major assumptions used in the applicant’s 2-D model (excluding the primary lid in the model) are listed below.

(i) The scenario in which the puncture bar impacts the thermal-shield is addressed. The damaged thermal-shield model assumes that, even in a deformed shape, the thermal shield remains in close contact with the lid and hence, transfers a large amount of heat to the secondary lid during a 30-minute fire transient.

(ii) The heat conduction between the primary and secondary lids is neglected to eliminate the heat loss from the secondary lid to the primary lid.

(iii) The radiation heat transfer between the primary and secondary lids is neglected to reduce the heat loss from the secondary lid to the primary lid.

(iv) The two circular plates of the secondary lid are assumed to be totally connected as a solid plate to increase the heat input during 30-minute fire transient.

(v) A larger radiation emissivity of 0.3 is used, instead of 0.15, between two thermal shield plates during the 30-minute fire transient. The use of a radiation emissivity of 0.3 increases the heat input into the secondary lid and the containment seals.

The staff reviewed these assumptions and found them acceptable.

3.3 Findings

The staff confirmed that (i) the thermal-shield design features are adequately described and evaluated, (ii) the 2-D thermal model, including only the secondary lid, is discussed and described in sufficient detail for verification of thermal-shield effectiveness, (iii) the assumptions, used in the analysis, provides conservative predictions and, (iv) a calculated maximum seal temperature of 375°F is obtained from the damaged thermal-shield model.

The staff finds that the model analysis addressing the scenario in which the puncture bar impacts the thermal-shield is acceptable and that all temperatures in the package components due to HAC conditions are below their maximum allowable limits. The maximum HAC seal temperature of 375°F, during the cool-down period of the fire transient, has a “built-in” margin of safety. The maximum temperature in the lead shielding is calculated to be 274°F, well below the melting point of 622°F, and the steel body of the package is also well below the materials’ service limits. Thus, the staff finds that the secondary lid seal will maintain its containment function during a fire transient and a post-fire cool-down period.

The staff has reasonable assurance that the thermal shield is capable of substantially reducing the secondary lid seal temperatures during an HAC fire accident and that the package meets the thermal requirements of 10 CFR Part 71.

4.0 CONTAINMENT EVALUATION

The applicant has proposed no containment changes to the Model No. 10-160B package design. The staff determined there is reasonable assurance that the containment seals will maintain their containment function during HAC.

5.0 SHIELDING

The applicant has proposed no shielding changes to the Model No. 10-160B package shielding design and evaluation.

6.0 CRITICALITY EVALUATION

The applicant has proposed no changes to the Model No. 10-160B package criticality evaluation.

7.0 PACKAGE OPERATIONS

The applicant has proposed minor changes to the operating procedures of the package to account for the installation or removal of the thermal shield during package loading and unloading, and of its associated anti-tamper seals.

The staff reviewed the changes and determined they were acceptable.

8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

The applicant has proposed no changes to the general acceptance tests and maintenance program of the package.

CONDITIONS

The conditions specified in the Certificate of Compliance have been revised to incorporate several changes as indicated below:

Item No. 3(a) was revised to include the new name of the Certificate holder, Energy*Solutions* Services, Inc.

Condition No. 5(a)(2) has been revised to (i) include the thermal shield in the description of the package, (ii) the reduced weight of the contents to 14,250 lbs from 14,500 lbs, and (iii) a typographical error related to the schedule of the pipe used for the optional shield insert (the inner 8 inches SCH 60 steel pipe for the insert has been replaced with a SCH 40 pipe).

Condition No. 5(a)(3) has been revised to include Drawing No. C-110-D-29003-010, sheets 1 through 5, Rev. 16, and the new drawing related to the Secondary Lid Thermal Shield, Drawing No. DWG-CSK-12CV01-EG-0002-01, Rev. 3.

Condition No. 13 on the use of CoC Revision No. 17 until December 31, 2012, was removed because it became obsolete. Since all existing packages have been modified to include the required thermal shield, no previous revision of the certificate is authorized.

The reference section was updated to include the supplements dated July 20 and August 10, 2012. The expiration date of the certificate was not changed.

CONCLUSION

Based on the statements and representations in the application, as supplemented, and the conditions listed above, the staff concludes that the Model No. 10-160B package design has been adequately described and evaluated and that these changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9204, Revision No. 20,
on August 23, 2012.