August 23, 2012

Mr. Patrick L. Paquin
General Manager – Engineering
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Energy*Solutions*
Suite 100, Center Point II
100 Center Point Circle
Columbia, SC 29210

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 9204 FOR THE MODEL NO. 10-160B PACKAGE

Dear Mr. Paquin:

As requested by your letter dated July 20, 2012, supplemented July 26 and August 10, 2012, enclosed is Certificate of Compliance No. 9204, Revision No. 20, for the Model No. 10-160B package. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The staff's Safety Evaluation Report is also enclosed.

The approval constitutes authority to use the package for shipment of radioactive material and for the package to be shipped in accordance with the provisions of 49 CFR 173.471.

If you have any questions regarding this certificate, please contact Pierre Saverot of my staff at (301) 492-3408.

Sincerely,

/RA/

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

Docket No. 71-9204
TAC No. L24669

Enclosures:
1. Certificate of Compliance No. 9204, Rev. No. 20
2. Safety Evaluation Report

cc w/encl 1 & 2: R. Boyle, Department of Transportation
J. Shuler, Department of Energy
Registered Users

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(Closes TAC No. L24669)

G:SFST\Part 71 Casework\71-9204.r20.letter&ser.doc and 71-9204.r20.doc
ADAMS P8 Package No.: ML12235A232 ADAMS P8 Letter No.; ML12235A236

OFC:	SFST	E	SFST	E	SFST		SFST		SFST		SFST	
NAME:	P. Saverot		JChang		MSampson		MDeBose		BTripathi		DPstrak	
DATE:	07/20/2012		08/01/2012		08/15/2012		08/06/2012		8/21/12		8/21/12	
OFC:	SFST	E	SFST	E	SFST		SFST		SFST		SFST	
NAME:	MWaters											
DATE:	8/23/12											

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^{o}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.