UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 28, 2015

Ms. Lori Podolak
Regulatory Affairs Department
QSA Global, Inc.
40 North Avenue
Burlington, MA 01803

SUBJECT: REVISION NO. 4 OF CERTIFICATE OF COMPLIANCE NO. 9357 FOR THE MODEL NO. SENTRY TRANSPORTATION PACKAGES

Dear Ms. Podolak:

As requested by your application dated October 22, 2014, as supplemented on February 25, March 3, June 25, and November 18, 2015, enclosed is Certificate of Compliance No. 9357, Revision No. 4, for the Model No. SENTRY transportation package. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The staff's safety evaluation report is also enclosed.

This 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 10 CFR 71.17 or 49 CFR 173.471.

If you have any questions regarding this certificate, you may contact me or Bernard White of my staff at 301-415-6577.

Sincerely,

/RA/

Steve Ruffin, Acting Chief
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9357
TAC No. L24960

Upon removal of Enclosure 3, this document is uncontrolled.

Enclosures:
1. Certificate of Compliance No. 9357, Rev. No. 4
2. Safety Evaluation Report
3. Registered Users

cc w/encls: R. Boyle, Department of Transportation
J. Shuler, Department of Energy, c/o L. F. Gelder

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SAFETY EVALUATION REPORT
Docket No. 71-9357
Model No. SENTRY
Certificate of Compliance No. 9357
Revision No. 4

SUMMARY

By application dated October 22, 2014, as supplemented on February 25, March 3, June 25, and November 18, 2015, QSA Global (QSA or the applicant) requested an amendment to Certificate of Compliance (CoC) No. 9357, Revision No. 4, for the Model No. SENTRY transportation package. QSA requested the CoC be revised to changes to the drawings. In support of its request, the applicant's November 18, 2015, submittal was a consolidated application.

EVALUATION

The Model No. SENTRY package consists of three designs, the Sentry 110, Sentry 330 and the Sentry 867. The three designs all share a similar structure but incorporate variation in the individual designs.

In its application, QSA requested minor changes to the package design, which include adding a tungsten cover shield to Sentry 867 shield plate, an option for class 3 or 4 tungsten in addition to the class 1 or 2, and adding supplemental shielding for those shields that measure between 200 and 500 mRem/hr on the surface or between 2 and 20 mR/hr, 1 meter from the surface of the shield.

STRUCTURAL EVALUATION

The applicant requested the use of optional supplemental depleted uranium (DU) shielding for all three SENTRY models. The supplemental shielding is attached to existing shielding (also DU). The applicant stated that the optional shielding does not exceed weight limits specified on sheet 1 of the licensing drawings, and is attached to existing shielding in the same fashion as was previously approved for similar supplemental shielding. Given this, the applicant stated that normal conditions of transport and hypothetical accident conditions evaluations would not be affected by this change since the package weights, with the supplemental shielding, will be bounded by those previously approved configurations and the maximum package weight in the CoC. The staff reviewed the applicant's evaluation and agrees that the structural performance of the package would not be altered with respect to the tests and conditions in Title 10 of the *Code of Federal Regulation* (10 CFR) 71.71 and 10 CFR 71.73.

The applicant requested the use of a tungsten cover shield as detailed in Drawing No. R86000, Rev. N, Sheet 6, Section A6-A6, of the licensing drawings for the rear plate assembly of Sentry 867. This tungsten cover shield sits over the flexible source assembly within the dust cover, and does not alter the package profile. The applicant stated that the tungsten cover shield will provide additional protection to the components beneath it by distributing impact loads experienced during the penetration and puncture test. In addition, the applicant stated that the

package's performance will not be diminished with respect to the drop tests for normal conditions of transport and hypothetical accident conditions with the addition of the tungsten cover shield. Since the port tube (also shown on sheet 6 of the licensing drawings) would continue to protect the rear plate assembly as observed in previous drop testing results, the staff has determined that the tungsten cover shield would not adversely affect Sentry 867's ability to meet the tests and conditions related to drop, penetration, and puncture as specified in 10 CFR 71.71 and 10 CFR 71.73.

Based on review of the statements and representations in the application, the staff concludes that the SENTRY package meets the structural requirements of 10 CFR Part 71.

Materials Evaluation

The shield is cast DU alloyed with 0.75% titanium (U-0.75%Ti). An S-shape tube made of Ti-3Al-2.5V is placed at the center of the shield to store the ^{60}Co source(s). The Model 867 shield S-tube has a partition in its center (also made of Ti-3Al-2.5V) to prevent the ^{60}Co sources from being able to exit the shield on the side opposite from which they were inserted.

The shell is a welded cylindrical body fabricated with Type 304 or 304L stainless steel. Two tube shaped access ports made of the same material are welded to the body of the package in diametrically opposed locations. Spacers are not required due to the larger dimension of the DU shield.

The DU alloy shield is placed inside the welded body of the package, and closed cell polyurethane foam of density 20±2 pounds per cubic foot fills the gap between the shield and the welded shell. The shield is attached to the access ports of the welded body using 0.73" Ti-6Al-4V pins that pass through holes in the shield and through shield mounting bars that are welded to the access port structures. Wherever the DU shield would normally be in contact with stainless steel, copper alloy 110 discs, brackets and cups are used to prevent direct contact and avoid galvanic corrosion of the DU shield.

Lock assemblies are used to secure the ^{60}Co sources in the center of the shield during transport. There is one lock assembly per ^{60}Co source, thus the Sentry 867 model has two lock assemblies. The lock assemblies are bolted with 17-4 PH stainless steel bolts to both access ports of the Sentry 867 model. The Sentry 867 model lock assemblies also have a selector ring, but use a locking pin mechanism instead of a lock slide mechanism to secure the ^{60}Co source(s) into position. The materials that are used to fabricate the lock assemblies are 300 series stainless steels (Types 301, 302, 303, 304/304L, and 316), as well as 17-4 PH stainless steel and American Society for Testing and Materials (ASTM) B777 nickel plated tungsten alloy. The locking pins used in the Sentry 867 lock assemblies are made of hardened tool steel. The lock assemblies are protected by a polyethylene and 300 series stainless steel (Types 302, 303, 304, 304L or 316) dust cover. A brass alloy 485 plunger lock is inserted in the lock cover assembly to prevent rotation of the selector ring and thus movement of the ^{60}Co source(s).

The optional rib and link assemblies that can be bolted to the basic package configuration to make it into the standard package configuration are made of 17-4 PH stainless steel. The bolts used to attach the ribs are also made of 17-4 PH stainless steel. Optional rib inserts made of polyethylene or polyurethane can be attached to the ribs using 300 series stainless steel screws. The ribs are bolted to the links using 300 series stainless steel heavy duty bolts and nuts.

Various tungsten alloy specifications cover requirements, chemistry, mechanical and physical properties for four classes of machinable, high-density tungsten base metal. These properties vary depending on the class, however the staff considers all classes to be acceptable based on the form, fit and function of the tungsten component(s) used in assembly of the Sentry 867.

The description of the package, including licensing drawings R86000, Rev. N, provide dimensions, weights, shielding features, structural features, and materials. The special form contents ensure proper containment of the radioactive material to be transported, thus the containment boundary need not be defined for these packages. Consequently, the staff finds that the description of the package provided by the applicant is adequate and satisfies the requirements of 10 CFR 71.31(a)(1), 10 CFR 71.33(a), and 10 CFR 71.43(a).

The materials used in the fabrication of the components of the QSA Sentry 110, Sentry 330 and 867 models are specified in the CoC Drawing No. R86000, Rev. N. The room temperature mechanical properties of the principal materials of construction are provided in the safety analysis report, Table 2.2a.

For every material listed in Table 2.2a, the staff verified that the form listed was in agreement with the standard specification for that material and found that this was the case. The staff also verified that the chosen material type and condition (where applicable) were covered by the standard specification cited for that material, and found this to be the case in every instance.

The minimum tensile strength, minimum yield strength, and elongation of the materials used in the QSA Sentry family of packages are listed in Table 2.2a. The staff checked these material properties against those provided in the corresponding ASTM and SAE International Aerospace Material Specifications (for the U-0.75%Ti) standards and found that these properties were correct for every combination of material type and condition listed in Table 2.2a.

Prevention of Galvanic, Chemical, or Other Reactions

Section 2.2.2 of the safety analysis report addresses potential galvanic or chemical reactions for the QSA Sentry family of packages.

Permanent dissimilar metal contacts in the Sentry 110, Sentry 330, and 867 models exist between the following alloys: 300 series stainless steel, 17-4 PH stainless steel, titanium alloys Ti-6Al-4V and Ti-3Al-2.5V, copper alloy 110, nickel (used to plate tungsten components), brass alloy 485, and bronze alloy 655. Staff has verified that the galvanic potential difference between all of the above alloys is small enough to prevent any galvanic reactions.

Galvanic corrosion and eutectic formation during hypothetical accident conditions could potentially take place if the DU shield came into contact with stainless steel, thus copper discs, brackets and cups are used to prevent any contact between the shield and any part of the stainless steel body of the transport package. Staff finds that the galvanic potential difference between copper and uranium is low enough to prevent any significant galvanic corrosion of the shield.

SHIELDING EVALUATION

The proposed amendment requested to add tungsten cover shield to the Model 867 dust cover assembly to provide additional shielding and further reduce external package dose rates. The addition of the tungsten cover shield in the dust cover assembly will replace some of the

polyethylene/polyurethane material previously located in that area. The tungsten in this location will perform the same or better than the polyethylene/polyurethane material that was tested for conformance to the maximum dose rates after the tests for normal conditions of transport and hypothetical accident conditions.

The staff reviewed the tungsten cover shield and determined that the modification will have no adverse impact on the Sentry 867's performance as a Type B transport package. Also, the staff concluded that tungsten provides better shielding and reduces the external package dose rates.

Another change request on this proposed amendment is to allow application of supplemental DU shielding to shields that initially measure a maximum of 500 mR/hr on the surface (instead of 225 mR/hr currently approved) or a maximum of 20 mR/hr at one meter from the surface (instead of the 10 mR/hr currently approved).

The staff reviewed Drawing No. 86000 Revision J, sheet No. 9 of 10 and found that the Note 6 was not clear about the use of the supplemental DU shielding attached to the shield by tape or strap. The applicant clarified on Drawing No. R86000 Revision K, sheet 11 of 11, Note 2 that the supplemental shields applied only when radiation measurements without supplemental shields are as follow:

- Package surface dose rate is at or over 200 mRem/hr but not over 500 mRem/hr.
- 1-meter dose rate from the package surface is at or over 2 mRem/hr, but nor over 20 mRem/hr.

Also, the applicant clarified that the package radiation limits must conform with 10 CFR Part 71 with supplemental shields, if needed. These changes are also included in Drawing No. R86000, Rev. N. Staff reviewed the use of supplemental shielding and found reasonable assurance that it satisfies the shielding requirements of 10 CFR Part 71.

Based on reviews of the statements and representations in the amendment, the staff concludes that the additional shielding has been adequately described and that the package meets the external radiation requirements of 10 CFR Part 71.

CONDITIONS

Condition No. 5(a)(3) was revised to include Drawing No. R86000, Rev. N, sheets 1-11.

Condition No. 10 has been updated to allow continued use of the previous revision for up to 1 year.

The references section has been updated to include this application.

CONCLUSION

Based on the statements and representations in the application, as supplemented, and with the conditions listed above, the staff agrees that with these changes, the package continues to meet the requirements of 10 CFR Part 71.

Issued with CoC No. 9357, Revision No. 4,
on 12-28-15.