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

August 25, 2014

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

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 6613, REVISION NO. 18, FOR THE MODEL NO. 702 TRANSPORTATION PACKAGE

Dear Ms. Podolak:

As requested by your letter dated December 12, 2013, as supplemented April 24, 2014, July 3, 2014, and July 14, 2014, enclosed is Certificate of Compliance No. 6613, Revision No. 18, for the Model No. 702 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.

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 Title 49 of the *Code of Federal Regulations* (49 CFR) 173.471. Those on the attached list have been registered as users of the package under the general license provisions of 10 CFR 71.17 or 49 CFR 173.471.

If you have any questions regarding this certificate, please contact me or John Vera of my staff at (301) 287-9165.

Sincerely,

/RA/

Timothy Lupold, Acting Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-6613
TAC No. L24870

Enclosures: 1. Certificate of Compliance No. 6613, Rev. No. 18
2. Safety Evaluation Report
3. Registered Users

Upon removal of Enclosure 3, this document is uncontrolled

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

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ADAMS P8 Package No.: ML14237A055 **Letter No.: ML14237A056**

OFC:	SFST	SFST	SFST	SFST	SFST	SFST
NAME:	JVera	WWheatley for MDeBose	ITseng	RTorres	JChang	VWilson
DATE:	8/5/2014	8/5/2014	8/6/2014	8/5/2014	8/6/2014	8/6/2014
OFC:	SFST	SFST	SFST	SFST	SFST	SFST
NAME:	D Tarantino for ACsontos	CAraguas	MRahimi	TLupold		
DATE:	8/20/2014	8/8/2014	8/7/2014	8/25/2014		

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UNITED STATES
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SAFETY EVALUATION REPORT
Docket No. 71-6613
Model No. 702 Transportation Package
Certificate of Compliance No. 6613
Revision No. 18

SUMMARY

By letter dated December 12, 2013, as supplemented April 24, 2014, July 3, 2014, and July 14, 2014, QSA Global, Inc. (QSA) requested an amendment to Certificate of Compliance (CoC) No. 6613. The changes included increasing the maximum content weights from 200 grams to 400 grams, clarifying the use of content activity and output activity for authorized contents, and revising the package thermal and pressure evaluations. QSA also provided a consolidated safety analysis report (SAR) in the course of this review.

NRC staff reviewed the application using the guidance in NUREG-1609 "Standard Review Plan for Transportation Packages for Radioactive Material." Based on the statements and representation in the application, as supplemented, and the conditions listed below, the staff concludes that the package continues to meet the requirements of 10 CFR Part 71.

EVALUATION

2.0 STRUCTURAL EVALUATION

2.1 Structural Evaluation

The maximum weight of the package contents increased from 200 grams to 400 grams. This increase to the maximum weight of the package has negligible increase to the 186 kilogram total weight of this transport package, and thus has a negligible effect on the package's ability to meet the Type B(U) transport requirements. The staff finds this change acceptable.

The term "shield cask" was clarified to include "shield container and special form source capsules" to clarify throughout that the special form source capsules would also be affected by an updated hypothetical increased internal pressure differential in the gasketed cask cavity of up to 7 psi (up from 6.8 psi) built up under normal conditions of transport (NCT), as calculated in Section 3.4.3 of the SAR. A similar change from 6.8 psi to 7 psi was also made for increased external pressure to reflect calculations in Sections 2.6.3 and 2.12.17 of the SAR. The changes in pressure differential from 6.8 psi to 7 psi have negligible effect on the stresses imparted by this pressure differential, which remain well below the tensile strength values of all affected components, as demonstrated by the applicant's analyses. Therefore, the staff finds the minor pressure differential changes and the editorial change clarifying that the special form source capsules are not vented to ambient to be acceptable.

The basis for compliance of capsule integrity was updated to be based on the heat test qualification requirements of special form radioactive materials outlined in 10 CFR 71.75(b)(4)

where “the specimen must be heated in air to a temperature of not less than 800°C (1475°F), held at that temperature for a period of 10 minutes, and then allowed to cool”, after which the containment must remain intact. During the test, each source is tested to withstand much higher pressures than the pressures required by 10 CFR 71 requirements. Therefore, the staff finds this new basis acceptable.

2.2 Materials Evaluation

The staff performed a materials review on the information submitted in References 1 through 3 regarding the request for amendment of Certificate of Compliance No. 6613 for the Model 702 transport package. This package contains no pyrophoric, flammable, or explosive components. The applicant expanded Table 3.2 of the SAR, “Thermal Properties of Principal Transport Package Materials,” to clarify stainless steel entries and add Titanium and MP35N alloy. The staff verified that no additional changes were made to the package construction or design following these additions. The new listed materials have melting temperatures well exceeding the thermal test temperature of 800°C (1,472°F) for hypothetical accident conditions (HAC). The carbon steel components of the Model 702 transport package are susceptible to brittle fracture at low temperature. However, the transport package was previously tested at temperatures down to -40°C (-40'F), which meet and exceed requirements in 10 CFR 71.71, without any loss of structural integrity or shielding efficiency. The staff did not identify any additional changes which would result in material incompatibilities or the generation of corrosive atmospheres due to thermolysis or radiolysis.

Based on its review of the materials and representation provided by the applicant, the staff concludes that the amendment requested in Reference 1 does not result in a change to the design or construction of the transport package. The staff has reasonable assurance that the materials used in the Model 702 package meet regulatory requirements of 10 CFR 71.

3.0 THERMAL EVALUATION

3.1 Requested Changes

The applicant proposed to increase the content weight of Model 702 transport package from 200 grams to 400 grams for heavier capsules, and the revised calculations provided in the SAR decreased the decay heat limit from 130 to 92 watts.

3.2 Decay Heat

The Model 702 transport package is a passive thermal device with no mechanical cooling system or relief valve. All package components, except for the shield cask and the special form capsule, are vented to the atmosphere, and therefore no pressure will build up in any other parts of the package under HAC. The maximum package source decay heat is 92 watts for the isotope Ir-192.

3.3 Normal Conditions of Transportation

With the maximum package source decay heat of 92 watts, the applicant calculated the package surface temperatures of 111°F (44°C) with no insolation and 160°F (71°C) with solar heating effects under NCT, as described in SAR Technical Report No. 233. The Model 702 package is for nonexclusive use shipments.

After reviewing the thermal assumptions used in the model and the resulting surface temperatures, the staff determined that none of the accessible surface temperature on the Model 702 will exceed 50°C in still air at ambient 38°C, as required by 10 CFR 71.43(g).

The maximum component temperature and maximum normal operating pressure for Model 702 are 160°F and 21.7 psi, respectively, under NCT, as described in SAR Section 3.4.3 and Technical Report No. 244.

The staff reviewed the thermal assumptions and calculations, provided in SAR Section 3.4.3 and Technical Report No. 244, and concluded that (1) the package is capable of withstanding this pressure and temperature with no adverse effect on the containment function and (2) all the important-to-safety components have the temperatures below their corresponding melting points to perform the transport safety function as designed.

3.4 Hypothetical Accident Conditions

The maximum component temperature and maximum pressure for Model 702 are 1483°F (806°C) and 68.0 psi (a pressure increase of 53.3 psi from the atmosphere), respectively, under HAC, as described in SAR Section 3.5.3 and Technical Report No. 234. The maximum stress on each bolt (304 stainless steel), induced by the pressure differential of 53.3 psi, is 458 psi which is only 5% of the yield strength of 10,000 psi for the 304 stainless steel.

The applicant stated in SAR Section 3.5.3 that the Neoprene gasket on the Model 702 will be melted and charred and the resulting gases will escape the package through the space left by the melted gasket. The other package materials are suitable for use at 806°C. The depleted uranium, which is susceptible to oxidation, is enclosed within the stainless steel and would not be exposed to oxygen.

The staff reviewed the thermal assumptions used in the HAC model and the calculations in SAR 3.5 and Technical Report No. 234. The staff concludes that the temperatures of critical components are below their melting points (SAR Table 3.2.A) and the induced thermal stress is not sufficient to cause package failure.

3.5 Evaluation Findings

Based on its review of the statements and calculations in this application, the staff concludes that the thermal design has been adequately described and evaluated, that the thermal performance of the package meets the thermal requirements of 10 CFR Part 71.

5.0 SHIELDING EVALUATION

The purpose of the shielding review is to verify that the changes to the package design meet the external radiation requirements of 10 CFR Part 71 for NCT and HAC. QSA proposed changes to the CoC and SAR. The staff reviewed the submittal using the guidance in NUREG-1609, “Standard Review Plan for Transportation Packages for Radioactive Material.” The staff’s evaluation of each change as it pertains to the shielding capability of the package is discussed below.

5.1 Addition of Ir-192 "output activity"

The applicant requested an additional content of 6,500 Ci of Ir-192. The applicant requested that this be specified as "output activity" rather than "content activity." The applicant uses the definition of "output activity" for source activity that is determined via measurement. The applicant references American National Standard N432 (Reference 4). Section 8.1.2 of Reference 4 gives the measurement procedure used for determining the activity and it lists the gamma constants for a few common source radionuclides. The applicant defines "content activity" as the assigned activity value of a source. This does not account for self-attenuation of the source material or attenuation through the source encapsulation, so the amount of radiation emitted from the source would be some value less. Revision 16[1] of the QSA 702 CoC already has a content of 15,000 Ci of Ir-192 as "output activity." The staff questioned why the applicant requested the addition of the same content in a lesser amount. In Reference 5 the applicant clarifies that specifying this content as "output activity" was an error and one of the purposes of the amendment request was to correct this error. The applicant clarified that the evaluations that they performed to determine the allowable Ir-192 limits was appropriate for determining content activity, therefore the 15,000 Ci Ir-192 limit in the CoC should have instead been content activity. The staff finds this change to be conservative, and therefore acceptable, as a source specified as "content activity" has less radioactive emissions than one specified in "output activity" as content activity does not account for self-shielding.

The applicant states that the 6,500 Ci Ir-192 is equivalent to the 15,000 Ci Ir-192 but divided by a factor of 2.3 to account for self-shielding. From the perspective of meeting external dose rate limits, any amount of Ir-192 lower than the evaluated 15,000 Ci would produce lower external dose rates no matter the mechanism for calculating the activity. However, the QSA-702's thermal evaluation is based on 92 Watts which corresponds to 15,000 Ci Ir-192 so the package cannot be loaded with more than this without being outside of its evaluation basis with respect to meeting regulatory temperature and pressure limits. Therefore the applicant must justify that the factor of 2.3 adequately represents the reduction in activity due to the self-shielding of the source.

In References 5 and 6 the applicant explains the basis for the factor of 2.3. This included a report that documented the basis for this factor. Some statements in the report did not give the staff confidence in the accuracy of this value and the staff was unable to review some of the important assumptions within the report related to source size and gamma spectra. This led the staff and the applicant to perform further analysis using MCNP to confirm this factor.

The applicant submitted MCNP calculations for 2 source sizes in Section 3.6.2 of Reference 6. In these calculations the applicant modeled the Ir-192 source and used a spherical tally surface and the F2 tally in MCNP which takes an average over the entire surface to obtain the dose rate. The staff finds the selection of this tally and surface used acceptable because the applicant states that in determining output activity they would place the source inside a well counter geometry which also averages emissions in all directions. The applicant compares

[1] This SER corresponds to CoC Revision 18. The changes submitted in the associated application were submitted when CoC Revision 16 was the most current CoC and therefore staff reviewed the application in context to the changes to Revision 16. Following submittal of this application, QSA submitted another CoC amendment request that was issued prior to the completion of this review and therefore was documented as Revision 17. Because the review for Revision 18 was nearly complete, staff applied some changes discussed in this SER to Revision 17.

these to a point source with no self-shielding from the source material or encapsulation and calculates the ratio of the two calculations.

The sources modeled by the applicant are cylindrical and have the following dimensions:

Source 1
3mm diameter
4mm height
1.675mm encapsulation wall thickness

Source 2
2.7mm diameter
5.25mm height
1.825mm encapsulation wall thickness

For Source 1 the applicant calculated a factor of 2.14 and for Source 2 the applicant calculated a ratio of 2.04. These calculations demonstrate that the applicant's factor of 2.3 is conservative as long as the source sizes do not exceed these. Therefore the staff has added these maximum source dimensions to the CoC

The applicant states that source encapsulations are stainless steel. Although they assumed 99% Iron and 1% Carbon at 7.8 g/cm^3, actual composition and density of stainless steel would vary slightly from this. However, the staff does not find that using other compositions or densities of steel would give such different results that any regulatory limits would be exceeded. This is primarily based on taking into account the conservatisms in the evaluation, i.e. using a factor of 2.3 versus a more realistic 2.14 or 2.04 and there is margin to regulatory limits for the thermal calculation as well.

The applicant also states that there may be additional encapsulation layers for some designs and that some designs may include metallic inserts/spacers surrounding the Ir-192 active volume. The applicant states that in those cases the maximum diameter of the Ir-192 material is reduced to accommodate the additional metallic inserts/spacers such that the overall dimensions do not exceed those of the evaluated dimensions stated above. The staff finds this acceptable with the condition that the material that replaces the Ir-192 have lower gamma attenuation than Ir-192. Although higher density materials with good attenuation properties are desirable for shielding, in this case, the staff is more concerned about the decay heat. Therefore, the staff finds that increasing the encapsulation material in the manor discussed above is acceptable as long as they provide overall less shielding than the evaluated configurations.

5.2 Change of "Output Activity" to "Content Activity" for Cs-137, Se-75, Yb-169

Cs-137, Se-75, Yb-169 were previously listed in Revision 16 of the CoC as "Output Activity." In a teleconference on March 26, 2014 (Reference 7), the staff questioned the applicant if these other contents were also erroneously listed as "output activity" as was the Ir-192. The applicant stated that this was an error and should be "Content Activity." The staff finds this change acceptable because how source activity is determined does not affect the shielding capability of the package, and external dose rates would actually decrease because realistically there is shielding from self-shielding and encapsulation that is not being credited. As discussed in Section 5.1 of this SER, this change could affect the assumptions used in the thermal evaluation, however determining activity as "content activity" gives the lowest possible thermal

output as no self-shielding or shielding from the encapsulation is credited and is a conservative change to the CoC.

5.3 Revision to Decay Heat Evaluation

The applicant revised the decay heat evaluation. The content with the limiting decay heat used for package evaluation is 15,000 Ci Ir-192. The applicant calculated the maximum decay heat for this source as 92 watts. The applicant had previously calculated the resulting value as 130 watts. The staff independently calculated the decay heat for 15,000 Ci of Ir-192 from all gamma and beta emissions listed in ICRP Publication 38 (Reference 8) and obtained the same decay heat value of 92 watts that the applicant obtained, therefore the staff finds the use of this value acceptable.

5.4 Added Reference to Special Form Source Capsule

The applicant added a reference to the X9099 special form source capsule to Section 2.10 and 2.12.19 of the SAR. The applicant lists this reference as one of the typical special form sources shipped in this package. DOT issued this special form certificate. The staff reviewed the information in the certificate and finds that the contents are within the acceptable limits of the CoC. The staff finds that the addition of this reference to the SAR is acceptable.

5.5 Conclusion

Based on review of the statements and representations in the application, the staff concludes that the shielding design has been adequately described and evaluated and that the package meets the external radiation requirements of 10 CFR Part 71.

CONDITIONS

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

Section 3.b. has been updated to identify the consolidated safety analysis report submitted July 3, 2014 as the package application.

Condition 5.(b)(2) has been updated to specify the allowed geometric configurations for Ir-192 as output activity.

Condition 5.(b)(3) has been updated to specify 92 watts as the maximum decay heat per package.

Condition 5.(b)(4) has been updated to specify 0.88 pounds (400 grams) as the maximum weight of contents.

The References section has been updated to identify the consolidated safety analysis report submitted July 3, 2014, as the package application, and add the supplement of July 14, 2014.

CONCLUSION

Based on the statements and representations in the application, as supplemented, and the conditions listed above, the staff concludes that the changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 6613, Revision No. 18.

REFERENCES

1. Letter from L. Podolak (QSA Global, Inc.) to NRC re: request for amendment of certificate of compliance USA/6613/B(U)-96, Rev. 16, for the Model 702 Type B(U) Transport Package, Docket No. 71-6613, December 12, 2013 (ADAMS Accession No. ML13350A160).

2. Letter from M. Fuller (QSA Global, Inc.) to NRC re: USA/6613/B(U)-96 (Current Revision 16). June 11, 2014 (ADAMS Accession No. ML14171A096).

3. Letter from L. Podolak (QSA Global, Inc.) to NRC re: corrected pages to SAR revision 14. July 14, 2014 (ADAMS Accession No. ML14213A011).

4. American National Standard N432; “Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography,” American National Standards Institute August 1980

5. Letter from L. Podolak (QSA Global, Inc.) to J. Vera (US NRC), Docket No. 71-6613, TAC No. L24870, April 24, 2014 (ADAMS Accession No. ML14154A085)

6. Enclosure, “702 SAR Revision 14,” to Letter from L. Podolak (QSA Global, Inc.) to J. Vera (US NRC), Docket No. 71-6613, TAC No. L24870, July 3, 2014 (ADAMS Accession No. ML14203A357)

7. NRC Form 699 – Conversation Record - Telephone Conference with Lori Podolak, QSA Global, Inc., re NRC Questions Regarding December 12, 2013 Application for Amendment of Certificate of Compliance No. 6613, for the Model 702 Package (Docket No. 71-6613). May 15, 2014, (ADAMS Accession No. ML14136A227)

8. "Radionuclide Transformations, Energy and Intensity of Emissions," Annals of the ICRP, ICRP Publication 38, Volumes 11-13 1983