

August 25, 2006

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

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 9027 FOR MODEL NUMBER 741-OP
TRANSPORT PACKAGE (TAC NOS. L23895, L23896, AND L23922)

Dear Ms. Podolak:

As requested by your application dated August 31, 2005, as supplemented October 25, 2005, February 20, July 17, August 11, and August 15, 2006, enclosed is Certificate of Compliance (CoC) No. 9027, Revision No. 18, for the Model No. 741-OP. In addition to the changes you requested, we made two additional changes to CoC No. 9027. The first was necessary to ensure continued compatibility of CoC No. 9027 with Title 10 of the Code of Federal Regulations (10 CFR) Part 71 due to a revision of 10 CFR Part 71 that took effect on October 1, 2004. The second change provides sufficient time to implement changes without disrupting shipments. This certificate supersedes, in its entirety, CoC No. 9027, Revision No. 17, dated September 13, 2001. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The staff's Safety Evaluation Report is also enclosed.

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. 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. Registered users may request by letter to remove their names from the Registered Users List.

Ms. Podolak

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If you have any questions regarding this certificate, please contact me at (301) 415-1179 or Stewart W. Brown of my staff at (301) 415-8531.

Sincerely,

/RA/

Christopher M. Regan, Acting Chief
Licensing Section
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9027

Enclosures: 1. CoC No. 9027, Rev. No 18
2. Safety Evaluation Report

cc: R. Boyle, Department of Transportation
J. Schuler, Department of Energy
Registered Users
RAMCERTS

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SAFETY EVALUATION REPORT

Docket No. 71-9027
Model No. 741-OP Transport Package
Certificate of Compliance No. 9027
Revision No. 18

SUMMARY

By application dated August 31, 2005, as supplemented by letters dated October 25, 2005, February 20, July 17, August 11, and August 15, 2006, AEA Technology QSA Inc./QSA Global Inc., (QSA Global or the applicant) requested an amendment to Certificate of Compliance (CoC) No. 9027, for the Model No. 741-OP transport package. The applicant requested CoC No. 9027 be amended to: (1) renew it for a term of five years, (2) revise the package identification number to include the "-96" designation, and (3) reflect new ownership by QSA Global. The applicant, to support its request, submitted a consolidated safety analysis report (SAR).

In addition, the U.S. Nuclear Regulatory Commission (NRC or the staff) made two additional changes to CoC No. 9027. The first change was necessary to ensure continued compatibility of CoC No. 9027 with Title 10 of the Code of Federal Regulations (10 CFR) Part 71 due to a revision of 10 CFR Part 71 that took effect on October 1, 2004. The second change provides the applicant sufficient time, using the previous revision of the CoC, to continue shipments while implementing the approved CoC revision and seek, if necessary, approvals from foreign National Competent Authorities.

The applicant made its request for renewal in a timely manner. The certificate has been renewed for a five year term. In addition, based on the statements and representations in the application, the staff finds that the other changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

EVALUATION

1.0 GENERAL INFORMATION

By application dated August 31, 2005, as supplemented by letters dated October 25, 2005, February 20, July 17, August 11, and August 15, 2006, QSA Global requested an amendment to CoC No. 9027, for the Model No. 741-OP transport package. The applicant requested CoC No. 9027 be amended to: (1) renew it for a term of five years, (2) revise the package identification number to include the "-96" designation, and (3) reflect new ownership by QSA Global.

The applicant, in support of its request for certificate renewal, provided a consolidated application as specified in 10 CFR 71.38(c). The staff reviewed the consolidated application and concluded that the application incorporated the changes to the Safety Analysis Report that were previously referenced in CoC No.9027.

1.1 Packaging Drawings

The applicant submitted the following drawings in support of this amendment request:

<u>Drawing Title</u>	<u>Drawing Number</u>
Model 741-Projector	R74190, Rev. G (Sheets 1-7)
Model 741-OP	R741-OP, Rev. E (Sheets 1-7)

The staff has concluded that these drawings will not affect the ability of the Model No. 741-OP transport package to meet the requirements of 10 CFR Part 71.

1.2 “-96” DESIGNATION

1.2.1 Background

On January 26, 2004, NRC published its final rule revising 10 CFR Part 71, “Packaging and Transportation of Radioactive Material.” NRC revised Part 71 to address compatibility with the International Atomic Energy Agency’s (IAEA) transportation safety standards, “Regulations for the Safe Transport of Radioactive Material” (TS-R-1) and other transportation safety amendments. The revised 10 CFR Part 71 final rule was published in the *Federal Register* (69 FR 3698). This rule became effective on October 1, 2004.

This revision to the rule, as noted in the *Federal Register* notice, grouped the proposed changes into categories, and the categories were identified as issues. Issues one through eleven addressed changes to IAEA regulations. Issues twelve through nineteen were NRC-initiated issues.

Section 71.19(e) of the revised rule states, “NRC will revise the package identification number to designate previously approved package designs as B, BF, AF, B(U), B(M), B(U)F, B(M)F, B(U)-85, B(U)F-85, B(M)-85, B(M)F-85, or AF-85 as appropriate, and with the identification number suffix “-96” after receipt of an application demonstrating that the design meets the requirements of this part.”

The applicant in its letter dated August 31, 2005, requested an amendment to Certificate of Compliance (CoC) No. 9027 for its Model No. 741-OP Transport Package to include the designation “-96” in the identification number.

1.2.2 Evaluation

The following is the staff’s evaluation of the applicant’s request and CoC No. 9027 versus each of the nineteen issues discussed in the *Federal Register* notice:

(1) Changing Part 71 to the International System of Units (SI) only

This proposal was not adopted for the final rule. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(2) Radionuclide Exemption Values

The final rule adopted the radionuclide activity concentration values and consignment activity limits in TS-R-1 for the exemption from regulatory requirements for the shipment or carriage of certain radioactive low-level materials. In addition, the final rule adopted an exemption from regulatory requirements for certain natural materials and ores containing naturally occurring radionuclides. Because the contents authorized in CoC No. 9027 exceed the exemptions values, this revision is not applicable to the Model No. 741-OP Transport Package. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(3) Revision of A_1 and A_2

The final rule adopted revised A_1 and A_2 values from TS-R-1. While the final rule is applicable to the Model No. 741-OP Transport Package, the revised A_1 and A_2 values do not impact the content limits specified in CoC No. 9027. Therefore, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(4) Uranium hexafluoride (UF_6) package requirements

The final rule provides a specific exception for certain UF_6 packages from the requirements of Section 71.55(b). This revision is not applicable to the Model No. 741-OP Transport Package. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(5) Introduction of the criticality safety index (CSI) requirement

The final rule adopted the CSI requirement from TS-R-1. This revision is not applicable to the Model No. 741-OP Transport Package because CoC No. 9027 limits the contents of the Model No. 741-OP to non-fissile material. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(6) Type C packages and low dispersible material

This proposal was not adopted for the final rule. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(7) Deep immersion test

The final rule adopted an extension of the previous version of Section 71.61 from packages for irradiated fuel to any Type B or C package containing activity greater than $10^5 A_2$. This revision is not applicable to the Model No. 741-OP Transport Package because CoC No. 9027 limits the contents of the Model No. 741-OP to less than $10^5 A_2$ for both cobalt-60 and iridium-192. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(8) Grandfathering previously approved packages

The final rule adopted a process for allowing continued use, for specific periods of time, of previously approved packaging designs without demonstrating compliance to the final rule. The applicant has decided in accordance with §71.19(e) to submit information demonstrating compliance with the final rule. Thus, the issue of grandfathering the design of the Model No. 741-OP Transport Package is not necessary.

(9) Changes to various definitions

The final rule adopted several revised and new definitions. These changes were adopted to provide a more effective understanding of Part 71. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(10) Crush test for fissile material package design

Section 71.73 requires the performance of a crush test for packages only when the package has a mass not greater than 500 kilograms (kg) (1100 pounds (lbs)), an overall density not greater than 1000 kg/ cubic meter (62.4 lbs/ cubic foot), and radioactive contents greater than $1000 A_2$ not as special form radioactive material. This revision is not applicable to the Model No. 741-OP Transport Package because CoC No. 9027 limits the contents of the Model No. 741-OP to sealed sources which meet the requirements of special form radioactive material. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(11) Fissile material package design for transport by aircraft

The final rule adopted a new section, Section 71.55(f), which addresses packaging design requirements for packages transporting fissile material by air. Section 71.4 provides a definition for fissile material. Specifically, the radionuclides uranium-233, uranium-235, plutonium-239, and plutonium-241 are considered fissile material. This revision is not applicable to the Model No. 741-OP Transport Package because CoC No. 9027 limits the contents of the Model No. 741-OP to either cobalt-60 or iridium-192. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(12) Special package authorizations

The final rule adopted provisions for special package authorization that will apply only in limited circumstances and only to one-time shipments of large components. This provision is not applicable to the Model No. 741-OP Transport Package. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(13) Expansion of Part 71 quality assurance (QA) requirements to CoC holders

The final rule added the terms “certificate holder” and “applicant for a CoC” to Subpart H and adds a new Section 71.9, on employee protection. Thus, the quality assurance requirements apply to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging that are important to safety. While the final rule is applicable to the Model No. 741-OP Transport Package, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(14) Adoption of the American Society of Mechanical Engineers (ASME) code

This proposal was not adopted for the final rule. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(15) Change authority for Dual-Purpose Package Certificate holders

This proposal was not adopted for the final rule. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(16) Fissile material exemptions and general licence provisions

The final rule adopted various revisions to the fissile material exemptions and the general license provisions in Part 71 to facilitate effective and efficient regulation of the transport of small quantities of fissile material. This revision is not applicable to the Model No. 741-OP Transport Package because CoC No. 9027 limits the contents of the Model No. 741-OP to non-fissile material. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

(17) Decision on petition for rulemaking on double containment of plutonium

The final rule removed the requirement that packages with plutonium in excess of 0.74 tera-Becquerel (20 Curies (Ci)) have a second separate inner confinement container. This revision is not applicable to the Model No. 741-OP Transport Package because the contents allowed by CoC No. 9027 do not include plutonium. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

- (18) Containment limits as applied to spent fuel and high-level waste (HLW) packages

This proposal was not adopted for the final rule. Thus, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

- (19) Modification of events reporting requirements

The final rule adopted expanded reporting requirements. While the final rule is applicable to the Model No. 741-OP Transport Package, no change is necessary to either CoC No. 9027 or the SAR for compliance with Part 71.

1.2.3 Conclusion

Based on the statements and representations in the application, the staff concludes that the design has been adequately described and meets the requirements of the revised 10 CFR Part 71. Thus, the staff finds including the designation “-96” in the identification number is acceptable.

2.0 STRUCTURAL

A potential fabrication deficiency was identified for approximately 300 previously manufactured source packages. The potential deficiency was related to the certification of the welders who made all the welds on the packages, and particularly the welds attaching the source shield to braces which position the source shield inside the housing. The original fabrication drawings specified that all welds be inspected to the acceptance criteria of the American Welding Society (AWS) Code D 1.1-"Structural Welding". This requirement implied, through invoking the use of AWS D1.1 as the governing welding code, that the welders themselves would also be AWS Code certified per the provisions of the D 1.1 Code. However, this provision was not specifically indicated on the fabrication drawings. Consequently approximately 300 source packages manufactured prior to 2006 and all the transportation overpacks manufactured from 1998 to 2006 were manufactured using welders who were not certified per the provisions of the governing AWS welding code.

The question of the suitability of the affected welds for continued service was examined. The applicant provided the detailed results of the tests (required by NRC regulations) which had previously been performed on one source package itself and seven other source packages with overpacks, all of which had been constructed using the non-certified welders. Additionally, the applicant provided a synopsis of the operating experiences with the welds that had been in service in these packages.

During manufacture, the source package welds were visually inspected on a sampling basis up until 1995. From 1995 onward the welds received 100 percent inspection due to small lot sizes. The overpack welds have been inspected on a lot sample basis. Approximately 15 to 20 percent of the overpack welds were thus examined to the Code criteria. The inspection criteria were based on the provisions of AWS D1.1, Sections 5.24, 6.9, and others.

Out of the population of welds examined from the approximately 300 packages manufactured, only seven source packages had welds that failed to meet the Code acceptance criteria. Most of these were repaired/reworked for acceptance. Rejections on overpack welds since 1999 included six non-conformance reports. In three cases they were non-conforming due to too many welds and dispositioned use-as-is. The others were repaired/reworked. This rejection rate is low, which demonstrates that the overall quality of the welding was adequate, even though the welders were not properly certified.

NRC regulation, 10 CFR 71.73 requires that a transportation package be tested for impact resistance by means of a drop test onto a hard, unyielding surface, from a height of 9 meter (m) (30 feet), while the package is at a temperature of minus 28.9 degrees Celsius (EC) (minus 20 degrees Fahrenheit (EF)) or lower. Additionally, other drop tests are conducted from lesser heights. The licensee conducted 9 m (30-foot) drop tests on one source package without an overpack and seven others with the overpack installed. These packages were from regular production units.

During these tests, the licensee cooled each package by placing it into "dry ice" (frozen carbon dioxide) for sufficient time to ensure that the packages were colder than a desired maximum (high) temperature of minus 40 EC (minus 40 EF). Note that this desired test temperature is 11.1 EC (20 EF) colder than the regulatory requirement. The actual temperature of most of the source packages at the time they were drop tested ranged well below the desired maximum (high) temperature of minus 40 EC (minus 40 EF), with some packages being between minus 56.7 EC (minus 70 EF) and minus 80 EC (minus 112 EF) when dropped from 9 m (30 feet). These test temperatures were verified by before-and-after-drop temperature measurements of the individual packages. This range of achieved test temperatures makes the drop tests a very severe test of the weld quality. This is due to the fact that the package welds, in all likelihood, were well below the ductile-to-brittle transformation temperature for the carbon steel used to manufacture the source package housing, braces, and attaching welds. At such low temperatures, any linear (crack-like) type weld flaw would be expected to propagate under the impact load imposed by the drop test.

However, in every case, the package welds survived the drop tests without failure. This result demonstrates that the package welds are of sufficient quality to withstand the required design accident conditions. It is especially notable that the one source projector that was dropped 9 m (30 feet) without the protective overpack installed survived without damage to any welds.

The applicant also reported that over a 20 year period, no package or overpack welds have failed or otherwise been discovered to be damaged or defective as a result of normal service.

The staff finds that the licensee-conducted cold drop tests of the packages were well beyond the severity of the regulatory required tests. The fact that no welds failed as a result of these severe tests and that a significant percentage of all welds have been inspected per the Code requirements provides reasonable assurance that the existing package welds are capable of continued service without danger of failure. The staff

further notes that all future welds will be produced by welders certified in accordance with the provisions of the AWS D 1.1 Code. Thus, no further remedial action is warranted.

In addition, the staff evaluated the lifting devices. The transportation package is designed to be lifted by the base of the overpack using a forklift or by slinging. The applicant evaluated the maximum stress on the base of the overpack through analysis. For this lifting analysis, the applicant modeled the base as a box section between the two overpack feet which is 0.81 m (32 inches (in.)) long, 0.48 m (19 in.) wide, and 0.38 m (15 in.) deep with a steel thickness of 0.15 cm (0.06 in.). The moment of inertia calculated for the cross-section is 10,406 cm⁴ (250 in⁴). Using the total weight of the heavier Model No. 680-OP, to determine the stresses that would bound the Model No. 741-OP stresses, $P = 2,780$ Newtons (N) (625 lbs), the length of the base between the two forks, $L = 0.23$ m (9 in.), and half the height of the box section, $c = 0.19$ m (7.5 in.), the maximum elastic stress that occurred at the loading point of the fork is calculated as 0.29 mega-Pascal(MPa) (42 lbs/in² (psi)). However, the staff performed confirmatory evaluations on the local stress, using a local thin plate model which resulted in substantially higher stress. In the staff's model, the bending moment of inertia of the wood base is 1.66 cm⁴ (0.04 in⁴) (rather than 10,406 cm⁴ (250 in⁴)), conservatively discounting the thin steel sheet. The maximum bending moment at the liftfork when subjected to a uniformly distributed load of 0.011 MPa (1.57 psi) is 3.2 m-N (28.2 in.-lbs) which is higher than 1.4 m-N (12.5 in.-lbs) at the center of the base. The maximum stress that occurred at the liftfork is therefore 2.07 MPa (300 psi), which is much higher than the 0.29 MPa (42 psi) calculated by the applicant. With a safety factor of 3 applied, the maximum stress in the base is 6.2 MPa (900 psi) which is less than 25 percent of the allowable stress of the wood material 25.4 MPa (3680 psi). Moreover, measurements of deformation were made at the center of the base to show that no plastic or buckling phenomena occurred during a 24 hr duration. Accordingly, the staff determined that the lifting device and its effect on the transportation package are adequate and thus in compliance with the requirements of 10 CFR 71.45(a).

Based on its review of the statements and representations in the application, the staff concludes that the structural design has been adequately described and evaluated to demonstrate its structural capabilities to meet the requirements of 10 CFR Part 71.

7.0 OPERATIONAL PROCEDURES

As part of the amendment application, the licensee modified the format of Section 7 of the SAR. As part of and along with the reformatting, the licensee added new subsections to the procedures and made changes to the text of procedures included in the approved SAR. The added subsections describe the authorized contents, procedures for loading the contents into the package, transportation by a consignor, and emergency response. The text changes were made to modify and/or clarify the procedures, where needed. The staff reviewed the proposed changes and finds that the operating procedures, as modified by the amendment, continue to meet the requirements of 10 CFR Part 71 and are adequate to assure the package will be operated in a manner consistent with its evaluation for approval.

8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

As part of the amendment application, the licensee modified the format of Section 8 of the SAR. As part of and along with the reformatting, the licensee added new subsections and removed some existing subsections. Important procedures from the removed subsections were transferred to other parts of Section 8. Descriptions of some of the tests were also modified. These modifications included consolidation of the test descriptions. One method of consolidation combined similar procedures into a single procedure that covered all affected components, such as for the visual inspections in Section 8.1.1. Another method replaced the description with a reference to places in Section 7 where the same procedures are described for package operations, such as for the component and material tests in Section 8.2.3. The staff reviewed the proposed changes and finds that the acceptance testing and maintenance programs, as modified by the amendment, continue to meet the requirements of 10 CFR Part 71 and that the maintenance program remains adequate to assure packaging performance during its service life.

9.0 CONDITIONS

9.1 Revised 10 CFR Part 71

On January 26, 2004, NRC published its final rule revising 10 CFR Part 71. NRC revised Part 71 to address compatibility with the IAEA's transportation safety standards, TS-R-1 and other transportation safety issues. The revised 10 CFR Part 71 final rule was published in the *Federal Register* (69 FR 3698). This rule became effective on October 1, 2004.

The NRC staff has determined that as a result of changes made to 10 CFR Part 71 that a change to CoC No. 9027 was necessary to ensure continued compatibility with the revised regulation:

Condition 9, page 2 of 3 - Revised wording from:

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

to:

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

As part of the 10 CFR Part 71 revision, certain sections were renumbered with no substantial change to the renumbered section. This change was necessary to address the renumbering of Section 71.12 to Section 71.17 that became effective on October 1, 2004.

9.2 Continued Use of Previous CoC Revision

The staff has determined that it is appropriate to allow applicants to use the previous revision of a CoC for a period of approximately one year. During this period applicants can continue shipments while implementing the approved CoC revision. In addition, applicants can continue shipments while seeking, if necessary, approvals from foreign National Competent Authorities. Therefore, the staff has added the following condition to CoC No. 9027:

Condition 10. Revision No. 17 of this certificate may be used until August 31, 2007.

CONCLUSION

In response to the applicant's request, CoC No. 9027 has been revised as follows: (1) the CoC has been renewed for a five year term that expires on August 31, 2011, (2) the CoC package identification number has been revised to include the "-96" designation, and (3) the CoC has been revised to reflect new ownership by QSA Global. The applicant, to support its request, submitted a consolidated application for the package. Also, staff made two additional changes to CoC No. 9027. The first change was necessary to ensure continued compatibility of CoC No. 9027 with Title 10 of the Code of Federal Regulations (10 CFR) Part 71 due to a revision of 10 CFR Part 71 that took effect on October 1, 2004. The second change provides the applicant sufficient time to use the previous revision of the CoC to continue shipments while implementing the approved CoC revision.

Based on the statements and representations in the application, the staff finds 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. 9027,
Revision No. 18, on August 25, 2006_____.

