QSA GLOBAL

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13 December 2005

Mr. Shawn Williams, Project Engineer
Licensing Section
Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
One White Flint
Rockville, MD 20852

Docket No.: 71-9314

Subject: URGENT Amendment Request for the Model 976 Series Type B Package

Dear Mr. Williams:

As requested, please find enclosed a revised list of affected pages which lists the specific pages in Revision 4 of the SAR that are changing from Revision 3. Also enclosed is a draft copy of the Certificate of Compliance indicating with change bars in the right hand margin the changes from Revision 1 to Revision 2 of the CoC. Last, I have also enclosed the individual pages in Revision 4 of the SAR that have changes to the textual information as referenced on the list of affected pages. Again changes are indicated by vertical bars in the right hand margin.

Should you have any additional questions or wish to discuss this submission after receipt please contact me as shown below. Again your assistance is greatly appreciated in this matter.

Sincerely,

Lori Podolak

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C. [signature] 13 Dec 05
RA/QA Approval — Date

[signature] 13 Dec 05
Engineering Approval — Date

Enclosures: Revised list of affected pages
Draft Revision 2 of the CoC for USA/9314/B(U)-96
Revised Pages from SAR Rev 4 as noted on the list of affected pages

NRC FORM 618 (8-2000) 10 CFR 71		CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIAL PACKAGES		U.S. NUCLEAR REGULATORY COMMISSION
1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE / PAGES
9314	2	71-9314	USA/9314/B(U)-96	1 OF 4

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 Materials."

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 SAFEYT ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION.

a. ISSUED TO *(Name and Address)*

QSA Global, Inc.
40 North Avenue
Burlington, MA 01803

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

AEA Technology/QSA Inc. application dated March 09, 2004 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

DRAFT

(1) Model No. 976 Series

(2) Description

The Model No. 976 Series packages are designed for use as transport packages for Type B quantities of radioactive material in special form. The Model No. 976 has six versions called the 976A, 976B, 976C, 976D, 976E and 976F. The Model 976A package contains a 855 shield container. The Model 976B package contains a 3015 shield container. The Model 976C package contains a 3056 shield container. The Model 976D package contains a 3018 shield container. The Model 976E package contains a 3078 shield container. The Model 976F package contains a 1911 shield container. All versions of the package include a 16 gauge stainless steel 20 gallon drum, four 3/8" – 16 UNC x ¾" long stainless steel lid closure bolts, a clamp band with M8 stainless steel bolt, and cork inserts to position and support the individual shield containers within the package. All Model No. 976 series packages measure 19 ¾" in diameter by 21 ¼" tall.

The shield containers are described as follows:

855 – An outer carbon steel shell, rigid polyurethane potting material, uranium shield, eight titanium "J" tubes, source stop, top and bottom support plates and a gasketed lid which is secured with eight 3/8" – 16 UNC x 5/8" long stainless steel hex head bolts. Approximately 11 ¼" in diameter at the base by 11 ¾" tall (without the eyebolt).

3015 – A lead shield container surrounded on the sides and partially on the top by an outer stainless steel jacket. The steel jacket incorporates two stainless steel lifting handles. The container includes a lower depleted uranium shielding insert encased in stainless steel, a tungsten capsule holder, an upper lead insert, a lead top shield plug with a stainless steel extension, and a gasketed shield lid which secures to the shield container body by two M10 stainless steel screws and washers. Measures approximately 7 ½" in diameter (including the handle bosses) by 10.1" tall.

5(a) (2) (Description Continued)

3056 – A lead shield container which incorporates stainless steel strapping, handle bosses and lifting handles along with a combination lower depleted uranium insert and upper lead insert with ten stainless steel "J" tubes. The lead insert is partially enclosed by stainless steel. The "J" tubes are covered with tube caps and the tube caps are further covered by a stainless steel "top hat" or lid secured to the container by an M12 steel rod and retaining nut. Measures approximately 7.7" in diameter (including the handle bosses) by 10.4" tall.

3018 – A lead shield container surrounded on the sides and partially on the top by an outer stainless steel jacket. The steel jacket incorporates two stainless steel lifting handles. The container includes a lower depleted uranium shielding insert encased in stainless steel and upper lead insert with four stainless steel "J" tubes. The "J" tubes are covered with tube caps. The shield inserts are secured to the shield body by means of a stainless steel bracket and two M10 stainless steel bolts and washers. The metal bracket also incorporates a stainless steel disk above the "J" tubes with further protects the tube caps during shipment. Measures approximately 7 ½" in diameter (including the handle bosses) by 10.8" tall.

3078 – A stainless steel encased, depleted uranium shield container which includes two stainless steel lifting handles. The shield container incorporates a stainless steel encased depleted uranium upper shield plug that is inserted into the shield body over an optional stainless steel or aluminum source holder can. The upper shield insert is secured to the shield body by a stainless steel cover bolted above the shield insert by four M8 stainless steel screws. Measures approximately 6.1" in diameter by 8.4" tall.

1911 – A stainless steel encased, lead shield container which includes a bolted shield lid and an M10 stainless steel lifting eyebolt. The shield lid is secured to the shield container body by four stainless steel M8 bolts and washers. The inner shield cavity incorporates either a depleted uranium upper and lower shield insert, a tungsten upper and lower shield insert or a lead upper and lower shield insert. Additional handling source stainless steel, aluminum or tungsten capsule holders or cans may be used in the shield insert cavities. Measures approximately 8" in diameter by 8 ¾" tall (without the eyebolt).

The following table gives the maximum package weight.

Model No.	Maximum Package Weight (lbs)
976A	300
976B	190
976C	190
976D	190
976E	226
976F	263

(3) Drawings

This packaging is constructed in accordance with the following QSA Global Inc. Drawings.:

R97608, Rev. E, Sheet 1 — 20 gallon drum
RCLM009, Rev. B, Sheets 1-2 — Band clamp
R97637, Rev. A, Sheet 1 — Top inner cork spacer
97623, Rev. A, Sheet 1 — Bottom inner cork insert
R97623A, Rev. A, Sheet 1 — Bottom inner cork insert, alt.
R97615, Rev. B, Sheet 1 — Top outer cork insert
R97616, Rev. B, Sheet 1 — Bottom outer cork insert

R976A, Rev. D, Sheet 1 — Model No. 976A with 855 shield container
R85590, Rev. E, Sheets 1-6 — 855 source container

R976B, Rev. E, Sheet 1 — Model No. 976B with 3015 shield container
R3015, Rev. C, Sheets 1-3 — 3015 source container

R976C, Rev. E, Sheet 1 — Model No. 976C with 3056 shield container
R3056, Rev. D, Sheets 1-4 — 3056 source container

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R976D, Rev. E, Sheet 1 — Model No. 976D with 3018 shield container
R3018, Rev. C, Sheets 1-4 — 3018 source container

R976E, Rev. E, Sheet 1 — Model No. 976E with 3078 shield container
R3078, Rev. D, Sheets 1-4 — 3078 source container

R976F, Rev. C, Sheet 1 — Model No. 976F with 1911 shield container
R1911, Rev. C, Sheets 1-8 — 1911 source container

(b) Contents

(1) Type and form of material

Iridium-192 as sealed sources which meet the requirements of special form radioactive material.

(2) Maximum quantity of material per package

Model No.	Maximum Capacity – Output Activity* (Ci)
976A	1,000
976B	350
976C	800
976D	500
976E	1,000
976F	1,000

* Maximum activity for Ir-192 is defined as output curies as required in accordance with American national Standard N432-1980, "Radiological Safety for the Design Construction of Apparatus for Gamma Radiography."

6. Tensile and yield strength for the materials of construction must comply with the following values:

Material	Tensile Strength	Yield Strength
Depleted Uranium	65 ksi	30 ksi
Copper	25 ksi	9 ksi
Steel (nominal)	53 ksi	36 ksi
Stainless Steel	75 ksi	30 ksi
Tungsten	142 ksi	109 ksi
Cork (minimum)	80 psi	NA
Lead (^{96}Pb/^{4}Sb)	3,990 psi	NA

7. The sources shall be secured in the shielded positions of the packaging in accordance with the Package Loading requirements contained in Section 7 of the application as supplemented. For "J" tube-style shield containers, the flexible cable of the source assembly and source cap must be of sufficient length and diameter to provide positive positioning of the source in the shielded position.

8. The name plate must be fabricated of materials capable of resisting the fire test of 10 CFR Part 71 and maintaining its legibility.

9. In addition to the requirements of Subpart G of 10 CFR part 71:

   (a) The package shall be prepared for shipment in accordance with the Package Loading requirements in Section 7 of the application, as supplemented; and

   (b) The package must meet the Acceptance Test and Maintenance Program of Section 8 of the application, as supplemented.

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

11. Expiration date: June 30, 2010

REFERENCES

AEA Technology/QSA Inc., application dated March 9, 2004.

Supplements dated: January 26, April 18, May 5, July 11, and July 13 2005.
Supplements dated: December 6 and December 13, 2005.

Safety Analysis Report

AEA Technology / QSA Inc.

Model 976 Series
Type B(U) - 96
Transport Package

6 December 2005

Revision 4

Section 1 - GENERAL INFORMATION

1.1 Introduction

The Model 976 Series are designed as transport packages and storage containers for Type B quantities of special form radioactive material. They conform to the Type B(U)-96 criteria for packaging in accordance 10 CFR 71, 49 CFR 173, and the IAEA Regulations for the Safe Transport of Radioactive Material (TS-R-1) which were in effect at the time of sign-off of this report.

1.2 Package Description

(Reference:
- *10 CFR 71.33*
- *IAEA TS-R-1, paragraph 220 & 807)*

The Model 976 Series packages are differentiated based on inner shield design, spacer configurations and activity capacities. The general design of the package is a steel jacketed lead and/or depleted uranium shield container housed within a cork lined, stainless steel drum. The containers are constructed in accordance with descriptive drawings in Section 1.4. Overall external dimensions for all 976 Series packages are 19 ¾" (502 mm) diameter and 21 ¼" (540 mm) tall. The package weights and Ir-192 maximum capacities for the 976 Series are shown in Table 1 below:

Table 1.2a: Model 976 Series Package Information

Identification	Inner Shield(s)	Nuclide	Form	Maximum Capacity[1]	Maximum Weight
976A	855	Ir-192	Special Form Sources	1,000 Ci	136 kg (300 lb)
976B	3015	Ir-192	Special Form Sources	350 Ci	86 kg (190 lb)
976C	3056	Ir-192	Special Form Sources	800 Ci	86 kg (190 lb)
976D	3018	Ir-192	Special Form Sources	500 Ci	86 kg (190 lb)
976E	3078	Ir-192	Special Form Sources	1,000 Ci	103 kg (226 lb)
976F	1911	Ir-192	Special Form Sources	1,000 Ci	119 kg (263 lb)

[1] Maximum Capacity Activity for Ir-192 is defined as output Curies as required in ANSI N432 and 10 CFR 34.20 and in line with TS-R-1 and Rulemaking by the USNRC and the USDOT published in the Federal Register on 26 January 2004 .

1.2.1.2.2 Model 3056 Shield: The 3056 shield container is effectively a lead shield pot with steel bracing around the pot diameter and bottom. The 3056 is approximately 6 ¼ inches (159 mm) in diameter (not including the handle bosses), and 10.4 inches (264 mm) tall. The shield container (with the handle bosses) is 7.7 inches in diameter. The shield incorporates two lifting handles 180 degrees apart on the sides. The 3056 includes a cover which protects the source tubes and caps during shipment. Primary radiation shielding is provided by a lead pot modified to use a depleted uranium inner core shield. The inner core shield provides additional, high efficiency radiation shielding in close proximity to the source positions in transport. The shielding components are clamped together by means of a steel cradle or sheath and a flange on the upper insert. Source location and retention is provided by a fabricated insert containing ten J-tubes and the use of source tube caps. Each source is secured close to the center of the shield by means of the attached flexible source holder within the J-tube and is closed by the tube cap. The 3056 shield weighs a maximum of 114 lbs (52 kgs).

1.2.1.2.3 Model 3015 Shield: The 3015 shield container is effectively a lead pot with a steel casement enclosing the sides and top surfaces of the container. The 3015 is approximately 6 inches (155 mm) in diameter, and 10.1 inches (257 mm) tall. The shield incorporates two, side lifting handles 180 degrees apart. The 3015 includes a cover which protects the shield plug assemblies and source cavity during shipment. Primary radiation shielding is provided by a lead pot. The minimum thickness of the lead pot is approximately 1.9 inches (47 mm). The source cavity also uses a depleted uranium insert with an added tungsten insert inside of the lead shield for added dose reduction. The basic tungsten insert design has minimum side and bottom wall thickness of 0.1 inches (2.54 mm). The tungsten insert can be modified, if desired, to provide cavities for holding individual sources or to increase the wall thickness. However, the minimum insert design will comply with the specifications on the drawings included in Section 1.4. Source location and retention is provided by a shield plug assembly held in place by the shield cover lid. The 3015 shield weighs a maximum of 114 lbs (52 kgs).

1.2.1.2.4 Model 3018 Shield: The 3018 shield container is effectively a lead pot with a steel casement enclosing the sides and top surfaces of the container. The 3018 is approximately 6 inches (156 mm) in diameter, and 10.8 inches (274 mm) tall. The 3018 includes a cover which protects the source tube caps during shipment. Primary radiation shielding is provided by a lead pot with a depleted uranium insert. The minimum thickness of the lead pot is approximately 1.9 inches (47 mm). The main insert containing the J-tubes is comprised of lead with a bottom core which provides ½ inch (14 mm) of depleted uranium surrounding the source location. Source location and retention is provided by a fabricated insert containing four J-tubes and the use of source tube caps. Each source is secured, close to the center of the shield, by means of the attached flexible source holder within the J-tube and is closed by the tube cap. The 3018 shield weighs a maximum of 114 lbs (52 kgs).

1.2.1.2.5 Model 3078 Shield: The 3078 shield container is effectively a welded steel cylinder, 6.1 inches (155 mm) in diameter, and approximately 8.4 inches (213 mm) tall. The shield incorporates two side lifting handles 180 degrees apart. The 3078 includes a cover which protects the source cavity during shipment. Shielding is provided by a depleted uranium pot and shield plug. The minimum thickness of the depleted uranium pot is 2.3 inches (58 mm). Source location and retention is provided by a shield plug held in place by the shield cover lid. The design also allows for the use of an optional steel or aluminum can within the source cavity. This can provides negligible shielding and is intended only to facilitate source insertion and removal from the shield cavity. The 3078 shield weighs a maximum of 150 lbs (68 kgs).

1.2.1.2.6 Model 1911 Shield: The 1911 shield container is effectively a welded steel cylinder, 8 inches (203 mm) in diameter, and 8 ¾ inches (222 mm) tall (without the eyebolt or lid bolt heights). The maximum weight of the 1911 shield is 184 lbs (84 kgs). The shield lid is secured to the body by four M8 x 25 mm hex head stainless steel bolts and M8 stainless steel washers. With the shield lid secured to the body by the M8 bolts/washers, the 1911 is designed to be lifted by an M10 steel eyebolt which is threaded onto a recess in the shield lid. The eyebolt is removed after loading of the 1911 into the 976F cork lined drum and during transportation. The shield lid protects the source cavity and removable shielding during shipment.

The main shielding for the 1911 is provided by a lead shield body encased by a welded steel cylinder. The minimum thickness of the primary lead shielding pot is 2 ½ inches (64 mm). Source location and retention is provided by a shield plug and insert assembly. The shield plug, in combination with the lower shield insert, provides the inner containment for the sources inside the outer lead shield body when held in place by the shield cover lid. The design incorporates one of three insert configurations within the source cavity to allow for different source loading applications within the 1911 shield. Approval of all three shield insert configurations is for the same Ir-192 radioactive capacity of 1,000 Ci. The inner shield insert combinations are as follows:

Section 2 - STRUCTURAL EVALUATION

This section identifies and describes the principal structural engineering design of the packaging, components, and systems important to safety and compliance with the performance requirements of 10 CFR Part 71.

2.1 Description of Structural Design

(Reference:

- *10 CFR 71.33(a)*
- *IAEA TS-R-1, paragraph 220 & 807(b))*

2.1.1 Discussion

The Model 976 Series transport packages are described in Section 1.2, "Package Description."

2.1.2 Design Criteria

The Model 976 Series transport packages are designed to comply with the requirements for Type B(U) packaging as prescribed by 10 CFR 71 and IAEA TS-R-1. All design criteria are evaluated by a straightforward application of the appropriate section of 10 CFR 71 or IAEA TS-R-1.

Some shields containers incorporated in the package were designed under previously approved QA programs, either in the USA under AEA Technology QSA, Inc. or its predecessors in the United Kingdom by competent authority under Nycomed Amersham plc. or its predecessors.

2.1.3 Weight and Centers of Gravity

The transport package weight varies from 190 lbs (86 kg) up to 300 lb (150 kg). The shipping cask weight varies from 114 lbs (52 kg) up to 225 lbs (102 kg). The center of gravity for all Model 976 Series transport packages is indicated on the drawings provided in Section 1.4.

2.1.4 Identification of Codes and Standards for Package Design

2.1.4.1 <u>Package Design</u>

See Section 2.1.2 relating to design criteria of the package. No specific codes or standards were directly incorporated in the design effort of the finished assembly for the 976 Series transport packages. However the design was based on the Type A and Type B(U) container requirements of

2.10 Special Form

(Reference:
- *USNRC, 10 CFR 71.75*
- *IAEA TS-R-1, paragraphs 602-604)*

The Model 976 Series transport packages are designed for use with a special form source capsules with a maximum inside radius 0.12 inches (3.05 mm) and a minimum wall thickness based on the weld penetration of 0.009 inches (0.23 mm). The source capsule must be qualified as Special Form radioactive material.

2.11 Fuel Rods

Not applicable. This package is not used for transport of fuel rods.

2.12 Appendix

2.12.1 AEA Technology plc. RMR 214 Issue 5, Raw Material Requirement, (RMR) Cork for Transport Containers

2.12.2 Test Plan 90 Report Revision 2 dated April 2005 (minus Appendix B-D).

2.12.3 Test Plan 163 Report Revision 1 dated April 2005 (minus Appendix C).

Section 2.12.2 Appendix: Test Plan 90 Report Revision 2 dated April 2005 (minus Appendix B-D).

A_{ts} = Area of the top and sides = 0.174 m^2 based on:

$$A_{ts} = \left(\left[\frac{diameter}{2} \right]^2 \pi \right) + (diameter)(height)\pi$$

T_a = ambient temperature = 20°C
T_w = shield maximum equilibrium temperature
T_m = shield median temperature = $(T_a + T_w)/2$
B = Stefan Boltzmann Constant = 5.670 x 10^{-8}
E = emissivity for rough stainless steel surface between 300 and 400°K = 0.3

Iteration for T_w balancing the heat in to the heat radiated produces a value of 97°C for the maximum temperature at the surface of the inner shield prior to the start of the thermal test.

3.5.2.5 Thermal Contribution Summary During the Fire Test

To raise the temperature of the shield containers with lead to the melting point of lead would require a significant amount of energy. The specific heat of lead, C_p = 0.15 kJ/kg-°K. From this relation, calculation of the required heat transfer rate is as follows:

$$Q_{Input} = C_p M (T_2 - T_1)$$

Where
Q_{Input} = Minimum heat input to melt the lightest lead container (Model 3015)
C_p = Specific Heat of Lead
M = Mass of the shield container = 114 lbs or 52 kgs for Model 3015 (Lightest shield)
T_2 = Melting temperature of lead = 573°K (300°C, see Table 3.2a)
T_1 = Ambient shield temperature = 370°K (See Section 3.5.2.4)

Therefore the required heat transfer rate to cause lead melting in the shield is 1,569 kJ or 1.569 x 10^6 Watts/sec. To achieve this in the 30 minutes (1,800 sec) of the thermal test requires a heat input of 872 Watts. Even when combining all the worst case thermal contribution factors, the required heat input in the most vulnerable area along the cork crack is less than 60% of the actual heat input that would melt the lead shield and will therefore be insufficient to degrade the lead shielding.