



QSA GLOBAL

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2 June 2015

Ms. Michele Sampson, Chief
Spent Fuel Licensing Branch
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Division of Spent Fuel Management
Mailstop 3WFN-14A44
11555 Rockville Pike
One White Flint
Rockville, MD 20852

RE: 10 CFR 71.95(a)(3) report for CoC number USA/9035/B(U)-96 and Certificate Renewal Request

Dear Ms. Sampson:

QSA Global, Inc. is making a report under 10 CFR 71.95(a)(3) concerning the Model 680-OP Type B package (CoC 9035) and request renewal of the Type B CoC which will expire on October 31, 2015. As part of the Type B package reviews initiated after issues identified on the Model 702 container, we noted similar instances on the Model 680-OP package where the design was not adequately implemented across the production and descriptive drawings referenced under the CoC. This 71.95 notification identifies the issues found and, includes additional root cause analysis and corrective actions intended to prevent recurrence at the end of this letter.

1. Lock Assembly Plate Attachment Bolts on 680 device

The production drawing material requirement for these bolts prior to 4/25/2008 was 18-8 stainless steel. Revision H of drawing R68090 only required these bolts be steel or stainless steel. With Revision M of drawing R68090 (accepted under the CoC in October 2010) the material requirement for this part was changed to specify all end plate bolts to be 302, 304, 304L or 305 SS with the following properties:

FASTENER STRENGTH TABLE	
PROPERTY	VALUE
ULTIMATE TENSILE STRENGTH	70,000 PSI MIN
0.2% OFFSET YIELD STRENGTH	45,000 PSI MIN
ELONGATION IN 2 INCHES	30% MIN

As in the case with the 650L package, no phase in date was specified for the material property change for these bolts when the descriptive drawing was submitted and accepted under the CoC at Revision 22.

HMSSO1

This issue was further complicated by an evaluation made in September 2008 which determined that, due to difficulties associated with tensile and elongation testing of these screws, the results of hardness testing could be used to demonstrate compliance for parts to the fastener strength property table requirements. Upon subsequent review, it has been determined that since there is no straightforward correlation between percent elongation and material hardness, the alternate method of component acceptance based on hardness testing alone is not sufficient to demonstrate full compliance to the material property requirements on drawing R68090 Revision M.

We recommend going forward to specify the lock assembly plate bolts compliant with the chemical and mechanical property requirements of ASTM F879, austenitic alloy Group 1 in either CW or CW1 condition. This material reference is more appropriate for the expected use and performance characteristics necessary for this component.

Based on the inadequate phase in and acceptance criteria used for the material requirements of these bolts, there could be hundreds of units in current use that do not have lock assembly plate bolts that comply with the current CoC material requirements. The safety impact associated with this material issue is low since the parts meeting 18-8 stainless steel had been used safely without failure for decades when the 680 exposure device was transported as Type B under its own certificate. The current approval requires transport within the 680-OP overpack. In the unlikely case of failure of all 4 bolts securing the lock plate assembly to the 680 device, movement of the lock plate assembly away from the body of the main device would be limited by the shipping cover plate. This could allow source displacement from the fully shielded position of less than 2 inches, which could cause increase the dose rate readings from the device, but would not cause direct failure of the package such that dose rates at 1 meter from the package would exceed 1 R/hr.

Based on the above assessment, we believe continued use of stainless steel bolts by shippers of these packages will not create a substantial safety hazard under 10 CFR Part 21. We request amendment to the CoC to allow continued use of packages with stainless steel lock assembly plate bolts for a period of 1 year from the issue date of the amended CoC. During that time we will obtain, and provide to package users, replacement bolts that meet the chemical and mechanical requirements of ASTM F879, austenitic alloy Group 1, CW or CW1 condition. We have included revision to R68090 Rev N to allow these material condition changes. Use of ASTM F879 instead of the current material properties table, will produce a quantifiable bolt which will ensure control, safety and material conformance for parts obtained going forward.

2. End plate Connecting Tubes on 680 device

A requirement for these connecting tubes was added as of September 2010 that they comply with ASTM A500. The production drawing for these components specified the material as cold drawn seamless low carbon steel. Although Revision M of drawing R68090 changed the material requirement for this part to ASTM A500 for components manufactured after September 2010, a corresponding change to the production drawing was not implemented at that time and therefore production after September 2010 failed to comply with the requirements of R68090 Rev M.

Of the parts received after September 2010, some included material certifications to ASTM A513, but this only covered roughly 15% of the parts accepted. It is estimated that parts not compliant to ASTM A500 could exist on over 200 of the 680 devices in use as part of Type B packages.

The ASTM A513 material is slightly stronger than the ASTM A500 material, but it is also slightly less ductile. The fasteners that attach the side frames to these end plate connecting tubes would fail in the HAC drop tests long before the end plate connecting tubes would fail. As a result, both ASTM materials would be acceptable for use to meet the performance requirements for these parts as part of the 680-OP package.

Further, since this material specification change originally allowed for the continued transport of units using end plate connecting tubes specified only as “cold drawn seamless low carbon steel”, we request amendment to the CoC to revise the material specification for this part on drawing R68090 (see enclosed revision N) to read as follows:

“5/8 OD X 1/8 ± 1/32 wall x 13 ½ LG cold drawn seamless low carbon steel tubing tapped 7/16-20 X 1 1/8 Deep, Both Ends. Tubes made after Jun 2015 material comply with ASTM A500 or ASTM A513.”

Continued shipment of 680 devices in the 680-OP package using end plate connecting tubes to any of these material specifications will not create a substantial safety hazard under 10 CFR Part 21 during transport. The connecting tubes are surrounded within the 680 device by polyurethane foam fill. As demonstrated under HAC testing the low carbon steel tubing was sufficient to ensure attachment of the end plates to the 680 device and compliance of the package to the test criteria.

This drawing specification change will allow continued safe transport of existing 680 devices as part of the 680-OP transport package. At this time we confirm that we have removed all non-compliant components from inventory and will revise the production drawing for this part to only allow acceptance of material that complies to either ASTM A500 or ASTM A513. No further manufacture or service of a 680 using this part will be performed until the part is compliant with the CoC.

3. Side Frames on 680 device

A requirement for the side frames was added as of September 2010 that they comply with ASTM A36. The production drawing for this component specifies the material as hot rolled steel. Although Revision M of drawing R68090 changed the material requirement for this part to ASTM A36 for components manufactured after September 2010, a corresponding change to the production drawing was not implemented at that time and therefore production after September 2010 failed to comply with the requirements of R68090 Rev M. It is estimated that parts not compliant to ASTM A36 could exist on over ~66 of the 680 devices manufactured after September 2010.

The HAC testing under Test Plan 72 – S2 demonstrated that the 680-OP package would pass the test sequence even if one of the two side frames was removed during the thermal test. As a result, 680 devices using side frames compliant to ASTM A36, or specified as only hot rolled steel, are sufficient to meet the performance requirements for these parts as part of the 680-OP package. This is further supported since this material specification change originally allowed for the continued transport of units using side frames specified as “hot rolled steel” for components prior to September 2010.

Based on the above, continued shipment of 680 devices in the 680-OP package using side frames made from hot rolled steel or ASTM A36 will not create a substantial safety hazard under 10 CFR Part 21 during transport. Therefore, we request amendment to the CoC to revise the material specification for this part on drawing R68090 (see enclosed revision N) to read as follows:

“3/4 Thick HRS, Side Frames made after Jun 2015 comply with ASTM A36.”

This drawing change will allow continued safe transport of existing 680 devices as part of the 680-OP transport package. At this time we confirm that we have removed all non-compliant components from inventory and will revise the production drawing for this part to only allow acceptance of material that complies to ASTM A36. No further manufacture or service of a 680 using this part will be performed until the part is compliant with the CoC.

4. Lock (Rear) Plate on 680 device

A requirement for the lock plate material was added as of September 2010 that they comply with HRS to ASTM A1018. Prior to that change, the production drawing for this component specified the material as cold drawn, flat, 1018 steel. Again the production drawing was not revised in 2010 to specify the new material requirement from the descriptive drawing. Parts received and accepted after September 2010 met the requirement of cold drawn, flat 1018 steel. Although these standards are not equivalent to ASTM A1018, they are acceptable to satisfactorily meet the performance requirements of this part. It is estimated that parts not compliant to ASTM A1018 could possibly affect up to 115 devices manufactured after September 2010.

The HAC testing under Test Plan 72 – S2 demonstrated that the 680-OP package would pass the test sequence using lock plates specified as cold drawn, flat 1018 steel. As a result, 680 devices using lock plates compliant to cold drawn, flat 1018 steel or certified to ASTM A36, A1011 or A1018 are sufficient to meet the performance requirements for this part on the 680-OP package. This is further supported since this material specification change originally allowed for the continued transport of units using lock plates specified as “cold drawn, flat 1018 steel” for components prior to September 2010.

Based on the above, continued shipment of 680 devices in the 680-OP package using lock plates made from hot rolled steel to ASTM A36 or A1011 will perform as well as parts compliant to ASTM A1018 and will not create a substantial safety hazard under 10 CFR Part 21 during transport. We request amendment to the CoC to revise the material specification for this part on drawing R68090 (see enclosed revision N) to read as follows:

“Rear Plate, $\frac{1}{4} \pm 1/16$ Cold Drawn, 1018 steel. Plates installed after Jun 2015 steel per ASTM A36, A1011 or A1018”

This drawing change will allow continued safe transport of existing 680 devices as part of the 680-OP transport package. At this time we confirm that we have removed all non-compliant components from inventory and will revise the production drawing for this part to only allow acceptance of material that complies to the standards referenced above. No further manufacture or service of a 680 using this part will be performed until the part is compliant with the CoC.

5. Selector Ring on 680 device

A requirement for the selector ring material was added as of September 2010 that they meet 304 stainless steel, compliant to CF-8 per ASTM A743. Prior to that change, the production drawing for this component specified the material as stainless steel. Although the production drawing was revised at that time to specify the new material requirement from the descriptive drawing, one lot of 44 parts was accepted on 10/25/10 that was not certified to ASTM A743. All subsequent lots for this part were accepted compliant to CF-8 per ASTM A743.

There is no safety significance associated with the 44 parts accepted as 304 stainless steel without certification to ASTM A743. Based on the properties of these materials and their function as part of the transport package, these parts are expected to perform as well or better than the CF-8, ASTM A743 casting material.

Based on the above, continued shipment of 680 devices in the 680-OP package using selector rings made from 304 stainless steel will perform as well as parts compliant to CF-8 per ASTM A743, and will not create a substantial safety hazard under 10 CFR Part 21 during transport. We request amendment to the CoC to revise the material specification for this part on drawing R68090 (see enclosed revision N) to read as follows:

“Selector ring 304 stainless steel. Rings made or replaced after Oct 2010 comply with CF-8 per ASTM A743”

This drawing change will allow continued safe transport of existing 680 devices as part of the 680-OP transport package.

6. Shell on 680 device

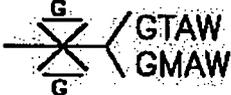
A requirement for the 680 shell components was added as of September 2010 that they comply with ASTM A36. The production drawing for this component specifies the material as hot rolled steel. Although Revision M of drawing R68090 changed the material requirement for this part to ASTM A36 for components manufactured after September 2010, a corresponding change to the production drawing was not implemented at that time and therefore production after September 2010 failed to comply with the requirements of R68090 Rev M. The majority of parts received and accepted after September 2010 were, however, certified compliant to ASTM A1018. ASTM A36 lists ASTM A1018 as an appurtenant material for hot rolled sheets and strips. This material variance is estimated to affect over ~50 of the 680 devices manufactured after September 2010.

The safety significance of the use of HRS without explicit compliance to ASTM A36 is low since HRS had been previously specified and this material was used in the performance testing that demonstrated compliance for NCT and HAC transport of the 680 in the 680-OP package.

Additionally, the welding performed on the shell assembly after May 1, 2010 was required to comply with AWS D1.1:2000. Although the production drawing for this assembly specifies welding to AWS, it was not revised at that time to specify the applicable AWS specification for the welds.

Regarding welding of the shell assembly, all welding for these parts was performed by QSA Global in-house qualified welders to AWS D1.3 or D1.1 as well as inspected by weld inspectors qualified to ASNT SNT-TC-1A. So although the drawing did not specify the AWS weld requirements, components manufactured and inspected after May 1, 2010 are compliant to the CoC.

During review of the weld specification for the shell on drawing R68090 Revision M, it was noted that the weld symbol currently shown is not correct and should be revised to reflect the symbol used on the production drawing (see below):

Descriptive Weld Call-Out	Correct Weld Call-Out
	

Based on the above, continued shipment of 680 devices in the 680-OP package using shells made from hot rolled steel or ASTM A36 will not create a substantial safety hazard under 10 CFR Part 21 during transport. Therefore, we request amendment to the CoC to revise the material specification for this part on drawing R68090 (see enclosed revision N) to read as follows:

"1/4 ± 1/16 Thick HRS, Shells made after Jun 2015 comply with ASTM A36."

We also request revision to R68090 on Revision N enclosed to correct the weld specified for the shell components as described.

These drawing changes will allow continued safe transport of existing 680 devices as part of the 680-OP transport package and will accurately describe the weld used for the 680 shell assembly on this package. At this time we confirm that we will revise the production drawing for this part to only allow acceptance of material that complies to ASTM A36 and accurately reflect welding and inspection to the requirements shown on R68090 Revision M. No further manufacture of a 680 using this part will be performed until the part is compliant with the CoC.

7. Door Track Specification on 680-OP Overpack Box

During review of drawing R680-OP Revision M it was noted that the quantity specified for the door track currently listed as "2" was incorrect. There are 2 tracks used on both ends of the box assembly so the quantity listed on page 1 of drawing R680-OP should specify "4" not "2" as currently noted. Enclosed is revision N to drawing R680-OP which corrects this error.

There is no safety significance associated with this issue and the change is made for accuracy purposes only.

8. Nameplate on 680-OP Overpack Box

Drawing R680-OP Revision M on sheet 2, note 9 requires compliance to the following:

9. UNLESS OTHERWISE NOTED, ALL STEEL COMPONENTS (EXCLUDING FASTENERS AND HARDWARE) MEET THE REQUIREMENTS OF ONE OF THE FOLLOWING SPECIFICATIONS:
 0.027 - 0.142 THICK, ASTM A1008, COLD ROLLED STEEL SHEET, CS TYPE A, B OR C
 0.027 - 0.230 THICK, ASTM A1011, HOT ROLLED STEEL SHEET, CS TYPE A, B OR C
 0.230 - 1.000 THICK, ASTM A1018, HOT ROLLED STEEL SHEET, CS TYPE A OR B

Based on the wording of this note, it applies to the nameplate used on the 680-OP box which is currently specified as steel, fire proof since it was not otherwise noted or excluded. Note 9 was not intended to apply to the package nameplate as the specification shown on page 1 of drawing R680-OP Revision M is adequate for this component and consistent with the specification used on our other Type B packages for the same component (reference USA/9296/B(U) drawings R88000 Revision T and R880SC Revision C). Specification of the package nameplate material to the standards currently referenced on drawing R680-OP Revision M is unnecessary and use of steel or stainless steel nameplates without material certification requirements will not create a substantial safety hazard under 10 CFR Part 21 during transport.

We request amendment to the CoC to revise the material specification for this part on drawing R680-OP (see enclosed revision N) to allow the nameplate to be steel or stainless steel, fire proof and to revise note 9 on page 2 to include an exclusion for fasteners, hardware and labels. This drawing change will clarify the applicability intent for note 9 on page 2 of drawing R680-OP and will allow continued safe transport of existing 680 devices as part of the 680-OP transport package.

10 CFR 71.95 Root Cause Analysis and Corrective Actions to Prevent Recurrence

The issues identified for the 680-OP package are similar in nature and cause as to the issues identified for the 650L, 770 and 702 transport packages addressed with your office under CoCs USA/9269/B(U)-96 letter dated 1/13/15, USA/9148/B(U)-85 letter dated 12/1/14 and USA/6613/B(U)-96 letters dated 7/2/14 and 7/14/14. Actions taken to prevent recurrence in response to these previously identified issues is believed to be sufficient to address the issues found during review of the 680-OP package compliance. No further programmatic corrective actions are considered necessary at this time.

The issues identified in this letter did not contribute to any incidents or package failures related to the safe use of the Model 680-OP in transport. The corrective actions previously taken in response to other QSA Global, Inc. Type B package approvals are considered sufficient to prevent recurrence of the issues identified for the Model 680-OP. Continued compliance will be verified as part of our routine Quality Assurance internal audits which include performance of Type B container processing for production staff.

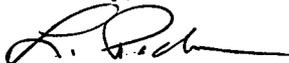
In addition to the other changes described in this letter, we request some minor changes to drawings R68090 and R680-OP. For both drawings we have removed AWS revision dates from the standard references on these drawings. This change has no significant impact on the performance of the package, and is consistent with a similar change that was approved under USA/9269/B(U)-96 as part of a request made in letter dated 1/13/15 which was incorporated at Revision 8 of the CoC.

Additionally, on sheet 1 of drawing R68090 we have added Note 5 to allow optional painting of steel components, excluding hardware. Historically the device components have been optionally painted so there are units in use that may include paint for steel components. To ensure this option is covered under the Type B approval we have added this note. We have included with this letter drawings R68090 Revision N and R680-OP Revision N to address all issues noted in this letter.

Revisions to this drawing prompted some corresponding changes in the SAR. Enclosed are affected pages in Revision 15 to the SAR (all other pages remain unchanged), a summary table which identifies changes from Revision 14 to Revision 15 of the SAR and the list of affected pages. As part of this submission action, we are requesting renewal of the Type B approval for this package design which expires on October 31, 2015.

Should you have any additional questions, or wish to discuss this issue or our amendment request, please contact me.

Sincerely,



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Regulatory Affairs/Quality Assurance
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RA/QA Approval

2 JUN 2015
Date



Engineering Approval

27 MAY 2015
Date

Enclosures: Drawing R68090 Revision N
 Drawing R680-OP Revision N
 List of Affected Pages
 SAR Revision 15 Affected page 2-2
 Change Table for SAR Revision 14 to Revision 15

cc: ATTN: Document Control Desk
 Director, Division of Spent Fuel Storage and Transportation
 Office of Nuclear Material Safety and Safeguards
 U.S. Nuclear Regulatory Commission
 11555 Rockville Pike
 One White Flint
 Rockville, MD 20852

Safety Analysis Report for the Model 680-OP Transport Package

List of Affected Pages	
Revision 1, 20 April 1999	Addition of Revision Page; Addition of List of Affected Pages; Replacement of pages 36-38; Replacement of Appendix A Index; Addition of Appendix A, Supplement - 1 Drawing Packet.
Revision 2, 09 June 2000	Replacement of Appendix A Index; Replacement of Appendix A Drawing R97012, Rev. C, pages 1 and 2.
Revision 3, 18 July 2001	Replacement of Appendix A Index; Replacement of Appendix A Drawing R680NP Rev. A sheet 1 of 1; Replacement of Drawing R68090, Rev D sheets 1 through 5.
Revision 4, 30 September 2004	Entire SAR revision including descriptive drawings. Formatted for compliance to IAEA TS-R-1 and USNRC draft Regulatory Guide DG-7003
Revision 5, 06 October 2004	Modification to reflect change in material thickness of overpack support feet from 1/16" to 13 gauge (0.09").
Revision 6, 05 May 05	Modifications to Sections 2.4.1, 2.5.1, 2.6.2, 2.7.1.3 and 2.7.4.3 per discussions with USNRC on 19 Apr 05.
Revision 7, 29 August 2005	Modification to Section 2.1.4.2 and drawings from Section 1.4.
Revision 8, 17 July 2006	Update of name to QSA Global Inc. through out, changes to pagination, drawing update R68090 Rev H and pages 1-1, 7-1, 7-2, 7-6, 7-7, 8-2, and 8-3
Revision 9, 11 August 2006	<ul style="list-style-type: none"> • Drawing update R680-OP Rev F correcting typographical error on sheet 6 of 7 drawing title reference. • Pages 8-2 and 8-3 to incorporate modification to Section 8.1.5 to add component test of lock assembly.
Revision 10, 14 August 2006	Pages 1-1, 2-1, 2-5 and 2-10 and update of drawing R680-OP Rev G in Section 1.4 to correct the maximum package weight. Page 8-3 to incorporate modification to Section 8.2.3 to add component test of lock assembly.
Revision 11, 03 February 2010	Entire SAR Revision including formatting for compliance to NUREG 1886 (Draft Report – May 2008) and responses to QSA letter dated 21 September 2009.
Revision 12, 19 February 2010	SAR updated to reflect compliance to NUREG 1886 (Final Report – March 2009).
Revision 13, 13 April 2010	SAR updated to clarify component mechanical properties in Table 2.2.A, added figure 1.3.A per NUREG-1886 (March 2009) recommendation and revised drawings contained in Appendix 1.3.
Revision 14, 30 August 2010	Updated Sections 1.3, 2.5, 2.6.9, 2.6, 2.6.3, 2.6.4, 2.7, 2.7.6, 2.10 and 3.5.1 to incorporate information provided in separate correspondence dated March 26 and 29, 2010 and to address issues from NRC RAI letter dated 17 May 2010
Revision 15, 27 May 2015	Revised drawings in Section 1.3 and page 2-2 Table 2.2.A to update materials information.

Revision 15 to the 680-OP SAR incorporates the following changes:

Section Reference	Description	Change Reported Pursuant to 71.95	Impact	Action Taken By QSA Regarding Affected Units
1.3	Revision to drawings R68090 and R680-OP to incorporate changes referenced in letter dated 2 June 2015	Y	Changes have no adverse impact on the safety or integrity of existing 680-OP transport packages (see letter dated 2 June 2015).	Amendment requested to NRC CoC to Cover affected units
2.2.1	<p>Table 2.2.A revised to update and consolidate references for properties of principal package materials. This included:</p> <ul style="list-style-type: none"> • Consolidation of all steel into a single reference with inclusion of steel sheet. • Removal of prior table footnote due to steel consolidation • Addition of table entry for stainless steel fasteners 	N	Changes for completeness and consolidation in conjunction with changes to drawings R68090 and R680-OP. Changes have no adverse impact on the safety or integrity of existing 680-OP transport packages (see letter dated 2 June 2015).	Amendment requested to NRC CoC to Cover affected units

Security-Related Information Figure
 Withheld Under 10 CFR 2.390

ERF #	3275
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APPROVALS	DATE	 QSA GLOBAL <small>40 NORTH AVE, BURLINGTON, MA 01803</small>	DESCRIPTIVE DRAWING
<i>S. G.</i> <i>[Signature]</i>	26 MAR 15 27 MAR 15		
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES TOLERANCES: FRACTIONS ± 1/8 .XX ± 0.12 .XXX ± 0.06 .XXX ± 0.020		TITLE MODEL 680 PROJECTOR	
		SIZE A	DWG. NO. R68090
		SCALE: 1:1	SHEET 1 OF 7
			REV N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL. \pm 1/8			
SIZE	DWG. NO.	R 68090	REV
A	SCALE: NONE	SHEET 2 OF 7	N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL \pm 1/8			
SIZE	DWG. NO.	R 68090	REV
A	SCALE:	NONE	SHEET 3 OF 7
			N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL. \pm 1/8			
SIZE	DWG. NO.	R 68090	REV
A	SCALE:	NONE	SHEET 4 OF 7
			N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIMS ARE INCHES, TOL ± 1/8			
SIZE	DWG. NO.	R 68090	REV
A	SCALE:	NONE	SHEET 5 OF 7 N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

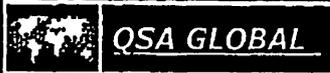
UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL \pm 1/8			
SIZE	DWG. NO.	R 68090	REV
A	SCALE:	NONE	SHEET 6 OF 7
			N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL ± 1/8			
SIZE	DWG. NO.	R 68090	REV
A	SCALE: NONE	SHEET 7 OF 7	N

Security-Related Information Figure
 Withheld Under 10 CFR 2.390

ERF # 3275

APPROVALS	DATE	 40 NORTH AVE. BURLINGTON, MA 01803	DESCRIPTIVE DRAWING
 	22 MAY 15 27 MAY 15		
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES TOLERANCES: FRACTIONS $\pm 1/8$ XX ± 0.12 XXX ± 0.08 XXXX ± 0.020		SIZE A	DWG. NO. R680-OP SCALE: NONE SHEET 1 OF 7
			REV N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL ± 1/8			
SIZE	DWG. NO.	R680-0P	REV
A	SCALE:	NONE	SHEET 2 OF 7 N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL \pm 1/8			
SIZE	DWG. NO.	R680-0P	REV
A	SCALE: NONE	SHEET 3 OF 7	N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL \pm 1/8			
SIZE	DWG. NO.	R680-OP	REV
A	SCALE:	NONE	SHEET 4 OF 7 N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL \pm 1/8			
SIZE	DWG. NO.	R680-OP	REV
A	SCALE:	NONE	SHEET 5 OF 7
			N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL \pm 1/8			
SIZE	DWG. NO.	R680-0P	REV
A	SCALE:	NONE	SHEET 6 OF 7 N

Security-Related Information Figure
Withheld Under 10 CFR 2.390

UNLESS OTHERWISE SPECIFIED: ALL DIM.S ARE INCHES, TOL \pm 1/4			
SIZE	DWG. NO.	R680-0P	REV
A	SCALE: NONE	SHEET 7 OF 7	N

Safety Analysis Report for the Model 680-OP Transport Package

QSA Global, Inc.
Burlington, Massachusetts

27 May 2015 - Revision 15
Page 2-2

2.2 Materials

2.2.1 Material Properties and Specifications

Tables 2.2.A and 2.2.B list the relevant mechanical properties (at ambient temperature) of the principal materials used in the Model 680-OP transport package. The references in the last column are listed after the tables.

Table 2.2.A: Mechanical Properties of Principal Package Materials

Material	Tensile Strength	Yield Strength	Elongation	Resource
Depleted Uranium (U-0.75 Ti)	65 ksi	30 ksi	12%	Reference #1, p. 20-35
Copper (99%)	20 ksi	-	25%	Reference #3, p6
Lead (99%)	1.7 ksi	7.9 ksi	30%	Reference #1, p. 12-3
Steel Sheet, Plate & Bar	49 ksi	30 ksi	12%	ASTM A1008, A1011, A1018, A36
Steel Tube	38 ksi	23 ksi	5%	ASTM A500, A513
Iron-Chromium Castings	70 ksi	30 ksi	35%	ASTM A743
Titanium Tube Ti-3Al-2.5V	90 ksi	75 ksi	10%	Reference #1, p. 9-3
Stainless Steel Fastener	80 ksi	40 ksi	20%	ASTM F879, F837

Table 2.2.B: Compressive Strength of Non-metallic Materials

Material	Compressive Strength	Resource
Polyurethane Foam 8 lbs/ft ³ 20 lbs/ft ³ *Foam Values are Nominal ± 2 lb/ft ³	Nominally 155 psi Nominally 960 psi	General Latex and Chemical Company
Wood	35 psi	Reference #2, p. 260

Resource references:

1. Howard E. Boyer and Timothy L. Gall, Editors, *Metals Handbook*. Metals Park, Ohio: American Society for Metals, 1985.
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