



**QSA GLOBAL**

**QSA Global, Inc.**

40 North Avenue

Burlington, MA 01803

Telephone: (781) 272-2000

Toll Free: (800) 815-1383

Facsimile: (781) 359-9191

10 August 2017

Mr. Bernard White, Senior Project Manager  
U.S. Nuclear Regulatory Commission  
Office of Nuclear Material Safety and Safeguards  
Division of Spent Fuel Management  
11555 Rockville Pike  
One White Flint  
Rockville, MD 20852

Docket : 71-9357  
TAC No.: L25122

Dear Mr. White:

The following is submitted in response to your letter for additional information dated 5/22/17. In response to your RAI questions we provide the following additional information:

## 2.0 Structural Evaluation

1. *For those components requested to be made of "300 series" or "400 series" stainless steels, specify the standard organization (i.e., ASTM or ASME materials) to which these materials will be fabricated.*

*A previously issued request for additional information on September 6, 2016, (see Agencywide Documents Access and Management System (ADAMS) Accession No. ML16251A011) the NRC requested the following:*

*For those components requested to be made of "300 series" or "400 series" stainless steels, specify the standard organization (i.e., ASTM or ASME materials) to which these materials will be fabricated, and show that there will not be any significant galvanic or chemical reactions that may occur as a result of contact between dissimilar materials.*

*It is assumed that a "300 series" or "400 series" refers to the ASME standard, however the drawings do not indicate the standard. It is unclear how these materials will interact metallurgically (galvanic or chemical reactions) with other components made of dissimilar materials that they may come into contact with. Additionally, it is not clear how future materials added to the 300 or 400 series standard will behave in this fashion.*

*The applicant's response did provide all of the requested information. The applicant's response with regards to galvanic or chemical reactions for "300/400 series" materials assuming the ASME standard appears to be reasonable. Please revise the tables on the licensing drawings (such as Sheet 1 above the title block) to indicate the standard (ASME) and the year of publication. Standards such as ASME constantly evolve, and can add or drop materials or be regrouped altogether.*

*Note: The applicant stated that there are no components in the licensing drawings that are referenced as being a "400 series" material. 400 series material was specified for the spring plunger on sheet 10 of the licensing drawings under the model 867 lock cove assembly view. The callout says:*

*Spring plunger optional 400 series stainless steel nose material*

*This information is needed to determine compliance with Title 10 of the Code of Federal Regulations (10 CFR) 71.33(a)(5) and 71.43(d).*

Response:

On 30 May 2017, QSA Global and NRC staff held a telephone conversation to discuss this issue. The intent of this call was to clarify the need for ASTM/ASME standard conformance for certain package components that were demonstrated as not important to the package safety or integrity detailed in our letter dated 4 October 2016.

QSA clarified that reference to type 300 series stainless steel for the components in question was to ensure these components are allowed to be made from a range of austenitic stainless steels for when the packages are used as radiography devices/source changers. From a transport standpoint, the type 300 series stainless steel components have no impact on the package integrity during transport and are only important when the package is used as a functional device in support of industrial radiography operations.

These components/features do not contribute to the transport package safety, but are part of the package design. As noted under ISG 20, these components appear on the drawing to ensure the package configuration is authorized, but specification of these components need to be flexible, and not unnecessarily restrictive, since they are non-safety related features.

During the conversation, it was agreed that QSA would revise drawing R86000 to identify the items described in our 4 October 2016 response letter as "NITS" or not important to safety (see attached drawing R86000 Revision U). This change is consistent with other QSA package drawing formatting, and will clearly identify these items during NRC package reviews.

Changes made to drawing R86000 Revision U which identify materials NITS and clarify material requirements for some materials with impact on package safety or compliance, are detailed in the enclosed drawing change table. Material changes to this drawing are intended to reflect the appropriate level of detail required to ensure performance of the component based on its purpose and impact on the package's integrity and/or compliance.

QSA believes this level of detail will meet the intent in ISG 20 of allowing flexibility in the drawings and SAR sections to include only the information needed for package performance and compliance. This also clearly identifies those package components that have no significant impact on the package safety features as they are not important to the satisfactory performance or evaluation of the package conformance for transport.

## 5.0 Shielding Evaluation

*Provide tolerances or justification for the choice of the reference dimensions on drawing R86000, sheet 9, Revision T.*

*In its response dated October 4, 2016, to the NRC request for additional information dated September 6, 2016, the QSA Global stated that it relied on acceptance criteria in Section 8.1.6 of the SAR to determine acceptability of the shield assembly, sometimes with the use of supplemental shielding. However, the applicant's acceptance criteria is not consistent with the dose rates provided in Tables 5.1a-g in the SAR dated November 18, 2015. While staff understands that certain dimensions are difficult to precisely measure, there does not appear to be a correlation between an actual depleted uranium (DU) shield thickness in the prototype tested and the measured dose rates. Staff would use an actual or minimum shield thickness as a point of reference for its confirmatory analysis.*

*NUREG/CR-5502, "Engineering Drawings for 10 CFR Part 71 Package Approvals," provides guidance for preparing drawings of transportation packages submitted in an application for approval under 10 CFR Part 71. It states that engineering drawings should have tolerances that are consistent with the package evaluation.*

*NMSS ISG-20 discusses the importance of clearly specifying the degree to which manufacturing variability is expected. Because the drawings will be referenced in Certificate of Compliance, it is important to capture this variability so any slight deviation will not cause the package to be out of compliance. Not only do tolerances for dimensions and weight assure safety performance of the packaging, but also provide flexibility and reasonable variation in the fabrication of the packagings.*

*Prior revisions had the same numeric value for the dimensions, but the applicant had labelled them as minimum. This practice is consistent with the criteria in NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Material." The Standard Review Plan for Transportation Packages states that any analysis should rely on dimensions and material properties that maximize the external dose rates. The applicant's prior drawings supported confirmatory analysis consistent with these conservative principles. However, the applicant's use of reference dimensions, without further justification, is not.*

*This information is required to determine compliance with 10 CFR 71.33(a) and 10 CFR 71.47.*

### Response:

On 28 April 2017, QSA Global and NRC staff held a telephone conversation. The intent of this call was to discuss, in further detail, the reasons and justification for supporting the requested shield drawing dimension changes from specific values with tolerances, to "REF" dimensions. This conversation was supported by the attached presentation "Sentry Packages Additional Information Regarding Shielding Evaluation" dated April 28, 2017 which was provided prior to the conversation.

In summary, the depleted uranium (DU) shields used in these transport packages are free-form shaped assemblies made by a casting process with inherent variability.

The free-form geometry results in a variable thickness throughout the shield where the minimum thickness might only be present as one small spot or section in the shield geometry. Due to the free-form shape, the minimum thickness is nearly impossible to locate and if found can only be verified by destroying the shield for measurement.

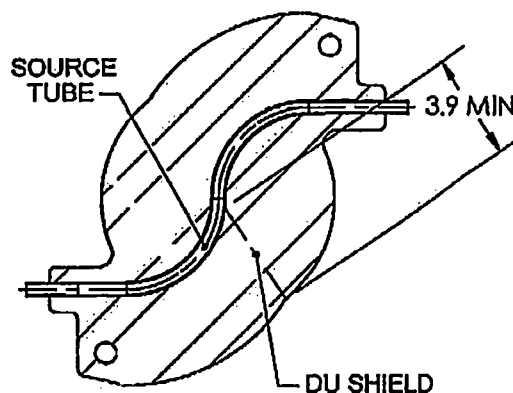


Figure 1  
Sentry 110 Depleted Uranium (DU) Shield X-Section

Other shield dimensions are affected by the inherent variability of the casting process. This variability is caused by many factors, such as non-uniform shrinkage of the cast shape when it cools, source tube movement and distortion from the molten DU as it surrounds the tube during the DU pouring process, and occasional density changes in the DU from impurities in the poured material.

Therefore, a true measurement of the shield geometry cannot be determined definitively on any individual shield without destructively inspecting the finished assembly. The process we alternatively employ for determining conformance of our depleted uranium shield/Type B package shielding involves direct physical survey measurements for 100% of the units manufactured. This method provides direct evidence of the shielding adequacy by a non-invasive/destructive means and also identifies any shielding density variations that may be present after the shield is poured and removed from the mold.

Natural variability in the casting process can produce shields that are outside the normal, expected tolerances for the "REF" dimensions on the drawing R86000 Rev T. These dimensional variations have no adverse impact on the package so long as the total shield weight is not exceeded per the drawings, and the final acceptance radiation profile surveys for the package comply with 10 CFR 71.47(a). When these requirements are met, the shield assembly is fully acceptable for use as a Type B container component.

The dimensions listed as "REF" on R86000 Revision T, sheet 9, are provided as "typical" shield dimensions based on the shield molds used to generate the finished shield assemblies. Acceptance for any individual Sentry package shield is based on each shield's physical shielding performance as demonstrated 100% by direct radiation profile measurement. The controls and evaluation process for the direct radiation profile measurement of these depleted uranium shields is specified in sections 5.4 and 8.1.6 of the SAR.

Unlike routine package surveys performed prior to shipment, Sentry package profiles involve a detailed surface and 1 meter survey performed in a low background area by means of a slow scan of the container. This process has been used by QSA for all its Type B transport containers for over 30 years covering the acceptance of over 14,500 Type B packages. During this time, no package accepted under this process has ever subsequently been identified as non-compliant to the radiation limits in 10 CFR 71.47(a).

The acceptance criteria for all Type B packages requires that the direct profile measurements, when corrected to the maximum package activity capacity, will comply with the limits specified in 10 CFR 71.47(a). Any new Sentry package failing to meet the accepted drawings referenced on the Type B certificate, including failing to pass the radiation profile criteria in the SAR and in the Notes on sheet 9 of drawing R86000, will not be used as a Type B package.

As required in the Safety Analysis Report (SAR) section 8.1.6 Shielding Tests, the radiation levels at the surface and 1 meter from the surface of every Model Sentry 110, Sentry 330 and 867 transport package is measured and evaluated prior to first use as a Type B package. This radiation profile, intended to demonstrate compliance of the transport package to regulatory dose rate limits of 10 CFR 71.47(a), is performed at the time of manufacture to identify any significant void volumes or shield porosity which could prevent the finished package from complying with the dose limits in 10 CFR 71.47(a).


The shielding verification by radiation survey inspection is further described on Drawing R86000 Revisions S and T (see Note 7 on sheet 9 and Note 3 sheet 11). Since the depleted uranium shields are free-form cast components where the minimum primary shielding features are difficult, if not impossible, to verify by direct measurement methods, the controlled radiation profile inspection process confirms that only packages meeting the dose limit requirements of 10 CFR 71.47(a) are accepted for use as an approved Type B transport package.

QSA maintains that the physical shield evaluation process for 100% of our Type B transport packages, is a more relevant and accurate method for determining shield acceptability than relying on a secondary external shield measurement which can, at best, only correlate to a theoretical effective shielding capacity for a depleted uranium shield containing no porosity. The depleted uranium shield pouring process can produce natural variability within the poured volume due to air bubbles that can create localized porosity in the shield assembly. Direct physical measurement of each depleted uranium shield ensures that any porosity that may be present in the shield is identified and corrected, when applicable, by application of supplemental shielding in affected areas. This type of manufacturing variability would not be identified by relying on physical shield dimensions alone.

Since each shield assembly, as part of the finished Type B package, is evaluated for conformance to the dose limit requirements of 10 CFR 71.47(a) based on a detailed radiation profile inspection, the use of reference dimensions for changes, as originally requested on drawing R86000 Revision S, will have no adverse impact on the package compliance because each shield assembly is directly measured for conformance to the dose limits as part of a detailed package radiation profile inspection. Failure of any manufactured Sentry 110, Sentry 330 or 867 package to meet the dose limits in 10 CFR 71.47(a) will result in rejection of the package. Packages where the dose rate measurements based on radiation profile do not comply with the requirements of 10 CFR 71.47(a) are not accepted for shipment or distribution under the USNRC Type B Certificate of Compliance.

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

Sincerely,

 e-Signed by Lori Podolak  
on 2017-08-10 14:16:28 GMT


Lori Podolak  
Senior RA/QA Specialist  
Regulatory Affairs/Quality Assurance  
Ph: (781) 505-8241  
Fax: (781) 359-9191  
Email: [Lori.Podolak@qsa-global.com](mailto:Lori.Podolak@qsa-global.com)

 e-Signed by Michael Fuller  
on 2017-08-10 14:31:30 GMT

RA/QA Approval

August 10, 2017

Date

 e-Signed by Steve Grenier  
on 2017-08-10 14:29:30 GMT

Engineering Approval

August 10, 2017



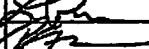

Date

Enclosures:


- Drawing R86000 Revision U
- Drawing Change Table
- Presentation "Sentry Packages Additional Information Regarding Shielding Evaluation" dated April 28, 2017.

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

Security-Related Information  
Figure Withheld Under 10 CFR 2.390.


|              |                                                                                                                                                                                                                                                                      |                                  |                                                                                                                                               |                                 |                 |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-----------------|
|              |                                                                                                                                                                                                                                                                      |                                  |  <b>QSA GLOBAL</b><br>40 NORTH AVE, BURLINGTON, MA 01603 | <b>DESCRIPTIVE<br/>DRAWING</b>  |                 |
| <b>ERF #</b> | <b>APPROVALS</b>                                                                                                                                                                                                                                                     | <b>DATE</b>                      | <b>TITLE</b>                                                                                                                                  | <b>SENTRY TRANSPORT PACKAGE</b> |                 |
| 3657         | <br><br> | 6 Jun 17<br>9 Aug 17<br>6 Aug 17 | <b>SIZE</b><br>A                                                                                                                              | <b>DWG. NO.</b><br>R86000       | <b>REV</b><br>U |
|              |                                                                                                                                                                                                                                                                      |                                  | <b>SCALE:</b> NONE                                                                                                                            | SHEET 1 OF 11                   |                 |

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|  <b>QSA GLOBAL</b> |                                  | <b>DESCRIPTIVE<br/>DRAWING</b> |
| <small>40 NORTH AVE, BURLINGTON, MA 01803</small>                                                       |                                  |                                |
| <b>TITLE SENTRY TRANSPORT PACKAGE</b>                                                                   |                                  |                                |
| <b>SIZE</b><br><b>A</b>                                                                                 | <b>DWG. NO.</b><br><b>R86000</b> | <b>REV</b><br><b>U</b>         |
| <b>SCALE: NONE</b>                                                                                      |                                  | <b>SHEET 2 OF 11</b>           |




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|  <b>QSA GLOBAL</b> |                               | <b>DESCRIPTIVE<br/>DRAWING</b> |
| <small>40 NORTH AVE, BURLINGTON, MA 01803</small>                                                       |                               |                                |
| <b>TITLE</b> <b>SENTRY TRANSPORT PACKAGE</b>                                                            |                               |                                |
| <b>SIZE</b><br><b>A</b>                                                                                 | <b>DWG. NO.</b> <b>R86000</b> | <b>REV</b><br><b>U</b>         |
| <b>SCALE:</b> NONE                                                                                      |                               | <b>SHEET 3 OF 11</b>           |


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|  |                    | <b>QSA GLOBAL</b>    | <b>DESCRIPTIVE<br/>DRAWING</b> |
| <small>40 NORTH AVE, BURLINGTON, MA 01803</small>                                     |                    |                      |                                |
| <b>TITLE</b> SENTRY TRANSPORT PACKAGE                                                 |                    |                      |                                |
| <b>SIZE</b>                                                                           | <b>DWG. NO.</b>    | <b>R86000</b>        | <b>REV</b>                     |
| <b>A</b>                                                                              | <b>SCALE: NONE</b> | <b>SHEET 4 OF 11</b> | <b>U</b>                       |


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|  <b>QSA GLOBAL</b> |                           | <b>DESCRIPTIVE<br/>DRAWING</b> |  |
| <small>40 NORTH AVE, BURLINGTON, MA 01803</small>                                                       |                           |                                |  |
| <b>TITLE</b> <b>SENTRY TRANSPORT PACKAGE</b>                                                            |                           |                                |  |
| <b>SIZE</b><br><b>A</b>                                                                                 | <b>DWG. NO.</b><br>R86000 | <b>REV</b><br>U                |  |
| <b>SCALE:</b> NONE                                                                                      |                           | SHEET 5 OF 11                  |  |


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|  |                                  | <b>QSA GLOBAL</b>  | <b>DESCRIPTIVE<br/>DRAWING</b> |
| <small>40 NORTH AVE, BURLINGTON, MA 01803</small>                                     |                                  |                    |                                |
| <b>TITLE</b> <b>SENTRY TRANSPORT PACKAGE</b>                                          |                                  |                    |                                |
| <b>SIZE:</b><br><b>A</b>                                                              | <b>DWG. NO.</b><br><b>R86000</b> | <b>SCALE:</b> NONE | <b>REV</b><br><b>U</b>         |
|                                                                                       |                                  |                    | <b>SHEET 6 OF 11</b>           |


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|  <b>QSA GLOBAL</b> |                    | <b>DESCRIPTIVE<br/>DRAWING</b> |            |
| <small>40 NORTH AVE, BURLINGTON, MA 01803</small>                                                       |                    |                                |            |
| <b>TITLE</b> <b>SENTRY TRANSPORT PACKAGE</b>                                                            |                    |                                |            |
| <b>SIZE</b>                                                                                             | <b>DWG. NO.</b>    | <b>R86000</b>                  | <b>REV</b> |
| <b>A</b>                                                                                                | <b>SCALE: NONE</b> | <b>SHEET 7 OF 11</b>           | <b>U</b>   |


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|  <b>QSA GLOBAL</b> |                 | <b>DESCRIPTIVE<br/>DRAWING</b> |
| <small>40 NORTH AVE, BURLINGTON, MA 01603</small>                                                       |                 |                                |
| <b>TITLE SENTRY TRANSPORT PACKAGE</b>                                                                   |                 |                                |
| <b>SIZE</b>                                                                                             | <b>DWG. NO.</b> | <b>REV</b>                     |
| <b>A</b>                                                                                                | <b>R86000</b>   | <b>U</b>                       |
| <b>SCALE: NONE</b>                                                                                      |                 | <b>SHEET 8 OF 11</b>           |

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|  <b>QSA GLOBAL</b> |                               | <b>DESCRIPTIVE<br/>DRAWING</b> |
| <small>40 NORTH AVE, BURLINGTON, MA 01803</small>                                                       |                               |                                |
| <b>TITLE</b> <b>SENTRY TRANSPORT PACKAGE</b>                                                            |                               |                                |
| <b>SIZE</b><br><b>A</b>                                                                                 | <b>DWG. NO.</b> <b>R86000</b> | <b>REV</b><br><b>U</b>         |
| <b>SCALE:</b> NONE                                                                                      |                               | <b>SHEET 9 OF 11</b>           |

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|  <b>QSA GLOBAL</b> |                    | <b>DESCRIPTIVE<br/>DRAWING</b> |            |
| 40 NORTH AVE, BURLINGTON, MA 01803                                                                      |                    |                                |            |
| <b>TITLE SENTRY TRANSPORT PACKAGE</b>                                                                   |                    |                                |            |
| <b>SIZE</b>                                                                                             | <b>DWG. NO.</b>    | <b>R86000</b>                  | <b>REV</b> |
| <b>A</b>                                                                                                | <b>SCALE: NONE</b> | <b>SHEET 10 OF 11</b>          | <b>U</b>   |



Security-Related Information  
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|  <b>QSA GLOBAL</b> |                        | <b>DESCRIPTIVE<br/>DRAWING</b> |
| 40 NORTH AVE, BURLINGTON, MA 01803                                                                      |                        |                                |
| <b>TITLE</b> SENTRY TRANSPORT PACKAGE                                                                   |                        |                                |
| <b>SIZE</b><br>A                                                                                        | <b>DWG. NO.</b> R86000 | <b>REV</b><br>U                |
| <b>SCALE:</b> NONE                                                                                      |                        | SHEET 11 OF 11                 |

**Summary Table of Changes to Drawing R86000 Revision T to Revision U**

| Change Location | Summary Change                                                                                                               | Change Reportable Under 71.95 | Impact of Change on Units Previously or Currently in Use under the Certificate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Action Taken By QSA Regarding Affected Units |
|-----------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Sheet 1         | Added identification for the cover bracket material to list this item as "NITS".                                             | No                            | <p>No change to package construction or design. Detail added for clarity.</p> <p>As describe in QSA letter 10/4/16, failure of this component will not significantly reduce the package effectiveness or integrity during transport. The cover bracket is present to serve as an operational convenience when the unit is not in transport. Whether the cover bracket is attached to the package or not has no impact or importance to the package safety from a transport standpoint.</p>                                                                                                                                                                                                                                                                                                                           | None. Not applicable.                        |
| Sheet 1         | Changed material for the Nameplate and nameplate rivets from Type 300 series stainless steel to "Fireproof Stainless Steel". | No                            | <p>No change to package component materials will be implemented until acceptance of this drawing revision under the CoC. Change made for simplification and clarity.</p> <p>As describe in QSA letter 10/4/16, failure of this component will not significantly reduce the package effectiveness or integrity during transport. The nameplate is present to serve as a warning and must remain attached to the package after undergoing the Thermal test in 10 CFR 71.73(c)(4). Ensuring these components are fireproof-stainless steel meets this requirement. This specification is also equivalent to how these components have previously been described on other QSA Type B package drawings such as for packages approved under USA/9269/B(U)-96, USA/9035/B(U)-96, USA/9027/B(U)-96 and USA/9314/B(U)-96.</p> | None. Not applicable.                        |
| Sheet 2         | Added identification for the large set screws and set screws to list these items as "Fireproof Stainless Steel".             | No                            | <p>No change to package component materials will be implemented until acceptance of this drawing revision under the CoC. Change made for simplification and clarity.</p> <p>As describe in QSA letter 10/4/16, failure of these component will not significantly reduce the package effectiveness or integrity during transport. These set screws are needed when the package is transported without the optional handling rib assemblies attached to the package. When transported in this configuration, the large set screws and set screws serve to plug the bolt attachment holes to prevent air ingress to the package interior during the thermal test in 10 CFR 71.73(c)(4).</p>                                                                                                                             | None. Not applicable.                        |

**Summary Table of Changes to Drawing R86000 Revision T to Revision U**

| Change Location | Summary Change                                                                                                                    | Change Reportable Under 71.95 | Impact of Change on Units Previously or Currently in Use under the Certificate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Action Taken By QSA Regarding Affected Units |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
|                 |                                                                                                                                   |                               | Ensuring these components are fireproof stainless steel is sufficient to ensure no deterioration of the internal foam fill and depleted uranium shield since their presence will prevent any oxidation of the depleted uranium shield by closing off these holes during the thermal test condition.                                                                                                                                                                                                                                                                                                                                                                                    |                                              |
| Sheet 3         | Added identification for the sealant material to list this item as "NITS".                                                        | No                            | No change to package construction or design. Detail added for clarity. As describe in QSA letter 10/4/16, failure of this component will not significantly reduce the package effectiveness or integrity during transport. The sealant is present to limit any potential depleted uranium shield contamination migration from the interior of the body weldment during servicing operations when the lock and/or front plate assemblies are removed from the device for detailed service. During transport, the sealant has no significant impact or importance to the package safety.                                                                                                 | None. Not applicable.                        |
| Sheet 3         | Changed material for the cotter pin from Type 300 series stainless steel to "Type 302, 304, or 316 Stainless Steel ASME B18.8.1". | No                            | Added detail made for accuracy and conformance to recommendations for component detail under ISG 20. Although the conformance for any 300 series stainless steel material for the cotter pin was justified in QSA's letter 10/4/16, since this component does have some importance to the transport package safety, we have expanded the material specification to specify acceptable material grades and reference the applicable ASME standard for this component.                                                                                                                                                                                                                   | None. Not applicable.                        |
| Sheet 4         | Added identification as "NITS" for the lockwasher, thread lubricant, rib insert, washer and screw components on this sheet.       | No                            | No change to package construction or design. Detail added for clarity. As describe in QSA letter 10/4/16, failure of these components will not significantly reduce the package effectiveness or integrity during transport. These components are present when the optional handling rib assemblies are attached to the package. Although the rib assemblies contain components important to ensuring compliance to the lifting/tie down requirements under 10 CFR 71.45, these components are not required to ensure conformance to these requirements. Since they are not important to the package safety or integrity, they have been identified as "NITS" in the material listing. | None. Not applicable.                        |

**Summary Table of Changes to Drawing R86000 Revision T to Revision U**

| Change Location | Summary Change                                                                                                                                                                            | Change Reportable Under 71.95 | Impact of Change on Units Previously or Currently in Use under the Certificate                                                                                                                                                                                                                                                                                                                                            | Action Taken By QSA Regarding Affected Units |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Sheet 4         | Changed material for the hex bolt from Type 17-4 stainless steel to include reference for this component to ASTM F593.                                                                    | No                            | <p>Added detail made for accuracy and conformance to recommendations for component detail under ISG 20.</p> <p>Since this component does have some importance to the transport package safety to ensure compliance with the lifting/tie down requirements under 10 CFR 71.45, we have expanded the material specification to reference the applicable ASTM standard for this component.</p>                               | None. Not applicable.                        |
| Sheet 4         | Changed material for the rib nut from Type 300 stainless steel to "Type 304 Stainless Steel per ASTM A182, A276, or A479"                                                                 | No                            | <p>Added detail made for accuracy and conformance to recommendations for component detail under ISG 20.</p> <p>Since this component does have some importance to the transport package safety to ensure compliance with the lifting/tie down requirements under 10 CFR 71.45, we have expanded the material specification to reference specific grade and the applicable ASTM standard options for this component.</p>    | None. Not applicable.                        |
| Sheet 4         | Changed material for the rib bolt from Type 300 stainless steel to "Type 316 Stainless Steel per ASTM F593"                                                                               | No                            | <p>Added detail made for accuracy and conformance to recommendations for component detail under ISG 20.</p> <p>Since this component does have some importance to the transport package safety to ensure compliance with the lifting/tie down requirements under 10 CFR 71.45, we have expanded the material specification to reference specific grade and the applicable ASTM standard options for this component.</p>    | None. Not applicable.                        |
| Sheet 4         | Changed material for the pin, rib link and welded rib assembly from Type 17-4 stainless steel to "Type 17-4 Stainless Steel Condition H900 or H1025 per ASTM A564 or A693 or ASME SA-693" | No                            | <p>Added detail made for accuracy and conformance to recommendations for component detail under ISG 20.</p> <p>Since these components do have some importance to the transport package safety to ensure compliance with the lifting/tie down requirements under 10 CFR 71.45, we have expanded the material specification to reference the applicable ASTM/ASME standard options and conditions for these components.</p> | None. Not applicable.                        |

**Summary Table of Changes to Drawing R86000 Revision T to Revision U**

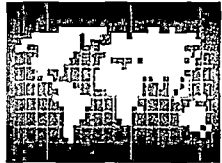
| Change Location | Summary Change                                                                                                                                                              | Change Reportable Under 71.95 | Impact of Change on Units Previously or Currently in Use under the Certificate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Action Taken By QSA Regarding Affected Units |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Sheet 5         | Added identification as "NITS" for the anti-rotate lugs, thread lubricant, thread locker, lug spring, tube seal, slide spring and collar roll pin components on this sheet. | No                            | No change to package construction or design. Detail added for clarity. As describe in QSA letter 10/4/16, failure of these components will not significantly reduce the package effectiveness or integrity during transport. These components are present on the package to support use of the container as an operational radiography device/source changer. During transport these components are passive and their failure in transport would not adversely impact the package safety or integrity. Since they are not important to the package safety or integrity, they have been identified as "NITS" in the material listing. | None. Not applicable.                        |
| Sheet 6         | Removed the "Deleted" item and row from the component table on this sheet.                                                                                                  | No                            | No change to package construction or design. Change made for administrative reasons and increase drawing clarity by removing unnecessary detail.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | None. Not applicable.                        |
| Sheet 6         | Added identification as "NITS" for the lubricant, thread lubricant, thread locker, tube seal, lock pin spring, plate roll pin and collar roll pin components on this sheet. | No                            | No change to package construction or design. Detail added for clarity. As describe in QSA letter 10/4/16, failure of these components will not significantly reduce the package effectiveness or integrity during transport. These components are present on the package to support use of the container as an operational radiography device/source changer. During transport these components are passive and their failure in transport would not adversely impact the package safety or integrity. Since they are not important to the package safety or integrity, they have been identified as "NITS" in the material listing. | None. Not applicable.                        |
| Sheet 7         | Added identification as "NITS" for the thread locker, slider spring, flat washer, retainer screw, set screw, shield roll pin, and retainer disc components on this sheet.   | No                            | No change to package construction or design. Detail added for clarity. As describe in QSA letter 10/4/16, failure of these components will not significantly reduce the package effectiveness or integrity during transport. These components are present on the package to support use of the container as an operational radiography device/source changer. During transport these components are passive and their failure in transport, without failure of another package component important to safety or integrity, would not adversely impact the package compliance during transport.                                       | None. Not applicable.                        |

**Summary Table of Changes to Drawing R86000 Revision T to Revision U**

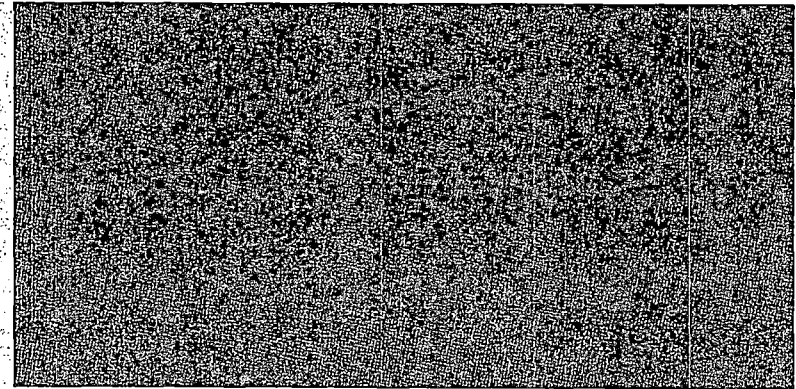
| Change Location | Summary Change                                                                                                                                                            | Change Reportable Under 71.95 | Impact of Change on Units Previously or Currently in Use under the Certificate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Action Taken By QSA Regarding Affected Units |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Sheet 7         | Added identification as "NITS" for the shaft roll pin, and changed the material from Type SAE 30302 or 30304 or Type 302 or 304 stainless steel to "Any stainless steel". | No                            | <p>No change to package construction or design. Detail added for clarity.</p> <p>As describe in QSA letter 10/4/16, this component is not relied upon to retain the source in the transport package during normal or hypothetical accident condition transport. As such, failure of this component will not significantly reduce the package effectiveness or integrity during transport.</p> <p>This component is present on the package to support use of the container as an operational radiography device/source changer. During transport this component is passive and its failure in transport, without failure of another package component important to safety or integrity, would not adversely impact the package compliance during transport.</p> | None. Not applicable.                        |
| Sheet 7         | Added identification as "NITS" for the shaft spring, and changed the material from Type 301, 302, 304, 316 or 17-7PH stainless steel to "Any stainless steel".            | No                            | <p>No change to package construction or design. Detail added for clarity.</p> <p>As describe in QSA letter 10/4/16, this component is not relied upon to retain the source in the transport package during normal or hypothetical accident condition transport. As such, failure of this component will not significantly reduce the package effectiveness or integrity during transport.</p> <p>This component is present on the package to support use of the container as an operational radiography device/source changer. During transport this component is passive and its failure in transport, without failure of another package component important to safety or integrity, would not adversely impact the package compliance during transport.</p> | None. Not applicable.                        |
| Sheet 7         | Added identification as "NITS" for the knob and changed the material from Type 302, 304, 316 or ACI CF8 stainless steel to "Type 300 Series or ACI CF8 stainless steel".  | No                            | <p>No change to package construction or design. Detail added for clarity.</p> <p>As describe in QSA letter 10/4/16, this component is not relied upon to retain the source in the transport package during normal or hypothetical accident condition transport. As such, failure of this component will not significantly reduce the package effectiveness or integrity during transport.</p> <p>During transport this component is passive and its failure in transport, without failure of another package component important to safety or integrity, would not adversely impact the package compliance during transport.</p>                                                                                                                               | None. Not applicable.                        |

**Summary Table of Changes to Drawing R86000 Revision T to Revision U**

| Change Location | Summary Change                                                                                                                                                                                                          | Change Reportable Under 71.95 | Impact of Change on Units Previously or Currently in Use under the Certificate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Action Taken By QSA Regarding Affected Units |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Sheet 8         | Added identification as "NITS" for the thread lubricant and security screw components on this sheet.                                                                                                                    | No                            | No change to package construction or design. Detail added for clarity. As describe in QSA letter 10/4/16, failure of these components will not significantly reduce the package effectiveness or integrity during transport. These components are present on the package to support use of the container as an operational radiography device/source changer. During transport these components are passive and their failure in transport, without failure of another package component important to safety or integrity, would not adversely impact the package compliance during transport.                                                                                                                              | None. Not applicable.                        |
| Sheet 10        | Added identification as "NITS" for all components on this sheet, excluding the cover pin and lock cover. Further for items previously identified as "Stainless steel" they are not identified as "Any Stainless steel". | No                            | No change to package construction or design. Detail added for clarity and consistency. For all components, other than the cover pin and lock cover, failure of these components will not significantly reduce the package effectiveness or integrity during transport. The cover pins ensure attachment of the lock cover during the normal and hypothetical accident transport condition testing. Failure of these components could increase vulnerability of the source assembly transported within the package. The remaining components on this sheet are not important to ensuring the package safety or integrity and failure of these components would not adversely impact the package compliance during transport. | None. Not applicable.                        |



**QSA GLOBAL**



# Sentry Packages

Additional Information Regarding  
Shielding Evaluation

April 28, 2017

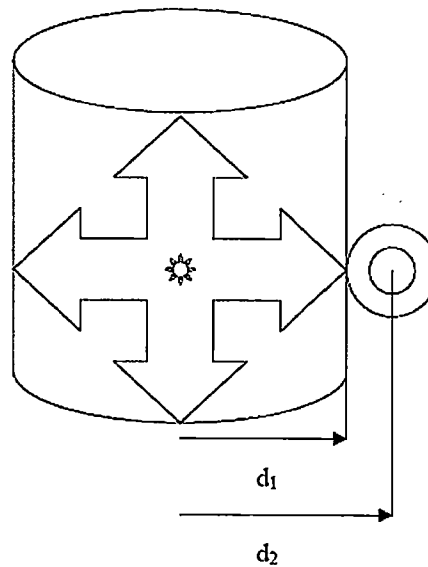


## Current Shield Evaluation Process

- ◎ Controls and evaluation process for depleted uranium (DU) shields used in the Sentry Packages is described in SAR sections 5.4 and 8.1.6.
- ◎ Unlike routine package surveys performed prior to shipment, Sentry package profiles involve a detailed surface and 1 meter survey. The survey is performed in a low background area by means of a slow scan of the container.

# Current Shield Evaluation Process

- The surface survey is performed with the detector housing in contact with the container surface and corrected to compensate for the survey meter probe off-set from the "true" surface of the package to provide a reading representative of what the probe would see if its detection center was located at the package surface.



$d_1$  = distance from activity center to surface of container.

$d_2$  = distance from activity center to surface of container plus radius of the survey meter probe.



## Current Shield Evaluation Process

- ◎ Sentry package DU shield acceptability is based on direct measurement performed on 100% of all manufactured packages prior to acceptance for Type B transport.
- ◎ Profile measurements are also corrected to the maximum package rated activity capacity to ensure all accepted packages will meet the dose limit requirements of 10 CFR 71.47(a).

**Note:** In the case of the Sentry 110 and 330 packages, since these packages are also required to meet dose limits related to their use as radiography devices, the maximum radiation level at 1 meter from the surface of these packages is further limited to 5 mR/hr, as opposed to the 10 mR/hr which is otherwise allowed under 71.47(a).

## Current Shield Evaluation Process

- ◎ Any new Sentry package failing to meet the accepted drawings referenced on the Type B certificate or failing to pass the radiation profile criteria in the SAR is not used as a Type B(U) package.

## Requested Drawing Changes Further Justification -

- ◎ Since the DU shield acceptance is based on shielding performance measurements taken by direct survey, limiting the shield drawings to specific DU dimensions is unnecessarily restrictive.
- ◎ Since the Sentry DU shields are free-form shaped with variable thickness dimensions, the dimensions shown as "REF" on Revision S of drawing R86000 sheet 9 and carried over to Revision T, are more appropriately listed as "Reference" dimensions.

## Requested Drawing Changes Further Justification -

- ◎ Natural variability in the casting process can produce shields that are outside the normal tolerances for the listed "REF" dimensions but are still fully acceptable for use as a component of these Type B containers.
- ◎ Thickness dimensions, relative to source tube position within the shield, cannot be verified by direct distance measurement, after casting.
- ◎ As such, to determine the dimension from the source tube center to the external shield surface for any individual shield, this dimension cannot be physically verified without cross-sectioning the shield assembly – which would then make it unusable in a Type B package.

## Requested Drawing Changes Further Justification -

- ◎ The dimensions listed as "REF" on R86000 Revision T, sheet 9 are provided as "typical" shield dimensions based on the shield molds used to generate the finished shield assemblies.
- ◎ Acceptance for ANY Sentry package shield, is based on each shields physical shielding performance as demonstrated by direct radiation profile measurements.



## Requested Drawing Changes Further Justification -

- ◎ We maintain that the physical shield evaluation process for 100% of our DU shield assemblies used as Type B package components is more relative and accurate for determining the shield acceptability than general shield external measurements.
- ◎ Since the DU shield pouring process can produce natural variability within the poured volume due to air bubble, and shield porosity, the direct physical measurement ensure that the DU material present on each individual shield, regardless of actual thickness in any specified location, is sufficient to ensure compliance with the package dose rate limits.



## Requested Drawing Changes Further Justification -

- ◎ QSA Global has used this radiation profile method of shield and Type B package acceptance for over 30 years.
- ◎ This profile method for shield acceptance has been used to accept over 14,500 Type B packages.
- ◎ During this time, no package accepted under this process has ever subsequently been identified as non-compliant to the radiation limits in 10 CFR 71.71 (a).



## Conclusions

- ◎ QSA maintains that revision of the drawing for the change to "REF" on the shield dimensions is reasonable and will pose no reduction in the Type B package safety, integrity or quality since acceptance is based on actual shielding capability of the individual shield performance.
- ◎ As demonstrated by historical shield profile performance for determining quality and compliance, requiring drawing conformance to specific, tolerance dimensions is unnecessarily restrictive. This level of detail adds no quality or safety to the component or package.

## Conclusions

- ◎ QSA maintains that verifying shield conformance on the radiation profile method is a reasonable and accurate method for determining shield acceptance as a Type B package component.
- ◎ For these reasons we continue to advocate for acceptance of the revised shield dimension specifications on drawing R86000 Revision T as appropriate to the necessary manufacturing, quality and safety requirements associated with the Sentry Type B packages.

# Questions/Discussion

