Nancy Osgood

From: Whitworth, Julia [jwhtwrth@lanl.gov]
Sent: Tuesday, February 10, 2009 7:09 PM
To: Nancy Osgood; rick.boyle@dot.gov; James.Williams@dot.gov; Cuthbertson, Abigail; james.shuler@em.doe.gov
Cc: Griffin, Justin M; Pearson, Michael W; Rasmussen, Richard; Bennett, Marvin
Subject: FW: S300 Reduced Page Changes
Attachments: Add_delete.pdf; Replacement.pdf

Nancy, as we discussed earlier this afternoon, please find the attached change pages for the S300 SAR to support the certificate revision to the S300 SAR. With your suggestion of inserting pages 1-4a and 6-1a, only 7 pages will change and/or be inserted.

As per Abby's discussion earlier today with Rick Boyle and Jim Williams of DOT, we are also withdrawing the special arrangement request, believing that this approach of amending the NRC Certificate of Compliance will be successful in addressing the problem and meeting the Australian schedule for revalidating the certificates. Please give me a call at 505-699-3915 or at 505-667-0534 if you have any questions or need any additional information. We greatly appreciate the effort that all of you are making to analyze these submittals and get the certificates issued.

Best regards,
Julia

Add/Delete Instructions for S300 SAR, Rev. 3

Delete the following pages from Rev. 2	Add the following pages from Rev. 3
Chapter 1, 1-3 through 1-4	Chapter 1, 1-3 through 1-4a
Chapter 2, 2-14 through 2-15	Chapter 2, 2-14 through 2-15
Chapter 6, 6-1	Chapter 6, 6-1 through 6-1a

1.2.1.5 Heat Dissipation

The S300 package is designed with a passive thermal system. The amount of decay heat generated by the maximum payload is insignificant, as discussed in Section 3.1.2, *Content's Decay Heat.*

1.2.1.6 Coolants

Due to the passive heat transfer design of the S300 package, no coolants are utilized.

1.2.1.7 Protrusions

The external configuration of the S300 packaging is that of a standard 55-gallon drum, and consequently has no significant protrusions.

1.2.1.8 Lifting and Tie-down Devices

The S300 packaging is lifted, handled, and tied down using separate hardware designed for these purposes. Consequently, there are no lifting or tiedown devices which are an integral or structural part of the packaging.

1.2.1.9 Pressure Relief System

Containment of radioactive materials is afforded by the payload SFC, which has no pressure relief devices. As discussed earlier, one filter vent is located in the drum lid and one in the pipe component lid.

1.2.1.10 Shielding

As discussed in Chapter 5, *Shielding Evaluation*, the payload sources emit alpha particles and neutrons. The HDPE neutron shielding insert is used to demonstrate compliance with NCT dose limits. As will be demonstrated, no shielding is required for compliance with HAC dose limits.

1.2.2 Contents

The S300 package transports a single Special Form Capsule (SFC) with total contents not exceeding 350 grams plutonium in solid form in a plutonium-beryllium (PuBe) sealed neutron source. The range of distribution of isotopes used to manufacture these sources is given in the following table, as a percentage of total plutonium.

Radionuclide	Mass Fraction
Pu-238	0-0.5%
Pu-239	73-97%
Pu-240	3-21%
Pu-241	0-3%
Pu-242	0-2%
Am-241	0-2.5%

The mass fraction for each of the plutonium nuclides is the fraction of that nuclide of the total plutonium present. The Am-241 fraction is grams of Am-241 per gram of plutonium and is additive to the plutonium content.

Total contents are limited to less than an A_1 quantity using the sum of the fractions rule. Dose rate measurements are made on all packages to ensure compliance with DOT regulations as stated in Section 7.1.3, *Preparation for Transport.*

There are two different SFC models of similar design, carrying the designations Model II and Model III. Each is fabricated of Type 304 stainless steel, with a nominal wall thickness of 1/2 inch, and bottom and threaded top cap thicknesses of 3/4 inch. The top cap holds a tapered sealing plug in place, and is designed with a shearable stem to preclude removing the cap once installed. The Model II has an additional impact plug held loosely in place with a snap ring. The capsule dimensions are given in the following table.

Capsule	Outer Diameter, in	Outer length, in*
Model II	3.0	11.75
Model III	2.5	7.0

*After stem shear-off.

The Model II SFC is shown in Figure 1-3, and the Model III SFC is shown in Figure 1-4. Additional discussion of the special form capsules is provided in Section 2.10, *Special Form.* Table 1-1 gives the maximum contents for the S300 package for the Model II and Model III capsules under non-exclusive and exclusive use.

Table 1-1 - S300 Package Contents Limits, grams of Pu

Payload Type	Non-Exclusive Use		Exclusive Use	
	Model II SFC	Model III SFC	Model II SFC	Model III SFC
Plutonium-Beryllium Sealed Sources	206	160	350	160

1.2.3 Special Requirements for Plutonium

The S300 package contains a maximum of 350 grams of Pu in solid form. Therefore, no special requirements apply.

1.2.4 Operational Features

The S300 package is not considered to be operationally complex. All operational features are readily apparent from an inspection of the drawing provided in Section 1.3.1, *Packaging General Arrangement Drawings*, and the previous discussions presented in Section 1.2.1, *Packaging*. Operational procedures and instructions for loading, unloading, and preparing an empty S300 package for transport are provided in Chapter 7, *Operating Procedures*.

2.7.7 Deep Water Immersion Test

The S300 package is a Type AF package; hence, this requirement does not apply.

2.7.8 Summary of Damage

The discussions of sections 2.7.1, *Free Drop*, through 2.7.7, *Deep Water Immersion Test*, demonstrate that the S300 package in conjunction with the SFC payload prevents release or dispersal of the radioactive contents of the SFC when subjected to all applicable hypothetical accident tests. In particular, the criteria established in Section 2.1.2, *Design Criteria*, namely that the S300 package protect the SFC from conditions more severe than those experienced in the special form qualification 30-ft free drop, percussion, and heat tests of the SFC, were met.

The results of the special form qualification tests are discussed in Section 2.10, *Special Form*. The shielding and criticality control consequences of the separation of the SFC and contents from the rest of the S300 packaging under HAC is discussed in Chapter 5, *Shielding Evaluation*, and Chapter 6, *Criticality Evaluation*.

2.8 Accident Conditions for Air Transport of Plutonium

The S300 package is not transported by air; hence, this section does not apply.

2.9 Accident Conditions for Air Transport of Fissile Material Packages

The S300 package is not transported by air; hence, this section does not apply.

2.10 Special Form

The radioactive contents of the SFC consist of ^{239}Pu in solid form as Plutonium-Beryllium sealed neutron sources. The contents are contained within special form capsules of two specific types: Model II and Model III. Each capsule is of similar design, and differ primarily only in dimensions. The sealing technique is the same for both models.

The Model II SFC, illustrated in Figure 1-3, is fabricated of Type 304 stainless steel, with a nominal wall thickness of almost 1/2 inch, and bottom and top threaded cap thicknesses of 3/4 inch. The contents are located below a snap ring that holds an impact plug in place axially, followed by a tapered sealing plug nominally 3/4 inch thick. The threaded cap is designed with a shearable stem to preclude removal of the cap once installed. The outer length of the closed Model II is 11-3/4 inches (excluding the shearable cap stem), and the outer diameter is three inches. The interior cavity length is 8-3/4 inches, and the interior cavity diameter is 2-1/16 inches. The Model II SFC meets the requirements of 10 CFR §71.75, and carries the IAEA Certificate of Competent Authority Special Form Radioactive Materials Certificate Number USA/0696/S-96, Revision 4, issued by the Department of Transportation.

The Model III SFC, illustrated in Figure 1-4, is fabricated of Type 304 stainless steel, with a nominal wall thickness of 1/2 inch, and bottom and top threaded cap thicknesses of 3/4 inch. The contents are located below a tapered sealing plug nominally 3/4 inch thick. The threaded

cap is designed with a shearable stem to preclude removal of the cap once installed. The outer length of the closed Model III is seven inches (excluding the shearable cap stem), and the outer diameter is 2-1/2 inches. The interior cavity length is 4-1/2 inches, and the interior cavity diameter is 1-1/2 inches. The Model III SFC meets the requirements of 10 CFR §71.75, and carries the IAEA Certificate of Competent Authority Special Form Radioactive Materials Certificate Number USA/0695/S-96, Revision 4, issued by the Department of Transportation.

Both capsules are assembled and tested according to written procedures. To ensure proper assembly, each capsule is checked with a gauge that measures how far the tapered plug has been inserted into the capsule body. Measurements of the tapered plug insertion are made both before and after the final tightening and shear-off of the cap stem. These measurements are recorded on the data sheet belonging to each capsule. If the measurements meet the standards established for the capsule design, proper assembly is assured.

2.11 Fuel Rods

The S300 package does not carry fuel rods; hence, this section does not apply.

6. CRITICALITY EVALUATION

This section describes the criticality evaluation, documenting the models and technical bases that support the conclusion that, for the plutonium limits provided in Chapter 1, *General Information*, the S300 package has a Criticality Safety Index (CSI) of zero. Therefore, an infinite array of packages would be subcritical if subjected to the Normal Conditions of Transport (NCT). Further, an infinite array of bare Special Form Capsules (SFC) would be subcritical if subjected to the Hypothetical Accident Conditions (HAC) of transport. Due to the relatively small plutonium mass limits and small internal volumes of the innermost vessels, all single packages are highly subcritical.

In this chapter, plutonium is modeled as pure Pu-239. However, the plutonium used in the PuBe sources was generated in a reactor and is therefore comprised of the following isotopes: Pu-238, Pu-239, Pu-240, Pu-241, and Pu-242. The Pu-240/Pu can range from approximately 3 to 21%, and the Pu-241/Pu can range from approximately 0 to 3%. Pu-240 is significantly less reactive than Pu-239, although Pu-241 is more reactive than Pu-239. Because Pu-240 is always present in significantly larger quantities than Pu-241, it is conservative to simply model all plutonium as Pu-239.

(End of page)

6.1 Description of Criticality Design

The S300 package has as its innermost containment vessel a single Special Form Capsule (SFC), as discussed in Section 2.10, *Special Form*. This SFC has been analyzed neutronically in isolation (as a single unit) and as infinite arrays and is shown to be subcritical for all NCT and HAC situations, for the content limits provided in Table 1-1. For conservatism and simplicity of analysis, most criticality evaluations have been based on the assumption that the package exterior to the SFC is not present. A few calculations have been performed to demonstrate that this claim of conservatism is indeed accurate. Thus the criticality design rests on the specified plutonium content limits and the very robust nature of the SFC.

6.1.1 Design Features

The only parts of the S300 package that are credited for criticality control are the plutonium content limits and the SFC. (As stated previously, it is demonstrated later in this chapter that neglecting all other parts of the package in the analyses is neutronically conservative.) While the SFCs are very robust and would likely not allow water ingress subsequent to the HAC, the internal volumes of both the Model II and the Model III are far below the minimum critical volumes for homogenous metal-water mixtures, thus assuring subcriticality were flooding to occur.

In essence, modeling only the SFC, either as a single unit or as an array, is analogous to making the assumption that as a result of either the NCT or the HAC that all parts of the package are removed or destroyed. This assumption obviously exceeds what could credibly occur. However, it can readily be shown to be conservative; it does result in simplified calculational analyses; and it leads to loading limits that are economical and acceptable.

6.1.2 Summary Table of Criticality Evaluation

A single SFC Model II or Model III is shown to be highly subcritical for the content limits given in Table 1-1 and under the conditions specified in 10 CFR 71.55(b), (d), and (e). Further, a single SFC is shown to be more reactive than a single S300 package under any of these conditions. Thus, the single S300 package is shown to be subcritical under all specified regulatory conditions.