

**Safety Evaluation Report for
Shipping a Revised Sleeve and Plug
Design in the 9977 Packaging**

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OVERVIEW

This Safety Evaluation Report (SER) summarizes the results of the Department of Energy (DOE) Packaging Certification Program (PCP) Staff's review of the "Application for Amendment for Shipping Revised Sleeve and Plug Design in the 9977 Packaging", June 29, 2010, submitted by Paul Mann of the National Nuclear Security Administration (NNSA). The Sleeve and Plug component is built to "Q" dimensions to confirm its ability to meet its performance requirements. Due to a dimensioning error, the Sleeve and Plugs have fit (interference) problems with the 6-inch Containment Vessels in some 9977s and cannot be fully inserted. A design change was implemented that decreases the outer diameter of the bottom portion of the Sleeve and Plug (revision to drawing R-R4-G-0053, 9977 Sleeve and Plug Details, Revision 2). DOE PCP reviewed this submittal and concurred that this change does not affect the Sleeve and Plug's ability to perform its shielding and criticality functions. DOE PCP authorizes in this Safety Evaluation Report (SER), the revised Sleeve and Plug configuration. The NNSA request was for both the Transportation and the Transportation/Storage Certificates of Compliance (CoCs) for the 9977.

The Safety Analysis Report for Packaging (SARP) for the Model 9977 Packaging, S-SARP-G-00001, Revision 2 was supplemented by Safety Analysis Report for Packaging, Model 9977, Addendum 1, S-SARA-G-00003, Revision 2 (SARA-1) which, amongst other contents, authorized a (one piece) aluminum Sleeve and Plug configuration that maximized the fissile material content mass in the package (Drawing R-R4-G-0053, 9977 Sleeve and Plug Details, Revision 1). The Model 9977-96 Package is currently certified under two Certificate of Compliance Numbers, USA/9977/B(M)F-96 (DOE) and USA/9977/B(M)F-96 (DOE-S/T-1), covering transportation and periodic and extended maintenance, respectively.

The Department of Homeland Security wanted to maximize the mass of fissile radioactive material (RAM) authorized as contents within the 9977 in support of its Domestic Nuclear Detection Office testing programs. SARA-1 to the 9977 SARP determined the bounding RAM masses based on decay heat rate, shielding, and sub-criticality criteria. The (one-piece) Sleeve and Plug component reduces the volume of the containment vessel in order to meet the Single Package Flooded condition requirement for sub criticality found in 10 CFR 71.55, General Requirements for Fissile Material Packages. For array analyses, the Sleeve and Plug provides spacing in order to meet the requirement for sub criticality. The Sleeve and Plug also provides spacing (elevation from the package bottom) in order to meet the normal conditions of transport (NCT) dose limit requirements.

General Information

Contents and Configuration Definition

No content definition changes were requested. The contents (RAM isotopes and masses, impurity elements and masses) as defined in Addendum 1 and authorized under the Revision 0 of the CoC 9977 (DOE-S/T-1) have not changed. The (one piece) Sleeve and Plug as defined by drawing R-R4-G-00053, 9977 Sleeve and Plug Details, Revision 1 is authorized in SARA-1. The Sleeve and Plug design is modified with a reduced outer diameter on its lower section. The revised (one piece) Sleeve and Plug is defined by drawing R-R4-G-00053, 9977 Sleeve and Plug Details, Revision 2.

Findings

Based on the review the DOE PCP Staff has concluded that the packaging design has been adequately described to meet the general requirements of 10 CFR 71.

Conditions of Approval

The DOE PCP Staff concluded that the revised CoC will change drawing R-R4-G-0053, 9977 Sleeve and Plug Details, from Revision 1 to Revision 2.

Structural Evaluation

This section of the SER covers the assessment of the Structural Evaluation information provided in the Application for Amendment.

The Sleeve and Plug, is required for subcritical control for SARA-1 Content Envelopes AC.3, AC.4 and AC.5. The one-piece aluminum Sleeve and Plug functions as volume control to maintain a subcritical configuration in the analysis of the single package flooded evaluation required by 10 CFR 71.55. Additionally, the spacing provided by the Sleeve and Plug from the side and bottom of the 6CV is required to comply with 10 CFR 71 NCT dose limits for Content Envelopes AC.1 and AC.3. However, the spacing function is not required for compliance with the hypothetical accident condition (HAC) dose limits. SARA-1 demonstrates that the Sleeve and Plug perform structurally as well as the 6CV under NCT and HAC events and its capability to withstand the NCT and HAC test requirements without compromising its volume-control function and or its positional shielding function. The 0.2 inch reduction in diameter on the lower 4 ½ inches of the Sleeve and Plug will not effect this conclusion.

Findings

Based on the review the DOE PCP Staff has concluded there are no structural issues associated with the revised Sleeve and Plug configurations.

Conditions of Approval

DOE PCP has concluded that no additional structurally-related conditions of approval need to be added to the existing CoC for the approval of this request.

Thermal Evaluation

This section of the SER covers the review of the Thermal Evaluation information provided in the Application for Amendment.

The revised Sleeve and Plug configuration has minimal effect of the temperature distribution within the 6CV. Decreasing the diameter of the bottom of the Sleeve and Plug (i.e. increasing the thickness of the air gap at this location) by 0.2 inches is expected to raise the local temperature by no more than a degree. The Maximum Normal Operating Pressure is based on the Content temperature for a point source in intimate contact with the bottom of the 6CV which still bounds the revised Sleeve and Plug configuration and assumed that the gas within the 6CV was at the maximum content temperature. The revised Sleeve and Plug configuration will provide slightly more free volume within the 6CV which will offset any local temperature increase.

Findings

Based on the review of the DOE PCP Staff has concluded there are no thermal issues associated with the revised Sleeve and Plug configurations.

Conditions of Approval

DOE PCP has concluded that no additional thermally-related conditions of approval need to be added to the existing CoC for the approval of this request.

Containment

This section of the SER covers the review of the Containment information provided in the Application for Amendment.

The contents included in SARA-1 to the 9977 SARP Revision 2 are not changed in the Application for Amendment. The proposed revision to the Sleeve and Plug Configuration does not increase the impact loading on the containment vessels, the temperatures that must be sustained, nor the pressure that must be contained. Therefore, the package containment performance (leak-tight in accordance with ANSI Standard N 14.5) documented in the 9977 SARP Revision 2 is equally valid for this Configuration. Package containment will be maintained throughout the maintenance period of the package as documented in SARA-1.

Findings

Based on the review the DOE PCP Staff has concluded there are no containment issues associated with the revised Sleeve and Plug configurations.

Conditions of Approval

DOE PCP has concluded that no additional containment-related conditions of approval need to be added to the existing CoC for the approval of this request.

Shielding Evaluation

This section of the SER covers the review of the Shielding Evaluation information provided in the Application for Amendment.

The Content Envelopes AC.1 through AC.5 were described, evaluated, and their compliance with the regulatory requirements documented in SARA-1. The evaluations show that as long as the restrictions on content mass and packaging configuration are met with additional spacing (e.g., Sleeve and Plug), the Content Envelopes are in compliance with regulatory requirements. The Sleeve and Plug configuration, shown in SARA-1 Figure A.5.1, increases the content distance to the package bottom and side wall. The dose rates in SARA-1 Table A.5.1 reflect the use of this required packaging configuration. The decrease in diameter of the lower section of the Sleeve and Plug does not change the analyzed configurations and, therefore, does not alter the calculated dose rates.

Findings

Based on the review the DOE PCP Staff has concluded there are no shielding issues associated with the revised Sleeve and Plug configurations.

Conditions of Approval

DOE PCP has concluded that no additional shielding-related conditions of approval need to be added to the existing CoC for the approval of this request.

Criticality Evaluation

This section of the SER covers the review of the Criticality Evaluation information provided in the Application for Amendment.

The SARA-1 Content Envelopes allow up to 4.4 kg ²³⁹Pu or 18 kg of U metal. As documented in SARA-1, justification for these Contents is based on a Nuclear Criticality Safety Evaluation (NCSE) using the models (geometry and material specifications) and general analysis approach used in the 9977 SARP baseline NCSE. The NCSE determines the quantities of several fissile materials that can be shipped in the 9977 shipping package with the aluminum Sleeve and Plug inserted in the 6CV. This evaluation is in compliance with the performance requirements of 10 CFR 71.55 and 71.59 for criticality safety. The analyses in SARA-1 demonstrate that the 9977 shipping package is subcritical with adherence to design features, limits and controls specified. The decrease in diameter of the lower section of the Sleeve and Plug does not change the analyzed configurations and, therefore, does not negate the demonstrated sub-criticality analysis.

Findings

Based on the review the DOE PCP Staff has concluded there are no criticality issues associated with the revised Sleeve and Plug configurations.

Conditions of Approval

DOE PCP has concluded that no additional criticality-related conditions of approval need to be added to the existing CoC for the approval of this request.