



U.S. DEPARTMENT OF ENERGY/NNSA

SAFETY GUIDE

OFFICE OF WEAPONS SURETY
PACKAGING AND TRANSPORTATION PROGRAM

SARP Completeness Review Checklist for DOE/NNSA Defense Programs Packages

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Revision 2

SG 200

US DOE SAFETY GUIDES

Safety Guides are issued to describe and make available to DOE contractors and the public methods acceptable to the DOE of implementing specific parts of the Department's regulations, to delineate techniques used by DOE in

evaluating specific problems or postulating accidents, or to provide guidance.

Safety Guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions different from those set out in the guides will be acceptable if they provide a basis for finding that the regulation has been met.

NOTICE OF REQUEST FOR COMMENTS

The DOE/NNSA Office of Weapons Surety (OWS) Packaging and Transportation Program (PTP) is pleased to offer this Guide to customers of the Nuclear Weapons Program Complex. Your comments are solicited. Please direct your written comments to Mr. Glenn Binns, DOE/AL, Program Manager, Packaging and Transportation Programs. The mailing address is:

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All comments will be reviewed, and upon request, a written response will be provided to the Guide reviewer by DOE/NNSA OWS PTP staff. The efforts of each Guide reviewer to improve this document are sincerely appreciated, and approved changes will be incorporated in future revisions.

Glenn Binns, Program Manager
Packaging and Transportation Program

REVISION NOTICE

This revision has been prepared to reflect changes in 10 CFR 71 requirements, to focus on requirements applicable to Defense Programs packages, and to reflect NNSA organizational changes.

APPROVAL SHEET

DOE/NNSA Safety Guide, SG 200, <i>SARP Completeness Review Checklist for DOE Defense Programs Packages, OWS PTP</i>	
Revision Number	Approval Signature DOE/NNSA OWS PTP
1	Glenn V. Binns Program Manager, Packaging and Transportation Program
2	General Update

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1.0 INTRODUCTION

The purpose of this safety guide is to establish a standard for determining the completeness of a Safety Analysis Report for Packaging (SARP) prior to its submittal to the DOE/NNSA OWS PTP.

DOE Order 461.1, *Packaging and Transfer or Transportation of Materials of National Security Interest*, requires that a SARP be submitted in support of a Type B package certification application and the associated request for an Offsite Transportation Certificate (OTC). This safety guide summarizes, in the form of a checklist, SARP requirements from the applicable regulations, orders, and guidance listed in Section 3.0. As the name implies, the checklist is intended to address completeness of the SARP in addressing requirements, and is not a substitute for a formal Panel review.

2.0 COMPLETENESS REVIEW CHECKLIST

2.1 Requirements

A SARP must be submitted in support of an application to certify a Type B package and to request the associated OTC.

To ensure that the SARP is complete in addressing the requirements of the applicable regulations, orders, and guidance, the organization submitting the application to certify a Type B package shall compare its SARP against the "SARP Completeness Review Checklist" found in the appendix of this safety guide before submitting the SARP to DOE/NNSA/OWS PTP. This requirement does not apply to a SARP submitted for recertification, unless substantial modifications were made to the SARP, and an independent review of the entire SARP is required (see the Recertification Requirements).

The comparison of the SARP against the Completeness Review Checklist shall be documented. The documentation should consist of filling in the data entries in the Completeness Review Checklist that are to be provided by SARP completeness reviewers, as explained in Section 2.2. An affirmation of the successful performance of the comparison and the availability of the documentation shall accompany the SARP submittal.

2.2 Structure and Use of the Checklist

The Completeness Review Checklist is organized by SARP chapter and section in the format defined by RG 7.9 to the extent practical, with the addition of a chapter on quality assurance. Since RG 7.9 has not been updated to be consistent with the current revision of 10 CFR 71, there will be significant differences in some sections. Where conflicts exist, 10 CFR 71 requirements will apply. For each SARP section, the requirements basis in regulation, order, or guidance are provided.

The remainder of the checklist consists of three entries that require responses/entries by SARP completeness reviewers:

1. The location in the SARP where the requirement is addressed. Note that it is not mandatory for the SARP to address a requirement in the location suggested by the checklist.
2. A YES, NO, or NOT APPLICABLE response to the question “Does the SARP address the requirement satisfactorily?”
3. A reference number for any comment that expands on an entry made in Item 2, above.

3.0 REFERENCES

The current revision of a reference should be used to determine requirements unless otherwise directed by DOE/NNSA/OWS PTP.

10 CFR 71	<i>Packaging and Transportation of Radioactive Materials</i> , U.S. Nuclear Regulatory Commission regulation.
49 CFR, Parts 100-178	<i>Transportation</i> , U.S. Department of Transportation regulation.
10 CFR 20	<i>Standards for Protection Against Radiation</i> , U.S. Nuclear Regulatory Commission regulation.
DOE Order 461.1	<i>Packaging and Transfer or Transportation of Materials of National Security Interest</i> , U.S. Department of Energy order.
RG 7.9	<i>Standard Format and Content of Part 71 Applications for Approval of Packaging for Radioactive Material</i> , U.S. Nuclear Regulatory Commission regulatory guide.
SG 100	<i>Design Guide for Packaging and Transfer or Transportation of Materials of National Security Interest</i> , U.S. Department of Energy safety guide.
SG 140.1	<i>Combination Test/Analysis Method Used to Demonstrate Compliance to DOE Type B Packaging Thermal Test Requirements</i> .
ANSI N14.5	<i>Leakage Tests on Packages for Shipment</i> , American National Standard for Radioactive Materials.
NUREG/CR-4775	<i>Guide for Preparing Operating Procedures for Shipping Packages</i> .
SG 500	<i>Defense Programs Packaging and Transportation Guide</i> .
SG 600	<i>Design Guide for Testing Type B Packaging</i>
ANSI/ANS-6.1.1	<i>Neutron and Gamma Ray Flux-to-Dose-Rate Factors</i> , American National Standard.

DOE/AL QC-1

DOE/AL Quality Criteria (QC-1).

UCID-21218.

Packaging Review Guide for Reviewing Safety Analysis Reports for Packaging, Lawrence Livermore National Laboratory, Revision 2.

NESD Recertification Requirements for Defense Programs Type B Packages, DOE/AL.

SARP COMPLETENESS REVIEW CHECKLIST

DOE/NNSA
Office of Weapons Surety
Packaging and Transportation Program



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Chapter 1 - General Information Safety Analysis Report for Packaging Completeness Review Checklist		
Name(s) of Reviewer(s) _____	Date of Review _____	
SARP No: _____	Title: _____	Date: _____

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
1.1	<u>Introduction</u> This section should include the following:				
	• proposed uses of the packaging	RG 7.9, 1.1			
	• model number	10 CFR 71.33(a)(3) RG 7.9, 1.1			
	• number of packages per shipment or transport index	RG 7.9, 1.1			
	• classification as Type B(U), B(M), or fissile material packaging	10 CFR 71.33(a)(1)			
1.2	<u>Package Description</u>	10 CFR 71.33			
1.2.1	<u>Packaging</u> The package description should include the following:				
	• gross weight	RG 7.9 1.2.1 10 CFR 71.33(a)(2)			
	• external dimensions and cavity size	RG 7.9, 1.2.1			
	• materials of construction	RG 7.9, 1.2.1			
	• identification of the containment vessel and system	10 CFR 71.33(a)(4) RG 7.9, 1.2.1			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	<ul style="list-style-type: none"> • identification and volumes of any receptacles containing coolant and types of coolant 	10 CFR 71.33(a)(6) RG 7.9, 1.2.1			
	<ul style="list-style-type: none"> • amount of shielding 	RG 7.9, 1.2.1			
	<ul style="list-style-type: none"> • pressure relief systems 	RG 7.9, 1.2.1			
	<ul style="list-style-type: none"> • closures 	RG 7.9, 1.2.1			
	<ul style="list-style-type: none"> • specific materials of construction and weights, dimensions, and fabrication methods of: <ul style="list-style-type: none"> - receptacles - materials specifically used as nonfissile neutron absorbers or moderators - internal and external structures supporting or protecting receptacles - valves, sampling ports, lifting devices, and tie-down devices - structural and mechanical means for the transfer and dissipation of heat 	10 CFR 71.33(a)(5)			
	<ul style="list-style-type: none"> • overall and cutaway sketches (8-1/2" x 11") of the package 	RG 7.9, 1.2.1			
	Plutonium shipments in excess of 20 curies per package must be shipped as a solid.	10 CFR 71.63(a)			
	A plutonium shipment in excess of 20 curies per package must be placed in a separate inner container within the outer packaging that meets the Package Approval Standards 10 CFR 71 Subpart E and the Package and Special Form Tests 10 CFR 71 Subpart F.	10 CFR 71.63(b)			
1.2.2	<p><u>Operational Features</u></p> <p>For complex package systems, include a description of the operation of the package including a schematic diagram showing all valves, connections, piping, openings, seals, and containment boundaries.</p>	RG 7.9, 1.2.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
1.2.3	<u>Contents of Packaging</u> The following types and variations of contents should be described:	10 CFR 71.33(b)			
	<ul style="list-style-type: none"> identification and maximum radioactivity of radioactive constituents 	10 CFR 71.33(b)(1)			
	<ul style="list-style-type: none"> identification and maximum quantities of fissile constituents 	10 CFR 71.33(b)(2) RG 7.9, 1.2.3			
	<ul style="list-style-type: none"> chemical and physical form 	10 CFR 71.33(b)(3) RG 7.9, 1.2.3			
	<ul style="list-style-type: none"> extent of reflection, the amount and identity of nonfissile materials such as neutron absorbers or moderators, and the atomic ratio of moderator to fissile constituents 	10 CFR 71.33(b)(4) RG 7.9, 1.2.3			
	<ul style="list-style-type: none"> configurations as required for nuclear safety evaluation 	RG 7.9, 1.2.3			
	<ul style="list-style-type: none"> material density 	RG 7.9, 1.2.3			
	<ul style="list-style-type: none"> maximum normal operating pressure 	10 CFR 71.33(b)(5)			
	<ul style="list-style-type: none"> maximum weight 	10 CFR 71.33(b)(6)			
	<ul style="list-style-type: none"> maximum amount of decay heat 	10 CFR 71.33(b)(7) RG 7.9, 1.2.3			
	<ul style="list-style-type: none"> maximum pressure buildup in the inner container 	RG 7.9, 1.2.3			
	<ul style="list-style-type: none"> any loading restrictions 	RG 7.9, 1.2.3			
	<ul style="list-style-type: none"> identification and volumes of any coolant 	10 CFR 71.33(b)(8)			
1.3	<u>Appendix</u> The Appendix should include the following information:	RG 7.9, 1.3			
	<ul style="list-style-type: none"> detailed information describing the packaging, operational features, and contents such as dimensional drawings, detailed operational schematics, and loading configurations 				

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	<ul style="list-style-type: none"> drawings that clearly detail the safety features which are considered in the analysis, for example: material lists, dimensions, valves, fasteners, and welder and welding procedure qualification requirements 	RG 7.9, 1.2.1			
	<ul style="list-style-type: none"> drawings that specify by appropriate weld symbol, the requirements for all safety-related packaging weld joints, including the method of nondestructive examination and the acceptance standard 	RG 7.9, 1.2.1			
	<ul style="list-style-type: none"> drawings sufficiently detailed to show, as a minimum, the surface finish and flatness requirements of the closure surfaces, the gasket specification and if appropriate, the method of gasket retention for gasketed joints in the containment system 	RG 7.9, 1.2.1			

Name(s) of Reviewer(s) _____	Date of Review _____
SARP No: _____	Title: _____
	Date: _____

Chapter 2 - Structural Evaluation Safety Analysis Report for Packaging Completeness Review Checklist

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.1	<u>Structural Design</u>				
2.1.1	<u>Discussion</u> This section should identify the principal structural members and systems that are vital to the safe operation of the package (such as containment vessel, closure devices, or valves). Discuss their design and performance, and reference the items on appropriate drawings.	RG 7.9, 2.1.1			
2.1.2	<u>Design Criteria</u> The structural design criteria based on the ASME code should be addressed, i.e., the appropriate ASME code section based on the number of A ₂ s in the contents. Alternate approaches should be justified.	SG 100			
	The following topics should be addressed: <ul style="list-style-type: none"> • The load combinations and factors that serve as design criteria should be described and referenced. 	RG 7.9, 2.1.2			
	<ul style="list-style-type: none"> • For each criterion identified, the maximum allowable stresses and strains (as a percentage of the yield or ultimate values) for ductile failure should be stated. 	RG 7.9, 2.1.2			
	<ul style="list-style-type: none"> • Consideration of other structural failure modes (e.g., brittle fracture, fatigue, buckling). 	RG 7.9, 2.1.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	<ul style="list-style-type: none"> Criteria used in the impact evaluation. 	RG 7.9, 2.1.2			
	<ul style="list-style-type: none"> Codes and standards that are used to determine material properties, design limits, or methods of combining loads and stresses should be identified. 	RG 7.9, 2.1.2			
	<ul style="list-style-type: none"> When different design criteria are used in various parts of the packaging or for different conditions, appropriate values for each case should be indicated. 	RG 7.9, 2.1.2			
	<ul style="list-style-type: none"> Codes and standards used to determine material properties, design limits, or methods of combining loads and stresses should be identified. Explanation should be provided for use of nonstandard codes. 	RG 7.9, 2.1.2			
2.2	<u>Weights and Centers of Gravity</u>	RG 7.9, 2.2			
	<p>The following information should be included:</p> <ul style="list-style-type: none"> The center of gravity of the package and any other centers of gravity referred to in the SARP should be located and identified. 				
	<ul style="list-style-type: none"> The total weight of the package should be listed. The weights of major individual subassemblies should be tabulated such that the sum of the parts equals the total of the package. 	RG 7.9, 2.2			
	<ul style="list-style-type: none"> A sketch or drawing that clearly shows the individual subassembly referred to and the reference point for locating its center of gravity should be included 	RG 7.9, 2.2			
2.3	<u>Mechanical Properties of Materials</u>	RG 7.9, 2.3			
	<p>The following information should be included:</p> <ul style="list-style-type: none"> The material mechanical properties used in the structural evaluation should be listed. 				

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	<ul style="list-style-type: none"> For materials subjected to dynamic loading or elevated temperatures, the appropriate mechanical properties under these conditions should be specified. 	RG 7.9, 2.3			
	<ul style="list-style-type: none"> The references for each material mechanical property should be referenced clearly to the publication and page number. 	RG 7.9, 2.3			
	<ul style="list-style-type: none"> Where material properties are determined by testing, the test procedures, conditions, and measurements should be described in sufficient detail to determine that the results are valid. 	RG 7.9, 2.3			
	<ul style="list-style-type: none"> The behavior of insulating material when exposed to the structural environments for NCT and HAC should be characterized. 	OWS PTP guidance			
2.4	<p><u>General Standards for All Packages</u></p> <p>Compliance with the following requirements should be demonstrated:</p>				
2.4.1	<p><u>Minimum Package Size</u></p> <p>The smallest overall dimension of the package may not be less than 10 cm (4 in).</p>	10 CFR 71.43(a) RG 7.9, 2.4.1			
2.4.2	<p><u>Tamper Indicating Features</u></p> <p>The outside of a package must incorporate a feature, such as a seal, that is not readily breakable, and which, while intact, would be evidence that the package has not been opened by unauthorized persons.</p>	10 CFR 71.43(b) RG 7.9, 2.4.2			
2.4.3	<p><u>Positive Closure</u></p> <p>The package must include a containment system securely closed by a positive fastening device which cannot be opened unintentionally or by a pressure that may arise within the package.</p>	10 CFR 71.43(c) RG 7.9, 2.4.3			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.4.4	<p><u>Chemical and Galvanic Reactions</u></p> <p>A package must be made of materials and construction that ensure that there will be no significant chemical, galvanic, or other reaction among the packaging components, among package contents, or between the packaging components and the package contents, including possible reaction resulting from inleakage of water to the maximum credible extent. Account must be taken of the behavior of materials under irradiation. To show compliance, for each component material of the packaging list all chemically or galvanically dissimilar materials in contact with each material of the packaging. Indicate any specific measures to prevent contact that have been taken, and discuss their effectiveness.</p>	<p>10 CFR 71.43(d)</p> <p>RG 7.9, 2.4.4</p>			
2.4.5	<p><u>Escape of Radioactive Contents Through a Valve</u></p> <p>A package valve, or other device, the failure of which would allow radioactive contents to escape, must be protected against unauthorized operation and, except for a pressure relief device, must be provided with an enclosure to retain any leakage.</p>	<p>10 CFR 71.43(e)</p>			
2.4.6	<p><u>Packaging Effectiveness</u></p> <p>A package must be designed, constructed, and prepared for shipment such that under the tests specified in §71.71, Normal Conditions of Transport (NCT) there would be no loss or dispersal of radioactive contents, no significant increase in external radiation levels, and no substantial reduction in the effectiveness of the packaging.</p>	<p>10 CFR 71.43(f)</p>			
2.4.7	<p><u>Transportation Use</u></p> <p>A package must be designed, constructed, and prepared for transport so that in still air at 38°C (+100°F) and in the shade, no accessible surface of the package would have a temperature exceeding 50°C (+122°F) in a nonexclusive use shipment, or 85°C (+185°F) in an exclusive use shipment.</p>	<p>10 CFR 71.43(g)</p>			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.4.8	<u>Continuous Package Venting</u> A package may not incorporate a feature intended to allow continuous venting during transport.	10 CFR 71.43(h)			
2.5	<u>Lifting and Tiedown Standards</u>	RG 7.9, 2.5.1			
2.5.1	<u>Lifting Devices</u> All devices and attachments that can be used to lift the package or its lid must be identified and drawings and sketches provided that show the location and construction of these items.				
	Lifting attachments that are structural parts of a package must be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner. Documented values of the yield stresses of the materials should be used to demonstrate compliance.	10 CFR 71.45(a) RG 7.9, 2.5.1			
	The package must be designed so that failure of any lifting device under excessive load would not impair the ability of the package to meet other requirements of 10 CFR 71, Subpart E.	10 CFR 71.45(a) RG 7.9, 2.5.1			
	Structural parts of the package that could be used to lift the package must be capable of being rendered inoperable for lifting the package during transport, or be designed with strength equivalent to that required for lifting attachments.	10 CFR 71.45(a)			
2.5.2	<u>Tiedown Devices</u> All devices that are a structural part of the package and can be used for tiedown must be identified and drawings and sketches provided that show the location and construction of tiedown devices and the overall tiedown system.	10 CFR 71.45(b) RG 7.9, 2.5.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	<p>The overall tiedown system should be discussed. Note: this requirement applies only to tiedown devices that are a structural part of the package. The tiedown arrangement in the transport vehicle is normally specified in the Offsite Transportation Certificate by reference, and is not discussed in the SARP.</p>	RG 7.9, 2.5.2			
	<p>If there is a system of tiedown devices which is a structural part of the package, the system must be capable of withstanding, without generating stress in any material of the package in excess of its yield strength:</p> <ul style="list-style-type: none"> • a static force applied to the center of gravity having a vertical component 2 times the weight of the package with its contents • a horizontal component along the direction in which the vehicle travels of 10 times the weight of the package with its contents • and a horizontal component in the traverse direction of 5 times the weight of the package with its contents. 	10 CFR 71.45(b)(1) RG 7.9, 2.5.2			
	<p>All other structural parts of the package that could be used to tie down the package must be capable of being rendered inoperable for tying down the package during transport, or be designed with strength equivalent to that required for tiedown devices.</p>	10 CFR 71.45(b)(2)			
	<p>Each tiedown device which is a structural part of a package must be designed so that failure of the device under excessive load would not impair the ability of the package to meet other requirements of §71.45.</p>	10 CFR 71.45(b)(3) RG 7.9, 2.5.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.6	<p><u>Normal Conditions of Transport</u></p> <p>A summary should be provided documenting that when subjected to the conditions specified in 10 CFR 71.71 (“Normal Conditions of Transport”) the package meets the standards specified in §71.43 and §71.51. The package should be assessed against each condition of §71.71 separately and a determination made that the applicable performance requirements have been satisfied. There should be no changes to the package that affect its ability to withstand the Hypothetical Accident Conditions.</p>	RG 7.9, 2.6, Packaging Review Guide			
	Evaluation of each condition must include a determination of the effect on the design of the conditions and tests specified. Separate specimens may be used for the free-drop, compression, and penetration tests provided the specimen is first subjected to the water spray test.	10 CFR 71.71(a)			
	A package must be designed, constructed, and prepared for shipment so that under the specified tests there would be no loss or dispersal of radioactive contents (as demonstrated to a sensitivity of 10^{-6} A ₂ per hour), no significant increase in external surface radiation levels, and no substantial reduction in the effectiveness of the packaging.	10 CFR 71.43(f) 10 CFR 71.51(a)(1)			
	With respect to the initial conditions for the tests the ambient air temperature before and after the tests must remain constant at that value between -29°C (-20°F) and at 38°C (+100°F) which is most unfavorable for the feature under consideration.	10 CFR 71.71(b)			
	The initial internal pressure within the containment system must be the maximum normal operating pressure, unless a lower internal pressure consistent with the ambient temperature considered to precede and follow the tests is more unfavorable.	10 CFR 71.71(b)			
	Compliance with the permitted activity release limits of §71.51(a) may not depend on filters or on a mechanical cooling system.	10 CFR 71.51(c)			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.6.1	<u>Heat</u>	10 CFR 71.71(c)(1)			
2.6.1.1	Note: the thermal evaluation for the heat test should be in Chapter 3 of the SARP. <u>Summary of Pressures and Temperatures</u> All temperatures and pressures, as determined in the thermal evaluation should be provided.	RG 7.9, 2.6.1.1			
2.6.1.2	<u>Differential Thermal Expansion</u> The calculations of the circumferential and axial deformations and stresses (if any) that result from differential thermal expansion should be provided. Both steady state and transient conditions should be considered.	RG 7.9, 2.6.1.2			
2.6.1.3	<u>Stress Calculations</u> Calculations of the combined stresses due to thermal gradients, pressure, and other mechanical loads should be reported.	RG 7.9, 2.6.1.3			
	Sketches should be provided that show the configuration and dimensions of the members or systems being analyzed. The points at which stresses are being calculated should be located on the sketches.	RG 7.9, 2.6.1.3			
	The analysis should consider whether repeated cycles of thermal loadings, together with other loadings, will cause fatigue failure or extensive accumulations of deformation.	RG 7.9, 2.6.1.3			
2.6.1.4	<u>Comparison with Allowable Stresses</u> The appropriate stress combinations should be compared with the design criteria in Section 2.1.2 of the SARP.	RG 7.9, 2.6.1.4			
	The SARP should demonstrate that the performance requirements have been met.	RG 7.9, 2.6.1.4			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.6.2	<p><u>Cold</u></p> <p>Note: the thermal evaluation for the cold test should be in Chapter 3 of the SARP.</p> <p>The effects of a steady-state ambient temperature of -40°F in still air and shade on the package material properties should be stated.</p>	10 CFR 71.71(c)(2)			
	<p>The resulting temperatures from the -40°F ambient on the vital components of the package and their effects on operation of the package should be stated.</p>	10 CFR 71.71(c)(2) RG 7.9, 2.6.2			
	<p>Brittle fracture should be considered.</p>	RG 7.9, 2.6.2			
2.6.3	<p><u>Reduced External Pressure</u></p> <p>The effects of external pressure equal to 25 kPa (3.5 lbf/in²) absolute on the package should be assessed.</p>	10 CFR 71.71(c)(3)			
2.6.4	<p><u>Increased External Pressure</u></p> <p>The effects of external pressure equal to 140 kPa (20 lbf/in²) absolute on the package should be assessed.</p>	10 CFR 71.71(c)(4)			
2.6.5	<p><u>Vibration</u></p> <p>The effects of vibration normally incident to transport should be assessed.</p>	10 CFR 71.71(c)(5)			
2.6.6	<p><u>Water Spray</u></p> <p>The effects of the water spray test should be assessed. The water spray test simulates exposure to rainfall of approximately 5 cm (2 in.) per hour for at least 1 hour.</p>	10 CFR 71.71(c)(6)			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.6.7	<p><u>Free-Drop</u></p> <p>The effects of the free-drop test should be assessed. The free-drop distance is specified in 10 CFR 71.71(c)(7). The target is required to be a flat, essentially unyielding, horizontal surface.</p>	10 CFR 71.71(c)(7)			
	The free-drop test must be performed on the most vulnerable orientation for maximum damage.	10 CFR 71.71(c)(7)			
	The free-drop test must be performed between 1.5 and 2.5 hours after the water spray test.	10 CFR 71.71(c)(7)			
2.6.8	<p><u>Corner Drop</u></p> <p>(Applies only to fiberboard, wood, or fissile material rectangular packages not exceeding 50 kg (110 lb) and fiberboard, wood, or fissile material cylindrical packages not exceeding 100 kg (220 lb).)</p> <p>If applicable, the package must be assessed for the effects of the corner drop test. The corner drop test consists of a free drop onto each corner of the package in succession (each quarter of the rim for cylindrical packages) from a height of 0.3 m (1 ft).</p>	10 CFR 71.71(c)(8)			
2.6.9	<p><u>Compression</u></p> <p>(Applies to packages weighing up to 5,000 kg (11,000 lb).)</p> <p>If applicable the package must be assessed for the effects of compressive load applied uniformly to the top and bottom of the package in the position of normal transport. The load must be the greater of 5 times the weight of the package, or the equivalent of 13 kPa (2 lbf/in²) multiplied by the vertically projected area of the package.</p>	10 CFR 71.71(c)(9)			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.6.10	<p><u>Penetration</u></p> <p>The package must be assessed for the effects of impact of the hemispherical end of a vertical steel cylinder of 3.2 cm (1.25 in) diameter and 6 kg (13 lb) mass, dropped from a height of 1 m (40 in) onto the exposed surface of the package that is expected to be most vulnerable to puncture. The long axis of the cylinder must be perpendicular to the package surface.</p>	10 CFR 71.71(c)(10)			
2.7	<p><u>Hypothetical Accident Conditions</u></p> <p>A summary should be provided documenting that when subjected to the conditions specified in §71.73 the package meets the standards specified in §71.51. The package should be assessed against each condition of §71.73 in the sequence specified in the regulation (cumulative damage) and a determination made that the applicable performance requirements have been satisfied.</p>	RG 7.9, 2.7			
	Evaluation for Hypothetical Accident Conditions (HAC) is to be based on sequential application of the tests specified, in the order indicated, to determine their cumulative effect on the package. An undamaged specimen may be used for the water immersion tests.	10 CFR 71.73(a)			
	The initial conditions for the HAC testing should include the result of the testing for Normal Conditions of Transport.	OWS PTP guidance, Packaging Review Guide			
	Brittle fracture should be considered.	RG 7.9, 2.7			
	With respect to the initial conditions for the tests, except for the water immersion test, the ambient air temperature before and after the tests must remain constant at that value between -29°C (-20°F) and at 38°C (+100°F) which is most unfavorable for the feature under consideration.	10 CFR 71.73(b)			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	The initial internal pressure within the containment system must be the maximum normal operating pressure unless a lower internal pressure consistent with the ambient temperature assumed to precede and follow the tests is more unfavorable.	10 CFR 71.73(b)			
2.7.1	<u>Free-Drop</u> The free-drop test consists of a drop of a distance of 9 m (30 ft) onto a flat, essentially unyielding horizontal surface, striking in the orientation of maximum damage. The SARP should discuss performance of the test and demonstrate that testing meets the requirements of §71.73(c)(1).	10 CFR 71.73(c)(1)			
	The package must be evaluated for the drop orientations that cause the most severe damage to the different systems and components. It is usually necessary to consider several drop orientations. At a minimum the center-of-gravity over point of impact must be considered.	RG 7.9, 2.7.1			
	The package should be assessed for the effects of the free-drop test in each tested orientation. A summary of results subsection should summarize the extent to which the packaging would be damaged in each orientation.	RG 7.9, 2.7.1.1 to 2.7.1.5			
	The assessment of the package may be by analysis, prototype testing, model testing or comparison to a similar package. Four methods of showing compliance (analysis, prototype testing, model testing, and comparison to similar packages) are discussed. Basic requirements are addressed below. Consult RG 7.9 Sections 2.7.1.a to 2.7.1.d for further details.	RG 7.9, 2.7.1			
	a. <u>Analysis</u> Calculations should be presented in sufficient detail to allow the results to be verified.	RG 7.9, 2.7.1.a			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	The response of the package in terms of stress and strain to components and structural members should be shown.	RG 7.9, 2.7.1.a			
	The structural stability of individual members, as applicable, should be investigated as well as stress due to impact combined with those stresses caused by temperature gradients, differential thermal expansions, pressure, and other loads.	RG 7.9, 2.7.1.a			
	b. <u>Prototype Testing</u> The test method, procedures, and targets that were used should be described.	RG 7.9, 2.7.1.b			
	If the package tested is not identical in all respects to the package described in the application the SARP should explain the differences and show that these differences would not affect the test results.	RG 7.9, 2.7.1.b			
	The materials used as substitutes for the radioactive contents during the tests should be described and effects on the test results evaluated.	RG 7.9, 2.7.1.b			
	The damage caused by the impact should be described quantitatively.	RG 7.9, 2.7.1.b			
	Photographs of the damaged packaging should be provided.	RG 7.9, 2.7.1.b			
	c. <u>Model Testing</u> The model should be described and detailed drawings showing its dimensions and materials of construction provided.	RG 7.9, 2.7.1.c			
	The scale factor used for the model should be stated. The laws of similitude used for the testing should be described in detail.	RG 7.9, 2.7.1.c			
	The same information required by RG 7.9, 2.7.1.b should be provided for the model tests.	RG 7.9, 2.7.1.c			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	Correlate the damage to the model to damage to a prototype to show that the prototype would be adequate to meet the performance requirements of 10 CFR 71.	RG 7.9, 2.7.1.c			
	<p>d. <u>Comparison to Similar Packages</u></p> <p>The comparison with similar packages should address the following information:</p> <ul style="list-style-type: none"> • dimensions materials, and configurations of both packages • overall weight of both packages • weight and form of the contents of both packages. 	RG 7.9, 2.7.1.d			
	<p>The comparison should demonstrate that:</p> <ul style="list-style-type: none"> • packages will have similar response to specified tests • forces acting on all vital safety systems and components of the proposed package have sufficient structural integrity • proposed package will meet all regulatory performance requirements. 	RG 7.9, 2.7.1.d			
	The comparison must demonstrate that the proposed package is, in all respects, better than or equal to the package previously approved and that the proposed package can meet all the regulatory performance requirements.	RG 7.9, 2.7.1.d			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.7.2	<p><u>Crush</u></p> <p>The crush test consists of subjecting the specimen to a dynamic crush test by positioning it to suffer maximum damage by the drop of a 500 kg (1,100 lb) mass from 9 m (30 ft) onto the specimen. Title 10 CFR 71 requires this test only under specific conditions. If the crush test is not applicable, the SARP should explain why the test is not applicable to the package. If it does apply, the SARP should discuss performance of the test and demonstrate that testing meets the requirements of §71.73(c)(2).</p>	10 CFR 71.73(c)(2)			
2.7.3	<p><u>Puncture</u></p> <p>The puncture test consists of a free-drop of the package of 1 m (40 in.) onto the upper end of a solid, vertical, mild steel bar. The SARP should discuss performance of the test and demonstrate that the testing meets the requirements of §71.73(c)(3).</p>	10 CFR 71.73(c)(3)			
2.7.3.1	<p><u>Summary of Pressures and Temperatures</u></p> <p>The temperatures and pressures as determined in the thermal evaluation (Chapter 3 of the SARP) that are used in the analyses specified by RG 7.9, Sections 2.7.3.2, 2.7.3.3, and 2.7.3.4 should be summarized.</p>	RG 7.9, 2.7.3.1			
2.7.3.2	<p><u>Differential Thermal Expansion</u></p> <p>The circumferential and axial deformations and stresses that result from differential thermal expansion should be calculated. Peak conditions, post-fire steady-state conditions, and all transient conditions should be considered.</p>	RG 7.9, 2.7.3.2			
2.7.3.3	<p><u>Stress Calculations</u></p> <p>Stresses due to thermal gradients, differential expansion, pressure, and other mechanical loads should be calculated.</p>	RG 7.9, 2.7.3.3			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	Sketches showing the configuration and dimensions of the members of systems under investigation, including points at which the stresses are calculated, should be provided.	RG 7.9, 2.7.3.3			
2.7.3.4	<u>Comparison with Allowable Stresses</u> Calculated stresses should be compared with the design criteria in Section 2.1.2 of the SARP. The SARP should demonstrate that the performance requirements specified in 10 CFR 71 have been satisfied.	RG 7.9, 2.7.3.4			
2.7.4	<u>Thermal</u> The thermal test requirements are specified in §71.73(c)(4). Except as noted in subsections below, detailed results of the thermal test should be reported in Chapter 3 of the SARP.	10 CFR 71.73(c)(4) RG 7.9, 2.7.3			
2.7.5	<u>Immersion -- Fissile Material</u> The fissile material immersion test consists of immersion under a head of water of at least 0.9 m (3 ft). The SARP should discuss performance of the test and demonstrate that testing meets the requirements of §71.73(c)(5).	10 CFR 71.73(c)(5) RG 7.9, 2.7.4			
2.7.6	<u>Immersion -- All Packages</u> The immersion test for all packages consists of immersion of an undamaged specimen under a head of water of at least 15 m (50 ft) (for test purposes, an external pressure of water of 150 kPa or 21.7 lbf/in ² gauge). The SARP should discuss performance of the test and demonstrate that testing meets the requirements of §71.73(c)(6).	10 CFR 71.73(c)(6) RG 7.9, 2.7.5			
2.7.7	<u>Summary of Damage</u> A discussion of the condition of the package after the accident test sequences should be provided. Damage to vital safety systems and components should be related to the acceptance standards.	RG 7.9, 2.7.6			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
2.8	<p><u>Special Form</u></p> <p>DOE DP packages are normally not special form. Therefore, the SARP generally should state that the contents are normal form and that special form requirements do not apply. If the SARP to be evaluated has special form contents refer to 10 CFR 71.75 and RG 7.9, Section 2.8.</p>	<p>10 CFR 71.4 (definitions)</p>			
2.9	<p><u>Fuel Rods</u></p> <p>DOE DP packaging currently does not have responsibility for any packages containing fuel rods. The SARP should state that these requirements do not apply.</p>				
2.10	<p><u>Appendix</u></p> <p>The appendix should include supporting information, such as justification of assumptions or analytical procedures, test results, photographs, computer program descriptions and input/output, reference lists, and applicable pages from referenced documents.</p>	<p>RG 7.9, 2.10</p>			

Chapter 3 - Thermal Evaluations Safety Analysis Report for Packaging Completeness Review Checklist		
Name(s) of Reviewer(s) _____	Date of Review _____	
SARP No: _____	Title: _____	Date: _____

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
3.1	<u>Discussion</u> The significant thermal design features and operating characteristics of the package should be described.	10 CFR 71.33 (a)(5)(v) RG 7.9, 3.1			
	The volumes of any coolants used in the package contents should be identified and evaluated for their effects on the packaging performance.	10 CFR 71.33(b)(8)			
	The operation of all subsystems should be discussed.	RG 7.9, 3.1			
	Thermal criteria that will be applied directly to thermal results should be identified.	RG 7.9, 3.1			
	The significant results of the thermal analysis or tests and the implication of these results on the overall package should be summarized.	RG 7.9, 3.1			
	The minimum and maximum decay heat loads assumed in the thermal evaluation should be stated.	10 CFR 71.33(b)(7) RG 7.9, 3.1			
	Properties evaluated in the thermal chapter of the SARP that are used to support other evaluations, e.g., pressure or temperature, should be identified.	RG 7.9, 3.1			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
3.2	<u>Summary of Thermal Properties of Materials</u> The thermal properties of all materials used in the thermal evaluation should be listed, with references provided for cited data.	RG 7.9, 3.2			
3.3	<u>Technical Specifications of Components</u> The technical specifications of package components should be included, for example: operating pressure range and temperature limits.	RG 7.9, 3.3			
	A summary of test data should be supplied in support of performance specifications.	RG 7.9, 3.3			
	The behavior of insulating material when exposed to the thermal environment for NCT and HAC should be characterized.	OWS PTP guidance			
3.4	<u>Thermal Evaluation for Normal Conditions of Transport</u> This section of the SARP should demonstrate compliance with the heat and cold conditions specified for NCT.	10 CFR 71.71(c)(1) and (c)(2)			
3.4.1	<u>Thermal Model</u>				
3.4.1.1	<u>Analytical Model</u> The analytical thermal model should be described in detail. The model should include gaskets, valves, contents, and the overall package.	RG 7.9, 3.4.1.1			
	Modeling assumptions should be identified and justified.	RG 7.9, 3.4			
3.4.1.2	<u>Test Model</u> The test item and procedures used should be described.	RG 7.9, 3.4.1.2			
	The procedures used to correlate the test data to the thermal environment specified in 10 CFR 71.71(c) should be described.	RG 7.9, 3.4.1.2			
	Temperature data should be taken from gaskets, valves, other areas of the containment boundary, as well as from the overall package.	RG 7.9, 3.4.1.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
3.4.2	<u>Maximum Temperatures</u> The SARP should evaluate the package at an ambient temperature of 38°C (+100°F) in still air and insolation according to the table in 10 CFR 71.71(c)(1).	10 CFR 71.71(c)(1)			
	The decay heat of the contents should be considered as part of the thermal load.	RG 7.9, 3.4			
	The maximum temperature for each major component of the package should be listed.	RG 7.9, 3.4.2			
3.4.3	<u>Minimum Temperature</u> The SARP should evaluate the package at an ambient temperature of -40°C (-40°F) in still air and shade.	10 CFR 71.71(c)(2)			
	The minimum temperature for each major component of the package should be listed.	RG 7.9, 3.4.3			
	The evaluation should include the minimum heat load. When a decay heat load greater than zero is required for safe operation, assurance of that heat load must be provided. Shipment of an empty package should be addressed.	RG 7.9, 3.4.3			
3.4.4	<u>Maximum Internal Pressures</u> The maximum normal operating pressure should be identified. The maximum internal pressures for the limiting combination of thermal loading should be identified. The evaluation should consider effects of phase changes, gas generation, chemical decomposition, fluid expansion and compression, etc.	RG 7.9, 3.4.4			
3.4.5	<u>Maximum Thermal Stresses</u> The SARP should list the temperature distribution resulting from the conditions that result in the limiting combination of thermal gradient and isothermal stresses.	RG 7.9, 3.4.5			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
3.4.6	<u>Evaluation of Package Performance for NCT</u> The SARP should evaluate package performance, including system and subsystem operation for NCT and compare the results to allowable limits of temperature, pressure, etc.	RG 7.9, 3.4.6			
	Information to be used in other chapters of the review should be designated.	RG 7.9, 3.4.6			
	Summary tables with appropriate comments should be provided.	RG 7.9, 3.4.6			
	The SARP should state whether the package will be transported in an exclusive use or nonexclusive use shipment. A package must be designed, constructed, and prepared for transport so that in still air at 38°C (+100°F) and in the shade, no accessible surface of a package would have a temperature exceeding 50°C (+122°F) in a nonexclusive use shipment or 85°C (+185°F) in an exclusive use shipment.	10 CFR 71.43(g)			
3.5	<u>Hypothetical Accident Thermal Evaluation</u> This section of the SARP should demonstrate compliance with the thermal test specified for HAC.	10 CFR 71.73(c)(4)			
	This section of the SARP should demonstrate compliance with SG 140.1, <i>Combination Test Analysis/Method Used to Demonstrate Compliance to DOE Type B Packaging Thermal Test Requirements</i> , dated February 10, 1992.	SG 140.1			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	The effects of insolation after the thermal test should be addressed.	OWS PTP guidance			
3.5.1	<u>Thermal Model</u>				
3.5.1.1	<u>Analytical Model</u> The analytical thermal model should be described in detail. The model should include gaskets, valves, contents, and the overall package.	RG 7.9, 3.5.1.1			
3.5.1.2	<u>Test Model</u> The test item and procedures used should be described.	RG 7.9, 3.5.1.2			
	The procedures used to correlate the test data to the thermal environment specified in 10 CFR 71.73(c)(4) should be described.	RG 7.9, 3.5.1.2			
	Temperature data should be taken from gaskets, valves, and other areas of the containment boundary as well as from the overall package.	RG 7.9, 3.5.1.2			
3.5.2	<u>Package Conditions and Environment</u> The effects of the free-drop, crush (if applicable) and puncture tests specified in 10 CFR 71.73 should be assessed to determine the condition of the package prior to the thermal evaluation, particularly the thermal design features.	10 CFR 71.73(a) RG 7.9, 3.5.2			
3.5.3	<u>Package Temperatures</u> The results of the thermal analysis or test should be provided. Temperatures should be reported at package locations significant to safety analysis and review. (Reference the section where results are calculated.)	RG 7.9, 3.5.3			
	If transient temperature distributions are provided, the data should extend beyond the one-half hour test period to report past the time maximum temperatures are achieved.	RG 7.9, 3.5.3			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
3.5.4	<u>Maximum Internal Pressures</u> The maximum internal pressures that result from the thermal test should be provided.	RG 7.9, 3.5.4			
	Pressures that result in the most severe thermal loading in combination with any other structural loads that have developed should be determined.	RG 7.9, 3.5.4			
3.5.5	<u>Maximum Thermal Stresses</u> The most severe thermal stress conditions that result from the thermal test should be provided.	RG 7.9, 3.5.5			
	The temperatures corresponding to the maximum thermal stresses should be reported.	RG 7.9, 3.5.5			
3.5.6	<u>Evaluation of Package Performance for Hypothetical Accident Thermal Conditions</u> The SARP should evaluate package performance, including system and subsystem operation, for HAC with respect to the results of the thermal test. Results should be compared with allowable limits, e.g., pressure and temperature, for packaging components.	10 CFR 71.35(a) 10 CFR 71.73(c)(4) RG 7.9, 3.5.6			
	An estimate of the damage to the package should be provided. This assessment should include structural damage, breach of containment, and loss of shielding.	RG 7.9, 3.5.6			
3.6	<u>Appendix</u> Supplemental information which supports the thermal evaluation for the packaging and contents should be included. This may include information such as justification of assumptions, analytical procedures, test results, computer program descriptions, and computer input/output.	RG 7.9, 3.6			
	Information to be used in other chapters of the review should be designated.	RG 7.9, 3.5.6			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	Summary tables with appropriate comments should be provided.	RG 7.9, 3.5.6			

Name(s) of Reviewer(s) _____	Date of Review _____
SARP No: _____	Title: _____
	Date: _____

Chapter 4 - Containment Evaluation Safety Analysis Report for Packaging Completeness Review Checklist

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
4.1	<u>Containment Boundary</u> The containment boundary for the packaging should be identified.	10 CFR 71.33(a)(4) RG 7.9, 4.1			
4.1.1	<u>Containment Vessel</u> A summary of design specifications for the containment vessel should be provided.	RG 7.9, 4.1.1			
4.1.2	<u>Containment Penetrations</u> Identify all penetrations into the primary containment.	RG 7.9, 4.1.2			
	A summary of the performance specifications for all components that penetrate the containment boundary should be provided.	RG 7.9, 4.1.2			
	Package valves or other devices, the failure of which would allow radioactive contents to escape, must be protected against unauthorized operation and, except for a pressure relief device, provided with an enclosure to retain any leakage (may be discussed under General Standards in Chapter 2 of the SARP).	10 CFR 71.43(e)			
	A package may not incorporate a feature intended to allow continuous venting during transport (may be discussed under General Standards in Chapter 2 of the SARP).	10 CFR 71.43(h)			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
4.1.3	<u>Seals and Welds</u> All seals and welds that affect the packaging containment must be identified.	RG 7.9, 4.1.3			
	A summary of the design specifications for the above seals and welds should be provided.	RG 7.9, 4.1.3			
4.1.4	<u>Closure</u> The closure devices used for the containment should be identified.	RG 7.9, 4.1.4			
	The initial bolt torque required to maintain a positive seal during NCT and HAC should be specified for all containment closure devices.	RG 7.9, 4.1.4			
	The package must include a containment system securely closed by a positive fastening device which cannot be opened unintentionally, or by a pressure that may arise within the package (may be discussed under General Standards in Chapter 2 of the SARP).	10 CFR 71.43(c)			
4.2	<u>Requirements for NCT</u> The SARP should address the effects of NCT on other (nonradioactive) materials present in the weapon component and determine effects on the package containment boundary.	OWS PTP guidance			
	The SARP should summarize and use the pertinent results of the structural and thermal evaluations to demonstrate that the package meets containment requirements under NCT.	10 CFR 71.51(a)(1) RG 7.9, 4.2			
4.2.1	<u>Containment of Radioactive Material</u> The SARP should determine the containment criteria to satisfy §71.51(a)(1).	RG 7.9, 4.2.1			
	Compliance with the permitted activity release limits may not depend on filters or a mechanical cooling system.	10 CFR 71.51(c)			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
4.2.2	<p><u>Pressurization of Containment Vessel</u></p> <p>The SARP should identify any mixture of vapors or gases that could form in the containment vessel, and show that any increase in pressure or explosion within the containment vessel due to these vapors or gases could not significantly reduce package effectiveness.</p>	<p>10 CFR 71.43(c)</p> <p>RG 7.9, 4.2.2</p>			
4.2.3	<p><u>Containment Criterion</u></p> <p>The SARP should specify a verifiable containment criterion, e.g., leak test, that can be used to demonstrate that the containment criteria of RG 7.9, 4.2.1 are satisfied.</p>	RG 7.9, 4.2.3			
4.3	<p><u>Containment Requirements for Hypothetical Accident Conditions</u></p> <p>The SARP should summarize and use the pertinent results of the structural and thermal evaluations to demonstrate that the package meets containment requirements under HAC.</p>	RG 7.9, 4.3			
	<p>The SARP should address the effects of HAC on other (nonradioactive) materials present in the weapon component and determine effects on the package containment boundary.</p>	OWS PTP guidance			
4.3.1	<p><u>Fission Gas Products</u></p> <p>DOE/NNSA is not responsible for shipments of spent fuel. This section should be identified as not applicable.</p>	RG 7.9, 4.3.1			
4.3.2	<p><u>Containment of Radioactive Material</u></p> <p>Compliance with the activity release limits may not depend on filters or a mechanical cooling system.</p>	<p>10 CFR 71.51(a)(2)</p> <p>10 CFR 71.51(c)</p>			
	<p>The SARP should determine the containment criteria to satisfy 10 CFR 71.51(a)(2).</p>	RG 7.9, 4.3.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
4.4	<p><u>Special Requirements</u></p> <p>The SARP should address compliance with these requirements, if applicable. Note: special plutonium requirements generally will not apply to packages certified by DOE/NNSA.</p>	10 CFR 71.63			
4.5	<p><u>Appendix</u></p> <p>Appropriate supporting information and analysis should be included in the analysis. If not included in the body of the SARP, the following topics should be addressed:</p> <ul style="list-style-type: none"> • determination of A₂ for the contents • determination of the source term • calculation of allowable leak rate per ANSI N14.5. 	OWS PTP guidance RG 7.9, 4.5			

Chapter 5 - Shielding Evaluation Safety Analysis Report for Packaging Completeness Review Checklist		
Name(s) of Reviewer(s) _____	Date of Review _____	
SARP No: _____	Title: _____	Date: _____

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
5.1	<u>Discussion and Results</u> The significant shielding design features of the packaging should be discussed.	RG 7.9, 5.1			
	The adequacy of the shielding design with regard to meeting dose rate requirements under both NCT and HAC should be discussed.	10 CFR 71.47(a) 10 CFR 71.51(a)(2)			
	The results should be presented in a form similar to Table 5.1 of RG 7.9.	RG 7.9, 5.1			
5.2	<u>Source Specification</u> The gamma and neutron source terms used in the shielding analysis should be stated. Any increase in source terms with time should be addressed.	RG 7.9, 5.2			
5.2.1	<u>Gamma Source</u> The gamma decay source strength (such as photons/sec and/or MeV/sec) should be tabulated as a function of photon energy.	RG 7.9, 5.2.1			
	The method used to determine the gamma source strength and distribution should be described in detail.	RG 7.9, 5.2.1			
	If dose rate requirements of 10 CFR 71.47(a) cannot be met, requirements for exclusive use shipments must be addressed.	10 CFR 71.47(b)			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
5.2.2	<u>Neutron Source</u> The neutron source strength, e.g., neutrons/sec, should be tabulated as a function of neutron energy.	RG 7.9, 5.2.2			
	The method used to determine the neutron source strength and distribution should be described in detail.	RG 7.9, 5.2.2			
5.3	<u>Model Specification</u> The model used in the shielding evaluation should be described.	RG 7.9, 5.3			
5.3.1	<u>Radial and Axial Shielding Configuration</u> Sketches to scale should be provided which show all dimensions of the radial and axial shielding materials. Differences between the shipping configuration and the model should be discussed in detail and should demonstrate that the resulting dose rates are conservative.	RG 7.9, 5.3.1			
	Dose point locations for the various calculations on and off the external surface of the package should be identified.	10 CFR 71.47(a) 10 CFR 71.51(a)(2) RG 7.9, 5.3.1			
	Differences between the model for NCT and HAC should be clearly identified.	RG 7.9, 5.3.1			
5.3.2	<u>Shield Regional Densities</u> Provide material masses, densities (g/cm^3) and atomic number densities (atoms/barn-cm) in sufficient detail to allow computational verification for constituent nuclides of all materials used in the calculational models for normal and accident analyses.	RG 7.9, 5.3.2			
	The sources of data should be referenced for uncommon materials.	RG 7.9, 5.3.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
5.4	<u>Shielding Evaluation</u> A general description of the basic method used to determine the gamma and neutron dose rates at the selected points on and off the external surface of the package under NCT and HAC should be provided.	RG 7.9, 5.4			
	The shielding evaluation should include a description of the spatial source distribution.	RG 7.9, 5.4			
	The shielding evaluation should discuss all computer codes used, including references to their documentation: <ul style="list-style-type: none"> • Basic input parameters should be discussed in detail. • The basis should be provided for selecting the computer code(s), cross sections and buildup factors. 	RG 7.9, 5.4			
	Flux-to-dose conversion factors should be tabulated as a function of the energy groups used in the shielding calculations, and based on ANSI/ANS-6.1.1.	RG 7.9, 5.4			
5.5	<u>Appendix</u> The appendix should include information such as justification of assumptions or analytical procedures, test results, photographs, computer program descriptions and input/output data, and applicable pages from referenced documents.	RG 7.9, 5.5			

Chapter 6 - Criticality Evaluation Safety Analysis Report for Packaging Completeness Review Checklist		
Name(s) of Reviewer(s) _____	Date of Review _____	
SARP No: _____	Title: _____	Date: _____

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
6.1	<u>Discussion and Results</u> The significant criticality design features should be discussed.	RG 7.9, 6.1			
	The adequacy of the criticality evaluation should be discussed. The SARP should include a table similar to Table 6.2 of RG 7.9, summarizing the criticality evaluation. Note: the table must be modified to reflect current standards for fissile material packages, e.g., no fissile classes. The value of “N” as defined in §71.59 should be stated.	RG 7.9, 6.1			
6.2	<u>Package Fissile Material Loading</u> A summary table providing the maximum fissile material loading and fissile material parameters for NCT and HAC should be included.	RG 7.9, 6.2			
6.3	<u>Model Specification</u>				
6.3.1	<u>Description of Calculation Model</u> Dimensioned, or scaled drawings or sketches of the precise geometric models used in the calculations should be provided. The materials used in all regions of the models should be identified.	RG 7.9, 6.3.1			
	Differences between the actual package configuration and the model should be identified, and the models shown to be conservative.	RG 7.9, 6.3.1			
	Differences between the models for NCT and HAC should be clearly identified.	RG 7.9, 6.3.1			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
6.3.2	<u>Package Regional Densities</u> The material masses, densities (gm/cm ³) and the atomic number densities (atoms/barn-cm) should be given for the constituent nuclides of all materials used in all the calculational models.	RG 7.9, 6.3.2			
	Fissionable isotopes should be considered at their most reactive credible concentration.	RG 7.9, 6.3.2			
6.4	<u>Criticality Calculation</u>	RG 7.9, 6.4			
6.4.1	<u>Calculational or Experimental Method</u> A general description of the basic method used to calculate the effective multiplication constant of the package under NCT and HAC should be provided. The description should include the computer program and neutron cross-sections used, along with their referenced documentation.	RG 7.9, 6.4.1			
	The basis for selecting the program and cross-sections should be discussed.	RG 7.9, 6.4.1			
6.4.2	<u>Contents Loading Optimization</u> The content loading for the maximum reactivity must be evaluated for both the single package and arrays of packages for both NCT and HAC.	10 CFR 71.55 10 CFR 71.59 RG 7.9, 6.4.2			
	Approximations, boundary conditions, calculational convergence criteria, and cross-section adjustments should be discussed.	RG 7.9, 6.4.2			
	Compliance with the requirements of §71.55 should be addressed for a single package: <ul style="list-style-type: none"> Fissile material packages must be designed and constructed in accordance with §71.41 - 71.47 and 71.51. A general statement addressing compliance should be included in Chapter 6 of the SARP. 	10 CFR 71.55 RG 7.9, 6.4.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	<ul style="list-style-type: none"> A package used for fissile material must be designed and constructed and the contents so limited that it would be subcritical under conditions specified in §71.55(b). The SARP must provide adequate calculations and discussion to demonstrate compliance. 	10 CFR 71.55(b) RG 7.9, 6.4.2			
	<ul style="list-style-type: none"> If the conditions of §71.55(b) cannot be satisfied, the SARP must address the caveats included in §71.55(c) in sufficient detail for reviewers to conclude that an exception to §71.55(b) requirements can be approved. 	10 CFR 71.55(c) RG 7.9, 6.4.2			
	<ul style="list-style-type: none"> Under NCT, the SARP must address compliance with the requirements of §71.55(d). 	10 CFR 71.55(d) RG 7.9, 6.4.2			
	<ul style="list-style-type: none"> Under HAC, the SARP must address compliance with the requirements of §71.55(e). 	10 CFR 71.55(e) RG 7.9, 6.4.2			
	Compliance with the requirements of §71.59 should be addressed for arrays of fissile material packages:	10 CFR 71.59 RG 7.9, 6.4.2			
	<ul style="list-style-type: none"> The value of “N” should be determined based on the conditions established in §71.59(a). 	10 CFR 71.59(a) RG 7.9, 6.4.2			
	<ul style="list-style-type: none"> The transport index for nuclear criticality control shall be determined based on requirements in §71.59(b). 	10 CFR 71.59(b) RG 7.9, 6.4.2			
	<ul style="list-style-type: none"> For packages with a transport index for nuclear criticality control, the SARP should address whether the shipment is exclusive use or non-exclusive use. 	10 CFR 71.59(c) RG 7.9, 6.4.2			
6.4.3	<p><u>Criticality Results</u></p> <p>The results of reactivity calculations establishing the most reactive configurations for both the single package and arrays of packages under NCT and HAC should be provided.</p>	RG 7.9, 6.4.3			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	Justification should be provided for any interpolations and extrapolations.	RG 7.9, 6.4.3			
	A discussion of the validity and conservatism of the analysis should be included.	RG 7.9, 6.4.3			
	The bias established should be taken into account.	RG 7.9, 6.4.3			
6.5	<u>Critical Benchmark Experiments</u>	RG 7.9, 6.5			
6.5.1	<u>Benchmark Experiments and Applicability</u> A general description of the selected critical benchmark experiments should be provided. The applicability of the benchmarks in relation to the package and its contents should be shown.	RG 7.9, 6.5.1			
6.5.2	<u>Details of Benchmark Calculations</u> Actual nuclear and geometric input parameters used for the benchmark calculations should be provided.	RG 7.9, 6.5.2			
6.5.3	<u>Results of Benchmark Calculations</u> The results of the benchmark calculations should be provided. The calculational bias, if any, should be established and discussed.	RG 7.9, 6.5.3			
6.6	<u>Appendix</u> The appendix should include information such as justification of assumptions or analytical procedures, test results, photographs, computer program descriptions and input/output files, and applicable pages from referenced documents.	RG 7.9, 6.6			

Chapter 7 - Operating Procedures Safety Analysis Report for Packaging Completeness Review Checklist		
Name(s) of Reviewer(s) _____	Date of Review _____	
SARP No: _____	Title: _____	Date: _____

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
7.0	<p><u>Introduction</u></p> <p>Chapter 7 of the SARP should describe the operating procedures to be used in the preparation for and performance of package loading and unloading operations. At a minimum, Chapter 7 should demonstrate the ability to comply with operating procedures requirements in 10 CFR 71, Subpart G. General note: Reg Guide 7.9 contains a suggested format with three main sections: procedures for loading, unloading, and empty transport. Chapter 7 of many of the SARPs that have been submitted to DOE/NNSA is written in a format specified by NUREG/CR-4775. This or other alternate formats are acceptable provided that all required information is included.</p>	RG 7.9, 7			
	<p>The adequacy of the criticality evaluation should be discussed. The SARP should include a table similar to Table 6.2 of RG 7.9, summarizing the criticality evaluation. Note: The table must be modified to reflect current standards for fissile material packages, e.g., no fissile classes. The value of “N” as defined in §71.59 should be stated.</p>	RG 7.9, 7			
	<p>Chapter 7 should also show that the procedures to be used ensure that occupational radiation exposures are maintained as low as is reasonably achievable (ALARA).</p>	RG 7.9, 7			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	The SARP should state that users of the package must develop site-specific operating procedures that have guidance and requirements equivalent to those in Section 7 of the SARP.	OWS PTP guidance			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
7.1	<p><u>Procedures for Loading Package</u></p> <p>The SARP must demonstrate compliance with the routine determination prior to each shipment as specified in §71.87:</p> <ul style="list-style-type: none"> • The package is proper for the contents to be shipped. • The packaging must be in unimpaired physical condition except for superficial defects such as marks or dents. The SARP should specify the inspections made prior to loading the package to determine that the package is not damaged. • Each closure device of the packaging, including any required gasket, must be properly installed and secured and free of defects. The following should be addressed: inspection, criteria for replacement, and, if applicable, procedures for repair. • Any system for containing liquid must be adequately sealed and have adequate space or other specified provision for expansion of the liquid. • Any pressure relief device must be operable and set in accordance with written procedures. • The package must be loaded and closed in accordance with written procedures. • For fissile material, any moderator or neutron absorber, if required, must be present and in proper condition. • Any structural part of the package which could be used to lift or tie down the package during transport must be rendered inoperable for that purpose unless it satisfies the design requirements of 10 CFR 71.45. • The level of non-fixed (removable) radioactive contamination on the external surface must be within 49 CFR 173.443 limits. • External radiation levels around the package and vehicle (if applicable) must not exceed §71.47 limits. • Accessible package surface temperatures must not exceed the limits specified in §71.43(g). 	<p>10 CFR 71.87</p> <p>RG 7.9, 7.1</p>			7-3

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	The SARP should discuss inspections, tests, and special preparations of the package for loading.	RG 7.9, 7.1			
	If special considerations on the use of lifting lugs are necessary, these considerations, e.g., limits on the angle of lifting slings or other restrictions on the use of the lifting lugs, should be stated.	RG 7.9, 7.1			
	Optional loading arrangements should be described.	RG 7.9, 7.1			
	Torque requirements should be addressed for the closure devices, as well as any other threaded devices that are part of the containment boundary.	RG 7.9, 7.1			
	Procedures for removing residual moisture, if applicable, should be described.	RG 7.9, 7.1			
	Instructions should include affixing security seals.	RG 7.9, 7.1			
	Leak test procedures should be addressed.	RG 7.9, 7.1			
	Marking and labeling requirements should be addressed.	RG 7.9, 7.1			
	Any special instructions necessary for inserting the contents should be discussed.	RG 7.9, 7.1			
7.2	<p><u>Procedure for Unloading the Package</u></p> <p>Ensure instructions to the package recipient are adequate, for example:</p> <ul style="list-style-type: none"> • ensuring that appropriate paperwork is available for working on the packaging • ensuring that radiological surveys and safety inspections of the packaging are made, and • verifying that it is clear what the contents are, and in what form they are shipped. 				

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	This section should include inspections, tests, and special preparations of the package for unloading.	RG 7.9, 7.2			
	If applicable, instructions should address removal of radioactive contamination.	RG 7.9, 7.2			
	Compliance with the requirements of 10 CFR 71.89 should be demonstrated. This section specifies that the shipper must provide any special unloading instructions to the consignee in accordance with 10 CFR 20.1906(e).	10 CFR 71.89			
	Instructions regarding package unloading should be provided, such as: <ul style="list-style-type: none"> • a list of any special equipment which may be needed • closure removal • contents removal • inspection of interior of packaging after contents have been removed, and • possible preparation of packaging for short- or long-term empty storage. 				
	Instructions should be provided regarding surface contamination and radiation survey requirements.	10 CFR 20.1906			
7.3	<u>Preparation of Empty Package for Transport</u> The inspections, tests, and special preparations necessary to ensure the packaging is properly closed should be discussed.	RG 7.9, 7.3			
	The SARP should specify inspections, tests, and special preparations of the packaging to ensure that the packaging is prepared for shipment such that its effectiveness will not be impaired.	RG 7.9, 7.3			
	The SARP should address 49 CFR requirements for shipping empty containers.	49 CFR 173.428			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
7.4	<p><u>Appendix</u></p> <p>As appropriate, this appendix should include supporting documentation, detailed discussions and analysis of procedures, and graphic presentations.</p>	RG 7.9, 7.4			

Chapter 8 - Acceptance Tests and Maintenance Program			Safety Analysis Report for Packaging Completeness Review Checklist		
Name(s) of Reviewer(s) _____		Date of Review _____			
SARP No: _____	Title: _____	Date: _____			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
8.1	<u>Acceptance Tests</u> Prior to applying the model number to the package, the package owner must determine that the container was fabricated in accordance with the approved design.	10 CFR 71.85(c)			
	Prior to first use the SARP should state that the container will be inspected for defects that could significantly reduce the effectiveness of the packaging. Examples of defects include cracks, pinholes, and uncontrolled voids.	10 CFR 71.85(a)			
8.1.1	<u>Visual Inspection</u> The plan for visual inspections to be performed and the intended purpose behind each inspection should be discussed.	RG 7.9, 8.1.1			
	The criteria for acceptance for each of these inspections should be stated, as well as the action to be taken if noncompliance is encountered.	RG 7.9, 8.1.1			
8.1.2	<u>Structural and Pressure Tests</u> Structural and pressure tests to be performed should be identified and described.	RG 7.9, 8.1.2			
	The acceptance criteria for each test should be stated, as well as the action to be taken when the prescribed criteria are not met. An estimate of the sensitivity of each test should be provided.	RG 7.9, 8.1.2			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
	Where the defined maximum normal operating pressure exceeds 35 kilopascal (5 lbf/in ²) gauge, the SARP must require the containment system to be tested at an internal pressure at least 50% higher than the maximum normal operating pressure.	10 CFR 71.85(b)			
8.1.3	<u>Leak Tests</u> The leak tests to be performed and their acceptance criteria should be described.	RG 7.9, 8.1.3			
	The action to be taken if the acceptance criteria are not met should be stated.	RG 7.9, 8.1.3			
	An estimate of the sensitivity of each leak test should be included.	RG 7.9, 8.1.3			
	Compliance with leak test requirements in ANSI N14.5 should be addressed.				
8.1.4	<u>Component Tests</u> The acceptance tests to be performed and their acceptance criteria should be described.	RG 7.9, 8.1.4			
	The action to be taken if the criteria are not met should be discussed.	RG 7.9, 8.1.4			
	Valves, rupture discs, and fluid transport devices should be tested under the most severe service conditions for which the packaging design assumes their acceptable performances.	RG 7.9, 8.1.4.1 RG 7.9, 8.1.4.2			
	Other components whose failure would impair the packaging effectiveness should be identified and tested under the most severe conditions for which they are designed.	RG 7.9, 8.1.4.3			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
8.1.5	<p><u>Tests for Shielding Integrity</u></p> <p>The SARP should discuss tests to be performed to establish shielding for both gamma and neutron sources. Note: the types of contents shipped under the authority of DOE/NNSA generally result in low dose rates and do not require material specific for shielding.</p>	RG 7.9, 8.1.5			
8.1.6	<p><u>Thermal Acceptance Tests</u></p> <p>The SARP should address tests for verifying that each package performs, within some defined variance, in accordance with the results of the thermal analyses or tests for NCT. Note: the guidance given in RG 7.9, 8.1.6 (8.1.6.1 through 8.1.6.3) should generally not be applicable for the types of contents shipped under the authority of DOE/NNSA. Generally, verification of insulation material properties is sufficient.</p>	RG 7.9, 8.1.6			
8.2	<p><u>Maintenance Program</u></p> <p>The maintenance program should include periodic testing, inspection, and replacement schedules.</p>	RG 7.9, 8.2			
	<p>The maintenance program should include criteria for replacement and repair of components and subsystems on an as-needed basis.</p>	RG 7.9, 8.2			
8.2.1	<p><u>Structural and Pressure Tests</u></p> <p>The tests to be performed should be described, including the frequency of performance, instrumentation, and test sensitivity.</p>	RG 7.9, 8.2.1			
8.2.2	<p><u>Leak Tests</u></p> <p>The tests to be performed should be described, including the frequency of performance and sensitivity. The SARP should demonstrate that the prescribed leak tests are in accordance with ANSI N14.5.</p>	<p>RG 7.9, 8.2.2</p> <p>OWS PTP guidance</p>			

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
8.2.3	<u>Subsystem Maintenance</u> If applicable, describe test and replacement schedules for packaging subsystems, e.g., auxiliary cooling systems, whose inadequate performance could impair the total package safety.	RG 7.9, 8.2.3			
	The schedules should be justified, using verifiable test or manufacturer's data.	RG 7.9, 8.2.3			
8.2.4	<u>Valves, Rupture Discs, and Gaskets on Containment Vessel</u> The test and replacement schedules for these components should be provided.	RG 7.9, 8.2.4			
	The schedules should be justified, using verifiable test or manufacturer's data. For most systems, this would include, as a minimum, a visual inspection prior to each shipment and an annual O-ring replacement.	RG 7.9, 8.2.4			
8.2.5	<u>Shielding</u> The SARP should discuss the test and inspection schedules, as well as corrective actions to be used to ensure adequate shielding performance. Note: the guidance given in RG 7.9, 8.2.5 should generally not be applicable for the types of packages shipped under the authority of DOE/NNSA. Most contents result in low dose rates and do not require material specific for shielding.	RG 7.9, 8.2.5			
8.2.6	<u>Thermal</u> The SARP should describe any tests required to verify thermal performance. Criteria for replacement of insulation should be addressed.	RG 7.9, 8.2.6			
8.2.7	<u>Miscellaneous</u> Any additional tests that should be performed periodically on components and subsystems should be adequately described.	RG 7.9, 8.2.7			

Chapter 9 - Quality Assurance Safety Analysis Report for Packaging Completeness Review Checklist		
Name(s) of Reviewer(s) _____	Date of Review _____	
SARP No: _____	Title: _____	Date: _____

	Requirement	Requirement Basis	Requirement SARP Location	Satisfactory? Y/N/NA	Comment Ref. No.
9	DOE contractors are required to develop and implement a Quality Assurance Program Plan (QAPP) that meets the requirements of 10 CFR 71, Subpart H for packaging certification; QC-1 for product acceptance; and 10 CFR 830 for facilities and records. The Plan must also comply with the guidance provided in SG 500. The SARP should provide a description of the QA Program in place. The QAPP would not normally be part of the SARP.	10 CFR 71.37 SG 500			

