



Ref: AFS-12-0007

January 6, 2012

ATTN: Document Control Desk
Director, Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: TRUPACT-III Amendment Request, Docket No. 71-9305, SAR Revision 6

AREVA Federal Services LLC (AFS) hereby submits Revision 6 of the Safety Analysis Report for the TRUPACT-III packaging, Docket No. 71-9305. This revision to the application is to respond to comments provided by NRC staff in telephone conversations over the last week. The change consists of a revision to SAR drawing note 48, clarifying the repair of containment boundary welds when radiographic examination is not possible. Included with this letter one paper copy of the revised pages and SAR drawings and one CD containing the entire SAR, Revision 6, in PDF file format. The CD is contained within an envelope labeled, "TRUPACT-III Docket 71-9305 Electronic Copy of Documents".

AFS and the U. S. Department of Energy (DOE) appreciate the NRC's timely response to this matter. To support the waste transportation needs of the DOE, AFS requests that this revision be approved and the revised TRUPACT-III Certificate of Conformance be issued as soon as possible. The urgency is to support the DOE agreements with the State of South Carolina for shipping of the large box TRU waste at the Savannah River Site (SRS).

Should you have any questions regarding this submittal, please contact me at (253) 552-1321 or via E-mail (phil.noss@areva.com).

Very Truly Yours,
AREVA Federal Services LLC

A handwritten signature in cursive script that reads "Phil Noss".

Phil Noss
Licensing Manager

cc: Huda Akhavannik, NRC (including six paper copies and one CD)
Andy Kee, AFS Project Manager

1145501

AREVA Federal Services LLC

505 S. 336th Street, Suite 400, Federal Way, WA 98003 - USA - Tel: 1 253.552.1310 - Fax: 1 253.552.1398



Contents of Electronic Media

This submission is composed of both paper copies and an electronic copy. The electronic copy is contained within an envelope labeled, "TRUPACT-III Docket 71-9305 Electronic Copy of Documents". The envelope contains one disc as follows:

Title	Media Type:	Contents
TRUPACT-III SAR	CD-R	One file of the complete text of the submittal: TRUPACT-III SAR, Complete, Rev. 6.pdf (19,172 kb) (578 pages)

**Delete and Insert Instructions
for
Updating TRUPACT-III Safety Analysis Report
Docket Number 71-9305**

SAR Section	Delete Rev. 5	Insert Rev. 6
Cover and Spine	Cover Page and Spine	Cover Page and Spine
Table of Contents	Pages i to ix	Pages i to ix
1.3.1	Pages 1.3.1-1 – 1.3.1-2	Pages 1.3.1-1 – 1.3.1-2
General Arrangement Drawings	51199-SAR, Rev. 5	51199-SAR, Rev. 6

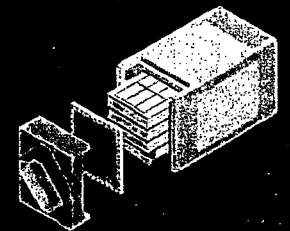




TRUPACT-III

Revision 6
January 2012

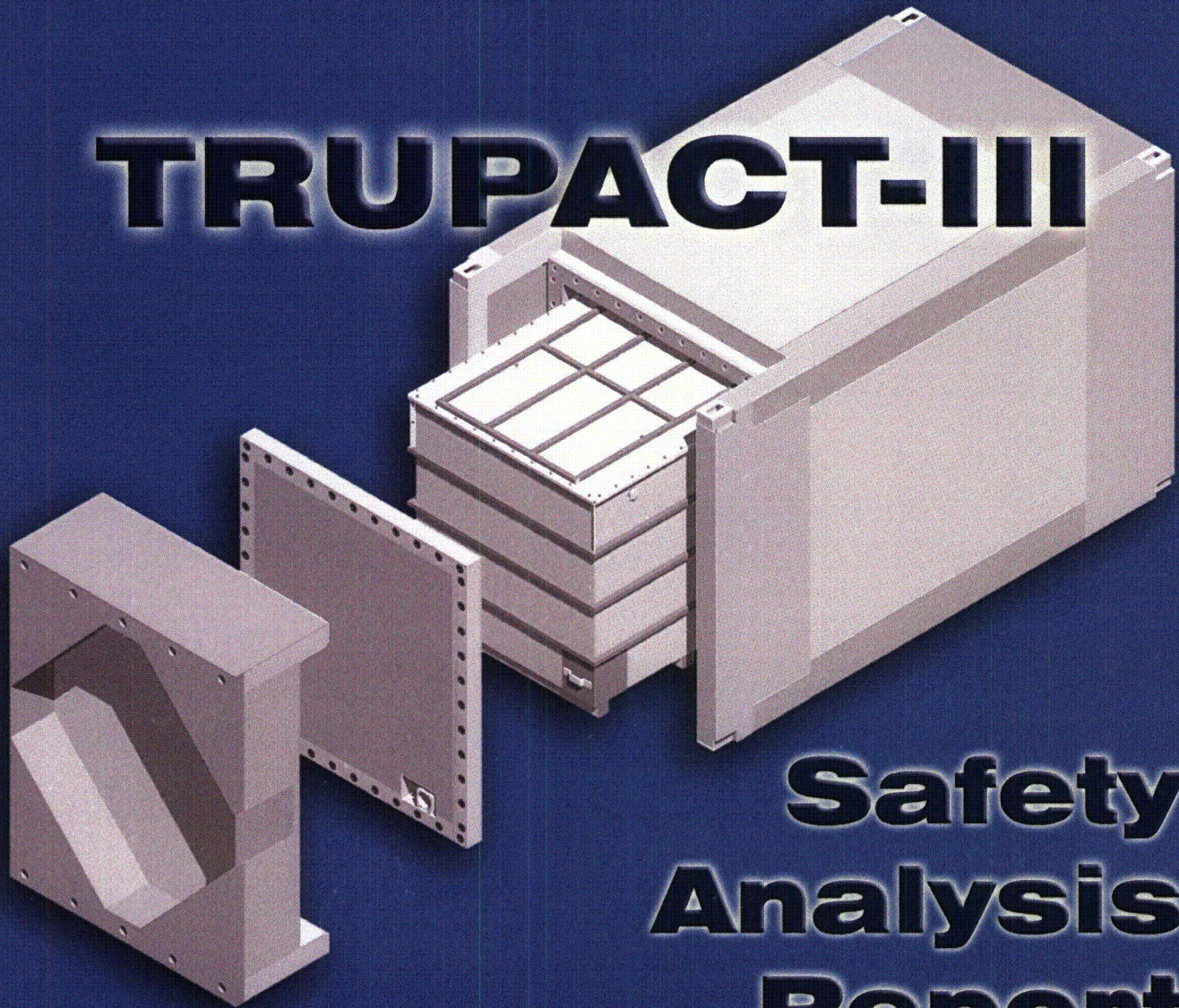
Safety
Analysis
Report



Docket 71-9305



TRUPACT-III



Safety Analysis Report

**Revision 6
January 2012**

AREVA Federal Services LLC

Docket 71-9305



TRUPACT-III



Safety Analysis Report

Revision 6
January 2012

AREVA Federal Services LLC

TABLE OF CONTENTS

1.0 GENERAL INFORMATION.....	1.1-1
1.1 Introduction	1.1-1
1.2 Package Description	1.2-1
1.2.1 Packaging	1.2-1
1.2.1.1 Body	1.2-1
1.2.1.2 Closure Lid.....	1.2-4
1.2.1.3 Overpack Cover	1.2-5
1.2.1.4 Gross Weight.....	1.2-6
1.2.1.5 Neutron Moderation and Absorption	1.2-6
1.2.1.6 Receptacles, Valves, Testing, and Sampling Ports	1.2-6
1.2.1.7 Heat Dissipation.....	1.2-7
1.2.1.8 Lifting and Tie-down Devices.....	1.2-7
1.2.1.9 Pressure Relief System.....	1.2-7
1.2.1.10 Shielding	1.2-7
1.2.2 Contents.....	1.2-8
1.2.3 Special Requirements for Plutonium.....	1.2-8
1.2.4 Operational Features.....	1.2-8
1.3 Appendices	1.3-1
1.3.1 Packaging General Arrangement Drawings	1.3.1-1
1.3.2 Glossary of Terms and Acronyms	1.3.2-1
2.0 STRUCTURAL EVALUATION.....	2.1-1
2.1 Description of Structural Design.....	2.1-1
2.1.1 Discussion	2.1-1
2.1.2 Design Criteria	2.1-1
2.1.2.1 Analytic Design Criteria (Allowable Stresses).....	2.1-2
2.1.2.2 Miscellaneous Structural Failure Modes	2.1-2
2.1.3 Weights and Centers of Gravity	2.1-7
2.1.4 Identification of Codes and Standards for Package Design	2.1-7
2.2 Materials.....	2.2-1
2.2.1 Material Properties and Specifications.....	2.2-1
2.2.2 Chemical, Galvanic, or Other Reactions	2.2-3
2.2.2.1 Packaging Materials of Construction.....	2.2-4
2.2.2.2 Payload Interaction with Packaging Materials of Construction	2.2-4

2.2.3	Effects of Radiation on Materials.....	2.2-5
2.3	Fabrication and Examination.....	2.3-1
2.3.1	Fabrication.....	2.3-1
2.3.2	Examination.....	2.3-1
2.4	General Requirements for All Packages	2.4-1
2.4.1	Minimum Package Size.....	2.4-1
2.4.2	Tamper-Indicating Feature	2.4-1
2.4.3	Positive Closure.....	2.4-1
2.4.4	Valves.....	2.4-1
2.4.5	Package Design	2.4-1
2.4.6	External Temperatures	2.4-2
2.4.7	Venting	2.4-2
2.5	Lifting and Tie-down Standards for All Packages	2.5-1
2.5.1	Lifting Devices.....	2.5-1
2.5.1.1	Lifting Forces.....	2.5-1
2.5.1.2	Lifting Failure Modes	2.5-2
2.5.1.3	Summary	2.5-4
2.5.2	Tie-down Devices.....	2.5-5
2.6	Normal Conditions of Transport	2.6-1
2.6.1	Heat	2.6-1
2.6.1.1	Summary of Pressures and Temperatures.....	2.6-2
2.6.1.2	Differential Thermal Expansion.....	2.6-2
2.6.1.3	Stress Calculations	2.6-2
2.6.1.4	Comparison with Allowable Stresses	2.6-9
2.6.1.5	Range of Primary-Plus-Secondary Stress Intensities	2.6-10
2.6.1.6	Closure Bolts.....	2.6-10
2.6.2	Cold	2.6-15
2.6.3	Reduced External Pressure.....	2.6-16
2.6.4	Increased External Pressure	2.6-16
2.6.5	Vibration.....	2.6-16
2.6.6	Water Spray.....	2.6-20
2.6.7	Free Drop.....	2.6-20
2.6.8	Corner Drop.....	2.6-20
2.6.9	Compression.....	2.6-20
2.6.10	Penetration.....	2.6-20

2.7 Hypothetical Accident Conditions	2.7-1
2.7.1 Free Drop.....	2.7-1
2.7.1.1 Technical Basis for the Free Drop Tests.....	2.7-1
2.7.1.2 Certification Test Unit and Test Conditions	2.7-8
2.7.1.3 Test Criteria	2.7-8
2.7.1.4 Summary of Results of the Free Drop Analyses and Tests.....	2.7-9
2.7.1.5 Crush Deformation Extrapolations	2.7-13
2.7.2 Crush	2.7-25
2.7.3 Puncture.....	2.7-25
2.7.3.1 Technical Basis for the Puncture Drop Tests.....	2.7-25
2.7.3.2 Temperature of Puncture Drops.....	2.7-29
2.7.3.3 Summary of Results from Puncture Drop Tests	2.7-29
2.7.4 Thermal	2.7-37
2.7.4.1 Summary of Pressures and Temperatures.....	2.7-37
2.7.4.2 Differential Thermal Expansion.....	2.7-37
2.7.4.3 Stress Calculations.....	2.7-38
2.7.4.4 Comparison with Allowable Stresses	2.7-38
2.7.5 Immersion – Fissile Material.....	2.7-39
2.7.6 Immersion – All Packages.....	2.7-39
2.7.7 Deep Water Immersion Test (for Type B Packages Containing More than 10^5 A ₂).....	2.7-40
2.7.8 Summary of Damage	2.7-40
2.7.8.1 Debris Contamination of the Containment Seal on CTU-1	2.7-41
2.7.8.2 Closure Bolts.....	2.7-41
2.8 Accident Conditions for Air Transport of Plutonium	2.8-1
2.9 Accident Conditions for Fissile Material Packages for Air Transport	2.9-1
2.10 Special Form	2.10-1
2.11 Fuel Rods.....	2.11-1
2.12 Appendices	2.12-1
2.12.1 Engineering Tests	2.12.1-1
2.12.1.1 Introduction.....	2.12.1-1
2.12.1.2 Test Facilities	2.12.1-1
2.12.1.3 Test Unit Configuration	2.12.1-2
2.12.1.4 Scale Model Testing	2.12.1-5
2.12.1.5 Test Conditions and Measurement.....	2.12.1-7
2.12.1.6 Engineering Tests Performed.....	2.12.1-8
2.12.1.7 Engineering Test Results	2.12.1-8

2.12.2 Elastomer O-ring Seal Performance Tests.....	2.12.2-1
2.12.2.1 Introduction.....	2.12.2-1
2.12.2.2 Test Specimen and Equipment.....	2.12.2-1
2.12.2.3 Test Conditions	2.12.2-1
2.12.2.4 Test Procedure	2.12.2-2
2.12.2.5 Example of O-ring Seal Compression Calculation	2.12.2-2
2.12.2.6 Test Results.....	2.12.2-3
2.12.3 Certification Tests on CTU-1	2.12.3-1
2.12.3.1 Introduction.....	2.12.3-1
2.12.3.2 Test Facilities	2.12.3-1
2.12.3.3 Test Unit Configuration	2.12.3-2
2.12.3.4 Instrumentation	2.12.3-5
2.12.3.5 Initial Test Conditions.....	2.12.3-5
2.12.3.6 Certification Tests Performed	2.12.3-6
2.12.3.7 Test Results.....	2.12.3-6
2.12.3.8 Leakage Rate Tests and Post-Test Measurements	2.12.3-10
2.12.3.9 Acceleration Time History Plots.....	2.12.3-33
2.12.4 HAC Immersion Buckling Evaluation	2.12.4-1
2.12.4.1 Introduction	2.12.4-1
2.12.4.2 Mechanical Properties	2.12.4-1
2.12.4.3 Conditions Analyzed	2.12.4-1
2.12.4.4 Calculations	2.12.4-1
2.12.4.5 References.....	2.12.4-9
2.12.5 Closure Lid Debris Shield	2.12.5-1
2.12.5.1 Introduction.....	2.12.5-1
2.12.5.2 Contamination of the Containment O-ring Seal During Certification Testing	2.12.5-1
2.12.5.3 Debris Shield Design Criteria	2.12.5-3
2.12.5.4 Debris Shield Design	2.12.5-4
2.12.5.5 Finite Element End Drop Analysis	2.12.5-9
2.12.5.6 Finite Element Side Drop Analysis.....	2.12.5-18
2.12.5.7 Finite Element Payload Interaction Analysis.....	2.12.5-24
2.12.6 Certification Tests on CTU-2	2.12.6-1
2.12.6.1 Introduction.....	2.12.6-1
2.12.6.2 Test Facilities	2.12.6-1
2.12.6.3 Test Unit Configuration	2.12.6-1
2.12.6.4 Instrumentation	2.12.6-4
2.12.6.5 Initial Test Conditions.....	2.12.6-5

2.12.6.6 Certification Tests Performed	2.12.6-5
2.12.6.7 Test Results	2.12.6-5
2.12.6.8 Leakage Rate Tests and Post-Test Measurements	2.12.6-7
2.12.6.9 Acceleration Time History Plots (Free Drop Test LD91)	2.12.6-23
2.12.7 Closure Lid, Bolt, and Washer Interaction.....	2.12.7-1
2.12.7.1 Introduction.....	2.12.7-1
2.12.7.2 Finite Element Analysis Methodology	2.12.7-1
2.12.7.3 Finite Element Analysis Results	2.12.7-3
2.12.7.4 Closure Lid, Bolt, and Washer Interaction Summary.....	2.12.7-3
3.0 THERMAL EVALUATION.....	3.1-1
3.1 Description of Thermal Design	3.1-1
3.1.1 Design Features	3.1-1
3.1.1.1 TRUPACT-III Packaging.....	3.1-2
3.1.1.2 Payload Configuration	3.1-4
3.1.2 Content's Decay Heat.....	3.1-5
3.1.3 Summary Tables of Temperatures.....	3.1-5
3.1.4 Summary Tables of Maximum Pressures.....	3.1-5
3.2 Material Properties and Component Specifications	3.2-1
3.2.1 Material Properties	3.2-1
3.2.2 Technical Specifications of Components	3.2-4
3.3 Thermal Evaluation for Normal Conditions of Transport.....	3.3-1
3.3.1 Heat and Cold.....	3.3-1
3.3.1.1 Maximum NCT Temperatures	3.3-1
3.3.1.2 Minimum NCT Temperatures.....	3.3-3
3.3.2 Maximum Normal Operating Pressure.....	3.3-4
3.4 Thermal Evaluation for Hypothetical Accident Conditions	3.4-1
3.4.1 Initial Conditions.....	3.4-1
3.4.2 Fire Test Conditions	3.4-2
3.4.3 Maximum Temperatures and Pressure	3.4-3
3.4.3.1 Maximum HAC Temperatures.....	3.4-3
3.4.3.2 Maximum HAC Pressure	3.4-5
3.4.4 Maximum Thermal Stresses	3.4-6
3.5 Appendices	3.5-1
3.5.1 Computer Analysis Results	3.5.1-1
3.5.2 Thermal Model Details.....	3.5.2-1
3.5.2.1 Description of Thermal Model for NCT Conditions	3.5.2-1

3.5.2.2	Convection Coefficient Calculation.....	3.5.2-10
3.5.2.3	Insolation Loads.....	3.5.2-12
3.5.2.4	Effective Thermal Properties for Corrugated Wall/Lid Structures	3.5.2-12
3.5.2.5	Effective Thermal Properties for CSA End Detail & Lid Perimeter	3.5.2-16
3.5.2.6	Description of Thermal Model for HAC Conditions	3.5.2-22
3.5.3	Review of TRUPACT-III Package Full-Scale Drop Test Results.....	3.5.3-1
3.5.4	'Last-A-Foam' Response under HAC Conditions	3.5.4-1
4.0	CONTAINMENT	4.1-1
4.1	Description of the Containment System	4.1-1
4.1.1	Containment Vessel.....	4.1-1
4.1.2	Containment Penetrations.....	4.1-1
4.1.3	Seals and Welds.....	4.1-1
4.1.4	Closure.....	4.1-3
4.2	Containment Under Normal Conditions of Transport.....	4.2-1
4.2.1	Containment of Radioactive Material	4.2-1
4.2.2	Pressurization of Containment Vessel.....	4.2-1
4.2.3	Containment Criterion.....	4.2-1
4.3	Containment Under Hypothetical Accident Conditions.....	4.3-1
4.3.1	Fission Gas Products	4.3-1
4.3.2	Containment of Radioactive Material	4.3-1
4.4	Leakage Rate Tests for Type B Packages	4.4-1
5.0	SHIELDING EVALUATION.....	5-1
6.0	CRITICALITY EVALUATION	6.1-1
6.1	Description of Criticality Design.....	6.1-1
6.1.1	Design Features	6.1-1
6.1.2	Summary Table of Criticality Evaluation	6.1-1
6.1.3	Criticality Safety Index	6.1-2
6.2	Fissile Material Contents	6.2-1
6.2.1	General	6.2-1
6.2.2	Special Reflectors.....	6.2-2
6.2.3	Fissile Material Modeling	6.2-4

6.3	General Considerations	6.3-1
6.3.1	Model Configuration	6.3-1
6.3.2	Material Properties	6.3-2
6.3.3	Computer Codes and Cross-Section Libraries	6.3-3
6.3.4	Demonstration of Maximum Reactivity	6.3-3
6.4	Single Package Evaluation.....	6.4-1
6.4.1	Configuration.....	6.4-1
6.4.1.1	NCT Single Package Configuration.....	6.4-1
6.4.1.2	HAC Single Package Configuration	6.4-2
6.4.2	Results	6.4-2
6.5	Evaluation of Package Arrays under Normal Conditions of Transport.....	6.5-1
6.5.1	Configuration.....	6.5-1
6.5.2	Results	6.5-1
6.6	Package Arrays under Hypothetical Accident Conditions.....	6.6-1
6.6.1	Configuration.....	6.6-1
6.6.2	Results	6.6-3
6.7	Fissile Material Packages for Air Transport	6.7-1
6.8	Benchmark Evaluations.....	6.8-1
6.8.1	Applicability of Benchmark Experiments	6.8-1
6.8.2	Bias Determination.....	6.8-2
6.9	Appendix	6.9.1-1
6.9.1	Sample Input File	6.9.1-1
7.0	OPERATING PROCEDURES.....	7.1-1
7.1	Procedures for Loading the Package.....	7.1-1
7.1.1	Removal of the TRUPACT-III Package from the Transport Trailer/Railcar	7.1-1
7.1.2	Overpack Cover Removal	7.1-1
7.1.3	Closure Lid Removal.....	7.1-2
7.1.4	Loading the Payload into the TRUPACT-III Package	7.1-2
7.1.5	Closure Lid Installation.....	7.1-2
7.1.6	Overpack Cover Installation.....	7.1-4
7.1.7	Final Package Preparations for Transport (Loaded)	7.1-4
7.2	Procedures for Unloading the Package	7.2-1
7.2.1	Removal of the TRUPACT-III Package from the Transport Trailer/Railcar	7.2-1

7.2.2	Overpack Cover Removal	7.2-1
7.2.3	Closure Lid Removal.....	7.2-2
7.2.4	Unloading the Payload from the TRUPACT-III Package	7.2-2
7.2.5	Closure Lid Installation	7.2-2
7.2.6	Overpack Cover Installation.....	7.2-3
7.2.7	Final Package Preparations for Transport (Unloaded).....	7.2-3
7.3	Preparation of an Empty Package for Transport	7.3-1
7.4	Preshipment Leakage Rate Test	7.4-1
7.4.1	Gas Pressure Rise Leakage Rate Test Acceptance Criteria	7.4-1
7.4.2	Determining the Test Volume and Test Time	7.4-1
7.4.3	Performing the Gas Pressure Rise Leakage Rate Test	7.4-2
7.4.4	Optional Preshipment Leakage Rate Test	7.4-2
8.0	ACCEPTANCE TESTS AND MAINTENANCE PROGRAM.....	8.1-1
8.1	Acceptance Tests.....	8.1-1
8.1.1	Visual Inspections and Measurements	8.1-1
8.1.2	Weld Examinations	8.1-1
8.1.3	Structural and Pressure Tests	8.1-1
8.1.3.1	Lifting Device Load Testing.....	8.1-1
8.1.3.2	Containment Vessel Pressure Testing.....	8.1-2
8.1.4	Fabrication Leakage Rate Tests	8.1-2
8.1.4.1	Fabrication Leakage Rate Test Acceptance Criteria.....	8.1-3
8.1.4.2	Helium Leakage Rate Testing the Containment Structure Integrity..	8.1-3
8.1.4.3	Helium Leakage Rate Testing the Main Containment O-ring Seal ..	8.1-4
8.1.4.4	Helium Leakage Rate Testing the Vent Port Insert O-ring Seal	8.1-4
8.1.5	Component Tests.....	8.1-5
8.1.5.1	Polyurethane Foam	8.1-5
8.1.5.2	Balsa Wood.....	8.1-10
8.1.5.3	Butyl Rubber O-rings	8.1-11
8.1.5.4	Calcium Silicate Insulation Board	8.1-12
8.1.6	Tests for Shielding Integrity.....	8.1-13
8.1.7	Thermal Acceptance Test.....	8.1-13
8.2	Maintenance Program	8.2-1
8.2.1	Structural and Pressure Tests	8.2-1
8.2.1.1	Containment Vessel Pressure Testing.....	8.2-1
8.2.1.2	Interior Cavity Surfaces Inspection	8.2-1
8.2.2	Maintenance/Periodic Leakage Rate Tests	8.2-1

8.2.2.1	Maintenance/Periodic Leakage Rate Test Acceptance Criteria.....	8.2-2
8.2.2.2	Helium Leakage Rate Testing the Main Containment O-ring Seal ...	8.2-2
8.2.2.3	Helium Leakage Rate Testing the Vent Port Insert O-ring Seal.....	8.2-3
8.2.3	Component and Material Tests.....	8.2-4
8.2.3.1	Fasteners	8.2-4
8.2.3.2	Seal Areas and Grooves	8.2-4
8.2.4	Thermal Tests	8.2-5
8.2.5	Miscellaneous Tests	8.2-5
8.2.5.1	Valves and Rupture Discs	8.2-5
8.2.5.2	Gaskets	8.2-5
8.2.5.3	Shielding	8.2-5
8.2.5.4	Passive Filters	8.2-5

This page intentionally left blank.

1.3.1 Packaging General Arrangement Drawings


This section presents the TRUPACT–III packaging general arrangement drawing¹, consisting of 21 sheets entitled, *TRUPACT–III Packaging SAR Drawing*, Drawing Number 51199–SAR, Rev. 6.

Within the packaging general arrangement drawing, dimensions important to the packaging's safety are dimensioned and toleranced (e.g., sealing regions on the seal flanges). All other dimensions are provided as a reference dimension, and are toleranced in accordance with the general tolerance block.

¹ The TRUPACT–III packaging general arrangement drawing utilizes the uniform standard practices of ASME Y14.5M–1994, *Dimensioning and Tolerancing*, American National Standards Institute, Inc. (ANSI).

This page intentionally left blank.

Figure Withheld Under 10 CFR 2.390

	AREVA Federal Services LLC Packaging Projects Tacoma, WA 98402	
	TRUPACT-III PACKAGING SAR DRAWING	
	SCALE: NONE	WT. N/A
	REV: 0	SHEET 1 OF 21
	DRG NO.	
	D	51199-SAR
	CADFILE: 51199SAR1A.DWG	

51199-SAR	2	8
-----------	---	---

Figure Withheld Under 10 CFR 2.390

REV: 6	SHEET 2 OF 21
DRG NO.	
SIZE	
D	51199-SAR
ENCLOSURE 51199-SAR-2.DWG	

1

Figure Withheld Under 10 CFR 2.390

51199-SAR	4	8
-----------	---	---

Figure Withheld Under 10 CFR 2.390

REV: 0	SHEET 4 of 21
DATE	DWG NO.
SIZE	51199-SAR
D	EAJFRL81199SAR04A.DWG

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390

Figure Withheld Under 10 CFR 2.390