AREVA

Amendment/Renewal Application for CoC 9217 Model No. ANF-250 Transport Package

AREVA-NP/Transnuclear Inc.,
12/17/2009

Meeting Agenda

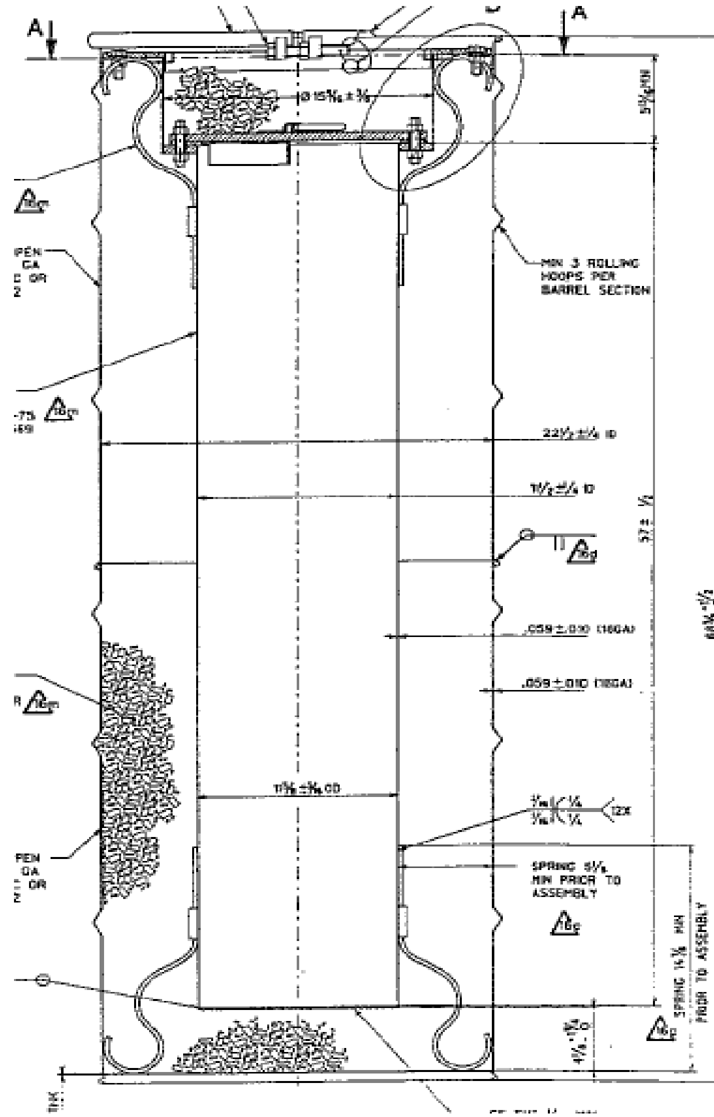
- Scope of Application for CoC Revision to ANF-250
- Description of ANF-250 Packaging
- Details of Criticality Analyses Changes
- Background on Low Angle Drop Tests
- Details of Low Angle Drop Tests Performed on ANF-250
- CoC 9217 Revision 14 Submittal Schedule
- Need for CoC 9217 Revision 14 Approval

Scope of Application for CoC Revision to ANF-250

- **Update chapter 2 to include shallow angle drop test results**
- **Update chapter 6 to include revised criticality analysis**
- **Update chapter 1 to provide a clear description of contents**
- **Editorial changes**

ANF-250 Package Description

- **ANF-250 Package has been licensed in the US (IAEA -73) since 1989, last revision in 2005 – valid until end of June 2010**
- **Validated in Germany in 2005 – valid until end of June 2010**
- **Authorized Contents include UO2 pellets and powder enriched to 5.0 wt. % U-235**
  - **Pellets are normally loaded in trays within the pellet suitcase – two suitcases per package**
  - **Powder is normally filled in plastic jugs and inserted within a steel powder container – four jugs per container**
  - **Limits on the mass of uranium (enrichment of U-235) and the amount of hydrogen are included in the certificate**



Criticality Analysis Revision Description

- The criticality analysis is revised to reflect the following:
  - A clear and unambiguous content description and maintain consistency with major geometry and material description of the analysis models
  - Update the computer codes and cross section library to the latest acceptable standards
  - Update the criticality benchmarks and the associated evaluation methods (USL) to the latest acceptable standards
  - Update the geometry and material models

Contents Description

- **Pellet / Scrap Contents**
  - **Diameter of the Pellets (maximum and minimum)**
  - **Maximum mass of Uranium at an enrichment of 5.0 wt. % U-235**
  - **Maximum mass of Uranium at an enrichment of 1.0 wt. % U-235**
  - **Limits on the maximum Hydrogen contents in the package**
  - **Criticality Safety Index**
  - **Conditions for Transport – Trays, Horizontal Configuration**
  - **More details on Scrap Contents (Size / Loading etc)**
  - **Gadolinia or other burnable absorbers**

Contents Description (continued)

- **Powder Contents**
  - **Maximum mass of Uranium as a function of U-235 enrichment**
  - **Maximum mass of Uranium at an enrichment of 5.0 wt. % U-235**
  - **Maximum mass of Uranium at an enrichment of 1.0 wt. % U-235**
  - **Limits on the maximum Hydrogen contents in the package**
  - **Criticality Safety Index**
  - **Gadolinia or other burnable absorbers**
- **A clear and unambiguous content description**

Criticality Analysis - Overview

- Existing Criticality Analysis – Computer Codes
  - SCALE 3 and SCALE 4 Code System
  - KENO Va Monte Carlo Module
  - 16-Group and 27-Group Cross Section Libraries
  - Analyses unchanged for over 20 years
- Proposed Criticality Analysis – Computer Codes
  - SCALE 6 Code System
  - KENO Va Monte Carlo Module
  - 238 Group, ENDF/B-V Cross Section Library
  - NITAWL for Cross Section Processing

Criticality Analysis - Overview

- Existing Criticality Analysis – Approach and Models
  - Powder modeled using INFHOMEDIUM
  - Pellets modeled using SQUAREPITCH and Cell Weighted Cross Sections
  - NCT Models with some flooding
  - HAC with full flooding (No Optimum moderation)

Criticality Analysis - Overview

- Proposed Criticality Analysis – Approach and Models
  - Powder using INFHOMEDIUM
  - Pellets using both SQUARE and TRIANGULAR Pitch
  - NCT Models with some flooding
  - HAC with Optimum Moderation
  - Scrap models with ASPHERICAL TRIANGULAR Pitch
  - More Sensitivity on Geometry and Material Layout
  - All calculations without burnable absorbers
  - Results conservatively applicable to UO_2 with burnable absorbers

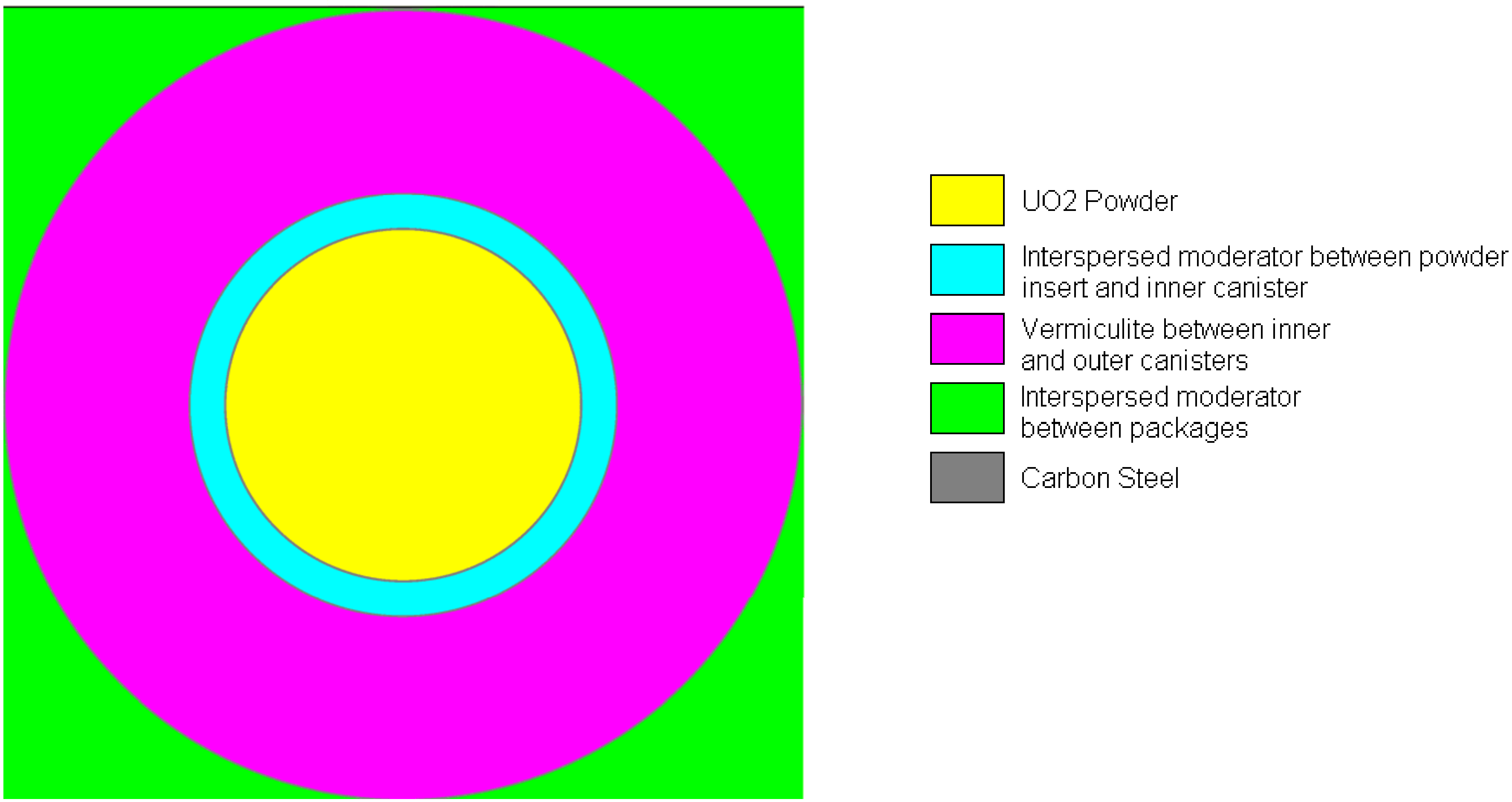
Criticality Analysis Approach - Powder

- **Single Package and Array of Packages are Evaluated**
- **CSAS25 Module of SCALE 6**
- **INFHOMEDIUM for Cross Section Preparation**
- **Powder, Plastic Bottle, Container and Package modeled explicitly**
- **Powder modeled with theoretical density**
- **NCT calculations with 1149 gm of Hydrogen**
- **NCT calculations with external moderation (water / void) but no water leakage into the container**
- **Sensitivity calculations with variations in geometry and material tolerances (particularly the amount of water in the vermiculite)**

Criticality Analysis Approach - Powder

- **HAC calculations with optimum internal and external moderation**
- **External Moderation includes space between the powder insert and inner container, space between the inner and outer container and the space between the package arrays**
- **Optimum External Moderation is determined by independently varying the densities**

KENO Model for Powder Evaluation



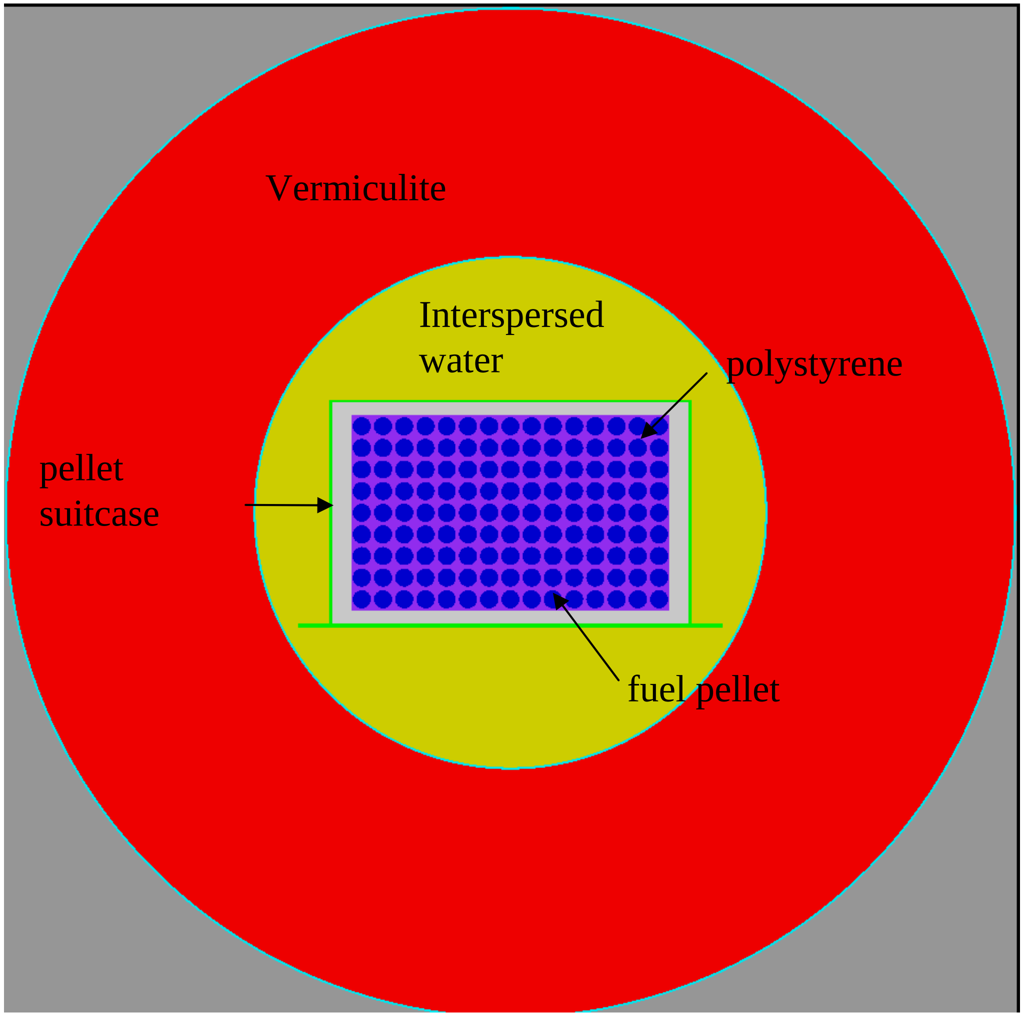
Criticality Analysis Approach - Pellets

- **CSAS25 Module of SCALE 6**
- **238 Group ENDF/B-V Cross Section Library using NITAWL for resonance corrections**
- **Pellets, Suitcases and Package modeled explicitly**
- **Pellets modeled with SQUAREPITCH both TRIANGULAR**
- **NCT calculations with 1149 gm of Hydrogen**
- **NCT calculations with external moderation (water / void) but no water leakage into the container**
- **Polystyrene Pellet Trays modeled explicitly for NCT**
- **Single Package and Array of Packages are Evaluated**

Criticality Analysis Approach - Pellets

- HAC calculations with optimum internal and external moderation
- External Moderation includes space between the powder insert and inner container, space between the inner and outer container and the space between the package arrays
- Optimum Internal Moderation will be varied with Mass of Uranium while determining the maximum k_{eff}
- Optimum Reactivity could occur at lower mass – 80 Kg instead of 120 Kg
- Sensitivity calculations with variations in geometry and material tolerances (particularly the amount of water in the vermiculite)

KENO Model for Pellet Evaluation



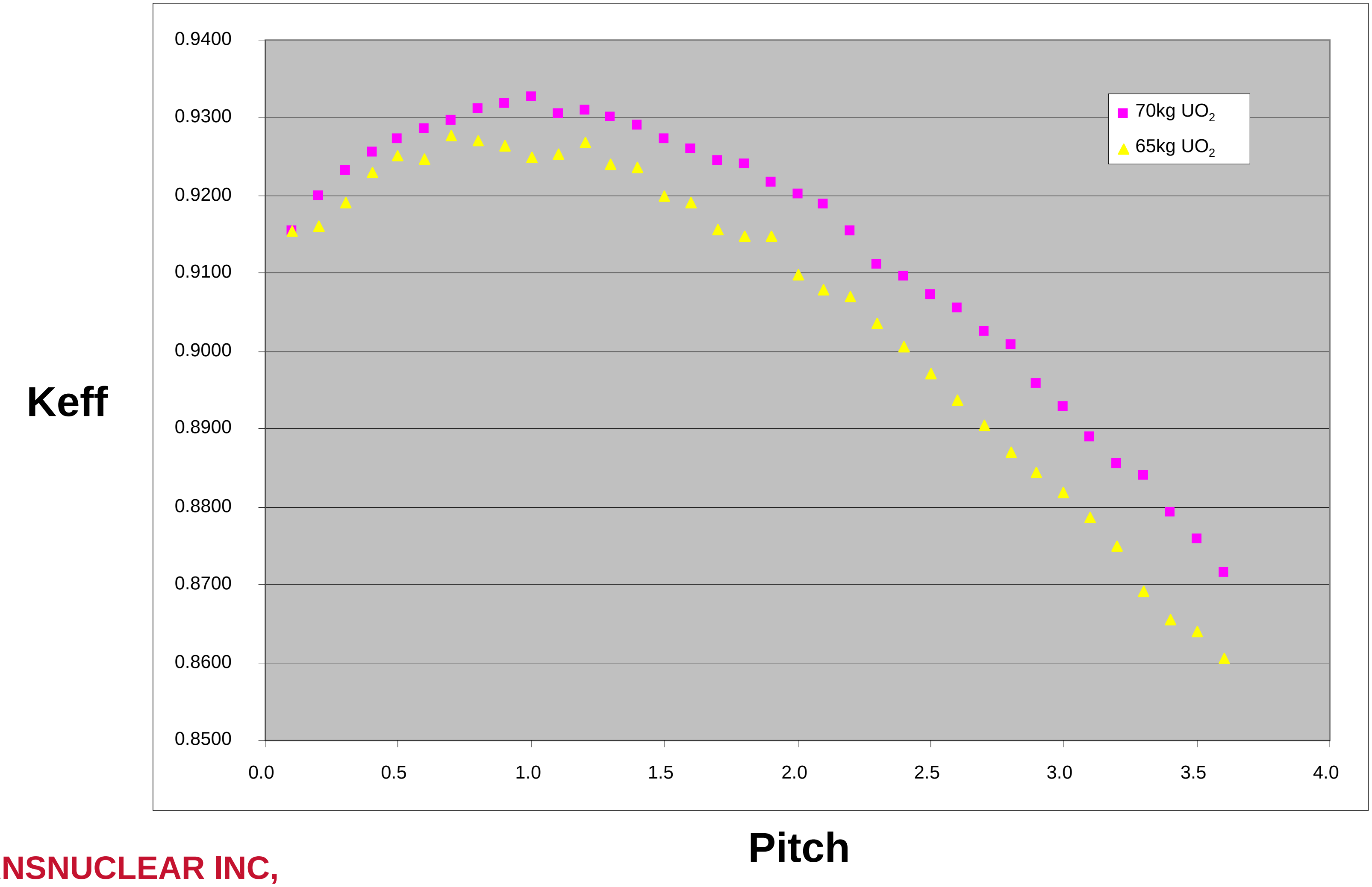
Criticality Analysis Approach - Scrap

- **All modeling approaches similar to Pellets**
- **Actual mode of packaging – may not be in Trays**
- **Modeled using Spheres arranged in a regular lattice**
- **Lattice arrangement using TRIANGULAR Pitch – Dodecahedron arrangement in CSAS25**
- **Calculate the optimum mass and maximum mass of Uranium for shipment**
- **Variation in parameters – diameter and pitch**
- **Array of Packages**

Criticality Analysis Benchmarks

- Pellet / Scrap benchmarks based on NUREG CR/6361 or Fresh Fuel Benchmarks for SCALE 6
- 23 benchmarks are selected for USL calculation from approximately 150 available benchmarks
- Upper Subcritical Limit (USL) calculated using Method-1
- USL functions are calculated for:
  - Energy of the Average Lethargy for Fission (EALF)
  - Enrichment
  - Hydrogen to Fissile Ratio (H/X)
- USLSTATS Program distributed with SCALE 6 is employed to calculate the USL
- Limiting USL ~ 0.9400

K_{eff} Versus Pitch for Scrap Evaluation



Criticality Analysis Benchmarks

- Powder benchmarks based on ORNL-CSD-TM-238 powder benchmarks for KENO Va
- 18 ORNL benchmarks are available
- USL function calculated for:
  - Energy of the Average Lethargy for Fission (EALF)
  - Enrichment
  - Hydrogen to Fissile Ratio (H/X)
- Limiting USL ~ 0.9388

Conclusions of Criticality Analysis Revision

- **ANF-250 Criticality Analysis is redone**
- **Methodology consistent with TNF-XI**

	NCT		HAC	
Configuration	**Single**	**Array**	**Single**	**Array**
UO_2 Powder (Maximum CSI = 1.8)				
1.0 wt% Enrichment	-	0.8359	-	0.8423
5.0 wt% Enrichment	0.8833	0.8864	0.9217	0.9364
UO_2 Pellets (maximum k_{eff} at 80 Kg U, maximum allowed = 120 Kg U, Maximum CSI = 0.9)				
5.0 wt% Enrichment	0.6300	0.8133	0.7727	0.9338
1.0 wt% Enrichment	-	0.5547	-	0.6062
UO_2 Scrap (maximum allowed = 60 Kg U, Maximum CSI = 0.9)				
5.0 wt% Enrichment	-	0.7990	-	0.9333

Background on Low Angle Drop Tests

- On November 15, 2001, the NRC performed a 9 meter (30-foot) HAC drop test of the Model No. ABB-2901 (CoC No. 9274) with the package oriented 17.5 deg from the horizontal.
- The test resulted in a complete separation of the lid and top insulation from the drum body.
- Specific Corrective Actions to be taken by the CoC holder (Framatome ANP) are listed in Confirmatory Action Letter CAL No. 02-8-001, dated June 20, 2002.
- Memorandum from Robert A. Nelson (NRC-SFST) to William H. Ruland (NRC-SFST), dated April 9, 2007, ML071020309, has ANF-250 package listed as one of the seven drum-type packages that are subject to an RAI from NRC during the next renewal or amendment.

Background (continued)

- **Due to the similarities between the ABB-2901 package and the BW-2901 package, a comprehensive series of low angle drop tests were performed by Framatome ANF on BW-2901 package to address the issues identified in CAL 02-8-001. The results of these tests are documented in Framatome ANP Letter to the NRC, EHSLR: 02:025, dated July, 02, 2002.**
- **The CAL Response Letter also documents the results of the similar low angle drop testing which was performed on another drum type licensed package, ANF-250 (CoC 9217), used by Framatome ANF.**
- **TN is submitting a request for revision of CoC 9217 to include the low angle drop tests on ANF-250 package which were documented in the CAL Response Letter.**

Description of ANF-250 Low Angle Drop Tests

- **Two ANF-250 containers (#1230 and #980) were designated and delivered to the MAR facility at Lynchburg for testing.**
- **ANF-250 #1230 was loaded with a 361 lb. dummy payload (675 lb. gross weight) and the container lid secured with a "half-circle" closure ring torqued to 45 ft-lbs.**
- **Container was dropped from 30 feet at an incidence angle of 17.5° (lid downward) onto a reinforced concrete pad. This container was then subjected to two consecutive puncture tests with the drum aligned at an incidence angle of 54° (lid upward) on the first puncture test and 60° (lid upward) on the second. It was set for the puncture pin to impact on the lid closure ring directly on the ring closure bolt (opposite the side deformed by the 30-ft. drop) for both attempts.**

ANF-250 Low Angle Drop Tests (continued)

- ANF-250 Shipping Container Serial #980 was loaded with a 361 lb. dummy payload (661 lb. gross weight) and the container lid secured with a standard “V” closure ring torqued to 45 ft-lbs.
- Container was dropped from 30 feet at an incidence angle of 17.5° (lid upward) and the closure bolt at the 12 o’clock position onto a reinforced concrete pad. It was then rotated 180° and subjected to a second 30 ft. drop, this time with the lid downward (16° incidence angle) with impact on the closure bolt.

Results of ANF-250 Low Angle Drop Tests

Container Serial #	Test Type	Cumulative Tests	Pass/Fail	Drum Lid / Closure Ring Status	Measured Damage
1230 (ANF-250)	30-ft. Drop	1	Pass	Fully Intact (Fig. 2-36)	3” max. sidewall deformation (near mid-span)
	Pin/Puncture	2	Pass	Fully Intact (Fig. 2-37)	No additional deformation
		3	Pass	~3” lid separation at point of impact (Fig. 2-38)	No additional deformation
980 (ANF-250)	30-ft. Drop	1	Pass	Fully Intact (Fig. 2-39)	3” max. sidewall deformation (near mid-span)
		2	Pass	Fully Intact (Fig. 2-40)	3” max. sidewall deformation on both sides (near mid-span)

Results of ANF-250 Low Angle Drop Tests (continued)

- **Figure 2-36: ANF-250 Container #1230 After 1st Test**

Results of ANF-250 Low Angle Drop Tests (continued)

- **Figure 2-37: ANF-250 Container #1230 After 2nd Test**

Results of ANF-250 Low Angle Drop Tests (continued)

- **Figure 2-38: ANF-250 Container #1230 After 3rd Test**

Results of ANF-250 Low Angle Drop Tests (continued)

- **Figure 2-39: ANF-250 Container # 980 After 1st Test**

Results of ANF-250 Low Angle Drop Tests (continued)

- **Figure 2-40: ANF-250 Container # 980 After 2nd Test**

Conclusion of Low Angle Drop Tests ANF-250

- The low incidence angle (17.5°) drop orientation was determined to not be any worse from a "maximum damage" or lid separation standpoint than prior testing done at steeper angles on drum-type shipping packages including ABB/BW-2901, DHTF, and ANF-250 containers. There is not an increased propensity for lid separation failure in drops at low incidence angles for these designs.
- There were no failures with respect to lid separation following the regulatory sequence of tests (30-ft drop followed by puncture test). Lid separation only occurred after repeated tests (beyond the requirements of the regulations) on the same container.
- ANF-250 SAR is revised to add this summary of low angle drop test results

CoC 9217 Revision 14 Submittal Schedule

- AREVA-NP and TN Inc has submitted letters on Nov 25th 2009 to NRC requesting transfer of CoC to TN Inc to be effective on December 15th 2009
- CoC Revision 13 expires June 30, 2010
- TN plans to submit a request for Revision 14 of CoC 9217 along with the supporting SAR by December 24th 2009 after receipt of CoC Transfer confirmation from NRC

Need for CoC 9217 Revision 14 Approval

- **AREVA desires to resume fuel shipments from Richland, Washington to Germany after September 1, 2010**
- **ANF-250 is the only package currently available for shipments of production pellets from Richland**
- **US DOT validations will be obtained after NRC approval of CoC 9217 Revision 14**
- **Validations are also required in Canada, UK, Belgium, Sweden, and Germany after the NRC and DOT approval for ANF-250 with CoC Revision 14**
- **Requesting NRC approval of CoC revision by May 1st 2010 so US DOT and foreign competent authority revalidations can be applied and completed before the need date for shipping**