TRANSNUCLEAR
AN AREVA COMPANY

April 8, 2010
E-29231

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Subject: Response to Request for Additional Information
Model No. ANF-250 Transportation Packaging
Certificate of Compliance No. 9217, Revision 15
Request for Renewal and Revision
Docket No. 71-9217

References:
1. Letter from Eric Benner (NRC) to Donald Shaw (TN), "Request for Additional Information for Review of the Model No. ANF-250 Packaging, Docket No. 71-9217" dated March 11, 2010

2. Letter from Eric J. Benner (NRC) to Jayant Bondre (TN), "REVISION 15 OF CERTIFICATE OF COMPLIANCE NO. 9217 FOR THE MODEL NO. ANF-250 PACKAGE," dated January 12, 2010

This submittal provides responses to the request for additional information (RAI) forwarded by Reference 1. Enclosure 1 herein provides each of the NRC staff RAI followed by a TN response. Enclosure 2 provides changed and new pages for the ANF-250 SAR. In the SAR, replacement and new pages are annotated as Revision 12, with changed areas indicated by italicized text and revision bars. A proposed marked-up CoC is included as Enclosure 3, with cumulative requested changes shown by italicized text and revision bars.

Transnuclear's initial application for renewal and revision to CoC 9217 was dated December 23, 2009 and requested renewal and revision of CoC 9217 Revision 14. Reference 2 was issued on January 12, 2010, approving CoC 9217 Revision 15 for the purpose of provided for the use of Revisions 13 or 14 until June 30, 2010. Accordingly, the subject line of this submittal indicates CoC 9217 Revision 15. As was the intent of Revision 15, TN requests that upon approval and issuance of Revision 16, use of Revisions 13, 14, or 15 be allowed until June 30, 2010.

Should the NRC staff require additional information to support review of this application, please do not hesitate to contact Mr. Donis Shaw at 410-910-6878 or me at 410-910-6881.

Sincerely,

Jayant Bondre, PhD
Vice President - Engineering

cc: Mr. Christopher Staab (SFST) (six copies, provided in a separate mailing)

7135 Minstrel Way, Suite 300, Columbia, MD 21045
Phone: 410-910-6900 ◆ Fax: 410-910-6902

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Enclosures:

1. RAIs and RAI Responses
2. Changed Pages for the ANF-250 Safety Analysis Report, Revision 12
3. Marked-up Certificate of Compliance with Suggested Changes

Structural

1-1 Perform a structural similarity evaluation of the two closure ring configurations, "Half-Circle" and "V," to demonstrate comparable structural capability for retaining the container closure lid in place during the shallow-angle drop test.

In the December 17, 2009, application meeting, reference was made on the "Half-Circle" and "V" closure ring configurations used in testing ANF-250 Containers #1230 and #980, respectively. As evidenced in the two puncture tests, Container #1230 was shown structurally adequate in retaining its closure lid during the shallow-angle drop. A structural evaluation must be provided to demonstrate the "V" type closure ring is equally effective for the same closure lid retaining function.

This information is required for evaluating the packaging to ensure its structural adequacy in meeting the requirements of 10 CFR 71.73(c)(3) on package free-drop tests.

Response to 1-1

The shallow angle drop tests performed by Areva were done with two different packages having both types of closure rings. They demonstrated that both the retention of the vermiculite surrounding the inner container and the ability of the inner container to prevent water inleakage were effective for the packages equipped with either type of closure ring.

However, to expedite the review process, the ANF-250 will be restricted to "half-circle" ("U") type closure ring. CoC Page 1, and SAR Pages 2-1 and 2-17a are revised to limit the closure ring to "half circle" ("U") type.

Criticality

2-1 Revise the application to evaluate the number (N) of packages that can be shipped according to the Criticality Safety Index calculations.

Table 6-1 of the application appears to indicate that the calculated number of packages that can be shipped is 132 for UO_2 Pellets, Normal Conditions of Transport (NCT) Array = 13x13x4, Hypothetical Accident Conditions (HAC) Array = 11x12x2, 56 for UO_2 Pellets, NCT Array = 11x12x3, HAC Array = 8x7x2, and 56 for UO_2 Pellet Scrap, NCT Array = 11x12x3, HAC Array = 8x7x2. Based on staff's review, these values need to be corrected.

This information is required in order for the staff to ensure that the package will meet the criticality safety requirements of 10 CFR 71.55 and 10 CFR 71.59 when loaded with the contents described in the application.

Response to 2-1

The value of "N" shown for each configuration in Table 6-1 is the minimum value calculated based on the array configurations employed in the criticality analysis.

The SAR Section 6.1.3 is revised to include the calculation that determines the criticality safety index and the corresponding number of packages based on the package array sizes employed in the criticality analysis. The revised number of packages for UO_2 pellets and UO_2 pellet scrap for a maximum enrichment of 5.0 wt% U-235 is 55. The revised number of packages for UO_2 pellets for a maximum enrichment of 1.0 wt% U-235 is 125. Table 6-1 is also revised to include this change.

The array sizes shown in SAR Table 6-1 are revised for consistency with those described in SAR Section 6.1.2. In addition, SAR page 6-2 is revised for consistency in the terminology to denote enrichment of U-235.

Enclosure 2 to TN E-29231

Changed Pages for the ANF-250 Safety Analysis Report, Revision 12

Transnuclear, Inc.

EMF-2055
Revision 12

Consolidated Safety Analysis Report (SAR) for the Use of the ANF-250 Packaging for the Transport of Fissile Radioactive Materials

Certificate of Compliance 9217
Docket No. 71-9217

Revision Log

Rev.	Date	Description
0 to 10	Various	Processed under previous ownership
11	12/23/09	**Revised pages as follows:** Title page Revision Log page i Table of contents pages ii, iii, iv SAR pages 1-1, 1-2 SAR pages 2-16, 2-17, 2-25 SAR pages 4-1 SAR pages 6-1 through 6-43 SAR page 7-1, 7-2 SAR pages 8-1, 8-2 SAR page 9-1 *(Note: Chapter 9 references and notes are deleted. References and notes are included in individual chapters.)* **Revised drawings as follows:** None **New pages as follows:** SAR page 2-17a SAR pages 2-121, 2-122 SAR pages 6-44 through 6-71 **New drawings as follows:** None **Removed pages:** Record of Review page Distribution page Attachment pages A-1 and A-2 are deleted.
12	*04/08/10*	***Revised pages as follows:*** *Title page* *Revision Log Page i* *Table of contents Page ii* *SAR Pages 2-1, 2-17a* *SAR Pages 6-2, 6-30* ***New pages as follows:*** *SAR Page 6-2a*

2. Structural Evaluation

This section presents the structural information and evaluations showing that the ANF-250 package meets the applicable package requirements of 10 CFR 71 and IAEA Safety Standards to ensure safe and reliable shipment of its radioactive contents. The normal conditions of transport and the hypothetical accident conditions of 10 CFR 71.71 and 71.73, of IAEA Safety Standards 1973 709-714 and 719-724, and of IAEA 1985 619-624, 626-629, and 631-633 have been addressed by evaluation or testing.

2.1 *Structural Design*

The ANF-250 package consists of an inner container centered and supported inside of an outer drum structure. The space between inner and outer container is filled with vermiculite. Details of the construction are shown in Drawing EMF-306,175. The inner container functions as the containment boundary for the payload for all normal conditions of transport. In the hypothetical accident condition, the pellet shipping suitcase (Drawing EMF-304,306) and the container insert (Drawing EMF-306,176) serve to confine the payload geometry to that assumed in the criticality analysis in the case of pellet shipments, or the shipping container insert (Drawing EMF-306,176) serves to confine the payload geometry and to prevent the in-leakage of water in the case of powder shipments.

The outer drum (Drawing EMF-306,175) consists of two 55-gallon (0.21 m^3) Type DOT 17C 16-gauge or equivalent drums welded together end-to-end to form a container roughly 1750 mm (69 in) long. Closure of the drum is with a 16 gauge lid Type DOT 17C and a *"half-circle" ("U") type* ring (12-gauge) with a 15.9 mm (5/8 in) bolt and nut.

The outer drum provides protection from the elements and in handling. It also provides spacing between the fissile material payloads of the containers for determining nuclear interaction in criticality safety.

The inner containment of the package is the 292 mm (11-1/2 in) inner diameter by 1454 mm (57-1/4 in) long 16-gauge steel inner container. The inner container closure is achieved by securing a 12.7 m (1/2 in) steel lid to an external flange by means of six 12.7 mm (1/2 in) hex head bolts and nuts. A seal is provided by means of a 6.4 m (1/4 in) thick silicon rubber gasket rated for 260°C (500°F) service.

2.1.1 Design Criteria

The series of evaluations and tests performed on the ANF-250 package were designed to demonstrate compliance with the current requirements for packaging as set forth in 10 CFR Part 71 and the IAEA Safety Series No. 6. The references for these requirements are listed in Table 2.1, where 10 CFR Part 71 has been used as the basis and comparable requirements from the IAEA Safety Series No. 6 are referenced. Table 2.2 is a listing of IAEA standards which are not specifically stated in 10 CFR Part 71 and are thus in addition to 10 CFR Part 71 requirements, or are different from the stated requirements of 10 CFR Part 71.

container in all accident conditions. In Section 6, it is shown that this is sufficient to prevent a criticality accident.

6. Shallow angle drop testing was performed on two previously certified packages, Containers #1230 and #980. Container #1230 *equipped with a "half-circle" ("U") type closure ring* was subjected to a 9 m drop followed by two puncture drops. These tests demonstrated that the previous drop tests remained bounding with respect to overall container deformation. Localized lid separation was observed after the second puncture drop, however the lid remained attached. The test was considered successful. Container #980 was subjected to two 9 m drops, and no lid separation was observed.

2.5.10 References

1. NRC Confirmatory Action Letter, CAL No. 02-8-001, Martin J. Virgillo to Robert S. Freeman, June 20, 2002.

2.6 *Appendix*

2.6.1 Tables

2.6.2 Figures

6.1.2 Summary Table of Criticality Evaluation

As required by 10 CFR Part 71.55(b), the ANF-250 is shown to be subcritical for the most reactive credible configuration and moderation by water to the most reactive credible extent. The cask is shown to be subcritical for five times "N" packages with void between packages and no in-leakage of water, as required by 10 CFR Part 71.59(a)(1). In addition, as required by 10 CFR Part 71.59(a)(2), two times "N" packages is shown to be subcritical with the fissile material in its most reactive configuration, optimum water moderation and close full water reflection consistent with its damaged condition.

Criticality calculations are performed for UO_2 powder at five different enrichments and for UO_2 pellets and scrap pellets at enrichments of 5.0 w/o U-235 (wt% U-235) and 1.0 wt% U-235. The calculations determine k_{eff} with the CSAS5 control module of SCALE6 [1] for various configurations, including all uncertainties to assure criticality safety under all credible conditions.

The results of the evaluation demonstrate that the maximum expected k_{eff}, including statistical uncertainty, will be less than the USL determined from a statistical analysis of benchmark criticality experiments. The statistical analysis procedure includes a confidence band with an administrative safety margin of 0.05.

Table 6-1 lists the bounding results for all conditions of transport. The highest calculated k_{eff}, including 2σ uncertainty, is an HAC array of ANF-250 packages containing UO_2 powder with an initial U-235 enrichment of 5.0 wt %, 50% water density in the inner container, and 1% water density between packages. The maximum allowed initial enrichment is also listed in Table 6-1. A 9x8x2 array was used for the NCT UO_2 powder array analyses and an 8x7x1 array for the HAC evaluations. For the UO_2 pellet analyses, a 7x8x2 array was evaluated for HAC and an 11x12x3 array for NCT analyses. The pellet scrap analyses use a 10x11x3 NCT array and a 7x8x2 HAC array.

These criticality calculations were performed with CSAS5 of SCALE6. For each case, the result includes (1) the KENO-calculated k_{KENO}, (2) the one sigma uncertainty σ_{KENO}, and (3) the final k_{eff}, which is equal to $k_{KENO} + 2\sigma_{KENO}$.

The criterion for sub-criticality is that

$$k_{KENO} + 2\sigma_{KENO} \leq USL,$$

where USL is the upper subcritical limit established by an analysis of benchmark criticality experiments. Three different USLs are developed for these analyses. From Section 6.8, the minimum USL over the parameter range for UO_2 powder is 0.9388. The minimum USL over the parameter range for *5.0* wt% enriched UO_2 pellets and pellet scrap is 0.9406, and the minimum USL over the parameter range for *1.0* wt% enriched UO_2 pellets and pellet scrap is 0.9372. From Table 6-1, for the most reactive case,

$$k_{KENO} + 2\sigma_{KENO} = 0.9342 + 2\ (0.0011) = 0.9364 \leq 0.9388.$$

6.1.3 *Number of Packages and* Criticality Safety Index

The calculations to determine the Criticality Safety Index (CSI, given in 10 CFR 71.59(b) as CSI = 50/"N") and the number of packages ("N") for a maximum enrichment of 5.0 wt% U-235 are shown below:

The NCT package array evaluations for UO_2 powder yield an N_{NCT} value of 28 (9x8x2/5).
The HAC package array evaluations for UO_2 powder yield an N_{HAC} value of 28 (8x7x1/2).
The limiting number of packages for UO_2 powder is 28 (minimum of 28 and 28, above)
The CSI is 1.786 (50/28). This is rounded conservatively to 1.8.
To be consistent with the CSI, the number of packages for UO_2 powder is limited to 27.

The NCT package array evaluations for UO_2 pellets yield an N_{NCT} value of 79 (11x12x3/5).
The HAC package array evaluations for UO_2 pellets yield an N_{HAC} value of 56 (7x8x2/2).
The limiting number of packages for UO_2 pellets is 56 (minimum of 79 and 56, above)
The CSI is 0.893 (50/56). This is rounded conservatively to 0.9.
To be consistent with the CSI, the number of packages for UO_2 pellets is limited to 55.

The NCT package array evaluations for UO_2 pellet scrap yield an N_{NCT} value of 66 (10x11x3/5).
The HAC package array evaluations for UO_2 pellet scrap yield an N_{HAC} value of 56 (7x8x2/2).
The limiting number of packages for UO_2 pellet scrap is 56 (minimum of 66 and 56, above)
The CSI is 0.893 (50/56). This is rounded conservatively to 0.9.
To be consistent with the CSI, the number of packages for UO_2 pellet scrap is limited to 55.

The calculations to determine the CSI and the number of packages ("N") for a maximum enrichment of 1.0 wt% U-235 are shown below:

The NCT and HAC calculations for UO_2 powder and pellet scrap are performed using infinite arrays. Therefore, the number of packages for UO_2 powder and pellet scrap is infinity. The corresponding CSI is 0.

The NCT package array evaluations for UO_2 pellets yield an N_{NCT} value of 135 (13x13x4/5).
The HAC package array evaluations for UO_2 pellets yield an N_{HAC} value of 132 (11x12x2/2).
The limiting number of packages for UO_2 pellets is 132 (minimum of 135 and 132, above)
The CSI is 0.379 (50/132). This is rounded conservatively to 0.4. To be consistent with the CSI, the number of packages for UO_2 pellets is limited to 125.

For these configurations described above, the values of the CSI and the corresponding "N" are included in Table 6-1.

The design has a criticality safety index (CSI) of 1.8 for transport of UO_2 powder and a CSI of 0.9 for transport of UO_2 pellets and pellet scrap. For 1.0 wt% enriched UO_2 powder and pellet scrap evaluated for an infinite array, the CSI is 0 and for 1.0 wt% enriched UO_2 pellets, the CSI is 0.4.

Table 6-1 Summary of Criticality Results

Configuration	NCT		HAC		USL Value
	Single	Array	Single	Array	
UO_2 Powder, NCT Array = Infinite, HAC Array = Infinite, N=∞, CSI = 0					
1.0 wt% Enrichment	–	0.8359	–	0.8423	0.9388
UO_2 Powder, NCT Array = *9*x*8*x2, HAC Array = 8x7x1, N=27, CSI = 1.8					
3.4 wt% Enrichment	0.8049	0.8120	0.8740	0.9350	0.9388
3.8 wt% Enrichment	0.8396	0.8423	0.8810	0.9145	0.9388
4.6 wt% Enrichment	0.8751	0.8733	0.9027	0.9274	0.9388
5.0 wt% Enrichment	0.8833	0.8864	0.9217	0.9364	0.9388
UO_2 Pellets, NCT Array = 13x13x4, HAC Array = 11x12x2, N=*125*, CSI = 0.4					
1.0 wt% Enrichment	–	0.5547	–	0.6062	0.9372
UO_2 Pellets, NCT Array = 11x12x3, HAC Array = *7*x*8*x2, N=*55*, CSI = 0.9					
5.0 wt% Enrichment	0.6300	0.8133	0.7727	0.9338	0.9406
UO_2 Pellet Scrap, HAC Array = Infinite, N=∞,CSI = 0 (same CSI as Pellets applied for 120 Kg U)					
1.0 wt% Enrichment	–	–	–	0.6959	0.9372
UO_2 Pellet Scrap, NCT Array = *10*x*11*x3, HAC Array = 8x7x2, N=*55*, CSI = 0.9					
5.0 wt% Enrichment	–	0.8035	–	0.9327	0.9406

Table 6-2 Vermiculite Composition (ASTM C-516-80 Type 1 Grade 1)

Compound within Mixture	Wt.% Minimum	Wt.% Maximum
SiO_2	38	46
Al_2O_3	10	16
MgO	16	35
CaO	1	5
K_2O	1	6
Fe_2O_3	6	13
TiO_2	1	3
H_2O	8	16
Other (not used)	0.2	1.2
Total	81.2	141.2
Density (g/cc)	0.0680	0.08047

NRC FORM 618 (8-2000) 10 CFR 71			U.S. NUCLEAR REGULATORY COMMISSION		
CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIAL PACKAGES					
a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9217	16	71-9217	USA/9217/AF	1 OF	4

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. ISSUED TO *(Name and Address)*

Transnuclear, Inc.
7135 Minstrel Way, Ste. 300
Columbia, MD 21045

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Siemens Power Corporation application
dated January 26, 2000, as supplemented.

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model No.: ANF-250

(2) Description

A uranium oxide powder/pellet-shipping container. The packaging consists of a 16-gauge steel inner vessel, approximately 11-1/2 inches ID by 57 inches long, with a bolted and gasketed top flange closure and steel welded bottom plate. The inner vessel is centered and supported in a 22-1/2-inch ID by 68-3/8-inch long, 16-gauge steel drum by twelve 1/4-inch diameter spring steel rods welded to the inner vessel at the top and the bottom of the vessel. A 3/8-inch thick steel flange and a 16-gauge inner band position and support the top of the inner vessel within the outer container. The annulus between the inner vessel and outer container is filled with vermiculite.

The inner vessel is closed by six ½-inch square shank studs with hex head nuts at each end. The outer container is closed with a 12-gauge locking ring with drop forged lugs and a 5/8-inch diameter bolt and lock nut. *A "half circle" ("U") type closure ring is used.* A product container insert is positioned within the inner vessel.

The maximum gross weight of the packaging and contents is 616 pounds.

(3) Drawings

(i) The ANF-250 shipping container is constructed in accordance with Siemens Power Corporation Drawing No. EMF-306,175, Rev. 16.

NRC FORM 618 (8-2000) 10 CFR 71	U.S. NUCLEAR REGULATORY COMMISSION
CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIAL PACKAGES	

a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9217	16	71-9217	USA/9217/AF	2 OF	4

(ii) The pellet shipping suit case is constructed in accordance with Siemens Power Corporation Drawing No. EMF-304,306, Rev. 8.

(iii) The powder and pellet product container inserts are constructed in accordance with Siemens Power Corporation Drawing No. EMF-306,176, Rev. 6, Sheets 1 and 2.

5.(b) Contents

(1) Type and form of material

(i) Dry uranium oxide powder enriched to a maximum 5.0 w/o in the U-235 isotope *with or without burnable absorbers.*

(ii) Dry uranium oxide pellets enriched to a maximum 5.0 w/o in the U-235 isotope *with or without burnable absorbers.*

(iii) Dry uranium oxide pellet scrap enriched to a maximum 5.0 w/o in the U-235 isotope with or without burnable absorbers.

(iv) Uranium oxide pellets enriched to a maximum of 1 w/o in the U-235 isotope *with or without burnable absorbers.*

(v) Uranium oxide pellet scrap enriched to a maximum of 1 w/o in the U-235 isotope with or without burnable absorbers.

(vi) Uranium oxide powder enriched to a maximum of 1 w/o in the U-235 isotope *with or without burnable absorbers.*

(2) Maximum quantity of material per package

Not to exceed 310 pounds and:

(i) For the contents described in 5(b)(1)(i):

The contents not to exceed the following:

Maximum Enrichment (wt% U-235)	Maximum Uranium Mass (kg U)	Maximum U-235 Mass (kg U-235)
3.4	62.4	2.12
3.8	41.0	1.56
4.6	31.2	1.44
5.0	27.7	1.38

NRC FORM 618 (8-2000) 10 CFR 71			U.S. NUCLEAR REGULATORY COMMISSION	
CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIAL PACKAGES				
a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE / PAGES
9217	16	71-9217	USA/9217/AF	3 OF 4

Not to exceed a maximum mass of 1149 g H, considering all sources of hydrogenous material within the inner vessel. The contents must be contained in product container described in 5(a)(3)(iii).

(ii) For the contents described in 5(b)(1)(ii):

The total contents not to exceed 120 kg U, with the U-235 content not to exceed 6 kg. Not to exceed a maximum mass of 1149 g H, including a maximum mass of 600 g polyethylene, considering all sources of hydrogenous material within the inner vessel. The contents must be contained in product container described in 5(a)(3)(ii).

(iii) For the contents described in 5(b)(1)(iii):

The total contents not to exceed 61.7 kg U, with the U-235 content not to exceed 3.08 kg. Not to exceed a maximum mass of 1149 g H, including a maximum mass of 600 g polyethylene, considering all sources of hydrogenous material within the inner vessel. The contents must be contained in product container described in 5(a)(3)(ii).

(iv) For the contents described in 5(b)(1)(iv):

The total contents not to exceed 120 kg U, with the U-235 content not to exceed 1.2 kg. The contents must be contained in product container described in 5(a)(3)(ii).

(v) For the contents described in 5(b)(1)(v):

The total contents not to exceed 120 kg U, with the U-235 content not to exceed 1.2 kg. The contents must be contained in product container described in 5(a)(3)(ii).

(vi) For the contents described in 5(b)(1)(vi):

The total contents not to exceed 120 kg U, with the U-235 content not to exceed 1.2 kg. The contents must be contained in product container described in 5(a)(3)(iii).

5.(c) Criticality Safety Index

Minimum criticality safety index to be shown on label for nuclear criticality control:

For contents described in 5(b)(1)(i) and limited in 5(b)(2)(i): 1.8

For contents described in 5(b)(1)(ii) and *5(b)(1)(iii), and* limited in 5(b)(2)(ii) *and 5(b)(2)(iii)*: 0.9

For contents described in 5(b)(1)(iv), *5(b)(1)(v)* and 5(b)(1)(vi), and limited in 5(b)(2)(iv), *5(b)(2)(v)*

NRC FORM 618 (8-2000) 10 CFR 71	U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9217	16	71-9217	USA/9217/AF	4 OF	4

and 5(b)(2)(vi): 0.4

6. In addition to the requirements of Subpart G of 10 CFR Part 71:

   a. The package must be prepared for shipment and operated in accordance with the Operating Procedures in Chapter 7 of the application.

   b. The packaging must meet the Acceptance Tests and Maintenance Program in Chapter 8 of the application.

7. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.

8. *Revision Nos. 13, 14, and 15 may be used until June 30, 2010.*

9. Expiration date: June 30, 2015.

REFERENCES

Siemens Power Corporation application dated January 26, 2000.

Supplements dated: January 31, June 6, June 15 and September 29, 2000; February 6 and August 21, 2001; December 16, 2004; November 25, 2009; December 21, 2009; *and December 23, 2009.*

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/

Eric J. Benner, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Date: *tbd.*