May 27, 2010

Mr. Donald Shaw
Licensing Manager
Transnuclear, Inc.
7135 Minstrel Way, Ste. 300
Columbia, MD 21045

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 9217 FOR THE MODEL NO. ANF-250 PACKAGE

Dear Mr. Shaw:

As requested by your application dated December 23, 2009, as supplemented by your letter dated April 8, 2010, enclosed is Certificate of Compliance No. 9217, Revision No. 16, for your Model No. ANF-250 package. This certificate supersedes, in its entirety, Certificate of Compliance No. 9217, Revision No. 15. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The staff's Safety Evaluation Report is also enclosed.

Transnuclear, Inc., is a registered user of the package under the general license provisions of 49 CFR 173.471. Those on the attached list have been registered as users of the package under the general license provisions of 10 CFR 71.17 or 49 CFR 173.471. The approval constitutes authority to use the package for shipment of radioactive material and for the package to be shipped in accordance with the provisions of 49 CFR 173.471.

If you have any questions regarding this certificate, please contact me at (301) 492-3294 or Chris Staab of my staff at (301) 492-3321.

Sincerely,

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

Docket No. 71-9217
TAC Nos. L24406 & L24407

Enclosures:
1. Certificate of Compliance No. 9217, Rev. No. 16
2. Safety Evaluation Report
3. Registered Users

cc w/encls 1&2: R. Boyle, Department of Transportation
J. Shuler, Department of Energy

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SAFETY EVALUATION REPORT
Docket No. 71-9217
Model No. ANF-250
Certificate of Compliance No. 9217
Revision No. 16

SUMMARY

By letter dated December 23, 2009, as supplemented by your letter dated April 8, 2010, you submitted an application for renewal and revision to Certificate of Compliance (CoC) No. 9217 for the Model No. ANF-250 packaging (ANF-250) and you successfully evaluated a 30-foot drop test at a shallow angle orientation for the effect of lid separation and the ability of the package to meet the requirements of 10 CFR Part 71.

Based on the statements and representations in the applications, the CoC has been renewed and will expire on June 30, 2015.

STRUCTURAL EVALUATION

The CoC renewal request incorporates an evaluation of packaging container lid separation potential during a 30-ft shallow-angle free drop followed by a puncture pin drop test. This is in recognition of the April 9, 2007, NRC memorandum, Robert A. Nelson to William H. Ruland (ADAMS: ML071020309), which has the ANF-250 package listed as one of the seven drum-type packages that are subject to a Request for Additional Information (RAI) from NRC during the next renewal or amendment. The evaluation of lid separation potential preempted the question that would have been identified in an RAI for the renewal request.

Section 2.5.8 of the consolidated application documents the January 2002 shallow-angle drop testing of two licensed containers, ANF-250 #1230 and #980, pulled from shipping operations. The containers were loaded with a 361-lb dummy payload, and the testing was performed at an ambient temperature of approximately 40^{o} F. Conducting testing at an ambient air temperature, as opposed to both the regulatory temperature cold (-20^{o} F) and hot (+100^{o} F) conditions, is consistent with that of NUREG/CR-6818, “Drop Test Results for the Combustion Engineering Model No. ABB-2901 Fuel Pallet Shipping Package,” for determining if bolted-ring drum could fail during shallow-angle free drops. It is acceptable in that, within the temperature of interest, a drum lid separation failure, which would mostly be associated with the lid buckling strength, is deemed insensitive to temperature related slight changes of modulus of elasticity of the steels for the lid and bolted ring closure assembly.

The Container #1230 testing consisted of three drops in the order of (1) 30-ft, lid downward, drop at an incident angle of 17.5^{o} with the lid closure ring bolt at the 12 o’clock position striking the target surface, (2) 40-inch puncture test with the drum aligned at an incident angle of 54^{o} for the pin to impact upward the lid closure ring directly on the bolt, and (3) 40-inch puncture test with the drum aligned at an incident angle of 60^{o} for the pin to impact the lid closure ring directly at the location 180 degrees apart from the bolt. The 30-ft drop, with the incident angle and impact configuration consistent with those of NUREG/CR-6818, resulted in a maximum deformation of three inches in the sidewall near the packaging mid-span. The first puncture caused no additional deformation. For the second puncture drop, the lid separated about three inches at the point of impact but remained attached with approximately 95% of the clamping ring staying engaged. Thus, the staff agrees with the applicant's conclusion that this series of drop tests demonstrate the ability of the ANF-250 container for meeting the 10 CFR Part 71.73(c)(1) Hypothetical Accident Conditions (HAC) free drop requirements when subject to shallow-angle impacts and subsequent puncture drops

To supplement the above results, two shallow-angle drops were performed using Container #980 in the order of (1) a 30-ft, lid upward, drop at an incident angle of 17.5^{o}, with the lid closure ring bolt at the 12 o'clock position striking the target surface, and (2) a 30-ft, lid downward, drop at an incident angle of 16^{o} with the impact on the closure bolt. The testing resulted in maximum sidewall deformations similar to that of the Container #1230 testing. It also demonstrated that the lid and closure ring remained intact after both drops.

On the basis of the above, the staff agrees with the applicant's conclusion that the results of the shallow-angle drop testing demonstrate the continued effectiveness of the packaging and the previous drop tests remain bounding with respect to overall container deformation for the criticality evaluation consideration. This satisfies the HAC free drop requirements of 10 CFR 71.73(c)(1), as presented in this consolidated application per the 10 CFR 71.38(c) provisions for CoC renewal.

CRITICALITY EVALUATION

This section presents the findings of the criticality safety review for an application to authorize shipment of the Model No. ANF-250 Transportation Package. The staff evaluated the package for its ability to meet the fissile material requirements of 10 CFR Part 71, including the general requirements for fissile material packages in 10 CFR 71.55, and the standards for arrays of fissile material packages in 10 CFR 71.59. The staff reviewed the criticality safety analysis of the package presented in the Safety Analysis Report (SAR), and also performed independent calculations to confirm the applicant's results. The staff's review considered the criticality safety requirements of the radioactive material transportation regulations in 10 CFR Part 71, as well as the review guidance presented in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material."

Description of the Criticality Design

Design Features

The ANF-250 package consists of a 16-gauge steel inner container with a bolted and gasketed top flange closure and steel welded bottom plate. The space between the inner and outer containers is filled with vermiculite. Closure of the inner container is maintained by a lid, gasket, and six hex-head bolts and nuts connected to a flange.

For the shipment of pellets, the pellets will be packed in pellet shipping suitcases as shown in drawings EMF-304 and EMF-306 of the SAR. The pellet suitcase is a flanged steel container that utilizes a flange and bolted closure containing a gasket. The fuel pellets are placed into polystyrene (PS) trays which are placed inside the suitcase. Two suitcases may be placed inside the inner container described above. These suitcases serve to confine the pellets to the geometry of the box.

Pellet scrap can also be shipped in the pellet suitcase. The scrap pellets can either be placed into the PS trays or can be placed in polyethylene (PE) plastic bags for shipment. Separate criticality evaluations are performed for the scrap pellet contents.

For the shipment of powder, the powder is placed in PE plastic jugs within the cylindrical steel shipping container insert as shown in drawing EMF-306,176, of the SAR. The insert has a bolted and gasketed top flange closure and a steel-welded bottom plate. The insert has been shown by the accident condition tests to prevent the in-leakage of water should a breach of the inner container of the ANF-250 occur during an accident condition.

Summary Table of Criticality Evaluations

The applicant provided a summary of criticality evaluations in Table 6-1 of the SAR, which is summarized in the following table for both Normal Conditions of Transport (NCT) and HAC. All results from the 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 $k_{KENO} + 2\sigma_{KENO}$.

Table 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 = 0.0					
1.0 wt% Enrichment	-	0.8359	-	0.8423	0.9388
UO_2 Powder, NCT Array = 8x9x2, 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=132, CSI = 0.4 N=125					
1.0 wt% Enrichment	–	0.5547	–	0.6062	0.9372
UO_2 Pellets, NCT Array = 11x12x3, HAC Array = 8x7x2, N=56, CSI = 0.9 N=55					
5.0 wt% Enrichment	0.6300	0.8133	0.7727	0.9338	0.9406
UO2 Pellet Scrap, HAC Array = Infinite, N=∞,CSI = 0.0 (same CSI as Pellets applied for 120 Kg U)					
1.0 wt% Enrichment	–	–	–	0.6959	0.9372
UO_2 Pellet Scrap, NCT Array = 11x12x3, HAC Array = 8x7x2, N=56, CSI = 0.9 N=55					
5.0 wt% Enrichment	–	0.8035	–	0.9327	0.9406

Criticality Safety Index (CSI)

The applicant demonstrated that infinite arrays of ANF-250 package are adequately subcritical under NCT and HAC. The design showed a criticality safety index (CSI, given in 10 CFR 71.59(b) as CSI = 50/“N”) of 1.8 for transport of UO_2 powder and a CSI of 0.9 for transport of UO2 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. The staff determined that the CSI, is in accordance with 10 CFR 71.59(b).

Fissile Material Contents

The ANF-250 is designed to transport various types of enriched uranium oxide. Dry uranium oxide powder enriched to a maximum 5.0 wt% in the U-235 isotope in which the quantity and contents not to exceed 310 pounds, and not to exceed a maximum mass of 1149 g H, considering all sources of hydrogenous material within the inner vessel. The criticality safety index for this content is 1.8. Dry uranium oxide pellets enriched to a maximum 5.0 wt% in the U-235 isotope in which quantity and contents not to exceed 310 pounds and a maximum of 120 kg U, with the U-235 content not to exceed 6 kg and not to exceed a maximum mass of 1149 g H considering all sources of hydrogenous material within the inner vessel. The mass of uranium per suitcase shall not exceed 60 kg. The criticality safety index for this content is 0.9. For dry uranium oxide pellet scrap enriched to a maximum 5.0 wt% in the U-235 isotope, the quantity and contents not to exceed 310 pounds and a maximum of 61.7g U, with U-235 content not to exceed 3.1 kg. The mass of uranium per suitcase shall not exceed 30.8 kg. The criticality safety index for this content per package is 0.9. In the case of uranium oxide powder enriched to a maximum of 1.0 wt% in the U-235 isotope, the quantity and contents not to exceed 310 pounds and a maximum 120 kg U, with the U-235 content not to exceed 1.2 kg. The criticality safety index for this content is 0. For, dry uranium oxide pellets enriched to a maximum 1.0 wt% in the 235U isotope, the quantity and contents not to exceed 310 pounds and a maximum of 120 kg U, with the U-235 content not to exceed 1.2 kg. The criticality safety index for this content is 0.4. Dry uranium oxide pellet scrap enriched to a maximum 1.0 wt% in the U-235 isotope. Quantity and contents not to exceed 310 pounds and a maximum of 120 kg U and the U-235 content not to exceed 1.2 kg. The criticality safety index for this content is 0.

General Considerations for Criticality Evaluations

Model Configuration

The applicant evaluated five different enrichments. 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, models of a single package and arrays of packages under both NCT and HAC were evaluated. The space between the inner and outer containers is filled with vermiculite. The applicant did not include the springs in the model.

According to the applicant, the packages were placed closer together in an array taking in consideration that steel is a neutron absorber and is more reactive. Conservatively, the inner vessel and outer container minimum tolerance dimensions were utilized in all the models.

For the UO_2 powder model, the applicant made two basic models, one for the NCT and one for the HAC. The fuel and moderator were modeled as a homogenized mixture of UO_2 and polyethylene (plastic jugs) inside the insert. The fuel mixture is modeled at full density so the height of the fuel mixture in the insert is dependent on the quantity of fuel and moderator. The region between the powder insert and the inner canister also includes any void space in the powder insert. For NCT, water is not assumed to mix with fuel since the powder insert was shown to maintain confinement integrity.

For the UO_2 pellet model, the applicant prepared two basic models. For the NCT analyses, a discrete fuel/moderator model was utilized, and for the HAC, a homogenized fuel mixture model was developed. According to the applicant, the main difference in the powder model and the pellet model was the configuration inside the inner container.

The NCT single package model was based on a discrete representation of the fuel pellets as a continuous column of fuel. Nine polystyrene trays were assumed in the model with each tray holding 15 columns of fuel pellets. Therefore an “assembly” of fuel cells (UO_2/PS) in a 15x9 array was modeled inside each suitcase and the suitcases were modeled inside the inner container.

For the UO_2 pellet scrap model

The applicant utilized the UO_2 pellet scrap model based on the fact that the model was basically the same as the pellet model except the pellet scrap was modeled as a sphere in a triangular pitch lattice cell with the cell-weighted homogenized fuel mixture also designated as cellmix=500 on SCALE.

Material Properties

The fuel pellets were conservatively modeled at full theoretical density, 10.96 g/cc UO_2 and enrichments ranging from 1.0 to 5.0 wt% U-235.

Table 6-3 of the SAR provided a complete list of all the relevant materials used for the criticality evaluation. The atom densities shown in Table 6-3 for UO_2 were for the discrete pellet model only. Other models use a homogenized fuel mixture and due to the large number of cases, the homogenized fuel atom densities and polyethylene and PS atom densities were not shown in Table 6-3 of the SAR.

Computer Codes and Cross Section Libraries

The CSAS5 control module of SCALE6 was used to calculate the effective multiplication factor (k_{eff}) of the fuel in the ANF-250 package. The CSAS5 control module allowed simplified data input to the functional modules BONAMI, NITAWL (with parm=nitawl card), and KENO V.a. These modules process the required cross sections and calculate the k_{eff} of the system. BONAMI performed resonance self-shielding calculations for nuclides that have Bondarenko data associated with their cross sections.

According to the applicant, the use of newer cross section processing options (CENTRM, ENDF/B-VI and ENDF/B-VII) available in the SCALE6 code did not result in any significant change in the results based on the low enriched UO_2 pellets. The 238-group ENDF/B-V cross section library was extensively benchmarked and was appropriate for this analysis.

Demonstration of Maximum Reactivity

The applicant performed multiple sensitivity studies for the single package and array configurations of the ANF-250 to determine the most reactive condition.

A single package analysis was performed for the NCT. The applicant established in the NCT analysis that the pellet suitcase interior will remain leak-tight; however, the inner vessel was allowed to fill with water (interspersed water). For the powder, the inner canister and void space of the powder insert were assumed to be filled with water, but water was not allowed to mix with the fuel since the powder was contained in PE bottles and was modeled as a homogeneous mixture with PE. The water content of the vermiculite was varied or the vermiculite replaced by

water, and the package was closely reflected all around of full density water. Single package analyses were not performed for UO_2 pellet scrap.
The applicant utilized fuel pellet/PS pellet tray model as the basis for the NCT pellet array evaluation. Based on the single package analyses, pellet OD was the basic model utilized for the pellet array analyses. The model has 1149 g H moderator (PS) in the package (suitcase). The array of packages was closely reflected all around with full density water; however, there was a void between the packages. The pellet scrap analyses were identical to the pellet analyses except for the use of homogenized fuel mixture models. The powder analyses used the homogenized fuel mixture models. In the HAC array pellet analysis, the suitcases were fully flooded and are modeled with maximum tolerance dimensions. The outer container was assumed to have its diameter and length reduced by two inches each as a result of the accident conditions.

Confirmatory Analyses

The staff performed confirmatory evaluations of the ANF-250 package, for UO_2 pellets fuel packed in shipping suitcases, UO_2 powder placed in PE plastic jugs, and UO_2 scrap pellets placed into the PS trays configurations. Using assumptions similar to the applicant's, the staff confirmed that the package will meet the criticality safety requirements of 10 CFR Part 71.

Single Package Evaluation

Configuration

The applicant evaluated the package using the bounding configuration determined in earlier sensitivity studies. Single package evaluations were performed for the ANF-250 package with UO_2 powder and UO_2 pellets.

The fuel and PE bottles were modeled as a homogenized mixture in the powder analyses. Water was included in this mixture for HAC. For the pellet analyses, the fuel and PS trays were modeled discretely for NCT and as a cell-weighted homogenized mixture of fuel and water for HAC. For both the powder and pellet evaluations, the most reactive configuration was with 100% water replacing the vermiculite and 100% interspersed water in the container. For the NCT evaluations, 1149g hydrogen was used in the models. In the HAC models, water was mixed with the fuel and the optimum moderation was determined. Cases were run using the maximum and minimum density vermiculite and the nominal, minimum, and maximum tolerance dimensioned pellet suitcase to determine the reactivity sensitivity of these variables. The structural analysis demonstrates that the cask remains leak tight under all accident conditions

Results

The results of the single package evaluations are given in Table 6-5 of the SAR. For the single package powder NCT evaluation, the k_{eff} values were shown in Table 6-5 for the different powder enrichments. The bounding k_{eff} is for 5% enrichment with 27.7 kg U at a value of 0.8809. The HAC single powder package results are shown in Table 6-7 for the different enrichments. The bounding k_{eff} was for 5% enrichment with 27.7 kg U at a value of 0.9127. For the pellet NCT evaluation, Table 6-4 of the SAR shows a bounding k_{eff} value of 0.6300 for 5% enrichment 126 kg U. For the pellet HAC evaluation, Table 6-6 of the SAR showed a bounding k_{eff} value of 0.7727 for 5% enrichment 80 kg U. These results show that credible reconfigurations typically decrease the maximum k_{eff}, and in the worst case increase k_{eff} negligibly.

Evaluation of Package Arrays under Normal Conditions of Transport

Package array evaluations were performed for the ANF-250 package with UO_2 powder, UO_2 pellets and pellet scrap.

Configuration

For NCT, the fuel and PE bottles were modeled as a homogenized mixture in the powder analyses. For the pellet analyses, the fuel and PS trays were modeled discretely and an additional model with homogenized fuel and PS was also evaluated. For pellet configuration under NCT, calculations were performed varying the interspersed water (around the suitcases) and the water content in the vermiculite to determine the optimum moderation condition. The results of these calculations are shown in Table 6-8 of the SAR. The configuration with 10% interspersed water density and no water in the vermiculite was identified as the most reactive for the pellet NCT array. The PS pellet trays modeled in the discrete model may be subject to minor changes, and since the mass of hydrogen was the main concern, alternate fuel pitches are examined to bound alternate pellet tray designs. To simplify modeling, a homogenized cell-weighted fuel/PS mixture was utilized. For pellet scrap configuration, the basic homogenized fuel mixture model used for the pellet analyses was also used for the pellet scrap analyses. The main difference was the cell weighting was based on a spherical fuel shape in a triangular lattice pitch. A homogenous mixture of UO_2 and hydrogen (modeled as water), both at full density, was assumed in the package. Finally, for the powder configuration, the moderator in the powder insert was subjected to a series of sensitivity studies. Table 6-12 of the SAR showed that the full density powder produces the highest reactivity, so it was utilized for the remainder of the analyses.

Package Array for NCT - Results

The applicant used discreet model evaluation for the pellet package array under NCT. A bounding k_{eff} value of 0.8095 was shown in Table 6-8 of the SAR. On Table 6-9 of the SAR, the results for the homogenized fuel/PS mixture and the bounding k_{eff} resulted to be 0.8133 for 120 kg U. Both models gave comparable results. On Table 6-11 of the SAR, the bounding k_{eff} value of 0.8035 was for 5.0 wt% U-235 enriched pellet scrap. For the powder package array NCT evaluation, the k_{eff} values were shown in Tables 6-13 through 6-17 for the different powder enrichments. The bounding k_{eff} was for 5% enrichment with 27.7 kg U at a value of 0.8864. The staff concurs with these values.

Evaluation of Package Arrays under Hypothetical Accident Conditions

For hypothetical accident conditions, water was assumed to leak into the package. The models, assumptions, and analysis performed to determine the most reactive configuration were described in Section 6.3.4 of the SAR.

The applicant performed models, assumptions and analysis to determine the most reactive configuration, which was provided in Section 6.3.4 of the SAR.

Configuration

For powder model contained 1149 g hydrogen due to the PE bottles plus additional water was required to determine the most reactive configuration (H/U-235).
For pellet suitcases, runs were performed to determine the sensitivity of the array reactivity to the interspersed water and the water content of the vermiculite. In the package model for the first three cases, the suitcases were located in the center of the inner vessel. A more reactive configuration for the two tier array would be to move the suitcases closer together (axially). Therefore, the model was altered to have the suitcases located at the top of the inner vessel, for the bottom array layer, and for the top array layer, the suitcases were modeled at the bottom of the inner vessel. The maximum reactivity resulted to be for the 7x8x2 array. The results were shown in Table 6-19 of the SAR.

For the pellet scrap, a homogenized fuel mixture model was used for HAC. A pitch of 1.2 cm with a spherical radius of 0.482 cm produced the highest reactivity for the 5 wt% enriched pellet scrap. The reactivity as a function of the cell pitch was shown in Figure 6-9 of the SAR. Similar analyses were performed for 1.0 wt% enriched pellet scrap and the results for an infinite array of packages were shown in Table 6-22 of the SAR.

Package Array for HAC – Results

For the pellet package 7x8x2 array HAC evaluation, a bounding k_{eff} value of 0.9338 was shown in Table 6-19 of the SAR. For pellet scrap, a bounding k_{eff} value of 0.9327 was shown in Table 6-21 of the SAR. For the powder package 8x7x1 array HAC evaluation, the k_{eff} values were shown in Tables 6-23 through 6-27 for the different powder enrichments. The bounding k_{eff} resulted to 0.9364. The staff concurs with these values.

Benchmark Evaluations

Experiments and Applicability

For the fresh fuel in the form of low enriched UO_2 powder and pellets/pellet scrap calculations, the applicant benchmarked the CSAS5 module of the SCALE6 system of codes against twenty-three (23) critical experiments for the UO_2 pellet USL evaluation and eighteen (18) critical experiments for the UO_2 powder USL evaluation. The material and geometrical characteristics of these criticality experiments were summarized in Tables 6-28 and 6-29 of the SAR.

Tables 6-29 and 6-31 of the SAR give the pertinent parameters for each experiment along with the results of each runs. All other parameters showed much lower correlation ratios indicating no real correlation. All parameters were evaluated for trends and to determine the most conservative USL using the USLSTATS 6 Program. There were no observable trends on any of these parameters.

Results from the USL evaluation are presented in Table 6-32 of the SAR for UO_2 powder and Table 6-33 for UO_2 pellets.

Bias Determination

The applicant determined the bias and the standard error of the bias for the fresh fuel in the form of low enriched UO_2 powder and pellets/pellet scrap calculations based on the k_{eff} results of the selected benchmark critical experiments. The applicant reported bias and standard error of the bias based directly on the calculated k_{eff} values in Table 6-32 of the SAR. The larger value of the bias plus the standard error of the bias resulted to be 0.9388. The minimum pellet USL functions generated for each of the trending parameters are provided in Table 6-33 of the SAR, in addition to the range of applicability of the benchmarks. For fuel enriched to 5% U-235, the lowest USL value was obtained for the EALF trending parameter for HAC with a USL = 0.9406. Therefore, this minimum USL was utilized in the analysis for the 5.0 wt. % U-235 enriched fuel. For the 1.0 wt.% U-235 enriched fuel, the enrichment USL was limiting at a value of 0.9372.

References

1. SCALE6: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation for Workstations and Personal Computers, Oak Ridge National Laboratory, Radiation Shielding Information Center Code Package CCC-750, February 2009.

2. U.S. Nuclear Regulatory Commission, “Criticality Benchmark Guide for Light-Water-Reactor fuel in Transportation and Storage Packages,” NUREG/CR-6361, Published March 1997, ORNL/TM-13211.

3. Oak Ridge National Laboratory, “Validation of KENO V.a Comparison with Critical Experiments,” ORNL/CSD/TM-238, December 1986.

4. USLSTATS: A Utility to Calculate Upper Subcritical Limits for Criticality Safety Applications, Version 6, Oak Ridge National Laboratory, January 26, 2009.

5. U.S. Nuclear Regulatory Commission, “Recommendations for Preparing the Criticality Safety Evaluation of Transportation Packages,” NUREG/CR-5661, Published April 1997, ORNL/TM-11936.

Criticality Findings

The applicant has demonstrated that the ANF-250 package, when loaded with fresh fuel in the form of low enriched UO_2 powder and pellets/pellet scrap meeting the characteristics in Section 6.2 of the application, it will be adequately subcritical under all conditions. Therefore, the applicant has shown and the staff agrees that the ANF-250 package meets the fissile material requirements of 10 CFR 71.55 for single packages, and 10 CFR 71.59 for arrays of packages with a 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.

CONCLUSIONS

The Certificate of Compliance has been renewed as requested by the applicant and will expire June 30, 2015.

Condition 5(b)(1), 5(b)(2), and 5(c) were revised to describe allowable contents in increased detail.

Condition 9 was added to state Revision No. 15 of this certificate may be used until July 1, 2011.

Condition 10 was added to state transport by air of fissile material is not authorized.

These changes do not affect the ability of the package to meet requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9217,
Revision No. 16, on May 27, 2010.