June 6, 2005

Mr. Charles M. Vaughan, Manager
Facility Licensing
Global Nuclear Fuel - Americas, L.L.C.
P.O. Box 780
Wilmington, NC 28402

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 4986 FOR THE MODEL NO. RA-3 PACKAGE

Dear Mr. Vaughan:

As requested by your application dated January 21, 2004, as supplemented December 3, 2004, and April 18 and May 10, 2005, enclosed is Certificate of Compliance (CoC) No. 4986, Revision No. 40, for the Model No. RA-3 package. This certificate supersedes, in its entirety, Certificate of Compliance No. 4986, Revision No. 39, dated January 27, 2003. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The staff's Safety Evaluation Report is also enclosed.

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 or Mr. Jose R. Cuadrado of my staff at (301) 415-8500.

Sincerely

/RA/

Robert Lewis, Chief
Licensing Section
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-4986
TAC No. L23695

Enclosures:
1. Certificate of Compliance No. 4986, Rev. No. 40
2. Safety Evaluation Report

cc w/encl:
R. Boyle, Department of Transportation
J. Shuler, Department of Energy
RAMCERTS
Registered Users

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SAFETY EVALUATION REPORT

Docket No. 71-4986
Model No. RA-3 Package
Certificate of Compliance No. 4986
Revision No. 40

SUMMARY

By application dated January 21, 2004, as supplemented December 3, 2004, and April 18 and May 10, 2005, Global Nuclear Fuel - Americas, LLC (GNF-A) requested an amendment to Certificate of Compliance (CoC) No. 4986 for the Model No. RA-3 package. GNF-A requested to modify the authorized contents in the CoC, by adding a new type of unirradiated (fresh) fuel assembly to the authorized contents of the package.

The amendment request included the necessary engineering analyses and proposed CoC and application page changes. The proposed application changes will be incorporated into the package application and referenced in the CoC.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the amendment request, including the proposed CoC and application revisions, and other supporting documents submitted with the amendment request. Based on the statements and representations in the application, as supplemented, the staff concludes that the Model No. RA-3, as amended, meets the requirements of 10 CFR Part 71.

1.0 GENERAL INFORMATION

The applicant requested to revise Condition 5 of the CoC, “Contents,” to include a new fuel type, identified as the GNF2 design, as authorized contents of the RA-3 package. As a result of this addition, several sections of the CoC were renumbered. These changes are discussed in detail in the “Conditions” Section of this Safety Evaluation Report (SER). The changes requested by the applicant only affect the criticality safety evaluations of the application. Therefore, only this section will be discussed in this SER.

In addition to the changes requested by the applicant, the staff has made additional revisions to the CoC in order to reflect changes to the regulations in 10 CFR Part 71, which became effective in October 1, 2004 (69 FR 3698). These changes do not affect the design of the package or the safety basis for this approval.

6.0 CRITICALITY

The proposed amendment adds a new 10x10 Boiling Water Reactor (BWR) fuel assembly design, the GNF2, to the approved contents of the Model No. RA-3 package. GNF2 assemblies have a nominal pellet diameter that is about 0.012 cm larger and a cladding nominal thickness that is about 0.0035 cm thinner than the respective parameters of the currently approved 10x10 BWR assemblies, specified in Condition 5(b)(1)(iii) of the CoC. GNF2 assembly specifications are provided in Section 5.1 and Table 5.1 of Appendix 8-J(a) of the revised consolidated application, submitted on May 10, 2005. The specifications limit the maximum peak and lattice average uranium-235 enrichments to 5.00 and 4.70 percent by weight, respectively. The latter enrichment varies according to the Gadolinia loading requirements given in Table 5.1 of Appendix 8-J(a). The purpose of the current review was to verify that the proposed changes to the Model No. RA-3 package meet the criticality requirements of 10 CFR Part 71 when loaded with GNF2 fuel assemblies. This review follows the guidance provided in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material."

6.1 Applicant's Model and Analysis

The applicant performed its criticality analyses using a proprietary code called GEMER 1.0. The code is a Monte Carlo neutron transport code that combines KENO geometry features with MERIT Monte Carlo code (a GE code) features. The cross-section library is a 190-group library derived from ENDF/B-IV cross section data with explicit resonance parameters. This version of GEMER is a new version and differs from the version(s) used in previous applications. Thus, the applicant provided a benchmark analysis from which the computational bias and the Upper Subcritical Limit (USL) were determined to be 0.017 and 0.933, respectively.

The applicant's analysis used the GNF2 design with the maximum peak and lattice average enrichments specified in Table 5.1 of Appendix 8-J(a) of the consolidated application. This analysis included calculations for a single package in the undamaged and damaged conditions, an array of 608 (16x19x2) undamaged packages, and an array of 135 (9x15x1) damaged packages. Since there were no design changes to the packaging, the applicant used models similar to those of previous analyses. The models of the single undamaged package and the array of undamaged packages differ from each other, however, with the ethafoam being replaced with void and the honeycomb density being reduced by half in the array model. The applicant stated, and staff agrees, that the reduction of these materials in the undamaged array is conservative since this array is an over-moderated system and these materials act as moderators. The applicant further investigated the effect of removing the plastic cluster separators in the undamaged array case. Analysis of the single package and array cases also included determinations of the optimum moderation condition for each case. The results of this analysis demonstrated that the damaged package array with the plastic cluster separators on the assemblies and 7 percent density water moderation was the most reactive configuration.

The applicant performed additional analysis to identify the most reactive GNF2 assembly enrichment and Gadolinia loading, assembly orientation, and assembly positioning in the basket. The most reactive assembly orientation was determined by calculating system reactivity for the assemblies' major axes rotated to various positions with respect to each other. System reactivity was also calculated for assemblies that are centered in the basket cells and at the maximum horizontal separation from each other. The calculations showed that the GBTA enrichment and Gadolinia loading configuration of the GNF2 design is the most reactive. GBTA configured GNF2 assemblies oriented with their major axes parallel and positioned at the maximum horizontal separation in the most reactive damaged array conditions resulted in the highest system k-effective, 0.9292 (including 2σ), which is lower than the USL.

An additional analysis was performed to determine the influence of partial rods on system reactivity. For this analysis, the applicant modeled partial rods as water holes and performed calculations for assembly configurations with and without Gadolinia-Urania rods. The calculation for the assembly with Gadolinia-Urania rods also involved shifting these rods within the assembly to accommodate placement of the partial rods. The presence of partial rods always decreased system reactivity. Since Gadolinia loading in partial length rods cannot be used to show compliance with the specified minimum Gadolinia requirements given in Table 5.1 of Appendix 8-J(a), the analysis doesn't consider Gadolinia-bearing partial rods.

6.2 Staff Review

Staff reviewed the applicant's description of the GEMER code and found that the code and the cross-section library are appropriate for analyzing this packaging and the proposed contents. Staff reviewed the sample input files in the application as well as the applicant's description of the code's treatment of the geometric input. Staff found that criticality model information, material properties, and package dimensions were properly input into the code and are consistent with the model descriptions given in the application and referenced materials.

Staff also reviewed the applicant's benchmark analysis. This review involved evaluation of the applicability of the selected benchmark experiments to the package analysis as well as investigation of potential trends in the computational bias. Staff reviewed the results for the LEU lattice with poisons and determined that the boron-10 influence would seem to strongly overshadow any effect due to Gadolinium; therefore, the staff also believes, with the applicant, that these experiments are not appropriate for benchmarking the current analysis. The staff also performed a confirmatory trending analysis for the 71 LEU experiments used as benchmarks in the application. Subsets of the experiments were investigated as part of this analysis. These subsets included a subset of experiments with no boron-10 and a subset that only contained experiments having fuel in the same form and geometry as the GNF2 assemblies. The calculated k-effective of the experiments was compared as a function of different parameters for each of these cases. Staff confirmed that there is no significant trend in the data and found that the bias calculated by the applicant is an appropriate bias for the criticality analysis in the application.

Staff also performed confirmatory calculations as part of its review. These calculations were conducted using the SCALE5 code system developed by Oak Ridge National Laboratory. In particular, the CSAS25 sequence was used for the calculations. Staff selected the 44-group cross section library derived from the ENDF-B/V cross section data for the calculations. The 44-group cross section library was developed particularly for use in criticality calculations involving light water reactor fuel. Staff confirmed that modeling of partial fuel rods as full length rods is conservative by performing calculations that modeled the partial rods as water holes and as one-third, two-thirds, and full-length rods; modeling these rods as full length rods resulted in the highest k-effective. Staff also confirmed that the most reactive assembly configuration and package conditions were those identified by the applicant to be the most reactive. Staff also found that removing the plastic separators resulted in a different optimum moderator density but did not result in a higher reactivity.

Based on staff's review of the applicant's analysis and confirmatory calculations, staff found that the applicant correctly identified the most reactive configuration. This configuration results in a maximum k-effective that is below the USL. Staff also reviewed the applicant's determination of the Criticality Safety Index (CSI) and found that the applicant used the correct 'N' value, the 'N' from the damaged array case, to calculate the CSI. The CSI was calculated to be 0.8.

6.3 Findings

Based on the review of the information and representations made by the applicant in the amendment application and independent analyses, the staff finds reasonable assurance that the package design with the proposed contents meets the criticality requirements of 10 CFR Part 71.

CONDITIONS

The following conditions in CoC No. 4986, Revision No. 40, have been revised as follows:

Condition 5(b)(1)(iv) has been revised to include GNF2 design fuel assemblies as authorized contents of the package. Accordingly, conditions previously numbered as 5(b)(1)(iv) and 5(b)(1)(v) are now renumbered as conditions 5(b)(1)(v) and 5(b)(1)(vi), respectively.

Condition 5(b)(2), and Condition 9 have been revised to reflect the numbering change in condition 5(b)(1).

Condition 5(c) of the CoC was revised to specify the Criticality Safety Index (CSI) for the GNF2 design fuel assemblies as 0.8. This condition is also revised to replace the wording "Transport Index for Criticality Control" with "Criticality Safety Index," as defined in 10 CFR 71.4.

Condition 12 of the certificate was revised to clarify that the package is approved for use under the general license provisions of 10 CFR 71.17. This change is due to a revision in the numbering of the sections of 10 CFR Part 71, which became effective on October 1, 2004 (69 FR 3698).

CONCLUSIONS

In addition to reviewing the changes to CoC No. 4986 against the applicable standards for each technical area, the staff also reviewed the proposed changes against the provisions of 10 CFR 71.19. The provisions in 10 CFR 71.19 specify additional requirements for previously approved packages, including Type AF packages approved by NRC before September 6, 1983. Specifically, 10 CFR 71.19(d)(2) states that modifications to the design or contents of a fissile material package will only be approved if the modifications are not significant with respect to the prevention of criticality. The staff has evaluated the changes requested by the applicant and determined that they meet the requirements of 10 CFR 71.19.

Based upon the staff's review, the statements and representations in the application, as supplemented, for the reasons stated in this Safety Evaluation Report, and with the conditions listed above, we conclude that these changes will not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 4986, Revision No. 40,
on June 6, 2005.