May 28, 2008

Mr. Scott P. Murray, Manager
Licensing & Liabilities COE
Global Nuclear Fuel - Americas, LLC
Mail Code K-84
3901 Castle Hayne Road
Wilmington, NC 28401

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 9309, REVISION NO. 7, FOR MODEL NO. RAJ-II PACKAGE

Dear Mr. Murray:

As requested in your letter dated June 12, 2007, and as supplemented, enclosed is Certificate of Compliance (CoC) No. 9309, Revision No. 7, for the Model No. RAJ-II package. The staff's Safety Evaluation Report is also enclosed. This revision supersedes, in its entirety, CoC No. 9309, Revision No. 6, dated May 17, 2006. Changes made to the enclosed CoC are indicated by vertical lines in the margins.

Those on the attached list have been registered as users of the package under the general license provisions of 10 CFR §71.17 and 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. Registered users may request by letter to remove their names from the Registered Users List if they are no longer users of the package.

If you have any questions regarding this certificate, please do not hesitate to contact me at (301) 492-3338 or Mr. Stewart Brown of my staff at (301) 492-3317.

Sincerely,

/RA/
Meraj Rahimi, Acting Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9309
TAC No. L24102

Enclosures:
1. CoC No. 9309, Rev No. 7
2. Safety Evaluation Report
3. Registered Users List

cc w/encl 1 & 2: R. Boyle, Department of Transportation
J. M. Shuler, Department of Energy
Registered Users

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SAFETY EVALUATION REPORT

Docket No. 71-9309
Model No. RAJ-II
Certificate of Compliance No. 9309
Revision No. 7

SUMMARY

By application dated June 12, 2007, and as supplemented by letters dated July 11, 2007, November 8, 2007, February 29, 2008, March 14, 2008, and March 20, 2008, Global Nuclear Fuel – Americas, LLC (GNF or the applicant) requested an amendment to Certificate of Compliance (CoC) No. 9309, for the Model No. RAJ-II package. The applicant requested that Condition 5(b), Contents, be revised to include either loose uranium carbide (UC) or PWR uranium-oxide (UO_2) fuel rods in a 5-inch stainless steel pipe container.

The staff reviewed this request in accordance with the guidance provided in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Materials." The staff determined based on its review, the requested change does not affect the ability of the Model No. RAJ-II package of meeting the requirements of 10 CFR Part 71.

EVALUATION

By application dated June 12, 2007, and as supplemented, GNF requested that CoC No. 9309 for the Model No. RAJ-II package be revised to include either loose UC or PWR UO_2 fuel rods in a 5-inch stainless steel pipe container. This application included Revisions 5 and 6 of the GNF RAJ-II package Safety Analysis Report (SAR).

In Section 6.1.3 of the SAR, the applicant provided criticality safety index (CSI) calculations for the various contents that the Model No. RAJ-II packaging is designed to transport. The application included results of CSI calculations for two different package loading configurations, (8x1x8 and 4x2x6 arrays) for either the loose UC or UO_2 fuel rod in 5-inch stainless steel pipe containers. The CSI calculation results were 1.6 and 2.1 for these two package arrays respectively. Therefore, a CSI of 2.1 shall be used for when the contents consist of either loose UC or PWR UO_2 fuel rods in a 5-inch stainless steel pipe container. This is the more limiting for this type of content.

In Section 6.3.3 of the SAR, the applicant described the GEMER computer code. This code was used to perform criticality safety evaluations for the Model No. RAJ-II package with contents of either loose UC or PWR UO_2 rods in 5-inch stainless steel pipe containers. The GEMER code is a Monte Carlo method based criticality analysis computer code that uses continuous energy library with explicit treatment of resolved resonance cross sections. The cross sections used in GEMER are obtained by collapsing the ENDF/B-IV into 190 groups. The cross sections in the resonance ranges are converted into resonance parameters of resonance kernels. The resonance cross sections in the Monte Carlo sampling are computed from the resonance kernels rather than from the broad group cross sections.

In Section 6.10.2 of the SAR, the applicant performed code bias analyses for the GEMER code. The GEMER code was validated against experiments that have uranium form, chemical composition, and moderator/reflection conditions similar to those of the application. For low-enriched UO_2 lattice systems without poison, the calculational bias and bias uncertainty of GEMER code were provided in Reference No. 13 of the SAR.

In order to demonstrate that ENDF/B-IV data could be used for criticality evaluations and have results with acceptable accuracy for this specific application, the applicant provided a comparison of the k_{eff} values calculated with the MCNP5 code using the ENDF/B-VII cross section library and the k_{eff} values calculated with the GEMER code using the ENDF/B-IV cross section library for eight benchmark experiments from the "International Handbook of Evaluated Criticality Safety Benchmark Experiments." The results show that the GEMER code produces a systematic under-prediction of the k_{eff}. A larger bias of -0.0132 was used in calculation of the k_{safe} value for a larger criticality safety margin.

In addition, the applicant provided details of its evaluation of the loose rod package and the Area of Applicability (AOA) for the benchmark experiments in Reference No. 13 of the SAR. The applicant explained in Reference No. 13 that the criticality model uses a free gas model for the UC fuel and an extra safety margin of 0.01 was added to account for unknown uncertainty because of lack of benchmark experiment data. The staff has determined based on the information presented in Reference No. 13 and the additional details provided by the applicant about the AOA for uranium carbide (UC) fuel. The staff concluded that benchmarks are valid and using free gas model for the UC fuel is acceptable.

The maximum U-235 enrichment of either a loose UC or PWR UO_2 fuel rod is 5%. The table below provides the maximum number of fuel rods per the 5-inch stainless steel pipe for different fuel types.

Maximum allowable numbers of fuel rods per 5-inch SS pipe in the RAJ-II package

Fuel Name	Fuel Assembly Size	Maximum Number of Fuel Rods Per 5-inch Pipe
GNF	10 X 10	30
GNF	9 X 9	26
GNF	8 X 8	22

Based on the applicant's analysis packages with the 8x8 GNF type fuel assembly exhibited the maximum k_{eff} peak in criticality versus fuel pin pitch. The results of the applicant's evaluation of the UC and UO_2 PWR rods in the 5-inch stainless steel pipe containers demonstrated that the above limits are also applicable to these new fuel types. The parameters for UC rods are the CANDU-14, CANDU-25, CANDU UC fuels, and the generic UO_2 PWR rods as listed in Table 6-2 of the SAR. Also, the applicant evaluated 8x1x8 and 6x2x4 arrays of packages of the UC and UO_2 PWR rods in the 5-inch stainless steel pipe containers assumed damaged and flooded with water. The results of the applicant's evaluation showed that the maximum k_{eff} ($k_{eff} + 2\sigma$) is 0.91310 for the 8x1x8 array and 0.83505 for the 6x2x4 array for the CANDU-25 (UC) rod packages.

The staff has evaluated GNF's amendment request and performed confirmatory analyses of the various package loading configurations. Based on this evaluation the staff determined that GNF has demonstrated that the Model No. RAJ-II package would continue to meet the criticality safety requirements of 10 CFR Part 71 with contents of either loose UC or PWR UO_2 rods in 5-inch stainless steel pipe containers.

CONCLUSION

CoC No. 9309 has been revised as follows:

1. Condition 5.(b)(1), Table 4 was revised to include loose UC or PWR UO_2 rods in 5-inch stainless steel pipe containers as approved contents.

Table 4: Fuel Rod Parameters

Parameter	**Units**	**Type**					
Fuel Assembly Type		8x8 [(1)] (UO_2)	9x9 [(1)] (UO_2)	10x10 [(1)] (UO_2)	CANDU-14 (UC)	CANDU-25 (UC)	Generic PWR (UO_2)
UO_2 or UC Fuel Density		<98% theoretical	<98% theoretical	<98% theoretical	<98% theoretical	<98% theoretical	<98% theoretical
Fuel rod OD	cm	≥1.10	≥1.02	≥1.00	≥1.340	≥0.996	≥1.118
Fuel Pellet OD	cm	≤1.05	≤0.96	≤0.90	≤1.254	≤0.950	≤0.98
Cladding Type		Zirc. Alloy	Zirc. Alloy	Zirc. Alloy	Zirc. Alloy or SS	Zirc. Alloy or SS	Zirc. Alloy or SS
Cladding ID	cm	≤1.10	≤1.02	≤1.00	≤1.267	≤0.951	≤1.004
Cladding Thickness	cm	≥0.038	≥0.036	≥0.038	≥0.033	≥0.033	≥0.033
Active fuel Length	cm	≤381	≤381	≤385	≤47.752	≤40.013	≤450
Maximum U-235 Pellet Enrichment	wt.%	≤5.0	≤5.0	≤5.0	≤5.0	≤5.0	≤5.0
Maximum Average fuel rod Enrichment	wt.%	≤5.0	≤5.0	≤5.0	≤5.0	≤5.0	≤5.0
Loose Rod Configuration							
Freely Loose		≤25	≤25	≤25	N/A	N/A	N/A
Packed in 5" SS Pipe or Protective Case [(3)]		≤22	≤26	≤30	≤74 [(2)]	≤130 [(2)]	≤105 [(2)]
Strapped Together		≤25	≤25	≤25	N/A	N/A	N/A

[(1)] Previous analysis (Ref. 1) based on most conservative loose rod configuration (i.e., no credit taken for 5" SS pipe)
[(2)] Including partial rods (in reality, apply dense packing of congruent rods in the pipe) and only in 5" SS pipes
[(3)] Protective case consists of SS box with lid

2. Condition 5.(c) was revised to include a CSI for shipment of either loose UC or PWR UO_2 rods in 5-inch stainless steel pipe containers.

5.(c) Criticality Safety Index, except for contents described in 5(b)(1)(v) and limited in 5(b)(2)(ii) 1.0

Criticality Safety Index for contents described in 5(b)(1)(v) and limited in 5(b)(2)(ii) 2.1

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

Issued with Certificate of Compliance No. 9309,
Revision No. 7, on May 28, 2008.