July 15, 2008

Mr. Anthony Patko
Director, Licensing
Engineering
NAC International
3930 East Jones Bridge Road, Suite 200
Norcross, GA 30092

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF THE CERTIFICATE OF COMPLIANCE NO. 9225, REVISION FOR THE MODEL NO. NAC-LWT PACKAGE

Dear Mr. Patko:

By letter dated January 25, 2008, NAC International submitted an amendment request to the U.S. Nuclear Regulatory Commission for Certificate of Compliance No. 9225. You requested MOX research reactor fuel as authorized contents for this package.

In connection with our review, we need the information identified in the enclosure to this letter. Additional information requested by this letter should be submitted in the form of revised Safety Analysis Report pages. To assist us in scheduling staff review of your response, we request that you provide this information by August 31, 2008. If you are unable to provide a response by that date, our review may be delayed.

Please reference Docket No. 71-9225 and TAC No. L24181 in future correspondence related to this request. The staff is available to meet to discuss your proposed responses. If you have any questions regarding this matter, I may be contacted at (301) 492-3339.

Sincerely,

/RA/

Kimberly J. Hardin, Senior Project Manager
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9225
TAC No. L24181

Enclosure: Request for Additional Information

Mr. Anthony Patko
Director, Licensing
Engineering
NAC International
3930 East Jones Bridge Road, Suite 200
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Request for Additional Information
NAC International
Docket No. 71-9225
Certificate of Compliance No. 9225
Model No. NAC-LWT Package

By application dated January 25, 2008, NAC International (the applicant) requested an amendment to Certificate of Compliance (CoC) No. 9225 for the Model No. NAC-LWT package. The applicant requested to incorporate up to 16 irradiated PWR mixed oxide (MOX) fuel rods and UO_2 fuel rods. The existing safety analysis report (SAR) and NAC License Drawings were revised to reflect inclusion of these additional contents.

This request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission staff in connection with its review of the application. The requested information is listed by chapter number and title in the applicant's Safety Analysis Report (SAR). NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and NUREG-1609, Supplement 1, "Standard Review Plan for Transportation Packages for MOX-Radioactive Material," were used by the staff in its review of the application.

Each individual RAI describes information needed by the staff for it to complete its review of the application and to determine whether the applicant has demonstrated compliance with regulatory requirements.

Editorial Review

0-1 Provide editorial changes or clarifications on the following items.

1. Page 1-1: The two bullet items (at the bottom of the page) that are marked with revision bars do not seem to be relevant to the current revision. Provide correction or explanation.

2. Page 5.1.1-1: The bullet item "up to 25 PWR or BWR UO_2 high burnup (up to 80,000 MWd/MTU) rods" which is marked with a revision bar does not seem to be relevant to this amendment request. Provide an explanation and necessary analyses if needed.

3. Page 5.1.1-1: The statement "The 25 high burnup PWR and BWR rods may be transported in three configurations: …" which is marked with a revision bar seems also to indicate that this amendment is seeking approval of 25 high burnup PWR or BWR rods packages. Clarify if this amendment is seeking approval to transport 25 high burnup PWR and BWR rods per package design.

4. Page 6-1: Add the CSI value to the package contents that includes the PWR MOX spent fuel rods package.

This information is needed pursuant to the requirements of 10 CFR 71.33.

Chapter 1 General Information Review

1-1 Provide Transport Index (TI) values in the SAR for the package of the PWR MOX spent fuel rods, the package of the mixed PWR MOX and UO_2 spent fuel rods, and up to 9 depleted burnable poison rods in the PWR MOX spent fuel package.

Chapter 1 of the SAR must include information on the TIs of all proposed PWR MOX spent fuel with/without depleted burnable poison rods packages. The revised SAR, however, does not contain this piece of information for the proposed packages.

This information is needed pursuant to the requirements of 10 CFR 71.33.

Chapter 3 Thermal Review

3-1 Delete the second sentence reference in Section 3.4.1.7 to the BWR decay heat of 2.1 kW as being "per rod," since it is actually the total BWR heat loading.

10 CFR 71.7 requires that "information provided to the Commission by a licensee, certificate holder, or an applicant for a license or CoC…….must be complete and accurate in all material respects."

3-2 Specify the allowable component temperatures that are mentioned in Section 3.4.1.15, which refers to Table 3.4-10 for normal conditions of transport (NCT). Additionally, specify the allowable temperatures that are mentioned in Section 3.5.3.15, which refers to Table 3.5.3.5 for hypothetical accident conditions (HAC).

These sections should clearly identify the NCT and HAC allowable temperatures for the important to safety components of the O-ring seals (including identification as to which seals are being used), the lead gamma shield, the ethylene glycol & water neutron shield (noting that it is assumed to fail for HAC and is not required to be met for that condition), and any other vital component temperatures (e.g., fuel cladding) for the NAC-LWT transportation package. Section 3.3, "Technical Specifications of Components," lists the safe operating range of the aforementioned components important to safety, but does not discuss the cladding allowable temperature limit.

10 CFR 71.7 requires that "information provided to the Commission by a licensee, certificate holder, or an applicant for a license or CoC…….must be complete and accurate in all material respects."

Chapter 5 Shielding Review

5-1 Provide justification that the SAS2H sequence of SCALE-5.0 is valid for calculating the source terms of the PWR MOX spent fuel with burnup up to 70 GWd/MTHM.

On page 5.3.18-1 of the SAR, the applicant states: "Source terms are generated based on a limiting description of PWR rods using the SCALE 5.0 SAS2H code. The limiting description of a PWR MOX rod bounds MOX rods from all PWR assembly array sizes."

Based on various publications, the SAS2H sequence of the SCALE-5.0 code is neither benchmarked nor validated for MOX fuel with burnup greater than 20 GWd/MTHM. Using this code to determine the source terms of spent MOX fuel, therefore, may not be acceptable because of lack of knowledge in the extended burnup range. The applicant is requested to provide justification for using this code beyond its validated range.

This information is needed pursuant to the requirements of 10 CFR 71.47 and 71.51.

5-2 Pertinent to the limiting MOX fuel assembly as described in Section 5.3.18.1, the following information is requested:

1. Clarify if there are any water holes or tubes in the MOX fuel assembly.

2. If yes, provide information on the number of water holes, number of tubes, and number of instrument tube(s) for the fuel assembly that was used in SAS2H depletion calculations.

3. If there are holes and tubes in the assembly modeled in the source term calculation, provide justification on why these tubes were not included in the model.

4. If the answer to item 1 is yes, redo the source term and shielding analyses for the PWR MOX spent fuel package because the calculation model provided in Figure 5.3.18-1 does not include any tubes or water holes. Consequently, the source term calculation may have produced erroneous results.

On page 5.3.18-1 of the SAR, the applicant described the limiting PWR MOX fuel assembly used as the design basis for shielding analyses of the package. However, the SAR provides no information on the number of water holes and/or the number of tubes in the fuel assembly. The SAS2H model presented in Figure 5.3.18-5 does not include any water holes or tubes. If there is indeed no water hole or tube in the assembly, the 176 rods simply cannot make up a square pitch assembly. Consequently, the source term calculations may have produced erroneous results.

This information is needed pursuant to the requirements of 10 CFR 71.47 and 71.51.

5-3 Pertinent to the spent fuel source terms versus the burnup equation:

1. Prove that the equation is valid for spent MOX fuel.

2. Provide justification that 1.0 for gamma and 4.22 for neutron are adequate values for parameter b for PWR MOX spent fuels.

On page 5.3.18-2 of the SAR, the applicant introduces an equation to relate the gamma and neutron source terms to the assembly burnup. However, it is not clear how these values are obtained. The staff's understanding is that this equation and these two

values are derived via regression analyses from data consisting of UO_2 spent fuel assemblies only. The data set does not include any MOX spent fuel. Hence, this equation and these values, 1.0 for gamma and 4.22 for neutron, may not be adequate for the PWR MOX spent fuels because of the vast differences between the nuclear characteristics of UO_2 fuel and MOX spent fuel. The applicant is requested to prove that this equation is still valid and the selected values for parameter b are adequate for the MOX spent fuel.

This information is needed pursuant to the requirements of 10 CFR 71.47 and 71.51.

5-4 Pertinent to the shielding analyses:

1. Provide justification for the conclusion that a tight array of load as assumed in the model produces conservative shielding evaluation results.

2. Provide a cask shielding analysis with source term loaded in the outer layer 16 cells of the 5 x 5 lattice.

On page 5.3.18-3 of the SAR, the applicant states: "The fuel rod lattice ([a] 5 x 5 array of tubes containing up to 16 fuel rods) detail is conservatively omitted in the model." The review of the sample input file seems to indicate that the model has a homogenized fuel region that is equivalent to the total area of a 4 x 4 array of fuel tubes in the insert. This indicates that the fuel rods were homogenized into the actual volume of 4 x 4 tubes. The assumption that all rods were loaded in a tight lattice rather than loaded in the outer layer 16 cells of the 25 tube array may not produce conservative results because the model may have overestimated the shielding effect caused by shadowing among the rods in the array.

This information is needed pursuant to the requirements of 10 CFR 71.47 and 71.51.

5-5 Pertinent to the MOX fuel package shielding model:

1. Provide details on how the mixed MOX and UO_2 spent fuel rods are homogenized in the Monte Carlo shielding analysis model and provide justification on why this simplification produces reliable shielding results.

2. Provide a sample input file for the MOX spent fuel source evaluation model.

3. Provide a sample input file for the mixed MOX and UO_2 fuel transportation package shielding evaluation model.

4. Provide the input file of the model that produced the results presented in Table 5.3.18-14 and Table 5.3.18-15.

On page 5.3.18-3 of the SAR, the applicant states: "The combination of 16 fuel rods, either UO_2 or MOX fissile material based, are loaded into a 5 x 5 tube array insert constructed from stainless steel. … The 16 rods are homogenized within the cross

sectional area of the canister spacer." It is not clear, however, how the rods with different material compositions are homogenized. The staff's review of the sample input file, Figure 5.3.18-5, "Sample MCNP Input File for PWR MOX Fuel (Response Method Benchmark Case)" found that the composition of material with material ID card 1 is for pure UO_2 fuel rather than MOX fuel as the title of the figure indicates. It is not clear which model produced the results presented in Table 5.3.18-14 and Table 5.3.18-15.

This information is needed pursuant to the requirements of 10 CFR 71.47 and 71.51.

5-6 Pertinent to the response function method for dose rate calculation:

1. Provide where and how the response function was used to calculate the dose rates at the various points of interest with respect to the cask.

2. Provide justification that the response function is reliable and accurate for dose rate calculations for the MOX spent fuel transportation package.

3. Provide justification that the response function is reliable and accurate for dose rate calculations for the mixed UO_2 and MOX spent fuel transportation package.

4. Provide information on how many sets of response function data were used in determining the dose rates of the various points of interest in respect to the cask.

On page 5.3.18-4 of the SAR, the applicant states: "A sample input file is provided in Figure 5.3.18-5. The sample input provides a complete source description used in the response function benchmark analyses." As this approach completely decoupled the dependence of the particle transport to the material composition of the media that the particles traverse and interact with, the reliability and the accuracy of this approach can be assessed only on a case-by-case basis. It is especially true for MOX fuel because of the large cross sections of the fission, (n, 2n), (gamma, n), (n, gamma), and (n, alpha) reactions and the secondary radiation generated by these nuclear reactions.

Furthermore, the staff needs help to understand if the response function is trying to determine the dose rates at various points of interest by interpolation based on a pre-calculated data set. If so, the correctness of the selected interpolation scheme must be taken into account in the actual application.

This information is needed pursuant to the requirements of 10 CFR 71.47 and 71.51.

Chapter 6 Criticality Review

6-1 Provide geometry data and corresponding input file for the square pitch PWR MOX spent fuel package criticality model.

Appendix A of the SAR provides two output files for the hexagonal pitch lattice loading pattern of the PWR MOX spent fuel rod packages. However, Section 6.7.1.3 of the SAR indicates that 3.6 cm square pitch loading pattern is the most reactive configuration.

This information is needed pursuant to the requirements of 10 CFR 71.33.

6-2 For the mixed PWR MOX and UO_2 spent fuel package:

1. Provide criticality safety evaluations for both NCT and HAC scenario.
2. Provide the MCNP code benchmark evaluation.
3. Provide the upper safety limit (USL) evaluation.

On page 6.7.1-11 of the SAR, the applicant states: “Evaluations of a mixed shipment of enriched UO_2 rods and MOX rods are not required, as the reactivity of the evaluated MOX rods are significantly higher than those of the UO_2 rods. Mixed shipments are, therefore, permitted.”

The staff reviewed this discussion regarding the acceptability of the mixed MOX and UO_2 fuel rods and found it not adequate for the following reasons:

1. The UO_2 and the MOX fuel system behave very differently because these two systems have significantly different energies of average lethargy causing fission (EALCFs). In addition, the UO_2 system has a lower EALCF under the flooded condition in comparison with that of a MOX system. On the other hand, the UO_2 system has a higher EALCF under dry conditions in comparison with that of a MOX system. As such, the behavior of the mixed UO_2 and MOX system is not clear.

2. The computer code the applicant used has never been benchmarked for fission systems of enriched UO_2 and MOX fuel. The reliability and accuracy of the results are not assessable.

This information is needed pursuant to the requirements of 10 CFR 71.55, 71.59, 71.71, and 71.73.

Chapter 7 Operating Procedures Review

7-1 Provide information on how to identify the cooling time of the fuel rods and add this information to the operating procedure as it is applicable.

On page 7.1-53 of the SAR, operating procedure number 17 requires the operators to verify that the fuel rods and burnable poison rods comply with the content type, form, and quality conditions of the CoC. The procedure, however, does not include verification of the cooling time or radiation level of the rods as a parameter. Because this parameter is very critical to shielding safety, it should be added as a requirement.

This information is needed pursuant to the requirements of 10 CFR 71.47 and 71.51.