AREVA

February 1, 2017
E-47060

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

Subject: Application for Revision 8 to Certificate of Compliance No. 9302 for the Model No. NUHOMS®-MP197 Packaging, Request for Additional Information, Docket No. 71-9302, TAC Number L25139.

References: [1] Letter dated December 14, 2016 from Pierre Saverot, NRC, to Glenn Mathues, TN Americas LLC, Request for Additional Information for Review of the Model No. NUHOMS MP-197 Package.

[2] Letter E-46110, August 31, 2016, Submittal of Specific Consolidated NUHOMS®-MP197 Transportation Package Safety Analysis Report Chapters, Revision 17A, Docket No. 71-9302.

[3] Letter E-45091, August 16, 2016, Application for Revision 8 to Certificate of Compliance No. 9302 for the Model No. NUHOMS®-MP197 Packaging, Docket No. 71-9302.

This submittal provides responses to the request for additional information (RAI) forwarded by the NRC letter [1] referenced above.

This submittal contains the following enclosures:

- Enclosure 1 provides each RAI followed by a TN Americas LLC response. This enclosure is proprietary.
- Enclosure 2 provides the public version of the Enclosure 1 RAI responses. This enclosure is non-proprietary.
- Enclosure 3 provides a revised copy of the NUHOMS®-MP197 Transportation Package SAR, Revision 17B affected appendix and chapters, specifically Appendix A.1.4.9, Chapter A.5, and Chapter A.7, resulting from the changes described in Enclosure 1. This enclosure is proprietary.
- Enclosure 4 provides a public version of the Enclosure 3 revised copy of the NUHOMS®-MP197 Transportation Package SAR, Revision 17B affected appendix and chapters. This enclosure is non-proprietary.
- Enclosure 5 provides an affidavit, in accordance with 10 CFR 2.390, specifically requesting that proprietary information included in Enclosures 1 and 3 of this submittal be withheld from public disclosure. That information may not be used for any purpose other than to support the review of the application for revision to the NUHOMS®-MP197 CoC.

NMSS01

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The changed areas in the SAR are marked as follows:

- New or changed pages show "Revision 17B" in the header.
- Changed areas are indicated using revision bars in the right-hand margin. Newly inserted text is shown in italics, and is gray-shaded to distinguish it from the changes proposed in Revision 17A of the application.

TN Americas LLC respectfully requests that the NRC provide notification upon completion of the safety review, including the determination that no additional information is required for issuance of the CoC. This is to enable the prompt submittal of a consolidated Revision 18 to the NUHOMS®-MP197 SAR (both the proprietary and the non-proprietary versions), which will include all the changes that were completed during this application for revision.

Should the NRC staff have any questions or require additional information to support the review of this application, please contact Mr. Glenn Mathues by telephone at 410-910-6538, or by e-mail at Glenn.Mathues@areva.com.

Sincerely,

Gregory T. Vesey
President
TN Americas LLC

cc: Pierre M. Saverot (NRC SFM) as follows:

- One paper copy of this transmittal letter
- One electronic copy of this transmittal letter and Enclosures 1, 3, and 5 on one DVD

Enclosures:

1. RAI Responses (Proprietary)
2. RAI Responses (Non-Proprietary)
3. NUHOMS®-MP197 Transportation Package Safety Analysis Report, Revision 17B Appendix A.1.4.9, Chapter A.5, and Chapter A.7 (Proprietary)
4. NUHOMS®-MP197 Transportation Package Safety Analysis Report, Revision 17B Appendix A.1.4.9, Chapter A.5, and Chapter A.7 (Non-Proprietary)
5. Affidavit Pursuant to 10 CFR 2.390

AREVA

E-47060:

Application for Revision 8 to Certificate of Compliance No. 9302 for the Model No. NUHOMS®-MP197 Packaging, Request for Additional Information, Docket No. 71-9302, TAC Number L25139

Revision 17B

February 2017

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Enclosure 2 to E-47060

RAI Responses
(Non-Proprietary)

CHAPTER 5 – Shielding Evaluation

RAI 5-1

Justify the adequacy of the TRITON/ORIGEN-ARP code for calculating the source terms and decay heat for spent fuel with a burnup of 70 GWd/MTU or use additional safety margins to account for the uncertainty of the fuel depletion beyond the burnup range that the code has been benchmarked for.

The applicant used the TRITON/ORIG EN-ARP code for calculating the source terms and decay heat for the spent fuel to be shipped in the Model No. NUHOMS MP-197 package. The applicant provided benchmark analyses for the code with some RCA measurement data.

However, the staff notes that there is limited RCA data in the 70 GWd/MTU burn up range and that these isotopes are mostly important to burnup credit. Although benchmarking the code using these isotopes may produce a general sense on how good the code is for performing depletion analyses, these isotopes are not ideal for benchmarking a code for source term and decay heat calculations.

Source term and decay heat calculations focus on different set of isotopes. NUREG/CR-6700 provides a clear delineation on those spent fuel isotopes that are important to criticality, shielding, and decay heat. As such, the benchmarking analysis may not be adequate for source term calculations for fuel at this burnup.

The applicant needs to provide a justification for the adequacy of the TRITON/ORIGEN-ARP code for calculating both the source terms and decay heat for spent fuel at a burnup of 70 GWd/MTU or, alternatively, use additional safety margins to account for the uncertainty of the depletion calculation beyond the burnup range that the code has been benchmarked for.

The staff needs this information to determine if the Model No. NUHOMS MP-197 package, containing 70 GWd/MTU burnup fuel, meets the regulatory requirements of 10 CFR 71.47(b) and 71.51(a).

Response to RAI 5-1

Decay heat and source terms in CoC 9302 MP197HB SAR Chapter A.5 are calculated using SCALE computer code system and the two-dimensional (2-D) depletion sequence module, TRITON/T-DEPL with ENDF/B-V cross-section library, and ORIGEN-ARP.

The TRITON/T-DEPL sequence of SCALE is validated, in Section A.5.4.1.1.3 of MP197HB SAR Chapter A.5, using publicly available experiment data from: NUREG/CR-6968 for low-burnup fuels, and NUREG/CR-7012 and NUREG/CR-7013 for high-burnup fuels.

[

]

The paragraph below has been added to SAR Section A.5.4.1.1.3:

[

]

The paragraphs and table below related to the NUREG/CR-6700 review of the radionuclides important to high-burnup decay heat and radiation sources calculation have been added to SAR Section A.5.4.1.1.3:

"NUREG/CR-6700 identifies the nuclide characteristics associated with high-burnup fuels greater than 45 GWd/MTU up to 70 GWd/MTU. In particular, NUREG/CR-6700 presents the rankings of the nuclides important for decay heat and radiation sources calculation for shielding analysis.

Section 4.1 of NUREG/CR-6700 identifies that approximately 90% of the decay heat from a 5 wt% - 70 GWd/MTU fuel assembly, after five years cooling time, is due to Cs-134, Ba-137m, Y-90, Cm-244 (ranging from an 18% down to a 16% contribution for each of these isotopes) and Pu-238, Rh-106, Cs-137 and Sr-90 (from about 8% down to less than 4% contribution for each of these isotopes). Note that Ba-137m and Y-90 are decay products of Cs-137 and Sr-90, respectively. For a 5 wt% - 70 GWd/MTU fuel assembly at 100 years cooling time, 90% of the decay heat is due to Am-241 (31%), Pu-238 (28%), Ba-137m/Cs-137 (17%) and Y-90/Sr-90 (14%).

Section 5 of NUREG/CR-6700 provides fractional contributions of individual radionuclides to the radiation dose rates from three different transport/storage designs: carbon steel transport cask, lead transfer cask, and concrete storage cask. The contributions of dominant radionuclides to dose rates for the three designs considering 5 wt% - 70 GWd/MTU BWR fuels at five years and 100 years cooling time are summarized below. The shielding rankings shown are from Table 12 of NUREG/CR-6700.

Shielding Rankings for Dominant Radionuclides - BWR Fuel

	5 wt% - 70 GWd/MTU BWR Fuel		
	Carbon Steel Design	Lead Design	Concrete Design
	Five Years Cooling Time		
Ba-137m	2.7%	(1)	11.6%
Cm-244	43.9%	45.8%	10.9%
Cs-134	19.1%	18.7%	34.9%
Co-60	10.7%	12.5%	15.1%
Eu-154	8.1%	8.2%	13.5%
Pr-144	6.1%	5.5%	5.4%
Rh-106	6.0%	5.6%	6.4%
total	96.6%	96.3%	97.8%
	100 Years Cooling Time		
Am-241	3.8%	4.8%	(1)
Ba-137m	12.2%	(1)	66.7%
Cm-244	46.2%	51.7%	14.8%
Cm-246	25.0%	28.0%	8.1%
Pu-238	4.0%	4.9%	(1)
Pu-240	3.0%	3.4%	(1)
Pu-242	1.6%	1.8%	(1)
Y-90	3.0%	3.3%	5.8%
total	98.8%	97.9%	95.4%

(1) Not reported here (contribution less than 1.5%)

> Note that one of the major shifts in nuclide importance associated with high-burnup fuel is the increase in contribution of Cm-244 to decay heat and shielding radiation.
>
> The review of NUREG/CR-6700 suggests that an experimental database encompassing the following radionuclides would be appropriate for validating a computer code employed for high-burnup decay heat and radiation source calculations: Cm-244, Cm-246, Cs-134, Co-60, Eu-154, Pr-144/Ce-144, Rh-106/Ru-106, Ba-137m/Cs-137, Y-90/Sr-90, Pu-238, Pu-240, and Am-241."

The SCALE/TRITON benchmark documentation includes radiochemical assay data from two international programs ARIANE and REBUS for pressurized water reactor (PWR) fuels encompassing high-burnup fuel up to 60 GWd/MTU, NUREG/CR-6969. The computational benchmark is performed with TRITON with ENDF/B-V cross-section library and ORIGEN-S. Overall, the analyses show that the important contributors to decay heat and radiation sources calculation are fairly well-predicted: Am-241, Cm-244, Cs-137 are within a 5-6% range (Am-241 is about a 29% range with REBUS), Eu-154 (over-predicted) and Cs-134 (under-predicted) are within an 8-9% range, while plutonium isotopes, such as Pu-238, Pu-240 and Pu-242, are within a 5% range compared to measurements.

Furthermore, NUREG/CR-7162 documents the analysis of experimental radiochemical assay data from modern boiling water reactor (BWR) assemblies: MALIBU program providing measured isotopic data from SVEA-96 (10×10) Optima fuel assembly with burnups between 59 and 63 GWd/MTU, and ENUSA program providing measured isotopic data from GE14 (10×10) fuel assembly with burnups up to 56 GWd/MTU. The computational benchmark is performed with the TRITON and ENDF/B-VII cross-section library. Overall, the results are very similar to those in NUREG/CR-6969 with the exception of Cs-134, which is over-predicted by 10% for the MALIBU assay data, and under-predicted by 10% for the ENUSA assay data. Note that Cs-137 is well-predicted.

ARIANE, REBUS, and MALIBU are internationally sponsored programs designed to provide very high-quality evaluated isotopic measurement data for computer code validation.

Furthermore, "Analysis of isotopic assay data from the MALIBU program," an ORNL paper for the International Conference on Reactor Physics, Switzerland, 2009, presents the isotopic analysis of two fuel segments at 47 and 68 GWd/MTU. The computational analysis of the measurements is performed with TRITON and ENDF/B-V cross-section library. Overall, the results are consistent with results obtained from other evaluations with Am-241, Cm-244, Eu-154 within 10% range, and Cs-134 slightly above 10%; Cs-137 and Sr-90 are well-predicted as well as plutonium isotopes relevant to decay heat and radiation sources calculation, except for Pu-238, which is under predicted by 10%.

Finally, NUREG/CR-7012 compiles various NUREGs, including those mentioned above, that document comparisons of experimental data to calculated isotope compositions based on the TRITON sequence of SCALE for low and high-burnup fuels. NUREG/CR-7012 observes that: "the calculated isotopic results are generally found to be within the range of the experimental data for many important isotopes in spent fuel and the calculation bias does not depend to any significant extent on the burnup of the samples, and there are no significant trends observed for very high-burnup fuel."

In summary, Chapter A.5 provides adequate TRITON/ORIGEN-ARP benchmarks for calculating the source terms and decay heat of spent fuel with burnup up to 70 GWd/MTU. The benchmarking is based on experimental data presented in various NUREGs. The experimental data cover both the important-to-decay-heat and important-to-radiation isotopes at very high-burnup, up to 78.3 GWd/MTU. The resulting margins to the regulatory limits are shown to be substantial due to the method and the conservative depletion parameters employed for decay heat and dose rate calculations. Additionally, the conclusion in NUREG/CR-7012 is that the calculation bias and does not depend, to any significant extent, on the burnup of the samples, and there are no significant trends observed for very high-burnup fuel. As such, the TRITON/ORIGEN-ARP sequence is applicable to the high-burnup fuel analysis performed in SAR Chapter A.5 of CoC 9302 MP197HB Revision 8.

SAR Section A.5.4.1.1.3 has been revised to incorporate the ranking of the nuclides important for decay heat generation and radiation sources calculation and additional discussions on the adequacy of TRITON/ORIGEN-ARP for high-burnup fuel analysis. Section A.5.6 has been revised to include a new reference added as a result of the new content.

MP197 Impact:

SAR Sections A.5.4.1.1.3 and A.5.6 have been revised as described in the response

7.0 Operating Procedures

RAI 7-1

Revise the operating procedures to clearly instruct the user that the loading pattern, specified in Figures A.1.4.9-5a and A.5-24a, for aluminum dummy fuel assemblies and low burnup fuel assemblies, is required for loading the NUHOMS 69BTH Type F Dry Shielded Canister (DSC).

The applicant indicates in the SAR that the NUHOMS 69BTH Type F DSC requires a special loading pattern, as depicted in Figures A.1.4.9-5a and A.5-24a. Figure A.5-24a of the SAR also indicates that (i) some of the fuel cells must be loaded with dummy aluminum fuel assemblies, and (ii) some of the cells must be loaded with low burnup fuel. Therefore, it is imperative that the user of the package be aware of such requirements.

The staff notes also that these special requirements are not clearly stated in the operating procedures.

The applicant needs to revise the operating procedures to clearly instruct the user that the loading pattern, as specified in Figures A.1.4.9-5a and A.5-24a for aluminum dummy fuel assemblies and low burnup fuel assemblies, is required for loading the NUHOMS 69BTH Type F DSC.

The staff needs this information to determine if the Model No. NUHOMS MP-197 package, containing 70 GWd/MTU burnup fuel, meets the regulatory requirements of 10 CFR 71.47(b) and 71.51(a).

Response to RAI 7-1

As discussed in SAR Section 5.4.1.3.4, Figure A.5-24a illustrates one set of response function (RF) models from the calculation of the cooling times among several others. In the particular example shown on Figure A.5-24a, high-burnup reconfigured fuel is modeled in Zone 5, while intact fuel is modeled in Zones 1-4. In other cases (not shown on Figure A.5-24a), high-burnup reconfigured fuel is modeled inside a zone other than Zone 5, while the remaining zones are modeled with intact fuel inside.

As such, Figure A.5-24a was not intended to be utilized by the user as part of operating procedures. The operating procedures for the 69BTH DSC SAR, Chapter A.7 and Appendix A.7.7.9 (specifically Table A.7-2a) direct the user to Table A.1.4.9-1 to determine applicable fuel specifications for loading the 69BTH DSC.

More specifically, for Heat Loading Zone Configuration (HLZC) 8, Table A.1.4.9-1 refers the user to:

- Figure A.1.4.9-5a: indicates to the user which of the 69BTH DSC cells must be loaded with fuel (the instructions include the maximum authorized decay heat load for each cell), and which cells must be loaded with aluminum dummy assemblies, and

- Table A.1.4.9-5b: indicates to the user the acceptable combinations of burnup, enrichment and cooling times acceptable for loading in each zone of HLZC 8. Note that, although a Type F basket is required when using HLZC 8, HLZC 8 is not required when using a Type F basket. Other HLZCs (e.g., HLZCs 1, 2, 3 or 4) may be used with a Type F basket.

Therefore, the operating procedures currently indicated in the SAR, through the use of Table A.7-2a, alerts the user to all the requirements related to the use of HLZC 8.

Several changes have been made to the MP197HB SAR to provide clarity when loading the 69BTH Type F DSC:

- The titles of Tables A.1.4.9-4, A.1.4.9-5, and A.1.4.9-5a have been modified to include "For Heat Load Zoning Configurations 1, 2, 3 and 4" to clarify that these tables apply only to Heat Loading Zone Configurations 1, 2, 3, and 4.
- The title of Figure A.5-24a has been modified to say "NCT 69BTH DSC MCNP Response Function (RF) Model Case for Heat Load Zone Configuration No. 8 with High-Burnup Reconfigured Fuel in Zone 5" for clarification.
- The caption in Figure A.5-24a has been modified to read "Intact Fuel in Zones 1-4."
- Step A.7.1.1.12 has been corrected to include the Type F basket.
- Step A.7.1.1.13 has been revised to correct the table number from "Table A.7-2" to "Table A.7-2a."

MP197 Impact:

SAR Section A.7.1.1 has been revised as described in the response.

SAR Tables A.1.4.9-4, A.1.4.9-5, and A.1.4.9-5a have been revised as described in the response.

SAR Figure A.5-24a has been revised as described in the response.

AFFIDAVIT PURSUANT
TO 10 CFR 2.390

TN Americas LLC)
State of Maryland) SS.
County of Howard)

I, Gregory T. Vesey, depose and say that I am President of TN Americas LLC, duly authorized to execute this affidavit, and have reviewed or caused to have reviewed the information that is identified as proprietary and referenced in the paragraph immediately below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.390 of the Commission's regulations for withholding this information.

The information for which proprietary treatment is sought meets the provisions of paragraph (a) (4) of Section 2.390 of the Commission's regulations. The information is contained in Enclosures 1 and 3, as listed below:

- Enclosure 1 – Portions of the RAI Responses
- Enclosure 3 – Portions of Chapter A.5 and Chapter A.7 of the Safety Analysis Report (SAR) for the NUHOMS®-MP197 transportation packaging.

I have personal knowledge of the criteria and procedures utilized by TN Americas LLC in designating information as a trade secret, privileged or as confidential commercial or financial information.

Pursuant to the provisions of paragraph (b) (4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced document, should be withheld.

1) The information sought to be withheld from public disclosure involves portions of the Model NUHOMS®-MP197 transportation packaging SAR, related to the design of the Model NUHOMS®-MP197 transportation packaging, which are owned and have been held in confidence by TN Americas LLC.

2) The information is of a type customarily held in confidence by TN Americas LLC, and not customarily disclosed to the public. TN Americas LLC has a rational basis for determining the types of information customarily held in confidence by it.

3) Public disclosure of the information is likely to cause substantial harm to the competitive position of TN Americas LLC, because the information is related to the design and analysis of the Model NUHOMS®-MP197 transportation packaging, the application of which provides a competitive economic advantage. The availability of such information to competitors would enable them to modify their product to better compete with TN Americas LLC, take marketing or other actions to improve their product's position, or impair the position of TN Americas LLC's product, and avoid the development of similar data and analyses in support of their processes, methods, or apparatus.

Further the deponent sayeth not.

Gregory T. Vesey
President, TN Americas LLC

Subscribed and sworn before me this 1st day of February 2017.

Notary Public

My Commission Expires 10 / 16 / 19

RONDA JONES
NOTARY PUBLIC STATE OF MARYLAND
My Commission Expires October 16, 2019