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April 10, 2008

U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Attn: Document Control Desk

Subject: Submittal of NAC Response to NRC Request for Additional Information for the Review of the Certificate of Compliance No. 9225, Revision for the Model No. NAC-LWT Package to Add LEU TRIGA Fuel Clusters

Docket No. 71-9225 TAC No. L24175

Reference:
1. Safety Analysis Report (SAR) for the NAC Legal Weight Truck Cask, Revision 38, NAC International, November 2007
2. Model No. NAC-LWT Package, U.S. Nuclear Regulatory Commission (NRC) Certificate of Compliance (CoC) No. 9225, Revision 46, February 5, 2008
3. Submittal of a Request for an Amendment of Certificate of Compliance (CoC) No. 9225 for the NAC-LWT Cask to Incorporate TRIGA LEU Cluster Rods as Authorized Contents, NAC International, January 17, 2008
4. Submittal of a Supplement to an Amendment Request for Certificate of Compliance (CoC) No. 9225 for the NAC-LWT Cask to Incorporate TRIGA LEU Cluster Rods as Authorized Contents, NAC International, February 27, 2008
5. Request for Additional Information for Review of the Certificate of Compliance No. 9225, Revision for the Model No. NAC-LWT Package to Add TRIGA Fuel Clusters, NRC, April 4, 2008

NAC International (NAC) herewith submits its response to Reference 5 and the resulting Revision LWT-08C NAC-LWT SAR changed pages.

This submittal consists of eight copies of this transmittal letter, eight copies of the Reference 5 RAI questions with the NAC responses presented in standard NAC RAI response format, and eight copies of the Revision LWT-08C changed SAR sections for Reference 1, which incorporate the requested information. Consistent with NAC administrative practice, this proposed revision is numbered to uniquely identify the applicable changed pages, and revision bars mark the SAR text changes that are proposed. A List of Effective Pages is included for clarity. Upon final approval, the Revision LWT-08C pages will be reformatted, assigned the next appropriate revision number, and incorporated into the NAC-LWT SAR.

NMSS01

ED20080040

Approval of the LEU TRIGA cluster rod contents and their addition to the authorized contents of the Reference 2 CoC is critical to permit the transport of foreign research reactor (FRR) fuel in support of the U.S. Department of Energy's (DOE) National Nuclear Security Administration FRR fuel acceptance program. The DOE has scheduled the loading of LEU TRIGA cluster rods at a research reactor in Romania for later this spring. In order to meet the currently scheduled loading and transport dates, NAC requests approval of this amendment before April 30, 2008 to allow NAC to obtain a U.S. Department of Transportation Certificate of Competent Authority for the revised NRC CoC and to submit the revised licensing documents to the affected foreign competent authorities for revalidation in a timely manner. NAC has been proceeding with procurement of the revised TRIGA cluster rod inserts and sealed damaged fuel canisters at risk to support the loading and transport campaign schedule.

If you have any comments or questions, please contact me on my direct line at 678-328-1274.

Sincerely,

Anthony L. Patko

Anthony L. Patko
Director, Licensing
Engineering

Enclosures:
(1) NAC Response to US NRC RAI dated April 4, 2008
(2) NAC-LWT SAR, Revision LWT-08C Changed Pages dated April 2008

NAC INTERNATIONAL

RESPONSE TO THE

UNITED STATES
NUCLEAR REGULATORY COMMISSION

REQUEST FOR ADDITIONAL INFORMATION

APRIL 4, 2008

FOR REVIEW OF THE CERTIFICATE OF COMPLIANCE NO. 9225, REVISION FOR THE MODEL NO. NAC-LWT PACKAGE TO ADD TRIGA FUEL CLUSTERS

(TAC NO. L24175, DOCKET NO. 71-9225)

APRIL 10, 2008

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CHAPTER 5 SHIELDING

5-1 Clarify why 19 wt% U-235 enrichment was used in the shielding evaluation instead of 20 wt%.

In Table 5.1.1-2 on page 5.1.1-12 of the SAR, the applicant indicates that the enrichment of the TRIGA LEU rod cluster elements is 19 wt%. The sample fuel depletion input file provided in the SAR also used 19 wt%. The data in Table 1.2-2 on page 1.2-36 of the SAR, however, indicates that the design basis enrichment for the LEU TRIGA rod cluster fuel is 20 wt%.

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

NAC International Response

Uranium oxide fuels, based on ^{235}U as the fissile isotope, produce increasing source terms with reduced enrichment due to the production of higher actinides primarily associated with the generation and depletion of plutonium (generated by neutron absorption in ^{238}U). This phenomenon is apparent in all uranium oxide depletion calculations. The shielding evaluations, therefore, employed 19 wt% ^{235}U as the basis for source generation, producing a bounding (conservative) source. Conversely, criticality evaluations are based on a maximum ^{235}U enrichment to minimize the amount of parasitic neutron absorption in ^{238}U in the fresh fuel analysis. Criticality evaluations are, therefore, based on 20 wt% ^{235}U fuel material. TRIGA cluster rod information is presented in Table 1.2-3 on page 1.2-37 and lists a maximum 19.9 to 93.3 wt% ^{235}U (for the LEU and HEU, respectively). The analyses in Chapter 5 and 6 are consistent and bound the design basis fuel information shown in Table 1.2-3. Note that Table 1.2-2 on page 1.2-36 referenced in the RAI contains data for TRIGA fuel elements, not TRIGA cluster rods.

The relative changes in heat load and radiation source produced by the 19 wt% enriched material compared to 20 wt% material are shown in Table 5.1-1 to Table 5.1-3 of this response. This information is provided to the NRC review staff as substantiation of the previous statement. However, as the use of minimum enrichment is a standard industry

NAC International Response to RAI 5-1 (cont'd)

practice and has repeatedly been accepted by the NRC, no changes to the SAR are made, except a clarification to Table 5.3.7-1, TRIGA Fuel Cluster Rod Parameters, adding a footnote to the enrichment line as follows: "Enrichments represent minimum values. Lower limit enrichments produce maximum source terms."

NAC International Response to RAI 5-1 (cont'd)

Table 5.1-1 Heat Load Comparison 19 wt% ^{235}U to 20 wt% ^{235}U (140 GWd/MTU – 5.3 Years Cooled – All Remaining SAS2H Parameters Constant)

	W/rod		
	19 wt% ^{235}U	20 wt% ^{235}U	Delta
Actinides	1.84E-01	1.75E-01	-5%
Fission Products	1.69E+00	1.68E+00	-1%
Total	1.87E+00	1.86E+00	-1%

NAC International Response to RAI 5-1 (cont'd)

Table 5.1-2 Gamma Source Comparison 19 wt% ^{235}U to 20 wt% ^{235}U
(140 GWd/MTU – 5.3 Years Cooled - All Remaining SAS2H Parameters Constant)

	Fuel Gamma			Hardware		
	g/s/rod			g/s/kg		
Group	19wt% ^{235}U	20 wt% ^{235}U	Delta	19wt% ^{235}U	20 wt% ^{235}U	Delta
1	8.40E+01	7.07E+01	-19%	0.00E-00	0.00E-00	--
2	3.96E+02	3.33E+02	-19%	0.00E-00	0.00E-00	--
3	2.02E+03	1.70E+03	-19%	0.00E-00	0.00E-00	--
4	5.03E+03	4.23E+03	-19%	0.00E-00	0.00E-00	--
5	5.93E+06	5.64E+06	-5%	1.00E-15	8.55E-16	-17%
6	4.90E+07	4.68E+07	-5%	4.36E+04	4.13E+04	-6%
7	2.40E+09	2.41E+09	0%	2.81E+07	2.66E+07	-6%
8	8.95E+08	8.75E+08	-2%	1.16E+02	1.15E+02	0%
9	3.97E+10	3.85E+10	-3%	1.18E+12	1.12E+12	-6%
10	1.81E+11	1.76E+11	-3%	4.19E+12	3.98E+12	-6%
11	5.33E+11	5.16E+11	-3%	2.35E+10	2.30E+10	-2%
12	4.45E+12	4.42E+12	-1%	4.96E+06	4.70E+06	-6%
13	1.09E+12	1.06E+12	-3%	1.43E+07	1.35E+07	-6%
14	1.16E+11	1.17E+11	0%	2.26E+08	2.14E+08	-6%
15	1.76E+11	1.77E+11	0%	1.72E+08	1.63E+08	-6%
16	6.28E+11	6.28E+11	0%	3.47E+09	3.28E+09	-6%
17	7.85E+11	7.89E+11	0%	1.44E+10	1.36E+10	-6%
18	2.71E+12	2.72E+12	0%	7.24E+10	6.86E+10	-6%
Total	1.07E+13	1.06E+13	-1%	5.49E+12	5.21E+12	-5%

NAC International Response to RAI 5-1 (cont'd)

Table 5.1-3 Neutron Source Comparison 19 wt% ^{235}U to 20 wt% ^{235}U (140 GWd/MTU – 5.3 Years Cooled - All Remaining SAS2H Parameters Constant)

	n/s/rod		
Group	**19wt% ^{235}U**	**20 wt% ^{235}U**	**Delta**
1	2.74E+03	2.30E+03	-19%
2	3.15E+04	2.66E+04	-18%
3	3.56E+04	3.02E+04	-18%
4	1.97E+04	1.67E+04	-18%
5	2.64E+04	2.23E+04	-19%
6	2.87E+04	2.42E+04	-19%
7	5.62E+03	4.73E+03	-19%
TOTAL	1.50E+05	1.27E+05	-18%

CHAPTER 5 SHIELDING

5-2 Clarify the exact value of the H/Zr ratio and correct the inconsistencies throughout the SAR for the LEU TRIGA rod cluster fuel.

On page 5.1.1-4 of the SAR, the applicant states that the TRIGA LEU rod cluster elements are modeled with an H/Zr ratio of 1.6. However, the data provided in Table 1.2-1 on page 1.2-35 gives the H/Zr ratio as 1.7.

This information is needed pursuant to the requirements of 10 CFR 71.47, 71.55, and 71.59.

NAC International Response

Table 1.2-3 on page 1.2-37 states that the maximum H/Zr design basis ratio is 1.7. As recognized by the RAI, page 5.1.1-4 of the SAR states: "Both elements are modeled with a nominal H to Zr ratio of 1.6." The key to this statement is "nominal." The value of 1.6 represents the nominal H to Zr ratio to which the rods are fabricated. As the criticality analysis is sensitive to this variable, Table 6.2.6-2 of the SAR contains 1.6 as the H to Zr ratio, with a footnote stating: "Specifications allow for a maximum H to Zr ratio of 1.7." The increase in ratio is specifically evaluated in the criticality chapter. The manufacturing tolerance on fuel internal moderator ratio is not expected to affect source evaluations significantly and was, therefore, not specifically addressed within the SAR. The primary effect of the H/Zr ratio increase is a slight increase in moderation, softening the spectrum with a corresponding minor decrease in source. Tables 5.2-1 through 5.2-3 of this response contain heat and source comparisons for the 19 wt% ^{235}U enriched 140 GWd/MTU case at H/Zr ratios of 1.6 and 1.7. As demonstrated by these results, there is a minor decrease in source for the increased H/Zr ratio.

To clarify Chapter 5, page 5.1.1-4 of the SAR is modified to state: "Both elements are modeled with a nominal H to Zr ratio of 1.6. A manufacturing tolerance produced H to Zr ratio of 1.7 is evaluated in Chapter 6 for criticality. The manufacturing tolerances have no significant effect on the shielding evaluations."

NAC International Response to RAI 5-2 (cont'd)

Table 5.2-1 Heat Load Comparison H/Zr = 1.6 to H/Zr = 1.7
(140 GWd/MTU – 5.3 Years Cooled – All Remaining SAS2H Parameters Constant)

	W/rod		
	H/Zr = 1.6	**H/Zr = 1.7**	**Delta**
Actinides	1.84E-01	1.80E-01	-2%
Fission Products	1.69E+00	1.68E+00	-1%
Total	1.87E+00	1.86E+00	-1%

NAC International Response to RAI 5-2 (cont'd)

**Table 5.2-2 Gamma Source Comparison H/Zr = 1.6 to H/Zr = 1.7
(140 GWd/MTU – 5.3 Years Cooled – All Remaining SAS2H Parameters Constant)**

	Fuel Gamma			Hardware		
	g/s/rod			g/s/kg		
Group	H/Zr = 1.6	H/Zr = 1.7	Delta	H/Zr = 1.7	H/Zr = 1.6	Delta
1	8.40E+01	8.16E+01	-3%	0.00E-00	0.00E-00	--
2	3.96E+02	3.85E+02	-3%	0.00E-00	0.00E-00	--
3	2.02E+03	1.96E+03	-3%	0.00E-00	0.00E-00	--
4	5.03E+03	4.89E+03	-3%	0.00E-00	0.00E-00	--
5	5.93E+06	5.91E+06	0%	1.00E-15	9.53E-16	-5%
6	4.90E+07	4.89E+07	0%	4.36E+04	4.34E+04	-1%
7	2.40E+09	2.40E+09	0%	2.81E+07	2.80E+07	-1%
8	8.95E+08	8.94E+08	0%	1.16E+02	1.14E+02	-1%
9	3.97E+10	3.93E+10	-1%	1.18E+12	1.18E+12	-1%
10	1.81E+11	1.79E+11	-1%	4.19E+12	4.17E+12	-1%
11	5.33E+11	5.28E+11	-1%	2.35E+10	2.31E+10	-2%
12	4.45E+12	4.44E+12	0%	4.96E+06	4.93E+06	-1%
13	1.09E+12	1.08E+12	-1%	1.43E+07	1.42E+07	-1%
14	1.16E+11	1.16E+11	0%	2.26E+08	2.25E+08	-1%
15	1.76E+11	1.76E+11	0%	1.72E+08	1.71E+08	-1%
16	6.28E+11	6.27E+11	0%	3.47E+09	3.45E+09	-1%
17	7.85E+11	7.85E+11	0%	1.44E+10	1.43E+10	-1%
18	2.71E+12	2.71E+12	0%	7.24E+10	7.20E+10	-1%
Total	1.07E+13	1.07E+13	0%	5.49E+12	5.46E+12	-1%

NAC International Response to RAI 5-2 (cont'd)

Table 5.2-3 Neutron Source Comparison H/Zr = 1.6 to H/Zr = 1.7
(140 GWd/MTU – 5.3 Years Cooled - All Remaining SAS2H Parameters Constant)

	n/s/rod		
Group	**H/Zr = 1.6**	**H/Zr = 1.7**	**Delta**
1	2.74E+03	2.66E+03	-3%
2	3.15E+04	3.06E+04	-3%
3	3.56E+04	3.46E+04	-3%
4	1.97E+04	1.92E+04	-3%
5	2.64E+04	2.57E+04	-3%
6	2.87E+04	2.79E+04	-3%
7	5.62E+03	5.46E+03	-3%
TOTAL	1.50E+05	1.46E+05	-3%

CHAPTER 5 SHIELDING

5-3 Provide the following information on the LEU TRIGA rod cluster spent fuel parameters:

1. Clarify what the decay heat, gamma source, and neutron source data are for in Table 5.1.1-3. Revise the SAR if there is any error in the data presented.
2. Provide gamma source and neutron source spectra and source data for the LEU TRIGA rod cluster with 140 GWd/MTU burnup with 90 days of cool time.

On page 5.1.1-14 of the SAR, the applicant provides nuclear and thermal source parameters for the TRIGA rod cluster payload. The note (number 7) to this line item, however, indicates that the data are for HEU fuel with 150 GWd/MTU burnup and 1.342 years of cool time. The vertical bar indicates that these changes are for the current revision. A clarification of how these changes affect the current request and the information relevant to the LEU TRIGA rod cluster need to be provided.

On page 5.3.7-7 of the SAR, the applicant provides gamma source and neutron source spectrum and source data for the LEU TRIGA rod cluster with 30 GWd/MTU burnup with 1.5 years of cool time. This is not the same payload as defined in Table 1.2-1 on page 1.2-35 or Table 5.1.1-1 on page 5.1.1-8 of the SAR.

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

<u>NAC International Response</u>

Prior to the current request, cluster rod data was not included in Table 5.1.1-3. A footnote, (7) in Revision 38 of the NAC-LWT SAR states: "TRIGA Fuel Elements are the bounding values used in dose determination for TRIGA cluster rods fuel type." NAC chose to update the table to include TRIGA cluster rod values. Per analysis in Section 5.3.7, in particular Tables 5.3.7-16 and 5.3.7-17, the HEU data is bounding and was, therefore, included in Table 5.1.1-3. As stated in footnote 7 of amendment request LWT-07G, the cluster rod data is for HEU fuel with 150 GWd/MTU burnup and 1.34 years cool time (cool time required to reach the 1.875 W heat load limit for the elements). The footnote also states that this source combination represents the "maximum dose rate burnup/cool time combination."

NAC International Response to RAI 5-3 (cont'd)

NAC noted a discrepancy in the TRIGA cluster rod data in Table 5.1.1-3 in that heat load was provided in the table on a per cask basis (1.875 W $\times$ 560 rods = 1.05 kW), while the remaining cluster rod data was provided on a per rod basis. To provide a link between Table 5.1.1-3 and the Section 5.3.7 source term tables (given on a per rod basis), the information in Table 5.1.1-3 was modified to a per rod basis with the appropriate payload description (TRIGA Cluster Rod rather than 560 TRIGA Cluster Rods). The decay heat was not changed to match the per rod value and will be changed as a response to this RAI to 1.875E-03 (as the heading is kW).

Table 5.1.1-3 is also modified to include LEU fuel data in addition to the HEU fuel information. The data is directly extracted from the bounding dose rate case documented in Section 5.3.7, Tables 5.3.7-5 and 5.3.7-6. The bounding dose rate case for the LEU fuel is 30 GWd/MTU and 1.5 years cool time.

The revised Table 5.1.1-3 lines and footnote are as follows:

HEU TRIGA Cluster Rod[7]	1.875E-03	1.12E+13	4.918E+01	N/A	N/A
LEU TRIGA Cluster Rod[7]	1.875E-03	1.11E+13	4.005E+02	N/A	N/A

7. Source term at TRIGA cluster rods maximum dose rate burnup/cool time combination. For HEU fuel, 150 GWd/MTU, 1.34 years cooled. For LEU fuel, 30 GWd/MTU, 1.5 years cooled. Gamma source includes source from activated inconel clad.

The NAC amendment is not requesting a 140 GWd/MTU burnup at 90 days cool time. The request justifies the ability of the NAC-LWT cask to transport 1.875 W TRIGA cluster rods (see Table 1.2-4 TRIGA Cluster Rod column, which contains a variable cool time definition that points to footnote 9 stating: "Minimum cool times … down to 90 days, are determined so that the maximum decay heat … any fuel cluster rod is $\leq$ 1.875 watts."). LEU rods may be loaded at a maximum burnup of 140 GWd/MTU. Per the dose summary shown in SAR Table 5.3.7-17, LEU TRIGA rods require 5.3 years prior to reaching a calculated heat load of 1.875 watts.

NAC International Response to RAI 5-3 (cont'd)

Reduced burnup rods require reduced cool time (for example, per Table 5.3.7-17, the 2 GWd/MTU fuel may be loaded at cool time of 117 days). A generic minimum cool time of 90 days is requested to assure that any short half-life nuclides (half life in hours or days such as 8 days for ^{131}I) are decayed to negligible proportions.

Maximum dose rates are produced by the 30 GWd/MTU 1.5-year cooled spectra presented in SAR Tables 5.3.7-5 and 5.3.7-6 for LEU TRIGA fuel cluster rods. To address the reviewer request for source information at the maximum burnup, SAR Tables 5.3.7-5 and 5.3.7-6 are also revised to include the maximum burnup (140 GWd/MTU) source at the 1.875 W heat load (5.3 years).

NAC International Response to RAI 5-3 (cont'd)

Table 5.3.7-5 Representative LEU TRIGA Fuel Cluster Rod Gamma Spectra

				30 GWd/M TU – 1.5 Years		140 GWd/MTU – 5.3 Years	
				Fuel Gamma	Hardware	Fuel Gamma	Hardware
Group	E_{min}	E_{max}	E_{av}	g/s/rod	g/s/kg	g/s/rod	g/s/kg
1	8.00E+00	1.00E+01	9.00E+00	1.6759E-01	0.0000E+00	8.3995E+01	0.0000E+00
2	6.50E+00	8.00E+00	7.25E+00	7.9334E-01	0.0000E+00	3.9568E+02	0.0000E+00
3	5.00E+00	6.50E+00	5.75E+00	4.0740E+00	0.0000E+00	2.0176E+03	0.0000E+00
4	4.00E+00	5.00E+00	4.50E+00	1.0234E+01	0.0000E+00	5.0286E+03	0.0000E+00
5	3.00E+00	4.00E+00	3.50E+00	1.9609E+07	3.5241E-18	5.9296E+06	1.0031E-15
6	2.50E+00	3.00E+00	2.75E+00	1.9278E+08	1.5442E+04	4.9029E+07	4.3586E+04
7	2.00E+00	2.50E+00	2.25E+00	4.4530E+10	9.9589E+06	2.4023E+09	2.8109E+07
8	1.66E+00	2.00E+00	1.83E+00	4.8799E+09	7.9346E+07	8.9544E+08	1.1584E+02
9	1.33E+00	1.66E+00	1.50E+00	3.5841E+10	4.1965E+11	3.9671E+10	1.1845E+12
10	1.00E+00	1.33E+00	1.17E+00	6.1250E+10	1.4860E+12	1.8088E+11	4.1943E+12
11	8.00E-01	1.00E+00	9.00E-01	1.5418E+11	2.7182E+11	5.3290E+11	2.3524E+10
12	6.00E-01	8.00E-01	7.00E-01	1.6820E+12	7.0347E+06	4.4478E+12	4.9556E+06
13	4.00E-01	6.00E-01	5.00E-01	4.4530E+10	5.1626E+09	1.0886E+12	1.4277E+07
14	3.00E-01	4.00E-01	3.50E-01	4.8799E+09	1.1079E+08	1.1637E+11	2.2578E+08
15	2.00E-01	3.00E-01	2.50E-01	3.5841E+10	1.0458E+08	1.7638E+11	1.7208E+08
16	1.00E-01	2.00E-01	1.50E-01	6.1250E+10	1.3677E+09	6.2780E+11	3.4656E+09
17	5.00E-02	1.00E-01	7.50E-02	1.5418E+11	5.2957E+09	7.8533E+11	1.4365E+10
18	1.00E-02	5.00E-02	3.00E-02	1.6820E+12	2.6174E+10	2.7120E+12	7.2383E+10
Total				1.0913E+13	2.2158E+12	1.0711E+13	5.4930E+12

NAC International Response to RAI 5-3 (cont'd)

Table 5.3.7-6 Representative LEU TRIGA Fuel Cluster Rod Neutron Spectrum

Group	E_{min}	E_{max}	E_{av}	30 GWd/M TU – 1.5 Years n/s/rod	140 GWd/MTU – 5.3 Years n/s/rod
1	6.43E+00	2.00E+01	1.32E+01	3.907E-01	2.738E+03
2	3.00E+00	6.43E+00	4.72E+00	1.025E+01	3.151E+04
3	1.85E+00	3.00E+00	2.43E+00	2.027E+01	3.559E+04
4	1.40E+00	1.85E+00	1.63E+00	6.741E+00	1.972E+04
5	9.00E-01	1.40E+00	1.15E+00	5.921E+00	2.644E+04
6	4.00E-01	9.00E-01	6.50E-01	4.708E+00	2.870E+04
7	1.00E-01	4.00E-01	2.50E-01	9.014E-01	5.616E+03
8-27				0	0
Total				4.918E+01	1.503E+05

CHAPTER 5 SHIELDING

5-4 In the calculations of the radiation source terms of the LEU TRIGA rod cluster spent fuel:

1. Provide core operating parameters such as, fuel and moderator temperature, power density, depletion time, and cool time.
2. Revise the source term calculations and update the results in the SAR for the LEU TRIGA rod cluster with 140 GWd/MTU burnup with 90 days of cool time.
3. Provide input file for source term determination of the LEU TRIGA rod cluster with 140 GWd/MTU burnup with 90 days of cool time.

No data, such as fuel and moderator temperature, power density, depletion time, and cooling time, that are critical for determining source terms, were provided in the SAR.

The application did not include the results of the source term evaluations nor the input file for the source term calculation for the LEU TRIGA rod cluster with 140 GWd/MTU burnup with 90 days of cool time.

This information is needed pursuant to the requirements of 10 CFR 71.33 and 71.47.

NAC International Response

Core power is listed in Section 5.3.7.1 as 14 MW for a typical core of 29 fuel assemblies with 25 rods per assembly. This yields a power of 0.0193 MW/rod, which is translated into the SAS2H input. Cool times for the sample burnup matrix are included in Table 5.3.7-16 and Table 5.3.7-17 (HEU and LEU cases, respectively) to reach the 1.875 W per rod limit.

Section 5.3.7.1 is modified to include the relevant depletion parameters requested. In particular, a fuel and clad temperature of 517K, and a moderator temperature of 363K (unpressurized nonboiling reactor), at a density of 0.981 g/cm^3 are included in the text section. Also included are sample SAS2H input files for the maximum burnup HEU and LEU cases.

NAC International Response to RAI 5-4 (cont'd)

As noted in the Section 5.7.3 analysis description, source terms at various burnup levels are calculated (for LEU material between 2 GWd/MTU and 140 GWd/MTU) and, therefore, require various depletion times. Since they are simple arithmetic adjustments of the data provided in the sample input, no further depletion time detail is provided as part of this response.

As noted in the response to RAI 5-2, this application does not request a 140 GWd/MTU fuel rod at a 90-day cool time; therefore, no such file is provided. As shown in Table 5.3.7-17, the LEU fuel burned to 140 GWd/MTU must be cooled 5.3 years to meet cask heat load limits (and at 5.3 years meets dose limits). The 140 GWd/MTU, 5.3-year cooled SAS2H input file is included in the SAR as part of this RAI response.

CHAPTER 5 SHIELDING

5-5 Provide clarification on what calculational method or tool that was used to produce results with accuracy to 10^{-50}. Provide a discussion on the accuracy and reliability of the rest of the results.

Table 5.3.7-12 of the SAR provides dose rates for the LEU TRIGA rod cluster spent fuel package. The table shows that some data are in the order of 10^{-50}. It is not clear to the staff what method or computer code system produces results that are within this level of accuracy.

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

NAC International Response

As indicated in the first paragraph of Section 5.3.7 (the second paragraph in the LWT-08C revision), the SCALE SAS1 sequence is used to determine dose rates. It was not NAC's intention to justify accuracy of the code within 10^{-50}. The use of the one-dimensional code was deemed to be acceptable for this application, as comparisons to three-dimensional results indicate conservative dose rates (see Section 5.3.7, third paragraph). Code results from the one-dimensional transport calculation are influenced by modeling assumptions (e.g., conservatively removed shield material from the model), mesh spacing and homogenization within the basket geometry, in addition to accuracy of the data libraries.

The intent of the low magnitude values in the gamma response tables was simply to demonstrate that at energy groups below 0.6 MeV, the NAC-LWT cask bulk shields reduce dose to negligible levels.

For example:

In group 13, 0.4 to 0.6 MeV, the 140 GWd/MTU, 5.3-year cooled fuel has a fuel source of $\sim 1 \times 10^{12}$ g/sec/rod, which in the homogenized model translates to $\sim 1.5 \times 10^{9}$ g/sec/cm^3. Given a normal condition response of 5×10^{-8} mrem/hr per 10^{10} g/sec/cm^3 (Table 5.3.7-12), this yields a dose of $\sim 8 \times 10^{-9}$ mrem/hr.

NAC International Response to RAI 5-5 (cont'd)

To avoid any implications as to the accuracy of the analysis at these levels, energy lines 13 – 15 are marked as approximately 0 (~0) in the SAR tables.