NAC INTERNATIONAL

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July 15, 2014

U.S. Nuclear Regulatory Commission
11555 Rockville Pike
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Attn: Document Control Desk

Subject: Submission of Supplemental Information to NAC's Response to the NRC's Request for Additional Information for NAC's Amendment Request for Certificate of Compliance (CoC) No. 9225 for the NAC-LWT Cask to Incorporate New MTR Fuel Parameters as Authorized Content

Docket No. 71-9225 TAC No. L24875

References:

1. ED20130187, Submission of NAC Amendment Request for Certificate of Compliance (CoC) No. 9925 for the NAC-LWT Cask to Incorporate New MTR Fuel Parameters as Authorized Content, December 31, 2013
2. Model No. NAC-LWT Package, U.S. Nuclear Regulatory Commission (NRC) Certificate of Compliance (CoC) No. 9225, Revision 59, November 5, 2013
3. ED20140029, Submission of NAC's Responses to the NRC's Request for Additional Information for NAC's Amendment Request for Certificate of Compliance (CoC) No. 9225 for the NAC-LWT Cask to Incorporate New MTR Fuel Parameters as Authorized Content, May 30, 2014
4. Safety Analysis Report (SAR) for the NAC Legal Weight Truck Cask, Revision 41, NAC International, April 2010

NAC International (NAC) hereby submits supplemental information to revise and further clarify the contents of Reference 3. Changes to the information previously provided in Reference 3 are the following:

1. NAC International's response to RAI 6.1 has been revised to add further clarification to the acceptability of the proposed content
2. Proposed Condition 5.(b)(2)(iv)(b) of Reference 2 has been revised to reflect what analyses have been performed for LEU, MEU, and HEU fuel at 30 and 40 Watts

Upon NRC review of NAC's RAI responses (Reference 3), the NRC staff requested further clarification of some of the responses. On July 8th, 2014, a conference call was held to discuss information provided in Reference 1 and Reference 3. As agreed upon during the call, NAC is providing a summary of selected portions of the discussion herein.

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During the call, the NRC staff noted that only a minimum plate thickness had been specified in Reference 1 and requested NAC provide further information regarding MTR fuel design specifications. NAC stated there is no standard MTR fuel. Number of fuel plates run from single digits to the twenty three maximum applied in the CoC. Large ranges in height and significant differences in active fuel width are seen. For the same plate thickness, fuel core thickness can vary even within a plate. Depth (sum of the plate thickness's plus gaps) of the element is in the range of 3 inches. It was asked if the height of the plates is correlated with any other geometric parameter of the plate. NAC responded there is no correlation between a plate's height and any other parameter but that thicker plates result in fewer plates per element. Water to plate thickness ratios have to be maintained to achieve usable (critical) in-core configurations. Due to a roughly fixed element depth a significant plate thickness increase without a plate number decrease would result in a significantly under-moderated condition and therefore not be suitable for in-core use. It was also stated that the conditions of the CoC reflect this and are therefore driven by criticality and not shielding concerns.

It was requested that NAC provide a justification for the positioning of fuel elements in the shielding model. NAC explained that the current model is based on initial MTR licensing that placed fuel elements in the highest point in the basket module. The fuel in the model was assumed to be cut and shifted towards the front of the cask cavity. Later models decreased the cutting distance (increasing the material remaining beyond the active fuel region), but the fuel region location was maintained within the model. It was explained that SAS4 requires symmetry about the centerline of the model and that moving the source region to the ends of the cask cavity would artificially increase the two meter (analysis limiting) dose value. NAC stated that maintaining the fuel location was acceptable due to conservatism in the shielding/source model. Cutting is not typically performed to the minimum length modeled. Also, the model applies a uniform burnup profile rather than a chopped cosine shape that neutronic analysis would produce. A uniform profile moves source to the minimum shielded location. Source terms from NAC source generation calculations are significantly higher than those of fuel elements typically transported (as confirmed by heat loads provided by reactor sites). Overall, this provides reasonable assurance that calculated dose rates are bounding for any proposed shipment.

The NRC requested that an explanation be provided as to why decay times between cycles, the down times between cycles, and the number of cycles were held constant in analyses regardless of MTR fuel burnup. It was also requested that NAC compare the assumptions made to operations of reactors which use MTR fuel. NAC stated that the decay time between cycles is based on engineering judgment and assumed to be 30 days. MTRs' typical operation are intermittent power cycles with only few MTRs operateing in constant full power mode similar to commercial power reactors. The assigned total depletion time (power plus down time between cycles) is significantly less than that seen in shipping documentation NAC has been privy to. The power level assigned to the calculation depletion cycles is constant at maximum power seen across any MTR core NAC had data for. Uniform depletion could not be achieved, as burnup is increased as fissile material mass is decreased (in particular for the bounding high burnup levels producing maximum dose). Shifting power to early in assembly life would reduce calculated source terms.

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It was requested that NAC explain why Note 4 of Table 1.2-4 of Reference 4, "Fuel Characteristics" was not entirely addressed by proposed revisions to Reference 2 in Reference 3. It was explained to the NRC that the nominal 0.28-inch remaining material specified in Note 4 of Table 1.2-4 was not part of the proposed CoC contents as it was not considered crucial to safety performance of the system by NAC or the NRC review staff at the time the CoC was previously issued. The default dimension (0.28") leaves little margin for actual cutting of the elements and no expectation exists that cutting within this margin will occur (cutting closer than this could result in cutting into the fuel meat). Furthermore, the criticality analysis that used this dimension, conservatively used an alternating close shift pattern not considered physically realistic, therefore providing more margin. The higher mass HEU elements needed additional space and therefore had the spacing limitation imposed within the CoC.

Also discussed during the call was NAC's response to RAI Question 6.1 in Reference 3. The NRC requested further clarification to be added to substantiate the acceptability of proposed changes to the fuel parameters in condition 5.(b)(1)(iv)(c) of Reference 2. The NRC stated the issue was not a technical or safety concern, but added clarification would be of benefit to future readers. RAI 6.1 requested NAC clarify why allowing a maximum weight of 23.5 grams ^{235}U per plate with a maximum of 23 plates per element should be allowable when the maximum ^{235}U content is 490 grams. NAC's criticality and shielding analyses performed showed that 23 plates containing up to 23.5 grams of ^{235}U are safe when arranged in an element, as long as the total ^{235}U weight does not exceed 490 grams. The actual MTR fuel to be shipped contains a maximum of 21 fuel plates with a maximum ^{235}U weight of 23.3 grams per plate (maximum of 489.3 grams ^{235}U per element), so the fuel characteristics used in the analyses are consistent with the proposed contents. Enclosure 1 contains the additional clarification statements to NAC's response to RAI question 6.1 in Reference 3.

The NRC stated that proposed changes to condition 5.(b)(2)(iv) of Reference 2 in Reference 3 did not accurately reflect analyses which had been performed. NAC acknowledged the inadvertent misstatement and committed to revise the proposed condition to state that LEU MTR fuel elements with decay heat not exceeding 40 watts per element, and MEU and HEU MTR fuel elements with decay heat not exceeding 30 watts per element, may be loaded in any basket location. See Enclosure 2 for the revised proposed changes to Reference 2.

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

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Enclosures:

Enclosure 1 – Revised RAI Response to Question 6.1 of RAI Responses and Supporting References No. 9225 for NAC-LWT SAR, Revision LWT-14C ANSTO OPAL Amendment

Enclosure 2 – Revised Condition 5.(b)(2)(iv) of Proposed Changes for Revision 59 of Certificate of Compliance No. 9225, NAC-LWT SAR, Revision LWT-14C, ANSTO OPAL Amendment

Enclosure 1

Revised RAI Response to Question 6.1 of RAI Responses

and Supporting References

No. 9225 for NAC-LWT SAR

Revision LWT-14C ANSTO OPAL Amendment

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CRITICALITY EVALUATION

6.1 Clarify the intended content and provide appropriate criticality safety analysis to support this amendment request.

The application states that the amendment request is to allow up to 23.5 grams of U-235 per MTR plate and 23 plates per fuel element or 23 elements per fuel basket for loose plates and a maximum weight of 490 grams of U-235 per element or basket. The staff observed that these numbers do not match, i.e., 23 x 23.5 (grams) = 540.5 grams, the total weight of U-235 exceeds the 490 grams per fuel element/basket limit. Yet even with the lowest U-235 load per plate, the total uranium-235 load exceeds the 490 grams per element limit. The intended content should be clarified and the criticality safety analysis revised if necessary.

This information is needed to verify compliance with 10 CFR 71.55.

<u>NAC International Response to Criticality Evaluation RAI 6.1:</u>

The application documents that up to 23 plates with 23.5 g ^{235}U per plate is acceptable for criticality safety analysis. As documented, a reduced number of plates (< 23) are allowed to exist in the fuel element. MTR fuel elements are designed with various fuel plates. The MTR element that is part of this amendment request contains 21 fuel plates at a maximum 23.3 g ^{235}U (with a maximum per element mass of 486 g). The licensing evaluation could therefore have been based on a maximum 21 plates. As the 23 assembly configuration could be shown to be criticality safe, it was conservatively applied. Since it was evaluated to be criticality safe, it was placed within the CoC limitations. This approach is consistent with previously approved MTR amendment requests.

Shielding evaluations provide the effective limit on fuel mass; therefore, limits the number of plates at 23.5 grams per plate a fuel element may have. A 490 gram element was chosen to bound the element to be transported without unduly restricting the element load time (heat load is related to fuel mass at a fixed burnup; therefore, increases in fuel mass at a fixed burnup require increased cool time). The limits, as written, match the analysis and do not provide an inconsistency (i.e., an element may have lower fuel mass per plate and more plate, or vice versa, provided the shielding mass limit is maintained).

Both plate and element limits are within the CoC and must be met prior to transport. No revision to the criticality safety analysis is necessary.

The proposed changes to condition 5.(b)(1)(iv)(c) of the CoC allows a maximum of 23 plates containing up to 23.5 grams of ^{235}U so long as the total ^{235}U weight is less than 490 grams. The criticality analysis performed shows 23 plates containing up to 23.5 grams of ^{235}U is criticality safe. The shielding analysis shows that 490 grams of ^{235}U per element results in acceptable dose rates. Because the MTR element that is part of this amendment request contains a maximum of 21 fuel plates at a maximum of 23.3 grams ^{235}U per plate, the proposed limits bound the physical parameters of the proposed content and are consistent with the performed analyses.

Enclosure 2

Revised Condition 5.(b)(2)(iv) of Proposed Changes for Revision 59 of

Certificate of Compliance No. 9225

NAC-LWT SAR, Revision LWT-14C

ANSTO OPAL Amendment

CoC Sections (revised)

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5.(a)(2)(3) Drawings

LWT 315-40-02, Rev. 25 (Sheets 1-2) Body Assembly

CoC Page 8 of 31:

5.(b)(1) Type and form of material (continued)

(iv) (c) Expanded LEU MTR Fuel Content Description

<table>
<tr><td>Parameter</td><td>Base</td><td colspan="5">≤7.0 cm Active Fuel Width</td><td colspan="2">≤7.1 cm Active Fuel Width</td><td colspan="3">≤7.15 cm Active Fuel Width</td></tr>
<tr><td>Enrichment, wt. % ^{235}U</td><td>≤ 25</td><td colspan="5">≤ 25</td><td colspan="2">≤ 25</td><td colspan="3">≤ 25</td></tr>
<tr><td>Number of fuel plates</td><td>≤ 23</td><td colspan="5">≤ 23</td><td>≤ 17</td><td>≤ 23</td><td>≤ 22</td><td>≤ 23</td><td>≤ 23</td></tr>
<tr><td>^{235}U content per plate</td><td>≤ 22</td><td>≤ 22</td><td>≤ 22</td><td>≤ 21.5</td><td>≤ 23.5</td><td colspan="2">≤ 22</td><td>≤ 22</td><td>≤ 21.5</td><td>≤ 22</td></tr>
<tr><td>Plate thickness (cm)</td><td>≥ 0.115</td><td>≥ 0.119</td><td>≥ 0.115</td><td>≥ 0.115</td><td>≥ 0.130</td><td>≥ 0.115</td><td>≥ 0.200</td><td colspan="3">≥ 0.119</td></tr>
<tr><td>Clad Thickness (cm)</td><td colspan="11">≥ 0.02</td></tr>
<tr><td>Active fuel width (cm)</td><td>≤ 6.6</td><td colspan="5">≤ 7.0</td><td colspan="2">≤ 7.1</td><td colspan="3">≤ 7.15</td></tr>
<tr><td>Active fuel height (cm)</td><td>≥ 56</td><td>≥ 56</td><td>≥ 63</td><td colspan="3">≥ 56</td><td colspan="2">≥ 56</td><td>≥ 56</td><td>≥ 56</td><td>≥ 61</td></tr>
<tr><td>^{235}U content per element (g)</td><td>≤ 490</td><td colspan="5">≤ 490</td><td colspan="2">≤ 490</td><td colspan="3">≤ 490</td></tr>
</table>

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5.(b)(2) Maximum quantity of material per package (continued)

(iii) Deleted.

(iv) For MTR fuel elements as described in Item 5.(b)(1)(iv):

Up to 42 fuel elements positioned within the MTR fuel assembly basket (7 fuel elements per basket module). Each of the MTR basket cell openings may contain a loose plate canister. The contents of each loose plate canister are limited to the number of fuel plates, dimensions, and masses that are equivalent to an intact MTR fuel element, as specified in Item 5.(b)(1)(iv).

(a) The maximum decay heat is not to exceed 1.26 kilowatts per package, with each MTR fuel assembly basket module not to exceed 210 watts.

(b) LEU MTR fuel elements with decay heat not exceeding 40 watts per element, and MEU and HEU fuel elements with decay heat not exceeding 30 watts per element, may be loaded in any basket position.

(c) Mixed HEU, MEU, and LEU MTR contents, with decay heat limits as specified above, are authorized.

(d) MTR fuel elements with degraded or mechanically damaged cladding are authorized, provided the total surface area of through-clad corrosion and/or mechanical damage does not exceed 5% of the total surface area of the damaged element.

(e) For HEU-MTR fuel elements only, the center fuel element in any basket module is not to exceed 120 watts. The two exterior fuel elements vertically in-line with the center assembly for transport are not to exceed 70 watts.

(f) MTR fuel elements containing more than 23.5 g ^{235}U per plate (490 g ^{235}U per element) are limited to up to four elements loaded in basket positions 4, 5, 6, and 7 of a seven-element basket per Figure 7.1-1 of the application. Basket positions 1, 2, and 3 are to be blocked by spacer hardware.

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12. A personnel barrier must be used when shipping PWR or BWR assemblies. Shipments of MTR, DIDO fuel assemblies, TRIGA fuel elements, TRIGA fuel cluster rods, high burnup PWR or BWR rods, PWR MOX rods, TPBAR contents, PULSTAR fuel elements, spiral fuel assemblies, MOATA plate bundles, or irradiated hardware must use the ISO container.

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19. Revision 59 of this certificate may be used until October 31, 2015.

REFERENCES

NAC International, Inc., application dated June 18, 2010.

NAC International, Inc., supplements dated February 3, March 2, and May 24, October 26, and December 5, 2012; January 14, February 14, July 19 (two supplements), October 18, December 31, 2013; May 30 and July 15, 2014.