NAC INTERNATIONAL

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June 3, 2010

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

Attn: Document Control Desk

Subject: NAC International's Response to the NRC's Request for Additional Information (RAI) for the Review of the Certificate of Compliance No. 9235, Revision for the Model No. NAC-STC Package to Incorporate the Dairyland Power Cooperative's La Crosse BWR Spent Fuel as Approved Content

Docket No. 71-9235 TAC No. L24408

References:
1. Certificate of Compliance No. 9235 for the Model No. NAC-STC Package, U.S. Nuclear Regulatory Commission (NRC), Revision 11, June 12, 2009
2. Safety Analysis Report (SAR) for the NAC Storage Transport Cask, Revision 16, NAC International, September, 2006
3. Request for an Amendment of Certificate of Compliance (CoC) No. 9235 for the NAC-STC Transport System to Incorporate the Dairyland Power Cooperative's La Crosse BWR Spent Fuel as Approved Content, NAC International, December 17, 2009
4. Request for Additional Information for Review of the Certificate of Compliance No. 9235, Revision for the Model No. NAC-STC Package, NRC, April 20, 2010

NAC International (NAC) herewith submits its responses to Reference 4. NAC has prepared the responses to the RAI questions relative to Reference 3, along with the corresponding NAC-STC Safety Analysis Report (SAR) amendment STC-LACBWR Revision 10B changed pages.

Consistent with NAC administrative practice, this proposed SAR revision is numbered to uniquely identify the applicable changed pages. Revision bars mark the SAR text changes on the STC-LACBWR Revision 10B pages, and the included List of Effective Pages identifies the current revision level of all pages in the Reference 2 SAR.

In order to better facilitate the review process, NAC is providing the STC-LACBWR Revision 10B changed pages with corresponding backing pages. Consequently, some of the backing pages are identified as STC-LACBWR Revision 09A and have revision bars identical to those in the specific Revision.

NMSS01

ED20100068

All changes requested by the response to the RAI questions are included on STC-LACBWR Revision 10B changed pages and are marked with revision bars in the margin. Two additional minor corrections incorporated into the STC SAR are:

- Addition of Footnote 6 to Table 1.4-4 stating that the LACBWR fuel assemblies may contain zirconium shroud compaction debris, and
- In Table 1.4-5, added the previously inadvertently omitted "Overall Length (in.)" identifier for the 106.75 dimension.

STC-LACBWR Revision 10B also includes six revised license drawings. These drawings were re-reviewed in response to RAI question 8-2 and were updated with minor corrections. A detailed listing of all drawing changes is provided in Attachment 1 to this transmittal letter.

In accordance with NAC's administrative practice, upon final acceptance of STC-LACBWR Revision 10B of the application, the NAC-STC SAR Revision 09A and 10B changed pages will be reformatted and incorporated into the next revision of the NAC-STC SAR.

This submittal consists of one copy of each the following documents:

1. This transmittal letter, including two attachments
    a. List of Drawing Changes
    b. Proposed Changes, Revision 12 of CoC No. 9235
2. The Reference 4 RAI questions with the NAC responses presented in standard NAC RAI response format.
3. SAR amendment STC-LACBWR Revision 10B changed pages.

NAC proprietary shielding and criticality output data files in response to RAI questions 5-8 and 6-7 are being provided under separate cover.

Attachment 2 to this transmittal letter contains the proposed changes to Reference 1.

Approval of this amendment to Reference 1 and the issuance of the revised CoC/Safety Evaluation Report are being requested to ensure transportability of the Dairyland Power Cooperative's fuel stored in NAC-MPC storage units.

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 20, 2010
2. NAC-STC LACBWR Changed Pages (Revision 10B)

Attachment 1

List of Drawing Changes

STC-LACBWR, Revision 10B

Dairyland Power Cooperative

Drawing 423-800, Revision 15 – Cask Assembly – NAC-STC Cask

- Title block, scale callout, revised to "N.T.S."; was "1/6" for sheets 1, 2 & 3.
- Title block, weight callout, revised to "N/A"; was "Noted" for sheets 1, 2 & 3.

Sheet 2:

- Zone A7, deleted weight listed for Assy 99 & 98; was "Weight: 192,320#."
- Zone A7 Assy 98, revised subtitle to "Storage/Transport and Canistered Contents"; was "Storage/Transport."
- Zone C2, Detail C-C, deleted scale callout; was "Scale: 1/2."

Sheet 3:

- Zone A6, deleted scale callout; was "Scale: 1/2."

Drawing 423-803, Revision 9 – Lid Assembly – Inner, NAC-STC Cask

- Title block, scale callout, revised to "N.T.S."; was "1/16" for sheets 1 & 2.
- Title block, weight callout, revised to "N/A"; was "Noted" for sheets 1 & 2.

Sheet 1:

- Zones C2 & E2, deleted scale callout for Item 5 & Detail E-E; was "Scale: Full."
- Zone E3, deleted scale callout for Detail C-C; was "Scale: 1/2."
- Zone B6, deleted weight listed for Assemblies 99 & 98; was "Weight: 10,690#."
- Zone B6, Assembly 98, revised subtitle to "Storage/Transport and Canistered Contents: W/ Metal O-Rings"; was "Storage/Transport: W/ Metal O-Rings."

Sheet 2:

- Zones A3 & C3, Section B-B & D-D, revised subtitle to "Storage/Transport and Canistered Contents (Metallic Seals)"; was "Storage/Transport (Metallic Seals)."
- Zones A3, A7, C3 & C7, deleted scale callout for Sections B-B & D-D; was "Scale: Full."

Drawing 423-804, Revision 9 – Details – Inner Lid, NAC-STC Cask

- Title block, scale callout, revised to "N.T.S."; was "1/6" for sheets 1 & 2 and "1/2" for sheet 3.
- Title block, weight callout, revised to "N/A"; was "Noted" for sheets 1, 2 & 3.

Drawing 423-804, Revision 9 – Details – Inner Lid, NAC-STC Cask (cont'd)

Sheet 1:

- Zone A8, Detail H-H, deleted scale callout; was "Scale: 1/3."
- Zones B5 & C5, deleted weight listed for Assemblies 99 & 98; was "Weight: 10,690#."
- Zone B5, Assembly 98, revised subtitle to "Storage/Transport and Canistered Contents: W/ Metal O-Rings"; was "Storage/Transport: W/ Metal O-Rings."

Sheet 2:

- Zones A3, A7 & D2, deleted scale callout for Details G-G, B-B & Section D-D; was "Scale: 1/2."

Sheet 3:

- Zones A3 & D3, deleted scale callout for Sections E-E; was "Scale: 2/1."

Drawing 455-801, Revision 4 – Assembly, Transport Cask, NAC-MPC

- Title block, scale callout, revised to "N.T.S."; was "1/6" for sheets 1 & 2.
- Title block, weight callout, added "N/A"; for sheets 1 & 2.

Sheet 1:

- B.O.M., Item 2, revised Drawing No. to "423-803-98"; was "423-803-99."
- Zone D2, deleted scale callout for Detail B-B; was "Scale: 1/2."

Sheet 2:

- Zones A6 & A7, deleted scale callout for Details C-C & D-D; was "Scale: Full."
- Zone A3/A4, deleted scale callout for Section E-E; was "Scale: 1/3."

Drawing 414-801, Revision 2 – Cask Assembly, NAC-STC, CY-MPC

- Title block, scale callout, revised to "N.T.S. was "1/6" for sheets 1 & 2.
- Title Block, weight callout, revised to "N/A" was "Noted" for sheets 1 & 2.

Sheet 1:

- B.O.M., Item 2, revised Drawing No. to "423-803-98"; was "423-803-99."
- Zone D2, deleted scale callout for Detail C-C; was "Scale: 1/2."
- Zones C3 & D3, deleted weight listed for Cask Assemblies 99-97; was for Assy 99 "Weight: 206,635#", Assy 98 "Weight: 206,418#" & Assy 97 "Weight: 220,500#."

Drawing 630045-871, Revision 2 – Details TSC, MPC-LACBWR

Sheet 1:

- Zone F3, removed Datum A callout.
- B.O.M, deleted item 2 and 3 description.
- Zone E5, added diameter symbol to (60.5) dimension.
- Zone E4, changed (28.50°) dimension to (28.5°).

Sheet 2:

- Zone F1, changed boss seal from "SAE 564 BOSS SEAL" to "BOSS SEAL."

Attachment 2

Proposed Changes

Revision 12 of CoC No. 9235

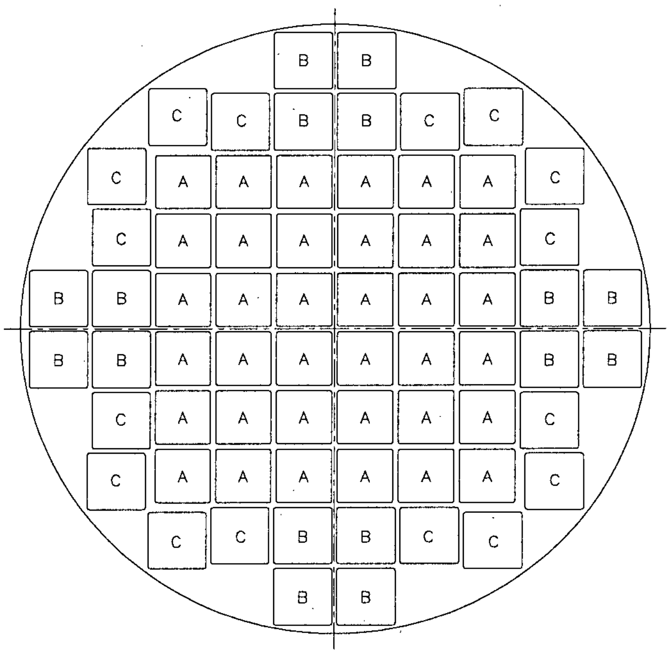
NAC-STC Cask

Proposed Changes for Revision 12 of Certificate of Compliance No. 9235
for the NAC-STC Cask (changes are highlighted)

Page No.	Description of Change
Pages 1 – 12	Revision Number 12
3 of 12	5.(a)(2) Description (Continued) 1st full paragraph, 1st sentence: The Yankee-MPC and CY-MPC TSC assembly includes a vessel shell, bottom plate, and welded shield and structural lids that are fabricated from stainless steel. 2nd paragraph, 1st sentence: The Yankee-MPC TSC fuel basket configuration .... 3rd paragraph, 1st sentence: The CY-MPC TSC fuel basket is designed to store .... Insert new paragraph between current 4th & 5th paragraphs as follows: The MPC-LACBWR TSC assembly consists of a vessel shell, a bottom plate and a welded closure lid/closure ring assembly that are fabricated from stainless steel. The MPC-LACBWR TSC bottom stainless steel plate thickness is 1.25 inches; the shell is ½-inch thick rolled steel plate and 70.6 inches in diameter. The closure lid is a 7.0-inch thick steel plate/forging. The closure lid redundant welded closure is provided by a closure ring. The closure lid is provided with vent and drain penetrations to access the TSC cavity and they are closed by redundant welded port cover plates. The MPC-LACBWR TSC fuel basket is designed to hold up to 68 irradiated La Crosse BWR fuel assemblies, including up to 32 damaged fuel assemblies contained in DFCs and up to 36 intact fuel assemblies.
Page 4 of 12	5.(a)(3) Drawings In section (iii), the following license drawing revision should be changed: 455-820, sheets 1-2, Rev. 3
Page 5 of 12	5.(a)(3) Drawings In section (v), the following license drawing revision should be changed: 423-843, Rev. 3 In section (vi), the following license drawing revision should be changed: 414-893, sheets 1-2, Rev. 3 Also in this section, for drawing 414-801, the comma should be deleted after sheets and moved to after 1-2 Add new section (viii) as follows: For the Dairyland Power Cooperative La Crosse BWR transport cask and TSC configuration, the TSC, fuel basket and DFCs are constructed and assembled in accordance with the following NAC International Drawing Nos.:

<table>
<tr><th>Page No.</th><th>Description of Change</th></tr>
<tr><td>Page 5 of 12
(cont'd)</td><td>
<table>
<tr><td>630045-800, Sheets 1-2, Rev. 0</td><td>630045-878, Rev. 1</td></tr>
<tr><td>630045-820, Rev. 0</td><td>630045-881, Sheets 1-2, Rev. 1</td></tr>
<tr><td>630045-870, Rev. 2</td><td>630045-893, Rev. 1</td></tr>
<tr><td>630045-871, Sheets 1-4, Rev. 2</td><td>630045-894, Rev. 1</td></tr>
<tr><td>630045-872, Sheets 1-2, Rev. 1</td><td>630045-895, Sheets 1-3, Rev. 1</td></tr>
<tr><td>630045-873, Rev. 1</td><td>630045-901, Rev. 0</td></tr>
<tr><td>630045-877, Rev. 1</td><td>630045-902, Sheets 1-2, Rev. 1</td></tr>
</table>
</td></tr>
<tr><td>NEW Page
10</td><td>
5.(b)(1) Contents – Type and Form of Material (Continued)

(v) Irradiated undamaged and damaged Dairyland Power Cooperative La Crosse Boiling Water Reactor (LACBWR) fuel assemblies based on design nominal or operating history record values listed below. Fuel assemblies may contain zirconium alloy shroud compaction debris.
<table>
<tr><th></th><th>Assembly Manufacturer</th><th></th></tr>
<tr><th></th><th>Exxon [1]</th><th>Allis Chalmers</th></tr>
<tr><td>Cladding Material</td><td>SS</td><td>SS</td></tr>
<tr><td>Maximum Number of Assemblies</td><td>68 [2]</td><td>32</td></tr>
<tr><td>Maximum Initial Uranium Content (kg/assembly)</td><td>111.9</td><td>121.4</td></tr>
<tr><td>Maximum Initial Enrichment (wt % ^{235}U)</td><td>3.71</td><td>3.94 [4]</td></tr>
<tr><td>Minimum Initial Enrichment (wt % ^{235}U)</td><td>3.71</td><td>3.64 [4]</td></tr>
<tr><td>Maximum Assembly Weight (lbs)</td><td>400 [3]</td><td>400 [3]</td></tr>
<tr><td>Maximum Burnup (MWd/MTU)</td><td>21,000</td><td>22,000</td></tr>
<tr><td>Maximum Decay Heat per Assembly (watts)</td><td>62</td><td>63</td></tr>
<tr><td>Minimum Cool Time (yrs)</td><td>23</td><td>28</td></tr>
<tr><td>Maximum Active Fuel Length (in)</td><td>83</td><td>83</td></tr>
</table>
Notes:
[1] Assemblies manufactured by Exxon Nuclear Company.
[2] May include up to 32 damaged LACBWR fuel assemblies in DFCs with optional inner containers.
[3] Not including weight of DFC.
[4] Two AC fuel types: Type 1 at an enrichment of 3.64 wt % ^{235}U and Type 2 at 3.94 wt % ^{235}U.
</td></tr>
</table>

Page No.	Description of Change
Page 10 of 12	5.(b) Contents (Continued) (2) Maximum quantity of material per package Correct numbering: the second (i) should be (v) (vi) is added as follows: (vi) For the contents described in Item 5.(b)(1)(v): up to 68 LACBWR assemblies, including up to 32 damaged fuel assemblies contained in DFCs, may be transported in the MPC-LACBWR TSCs. Total weight of contents within the MPC-LACBWR TSC is 28,870 lbs., including the weight of 32 DFCs. The maximum decay heat is 4.5 kW per package. LACBWR undamaged fuel assemblies and LACBWR DFCs must be loaded in accordance with the following loading pattern:  Slot A: Undamaged Exxon fuel maximum planar average enrichment 3.71 wt % ^{235}U. Slot B: Undamaged or damaged Exxon fuel maximum planar average enrichment 3.71 wt % ^{235}U, up to four slots maximum, B and C combined. Damaged Allis Chalmers fuel maximum enrichment 3.64 wt % ^{235}U. Slot C: Undamaged or damaged Exxon fuel maximum planar average enrichment 3.71 wt % ^{235}U, up to four slots maximum, B and C combined. Damaged Allis Chalmers fuel maximum enrichment 3.94 wt % ^{235}U. LACBWR DFCs are allowed to contain an additional 2% fissile material to account for loose pellets, not necessarily associated with the as-built fuel assembly.

Proposed Changes for Revision 12 of Certificate of Compliance No. 9235 for the NAC-STC Cask (changes are highlighted)

Page No.	Description of Change
Page 11 of 12	Item 8, 1st sentence, revise as follows: "… described in Item 5.(b)(2)(iii), 5.(b)(2)(v) and 5.(b)(2)(vi): if … at the time of closure and/or fabrication." Add new 2nd sentence as follows: For the MPC-LACBWR TSC, the TSC confinement/containment boundary shall be leak tested in compliance with ISG-18 and ANSI N14.5-1997 to assure no credible leakage.
Page 12 of 12	Item 15, revise as follows: Revision No. 11 of this certificate may be used until May 31, 2011. REFERENCES, 2nd sentence revise as follows: As supplemented June 3 and December 17, 2009, February 3 and June 3, 2010.

NAC INTERNATIONAL

RESPONSE TO THE

UNITED STATES NUCLEAR REGULATORY COMMISSION

REQUEST FOR ADDITIONAL INFORMATION

APRIL 20, 2010

FOR REVIEW OF THE CERTIFICATE OF COMPLIANCE NO. 9235, REVISION FOR THE MODEL NO. NAC-STC PACKAGE TO INCORPORATE DAIRYLAND POWER COOPERATIVE'S LA CROSSE BOILING WATER REACTOR AS AUTHORIZED CONTENT

(TAC NO. L24408, DOCKET NO. 71-9235)

JUNE 3, 2010

TABLE OF CONTENTS

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 1.0 – GENERAL INFORMATION

For future reference, use the same set of units in all tables providing the same information. English and metric units should not be mixed.

1-1 Show the metallic seals of the cask and their specifications on the applicable drawing.

The drawings provided with the application for the Model No. NAC-STC for the LACBWR content do not appear to identify and specify the metallic cask seals which are required to provide for a leaktight containment boundary.

This information is necessary to determine compliance with 10 CFR 71.33.

NAC International Response

The NAC-STC drawings for the inner lid (423-803) and for the port coverplate assembly (423-806) identify the metallic seals, including their supplier, to be used for the NAC-STC assemblies for the transport of canistered contents. As defined in Chapter 1 and Table 4.1-1 of the STC SAR, MPC canistered contents require the NAC-STC containment boundary to be sealed using metallic seals that are leak tested to ANSI N14.5-1997 leaktight criteria. Chapter 4, Section 4.5.1, includes the technical information on the Helicoflex metallic O-ring seals selected for the NAC-STC containment boundary.

As identified in the RAI 8-2 response, NAC has performed a thorough review of the applicable NAC-STC drawings and the transport assembly drawings for the MPC-LACBWR, CY-MPC and YR-MPC contents to ensure that the correct metallic seal assemblies are properly referenced and identified. As required, minor revisions have been incorporated in the revised drawings submitted herewith that appropriately specify that MPC canistered contents are required to include metallic seals for transport in the NAC-STC cask.

Refer to the RAI 8-2 response for the list of affected drawings.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 2 – STRUCTURAL REVIEW

2-1 Provide rationale for the various dynamic amplification factors used in the static evaluations of dynamic drop load conditions.

No basis was provided for the use of various g-loads used in the analysis of Normal Conditions of Transport (NCT) or Hypothetical Accident Conditions (HAC).

This information is necessary to determine compliance with 10 CFR 71.71 or 71.73.

<u>NAC International Response</u>

RAI 2-2 and 2-3 provide details on the specific conditions to be examined for the dynamic amplification factors used in the static evaluations of the basket. The responses to RAI 2-2 and 2-3 describe the conservatism included in the as-analyzed accelerations and the maximum accelerations developed by the impact limiter for the 1-foot and the 30-foot side drops.

No SAR pages are changed as part of this response.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 2.0 – STRUCTURAL REVIEW

2-2 Demonstrate that the applied 20g dynamic amplification factor is conservative, given the very small Margin of Safety (0.06) (Section 2.11.6.12.4) for the support disk stresses due to a 1-foot side drop.

Given the uncertainties present in dynamic analysis and given that "the canister wall and inner shell have different radii" and "a gap exists between the two surfaces" (page 2.11.6.13-4), staff does not have reasonable assurance that the analysis presented is conservative.

This information is necessary to determine compliance with 10 CFR 71.71.

NAC International Response

Section 2.11.6.12.7 contains the LACBWR basket evaluation of the 1-foot side drop for the normal condition. As indicated, the inertia loading employed in the basket evaluation was 20g's. The applied acceleration to the model represents the inertial loading developed in the 1-foot side drop. The 1-foot drop acceleration used in the basket evaluation is defined in Table 2.6.7.4.2-3, which reports the maximum deceleration of the cask body for the 1-foot side drop. Table 2.6.7.4.2-3 reports the 1-foot side acceleration to be 16.5g's, which is bounded by the 20g's employed in the basket evaluation. A reference to Table 2.6.7.4.2-3 was added to Section 2.11.6.12.7.

During the 1-foot side drop, the structural response will exhibit damping due to the basket-canister-inner shell interfaces and the composite design of the cask body with the steel-lead-steel design. The effect of the damping is neglected in the evaluation, which provides an unidentified level of conservatism. The design of the canistered system does allow for gaps to exist between the basket and canister and between the canister and the cask body inner shell for handling purposes. The effect of the gaps, as indicated on page 2.11.6.13-4, results in the load passing only through regions where contact between the basket and canister shell and inner shell does occur. The dimensions of the support disks and canister and inner shell included in the model

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

described in Section 2.11.6.12.2 allow for these gaps to be contained in the model. To permit the compression-only contact between the surfaces, ANSYS gap elements are defined between the surfaces. This allows for accurate modeling of the components with different radii.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 2.0 – STRUCTURAL REVIEW

2-3 Demonstrate that the applied 55g dynamic amplification factor is conservative given the very small Margin of Safety (0.05) (Section 2.11.7.8.4) for the support disk stresses due to a 30-foot side drop.

Given the uncertainties present in dynamic analysis and given that "the canister wall and inner shell have different radii" and "a gap exists between the two surfaces" (page 2.11.6.13-4), staff does not have reasonable assurance that the analysis presented is conservative.

This information is necessary to determine compliance with 10 CFR 71.71.

NAC International Response

Section 2.11.7.8.4 contains the LACBWR basket evaluation of the 30-foot side drop for the accident condition. As indicated in Section 2.11.7.8.4, the inertia loading employed in the basket evaluation was 55g's. The 30-foot drop acceleration used in the basket evaluation is defined in Table 2.6.7.4.2-4, which reports the maximum deceleration of the cask body for the 30-foot side drop. Table 2.6.7.4.2-4 reports the 30-foot side acceleration to be 49.5g's, which includes the 1.02 factor reported in Section 2.6.7.4.2.6 to account for the transient effect of the impact. The 30-foot side drop acceleration in Table 2.6.7.4.2-4 is bounded by the 55g's employed in the basket evaluation. The reference to Table 2.6.7.4.2-4 was added to Section 2.11.7.8.4.

During the 30-foot side drop, the structural response will exhibit damping due to the basket-canister-inner shell interfaces and the composite design of the cask body with the steel-lead-steel design. The effect of the damping is neglected in the evaluation, which provides an unidentified level of conservatism. The design of the canistered system does allow for gaps to exist between the basket and canister and between the canister and the cask body inner shell for handling purposes. The effect of the gaps, as indicated on page 2.11.6.13-4, results in the load passing only through regions where contact between the basket and canister shell and inner shell does occur. The dimensions of the support disks and canister and inner shell included in the model

NAC International Response to RAI 2-3 (cont'd)

described in Section 2.11.6.12.2 allow for these gaps to be contained in the model. To permit the compression-only contact between the surfaces, ANSYS gap elements are defined between the surfaces. This allows for accurate modeling of the components with different radii.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 2.0 – STRUCTURAL REVIEW

2-4 Provide a detailed explanation of the origin of the acceleration values applied to the fuel tube for the fuel rod buckling analysis.

The applicant stated that "the accelerations from the 30-foot end drop of the cask are applied in this analysis." Without further explanation of what the source of the applied acceleration is, as well as the methodology for obtaining it, staff is unable to make a safety finding with respect to fuel rod performance.

This information is necessary to determine compliance with 10 CFR 71.73.

<u>NAC International Response</u>

Section 2.11.9.1 contains the evaluation of the LACBWR fuel rod analysis for the 30-foot accident condition end drop. The section describes that the acceleration applied in the evaluation corresponds to the cask 30-foot end drop. The peak acceleration for the 30-foot end drop is contained in Table 2.6.7.4.2-4, which is 39.9 g's. A conservative time history was defined to be a square-shaped time history (as opposed to a gradual increase as shown in Figure 2.6.7.4.2-9 for the cold condition) whose peak acceleration was 39.9 g's. The duration of the 30-foot end drop was set to allow the velocity due to the acceleration to correspond to 527.4 inches/sec impact velocity for the 30-foot drop.

This description of the acceleration has been added to Section 2.11.9.1.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 2.0 – STRUCTURAL REVIEW

2-5 Justify the choice of the 11.2 degree basket orientation with the damaged fuel shifted to the top of the basket as the worst case angle and load condition.

No justification was provided to support the assertion that this was the worst case.

This information is necessary to determine compliance with 10 CFR 71.71.

NAC International Response

Table 2.11.6.12-4 for the normal condition and Table 2.11.7.8-3 for the accident condition contain the summary of the maximum stresses for each of the basket orientations evaluated and shows that the limiting condition occurs at the 0° orientation. Section 2.11.6.12.7 and Section 2.11.7.8.4 contain the LACBWR basket evaluation of the 1-foot and 30-foot side drops, respectively. In both evaluations, the basket orientations considered in the side drop evaluations are the 0°, 11.2°, 15.2°, 37° and 45°. These orientations are defined in Figure 2.11.6.12-5. As observed in this figure, the 0°, 11.2° and 37° orientations correspond to minimum web conditions along the periphery of the support disk. The 15.2° and 45° orientations were added to address the condition of the three slots forming a common intersection nearest the periphery. Section 2.11.6.12.7 and Section 2.11.7.8.1 both state that the five basket orientations were considered in the basket evaluation.

In this basket design, the damaged fuel cans are allowed to extend beyond the top support disk by 8.40 inches and below the bottom support disk by 3.86 inches. The damaged fuel cans contain damaged fuel that may be rubbleized. During transport, the rubbleized fuel could be positioned at the top of the damaged fuel can, which would extend beyond the top support disk or, in a similar manner, below the bottom support disk. Since the damaged fuel can length outside the top disk is more than twice that of the bottom disk of the basket, the maximum load to the disk occurs at the top of the basket.

To ensure that the bounding condition was assessed, the five basket orientations were evaluated (for the 1-foot drop and the 30-foot drop) for the fuel at the maximum top position in the fuel tube.

Section 2.11.6.12.7 and Section 2.11.7.8.1 are both modified in response to this RAI.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 2.0 – STRUCTURAL REVIEW

2-6 Revise the text in the second paragraph on page 2.11.7.8-28 to be consistent with Table 2.11.7.8-14 in Section 269 or vice versa, whichever is correct.

The text in the second paragraph on the referenced page gives a Margin of Safety of +0.26 for Section 269 as listed in the referenced table. Section 269 shows a Margin of Safety of 0.14.

This information is necessary to determine compliance with 10 CFR 71.73.

NAC International Response

The minimum Margin of Safety contained in Table 2.11.7.8-14 is +0.14 as indicated in the RAI. The minimum Margin of Safety in the second paragraph on page 2.11.7.8-28 has been corrected.

NAC INTERNATIONAL RESPONSE
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CHAPTER 2.0 – STRUCTURAL REVIEW

2-7 Clarify the meaning of the phrase "may be placed in an ancillary fuel handling sleeve."

This phrase is used in SAR Section 1.4.1 when describing the handling of damaged fuel. The reviewer is not familiar with the term "ancillary fuel handling sleeve."

This information is needed to determine compliance with 10 CFR 71.55(b)(1) and 71.55(d).

NAC International Response

The phrase was intended to describe a separate optional drainable used to facilitate handling and placement of the damaged fuel material into a LACBWR damaged fuel can. Section 1.4.1 has been revised to clarify the sentence as follows:

"LACBWR damaged fuel and fuel debris may be placed in a separate drainable damaged fuel rod or debris container to facilitate handling of the fuel/debris and for placement in a LACBWR damaged fuel can."

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 2.0 – STRUCTURAL REVIEW

2-8 Include the spring mass in the various tables in the SAR that describe fuel characteristics. Provide a reference for the mass.

SAR Section 3.6.4.4 contains a calculation used to determine the gas fill in the rods. The calculation used the spring mass but none of the fuel characteristics tables contain the spring mass.

This information is necessary to determine compliance with 10 CFR 71.43(f).

NAC International Response

Chapter 5 contains the total hardware mass in the plenum region that is activated, including the spring and clad mass in this region. Chapter 6 does not employ the spring in its models. Chapter 1 contains analysis key fuel characteristics. As noted in the following paragraph, spring mass, while used in the calculation, does not actually affect system pressure. Therefore, there is no table within the NAC-STC SAR into which the spring mass can be readily inserted. As an alternative, Section 3.6.4.4 text is revised to contain the requested information.

LACBWR fuel rods were backfilled to atmospheric pressure, as were the TSC and NAC-STC cavities. As the pressure calculations are based on the average gas temperature in the system, which is applied to all content gases, the potential failure of the fuel clad and release of the backfill gas will not result in an increase in system pressure (partial pressure of the backfill gas is the same as that of the cask and TSC backfill).

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 2.0 – STRUCTURAL REVIEW

2-9 Revise the SAR to add, and will be referenced in the CoC, a plan to ensure, that for any Multi-Purpose Canister (MPC) that has spent an extended time in storage, that the contents and MPC itself meet all the requirements of the CoC. This plan should include inspections to obtain data, or analysis to support that: 1) the mechanical and thermal properties of the components of the MPCs related to safety, and 2) the contents have not degraded during the storage period. Provide evidence that removal of the MPC from the storage overpack will not damage the MPC, and impact safety.

All mechanical and thermal properties of the materials of construction of the MPC used in this Part 71 analysis are for pristine materials. Many of the MPCs were constructed and loaded many years ago, and have been on a storage pad for a considerable number of years. The materials properties used for the evaluation of the safety systems and contents of the MPCs that have already been in storage service must be representative of the conditions at the time of transport, not at the time of the loading of the MPC. No evidence was presented to indicate that the thermal and mechanical properties of the MPCs or contents have not degraded during storage and are still applicable to the transportation evaluation. No consideration has been given in the SAR to the potential damage that may occur to the MPC during its removal from the storage overpack.

This information is needed to meet any thermal, shielding, criticality, or structural requirements of 10 CFR Part 71 where the materials properties are integral to the response of the system.

<u>NAC International Response</u>

Chapter 7, Operating Procedures, Section 7.1.3.2 is revised to incorporate the requirement for an MPC that has been placed in on-site storage to be evaluated in accordance with a documented procedure to ensure that it meets the NAC-STC CoC requirements prior to loading the canister into a transport cask for subsequent off-site transport.

The structural criteria used for design of the safety-related NAC-MPC system components are in accordance with ASME Code, Section III, Subsection NB, Class 1 Components, primary pressure boundary components of the MPC canister, and ASME Code, Section III, Subsection NG, Core Support Structures, for the basket and damaged fuel cans. Material properties utilized

NAC International Response to RAI 2-9 (cont'd)

for design and analyses of the canister and basket components are those defined in the ASME Code, Section II. Materials of fabrication are specified as ASME Code approved materials as defined on the applicable licensing drawings.

It is recognized that this pedigree of compatible structural criteria and material properties is the basis for reactor component designs initially licensed for 40 years of service with an additional 20 years. PWR Nuclear Steam Supply System (NSSS) normal service conditions expose hardware to pressures in the range of 2,500 psi and temperatures in normal operation range of 500°F to 600°F, with radiation levels in excess of 10^{12} R/hr and neutron flux in the range of 10^{14} n/cm^2-sec. Typical spent fuel dry storage systems may be exposed to radiation fields < 10^5 R/hr and neutron flux in the range of 10^4 to 10^6 n/cm^2-sec. NSSS pressure and temperature loads are cycled based on plant operational needs. Spent fuel dry storage systems are exposed to significantly less challenging loads that are passive fixed conditions limited to cycles in atmospheric ambient temperature and pressure, and are provided with an inert cavity atmosphere eliminating internal hardware and fuel corrosion. Based on this comparison and the recognition that the radiation exposure that a spent fuel dry storage system sees in its full design life is experienced by reactor hardware in a few days to weeks of reactor operations, there is reasonable assurance that MPC shells, fuel support basket and damaged fuel can hardware, subject to normal, off-normal and accident condition service loads during 10 CFR 72 storage operations, will not degrade and will maintain material properties that meet design performance criteria for many years.

Some ambient conditions may expose the canister shell outside surface to conditions that may influence the rate of corrosion. Marine or other site-specific ambient conditions that may create a more corrosive atmosphere over an extended storage period are evaluated as part of the canister pre-transport loading operation. This evaluation may be complemented by data collected during annual or site-specific system inspections performed as part of the 10 CFR 72 Maintenance Program. MPC hardware evaluations are identified as a basis for validating systems that have been placed in storage are acceptable and meet transport CoC material performance conditions.

The NAC-MPC system has been licensed for spent fuel with burnup up to 45 GWd/MTU. Spent fuel with burnup not exceeding 45 GWd/MTU maintained in an inert dry storage configuration has been demonstrated to maintain stable fuel rod cladding conditions without degradation

NAC International Response to RAI 2-9 (cont'd)

during extended storage periods. Therefore, additional evaluation of spent fuel conditions is not imposed for MPC systems maintained in a normal service configuration.

Systems that have been exposed to 10 CFR 72 off-normal and accident conditions require loading-specific evaluation to validate that the canister and content meet SAR and CoC requirements prior to transport.

The request to provide evidence that removal of the MPC from the storage overpack will not damage the MPC, and impact safety, is provided as part of the MPC 10 CFR 72 CoC, Technical Specification, Appendix A, Section 5.2, Preoperational Testing and Training Exercises. The procedure demonstrated as part of the 10 CFR 72 dry run is identical to the procedure that is used to move the MPC from the storage overpack for off-site transport. This procedure for retrieving the loaded MPC from the concrete cask has been performed several times during normal loading operations for the similar UMS® system. Duke Power stores empty UMS® canisters in the concrete cask prior to system loading. Therefore, the retrieval of a canister from the concrete overpack is part of Duke's normal system loading operations. Although the TSC retrieval of the empty canister at Duke is not identical to the process that would be used for retrieval of a loaded canister into the transfer cask, this operation, as part of normal fuel loading, does demonstrate the placement of the TSC into, and retrieval from, a concrete cask is a validated normal operating procedure that can be performed with confidence that the canister is not damaged.

Therefore, current 10 CFR 72 CoC and operational history provide adequate evidence that removal of the MPC from the storage overpack will not damage the MPC and impact safety.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 3.0 – THERMAL REVIEW

3-1 Explain in the SAR Section 3.6.4.4 the consequences of a failed TSC upon the cask pressure and compare it to the design pressure of the cask. Also, explain why the application is demonstrating that the canister boundary remains intact along with any advantage this has upon the cask containment.

Since this is a transportation package, credit is not usually given to any benefit the canister could provide from remaining intact. Pressure is usually calculated as a result of a non-mechanistic failure of fuel (i.e., 3% for NCT and 100% for HAC) upon the containment boundary (i.e., cask). Likewise a non-mechanistic failure of the canister should also be postulated. In Section 3.6.4.4 under the heading "Cask Pressure Calculation" states that cask pressures are calculated assuming a TSC failure, but no values are provided.

This information is necessary to determine compliance with 10 CFR 71.33.

<u>NAC International Response</u>

The second "Intact TSC Confinement Boundary" subsection on page 3.6.4-12 was incorrectly titled. The correct title for this subsection is "Failed TSC Confinement Boundary." This subsection contains the requested pressure for the cask cavity assuming hypothetical TSC failure.

The information on the intact TSC boundary is designed to provide expected cask pressure during transport at the assumed fuel failure fraction. This represents the pressure expected during normal conditions, as the TSC is designed to survive intact through all transport conditions. There is no credit applied in the analysis to the presence of the TSC boundary.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 4.0 – CONTAINMENT REVIEW

4-1 Revise Table 4.1-1 to identify the LACBWR spent fuel assemblies as part of the allowable contents under condition type B, in the "Content Condition" section of the table.

Section 4.1 states that "the components of the containment boundary are described in Table 4.1-1 as a function of the containment condition and contents," and it establishes that the LACBWR spent fuel assemblies are included under containment condition B. However, in Table 4.1-1 for Containment Condition B, the LACBWR spent fuel assemblies are missing under the section of "Content Condition" in the table. Section 4.6.1 also refers to Section 4.1 for the containment boundary components description, but an explicit declaration of these components is unavailable for this application.

This information is necessary to determine compliance with 10 CFR 71.33(a).

<u>NAC International Response</u>

Table 4.1-1 has been revised to add MPC-LACBWR spent fuel assemblies to the "Content Condition" under Containment Condition B (e.g., metallic containment boundary seals). Table 4.1-1 also defines the containment component description for the MPC-LACBWR spent fuel assembly contents as referred to in Section 4.6.1.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 4.0 – CONTAINMENT REVIEW

4-2 Revise Section 4.6.3 to assure proper reference to the containment boundary system.

Section 4.6.3 indicates that the HAC pressure is calculated assuming canister confinement failure, but it also states that the canister confinement boundary is maintained. Confirm that the containment vessel, which is part of the overpack, is the containment boundary relied to limit the release of contents below the leaktight level.

This information is necessary to determine compliance with 10 CFR 71.73(c).

NAC International Response

Section 4.6.3 is revised to clarify that the containment and pressure boundary for the transport of the LACBWR TSC in the NAC-STC cask.

Similar revisions are made to Section 4.6, as the first paragraph includes a statement on "releases of the TSC contents into the NAC-STC cask cavity." Only the NAC-STC cask containment boundary is relied upon to demonstrate compliance with 10 CFR 71. Therefore, references to the TSC capability of maintaining material confinement is moved to a later paragraph.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-1 Update the SAR with clarifying information about the Transport Index (TI).

In Section 1.0, on page 1-1, the SAR states: "The NAC-STC is assigned a TI of 21 based on the shielding evaluation summarized in Section 5.1.4." Although conservative, the staff finds this statement to be inaccurate as it does not pertain to the LACBWR fuel. Update the SAR with clarifying information about the TI.

This information is necessary to determine compliance with 10 CFR 71.47.

NAC International Response

Section 1.0, page 1-1, is revised to state that the listed TI is assigned based on uncanistered (directly loaded) and canistered contents per analysis summarized in Section 5.1.4 and Section 5.6 and that the listed TI represents the maximum (bounding) TI for any content.

As noted by the review staff, the TI for the LACBWR fuel content is stated to be 2 in Section 5.6

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-2 Provide a more detailed definition of the Dairyland Power Cooperative La Crosse BWR fuel in addition to the information provided in Tables 1.4-4 and 1.4-5.

Provide parameters such as: fuel type, lattice, maximum active fuel length, minimum initial enrichment, number of fuel rods per assembly, fuel rod OD, minimum cladding thickness, pellet diameter, etc. The table should be similar in nature to that given in Tables 5.6.2-1 and 6.8.2-1.

This information is necessary to determine compliance with 10 CFR 71.33(b).

NAC International Response

The additional information requested is included in the NAC-STC SAR by modification of Table 1.4-4. A footnote has been added to indicate potential presence of zirconium shroud compaction debris in the Allis Chalmers and Exxon fuel assemblies.

Not all data from Table 5.6.2-1 is included, as a number of data points, i.e., the height of individual source regions, have only minimal dose impact and margins to limits are large.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-3 Provide additional information justifying the condition of the package assumed for the NCT shielding analysis.

Provide information justifying that the condition of the impact limiters after the tests for NCT as specified in 10 CFR 71.71 is consistent with what was assumed in the shielding analysis during NCT. In addition, provide information clarifying the statement on page 5.6.3-2 of the SAR that states that "the impact limiter diameter [is] truncated to match the diameter of the neutron shield shell." Clarify why, in Figure 5.6.3-2 of the SAR, it appears as though this is only performed for the upper and not lower impact limiter.

This information is needed to satisfy the requirements of 10 CFR 71.43(f), 71.51(a)(1), and 71.71.

NAC International Response

Text to address the NCT configuration of the cask is added to Section 5.6.3.2 and Section 5.6.3.3.

Section 5.6.3.2: "Cask internals, including the aluminum canister spacers, are designed to retain positive safety margins through all transport conditions, including normal conditions of transport (NCT) 10 CFR 71.71 evaluations, and remain in their as-evaluated configuration."

Section 5.6.3.3: "10 CFR 71.71 temperature, pressure, vibration, and water spray conditions have no effect on the geometry of the cask per structural analysis presented in Chapter 2. Also documented in Chapter 2 is the potential for the steel cylinder penetration to result in a localized crush of 0.57 inch of the impact limiter, with no penetration. There is no effect on the cask body or neutron shield from the penetration condition. As there is no decrease in the amount of impact limiter shield material associated with the cylinder drop—only crush—and the model removed a significant amount of radial and axial material from the limiters, the as-modeled cask bounds the post-cylinder drop NCT cask configuration. Cask free and corner drops similarly may deform the impact limiters, but do not remove shield material from the system. Deformation of the impact

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

limiters during NCT documented in Section 2.11.6.15 of the NAC-STC SAR results in a configuration bounded by the truncated limiters shown in Figure 5.6.3-2. Cask internals, including the aluminum honeycomb spacers, are designed to retain positive safety margins through all transport conditions, including NCT 10 CFR 71.71 evaluations, and remain in their as-evaluated configuration."

Both top and bottom impact limiters were truncated in the analysis models, as documented in the sample input file shown in Figure 5.6.6-3 macrobody surfaces 656 and 657. Figure 5.6.3-2 is corrected to conform to the NAC-STC SAR statement and computer model.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-4 Define and justify the assumptions used for the lead slump in the shielding analysis.

Section 5.6.3.3 (page 5.6.3-2) of the SAR states that an account was made for the radial and axial lead slump due to the 30-foot drop. Define and justify the amount of lead slump assumed in the analysis.

This information is needed to satisfy the requirements of 10 CFR 71.51(a)(2) and 71.73.

NAC International Response

Section 5.6.3.3 is revised to include a reference to Section 3.4.1.1.1.2 where the initial cool-down lead gap is derived. The section is further augmented with a text discussion on the resulting slumps.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-5 Provide additional information justifying the uniform moderator density assumption for the source term calculations.

Section 5.6.2.3 of the SAR states: "The axial source profile applied in the shielding evaluation is based on a single in-lattice (core outlet) and out-lattice (core inlet) moderator density (see Table 5.6.2-2)." Clarify this statement. It is unclear to the staff what the single value of the moderator density is. The SAS2H input files in Figures 5.6.6-1 and 5.6.6-2 use the core outlet (0.434 g/cm^3) moderator density to generate the source term. Provide additional justifying information that the uniform density assumption is conservative. Include information about the energy spectra of the neutrons and gammas. Table 5.6.2-10, as well as Figures 5.6.2-4 through 5.6.2-6, show comparison in terms of gammas or neutrons per second and do not display any information about the energy spectra.

This information is needed to satisfy the requirements of 10 CFR 71.33(b)(1).

NAC International Response

As stated in the quoted sentence, the source term is derived based on a single in-lattice value that is based on the core outlet water density that is listed in Table 5.6.2-2 to be 0.434 g/cm^3. As observed by the reviewer, this is the value that is included in Figure 5.6.6-1 and Figure 5.6.6-2. Bulk boiling is not typical between fuel channels; therefore, the core inlet density is used in the small inter-assembly region between channels. The core inlet density is listed in the referenced Table 5.6.2-2 as 0.723 g/cm^3. As the sentence was not clear to the review staff, it has been reworded.

The SAR is revised to add Tables 5.6.2-11 through 5.6.2-13 containing the energy line comparison for data shown in Table 5.6.2-10. Text is added to Section 5.6.2.3 discussing the added tables and justifying the bounding nature of the design basis source.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-6 Provide additional information on the locations of the dose calculations.

Provide the dimensions of the transport vehicle as well as the location of all of the dose points where doses are calculated in Tables 5.6.1-1 through 5.6.1-4 of the SAR. Since the SAR specifies the use of surface detectors, it is not clear to the staff that the dose is being calculated in places where it is peaking and where there is streaming.

This information is needed to determine that the limits in 10 CFR 71.47 are met.

NAC International Response

The assumed 124-inch width of the transport vehicle is added to Section 5.6.3.4. This dimension is smaller than the 128-inch diameter of the balsa impact limiters defined in NAC License Drawings 423-257 and 423-258. As the impact limiters are expected to remain within the boundaries of the railcar bed (see NAC License Drawing 423-901), the use of the 124-inch dimension is conservative. Axial dimensions are taken from the modeled impact limiter surface and, therefore, do not require the railcar length.

The size of the surface detectors being applied is provided in Table 5.6.3-2 and Table 5.6.3-4 when used in conjunction with the modeled dimensions specified in Figure 5.6.3-2. This definition set translates into the following tables for radial, top, and bottom detectors (tallies).

Radial Tally

Inner Radius [cm]	Axial				Azimuthal		Total Div
	Lower [cm]	Upper [cm]	Div	Band [cm]	Div	Start Angle	
124.8140	-140.6890	458.8494	20	29.9769	1	0.0000	20
124.9140	155.2956	185.7756	1	30.4800	24	0.0000	24
125.0140	-55.1180	-32.2581	1	22.8599	24	0.0000	24
155.2940	-171.1690	489.3294	22	30.0227	1	0.0000	22
224.8140	-240.6890	558.8494	25	31.9815	1	0.0000	25
357.4800	-340.6890	658.8494	30	33.3179	1	0.0000	30
524.8140	-540.6890	858.8494	40	34.9885	1	0.0000	40

NAC International Response to RAI 5-6 (cont'd)

Top Tally

Axial [cm]	Radial Inner [cm]	Radial Outer [cm]	Radial Div	Radial Band [cm]	Azimuthal Div	Azimuthal Start Angle	Total Div
458.8494	0.0000	124.8140	10	12.4814	1	0.0000	10
489.3294	0.0000	155.2940	10	15.5294	1	0.0000	10
558.8494	0.0000	224.8140	10	22.4814	1	0.0000	10
658.8494	0.0000	324.8140	10	32.4814	1	0.0000	10
858.8494	0.0000	524.8140	10	52.4814	1	0.0000	10

Bottom Tally

Axial [cm]	Radial Inner [cm]	Radial Outer [cm]	Radial Div	Radial Band [cm]	Azimuthal Div	Azimuthal Start Angle	Total Div
-140.6890	0.0000	124.8140	10	12.4814	1	0.0000	10
-171.1690	0.0000	155.2940	10	15.5294	1	0.0000	10
-240.6890	0.0000	224.8140	10	22.4814	1	0.0000	10
-340.6890	0.0000	324.8140	10	32.4814	1	0.0000	10
-540.6890	0.0000	524.8140	10	52.4814	1	0.0000	10

The surface division set was deemed sufficient, as the cask bulk shielding is symmetric with streaming/shield transition regions being limited to the neutron shield/impact limiter interface regions (also contain the lower trunnion pocket region). In areas of streaming concern, in particular the lower trunnion region, the surface detectors were broken up into angular sections to capture any streaming potential. Similarly, an angular breakdown was obtained at the cask center region to assess any streaming through the neutron shielding/heat fin structure.

Locations of maximum dose rates for results presented in Section 5.6.1 tables are available in the Section 5.6.4 dose profiles. These plots indicate that maximum cask radial surface dose rates are obtained at the fuel peak burnup/source location in the center of the cask and that axial dose rates are maximum at the center of the impact limiter or cask lid (depending on NCT or HAC analysis configuration).

NAC International Response to RAI 5-6 (cont'd)

Note that the LACBWR canister is located within the central cask region (located there by spacers), minimizing the effects of any potential streaming through the shield configuration near the top and bottom of the cask cavity. Therefore, the dose profiles shown in Section 5.6.4 were expected. Further note that the resulting dose rates from the NAC-STC LACBWR analysis are a small fraction of licensing limits and that refining the mesh to any practical extent is not expected to produce significant changes in the presented results.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-7 Provide additional information about the assumptions used for the NS-4-FR in the shielding analysis under HAC.

Provide additional information explaining the basis for the assumed remaining elements of the NS-4-FR after an HAC fire. Provide the basis for determining that there will be boron left and how much, and that it would still be equally distributed throughout the original space where the neutron shield was.

This information is needed to satisfy the requirements of 10 CFR 71.51(a)(2) and 71.73.

NAC International Response

NS-4-FR is a fire-resistant solid neutron shielding material. The boron included in the shield is composed of boron carbide, which is not flammable and does not "melt" under accident conditions. 10 CFR 71.73 accident condition puncture may locally compromise the neutron shield shell, but will not remove significant portions of the shell material. There is, therefore, no expectation that applying the 10 CFR 71.73 fire to the exterior of the neutron shield shell will remove boron from the system. Furthermore, as gases have been removed from the analysis model, in particular all hydrogen, the moderator that will allow the neutrons to be thermalized is removed making the distribution of boron in the shield inconsequential to the analysis (note that maximum radial dose rate is calculated at under 10 mrem/hr versus the 1,000 mrem/hr limit).

A number of experimental studies have been made of NS-4-FR under fire conditions. General Atomics published report GA-A20770 in September 1992 titled "Thermal Testing of Solid Neutron Shielding Materials." In this report, results are presented for NS-4-FR under direct 10 CFR 71.73 conditions (including 800°C temperature and localized shell damage) that demonstrate only surface material changes (1/8- to 3/16-inch thick) with a material loss of 6 percent. This compares to a 50 percent material loss consolidated in the analysis.

No SAR pages are changed as part of this response.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-8 Provide a representative output file for the source and shielding analyses.

This information is needed so the staff can ensure that proper convergence is achieved and that the calculated radiation levels from the output files agree with those reported in the text.

This information is necessary to ensure compliance with 10 CFR 71.47 and 71.51.

NAC International Response

Output files from the shielding and source term analysis are transmitted as proprietary documents as a response to this RAI.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 5.0 – SHIELDING REVIEW

5-9 Provide additional information on the package design parameters.

Section 5.6.3.3 of the SAR states that: "Features common to both the normal and accident conditions models are the inner lid vent and drain ports, the inner lid neutron shield, the bottom forging neutron shield, the annular expansion foam region below the neutron shield (modeled conservatively as void), radial neutron shield heat fins, and the lower rotating trunnions." The staff requires additional information on the geometry of "the annular expansion foam region" and the "radial neutron shield heat fins." Provide additional information on the geometry of these design features and reference a drawing number.

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

NAC International Response

A note is added to Figure 5.6.3-2 pointing to NAC License Drawing 423-802 for cask body detail, including information on the neutron shield fins, expansion foam regions, and trunnions. Also included is a reference to NAC License Drawings 423-803 and 423-805 for cask inner and outer lid details and NAC License Drawings 423-257 and 423-258 for upper and lower impact limiter details.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 6.0 – CRITICALITY REVIEW

6-1 Provide additional information on the package design parameters.

Include a drawing that specifies the top and bottom neutron shield thickness and location within the lid geometry, dimensions of the radial lead and neutron shields, and thickness of steel on the top and bottom (axial locations) of the cask (be specific about dimensions, e.g., include height, radius, and distance from the center of the cask). Provide the thickness of the lead shield and its inner and outer radius. Include design tolerances.

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

NAC International Response

NAC License Drawing 423-802, included in the NAC-STC SAR, contains detailed cask body geometry information, including tolerances. Lid geometry detail is provided in NAC License Drawings 423-803 and 423-805. Cask spacers axially locating the canister in the cask are defined in NAC License Drawings 455-820 and 630045-820 per cask assembly License Drawing 630045-800. A note to this effect is added to Figure 6.8.3-4.

Figure 6.8.3-4 is revised to add a subset of dimensions relating to the radial shield configuration modeled. As the axial neutron shields are significantly outside the fuel region, they are not considered significant to the criticality safety analysis of the system, and dimensions are not included in the sketch. The analysis accounted for the volume of the NS-4-FR axial shield and conservatively filled the volume with void in the model (maximizes neutron interaction in the array and/or reflection from cask and exterior materials by removing borated hydrogen containing material). The paragraph titled "Transport Cask Model" in Section 6.8.3.2.1 and Figure 6.8.3-4 are revised to clarify the cask geometry modeled.

Note that Figure 6.8.3-4 contained dimensions in centimeters. The sketch was changed to inches consistent with the note and the other figures and license drawings.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 6.0 – CRITICALITY REVIEW

6-2 Identify any established codes and standards used in the criticality design and control.

Identify, describe, and justify the basis for any established codes and standards proposed for use.

This information is needed to satisfy the requirements of 10 CFR 71.31(c).

NAC International Response

Codes and standards specific to the criticality analysis primarily invoke the validation and application of the computer codes employed. Relevant information on the computer codes application is included in Section 6.8.5 of the NAC-STC SAR.

Design and fabrication codes and standards requirements on the cask are primarily related to the structural analysis of the cask, TSC, and basket and are, therefore, contained in Chapter 2 of the NAC-STC SAR.

As defined in 10 CFR 71.31(c), NAC has described and justified the basis and rationale used to formulate the package quality assurance program in Section 1.3.1 of the NAC-STC SAR.

No SAR pages are changed as part of this response.

**NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION**

CHAPTER 6.0 – CRITICALITY REVIEW

6-3 Provide additional information about the criticality analysis for NCT.

Provide additional information demonstrating that a single package under NCT is subcritical or demonstrate that the infinite array calculations presented in Chapter 6 of the SAR bound that of a single package under NCT.

This information is needed to satisfy the requirements of 10 CFR 71.55.

NAC International Response

Undamaged and damaged fuel assembly sections are revised to include single package analysis consistent with 10 CFR 71.55. Results are included for the most reactive physical configuration with optimum moderation with cask and containment fully water reflected as required by 10 CFR 71.55. Cask containment is the inner shell. No operating condition will remove the lead shell and the cask outer shell. In compliance with the regulation, the case of a fully water reflected containment system is nevertheless included.

Note that in the revised Chapter 6 of the NAC-STC SAR, the NCT array cases are based on a dry cask interior and no interspersed moderation. This is consistent with the undamaged form of the containment boundary per structural analysis, 10 CFR 71.59(a)(1) and NUREG-1617, Section 6.5.5.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 6.0 – CRITICALITY REVIEW

6-4 Provide additional information on the assumptions used for the criticality analysis for the package under NCT.

It is unclear if the impact limiter was modeled for the criticality analysis of the package under NCT.

This information is needed to satisfy the requirements of 10 CFR 71.55(d).

<u>NAC International Response</u>

Section 6.8.3.2.1, Calculation Model, subsection "Transport Cask Model" is revised to include additional description of the cask configuration used in the construction package and array NCT and HAC models. Section 6.8.3.2.2 is revised to include a "Cask/Cask Array Modeling" section.

Included in these revisions is the clarification that impact limiters are not included in the model. Removal of the impact limiters allows a closer approach of casks within the array calculations and a closer reflection of full density water for single package/cask cases. The limiters are located outside significant axial shields provided by the TSC lid and bottom plate and the cask lids and bottom weldment. Presence, or absence, of the limiters will not significantly affect analysis results.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 6.0 – CRITICALITY REVIEW

6-5 Provide clarifying information about a statement in Section 6.8.3.2.2.

Clarify the following statement in regard to assumption (g) about the canister lid modeling under "Basket and Canister Modeling" in Section 6.8.3.2.2: "While potentially affecting transport calculations due to the change in calculated cavity length, and the corresponding component axial shift, there is no effect on storage calculations as fissile material is located at the bottom of the canister cavity."

This information is needed to satisfy the requirements of 10 CFR 71.55.

NAC International Response

This note was incorrectly retained from the storage application. The assumption is removed, as the transport calculations located the lid at the drawing specified location. Axial material shift is addressed in the limiting (DFC) configuration. The axial spacer, located at the underside of the canister lid, and the structure of the DFCs assure that undamaged fuel assemblies are covered neutron absorber regardless of shift.

Note that assumption h) was removed in conjunction with this RAI, as it also did not apply to the transport cask models.

**NAC INTERNATIONAL RESPONSE
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CHAPTER 6.0 – CRITICALITY REVIEW

6-6 Provide additional information on the modeling of the canister spacers for the criticality analysis.

As stated on page 1.4-7 of the SAR, there are three aluminum honeycomb spacers placed above and below the canister. State what materials were used when modeling these spacers for the criticality analysis and justify that this would give maximum reactivity of the cask configuration. Specifically, provide information about what assumptions about flooding were used when calculating the maximum reactivity presented in Table 6.8.1-2. Demonstrate that the most optimal flooding condition was found.

This information is needed to demonstrate that the applicant has determined the maximum reactivity of the system per the requirements of 10 CFR 71.55(b).

NAC International Response

Section 6.8.3.2.2 is revised to include a "Cask/Cask Array Modeling" section. This section contains item b) that provides the justification for the material selection of the spacer region. The spacer volume is filled canister to cask gap material and is set to the canister internal moderator in the baseline analysis (e.g., void for the dry canister maximum reactivity DFC case). Maximum system reactivity was determined for both wet and dry canister to cask gaps.

NAC INTERNATIONAL RESPONSE
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CHAPTER 6.0 – CRITICALITY REVIEW

6-7 Provide a representative output file for the criticality analysis.

The staff needs this information to determine that the multiplication factors from the output files agree with those reported in the evaluation. In addition the staff needs this information to verify that the calculation passed important statistical checks and has appropriate convergence behavior.

This information is necessary to determine compliance with 10 CFR 71.55(b).

NAC International Response

Output files for the maximum reactivity cases listed in revised Table 6.8.1-2 are included as proprietary information in an attachment to the RAI responses.

NAC INTERNATIONAL RESPONSE
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CHAPTER 6.0 – CRITICALITY REVIEW

6-8 Provide additional information demonstrating that the damaged fuel model is conservative for the criticality analysis.

Section 6.8.4.2.6 of the SAR states that the homogenous mixture cases presented in Table 6.8.4-10 are less reactive than the heterogeneous cases. However, the staff cannot find a direct comparison. Provide information justifying this statement. Include such information as the assumptions (internal and external moderation, component shift, combined tolerance model, NCT, HAC, etc.) in the calculations shown in Table 6.8.4-10. Additionally, provide other calculations that were compared to when determining a conservative configuration of the damaged fuel model.

This information is necessary to determine compliance with 10 CFR 71.55(b) and 71.83.

NAC International Response

A direct comparison of the three DFC content configurations described in Section 6.8.4.2.6 (renumbered to a subsection of 6.8.4.2.2) is added to the section. The comparison is composed of the maximum reactivity cases from Table 6.8.4-9 through Table 6.8.4-11. A similar comparison is added to the preferential flooding most reactive configuration confirmation section. Both tables demonstrate that the unclad rod/loose pellet case is bounding.

The first paragraph of Section 6.8.4.2.2 is modified to include the discussion on cask configuration for the cases represented in Table 6.8.4-9 through 6.8-4-11. As stated in the previous paragraph, a comparison table is added to confirm that at preferential flooding, the reactivity of the unclad rods/loose pellet case is bounding.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 6.0 – CRITICALITY REVIEW

6-9 Provide additional information justifying that the interstitial and boundary conditions for the criticality array calculations are conservative.

a. Page 6.8.4-1 of the SAR states that "reflective boundary conditions are applied to an independently generated cylindrical body surrounding the cask body." The staff finds that applying reflective surfaces to a cylindrical geometry may be inappropriate for this purpose since it would not simulate array conditions. Justify that the cylindrical reflecting surface is representative or bounding of any square or hexagonal array configurations.

b. Provide additional information justifying the distance of separation of the casks for array conditions.

This information is needed to satisfy the requirements of 10 CFR 71.59(a).

NAC International Response

Analysis results in Section 6.8.4 are revised to provide a complete set of reactivities for boundaries including cylindrical, square, and hexagonal reflectors at two distances (0.5 and 20 cm). As the CSI is set to 100 based on HAC analysis of a single cask, fully water reflected, boundary, the enclosing body is not relevant to the analysis beyond providing sufficient distance to provide for full water reflection. Normal condition reactivities are low as the system has a dry interior and exterior. Low enriched fuel such as that proposed for the STC-LACBWR system will not achieve a critical configuration without moderator.

NAC INTERNATIONAL RESPONSE
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CHAPTER 6.0 – CRITICALITY REVIEW

6-10 Correct an information discrepancy relating to the value of the CSI in the SAR.

Page 1-1 of the SAR states: "The Criticality Safety Index (CSI) is zero, since an infinite number of packages with optimum moderation remain subcritical." This statement is inaccurate for the LACBWR fuel. Section 6.8.1 (page 6.8.1-2) of the SAR states that the CSI is 100. Correct the discrepancy.

This information is necessary to determine compliance with 10 CFR 71.59(b).

NAC International Response

Page 1-1 is revised to state that a zero CSI is applicable to the uncanistered (directly loaded) system and Yankee-MPC and CY-MPC systems, and that the CSI for the MPC-LACBWR system is 100.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 7.0 – PROCEDURES OF OPERATIONS REVIEW

7-1 Add a more complete description for the drying process to the operating procedure in SAR Section 7.6.1.

Currently SAR Section 7.6.1 step 12 states: "Vacuum dry the canisters until dryness criterion are met." This is insufficient. Steps including isolation of the pump, and criteria such as hold times and pressures should be included.

This information is needed to satisfy regulation 10 CFR 71.43(d).

NAC International Response

Section 7.6.1, Step 12, has been revised to add additional details and dryness acceptance criteria. It should be noted that the canister dryness verification is performed and verified in accordance with the proposed Amendment 6 to the storage Certificate of Compliance No. 72-1025, Technical Specifications, Appendix A, Limiting Conditions for Operations (LCO) A 3.1.2 for all NAC-MPC design types (e.g., Yankee Rowe, Connecticut Yankee and Dairyland Power Cooperative [MPC-LACBWR]) and the detailed procedures provided in Chapter 8 of the NAC-MPC Final Safety Analysis Report (FSAR).

Section 7.6.1, Step 13, has been revised for clarity.

NAC INTERNATIONAL RESPONSE
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CHAPTER 8.0 – ACCEPTANCE TESTING AND MAINTENANCE PROGRAM REVIEW

8-1 Perform the helium leak test on the entire containment boundary of the Model No. NAC-STC.

SAR Section 8.1.3, Leak Tests, does not commit to performing the leak test on the entire containment boundary including base metal. It appears to limit the leak tests to welds, O-rings and plugs.

ANSI 14.5-1997 suggests that the fabrication leak test be performed on the entire containment boundary. Also, 10 CFR 71.51(a)(1) requires that package must be designed, constructed, and prepared for shipment so that there would be no loss or escape of radioactive contents as demonstrated to a sensitivity of 10E-6 per hour under the tests specified in 10 CFR 71.71. One way of demonstrating this requirement is to leak test the entire containment boundary to leaktight conditions.

This information is needed to satisfy regulations 10 CFR 71.51. and 71.71.

<u>NAC International Response</u>

The leakage test requirements in Section 8.1.3 have been revised to clarify that helium leakage testing of the entire NAC-STC containment boundary, including base metal, will be performed in accordance with ANSI N14.5-1997 to leaktight conditions following the hydrostatic testing of the containment vessel and prior to lead pouring. In addition, a final leakage test of the closure seals will be performed prior to final acceptance of the cask based on the type of containment seals utilized (e.g., metallic or Viton), with appropriate leakage test acceptance criteria specified in accordance with the allowable leakage rates defined in Chapter 4, Containment, of the NAC-STC SAR.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

CHAPTER 8.0 – ACCEPTANCE TESTING AND MAINTENANCE PROGRAM REVIEW

8-2 Clarify the use of Viton O-rings in the Model No. NAC-STC with LACBWR contents and their ability to meet the leaktight criteria.

Drawing 871, Rev. 1, identifies Viton O-rings for use on the vent and drain ports. In SAR Section 8.1.3, under "Viton O-ring Testing," the applicant states that they are only leak tested to a sensitivity of 4.7 E-5 cm^3/sec (helium), which does not meet the ANSI 14-5 leaktight criteria.

This information is needed to satisfy regulation 10 CFR 71.51.

NAC International Response

The NAC-STC containment boundary for canistered contents, including the MPC-LACBWR TSC, is sealed by redundant metallic seals that provide a leaktight containment. The NAC-STC containment seals are defined on NAC Drawing Nos. 423-800, Cask Assembly – NAC-STC Cask; 423-803, Lid Assembly – Inner, NAC-STC Cask; and 423-804, Details – Inner Lid, NAC-STC Cask. These drawings have been revised to clarify that the metal seal assembly (Assembly 98 on all drawings) is mandatory for canistered contents such as MPC-LACBWR, YR-MPC and CY-MPC TSCs. The applicable NAC-MPC transport assembly drawings (NAC Drawings 630045-800, 455-801 and 414-801) have also been reviewed and revised as warranted to ensure the correct reference to the metal seal assembly for the NAC-STC transportation cask for canistered contents. It is noted that the nonmetallic Viton O-ring containment boundary seals are only authorized for 'bare fuel' directly loaded (e.g., noncanistered) for immediate transport.

NAC Drawing 630045-871 applies to the closure lid of the MPC-LACBWR Transportable Storage Canister (TSC). The Viton O-rings are installed with the vent and drain port quick-disconnect valved nipples in the TSC closure lid vent and drain ports. These seals are not containment or confinement components, and are provided for operational use only to allow in-plant operating systems connections to the TSC (e.g., vacuum drying system, helium backfill, etc.). These seals are closed by redundant welded port covers prior to loading the MPC-

NAC International Response to RAI 8-2 (cont'd)

LACBWR TSC into the NAC-STC cask for transport. Drawing No. 630045-871 has been reviewed and updated to correct or remove incorrect or superfluous information. The revised drawing is provided.

The following revised drawings are submitted for incorporation into the STC-LACBWR SAR amendment.

423-800, Rev. 15	Cask Assembly – NAC-STC Cask
423-803, Rev. 9	Lid Assembly – Inner, NAC-STC Cask
423-804, Rev. 9	Details – Inner Lid, NAC-STC Cask
455-801, Rev. 4	Assembly, Transport Cask, NAC-MPC
414-801, Rev. 2	Cask Assembly, NAC-STC, CY-MPC
630045-871, Rev. 2	Details TSC, MPC-LACBWR