

LTR-LCPT-17-03-Rev1-NP Attachment

Application for Certificate of Compliance for the Traveller PWR Fuel Shipping Package

NRC Certificate of Compliance  
USA/9297/AF-96  
Docket 71-9297

Safety Analysis Report, Revision 13

# **Application for Certificate of Compliance for the Traveller PWR Fuel Shipping Package**

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## RECORD OF REVISIONS

<u>Rev. No.</u>	<u>Date</u>	<u>Description of Revision</u>
0	March 2004	Original application. (Ref: NMS-NRC-04-004)
1	November 2004	Response to NRC request for additional information. (Ref: NMS-NRC-04-009, NMS-NRC-04-011)
2	February 2005	Response to NRC request for additional information. (Ref: NMS-NRC-05-002)
3	March 2005	Response to NRC request for additional information. Correct one error, revise certain tables to make the SAR parameter tables consistent with those that will be published in the CoC, clarify the results of the rod container analysis, and clarify the maintenance requirements for the shock mounts. (Ref: NMS-NRC-05-003)
4	March 2005	Response to NRC request for additional information. Correct entries in various tables that list the Traveller design weights. Clarify in Sections 2 and 3 that the shock mounts were intact following the drop and fire tests. Provide justification in Section 2 for establishing payload weights that are higher than fuel assembly weights used in actual testing. (Ref: NMS-NRC-05-004)
5	March 2006	Information about loose rod pipe packaging in license drawings and revision to Safety Analysis Report to describe this new loose rod pipe packaging. (Ref: UAM-NRC-06-005)
6	September 2006	A packaging component used to secure these non-Westinghouse fuel assembly types in the Traveller was designed after approval of the Traveller. Information about packaging components used to secure the contents. (Ref: UAM-NRC-06-011)
7	October 2007	Response to NRC request for additional information. Added sketch of package in Chapter 1 and revised Section 1.1 Revised Sections 2.6.3 and 2.6.4 to delete reference to calculations because the package is not sealed against pressure. Revised Section 2.7.1.2 regarding test sequence justification. Revised Section 8.2.3.3 to clarify shock mount inspection frequency. Revised Section 8.2.5 to clarify BORAL plate inspection frequency. Administrative change to Table 6-21, showing the correct number of fuel and non-fuel rods in a 15x15 STD/OFA fuel assembly. (Ref: LCPT-10-6)
8	May 2010	Add CE16NGF and CE16VA fuel assemblies to criticality safety evaluation. (Ref: LCPT-10-14)

**RECORD OF REVISIONS (cont.)**

<u>Rev. No.</u>	<u>Date</u>	<u>Description of Revision</u>
9	November 2010	<p><u>Style and Composition</u>                      An appendix is added to each section of the application as recommended in Regulatory Guide 7.9 to provide a list of documents that are referenced in the text of that section. The addition of this first appendix may result in renumbering of headings and pages where other appendices already existed for that section. Typographical changes have also been made. <u>Section 1 – General Information</u></p> <p>1.2.1.2 Outerpack                      Added description of vibration and shock dampening system.</p> <p>1.2.1.3 Clamshell                      Revised to provide more detailed description of clamshell features, including a design change for an alternate top end plate. Figures were revised to show typical configurations for the axial restraint and axial spacer.</p> <p>1.2.1.4 Rod Container                      Removed rod box as an option.</p> <p>1.2.3 Contents                      Revised description to add more detailed description of fuel assembly and components that may be transported in the fuel assembly. Added a Figure 1-8 showing a typical PWR fuel assembly. Added wording to describe the number of rods per pipe and how the rods are loaded.</p> <p>1.4 Appendices                      Added Appendix 1.4.1, References.                      Renamed Appendix 1.4.2, Engineering Drawings for Packaging                      The engineering drawings for packaging Drawing No. 10004E58 Safety Related Items, Traveller XL and STD was revised to show modifications to the clamshell top end plate and changes to the outer pack such as silicone rubber weather gasket, tie down chain tray gussets, new swing bolts, and clamshell cam lock wave washer.</p> <p><u>Section 2 – Structural Evaluation</u></p> <p>2.12.3.2.4.1 Internal/External Pressure                      Added silicone foam rubber seal and removed description of seal function as providing thermal protection.</p> <p>2.12 Appendices                      Added Appendix 2.12.1, References                      Added Appendix 2.12.6, Supplement to Drop Analysis for the Traveller XL Shipping Package – Clamshell Axial Spacer Structural Evaluation.                      Added Appendix 2.12.7, Supplement to Drop Analysis for the Traveller XL Shipping Package – Clamshell Removable Top Plate Structural Evaluation.</p>

**RECORD OF REVISIONS (cont.)**

<u>Rev. No.</u>	<u>Date</u>	<u>Description of Revision</u>
9 (cont.)		<p><u>Section 3 – Thermal Evaluation</u>                      Revised introduction to clarify that there is no heat generating material. Tables 3-2 and 3-3 and bullets in the text were revised to be consistent with ASME Code</p> <p>3.1.3 Description of maximum temperatures                      Added silicone rubber gasket to Table 3-1, Summary Table of Temperatures for Traveller Materials</p> <p>3.1.4 Description of maximum pressures                      Added silicone rubber gasket.</p> <p>3.4 Thermal Evaluation Under Normal Conditions of Transport                      Revised to clarify that there is no heat generating material.</p> <p>3.5.3 Maximum Temperatures and Pressures                      Revised description of the purpose for seals used around the Outerpack door. Added silicone foam rubber as an acceptable seal material. Added Figure 3-8A to show location of weather seal gaskets.</p> <p><u>Section 4 – Containment</u>                      Added Section 4.3, Appendices, and 4.3.1 References. No references are cited.</p> <p><u>Section 5 – Shielding Evaluation</u>                      Added Section 5.1, Appendices, and 5.1.1 References. No references are cited.</p> <p><u>Section 6 – Criticality Evaluation</u>                      Section 6.2, Fissile Material Contents                      Added statement that reactor control cluster (RCC) assemblies, secondary source assemblies, and solid stainless steel rods that may be placed in the PWR fuel assembly are non-fissile material.</p> <p>6.2.1 PWR Fuel Assemblies                      Added justification for allowing RCC, secondary source rods, or stainless steel rods in fuel assembly contents.</p> <p>6.2.2 PWR and BWR Rods                      Revise limit for wrapping or sleeving in Table 6-5 Fuel Rod Parameters</p> <p>6.3.1.1 Contents Models                      Removed rod box as an option.</p> <p>6.10.2 PWR Fuel Assembly Parameters                      Revised dimensions for guide tube and pellet in Table 6-22 Parameters for 16X16 Fuel Assemblies</p> <p>6.10 Appendices                      Added Appendix 6.10.1, References</p> <p><u>Section 7 – Package Operations</u>                      Revised all sections to incorporate operating experience and more accurately represent the current package operations.                      Added Section 7.4, Appendices, and 7.4.1 References. No references are cited.</p>

**RECORD OF REVISIONS (cont.)**

<u>Rev. No.</u>	<u>Date</u>	<u>Description of Revision</u>
9 (cont.)		<p><u>Section 8 – Acceptance tests and Maintenance Program</u>                      Replace “poison plate” with term “neutron absorber plate”, and replace “neutronics testing” with term “neutron absorber testing” to standardize reference to BORAL neutron absorber material.                      Add criteria for visual inspection of neutron absorber plates to Section 8.2.5.                      8.1.5.1.4 Thermal Properties                      Thermal properties is revised to show the thermal conductivity for FR-3706, FR-3610, and FR-3620.</p>
10	September 2013	<p><u>Style and Composition</u>                      A number of typographical errors throughout the entire document have been corrected in this revision.                      A side result of the typographical corrections has been the addition of several pages, in order to accommodate paragraphs or figures which no longer had room to fit on the pages they previously occupied.  <u>Section 1 – General Information</u>                      1.2.1.1 Package Types                      Revised weights of packages where required.                      1.2.1.4 Rod Pipe                      Further corrections added to clarify that the Rod Pipe will be the only rod container moving forward.                      1.4.2 Engineering Drawings for Packaging                      Included the most recent revisions to the licensing drawings  <u>Section 2 – Structural Evaluation</u>                      Updated equations and weights throughout the Section.                      2.11.1 Rod Pipe                      Further corrections added to clarify that the Rod Pipe will be the only rod container moving forward.                      2.12 Appendices                      Revised the appendices to provide an updated structural analysis which accounts for the revised weight of the Traveller package.                      2.12.3.2.2 Lifting                      Provided additional information on Traveller STD four-point lift.                      Tables 2-7, 2-8, and 2-9                      Removed, as the information was either already present or was consolidated elsewhere.  <u>Section 6 – Criticality</u>                      6.1.2, and 6.1.3                      Corrections added to clarify that the Rod Pipe will be the only rod container moving forward.                      Figure 6-17                      Replaced with the correct figure.  <u>Section 7 – Package Operations</u>                      7.1.1.3                      Clarification and consolidation of information.                      7.1.2, 7.12.1, and 7.2.2                      Added tolerances for Torque figures.</p>

**RECORD OF REVISIONS (cont.)**

<u>Rev. No.</u>	<u>Date</u>	<u>Description of Revision</u>
10 (cont.)		<u>Section 8 – Acceptance Tests and Maintenance Program</u> Clarification and consolidation of information.
11	December 2013	<u>Section 1 – General Information</u> 1.2.1.3 Maximum Quantity of Material per Package Revised allowable weight for packing materials which are equivalent to polyethylene.
12	March 2015	Addition of the Traveller-VVER packaging with VVER fuel assembly contents in each chapter as required for design approval. Chapters 1, 2, 3 and 6 contain majority of the content addition (including Sections 1.2.1.1.3 and 1.2.1.3, Section 2.12.8, Section 3.3.1.1, and Section 6.10.11).  Addition of tie-down detail calculations (Section 2.12.3.2.3). Revision of text to clarify acceptable seal materials, however no changes to materials made (Chapter 2 and Chapter 8).  Minor style and composition, non-technical edits made throughout SAR to clarify text.
13	January 2017	Complete revision of Section 6, including development of bounding fuel parameters defined for each fuel bin as categorized fuel assemblies (CFAs), which represent a combination of fuels, as discussed in Sections 6.9.2 and 6.2. Revision of method for establishing subcriticality, by evaluation of uncertainties as independent sensitivities and accumulation of penalties, as discussed in Section 6.3.4. Updated code version to SCALE 6.1.2, and SCALE model of Traveller packaging, as discussed in Section 6.3.  Clarifications added to Sections 1, 4, 5, 7, and 8, major details have not changed. Sections 1, 4, 5, 7, and 8 are fully updated to Revision 13 pages and change bars are not used. Sections 7 and 8 include additional details to represent current usage of the packages, and activities that are applicable to all sites that use the packages.  Section 2 and 3 include an update to reference sections to address the update of IAEA regulations, as incorporated by 49 CFR 171.7. Section 2.12.8.3 (pages 2-240 – 2-240C) includes additional details of the VVER fuel assembly performance expectations resultant of the previously defined Traveller VVER FEA. New Section 2.12.9 has been added to discuss performance comparison of zirconium alloys. Section 3.2.1 and tables have been revised to incorporate additional material property references. Section 3.6.5.1 (pages 3-46, 3-46A) includes additional details of the condition of the moderator block after fire testing, as justification to support the evaluations defined in Section 6.3.4.3.3.

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### TRAVELLER SAFETY ANALYSIS REPORT ACRONYM LIST

Acronym	Definition	Acronym	Definition
ASME	American Society of Mechanical Engineers	NCT	Normal Conditions of Transport
ANSI	American National Standards Institute	NFD	Nuclear Fuel Division of Westinghouse
ASTM	American Society for Testing and Materials	OD	Outer diameter
AWS	American Welding Society	OR	Outer radius
BORAL	Borated aluminum	PWR	Pressurized water reactor
BWR	Boiling water reactor	QC	Quality control
CFA	Categorized fuel assembly	QTC	Qualified test unit
CFR	Code of Federal Regulation	SAR	Safety Analysis Report
CG	Center of gravity	SS	Stainless steel
CS	Clamshell	SSR	Specific Safety Requirements
CSI	Criticality safety index	TE	Total energy
CTE	Coefficient of thermal expansion	UHMW	Ultra-high molecular weight
CTU	Certified test unit	UNC	Unified thread coarse
DFT	Directional flame thermometers	USL	Upper subcritical limit
DTE	Differential thermal expansion	WtF	Water-to-Fuel
EALF	Energy of average lethargy causing fission		
FA	Fuel assembly		
FAA	Federal Aviation Administration		
FEA	Finite Element Analysis		
FEM	Finite Element Model		
GT/IT	Guide tubes/instrument tubes		
HAC	Hypothetical Accident Conditions		
IAEA	International Atomic Energy Agency		
ICRP	International Commission on Radiological Protection		
ID	Inner diameter		
IE	Internal energy		
IR	Inner radius		
KE	Kinetic energy		
$k_{eff}$	Effective neutron multiplication factor		
LEU	Low-enriched uranium		
LWR	Light-water reactor		

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