Westinghouse Electric Company
Nuclear Fuel
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USA

Director, Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
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Our ref: UAM-NRC-06-007
Your Ref: Docket No. 71-9297
TAC No. 123915

Attention: Document Control Desk

April 12, 2006

Subject: CERTIFICATE OF COMPLIANCE NO. 9297 FOR THE MODEL NO. TRAVELLER PACKAGE: Submission of Revision 5 to the Safety Analysis Report (SAR)

Additional information is provided to supplement information provided for technical review in the application request dated March 17, 2006 (Our ref: UAM-NRC-06-005).

This supplement revises license drawing 10006E58 to delete Sheet 1 for a 5 inch rod pipe and modify details for the 6 inch diameter rod pipe packaging and contents. In addition to increasing the weight limit for the 6 inch diameter rod pipe to 1650 lb (748 kg) in license drawing 10006E58 Revision 4, the item details were modified in Revision 5 of the license drawing. In addition Section 1.2.1.4 and Section 2.11.1 of the Safety Analysis Report are also revised to remove reference to a 5 inch rod pipe.

Please direct any questions to me at (803) 647-3552.

Sincerely,
WESTINGHOUSE ELECTRIC COMPANY, LLC

Norman A. Kent
Manager Transport Licensing and Regulatory Compliance
Nuclear Material Supply

Enclosures

Description and Justification of Proposed Changes
Proposed wording for Certificate of Compliance USA/9239/AF
Pages affected in License Application

UAM-NRC-06-007-Traveller SAR Rev 5_RAI.doc

By Federal Express

Information in this record was deleted
in accordance with the Freedom of Information
Act, exemptions 4
FOIA- 2007-213

D-3
NMSS01

Description and Justification of Proposed Changes

The TRAVELLER packages are being implemented to transport fuel rods that have been loaded into fuel assemblies, referred to as loose rods, between fuel fabrication facilities. The maximum weight of the rod pipe packaging and loose rod contents was stated as 660 lbs on the license drawing. This limit was based on the 5 inch diameter rod pipe with the maximum capacity loose rod contents. The option to use a 6 inch diameter rod pipe loaded with the maximum capacity loose rod contents weighs 1650 pounds and exceeds the 660 lb maximum allowed weight as specified on the licensing drawing. The 5 inch pipe product container is removed from the TRAVELLER application.

The package has been analyzed for hypothetical drop conditions of 10CFR71.73 for weight up to 1,971 pounds. In addition, the TRAVELLER STD has been analyzed and tested for normal transport weights between 600 pounds and 1,676 pounds. The TRAVELLER XL has been analyzed for normal transport of contents that weigh from 1,404 to 1,971 pounds. The TRAVELLER design utilizes two primary components that limit deformation and lattice expansion in the event of an accident. A clamshell confines the fuel assembly and an outerpack absorbs the impact energy from hypothetical accidents. The maximum capacity weight for a loaded rod pipe is less than the maximum contents weight that was analyzed for the TRAVELLER STD or a TRAVELLER XL.

When subject to the 9-meter drop described in 10CFR71.73, the rod pipe will be subject to dynamic drop loads similar to the loads experienced by the fuel assembly. The rod pipe is fit to conform into the clamshell axially with a rubber spacer, and is restrained laterally by the bent flanges with foam rubber "clamps" similar to retraining a fuel assembly at the spacer grid locations. Fuel assembly drop testing indicates the fuel assembly and clamshell were highly coupled to the extent that the clamshell bottom plate impacted the outerpack impact limiter with the kinetic energy of the fuel assembly and clamshell. The TRAVELLER response to the 9-meter HAC drop test resulted in the kinetic energy of the fuel assembly clamshell mass being absorbed by the outerpack impact limiter such that the strain damage to the fuel assembly and clamshell was minimal. Subsequent drop test inspections indicated that the clamshell retained its pre-test geometry and its structural integrity. Nearly all of the kinetic energy was absorbed by the outerpack impact limiter. A rod pipe having less mass than the tested fuel assembly will require the impact limiter to absorb less energy. It is concluded that the drop test mass of 1971 pounds is bounding, and the proposed maximum pipe mass of 1670 pounds will not effect the performance of the TRAVELLER as a result of a 9-meter HAC drop.

Pages affected in License Application

List of effective pages

Chapter 1 – General Information

Page 1-6

Deleted description to 5 inch diameter rod pipe.

Revised description of end closures for 6 inch rod pipe.

Page 1-6A

Deleted description of a 5 inch diameter rod pipe.

Changed last sentence to introduce a rod pipe whose total weight does not exceed 1650lb (748kg).

Appendix A

Drawing 10006E58, Rev. 5, "Shipping Package Loose Rod Pipe"

Sheet 1

1. In the BoM, remove Group 02, Item 02 and all associated BoM information (Part Name and Size).

2. Remove Group 02 and all associated views, associated notes and associated information.

Sheet 2

1. Move all Group 01 views and associated information to Sheet 1. Delete Sheet 2.

2. In Zone E7, remove the following text from the existing note: "FLANGE AND", "EACH" and "BOTH ENDS". The note should read

"END PLATE THICKNESS .25
STOCK PLATE MIN, TYP."

3. In Zones D5/C6, remove the text "OPTIONAL" from the existing note.

4. In Zone E4, remove the text "OPTIONAL" from the existing note.

5. In Zone D7/D8 add new leader and associated note to the flange similar to the sketch shown below:

FLANGE THICKNESS .25
STOCK PLATE MIN, TYP.

Drawing 10006E58, Rev. 4, "Shipping Package Loose Rod Pipe"

SHEET 1

1. Under the BoM, add text: "NOTES:"

2. Under the newly added "NOTES:", add note A as follows, "LOCATION OF OPTIONAL CENTER FLANGES AND TABS VARY TO ACCOMMODATE SHIPPING AND HANDLING OPERATIONS FOR ALL GROUPS."

3. Under the newly added "NOTES:", add note B as follows, "LOCATION OF OPTIONAL LIFTING PROVISIONS VARY TO ACCOMMODATE SHIPPING AND HANDLING OPERATIONS FOR ALL GROUPS."

4. In Zone G3, add text "OPTIONAL" in front of existing word "GASKET".

5. In D8, change "BREATHER VALVE LOCATION OPTIONAL" to "OPTIONAL BREATHER VALVE, LOCATION MAY VARY"

6. In ZoneD5, add text "(5" PIPE)" adjacent to existing text "GROUP 02".

7. In ZoneD5, change "167" to "200".

8. In Zone D4, add a balloon for item 2 with leader pointing to outside surface of pipe similar to below sketch:

9. In Zone E5/E6, add a depiction of an optional rectangular flange (approximately .22" thick), add a new break line (similar to existing break line which is shown in the sketch below, left of the flange, for clarity) right-adjacent to the new optional flange, and add the associated note as shown:

OPTIONAL .22" MIN THICK
FLANGE LOCATED AT
APPROXIMATE CENTER.
ADD TABS AS REQUIRED TO
ACCOMMODATE SHIPPING
AND HANDLING OPERATIONS.

10. In Zone G4, change weld callout from "TYP. BOTH ENDS" to "TYP ALL FALNGES".

11. In Zone D2, under dimension "6.50 ± .18" add new text "(OPTIONAL FLANGE NOT SHOWN)".

12. In Zone B2, under existing text "SECTION A-A", add new text "(OPTIONAL FLANGE NOT SHOWN)".

13. In Zones F6 and F4, add depiction of optional lifting provisions at approximate location as shown in the sketch below. For the lifting provision in Zone F6, add associated leader as shown :

14. In Zones F2 and D2, add depiction of optional lifting provision to both the end view (Zone F2) and section A-A view (Zone D2) by adding a small rectangle on the top surface similar to shown in the sketch below:

SHEET 2

1. In Zone E4, add text "OPTIONAL" in front of existing word "LIFTING".

2. In Zone D5, add text "OPTIONAL" in front of existing word "FLANGE", and add text "AND TABS" after existing word "FLANGE".

3. In ZoneC4, add text "(6" PIPE)" adjacent to existing text "GROUP 01".

4. In ZoneD4, change "166.5±.2" to "198 MAX".

5. In ZoneE4, change "167.1±.2" to "200 MAX".

6. In Zone C3, add a balloon for item 1 with leader pointing to outside surface of pipe similar to below sketch:

Chapter 2 - STRUCTURAL EVALUATION

Pages 2-32 and 2-32A

Changed heading for section 2.11.1 from Rod Box to Rod Container.

Revised weight and length of rod pipe.

Added description of performance of rod pipe and box for 9-meter impact test.

Proposed wording for Certificate of Compliance USA/9297/AF-96
(changes are shown in *bold italics*)

5.(a)(2) Description (Continued)

The Traveller package is designed to carry loose rods using either of two types of rod containers: a rod box or rod pipe. The rod box is an ASTM, Type 304 stainless steel container 0f rectangular cross section with stiffening ribs located approximately every 60 centimeters (cm) (23.6 inches (in.)) along its length. It is secured by fastening a removable top cover to the container body using socket head cap screws. ***The rod pipe consists of a 6" (15.2 cm) standard 304 stainless steel, Schedule 40 pipe, and standard 304 stainless steel closures at each end. The closure is a 0.25 inch (11.18 mm) thick cover secured with Type 304 stainless steel hardware to a flange fabricated from 0.25 inch (11.18 mm) thick plate.***

5.(a)(3) Drawings

The packagings are fabricated and assembled in accordance with the following Westinghouse Electric Company's Drawing Nos.:

10004E58 Rev. 3 (Sheets 1-8)
10006E58 Rev. ***5***
10006E59 Rev. 1 (Sheets 1-2)

TRAVELLER SAFETY ANALYSIS REPORT
INSTRUCTIONS FOR INSERTING REVISION 5 CHANGE PAGES

Pages are provided to facilitate double-sided printing that are not affected by Revision 5.

Remove Pages	Insert Pages
Cover (Rev. 4)	Cover (Rev. 5)
List of Effective Pages - page i (Rev. 4), page ii (Rev. 4)	List of Effective Pages - page i (Rev. 5), page ii (Rev. 4)
1-5(Rev. 0),1-6(Rev. 1), 1-6A (Rev. 1), 1-6B (Rev. 1)	1-5(Rev.0),1-6 (Rev. 5), 1-6A (Rev. 5), 1-6B (Rev. 1)
Licensing Drawing 10006E58 Rev 1 (1 sheet)	Licensing Drawing 10006E58 Rev 5 (1 sheet)
2-31 (Rev. 0), 2-32 (Rev. 1), 2-32A (Rev. 1), 2-32B (Rev. 1)	2-31 (Rev. 0), 2-32 (Rev. 5), 2-32A (Rev. 5), 2-32B (Rev. 1)

Westinghouse Electric Company, LLC
Columbia Fuel Fabrication Plant
Columbia, SC

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

NRC Certificate of Compliance

USA/9297/AF-96

Docket 71-9297

Initial Submittal: March 2004
Revision 1: November 2004
Revision 2: February 2005
Revision 3: March 2005
Revision 4: March 2005
Revision 5: March 2006

Westinghouse

TRAVELLER SAFETY ANALYSIS REPORT
LIST OF EFFECTIVE PAGES

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ii	0	2-11	0	2-45	0	2-85	0
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10004E58	3	2-22A	1	2-59	0	2-99	1
10006E58	5	2-22B	1	2-60	0	2-100	0
10006E59	1	2-22C	1	2-61	0	2-101	1
		2-22D	1	2-62	0	2-102	0
i	5	2-23	2	2-63	0	2-103	1
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iii	0	2-25	2	2-65	0	2-105	2
iv	0	2-26	0	2-66	0	2-106	1
v	1	2-27	0	2-67	2	2-106A	1
vi	1	2-28	0	2-67A	2	2-106B	1
vii	2	2-29	0	2-67B	2	2-107	0
viii	1	2-30	0	2-68	2	2-108	0
ix	1	2-31	0	2-69	0	2-109	0
x	2	2-32	5	2-70	0	2-110	0
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		2-32B	1	2-72	0	2-112	0
2-1	1	2-33	0	2-73	0	2-113	0
2-1A	1	2-34	4	2-74	0	2-114	0
2-1B	1	2-35	0	2-75	0	2-115	0
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2-3	0	2-37	0	2-77	0	2-117	0
2-4	4	2-38	2	2-78	0	2-118	0
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2-7	0	2-41	0	2-81	0	2-121	0
2-8	0	2-42	0	2-82	0	2-122	0
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TRAVELLER SAFETY ANALYSIS REPORT
LIST OF EFFECTIVE PAGES (cont.)

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2-133	0	2-164	0	ii	1	3-38	1
2-134	2	2-165	0	iii	1	3-39	0
2-134A	1	2-166	0	iv	1	3-40	0
2-134B	1	2-167	1			3-41	0
2-134C	1	2-168	1	3-1	0	3-42	1
2-134D	1	2-169	0	3-2	2	3-42A	1
2-135	1	2-170	0	3-3	0	3-42B	1
2-135A	1	2-171	0	3-4	1	3-43	0
2-135B	1	2-172	2	3-5	0	3-44	0
2-135C	1	2-173	0	3-6	0	3-45	0
2-135D	1	2-174	0	3-7	0	3-46	4
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2-137	0	2-176	0	3-9	0	3-46B	1
2-138	0	2-177	1	3-10	1	3-47	0
2-139	1	2-178	0	3-11	0	3-48	0
2-139A	1	2-179	0	3-12	0	3-49	1
2-139B	1	2-180	0	3-13	0	3-50	1
2-140	0	2-181	0	3-14	0		
2-141	1	2-182	0	3-15	0		
2-142	0	2-183	2	3-16	0	i	0
2-143	0	2-184	0	3-17	0		
2-144	0	2-185	0	3-18	1	4-1	0
2-145	1	2-186	0	3-19	1		
2-146	0	2-187	0	3-20	0	i	0
2-147	0	2-188	0	3-21	0		
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2-152	0	2-192A	4	3-26	1	ii	2
2-153	0	2-192B	4	3-27	0	iii	2
2-154	0	2-192C	4	3-28	0	iv	2
2-155	1	2-192D	4	3-29	0	v	2
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2-155B	1	2-194	0	3-31	0	vii	2
2-156	2	2-195	0	3-32	0		
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2-159	0	2-198	0	3-35	1	6-3	2
2-160	0	2-199	0	3-35A	1	6-4	2
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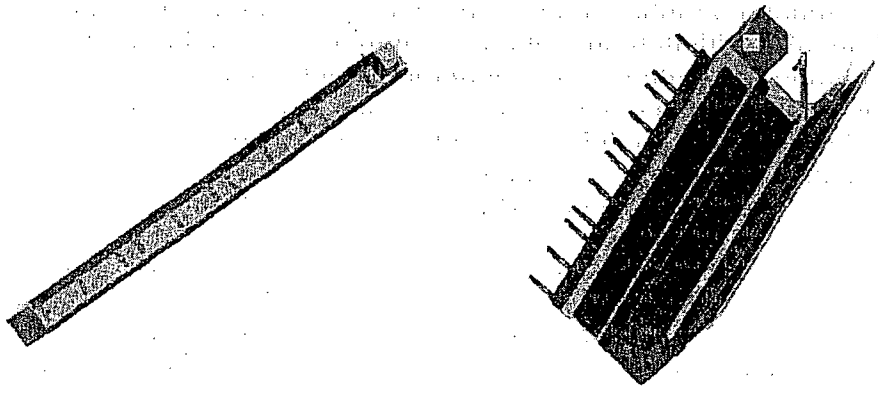

Figure 1-3 Clamshell in Closed Position (left) and Opened Position (right)

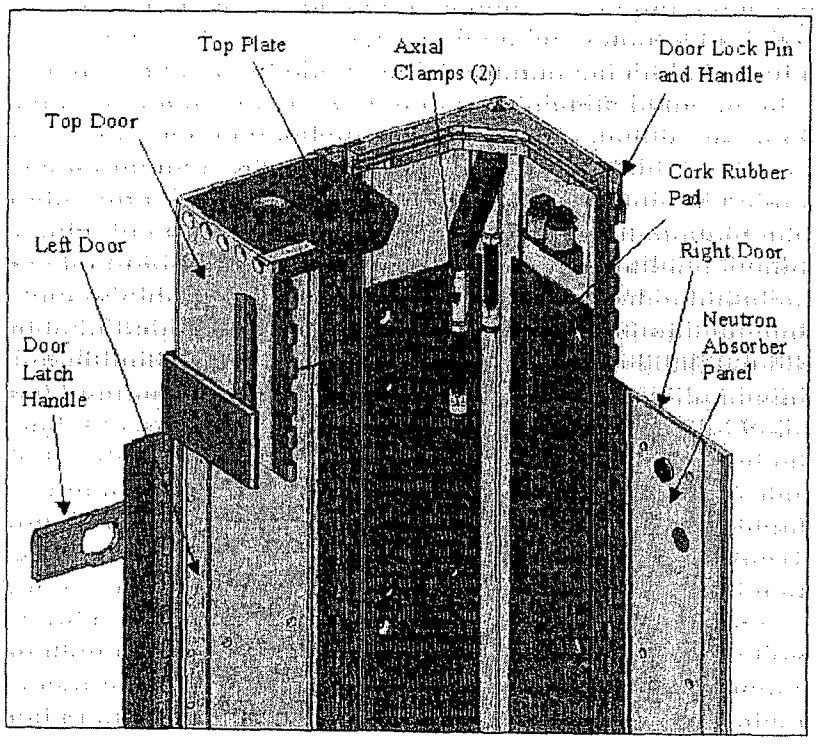

Figure 1-4 Clamshell Top End Components

C01

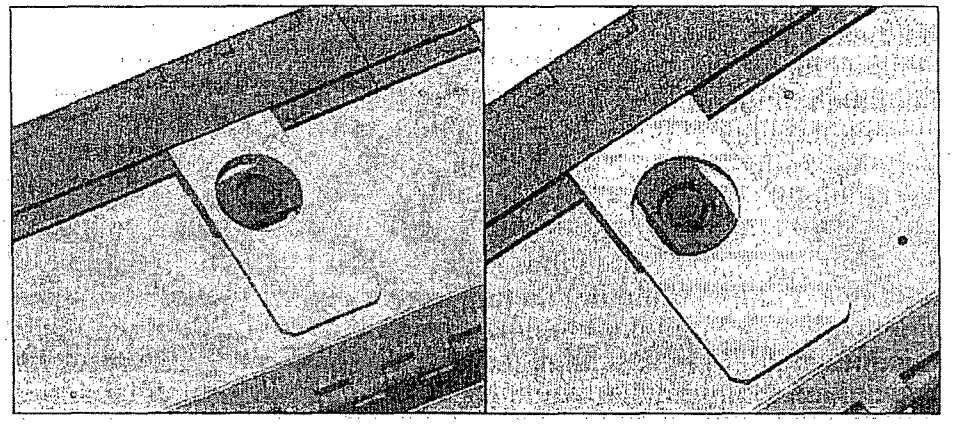

Figure 1-5 Clamshell Latch Locked Position (left) and Open Position (right)

1.2.1.4 Rod Container

The Traveller is designed to carry loose rods using either of two types of rod containers: a rod box or rod pipe. Both can be seen in Figure 1-6. The rod box is an ASTM, Type 304 stainless steel container of rectangular cross section with stiffening ribs located approximately every 23.6 inches (600 mm) along its length. It is secured by fastening a removable top cover to the container body using socket head cap screws. The rod pipe consists of a 6" (15.2 cm) standard 304 stainless steel, Schedule 40 pipe, and standard 304 stainless steel closures at each end. The closure is a 0.25 inch (11.18 mm) thick cover secured with Type 304 stainless steel hardware to a flange fabricated from 0.25 inch (11.18 mm) thick plate.

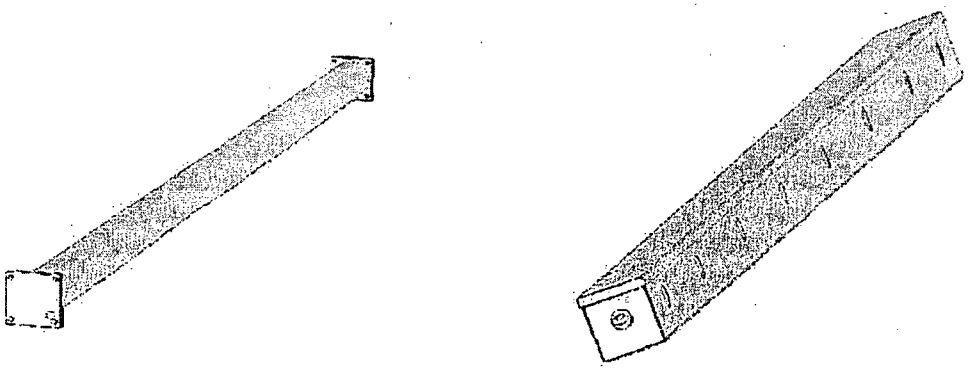

Figure 1-6 Rod Pipe (left) and Rod Box (right)

C02

The fuel assembly, rod box and rod pipe are all held in place by the clamshell restraining devices. Axial restraint is provided by the axial clamp assembly shown on Sheet 7 of 8 of drawing 10004E58. The axial clamp arm is bolted into the top shear lip and the contact to the fuel assembly, box or pipe is performed by an adjustable jack screw. Lateral and vertical restraint is accomplished through the use of removal rubber pads located inside the clamshell door lip in conjunction with the latch assemblies on the clamshell doors. The rubber pads are of varying thickness to accommodate the different fuel designs and loose rod shipping boxes/pipes. The rod pipe design has a maximum loaded weight of 1650lb (748kg). The rod box has a maximum loaded weight of 660lb (300kg).

2.10 SPECIAL FORM

The contents of the Traveller series of packages do not classify as special form material.

2.11 FUEL RODS

In the Traveller XL and STD packages, the fuel rods within the package provide containment for the nuclear fuel. This containment was successfully demonstrated in 3 full-scale test campaigns comprising a total of nine (9) 30 foot free drops, and the corresponding 1.3 meter free-drops and pin puncture tests. These tests resulted in 100% containment of the fuel pellets within rod of every fuel assembly.

For all 9-meter drop test orientations except for the bottom-down end drop (long axis of package aligned with the gravity vector), every fuel rod survived with no damage except slight to moderate buckling of the cladding. Rod pressure test sampling was routinely performed on these fuel assemblies. Except for the bottom-down end drop, all of the rods sampled remained intact and pressurized. All rods visually appeared in excellent condition.

A total of two (2) full-scale Traveller XL packages (QTU-2 and CTU) were tested in a bottom-down end drop orientation. Both of these fuel assemblies (dummy Westinghouse 17x17 XLs) experienced a small percentage of rods with cracked welds in the location of the bottom end plug. In the worst case assembly (CTU), post-test inspection of the fuel assembly indicated that approximately 7.5% of the fuel rods were visibly cracked at the end plug weld zone. The average magnitude of the crack widths measured approximately 0.030 inches (0.76 mm) encompassing about one-half of a rod diameter. This minor cracking is considered insignificant since fuel pellets of diameter 0.374 inches (9.50 mm) are approximately 12.5 times larger than the average visible crack widths. A crack width of 0.075 inches (1.91 mm) was the largest observed. This width is not sufficient for fuel pellets to escape. Therefore, the containment system satisfies its requirement of containing loss of fuel.

Due to the nature of the bottom-down end impact, the fuel rod array is tightly packed and forced into the bottom nozzle. As the bottom nozzle buckles, the rods located nearest the corners of the adapter plate experience a side loading due to the deformed shape of the plate. This moment is sufficient to crack the weld, however, it is clearly not sufficient to completely break off the bottom end plug since the array of rods is so tightly packed. No complete separation of the bottom end plug was observed in any fuel rods for both fuel assemblies. Therefore, the fuel pellets are safely contained within each fuel rod. Further details can be found in Appendix 2.12.4, Traveller Drop Tests Results.

2.11.1 Rod Container

The Traveller Clamshell is primarily designed to transport PWR fuel assemblies. To accommodate loose fuel rods, two rod storage containers have been designed. One is a 304 stainless steel rod pipe with a maximum diameter of 6.625 inches (6" Schedule 40 pipe), maximum length 200 inches, and a maximum loaded weight of 1650 lbs. The second option is a 304 stainless steel box with a 5.12 inches cross-section. This box is 170.5 inches long and the maximum loaded weight is 660 lbs.

The loose rod pipe and box are relatively rigid structures as compared to a fuel assembly. Both the rod pipe and box are single structural members closed by rigid mechanisms. Because the fuel assembly is less stiff than the rod pipe or rod box, the fuel assembly is more likely to deform plastically from localized buckling. The rod pipe is fit to conform into the clamshell axially with a rubber spacer, and is restrained

laterally by the bent flanges with foam rubber "clamps" similar to retraining a fuel assembly at the spacer grid locations.

The TRAVELLER response to the 9-meter HAC drop test resulted in the kinetic energy due to the combined mass of the fuel assembly and clamshell being absorbed by the outerpack impact limiter and minor fuel assembly buckling. As a result, the strain damage to the fuel assembly was minimal, and the clamshell retained its pre-test geometry and its structural integrity even though the full stroke of the impact limiter was not utilized. When subject to the 9-meter impact test described in 10CRF71.73, the rod pipe or box is expected to utilize the full stroke of the impact limiter due to their rigidity. The resulting applied impact force to the rod box or pipe is expected to be less then that imparted to the fuel assembly. Furthermore, the rod box and pipe is expected to act in a coupled manner similar to the fuel assembly and result in similar load paths. With the maximum mass of 1650 pounds, the rod pipe or box will have less impact energy imparted on their rigid structure as well. The maximum rod pipe or box mass is less than the maximum fuel assembly mass used in the 9-meter impact test. Therefore, the performance of the TRAVELLER packaging with rod pipe or box contents bounds the performance of the TRAVELLER 9-meter HAC drop.

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