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1 GENERAL INFORMATION

1.1 INTRODUCTION

The Traveller™ (Patent Pending)[1] is a new shipping package designed to transport non-irradiated uranium fuel assemblies or rods with enrichments up to 5.0 weight percent. It will carry several types of PWR fuel assemblies as well as either BWR- or PWR rods. This is described further in Section 6. The proposed Criticality Safety Index (CSI) for the Traveller is 0.7 when transporting fuel assemblies and 0.0 when transporting loose rods. The following sections describe the package design and testing program in detail. Drawings are presented in Section 1.4.1.

1.2 PACKAGE DESCRIPTION

1.2.1 Packaging

The Traveller package is designed to carry one (1) fuel assembly or one (1) container for loose rods. It is made up of three basic components: 1) an Outerpack, 2) a Clamshell, and 3) a Fuel Assembly or Rod Container. The Outerpack and Clamshell are connected together with a suspension system that reduces the forces applied to the fuel assembly during transport. The Rod Container is secured inside the Clamshell during transport of loose rods.

1.2.1.1 Package Types

There are two types of packagings in the Traveller family.

1.2.1.1.1 Traveller Standard (Traveller STD)

- Gross Weight = 4,500 pounds (2041 kg)
- Tare Weight = 2850 pounds (1293 kg)
- Outer Dimensions = 197.0" length x 27.0" width x 39.3" height
  (5004 mm x 688 mm x 998 mm)

[1] Traveller is a Westinghouse trademark.

1.2.1.1.2 Traveller XL

- Gross Weight = 5,100 pounds (2313 kg)
- Tare Weight = 3155 pounds (1431 kg)
- Outer Dimensions = 226.1" length x 27.1" width and 39.3" height (5740 mm x 688 mm x 998 mm)

1.2.1.2 Outerpack

The Outerpack is a structural component that serves as the primary impact and thermal protection for the Fuel Assembly. It also provides for lifting, stacking, and tie down during transportation. The Outerpack is a long tubular design consisting of a top and bottom half as shown in Figure 1-1. Each half consists of a stainless steel outer shell, a layer of rigid polyurethane foam, and an inner stainless steel shell. The stainless steel provides structural strength and acts as a protective covering to the foam. A typical cross-section showing key elements of the package is depicted in Figure 1-2.

The outerpack is comprised of independent impact limiters at the top end and lower end. Each end impact limiter is a system containing a pillow sub-assembly adjacent to 20 pcf polyurethane foam. The 20 pcf foam is encased by the package outerpack stainless steel skins. The top pillow sub-assembly consists of 6 pcf foam encased between two stainless steel plates to allow mating with the upper outerpack. A detail of the top pillow assembly is shown on 10004E58, sheet 6. The lower pillow assembly consists of 6 pcf foam encased in a stainless steel circular housing which allows mating with the lower outerpack. A detail of the lower pillow assembly is also shown on 10004E58, sheet 6.

The foam is a rigid, closed cell polyurethane that is an excellent impact absorber and thermal insulator and has well defined characteristics that make it ideal for this application. The steel-foam-steel "sandwich" is the primary fire protection, and is described in more detail in Section 3.

The inside of the Outerpack is lined with blocks of Ultra High Molecular Weight (UHMW) polyethylene. The polyethylene has a dual purpose. It provides a conformal cavity for the Clamshell and fuel assembly to fall into during low-angle drops. It is also a significant component used for criticality safety. Further discussion is presented in Chapter 6, Criticality Evaluation, of this document.

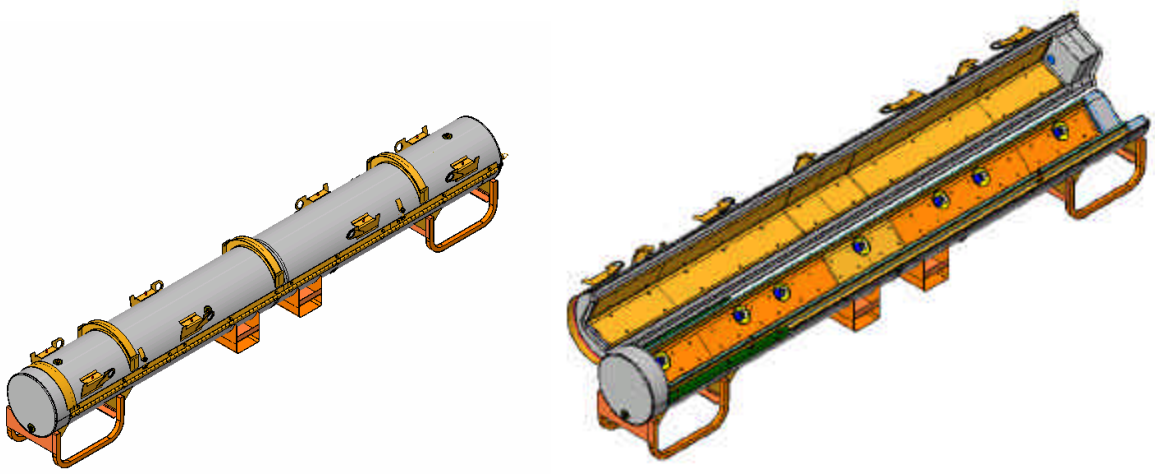

Figure 1-1 Outerpack Closed Position (left) and Opened Position (right)

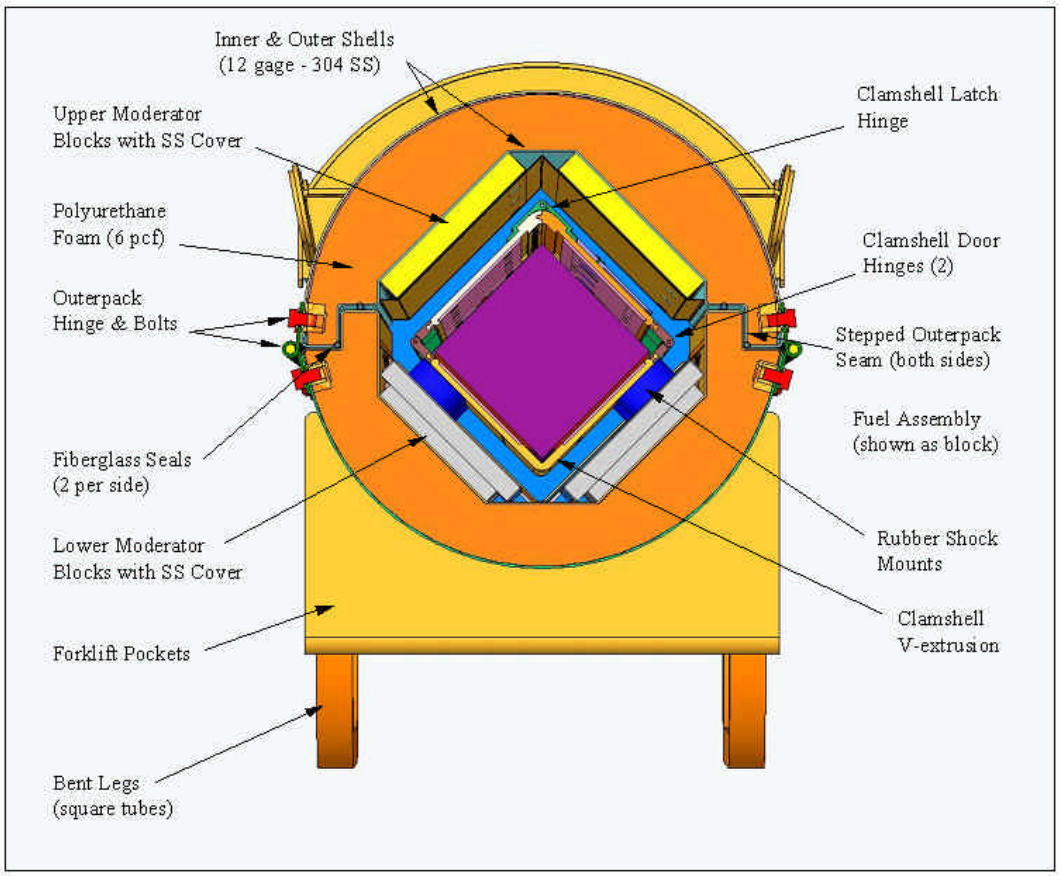

Figure 1-2 Outerpack Cross-Section View (typical)

1.2.1.3 Clamshell

The Clamshell is a structural component consisting of a lower aluminum "v" extrusion, two aluminum door extrusions, and a small top access door. Piano type hinges (continuous hinges) connect each door to the "v" extrusion. The doors are then held closed with a latch mechanism and eleven quarter-turn bolts (9 for the Traveller STD). At the bottom nozzle end, a base plate is bolted to the "v" extrusion. At the top nozzle end, the top plate and small v-shaped door are bolted together. These form the top door which is hinged at one side to allow it to swing open, leaving access to the top nozzle from above. The top door is secured with a short hinge pin which is inserted along the length of the top door. The Clamshell assembly is shown closed, and opened in Figure 1-3. A more detailed schematic showing key Clamshell components of the top end is depicted in Figure 1-4.

The quarter-turn Clamshell fasterners are shown in Figure 1-5. By rotating the nut plus or minus 90 degrees opens or closes the latch. Spring- loaded plungers on both sides of the nuts positively restrain each nut during shipping and handling, and precludes inadvertent opening of the latch.

The Fuel Assembly or Rod Tube is secured inside the Clamshell at three locations down the length. At the top end, two jackscrews with neoprene pads clamp the fuel assembly axially against the bottom plate. Adjustable spring-loaded pads are positioned at any axial location between end locations to secure the fuel assembly along its length. These pads will be located at mid-grid locations.

The "v" extrusion is lined with a cork rubber pad to cushion the contents and prevent damage during normal handling and transport conditions. The bottom plate is similarly lined with cork rubber.

Neutron absorber plates are installed in each leg of the "v" extrusion and in each of the doors. The absorber is a borated aluminum plate inserted in pocket in each extrusion and attached with screws. The plates are solely for neutron absorption and do not provide any structural support. More details are described in Section 6, Criticality Evaluation and Section 8, Acceptance Tests and Maintenance Program.

The purpose of the Clamshell is to protect the contents during routine handling and in the event of an accident. During routine handling, the Clamshell doors are closed immediately after the contents are loaded. This provides a physical barrier to debris or accidental damage. During accident conditions, the Clamshell provides a physical barrier to rod bowing, lattice expansion, and loss of rods. It also provides neutron absorption.

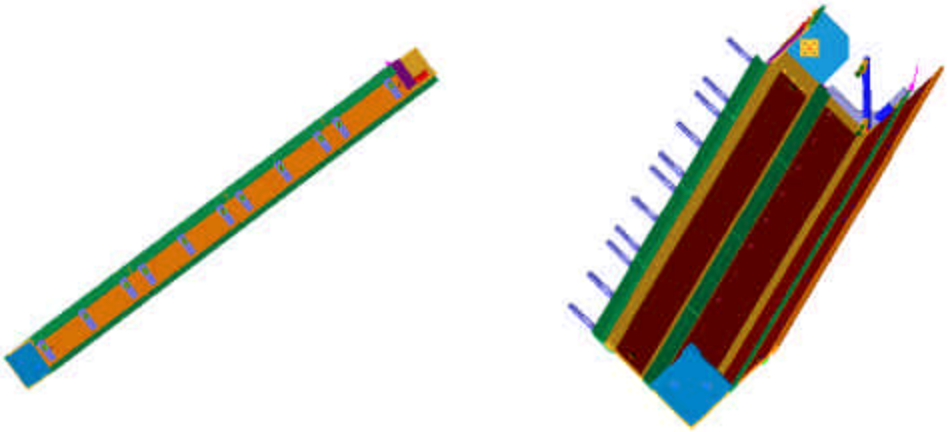

Figure 1-3 Clamshell in Closed Position (left) and Opened Position (right)

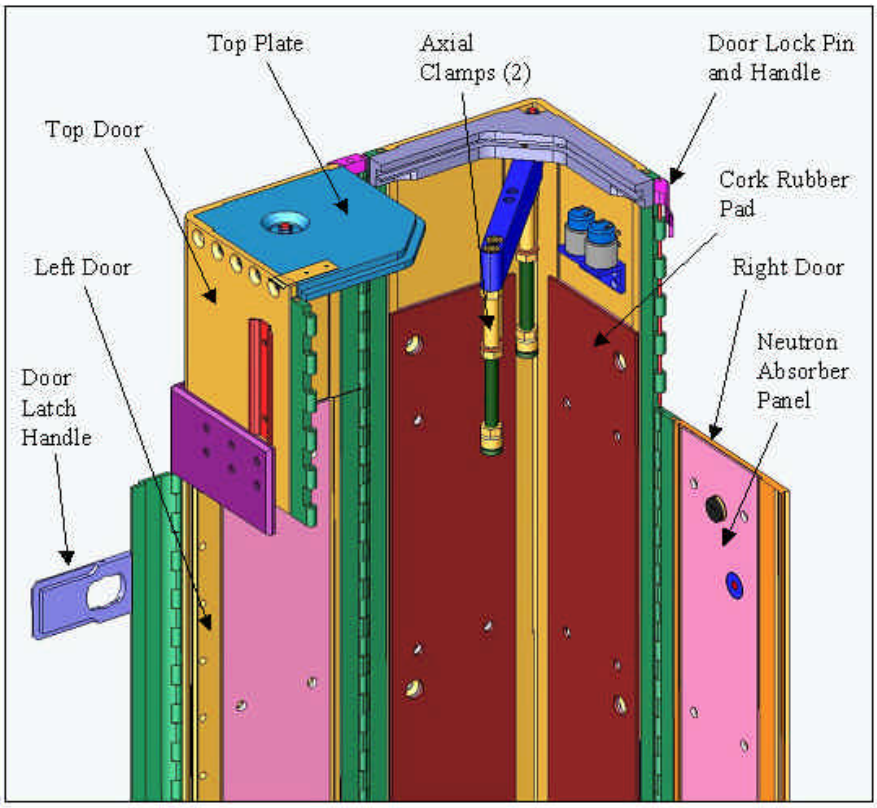

Figure 1-4 Clamshell Top End Components

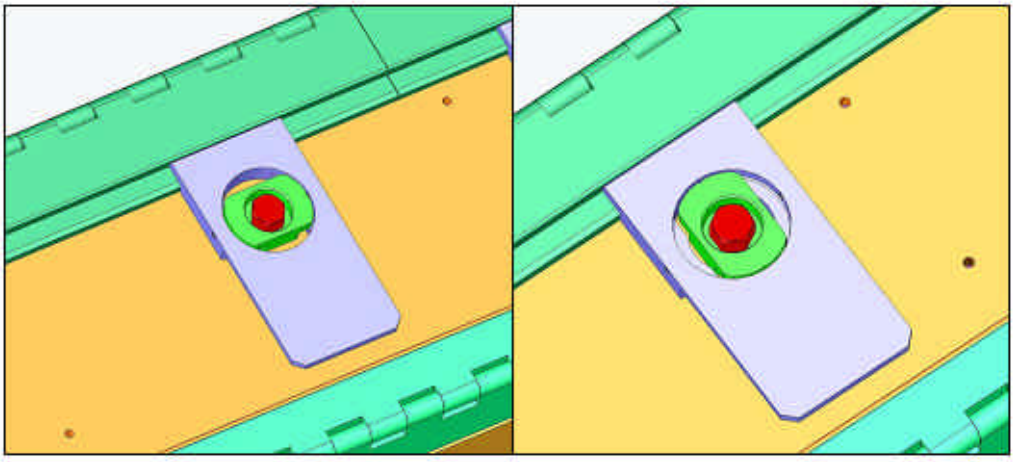

Figure 1-5 Clamshell Latch Locked Position (left) and Open Position (right)

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 5" (12.7 cm) or a 6" (15.2 cm) standard 304 stainless steel, Schedule 40 pipe. The pipes are secured with a 0.44 inch (11.18 mm) flange and Type 304 stainless steel hardware on each end.

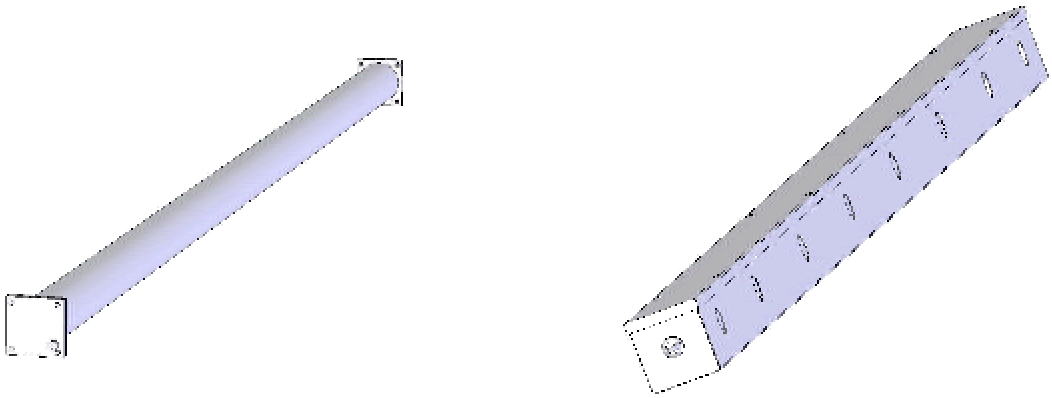

Figure 1-6 Rod Pipe (left) and Rod Box (right)

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 maximum loaded weight of the pipe or box is 660 pounds.

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1.2.2 Containment System

The Containment System is described in both IAEA Regulations for the Safe Transport of Radioactive Material, Safety Standard Series No. TS-R-1 (213) and the Code of Federal Regulations, Title 10, Part 71.4 as, "the assembly of components of the packaging intended to retain the radioactive material during transport." The Containment System for the Traveller is the fuel rod. Containment is described in greater detail in Section 6.

1.2.3 Contents

1.2.3.1 Traveller

Identification and Enrichment of Special Nuclear Material (SNM) – The SNM is unirradiated uranium enriched up to 5 weight % in the isotope U^{235}, U^{234} and U^{236} quantities will be such that their activity will not exceed established A_2 limits.

Form of SNM – The SNM is in the form of non-dispersible pellets inside the cladding to form fuel rods.

1.2.4 Operational Features

Fork lift pockets and tubular legs are attached to the bottom Outerpack. Stacking brackets, which double as lift points, are attached to the top Outerpack and are located in eight (8) locations. The package must be uprighted onto one end for loading and unloading. Two lifting points are attached to the top nozzle end of the top Outerpack.

1.3 GENERAL REQUIREMENTS FOR ALL PACKAGES

1.3.1 Minimum Package Size

The smallest overall dimension of the Traveller packages is outer shell diameter, approximately 25 inches (64 cm). This dimension is greater than the minimum dimension of 4-inches specified in 10 CFR §71.43(a), TS-R-1 (634). Therefore, the requirements of 10 CFR §71.43(a), TS-R-1 (634) are satisfied by the Traveller packages.

1.3.2 Tamper-Indicating Feature

Two (2) tamper indicating seals (wire/lead security seal) are attached between the upper and lower Outerpack halves to provide visual evidence that the closure was not tampered. Thus, the requirements of 10 CFR §71.43(b), TS-R-1 (635) are satisfied.

The Traveller series of packages cannot be opened inadvertently. Positive closure of the Traveller packages is provided by high strength ¾-inch hex head screws. Thus, the requirements of 10 CFR §71.43(c), TS-R-1 (639) are satisfied.

1.4 APPENDICES

1.4.1 Package Drawings