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Your ref: Docket No. 71-9297
Our ref: LTR-LCPT-11-3

February 8, 2011

SUBJECT: Event Report - Docket 71-9297, Certificate of Compliance USA/9297/AF-96,
TRAVELLER Shipping Package

Dear Mrs. Vonna Ordaz:

A written report is hereby submitted in compliance with 10 CFR 71.95. The written report is for an instance in which a condition of approval in the Certificate of Compliance for Model TRAVELLER (USA/9297/AF-96) was not observed in making a shipment.

(1) Abstract / Background

The TRAVELLER package consists of an inner container and protective outer-pack. The outer-pack 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 outer-pack has an upper and lower section joined together by closure consisting of a hinged flange and bolts.

A hinge on each side secures upper outer-pack to the lower outer-pack. The hinge is shown as item 86 in drawing 10004E58. The hinge is secured to the outer packaging with 3/4-10 1 inch long hex head bolts. There are a total of 48 bolts used to secure the closure hinge to the outer-pack, 24 on each side of the package. The closure hinge consists of four sections each secured to the outer-pack by 6 bolts. Three bolts on the lower outer-pack side of each hinge segment are permanently secured with tack welds, while three bolts on the upper outer-pack side are removable. The bolts for one of the closure hinge sections were not installed properly when a TRAVELLER package was prepared for shipment.

The closure hinge bolts may be removed from both sides of the package to allow separating upper outer-pack from the lower outer pack from a horizontal position, or the bolts may be removed from just one side to allow opening the outer pack in a vertical orientation while upper pack is supported on the lower outer pack by the hinge that remains secured on the other side. The package is normally operated in the vertical orientation and bolts may be removed from either side as determined by the direction of swing for the upper outer-pack as required to operate the package.

**** Electronically approved records are authenticated in the Electronic Document Management System.***

The Certificate of Compliance 9297, revision 4, specifies condition 6.(a) as follows:

6. In addition to the requirements of Subpart G of 10 CFR Part 71:

(a) The package must be prepared for shipment and operated in accordance with the Operating Procedures in Chapter 7 of the TRAVELLER License Application, as supplemented.

Chapter 7.0 Package Operations specifies the following steps for package loading to ensure proper closure of the package:.

7.1.2.2 Close Shipping Package

- Verify that the cover flange is free of debris and close overpack door.
- Tighten package closure fasteners to secure cover.
- Install one approved tamper proof security seal on each end of the package.

7.1.2.3 Inspection

- Verify that the package lid is properly seated and all closure bolts are present.
- Verify that the required decals, license plates, labels, stencil markings, etc. are present and legible.

These general package loading steps are enumerated in more detailed mechanical operating and quality control inspection procedures. The mechanical operating procedures contains steps to install 12 hinge bolts and lock washers and torque 24 outer-pack hinge bolts on both sides of the package. These steps are intended to insure that the hinge bolts on both sides of the package are secure prior to shipment regardless of whether the hinge bolts were removed. A checklist is used to document performance of procedure steps that are significant to quality control, safety, and safeguards. One operator initials for performance of each step identified on the checklist, and a second operator initials for verification the identified step was performed correctly. In addition to the mechanical operating procedure, there is a quality control instruction for inspections done before and after loading the fuel assembly contents. The TRAVELLER package has an inspection checklist that documents an independent check by a quality control inspector. Hence, the mechanical operating procedure and quality control checklists document the performance, verification, and inspection of proper installation of the outer-pack hinge bolts by three different individuals.

This information is provided in compliance with 10 CFR 71.95 (c)(1).

(2) Narrative of the Event

A fuel assembly was loaded in a TRAVELLER package at the Westinghouse Columbia Fuel Fabrication Facility (CFFF) on November 12, 2010. The package was shipped to a nuclear power plant facility and arrived on December 7, 2010. On or about December 8, 2010, operators at the facility noticed during operations to remove the fuel assembly from the package that a section of the hinge was not secured properly. As shown in Figure 1, three bolts

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intended to secure the hinge section were installed, but the hinge was not attached to the upper outer-pack. Representatives from the nuclear power plant facility immediately informed Westinghouse of this package condition. The package was transported a distance of approximately 850 miles from CFFF to the nuclear power plant facility, and was in transit for 2 days.



Figure 1 – TRAVELLER package closure hinge condition as transported

Administrative controls failed to ensure the package closure was properly installed prior to shipment. The administrative steps in the procedure and quality control instructions (QCI) were intended to ensure proper installation of the closure, such that closure bolts secure the hinge section to the upper outer-pack.

The operator and QC inspector failed to notice that not all bolts were installed through the hinge connections. The packing check list along with the detailed operating procedure requires one operator to install the closure bolts and then have another operator check that the bolts are installed. The procedure and checklist requires QC inspector to verify proper operation of the torque wrench and verify installation of the closure hinge bolts. It appears this step wrench was not correctly performed.

No equipment or software failures and no external events contributed to the cause of this incident.

This information is provided in compliance with 10 CFR 71.95 (c)(2).

(3) Assessment of Safety Consequences and Implications of the Event

Margin to failure for the closure hinge bolts during normal handling of the package and accident transport conditions is affected by not properly securing the outer-pack closure.

Accident Transport Conditions

Impact protection - The number of bolts is the same for the XL and STD designs, thus the loading per bolt is lower for the STD design. There are 48 bolts $\frac{3}{4}$ -inch bolts in the Outer-pack, 24 attaching the hinge sections to the lower outer-pack and 24 attaching the upper Outer-pack to the hinge sections. The design load during impact for both packages are below the ultimate design loads for the Outer-pack bolts.

The maximum load is imposed on the bolts during a side impact, slap down orientation. The safety factor for the bolts is 1.12 for the bounding TRAVELLER XL worst bolt. Failure to fasten the section of hinge reduces the number of bolts from 12 to 9 on one side of the outer-pack. This would increase the actual stress on the remaining 21 bolts (9 on one side and 12 on the opposite side) by approximately a factor of 1.15 which reduces the safety factor to less than 1. The reduction of the safety factor to less than 1 implies that one or more of the remaining bolts may fail under load imposed by the side impact.

The reduction in safety factor is mitigated by the difference in the actual weight of the package as shipped as compared to the weight of the package as tested and analyzed. The weight of the contents as tested was approximately 1900 lbs., where as the contents actually shipped is approximately 1500 lbs.. An impact of the package as shipped would have resulted in about 80 percent of the force assumed in design of the closure hinge bolts. This reduction in impact force would offset reduction in safety factor due to the reduced number of bolts installed. The safety factor for the bolts in the configuration as shipped would have been greater than 1.0. In fact, the safety factor for an accident resulting in the design basis impact would have been approximately 1.2, or greater than accepted design safety factor for the closure. Hence, it is unlikely that any of the bolts securing the closure hinge would have failed in a transportation accident.

Thermal protection - A polyurethane insulated, double walled, stainless steel outer-pack protects the inner container in the TRAVELLER package. This outer-pack provides sufficient insulation to prevent significant heat conduction and maintain low interior temperatures during a hypothetical fire accident. The outer-pack also incorporates design features that prevent convective heat transfer. A continuous hinge and a large lip over the bottom seam function as a heat shield that prevent hot gases from entering the outer-pack seams. The hinge provides closure that prevents the seam between the upper outer-pack and lower outer-pack from opening due to thermal stress during a fire in addition to mechanical stresses from an impact.

The thermal tests showed that, where the outer-pack seam was covered by a hinge, that hot gas flow through the package was eliminated. Peak internal temperatures were approximately 100°C. With gaps in the outer-pack seams, peak internal temperatures exceeded the 350°C, the ignition temperature of polyethylene. The polyethylene moderator is covered with stainless steel to further reduce the likelihood of combustion.

Failure to secure a section of the closure hinge may have resulted in opening the gap on one side of the package during a fire. There would not have been a path for hot gases to flow

through the package, and any temperature increase would have been limited to that caused by radiative heat transfer. The likelihood of greater heat transfer to the interior of the outer-pack would increase, but not to the point of melting the aluminum inner container or polyethylene without a path for convective heat transfer through the package. Combustion of the polyethylene is unlikely because a protective steel cover.

Routine and Normal Transport Conditions

The outer-pack provides for lifting, stacking, and tie down during transportation. Loads imposed routine handling and normal transport conditions are much lower than experienced during accident transport conditions. Failure to secure one section of hinge would increase the stress imposed on the installed bolts, but the margins to failure for these conditions is much larger than for accident transport conditions. The 21 install outer-pack bolts would have adequate margin to failure when subject to the accident transport conditions. Therefore, the 21 installed bolts are more than adequate to withstand the loads experienced during routine handling and normal conditions of transport.

This information is provided in compliance with 10 CFR 71.95 (c)(3).

(4) Corrective Actions

Procedures and checklists were revised to emphasize verification of the proper installation of the closure hinge on both sides of the package.

Operators and QC inspector involved in this incident were disciplined to reinforce the importance of procedural compliance.

Lessons learned were shared with operations personnel involved with transportation and package preparation for shipment.

This information is provided in compliance with 10 CFR 71.95 (c)(4).

(5) Extent of Condition

The closure hinge was installed properly on all the remaining packages that made up the balance of the subject shipment. A review of prior incidents involving preparation of packages for shipment revealed other instances caused by procedure deficiencies and failure to comply with procedures, but none of these instances involved installing the closure hinge on the TRAVELLER package.

This information is provided in compliance with 10 CFR 71.95 (c)(5).

(6) Contact

Please contact Peter Vescovi at 803 647-3167 for any additional information about this event.

This information is provided in compliance with 10 CFR 71.95 (c)(6).

(7) Extent of Exposure to Radiation

No individuals were exposed to radiation as a result improper installation of the TRAVELLER package closure.

This information is provided in compliance with 10 CFR 71.95 (c)(7).

Sincerely,

** Electronically approved*

Peter J. Vescovi
WESTINGHOUSE ELECTRIC COMPANY, LLC
NF Global Supply Chain Management
Global Logistics/Licensing, Compliance and Package Technology

cc

Brian Bayley, Director, Global Logistics
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