71-9253

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December 7, 1995
Fort St. Vrain
ISFSI
P-95108

Dr. William D. Travers, Director
Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Docket No. 71-9253

SUBJECT: Request for License Amendment to Permit Certain Radioactive Materials at the FSV ISFSI, Necessary to Conduct Licensed Activities

REFERENCE: PSCo letter, Fisher to Chappell, dated September 11, 1995 (P-95080)

Dear Dr. Travers:

In the referenced letter, Public Service Company of Colorado (PSCo) requested that the NRC amend Certificate of Compliance (C of C) No. 9253 for the TN-FSV spent fuel shipping cask to identify the latest TN-FSV cask drawings which reflect the as-built cask design, and revise the cask loading and handling procedure guidelines contained in Section 7 of the TN-FSV SAR. In a phone conversation dated November 8, 1995 between the NRC's Mr. Tim McGinty, Mr. David Tang and Ms. Marissa Bailey and PSCo's Mr. Mike Holmes and Mr. Jeff Johns, the NRC requested additional information related to the referenced letter. This letter responds to the request for additional information (RAI), which involved two concerns: one related to the orientation of the gussets in the impact limiters in the event of a side/slapdown drop accident, and the other related to the cask pressure rise leak testing.

NRC RAI Regarding Orientation of Cask Impact Limiters: The NRC requested that PSCo provide additional information to justify the 30 degree rotation of the impact limiters (described in the referenced letter), which results in one of the six gussets in each

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impact limiter being perpendicular to the ground when the cask is mounted on the trailer. The NRC expressed a concern that this orientation could increase the stiffness of impact associated with a side and/or slapdown drop due to the positioning of a gusset in each impact limiter perpendicular to the ground. The increased stiffness may in turn result in a higher cask g-loading.

PSCo Response: The impact limiters were rotated to change the position of the lifting lugs, as discussed in the referenced letter. As the NRC noted, one of the six gussets is aligned perpendicular to the ground in the new configuration. This is not necessarily the orientation of the impact limiter in a side/slapdown drop event, as the cask could be dropped in any orientation. However, in the event of a side/slapdown drop accident, in which the impact limiters contact the surface with one gusset perpendicular to the surface, the gusset in question has a lower strength than the crush strength of the wood (primarily due to the much greater volume of wood), and the gusset would buckle without affecting performance of the impact limiter. This was considered in the design of the impact limiters. TN-FSV SAR Section 2.10.2.3, "Design Criteria", states:

> "The welded stainless steel structure of the impact limiter is designed so that the wood is maintained in position and is confined during crushing of the impact limiters. The outer shell and gussets are designed to buckle and crush during impact. Local failure of the shell is allowed during impact limiter crushing."

TN-FSV SAR Section 2.10.2.4.2, "Assumptions and Boundary Conditions", states:

> "The crushing resistances of the impact limiter shell and gussets have a negligible effect on the crush strength of the limiter and, therefore, a negligible effect on the impact forces and inertia loads."

Mr. Tang of the NRC indicated that PSCo should consider Table 2.10.2-5, and similar tables, which identify the depth of crush of the impact limiter versus the crush force, in regards to the NRC's concern. These tables document computer modelling which projected displacement of the impact limiters for several different forces, at various impact angles, considering both primary (first impact limiter to strike the surface) and secondary (second impact limiter to strike the surface) impacts. It should be noted that the impact angles do not relate to the orientation of the impact limiters and their gussets, but to the orientation of the cask at moment of impact. For instance, an impact angle of 0° indicates the cask is horizontal at the moment of impact, and an impact angle of 15°

indicates one end of the cask is elevated 15° relative to the surface when the primary end impacts. The orientation of the impact limiter is not specified in these tables since the displacement versus force values are not significantly affected by orientation of the impact limiters and gussets with respect to the surface.

One of the 30 ft. dynamic drop tests of the impact limiters using a 1/2 size scale model was a 15° slapdown drop, discussed in TN-FSV SAR Section 2.10.3.4. The impact limiters were oriented with one gusset perpendicular to the ground in this drop, as can be seen in photographs of the impact limiters following this test on TN-FSV SAR page 2.10.3-37. The impact limiters responded as designed in this test, and the orientation of the gussets did not adversely affect performance.

Based on the above, it is concluded that the effects of the gussets on the impact limiters' performance was considered in their design, and the impact limiters for the TN-FSV casks will function to absorb impact energy and protect the casks in drop accidents, irrespective of the orientation of the impact limiter gussets.

NRC RAI Regarding Revisions to the Pressure Rise Leak Test: The NRC requested additional justification for changing the initial pressure in the pressure rise leak tests from the 10 mbar pressure currently in TN-FSV SAR Section 7.1, "Procedures for Loading Package", to the 60 cm. mercury (Hg) vacuum proposed by PSCo. In addition, the NRC requested the calculations that show how the test meets the requirement in the TN-FSV C of C that leakage not exceed 1.0 E-3 std cm^3/sec, and demonstrate that test sensitivity requirements are met.

PSCo Response: Atmospheric pressure at the Fort St. Vrain site is 12.3 psia, which is equivalent to 63.6 cm. of Hg. A perfect vacuum would thus be a vacuum of 63.6 cm. Hg. A pressure of 10 mbar absolute corresponds to a vacuum of 62.9 cm. Hg. As discussed in the referenced letter, PSCo has determined that its cask leak test equipment cannot consistently and reliably attain this vacuum. However, a 60.0 cm. Hg vacuum can be achieved, and it is for this reason that PSCo requested the change in the referenced letter.

Attachment 1 includes calculations showing how PSCo arrived at the acceptance criteria specific to its leak test equipment that correspond to the maximum allowable leak rate of 1.0 E-3 std cm^3/sec (TN-FSV C OF C Sections 6(a) and 6(b)). Included are calculations on the sensitivity of the leak testing. A key factor in the calculations is the volume subject to the test, which includes the volume of the test equipment. The volume of the leak testing system for test of the cask lid o-ring seals is 310 cm^3. The volume of the leak testing system for test of the cask vent port is 489 cm^3.

Based on the Attachment 1 calculations and above information, it is concluded that the acceptance criteria for the FSV pressure rise leak tests of the TN-FSV casks have been correctly formulated to assure leakage rates do not exceed 1.0 E-3 std cm^3/sec, and the sensitivities of the leak tests meet the C of C requirements. The 60.0 cm. Hg vacuum requested by PSCo for the initial leak test pressure represents a substantial differential pressure with respect to atmospheric, sufficient to cause detectable leakage should the cask main lid or vent port be improperly sealed.

Should you have any questions concerning this submittal, please contact Mr. M. H. Holmes at (303) 620-1701.

Very truly yours,

Frederick J. Borst

Frederick J. Borst
Decommissioning Program Director
and ISFSI Manager

FJB/JRJ

Attachments

cc: Regional Administrator,
Region IV

Mr. Robert M. Quillin, Director
Radiation Control Division
Colorado Department of Public Health and Environment

ATTACHMENT
P-95108

CALCULATIONS ASSOCIATED WITH THE TN-FSV PRESSURE RISE LEAK TESTING AT THE FSV NUCLEAR STATION

Section 7.1 of the TN-FSV SAR currently states that the pressure rise leak testing is performed with an initial pressure of 10, +2, -0 mbar absolute for the cask main lid leak test and an initial pressure of 7-10 mbar absolute for the vent port cover leak test. As shown by the following calculations, an absolute pressure of 10 mbar is equivalent to 62.9 cm. of mercury (Hg) at Fort St. Vrain (FSV). The FSV site has an elevation of about 4790 ft. above sea level, with an atmospheric pressure of 12.3 psia.

1 standard atmosphere = 14.7 psia = 76.0 cm Hg

FSV atmospheric pressure = 12.3 psia = 63.6 cm Hg

1 bar = 1 E5 Newtons/meter = 0.987 std. atmosphere = 75.0 cm Hg

10 mbar = 0.01 bar = 0.75 cm Hg pressure above zero absolute pressure

This corresponds to a vacuum of 63.6 cm Hg - 0.75 cm Hg = 62.9 cm Hg below atmospheric pressure at the FSV site. The pressure rise leak test equipment at FSV does not have the capability to consistently and reliably achieve and maintain a 62.9 cm Hg vacuum (10 mbar absolute pressure). However, it was determined that the FSV leak test equipment can achieve a 60.0 cm Hg vacuum.

The following calculations demonstrate how the leak test acceptance criteria were arrived at for the TN-FSV cask for leak testing at the FSV nuclear station. The TN-FSV Certificate of Compliance No. 9253 (C of C), in addition to the summary of the cask operating procedure documented in Section 7.1 of the TN-FSV SAR, requires leak testing of the main cask lid seal and the vent port cover seal prior to each shipment. Volumes of the leak testing configuration, including leak test equipment, piping, hose and fitting connections for testing these two items were measured and calculated as follows:

main lid seal	310 cm^3
vent port cover seal	489 cm^3

The C of C and Section 7.1 of the TN-FSV SAR require pressure rise leak testing of the package seals prior to each shipment, with an acceptance criteria of a leak rate no greater than 1 E-3 std.

cm^3/sec. The testing is required to have a sensitivity of at least 1 E-3 std. cm^3/sec.

Assuming the maximum permissible leak rate of 1 E-3 std. cm^3/sec, and using the ideal gas law, the equation for the mass of air that would leak in during 5 minutes (300 seconds) specified duration of the leak tests, at standard conditions of temperature and pressure, is as follows:

$$m = \frac{(P_{std})\ (V)}{(R_{air})\ (T_{std})} \quad \text{and } \Delta m = \frac{(P_{std})\ (\Delta V)}{(R_{air})\ (T_{std})}$$

$$\Delta m = \frac{(P_{std})\ (1\text{ E-3 cm}^3/\text{sec})\ (300\text{ sec})}{(R_{air})\ (T_{std})} \qquad \textbf{(1)}$$

Using the above equation for Δm, solve for the change in pressure that would occur by introducing the mass of air, Δm, into a fixed volume:

$$\Delta P = \frac{(\Delta m)\ (R_{air})\ (T)}{V_{test}}$$

Substituting for Δm from equation **(1)** above, and setting P_{std} equal to 405.5 inches water:

$$\Delta P = \left[\frac{(405.5\text{ in }H_2O)\ (1\text{ E-3 cm}^3/\text{sec})\ (300\text{ sec})}{(R_{air})\ (T_{std})\ /\ (V_{test})}\right] (R_{air})\ (T)$$

The (R_{air}) (T) terms cancel, resulting in:

$$\Delta P = \frac{(405.5\text{ inches }H_2O)\ (1\text{ E-3 std cm}^3/\text{sec})\ (300\text{ sec})}{V_{test}} \qquad \textbf{(2)}$$

$$\Delta P = \frac{121.65\text{ inches }H_2O \cdot \text{cm}^3}{V_{test}}$$

Using this equation, the following acceptance criteria were arrived at for the TN-FSV pressure rise leak tests at FSV:

main lid seal $\frac{121.65\text{ inches }H_2O \cdot \text{cm}^3}{310\text{ cm}^3} = 0.3924$ inches H_2O

vent port cover seal $\frac{121.65\text{ inches }H_2O \cdot \text{cm}^3}{489\text{ cm}^3} = 0.2487$ inches H_2O

Based on these calculations, the operating procedures for the TN-FSV casks specify maximum permissible pressure increases of 0.3924 inches of water for the main lid seal leak test and 0.2487 inches of water for the vent port cover seal leak test (both of 5 minutes duration).

SENSITIVITY OF THE PRESSURE RISE LEAK TESTING

As stated in the C of C, the sensitivity of the pressure rise leak tests performed prior to each shipment is required to be at least 1 E-3 std. cm^3/sec, and the sensitivity of the pressure rise leak tests performed within the 12 month period prior to shipment, and after seal replacement, is required to be at least 5 E-4 std. cm^3/sec.

Using equation **(2)** above, the same test volumes, and assuming a maximum leakage rate of 5 E-4 std. cm^3/sec, the pressure rise in inches of water would be:

$$\Delta P = \frac{(405.5 \text{ inches } H_2O)\ (5 \text{ E-4 std } cm^3)\ (300 \text{ sec})}{V_{test}}$$

main lid seal $\Delta P = 0.196$ inches H_2O

vent port cover seal $\Delta P = 0.124$ inches H_2O

Readability of the gage for the FSV leak test system is 0.0001 inch water, so that the above minimum required sensitivities are easily met. The sensitivities of the FSV leak test equipment for the tests of 5 minutes duration are determined from equation **(2)** above, using the same test volumes, as follows:

$$\Delta P = \frac{(405.5 \text{ inches } H_2O)\ (\text{LEAK RATE})\ (300 \text{ sec})}{V_{test}}$$

$$0.0001 \text{ inch } H_2O = \frac{(405.5 \text{ inches } H_2O)\ (\text{LEAK RATE})\ (300 \text{ sec})}{V_{test}}$$

For the main lid seal leak test, the minimum detectable LEAK RATE = 2.55 E-7 std. cm^3/sec, which is the sensitivity of this test.

For the vent port cover seal leak test, the minimum detectable LEAK RATE = 4.02 E-7 std. cm^3/sec, which is the sensitivity of this test.

Based on the above calculations, it is determined that the FSV leak test equipment meets the sensitivity requirements established in the C of C.