NUCLEAR CONTAINERS, INC.

Chemical & Nuclear - Engineering and Equipment Fabrication

125 Iodent Way, Suite B - Elizabethton, Tennessee 37643
Telephone: (423) 543-4211 Fax: (423) 543-6007 (800) 221-2465

February 26, 1997

Mr. Cass R. Chappell
Section Leader, Package Certification Section
Office of Nuclear Material Safety and Safeguards
United States Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

Subject: Docket Number 71-9234
Rev. 2 to NCI-21PF-1 Packaging Safety Analysis Report

Dear Mr. Chappell,

Enclosed for your review is Revision 2 to the Safety Analysis Report written for the NCI-21PF-1 overpacks. This revision of the SAR has been prepared upon request and includes testing and analyses performed to respond to questions dated August 15, 1995 and December 22, 1994.

Responses to the questions are included as an attachment to this letter.

If you have any questions or comments, please call me.

Very truly yours,

William M. Arnold

William M. Arnold
Operations Manager

WMA/hl

Enclosures

9703040382 970226
PDR ADOCK 07109234
B PDR

NT01

1/3

040133

Change: LA E. Zieser Ltr. Encl. 4 0

Safety Analysis Report for the NCI-21PF-1 Protective Shipping Package

Submitted by:
Nuclear Containers, Inc.
125 Iodent Way, Suite B
Elizabethton, Tennessee 37643

Revision 2
March, 1997

Prepared by:
Transnuclear, Inc.
Four Skyline Drive
Hawthorne, New York 10532

Docket Number: 71-9234
Comments provided in enclosure to letter dated: August 15, 1995

I. Water Inleakage

Show that there will be no leakage of water into the containment system (the 30B cylinder) under hypothetical accident conditions, including the immersion tests specified in 10 CFR 71.73 (c) (4) and 71.73 (c) (5). Note that the package design relies upon exclusion of water to assure sub-criticality and to prevent a chemical reaction between water and the uranium hexaflouride contents (see 10 CFR 71.43 (d)). Also note that the post-test leak rates recorded in the application (1.4 cm^3/sec and 0.1 cm^3/sec) are not sufficiently low to prevent water inleakage.

The cylinder was leak tight ($< 1 \times 10^{-7}$ std cc/sec) after the 30 foot drop test, the 40 inch puncture test, and the 30 minute fire as described in Section 2.7 and Appendix 2.10.5 of the SAR. Following this air leakage test, an equivalent hydrostatic test was performed on the cylinder. No water leakage was detected.

II. Containment

It is not clear that the package meets the release criteria in 10 CFR 71.51 (a) (2) for Type B(U) packages. The first package tested had a post-test leak rate that was ten times greater than the maximum allowable leak rate. The second package was not subjected to the full test sequence and had been modified by the addition of a steel plate inside the overpack. The application states that "we recommend that only undamaged and unrepaired 30B cylinders be allowed for future Type B shipments and that this restriction be stipulated in Certificate of Compliance No. 9234." Either show that the package design, without the steel plate, is adequate to meet the containment requirements of 10 CFR Part 71, considering 30B cylinders normally in service, or revise the application to limit the authorized contents to a Type A quantity.

The NCI-21PF-1 protective shipping package (with Valve Protection Device installed) as described in Revision 2 of the SAR is adequate to meet the containment requirements of 10 CFR Part 71 regardless of whether the 30B cylinder skirt has been damaged and repaired. Leakage tests after the hypothetical test sequence show that the cylinder was leak tight. This is described in Appendix 2.10.5 and Section 2.7.

III. Stainless Steel Corrosion

Revise the application to show that the stainless steel and phenolic foam do not undergo chemical or galvanic reactions. The information provided does not adequately address the possible corrosion of the steel shells, and does not address corrosion of stainless steel that is not coated or which has coating imperfections. The evaluation should consider the maximum chloride level allowed by the foam specification (see item d. under Foam Specification below).

Corrosion tests of the stainless steel (both bare and painted) and the phenolic foam have been performed and evaluated. These tests show that there will be no significant corrosion of the stainless steel for a period of 20 years. These test results have been incorporated in Section 2.4.4 and Appendix 2.10.3 of Revision 2 of the SAR. Actual worldwide use of the NCI-PF-1 foam formulation for the past six years has also shown no corrosion of the overpacks.

IV. Thermal

Justify that the package is adequately designed for the fire test. Address the following items:

a. **The application states that the thermal test is to be considered acceptable if the average temperature of the cylinder does not exceed 150°F. However, the reported test results were that the average temperature of the cylinder was 197°F and that the temperature exceeded 275°F at some locations.**

b. **The maximum temperature range for the temperature sensitive labels used on the cylinder was 275°F. Several of the labels did not produce a reading because the temperature exceeded 275°F. However, these higher temperatures were not considered when calculating the average cylinder temperature. It is not clear that the average cylinder temperature was as low as 197°F.**

c. **The thermal analysis reported that approximately 31 percent of the uranium hexafluoride could liquefy under the fire test condition. Evaluate the fire test condition if there was a partial load of uranium hexaflouride, i.e. evaluate the temperature and pressures that the cylinder could experience if the cylinder were not filled to its maximum capacity.**

The 30B cylinder is limited to containing UF6 below 250°F. At 250°F, the UF6 would melt and the pressure within the cylinder could exceed the cylinder design pressure of 250 psig. From the fire test results, the average cylinder temperature was 160°F and did not exceed 225°F anywhere on the cylinder.

Time temperature data was obtained from the fire event. Irreversible maximum temperature indicated tapes used during the testing agreed with the thermocouple results. The average cylinder temperature was obtained from the thermocouple data.

Section 2.7.3 and Appendix 2.10.5 present the temperature data from the fire test. Chapter 3 presents the thermal analysis. The thermal analysis demonstrates that under the fire conditions 10% of a full UF6 load could liquefy. Partial loadings of UF6 were also evaluated. If the UF6 load were to fall below 19%, all the contents could vaporize and the maximum design pressure of the 30B cylinder could be exceeded.

V. Foam Specification

Revise the foam specification as follows:

a. Delete the words "or equivalent" from the surfactant specification.

b. The boric anhydride should include a mesh size.

c. Delete the words "or equivalent" from the fiberglass rovings specification.

d. The application should be revised to demonstrate that 300 ppm chlorides will not corrode the stainless steel shells over the life of the packaging. Alternatively, the foam specification should be revised to specify a maximum chloride content significantly less than 300 ppm.

e. The range of acceptable values for the compressive strength of the foam should be specified. The test method used to determine the compressive strength should also be specified.

f. The range of acceptable values for the thermal conductivity of the foam should be specified. The test method used to determined the thermal conductivity should also be specified.

The foam specification (Appendix 2.10.3) and the SAR have been revised as requested.

VI. Cylinder Leakage Measurements

Revise the application to describe the details of the leak tests performed on the cylinder before and after the hypothetical accident tests. This should include a detailed description of the test protocol, the equipment and instrumentation used for the tests, how the system was calibrated, and how the test sensitivity was determined. State the units of the leakage that was measured, including whether the leakage rate is for helium or air. Justify that the leak test performed after the drop tests had a sensitivity sufficiently low to measure the maximum allowable post accident leak rate. (Note that ANSI N14.5 recommends a minimum leak test sensitivity of one half the smallest leak rate to be measured.)

The SAR includes this information in Appendix 2.10.5 and Section 2.7.6.

VII. Drawings

Revise the drawings of the package to clearly specify the following:

a. Maximum weight of cylinder and contents.
b. Maximum and minimum weight of the overpack.
c. Maximum weight of a loaded package.
d. The minimum and maximum foam density.

Revised drawings are included in the submittal.

Comments provided in Enclosure to letter dated: December 22, 1994

1. Provide a full and complete specification for the foam material to be used in the packaging. Note that the revised foam should not be designated SP-9 since it does not conform to the SP-9 specification issued by the Atomic Energy Commission and its successors. The specification should include the acceptable values for foam density and the range within which it can vary.

The new foam formulation has been designated as the NCI-PF-1 fire resistant phenolic foam. A full and complete specification which includes acceptable values for foam density, compression strength and thermal conductivity has been provided in Appendix 2.10.3 of the Safety Analysis Report, Revision 2.

2. Provide test results and engineering analyses which show that the packages with the revised foam meet the performance requirements specified in 10 CFR Part 71 for normal and hypothetical accident conditions. The information should specifically include the results of the impact and fire tests conducted on packages made with the revised foam (i.e. the low chloride foam). Note that the test results reported in your submittal dated January 11, 1993, were not for packages with the revised foam, and did not include fire testing of the package.

The NCI-21PF-1 overpack (fabricated with NCI-PF-1 foam) containing the 30B cylinder with valve protection device meets the performance requirements specified in 10 CFR Part 71 for both normal and accident conditions. Section 2.7 and Appendix 2.10.6 provide the test results and supporting engineering analyses conducted on the NCI-21PF-1 protective shipping package.

3. **Show that there will be no chemical, galvanic or other reaction among packaging components, including corrosion of the stainless steel shells by chemicals present in the foam. If the coating or epoxy primer is relied upon to prevent corrosion, specify the procedures that will be followed to assure that the primer is applied correctly, and in sufficient quantity and thickness. Show that the primer will be effective over the service life of the packaging.**

Section 2.4.4 and Appendix 2.10.3 of the SAR demonstrate that there will be no chemical, galvanic or other reaction among the packaging components, including corrosion of the stainless steel shells by chemicals present in the foam.

4. **Revise the drawings of the package to clearly specify the following weights:**

   a. **Maximum weight of the cylinder and contents.**
   b. **Maximum and minimum weight of the overpack**
   c. **Maximum weight of a loaded package.**

   Show that a package with a minimum weight overpack and a maximum weight cylinder will meet the performance requirements of 10 CFR Part 71 (see item No. 2 above).

Revised drawings are included in the SAR. The testing described in Appendix 2.10.5 and Section 2.7 was performed on a representative overpack taken from service for this test program. Since no overpacks can be built under the current C. of C. and the variation in weight is dependent on fabrication processes, it was not possible to perform the tests with a minimum weight overpack. The test was performed with a representative cylinder. Any additional weight required to meet the maximum package weight was added as cargo (steel shot inside the cylinder).