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¹ Original Issue refers to application dated December 1985.

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Eleven drawings (18 sheets) revised as listed on Page XVII-1.

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XV.2 Cask Loading

1. Verify the cask is in an unimpaired physical condition as required by 10 CFR 71.87(b).

2. Verify the neutron shield fluid level.

Note: The neutron shield tank may be empty when the cask is in Configuration D.

3. If the cask is to be used in configuration C, verify the presence of the boral sheets in the basket.

4. Disengage the outer closure head bolts. Remove the outer closure head and place it in a suitable storage location. Inspect the o-ring and replace it if necessary. Inspect each lid bolt and replace it if necessary.

5. Remove the valve caps from the inner closure head. Inspect the o-ring seals, and replace them as necessary. Visually inspect the valved quick disconnect nipples and replace them if necessary.

6. Disengage the inner closure head bolts. Remove the inner closure head and place it in a suitable storage location. Inspect the elastomer o-ring and replace it if necessary. Replace the metallic o-ring. Inspect each lid bolt and replace it if necessary.

7. Visually inspect the inner cavity for foreign material or damage. Inspect the gasket in the suction drain line flange and replace it if necessary.

8. If needed, install, or verify the presence of, a spacer on the inner closure head.

9. *Open the inner container closure head valves.

10. *Remove the fuel assembly spacer plug (if needed).

XV.2.1 Wet Loading of Fuel

- 1. Fill the cask cavity with clean water.**
- 2. Engage the cask lifting yoke with the cask lifting trunnions and lift the cask. Carefully lower the cask into the pool and place it in the loading area. Rinse the cask with clean water as it enters the pool.**
- 3. Disengage the lifting yoke from the cask and place the yoke in a suitable storage location.**
- 4. Identify the fuel to be loaded. Verify the fuel meets the requirements of the Certificate of Compliance.**

5. Carefully place the fuel (assembly or rods in container) in the cask.
6. Confirm that the fuel or container is correctly seated.
7. Repeat steps XV.2.1 #5 and #6 as necessary to load multiple assemblies or containers.
8. *Install the fuel assembly spacer plug in the cask (if needed).
9. Attach a valve access attachment to each valve on the inner closure head. This provides an open condition for these penetrations.
10. Replace the closure lid on the cask. This may be accomplished with the yoke, or with separate rigging. Guide pins, which are located in the cask flange, provide final alignment.
11. Visually verify that the lid is seated.
12. Engage the cask lifting yoke with the cask lifting trunnions. Verify the yoke engagement before lifting the cask.
13. Lift the cask to the pool surface. Install and hand tighten the inner head bolts.
14. Raise the cask out of the water and place it in a decontamination pit, or other area as appropriate and disconnect the lifting yoke. Rinse the cask with clean water as it exits the pool.
15. Remove the guide pins and install the shipping bolts.
16. Torque the inner head bolts to the specific torque requirements in three passes. (See Table XV.1 for Torque and Lubricating Requirements.)
17. Connect a clean water supply line to the drain valve, and a drain line to the vent valve. Flush the cask with at least two volumes of clean water. Disconnect the water supply and drain lines.
18. Connect a helium/~~argon~~/nitrogen supply line the vent valve and a drain line to the drain valve.
19. Pressurize the cask cavity to force out approximately five gallons of water.
20. Close drain valve and pressurize the inner cavity to 10 psig. Close vent supply valve and gas supply valve.
21. *Remove the gas supply and drain lines.
22. Check for five minutes for leaks through the inner closure head and inner closure head valves by observing the presence of bubbles. The presence of bubbles requires corrective measures and repeating of all operational steps subsequent to that step at which corrective measures were effective.
23. Drain water from closure head cavity by attaching fixtures with valved couplers to valved nipples to open the closure head cavity drain valves.

24. Reconnect a helium/argon/nitrogen supply line to the vent valve and a drain line to the drain valve.
 25. Pressurize the cask cavity to force out any water. Purge the cask with at least 400 liters of gas for 5 minutes after the last traces of water disappear from the drain line.
 26. Remove the gas supply and drain lines.
- Note:** If the cask is used to ship contents with a decay heat load of greater than 2.0 kW, all residual water is removed from the cavity by vacuum drying as described in steps #27 through #29. If the cask is used to ship contents with a decay heat load of less than 2.0 kW, the cask cavity must be purged twice more with at least 400 liters of gas.
27. Connect a vacuum pump to the vent valve. Connect a vacuum gauge to the drain valve.
 28. Evacuate the cask cavity to 3 mm Hg and hold for at least five minutes.
 29. Remove the vacuum pump and vacuum gauge.
 30. Perform the helium leak test on the inner cavity head as required by Section XVI.
 31. Backfill the inner cavity with helium to atmospheric pressure.
 32. *Attach a suction pump line to annulus valve and remove water from outer cavity.
 33. *Disconnect line from cask cavity suction drain line.
 34. Drain water from closure head cavity by attaching fixtures with valved couplers to valved nipples to open the closure head cavity drain valves. Blot up any freestanding water on the inner head.

XV.2.2 Dry Loading of Metallic Fuel

1. Replace the closure lid on the cask, but not the lid bolts.
2. Identify the fuel to be loaded. Verify the fuel meets the requirements of the Certificate of Compliance. The failed fuel canisters (FFCs) must be loaded and vacuum dried and sealed as described in Section XV.5.
3. Place the carriage assembly on top of the dry loading stand.
4. Position the carriage assembly for closure lid removal. Connect the closure lid to the removal cylinder and remove the lid from the cask.
5. Position the carriage for fuel loading.

6. Match mark the carriage assembly and turntable to each fuel canister location in the cask cavity. For sound fuel rods, there will be three unsealed canisters; with 4.0-inch FFC(s), there will be three sealed canisters; and with 2.75-inch FFC(s) there will be six sealed canisters.
7. Move the carriage and turntable to fuel canister position number 1.
8. Place the shielded transfer cask containing a fuel canister onto the turntable.
9. Lower the fuel canister from the transfer cask into the shipping cask.
10. Repeat steps XV.2.2 #7, #8, and #9 to complete loading of the cask.
11. Replace the closure lid onto the cask by re-positioning the carriage assembly and actuating the closure lid cylinder.
12. Visually confirm that the closure lid is seated properly.
13. Remove the carriage assembly from the loading stand.
14. Install and hand tighten the inner closure head bolts.
15. Torque the inner head bolts to the specific torque requirements in three passes. Torque the shipping bolts to the specified torque requirements. (See Table XV.1 for Torque and Lubricating Requirements.)
16. Fill the head cavity with water.
17. Connect a helium/air/nitrogen supply line to the vent valve and a drain line to the drain valve.
18. Pressurize the cask cavity to 10 psig. Close vent supply valve and gas supply valve.
19. Check for five minutes for leaks through the inner closure head and inner closure head valves by observing the presence of bubbles. The presence of bubble requires corrective measures and repeating of all operational steps subsequent to that step at which corrective measures were effective.
20. Remove the water from the head cavity.
21. Remove the gas supply and drain lines.
22. Perform the helium leak test on the inner cavity head as required by Section XVI.
23. Backfill the inner cavity with helium to atmospheric pressure.

XV.2.3 Dry Horizontal Loading of Fuel

1. Identify the fuel to be loaded. Verify the fuel meets the requirements of the Certificate of Compliance.
2. Carefully place the fuel (assembly or rods in container) in the cask.

XV.4. Preparation of the Cask for Shipment

This section is applicable to shipping an empty or loaded cask.

1. Place valve caps over inner head valves and tighten to torque specified in Table XV.1.

2. Perform required leak test on valve caps as required by Section XVI.

Note: If the cask is empty, the leak tests are not necessary.

3. Reposition outer closure head on cask and tighten the outer closure head bolts to the torque specified in Table XV.1.

Note: If the cask is used to ship contents with a decay heat load of greater than 2.0 kW, all residual water is removed from the inner head cavity by vacuum drying as described in steps #4 through #7.

4. Connect a vacuum pump to the outer closure head vent valve. Connect a vacuum gauge to the outer closure head drain valve.

5. Evacuate the closure head cavity to one half the vapor pressure of water (see next step) at the temperature of the cask and maintain for 15 minutes.

6. Stop the vacuum pump and monitor the pressure for 10 minutes. If the pressure rise is less than one quarter of the vapor pressure of water at the temperature of the cask, the cask is adequately dried for shipment. If not, repeat steps #3 and #4. At 70°F the vapor pressure of water is 18 mm of mercury.

7. Remove the vacuum pump and vacuum gauge.

8. Perform leak test on outer closure head as required by Section XVI.

Note: If the cask is empty, the leak tests are not necessary.

9. Bolt outer closure head valve caps to torque specified in Table XV.1 and perform the leak tests required by Section XVI.

Note: If the cask is empty, the leak tests are not necessary.

10. Decontaminate the cask as needed.

11. Engage the cask lifting yoke with the cask lifting trunnions and lift the cask. Transfer the cask to the trailer and lower the cask onto the rear trunnions. Lower the cask to rest on the front tie-down saddle, moving the crane as required to maintain cask engagement to the trailer and crane cables vertical.

12. Disengage the lifting yoke and place it in a suitable location.

13. Install the cask tie-down bolts.

14. Install the top and bottom impact limiters.

15. If the cask **is not empty** install a tamper indicating seal on the top impact limiter.
16. Install the personnel barrier or close the ISO container.
17. Survey the shipping container for contamination and dose rates. Ensure compliance with 10 CFR 71.47 and 10 CFR 71.87(i).
18. Display shipping placards as required by 49 CFR.

SECTION XVI MAINTENANCE PROGRAM

Each cask shall be subjected to a series of tests and inspections prior to each shipment as indicated in the following maintenance program schedule. These tests ensure the leak-tightness of the properly sealed package. Periodically (annually) each cask shall be leak tested and pressure tested to ensure that no degradation of the package integrity has occurred over time. In addition to testing, certain components are replaced and a comprehensive visual inspection of the cask surfaces and major components is completed. Annual tests, inspections and part replacements are shown on the following maintenance program schedule.

Each cask must have a current annual inspection prior to its use. Each required annual servicing of a cask shall be performed normally during or before the calendar month in which the annual servicing is due. In every case, however, it shall be performed no later than thirty (30) days following the date the servicing is due. During inactive periods, the maintenance and testing frequency may be disregarded provided that the package is brought into full compliance prior to the next use of the package.

Engineering approval is required prior to making any repairs of damaged areas. All such repairs will be fully documented. The replacement of valves, pressure gages, fittings, seals, and thread fasteners is considered normal maintenance and would not require engineering approval.

Seals, o-rings, and gaskets described in the following schedule must be visually inspected for wear or damage and replaced as necessary during cask use.

Maintenance Program

Periodic maintenance and testing of sealing surfaces, containment boundaries, and relief valves of the cask are shown below. Certain seals and o-rings must be replaced prior to testing.

1. Inner Closure Head Seal and Inner Cavity

Each Shipment	<u>Helium Leak Test</u>
Annually	Helium Leak and Pressure Testing ^{1,2}
Annually	Seal Replacement
Annually	Visual Inspection
2. Inner Closure Head Valve Caps, Cavity Drain Valve Caps

Each Shipment	Visual Inspection
	<u>Helium Leak Test</u>
Annually	Helium Leak and Pressure Testing ^{1,2}
Annually	Seal Replacement
Annually	Visual Inspection
3. Drain Line Gasket

Each Shipment	Visual Inspection, Replace as Necessary
Annually	Seal Replacement
4. Outer Closure Head

Each Shipment	Air Pressure Test to 10 psig
Annually	Helium Leak and Pressure Testing ^{1,2}
Annually	Seal Replacement
Annually	Visual Inspection
5. Water Jacket & Expansion Tank; and Valves

Annually	Check Fluid Level, Specific Gravity and Boron Concentration ³
Annually	Pressure Test to 40 psig ^{4,5}
Annually	Visual Inspection
Each Shipment	Check Fluid Level
6. Water Jacket Relief Valve

Annually	Replace With New Pre-Set Valve, or Verify Cracking and Reseating Pressure (Allowable Variation is +5% - 12% of Nominal Cracking Pressure, 200 psig).
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|----|---|---|
| 7. | <u>Fasteners, Studs, Washers - "O"-Ring Clips</u> | |
| | Each Shipment | Replace as Necessary |
| 8. | <u>Valve Box Gasket</u> | |
| | Each Shipment | Visual Inspection; Replace as Necessary |
| | Annually | Gasket Replacement |

ADDITIONAL TEST AND INSPECTIONS FOR CONFIGURATION A:

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|-----|--|---|
| 9. | <u>Inner Container Closure Head Valve Caps</u> | |
| | Each Shipment | <u>Helium Leak Test</u> |
| | Annually | Helium Leak and Pressure Testing ^{1,2} |
| | Annually | Seal Replacement |
| | Annually | Visual Inspection |
| 10. | <u>Inner Container</u> | |
| | Annually | Helium Leak and Pressure Testing ^{1,2} |
| | Annually | Visual Inspection |

- ¹ Introduce helium and pressurize cavity to a pressure of 23.5 psig. Isolate cavity and monitor pressure for a minimum of 30 minutes. Any observed drop in pressure shall be cause for rejection of the test. Reduce helium pressure and perform helium leak test in accordance with Section XVI, Appendix A. A leak rate greater than 1×10^{-6} std cm³/s will be cause for rejection of the test.
- ² When a packaging is to be used for the transport of contents with a total decay heat load greater than 4.0 kW, the helium pressure drop test shall be replaced by the performance of a hydrostatic test to 220 psig.
- ³ For shipment of PWR assemblies having a maximum average burnup between 40,000 MWD/MTU and 56,000 MWD/MTU, the neutron shield fluid must be verified to contain at least 1.0 weight percent boron. (Borated fluid may be left in the shielding tanks during shipment of other contents permitted by the Certificate.)
- ⁴ Connect clean air supply to threaded connection on the water jacket and expansion tank (through water jacket relief valve opening) and pressurize to 40 psig. Hold pressure for 10 minutes and then inspect water jacket and expansion tank welds and ports for leakage. Fluid leakage from any weld or port shall be cause for rejection of the test.
- ⁵ When a packaging is to be used for the transport of contents with a total decay heat greater than 4.0 kW, the specified pressure test shall be replaced by the performance of a hydrostatic test to 405 psig.

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APPENDIX A
SECTION XVI
HELIUM LEAK TESTING

A.1. Leak Tests

The cask containment boundary is subjected to a leak test to verify containment. The test is performed using helium and a helium mass spectrometer connected to the test port of the lid or one of the port covers. The mass spectrometer has a minimum sensitivity such that it is capable of detecting a leak rate of less than 1×10^{-9} std cc/sec and is calibrated before and after the test with a standard having a known leak rate between 5×10^{-7} and 1×10^{-9} cc/sec. The procedure is performed between 40°F and 125°F and is temperature corrected. New o-rings are to be used. The basic procedures for the cask lid and for the vent and drain ports are provided in the following sections:

A.2. Inner Closure Head Leak Test

1. Remove both port covers and install the cask lid.
2. Attach a roughing pump to either the vent or drain valve.
3. Attach the helium mass spectrometer to the other valve.
4. Start the vacuum pump and pull a vacuum on the cask cavity.
5. Once the vacuum is sufficient to place the mass spectrometer in test mode, place an enclosure over the lid and purge with helium.
6. Monitor the leak rate until stable.
7. The leak test is acceptable if the leakage rate is less than 1×10^{-6} std-cc/sec.
8. If the leak rate is unacceptable, replace the seal and repeat the test.

A.3. Inner Closure Head Vent Valve Cap Leak Test

1. Remove the cask vent valve and install the vent valve port cover.
2. Introduce a vacuum into the cask cavity to less than 2 psia.

3. Backfill the cask cavity to atmospheric pressure with helium.

4. Repeat steps 2 and 3. This ensures the cask is filled with a helium concentration of approximately 98%.

5. Remove the test port plug from the vent port cover.

6. Attach the helium mass spectrometer to the vent port cover test port and start the test.

7. Repeat steps 6 through 8 in Section 2 to test the vent port cover.

A.4 Inner Closure Head Drain Valve Cap Leak Test

Note: If the drain port leak test is not performed immediately after the cask lid or vent port cover leak test, steps 2 through 4 of Section 2 shall be performed to ensure that the cask cavity contains helium.

1. Remove the cask drain valve and install the drain valve port cover.

2. Remove the test port plug from the drain port cover.

3. Attach the helium mass spectrometer to the drain port cover test port and start the test.

4. Repeat steps 6 through 8 in Section 2 to test the drain port cover.

Section XVII ENGINEERING DRAWINGS

General

70514F	Sheet 1	Rev. 8	NLI 1/2 Cask and Trailer General Arrangement
70514F	Sheet 2	Rev. 8	NLI 1/2 Cask and Trailer General Arrangement
70885F	Sheet 1	Rev. 3	Spent Fuel Cask Details
70885F	Sheet 2	Rev. 2	Spent Fuel Cask Details
70885F	Sheet 3	Rev. 2	Spent Fuel Cask Details
70885F	Sheet 4	Rev. 1	Spent Fuel Cask Details
70887F	Sheet 1	Rev. 1	Outer Closure Head
70888F	Sheet 1	Rev. 3	Spent Fuel Cask General Assembly

Configuration (A)

70516F	Sheet 1	Rev. 8	Spent Fuel Cask General Assembly
70562F	Sheet 1	Rev. 1	Inner Container
70562F	Sheet 2	Rev. 2	Inner Container
70562F	Sheet 3	Rev. 0	Inner Container
70562F	Sheet 4	Rev. 0	Inner Container

Configuration (B)

70886F	Sheet 1	Rev. 2	Basket Concept
70884F	Sheet 1	Rev. 2	Inner Closure Head

Configuration (C)

460-052-F8	Sheet 1	Rev. 4	Rockwell Fuel Basket – NLI 1/2 Cask
460-052-F9	Sheet 1	Rev. 3	Container – Fermi Fuel, Rockwell Basket – NLI 1/2 Cask, Assembly of

Configuration (D)

347-291-F12		Rev. 1	Liner – 3 Element, NLI 1/2 Cask, Fuel Movement Project
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FIGURE WITHHELD UNDER 10 CFR 2.390

DATE	TIME	UNIT	SEC	BUILD NO.	DESCRIPTION
LWT OF MATERIAL					
NUMBER OF G. CASES Q. & R. END AND SEC. REASON		NLC NATIONAL LEAD COMPANY NUCLEAR DIVISION WASHINGTON, D.C.			
		LWT SYSTEM 1/2 RUBER CONTAINER CONCEPT			
CASE NO.	Q. & R.	SEC.	BUILD NO.	REMARKS	BY
27122	2160-10	1	70842F		W
FORM 17				PAGE 2 OF 2	

DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME
1968	0817	1968	0817	1968	0817	1968	0817
RELATIONS D-1 & CHIEF (L.C.) ENG. (L.C.) QC PROS				DATE OF MATERIAL 1968 0817			
NATIONAL LEAD COMPANY NUCLEAR DIVISION WASHINGTON PLANT				LWT SYSTEM 1/2 INNER CONTAINER CONCEPT			
COPIES 20032				FROM 3340-10			
TO 3340-10				FROM 3340-10			
DATE 1968 0817				DATE 1968 0817			