

May 20, 2004

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**RE: Certificate of Compliance No. 9258 for the Model No. F-294  
Request for Additional Information**

Dear Ms. Barto:

Further to our telephone conversation of May 14 and 17, 2004, please find attached the revised chapter 7 of MDS Nordion report number IN/TR 9301 F294 (4c), "Safety Analysis Report for the F-294 Transport Package," which addresses your concerns with respect to the loading of the F-457 carrier. The revision is found on page 7.3.

If you have any questions or require further information please feel free to contact me by telephone at (613) 592-3400 extension 2421 or by email at [mcharette@mds.nordion.com](mailto:mcharette@mds.nordion.com).

Yours sincerely



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Attached: Chapter 7 of IN/TR 9301 F294 (4c)

Copy to: Mike Krzaniak, Karine Glenn, Luc Desgagne, MDS Nordion

U mss01

Effective Date: 20 MAY 2004

## Safety Analysis Report for F-294 Transport Package

### Signatures

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NOTE: The portion of this text affected by the changes is indicated by a vertical line in the margin.

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## CHAPTER 7 – OPERATING PROCEDURES

This chapter describes the operating procedures for the F-294 package. There are two (2) transport scenarios: i) international shipments and, ii) domestic shipments within the USA.

### i) International shipments

For international shipments *originating from the Customer's site* to MDS Nordion Inc., Ottawa, Ontario, Canada, the F-294 is loaded and prepared for shipment as per MDS Nordion procedure IN/OP 0283 F294 (Ref. [1]).

### ii) Domestic shipments within the USA

For domestic shipments within the USA, there can be four distinct phases in a single round trip:

Phase 1: An empty F-294 package with appropriate equipment is sent from MDS Nordion, Ottawa, Ontario, Canada to a Wet Source Storage Gamma Irradiator (Category IV) customer's site A.

Phase 2: At customer's site A in the USA, the F-294 is loaded with the appropriate number of C-188 sealed sources and prepared for shipment from customer's site A to customer's site B as per MDS Nordion Procedure IN/OP 0283 (Ref. [1]).

Phase 3: At customer's site B, the sources from the F-294 are unloaded and transferred to the irradiator at site B as per MDS Nordion Procedure IN/OP 0284 F294 (Ref. [2]). At the conclusion of this phase the F-294 package is empty.

Phase 4: An empty F-294 package is shipped back to MDS Nordion, Ottawa, Ontario, Canada as per MDS Nordion Procedure IN/OP 0285 F294 ( Ref. [3]).

In addition, the F-294 package can be used for multiple round trips from a Wet Source Storage Gamma Irradiator customer's site A and to a Wet Source Storage Gamma Irradiator customer's site B or vice versa.

Phase 1: An empty F-294 package is sent to a customer's site A from MDS Nordion.

Phase 2: The F-294 is loaded at the customer's site A and prepared for shipment to the customer's site B.

Phase 3: The F-294 is unloaded at the customer's site B. The empty F-294 is returned to the customer's site A for a second trip.

Phase 4: The F-294 is loaded (second load) at the customer's site A and prepared for shipment to the customer's site B.

Phase 5: The F-294 is unloaded (second unload) at the customer's site B. The empty F-294 is then returned to the customer's site A for a third trip (third load) or returned empty to MDS Nordion, Ottawa, Ontario, Canada.

## 7.1 PROCEDURES FOR LOADING THE PACKAGE

The underwater loading of the C-188 sealed sources in the F-294 package at a customer's site A and the preparation for shipment of F-294 transport package is carried out as follows:

### 7.1.1 PURPOSE

This operating procedure is to ensure that the underwater loading of C-188 cobalt-60 sealed sources and the preparation for shipment of the F-294 transport package from a customer's irradiator site A to the customer's site B is in compliance with the design specifications, handling requirements, and regulatory requirements. The F-294 transport package shall be transported as "exclusive use" shipment as per 10 CFR Part 71 regulations.



### **7.1.2 SCOPE**

This operating procedure describes the following operations:

1. The underwater loading of the F-313 cage (carrier) or F-457 cage (carrier), containing C-188s (cobalt-60) sources, into the cavity of the F-294 package.
2. Preparation for shipment of the F-294 package.
3. Instructions for securing the F-294 package on the road vehicle.

These are the minimum requirements that must be achieved.

### **7.1.3 COMPLIANCE AND RESPONSIBILITY**

It is the responsibility of MDS Nordion International personnel or its agent to ensure that the F-294 transport package is prepared for transport in compliance with the regulatory requirements.

It is the responsibility of the customer, in the role of the consignor, to approve the release of the F-294 shipment.

It is the responsibility of the pertinent regulatory authority to enforce compliance as per the F-294 transport package license.

### **7.1.4 TRANSFERRING F-294 EMPTY PACKAGING FROM THE IRRADIATOR SITE TO THE POOL**

1. Verify that the F-294 packaging is empty.
2. Remove the shipping skid.
3. Remove the crush shield and the cylindrical fireshield from the packaging.
4. Inspection.
  - 4.1 Inspection and replacement for top closure components.
    - a) Inspect the neoprene gasket, the sealing surfaces and the closure bolts.
    - b) If necessary, replace the gasket or closure bolts.
  - 4.2 Inspection and replacement for the vent line closure components.
    - a) Inspect the vent line caps, gasket and seal surfaces.
    - b) If necessary, replace the gasket.

Ref: Apply 20 ft.-lb.  $\pm$  2 ft.-lb. torque to close the vent line cap.
  - 4.3 Inspection and replacement for the drain line closure components.
    - a) Inspect the vent line caps, gasket and seal surfaces.
    - b) If necessary, replace the gasket.

Ref: Apply 50 ft.-lb.  $\pm$  5 ft.-lb. torque to close the drain line cap.
  - 4.4 Inspection of the cylindrical fireshield.
    - a) Ensure that the openings of the fireshield that allow air to flow through the transport package are unobstructed.
5. Confirm that the source rack is lowered into the pool and is fully disabled.
6. Sling the F-294 to the crane.
7. The F-294 packaging can now be transferred into the irradiator shielded building.
8. Lift the container and lower it into the pool.
9. Lift the shield plug clear of the container, giving access to the cavity of the F-294.

**Note**

*When handling sources/source carriers underwater, always have an audible radiation monitor at your work position for warning if, by accident, any source/carrier is lifted too close to the pool surface. When removing any item from the pool, always check it with the radiation monitor as the item is being brought to the surface.*

**7.1.5 UNDERWATER LOADING OF C-188 CAPSULES**

1. Load C-188s into the source carrier as per loading diagram, see Figure 7.1- F1 a, for the F-313 source carrier or 7.1-F1b for the F-457 source carrier. Do not exceed 360 kCi of Cobalt-60, the licensed limit of the F-294 transport package. Retain all wipes for the possibility of further testing. The activity should be distributed evenly around the carrier.

When using the F-457 source cage, the outer ring is filled first. For most configurations, the maximum allowable pencil activity on the inside ring can be calculated from the following formula.

$$\text{Maximum Allowable Pencil Activity on Inner Ring} = \frac{(360 - \text{Outer Ring Total Activity in kCi})}{40.0}$$

Deviations from this guideline are acceptable provided that the maximum source temperature does not exceed 482°C.

**Note**

*The wipes of C-188s and source carrier are taken underwater at the customer's site. The wipes are returned to MDS Nordion or its agent for confirmatory measurements.*

2. Lift the source carrier and place it on the bottom of the cavity of the F-294 container.
3. Replace the shield plug. Fasten two out of sixteen bolts with the F-294 at the bottom of the pool.
4. Slowly raise the F-294 package out of the water from the bottom of the pool to the top of the pool.

**Warning**

**Stand clear as steam and hot water may blow out of the vent plug holes when the container is raised out of the water.**

5. Ensure that the shield plug is fully secured. Torque each bolt to  $100 \pm 10$  ft.-lb. ( $133 \pm 13$  N m).
6. Blow argon through the vent line, forcing out ALL the remaining water in the F-294 cavity through the drainline back into the pool. The following steps outline the procedure for purging F-294 cavity with argon and the criteria for ensuring all the water has been drained from the F-294 cavity.
  - 6.1 Connect the equipment as per Figure 7.1-F2.
  - 6.2 Open Valve VX to set argon pressure at 30 psi and let argon flow from the center vent line connection through the F-294 cavity.
  - 6.3 Check for water or water spray flowing from the drain line outlet.
  - 6.4 Repeat blowing argon until there is no water spray exiting from drain line outlet. Use a rag or paper towel for detecting water.

7. Seal off vent line connection using gasket, vent line shield insert, cap. Use 20 ft.-lb.  $\pm$  2 ft.-lb. torque on the cap. Seal off drain line connection using gasket and cap. Use 50 ft.-lb.  $\pm$  5 ft.-lb. torque on the cap.
8. The F-294 container is transferred from inside the irradiator building to outside the irradiator building. The F-294 can be placed on the truck trailer bed or a designated staging area for a specified period (Ref. [2]) before the final argon purge.

#### 7.1.6 **PERFORM THE CAVITY WATER FLUSH TEST PROCEDURE**

1. Remove the crush shield from the top of the container. Remove the cylindrical fireshield from the container.
2. Remove the drainline cap and the top vent center cap and the vent-line shield plug from the container. If any water drains from the container, collect the water and check it for any contamination. Document and report the drainage of discolored water from the container.
3. Thread the brass adapter with the filter into top center vent plug.
4. Connect the brass adapter supplied to the lower drain tube of the F-294 package.
5. Close the spigot valve on the US 10-gallon plastic container, check all hose connections for tightness and fill 4/5th full with de-ionized water. Use of two (2) US 5-gallon plastic containers in place of one (1) US 10-gallon container is permitted.
6. With plastic tubing attached to each end of the filter, secure one end of plastic tube to the lower draintube adapter on the F-294 package and the other end to the spigot on the US 10-gallon plastic container.

##### **Note**

*For optimum flow of the water into the cavity,  
open the spigot with the water-filled plastic container below the drain-tube level  
to allow water to fill the plastic tube,  
then raise the water-filled plastic container to the top of the transport package.*

7. Support the bottom of the water-filled plastic container above, or level with, the top of the F-294 package.
8. Remove the cap of the US 10-gallon plastic container and open the spigot, allowing water to slowly fill the F-294 package cavity.

##### **Warning**

**Steam and hot water may blow out of the vent holes as the cavity fills.**

9. Monitor the filter on the top vent hole during filling for increase in the radiation fields. If the radiation field at the monitoring position increases, immediately close the spigot to prevent further entry of water into the cavity. Evacuate the area, taking care to prevent the possible spread of contamination. Restrict access to the area. Notify the facility's Radiation Safety Officer, the local competent authority and MDS Nordion.
10. As soon as the cavity and the vent tube(s) are full, lower the plastic container to the ground and allow all the water to drain back into the plastic container through the filter. Monitor the filter in the plastic tube with the survey meter.

11. When all the water has drained from the cavity, close the spigot on the plastic container, and disconnect the plastic tube from the lower drain tube adapter on the F-294 package and the brass adapter with the filter from the top center vent plug.
12. Remove the filters to a low background area and monitor the filters. Wearing protective gloves, carefully cut open each filter and remove the filter material. Place the filter material in a labeled and lockable plastic bag and slowly scan for radioactive contamination. Record the highest count rate during the scan.

**Note**

*1. The instrument must be used in the geometry (or as close as practically possible) for which the instrument conversion factor was established.*

*The filter material, therefore, should be as flat as possible for the scan.*

*2. Care must be taken to ensure that the instrument is allowed to reach equilibrium before the reading is made.*

13. Removable contamination test evaluation:
  - 13.1 If the net count rate corresponds to an activity less than 5 nCi (185 Bq), the test is negative. If the test is negative, no further action is required except proper record-keeping. Retain all wipes/filters for the possibility of further testing.
  - 13.2 If the net count rate corresponds to an activity more than 5 nCi (185 Bq), the test is positive. If the test is positive, inform the local Radiation Safety Officer and MDS Nordion for further disposition.
  - 13.3 If the net count rate is greater than 0.5 nCi, but less than 5 nCi, contact MDS Nordion. Do not proceed further until authorized to do so.
14. Remove the brass adapter from the end of the lower drain tube of the shipping container.
15. If the F-294 package is to be transferred to the pool in the irradiator shield building, proceed to Section 5 of this procedure.
16. If the task is delayed, the cavity must be properly drained and purged with Argon before vent and drain cap may be replaced.

#### **7.1.6.1 Notifying MDS Nordion of Deficiencies**

MDS Nordion, Ottawa, Ontario, Canada, or its agent, shall be notified immediately if any of the following deficiencies are evident.

1. Deficiencies of the F-294 on arrival at the customer's site B, including:
  - a) Radiation levels over 200 mrem/h at the surface of the transport package.
  - b) Transport Index (TI) greater than 10.
  - c) Non-fixed contamination from the external surface showing a wipe reading greater than 3 nCi.
2. Drainage of discolored water from the container. If this occurs, a sample of water shall be taken and returned to MDS Nordion for analysis.
3. Contamination found to be above 0.5 nCi when using the cavity water flush test procedure.
4. Any other abnormalities that are indicated when following the step-by-step procedures.

### 7.1.7 PREPARATION FOR SHIPMENT OF LOADED F-294

1. After a specified waiting period for F-294 as per Figure 7.1-F3, a final argon purge of the F-294 cavity can begin. The following steps outline the procedure for purging the F-294 cavity with argon and the criteria for ensuring all the water has been drained from the F-294 cavity.
  - 1.1 Open the closures on vent lines and drain line.
  - 1.2 Connect the equipment as per Figure 7.1-F2.
  - 1.3 Open Valve VX to set argon pressure at 30 psi and let argon flow from the center vent line connection through the F-294 cavity.
  - 1.4 Check for water or water spray flowing from the drain line outlet.
  - 1.5 Repeat blowing argon until there is no water spray exiting from drain line outlet. Use a rag or paper towel for detecting water.
  - 1.6 Seal off drain line connection using gasket and cap. Use 50 ft.-lb.  $\pm$  5 ft.-lb. torque on the cap.
  - 1.7 Disconnect the argon line to center ventline.
  - 1.8 Seal off vent line connection using gasket, vent line shield insert and cap. Use 20 ft.-lb.  $\pm$  2 ft.-lb. torque on the cap.
2. Check all external surfaces on the package for contamination. The level of non-fixed contamination shall be determined by wiping an area of 300 cm<sup>2</sup> of the external surface by hand with a dry filter paper or a wad of dry cotton wool or any other material of this nature. The maximum permissible level of removable contamination on the wipe is 0.37 Bq/cm<sup>2</sup> (10<sup>-5</sup>  $\mu$ Ci/cm<sup>2</sup>). This translates to a wipe reading of 110 Bq (3 nCi).
3. Perform a radiation survey of the assembled package. Radiation levels shall not exceed 2 mSv/h (200 mrem/h) on the external surface of the package or 0.1 mSv/h (10 mrem/h) at any point one meter from the surface of the package. See Table 7.1-T1.
4. Secure the cylindrical fireshield. Torque each bolt to 200  $\pm$  20 ft.-lb. (272  $\pm$  27 N-m).
5. Secure the crush shield on the package using sixteen (16) fasteners.
  1. Secure with eight (8) top fasteners using torque of 200  $\pm$  20 ft.-lb. (272  $\pm$  27 N-m) on each fastener.
  2. Secure with eight (8) side fasteners, using 50  $\pm$  5 ft.-lb. (68  $\pm$  7 N-m) on each fastener.
6. Heat screen is not required as F-294 accessible surface temperatures are less than 82°C (182°F) and as F-294 package is transported as "exclusive use" shipment.
7. Insert two wire seals through the crush shield and container ring. Join the wire with the lead pellet.
8. Secure the container to the shipping skid. Torque each bolt to 200  $\pm$  20 ft.-lb. (272  $\pm$  N-m).
9. Attach the completed "DANGER - This Package is Loaded with High Activity Source" placard.
10. Affix Category labels as per Table 7.1-T1.
11. Affix one UN2916 Label next to each of the Radioactive Category labels.
12. Transport vehicles and freight containers carrying radioactive material transport packages must display placards in accordance with the applicable transport regulations. In case of road transport within North America, the trailer of the transport vehicle must display placards on both sides, and front and rear, indicating that it carries radioactive materials.

**Table 7.1-T1**  
**Package Label Requirements**

Label	Radiation Level at External Surface of Package	Transport Index (T.I.) <sup>1</sup>	Radiation Level at External Surface of Vehicle
Radioactive I (white)	$\leq 5.0 \mu\text{ Sv/h}$ (0.5 mrem/h)	-	-
Radioactive II (yellow)	$>5.0 \mu\text{ Sv/h}$ (0.5 mrem/h) $\leq 500 \mu\text{ Sv/h}$ (50 mrem/h)	$\leq 1.0$	
Radioactive III (yellow)	$>500 \mu\text{ Sv/h}$ (0.5 mrem/h) $\leq 2,000 \mu\text{ Sv/h}$ (200 mrem/h)	$> 1$ and $\leq 10.0$	
Radioactive III (yellow) <sup>2</sup>	$>2,000 \mu\text{ Sv/h}$ (200 mrem/h) $\leq 10,000 \mu\text{ Sv/h}$ (1,000 mrem/h)	-	$\leq 2,000 \mu\text{ Sv/h}$ (200 mrem/h)

<sup>1</sup> T.I. - Radiation level in microsieverts per hour at 1m from the external surface of the package divided by 10 (mrem/h at 1 m).

<sup>2</sup> Exclusive use condition, road transport only. For further information on road transport, see IAEA TS-R-1, *Regulations for the Safe Transport of Radioactive Material*, 1996 Edition (Revised).

### 7.1.8 INSTRUCTIONS FOR SECURING THE PACKAGE ON ROAD VEHICLES

- The F-294 transport package has been designed so that it can be secured to the transport vehicle. As the transport package is a heavy load, local regulations relevant to the security of the load during transport may apply. Due to the high heat content of the F-294 transport package, the following is mandatory:
  - it is prohibited to cover the F-294 transport package
  - it is prohibited to transport F-294 transport package in a closed vehicle.
- The F-294 transport package should be positioned on the vehicle bed with skid channels parallel to the direction of travel. Shocks should be used at the base of the skid channels (front and back, in the direction of travel). These should be firmly fastened to the bed of the vehicle as described in MDS Nordion Specification IN/GI 0006 Z000 (Ref. [4]). Section 2.3 (attachment) and 2.4 (lumber).
- Bracing, if applicable, shall be in accordance with regulations of the State from where the shipment originates.
- If the package is tied down (rather than braced), one-inch shackles with load binders or turnbuckles and minimum 3/8 in. chains shall be used. The angle of the chain to the vertical should be between 50 and 60 degrees.
- Tension the chains equally, to the point that each one is taut, with all visible sag removed.
- The appropriate reference documents may be supplied to the carrier by the shipper, if not already in their possession. Other guidelines and regulations may apply in other jurisdictions.

### 7.1.9 ADDITIONAL INSTRUCTIONS

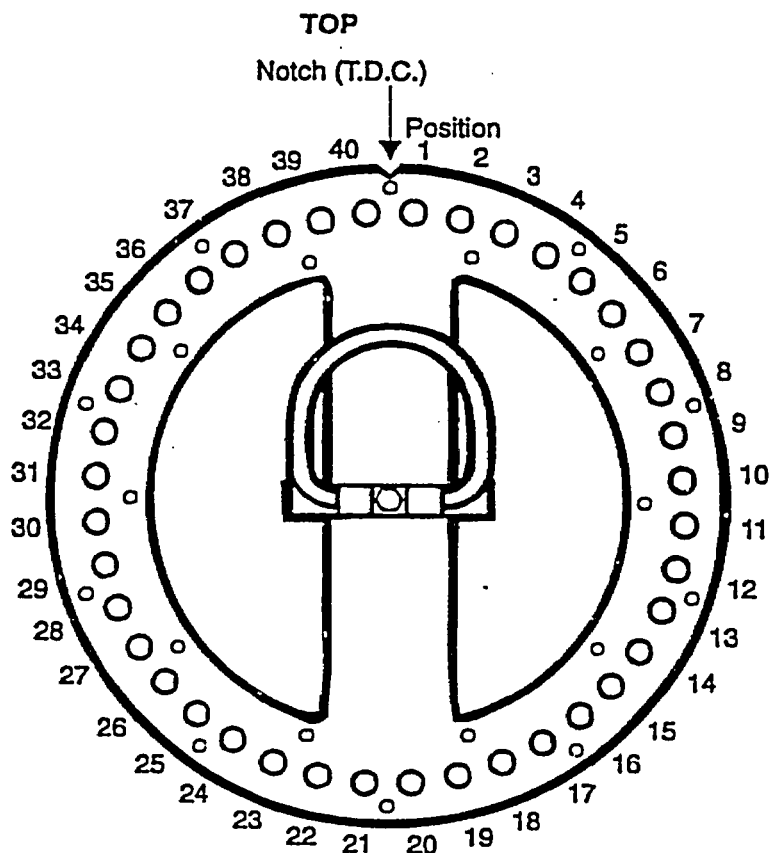
- Any other additional instructions with respect to the shipment as per USNRC Certificate of Compliance shall be applicable.
- The following documents shall be approved prior to the shipment departure.
  - Release for Shipment
  - Radiation Survey
  - Record of C-188 Sources, Activity and Serial Numbers. Ensure that the total activity is less than the licensed capacity of the F-294 transport package.

3. Appropriate documents shall be provided to the carrier or his agent.
4. F-294 transport package shall be transported as "exclusive-use" shipment.
5. Any instruction with respect to the safe dissipation of heat.

### 7.1.10 LOADING PROCEDURE

This loading procedure is formalized in the MDS Nordion Operating Procedure IN/OP 0283 F294 (Ref. [1]) and only persons properly trained and authorized to handle the F-294 transport package are permitted to carry out this work. This ensures the effectiveness of the operating procedure and thereby the safety of the package.

**Figure 7.1-F1a**  
**Loading Diagram for the F-313 Source Carrier**



**Notes:**

1. Mark hole with X if hole position is empty.
2. Mark hole with C-188 S/N if hole position is filled.

**CONTAINER NO:**

**CARRIER NO:**

**LOADING DATE**

**P&S NO:**

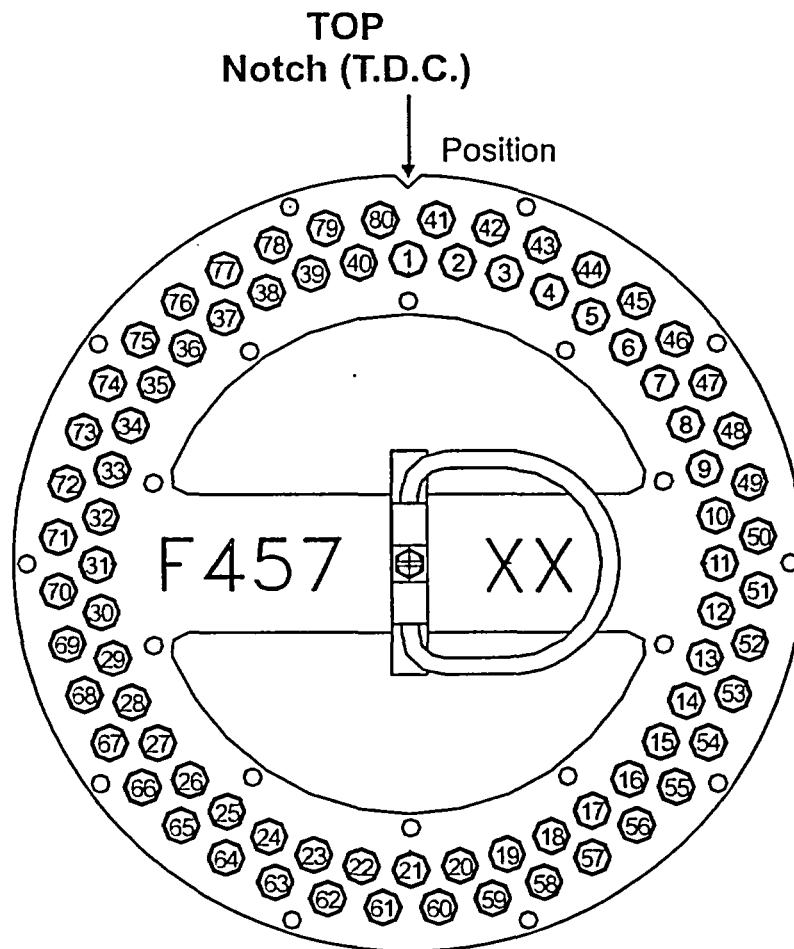
**WARRANTY**

**ACTIVITY**

**YRS.**

**CURIES**

**Figure 7.1-F1b**  
**Loading Diagram for the F-457 Source Carrier**



**Notes:**

1. Mark hole with X if hole position is empty.
2. Mark hole with C-188 S/N if hole position is filled.

**CONTAINER NO:**

**CARRIER:**

**LOADING DATE:**

**P&S NO:**

**WARRANTY:**

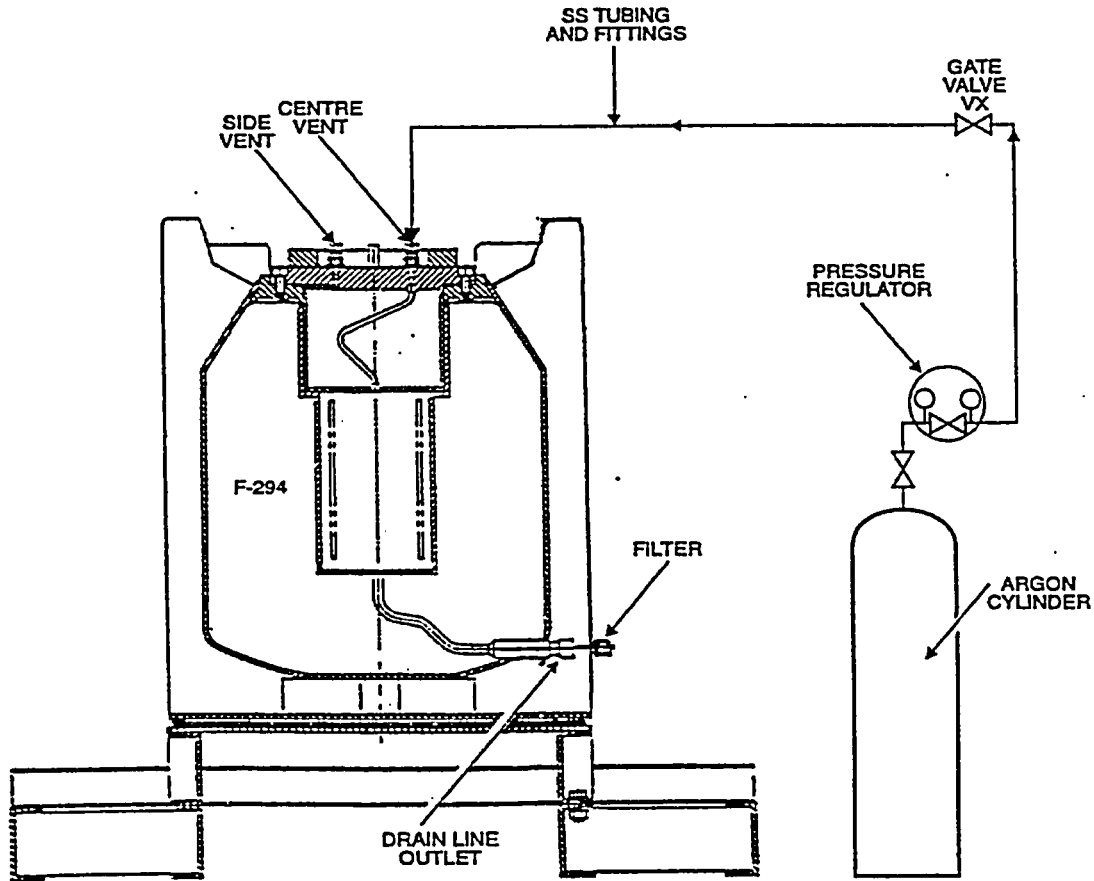
**ACTIVITY:**

**YRS.**

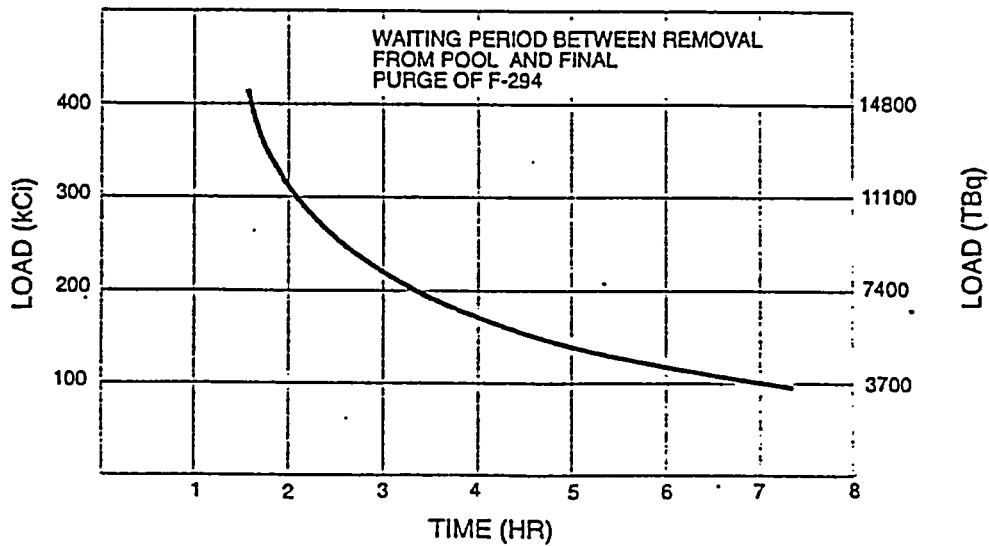
**CURIES**



**Figure 7.1-F2**  
**Argon Purging of F-294 Cavity**



**Figure 7.1-F3**  
**Waiting Period Between Removal from Pool and Final Purge of F-294 Package**



## 7.2 PROCEDURES FOR UNLOADING THE PACKAGE

The unloading of the C-188 sealed sources from the F-294 package at a customer's site B is carried out as follows:

### 7.2.1 PURPOSE

This operating procedure is to ensure that the underwater unloading of C-188 (cobalt-60) sources from the F-294 transport package at a customer's irradiator site B is in compliance with the design specifications, handling requirements and regulatory requirements.

### 7.2.2 SCOPE

This operating procedure describes the following operations:

1. Receipt of the F-294 transport package.
  - 1.1 Visual examination.
  - 1.2 Surface wipe test
  - 1.3 Radiation survey.
  - 1.4 F-294 cavity water flush test for contamination and to verify the source integrity.
  - 1.5 Cleaning of the F-294 package.
2. Transfer of loaded F-294 package to the bottom of the source storage pool.
3. Unloading of C-188s from the F-294 package.
4. Removal of the empty F-294 package from the pool.

These are the minimum requirements that must be achieved.

### 7.2.3 COMPLIANCE AND RESPONSIBILITY

- 1 It is the responsibility of MDS Nordion International personnel or its qualified agent to ensure that the operations described by these procedures are followed and the F-294 transport package is prepared for shipment in compliance with the regulatory requirements.
2. It is the responsibility of the customer at site B, in the role of the consignee, to accept the receipt of the F-294 shipment.
3. It is the responsibility of the pertinent regulatory authority to enforce compliance as per F-294 transport package license.

### 7.2.4 RECEIPT OF F-294 TRANSPORT PACKAGE

#### 7.2.4.1 Visual Inspection

Visually inspect the F-294 transport package for damage and deterioration. Damage and deterioration, if any, are designated as either superficial or integrity-related.

The fireshield, the crush shield and the packaging are to be inspected for the quality of the paint finish, punctures and dents, and cracks or corrosion of welds.

Check and verify that the tamper-proof seal is intact. If the tamper-proof seal is not intact, contact the RSO at the customer's site or MDS Nordion for further disposition.

**Note**

*Immediately contact MDS Nordion's Package Engineering Group regarding any damage or deterioration that may be integrity-related.*

Ensure that any damage or deterioration is clearly documented in the Installation Report.

**7.2.4.2 Surface Wipe Test**

Check all external surfaces on the package for contamination. The level of non-fixed contamination shall be determined by wiping an area of 300 cm<sup>2</sup> of the external surface by hand with a dry filter paper or a wad of dry cotton wool or any other material of this nature. The maximum permissible level of removable contamination on the wipe is 0.37 Bq/cm<sup>2</sup> (10<sup>-5</sup> μCi/cm<sup>2</sup>). This translates to a wipe reading of 110 Bq (3 nCi).

**7.2.4.3 Radiation Survey**

Perform a radiation survey of the assembled package. Radiation levels shall not exceed 2 mSv/h (200 mrem/h) on the external surface of the package or 0.1 mSv/h (10 mrem/h) at any point one meter from the surface of the package. See Table 7.1-T1.

**7.2.4.4 Perform the Cavity Water Flush Test Procedure**

1. Remove the crush shield from the top of the container. Remove the cylindrical fireshield from the container.
2. Remove the drainline cap and the top vent center cap and the vent-line shield plug from the container. If any water drains from the container, collect the water and check it for any contamination. Document and report the drainage of discolored water from the container.
3. Thread the brass adapter with the filter into top center vent plug.
4. Connect the brass adapter supplied to the lower drain tube of the F-294 package.
5. Close the spigot valve on the US 10-gallon plastic container, check all hose connections for tightness and fill 4/5th full with de-ionized water. Use of two (2) 5-gallon (US) plastic containers in place of one (1) 10-gallon (US) container is permitted.
6. With plastic tubing attached to each end of the filter, secure one end of plastic tube to the lower draintube adapter on the F-294 package and the other end to the spigot on the 10-gallon (US) plastic container.

**Note**

*For optimum flow of the water into the cavity, open the spigot with the water-filled plastic container below the drain-tube level to allow water to fill the plastic tube, then raise the water-filled plastic container to the top of the transport package.*

7. Support the bottom of the water-filled plastic container above, or level with, the top of the F-294 package.
8. Remove the cap of the 10-gallon (US) plastic container and open the spigot, allowing water to slowly fill the F-294 package cavity.

**Warning**

Steam and hot water may blow out of the vent holes as the cavity fills.

9. Monitor the filter on the top vent hole during filling for an increase in the radiation fields. If the radiation field at the monitoring position increases, immediately close the spigot to prevent further entry of water into the cavity. Evacuate the area, taking care to prevent the possible spread of contamination. Restrict access to the area. Notify the facility's Radiation Safety Officer, the local competent authority and MDS Nordion.
10. As soon as the cavity and the vent tube(s) are full, lower the plastic container to the ground and allow all the water to drain back into the plastic container through the filter. Monitor the filter in the plastic tube with the survey meter.
11. When all the water has drained from the cavity, close the spigot on the plastic container, and disconnect the plastic tube from the lower drain tube adapter on the F-294 package and the brass adapter with the filter from the top center vent plug.
12. Remove the filters to a low background area and monitor the filters. Wearing protective gloves, carefully cut open each filter and remove the filter material. Place the filter material in a labeled and lockable plastic bag and slowly scan for radioactive contamination. Record the highest count rate during the scan.

**Note**

*1. The instrument must be used in the geometry (or as close as practically possible) for which the instrument conversion factor was established.*

*The filter material, therefore, should be as flat as possible for the scan.*

*2. Care must be taken to ensure that the instrument is allowed to reach equilibrium before the reading is made.*

13. Removable contamination test evaluation:
  - 13.1 If the net count rate corresponds to an activity less than 5 nCi (185 Bq), the test is negative. If the test is negative, no further action is required except proper record-keeping. Retain all wipes/filters for the possibility of further testing.
  - 13.2 If the net count rate corresponds to an activity more than 5 nCi (185 Bq), the test is positive. If the test is positive, inform the local Radiation Safety Officer and MDS Nordion for further disposition.
  - 13.3 If the net count rate is greater than 0.5 nCi, but less than 5 nCi, contact MDS Nordion. Do not proceed further until authorized to do so.
14. Remove the brass adapter from the end of the lower drain tube of the shipping container.
15. If the F-294 package is to be transferred to the pool in the irradiator shield building, proceed to Section 5 of this procedure.
16. If the task is delayed, the cavity must be properly drained and purged with Argon before vent and drain cap may be replaced.

#### **7.2.4.5 Notifying MDS Nordion of Deficiencies**

MDS Nordion, Ottawa, Ontario, Canada, or its agent, shall be notified immediately if any of the following deficiencies are evident.

1. Deficiencies of the F-294 on arrival at the customer's site B, including:
  - a) Radiation levels over 200 mrem/h at the surface of the transport package.
  - b) Transport Index (IT) greater than 10.
  - c) Non-fixed contamination from the external surface giving a wipe reading greater than 3 nCi.
2. Drainage of discolored water from the container. If this occurs, a sample of the water shall be taken and returned to MDS Nordion for analysis.
3. Contamination found to be above 0.5 nCi when using the cavity water flush test procedure.
4. Any other abnormalities that are indicated when following the step-by-step procedures.

#### **7.2.5 TRANSFER OF LOADED F-294 PACKAGE TO THE BOTTOM OF SOURCE STORAGE POOL**

After successful completion of checking that the C-188 source integrity is sound, perform the following operations on the F-294 package.

##### **7.2.5.1 Transfer F-294 from Outside to Inside the Irradiator Building**

1. Remove the shipping skid.
2. Sling the F-294 to the crane.
3. Confirm that the source rack is lowered into the pool and fully disabled.
4. The F-294 package can now be transferred from the external grounds to the irradiator shielded building.
5. Remove the roof plug of the irradiator shield building.
6. Lower the F-294 package in the irradiator building into the pool.
7. Lift the shield plug clear of the container, giving access to the cavity of F-294.
8. Lift the source carrier out of the F-294 container cavity and place the source carrier at the bottom of the pool, clear of the container.
9. Replace the shield plug.
10. Lift the F-294 container and place it in the designated staging area outside the irradiator building.
11. If the F-294 container has to be returned empty to MDS Nordion, see Section 7.3.

#### **7.2.6 EMERGENCY ACTION FOLLOWING A SUSPECTED RADIATION INCIDENT**

1. Do not try to clean up the suspected contamination.
2. Leave the area of suspected high fields, taking care to prevent the possible spread of contamination. Post warning signs to restrict access to the area.
3. Check all operating personnel for possible contamination.

4. Inform the local Radiation Safety Officer, the pertinent regulatory authority, and MDS Nordion.
5. MDS Nordion will investigate every report of a suspected radiation incident. MDS Nordion may request the licensee to perform additional tests and arrange for qualified personnel to visit the site and assess the situation. MDS Nordion will confirm or disprove the presence of contamination, and report their findings to the pertinent regulatory authority.

### **7.2.7 UNLOADING PROCEDURE**

This unloading procedure is formalized in the MDS Nordion Procedure IN/OP 0284 F294 (Ref. [2]) and only persons properly trained and authorized to handle the F-294 transport package are permitted to carry out this work. This ensures the effectiveness of the operating procedure and thereby the safety of the package.

## **7.3 PREPARATION OF AN EMPTY PACKAGE FOR TRANSPORT**

From a customer's site, an empty F-294 package is prepared for shipment to MDS Nordion, Ottawa, Ontario, Canada as follows:

### **7.3.1 PURPOSE**

This operating procedure is to ensure that the preparation for shipment of the empty F-294 transport packaging to MDS Nordion, Ottawa, Ontario, Canada, from a customer's irradiator site B is in compliance with the design specifications, handling requirements, and regulatory requirements.

### **7.3.2 SCOPE**

This operating procedure describes the following operations:

- Preparation for shipment of the empty F-294 transport packaging.
- Instructions for securing the F-294 packaging on the road vehicle.

These are the minimum requirements that must be achieved.

### **7.3.3 COMPLIANCE AND RESPONSIBILITY**

1. It is the responsibility of MDS Nordion personnel or its agent to ensure that the F-294 transport packaging is prepared for shipment in compliance with the regulatory requirements.
2. It is the responsibility of the pertinent regulatory authority to enforce compliance as per F-294 transport package license.

### **7.3.4 OPERATIONS ON THE EMPTY F-294 TRANSPORT PACKAGING**

1. After the container is empty and on the trailer truck or in the designated staging area, monitor the radiation around the container to verify that it is definitely empty.
  - 1.1 Surface Wipe Test.

Check all external surfaces on the package for contamination. The level of non-fixed contamination shall be determined by wiping an area of 300 cm<sup>2</sup> or the external surface by hand with a dry filter paper or a wad of dry cotton wool or any other material of this nature. The maximum permissible level of removable contamination on the wipe is 0.37 Bq/cm<sup>2</sup> (10<sup>-5</sup> μCi/cm<sup>2</sup>).
2. Secure the shield plug. Torque each bolt to 100 ± 10 ft.-lb. (133 ± 13 N-m)
3. After purging, ensure that vent and drain lines are sealed.

4. Secure the cylindrical fireshield to the retaining bracket on the fixed skid. Torque each bolt to  $200 \pm 20$  ft.-lb. ( $272 \pm 27$  N·m).
5. Secure the crush shield on the package using sixteen (16) fasteners.
  1. Secure with eight (8) top fasteners using torque of  $200 \pm 20$  ft.-lb. ( $272 \pm 27$  N·m) on each fastener.
  2. Secure with eight (8) side fasteners, using  $50 \pm 5$  ft.-lb. ( $68 \pm 7$  N·m) on each fastener.
6. Secure the container to the shipping skid. Torque each bolt to  $200 \pm 20$  ft.-lb. ( $272 \pm$  N·m).
7. Cover the "Radiation Caution" plates with the "EMPTY" labels.
8. Remove the Category III labels.
9. Affix MDS Nordion return address labels on two opposite sides of the container.
10. The F-294 packaging is now ready for EMPTY shipment to MDS Nordion.

### **7.3.5 INSTRUCTIONS FOR SECURING THE EMPTY F-294 ON ROAD VEHICLES**

1. The F-294 transport package has been designed so that it can be secured to the transport vehicle. As the transport package is a heavy load, local regulations relevant to the security of the load during transport may apply.
2. The F-294 package should be positioned on the vehicle bed with skid channels parallel to the direction of travel. Shocks should be used at the base of the skid channels (front and back in the direction of travel). These should be firmly fastened to the bed of the vehicle as described in MDS Nordion Specification IN/GI 0006 Z000, Section 2.3 (attachment) and 2.4.4 (lumber) Ref. [4].
3. Bracing, if applicable, shall be in accordance with Regulations of the State from where the shipment originates.
4. If the package is tied down (rather than braced), one-inch shackles with load binders or turnbuckles and minimum 3/8 in. chains shall be used. The angle of the chain to the vertical should be between 50 and 60 degrees.
5. Tension the chains equally, to the point that each one is taut, with all visible sag removed.
6. The appropriate reference documents may be supplied to the carrier by the shipper, if not already in their possession. Other guidelines and regulations may apply in other jurisdictions.

### **7.3.6 ADDITIONAL INSTRUCTIONS**

1. Any other additional instructions with respect to the shipment as per USNRC Certificate of Compliance shall be applicable.
2. "Release for Shipment" document for the empty F-294 shall be approved prior to the shipment departure.
3. Appropriate documents shall be provided to the carrier or his agent.

### **7.3.7 OPERATING PROCEDURE**

The procedure for handling the F-294 package is formalized as MDS Nordion Operating Procedure IN/OP 0285 F294 (Ref. [3]) and only persons properly trained and authorized to handle the F-194 transport package are permitted to carry out this work. This ensures the effectiveness of the operating procedure and thereby the safety of the package.

## **7.4 REFERENCES**

- [1] MDS Nordion Procedure IN/OP 0283 F294, "Operating Procedure for the Underwater Loading and the Preparation for Shipment of the F-294 Transport Package from the Customer's Site A in the USA".
- [2] MDS Nordion Procedure IN/OP 0284 F294, "Operating Procedure for the Underwater Unloading of the F-294 Transport Package at the Customer's Site B in the USA".
- [3] MDS Nordion Procedure IN/OP 0285 F294, "Preparation for Shipment of the Empty F-294 Transport Package".
- [4] MDS Nordion Specification IN/GI 0006 Z000, "Guidelines for Securing Radioactive Packages Shipped by Road".