



**IAEA/ANL
Interregional Training Course**



**Technical and Administrative Preparations
Required for Shipment of Research Reactor
Spent Fuel to Its Country of Origin**

Argonne National Laboratory
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Lecture L.6.1a

**Preparing for Shipments of Spent Nuclear Fuel
to the Savannah River Site**

**Appendix B Agreement
Transportation Package (Cask) Acceptance Criteria**

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Savannah River Operations Office**

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**APPENDIX B AGREEMENT
TRANSPORT PACKAGE (CASK) ACCEPTANCE CRITERIA**

No. _____ UNDER CONTRACT NO. _____
WITH _____

A. Shipments

1. Shipments to the Savannah River Site can be routinely made by rail or by motor freight.
2. Agreement between the customer and the U. S. Department of Energy - Savannah River Operations Office is required on all shipping schedules. Further, the Savannah River Operations Office must be notified in advance of each shipment, giving such information as:
 - (a) Method of shipment
 - (b) Arrival date
 - (c) Number of transport packages (casks)
 - (d) Transport package contents (Approved Appendix A)
 - (e) Activity of primary coolant in curies*

Note: Clean water shall be added to the cask prior to shipment and the clean water sampled. The cask shall then be allowed to sit for a minimum of four hours and the water resampled. The sample will be analyzed for radioactivity levels. If the level of activity is greater than that listed on Table 1, "Acceptable Change in Cs-137 Concentration for Shipping Cask Water Samples" for the cask being sampled, the fuel will be determined to be failed, i.e., non-specification, and will not be shipped. If the level of activity is less than that listed on Table 1, and meets the other criteria as listed in Section B of Appendix B the fuel will be determined to be specification material and may be shipped. Handling procedures for fuel assemblies or elements not subject to the above treatment or which use a bonding material which can react violently with water will be established on an individual basis prior to shipment and may require special handling.
 - (f) Transport package outside radiation and contamination levels *
 - (g) Gross weight of the loaded transport package (cask) and container *
 - (h) Safety Analysis Report Packaging (SARP) documentation showing criticality safety analysis and letter indicating applicable SARP and Certificate of Competent Authority governing shipment
 - (i) Diagram showing configuration of fuel within the cask baskets
 - (j) Other information as required

* - Information should be transmitted immediately after determination.
3. F.O.B. Points
 - (a) Rail - Dunbarton, South Carolina
 - (b) Truck - Dunbarton, South Carolina
4. Fuel will not be shipped to the Savannah River Site until after DOE-SR review and approval of the relevant Appendix A Agreement for the shipment.

5. Fuel determined to be failed must be canned prior to shipment. Specific canning criteria will be provided to the customer on a case by case basis.

B. Condition of Fuel

The Spent nuclear fuel must meet the following criteria in order to be shipped to the Savannah River Site without be containerized. (These criteria are still under development and will be listed below.)

C. Coolant Medium

The Savannah River Site is equipped to handle transport packages (casks) containing water as the primary coolant or to handle dry cask shipments. The use of any liquid coolant other than water as the primary cooling medium, or the use of additives, such as antifreeze, will be considered on an individual basis prior to shipment and may require special handling.

D. Radioactive Contamination

1. External Contamination

Any transportation package received at the Savannah River Site having external contamination in excess of 22,000 d/m per 100 sq. cm. of beta-gamma or 2,200 d/m per 100 sq. cm. of alpha will require non-routine decontamination in accordance with Article VII.

2. Internal Contamination

The activity of the transport package will be determined at the Savannah River Site by sampling prior to opening the transport package. If the total beta-gamma activity of the coolant is significantly greater than that determined at the shipping point, the cask will be flushed in an attempt to reduce the activity; and, by various techniques, including laboratory analyses, an attempt will be made to determine the cause of the activity and the appropriate handling requirements for the material, which shall be considered non-routine under Article VII.

E. Microbiological Contamination

The Department of Energy is committed to maintaining the biological activity in the storage basins of the Savannah River Site at the lowest levels possible. In an effort to ensure the biological activity levels do not increase at the Savannah River Site, a 500 ml sample of water from the shipping facility's spent nuclear fuel storage pool is required. The sample shall be taken within 24 hours of fuel loading and shipped to the Savannah River Site using a transportation method approved by Savannah River Site.

F. Surface Temperatures

Cask designs that permit attainment of cask surface temperatures which present a handling hazard must also incorporate designs that permit safe handling techniques. Cost of provision of special handling tools must be borne by the customer.

G. Criticality Safety Document Requirements

Fuel contained in a cask shipped to the Savannah River Site must be critically safe when submerged in water with the cask lid removed. The fuel assemblies must be packaged in the cask so that they can be removed in water

without resulting in a criticality hazard. In addition, consideration must be given to the possibility of the cask coming into close proximity to other casks in transit and in the receiver's yard. The customer must submit for review and approval, the appropriate Certificate of Competent Authority and SARP detailing the model basis for determination that the cask is critically safe under accident conditions. Data from any critical experiments that have been performed shall also be included.

H. The Savannah River Site's Receiving Basins for Off-Site Fuels (RBOF)

1. General

Casks are handled in one cask unloading basin serviced by a 90.7 metric ton crane. The crane is of twin hook design, with an adapter to convert it to a single hook crane, with 7.52 meters maximum clearance to the palm of the hooks in the Basin area. Clearance to the palm of the hooks at the car unloading spot is 9.35 meters.

2. Cask Dimensional Limitations

The water-filled cask unloading basin is rectangularly shaped, 3.96 meters wide and 8.23 meters long. The floor level in the basin is at a water depth of 8.53 meters and in addition, the basin contains a pit 2.9 meters in diameter and a water depth of 13.41 meters. Cask assemblies are lowered into the basin and placed on the floor at the proper depth. The cask lid is removed and stored in the basin or in an external pit. The hoists on the 90.7 metric ton, twin hook crane operate independently or as a single unit. The span between the inside faces of the hooks can be varied from a minimum of 2.44 meters to a maximum usable span of 6.4 meters.

(a) Cask Limitations

	<u>Horizontal Cask (4,5)</u>	<u>Vertical Cask (4,5)</u>
Maximum loaded cask weight	90.7 metric ton	90.7 metric ton
Crane hook spacing, minimum	2.44 m	2.44 m
Maximum	6.4 m	6.4 m
Maximum height cask body (1)	4.27 m	-----
Maximum length, including trunnions(2)	7.42 m	10.06 m minus X
Maximum width cask	2.74 m	-----
Maximum diameter(6)	-----	2.69 m
Minimum clearance under trunnions (3)	See crane hook dimensions "D" below	

Notes:

- (1) Include any projections, such as dowel pins. Also presumes element removal in horizontal position.
- (2) X = Maximum fuel assembly length in meters.
- (3) For engagement of crane hooks.
- (4) Any variation from these limits will be handled on an individual basis.
- (5) The terms horizontal and vertical refer to the disposition of the long axis during under water unloading.
- (6) Includes any projections such as lifting trunnions

All casks are assumed to be top opening for unloading.

- (b) Crane hook dimensions (45.35 metric ton)
 - A. Width 15.88 cm
 - B. Depth through palm 52.07 cm
 - C. I.D. of throat 17.78 cm
 - D. Distance from tip to bottom of hook 31.75 cm
- (c) Crane hook dimensions (90.7 metric ton)
 - A. Width 25.4 cm
 - B. Depth through palm 88.9 cm
 - C. I.D. of throat 23.5 cm
 - D. Distance from tip to bottom of hook 71.12 cm

3. Fuel Assembly Packaging

Fuel assembly packages within the cask vary with the nature of the assemblies and the cask design. The weight of any fuel package to be removed from the cask as a unit and transported under water must not exceed three tons. The size of the fuel assembly package is limited to:

- Size of fuel assembly must fit within a 12.38 cm diameter bundling tube
- Vertical length of any unit, 298.45 cm.
- Handling of fuel assemblies not meeting this criteria must have prior DOE approval

I. Transport Package (Cask) Design

1. The transport package (cask) must be compatible with the Savannah River Site's Receiving Basins for Offsite Fuels and its handling equipment as described in Section F hereof. In addition, the cask design must include the following features:
 - (a) The cask must be equipped with tapered dowel pins or other positioning devices to guide the lid into position if the lid is to be replaced under water following unloading. These guides are required to prevent damage to the hold-down bolts or other parts of the cask.
 - (b) Provision for free drainage from all external surfaces and attachments.
 - (c) A means of sampling and flushing the cask primary coolant with the cask closed, while the cask is on the transport vehicle. This design feature must include valves that isolate cask coolant from the cask connection. If a secondary coolant is used, a sampler tap and isolation valves must be provided. When pipe connections or valves on the cask which will be used at the Savannah River Site are not equipped with American Standard Taper Threads, coupling adapters to American Standard Taper Threads must be provided.
 - (d) Means shall be provided for measurement of the maximum primary coolant temperature or cask cavity wall temperature at any time, by use of a portable readout instrument if desired.
 - (e) A siphon drain line or drain line to remove water from the cask for return shipment.
 - (f) Casks must be top opening.

- (g) If cask trunnion design is not compatible with the limits and dimensions given in Section F, a yoke must be furnished to handle the cask with the appropriate hook (45.35 or 90.7 ton). Such yokes are required to be rigid and must be designed so that the specific static stress does not exceed 1/5 of the ultimate strength of a member. (Refer to Specification No. 61 of the Electrical Overhead Crane Institute, Inc., No. 1 Thomas Circle, N.W., Washington, D.C. 20005) Also, yokes must be designated for vertical storage as they will be engaged and disengaged underwater. The customer must provide or ensure that three copies of the complete stress analysis of the yokes have been furnished to the Savannah River Operations Office for review.
 - (h) All inner cask surfaces which are likely to be contacted by the coolant must be of stainless steel or other acceptable non-corrosive metal. All external surfaces must be accessible for decontamination. These external surfaces, including weldments, must be smooth, free of weld spatter, and crevices or pockets.
 - (i) Cask design must be such as to permit cask handling operations prior to unloading, such as cask transfers and bolt removal, to be accomplished with a maximum total exposure of 24 mrem (.24 mSv) to operating personnel at the RBOF facility.
 - (j) Cask lifting devices must be a part of the cask proper and not the cask lid. Cask lids must contain a lid lifting eye and the lids will be handled by a single crane hoist or with an adapter yoke.
 - (k) All casks must be provided with some means to prevent over-pressurizing and some means of containment for liquid release.
 - (l) The outer edge of the bottom of the cask must be given at least a 1.27 cm radius to prevent gouging the stainless steel floor lining in the RBOF basins.
2. In order to assure that the cask meets the criteria of this Section H, the Customer must obtain the approval of the Director, Reactors and Spent Fuel Division, Savannah River Operations Office, prior to utilizing a cask for shipment to the Savannah River Site. The customer must provide three copies of the most recent versions of the following documents to the Director, Reactors and Spent Fuel Division at least 60 days prior to commencement of the shipment or 120 days for any cask not previously received at SRS: (1) the transport package SARP, (2) the COCA (from the U.S. Department of Transportation or the U.S. Nuclear Regulatory Commission), (3) a complete set of as-built drawings including all components of the transport packaging, (4) the transport packaging operations manual/procedures, and (5) details of the method of attachment of the transport package to the shipping vehicle. In the case of casks not yet constructed, it is recommended that design drawings be submitted to the Director, Reactors and Spent Fuel Division, for review and comment prior to actual construction. Any approvals given by the Reactors and Spent Fuel Division Director, pursuant to this section relate solely to the receipt and handling of such cask at the Savannah River Site and shall not be construed as indicating approval of any State, Federal or other regulatory agency, including the Nuclear Regulatory Commission.

J. Receipt of Solid Radioactive Waste

No contaminated waste materials which are not an integral part of the fuel assembly will be received by the Savannah River Site for disposal unless specifically arranged for and agreed to prior to shipment.

K. Provision of Special Tools

Unless otherwise agreed to by the parties, any and all tools required to inspect, lift, sample, unload, decontaminate or prepare the transport package for return that are above and beyond what would be reasonably expected to be available at a spent nuclear fuel receiving facility must be provided with the transport package.

L. Transport Package and Containers

Transport packages (casks) that are transported inside ISO containers shall only be received by the Savannah River Site when configured with one transport package per ISO container. The Savannah River Site does not have the capability to receive multiple transport packages in a single ISO container. If the cask is loaded horizontally, the ISO container must be marked to indicate the location of the top of the cask.

M. Correspondence

1. Customer Contact

Laboratory/Research Center/University	
Reactor Name	
City, State, Country	
Customer Name	
Title	
Customer Signature	
Phone Number	
Fax Number	
Date	

2. Department of Energy Contact

All correspondence or inquiries regarding this document and the information contained herein shall be directed to:

U.S. Department of Energy
 Savannah River Operations Office
 Reactors & Spent Fuel Division
 P.O. Box A
 Aiken, SC 29801

Phone and facsimile inquiries may be made to:

Phone: (803)-557-3759 Fax: (803)-557-3763

TABLE 1
Acceptable Change in CS-137 Concentration for Shipping Cask Water Samples

Cask Type	CS-137 Concentration Change (dpm/mL)	Free Volume of an Empty Cask (gallons)
BMI-1	_ 611	< 50
GE-2000	_ 235	< 130
GNS 11	_ 278	< 110
JMTR (JMS-87Y-18.5T)	_ 382	< 80
JMTR (JRC-80Y-20T)	_ 204	< 150
LHRL-120	_ 66	< 460
NAC-LWT	_ 278	< 110
NLI-1/2	_ 278	< 110
Pegase (IU-04)	_ 204	< 150