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CORE ACTIVITIES PROGRAM
TMI-2 CORE RECEIPT AND STORAGE PROJECT PLAN

A. L. (Ron) Ayers, Jr.

Idaho National Engineering Laboratory
Operated by the U.S. Department of Energy

Informal Report

Prepared for the
U.S. DEPARTMENT OF ENERGY
Under DOE Contract No. DE-AC07-76ID01570

EG&G Idaho

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ABSTRACT

The TMI-2 Core Receipt and Storage Project is funded by the U.S. Department of Energy and managed by the Technical Support Branch of EG&G Idaho, Inc. at the Idaho National Engineering Laboratory (INEL). As part of the Core Activities Program, this project will include (a) preparations for receipt and storage of the Three Mile Island Unit 2 core debris at INEL and (b) receipt and storage operations. This document outlines procedures; project management; safety, environment, and quality; safeguards and security; deliverables; and cost and schedule for the receipt and storage activities at INEL.

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NOTE: Appendix A is provided on microfiche attached to the inside of the back cover.

CORE ACTIVITIES PROGRAM

TMI-2 CORE RECEIPT AND STORAGE PROJECT PLAN

INTRODUCTION

The 28 March 1979 accident at Unit 2 of the Three Mile Island (TMI-2) Nuclear Power Station resulted in significant damage to the reactor core. An Environmental Impact Statement developed by the U.S. Nuclear Regulatory Commission (NRC) concluded [in part] that TMI should not become a permanent radioactive waste disposal site.[1] Subsequently, a Memorandum of Understanding (MOU) was signed by NRC and the U.S. Department of Energy (DOE) concerning removal and disposition of the TMI-2 core.[2] The MOU allows transport of the core debris to a DOE facility for interim storage. Ultimate disposal of the core will be determined by DOE.

The entire effort of transporting, storing, and examining the core has been divided into a two-part program. The TMI-2 Core Shipment Program is responsible for the effort at TMI, including preparation and transport of the core to the Idaho National Engineering Laboratory (INEL). The Core Activities Program is responsible for receiving, storing, and examining the core at INEL. As part of the Core Activities Program, the TMI-2 Core Receipt and Storage Project (TCR&SP) will include (a) preparations for receipt and storage of the core at INEL and (b) receipt and storage operations.

Current plans assign the following responsibilities for the core removal and disposition activities:

- General Public Utilities Nuclear Corp. (GPU Nuclear) will remove the core debris from the reactor, package the debris in canisters, prepare the canisters for transport, and load the canisters into shipping casks

- DOE, through the Technical Integration Office (TIO) of EG&G Idaho, Inc. at TMI, will coordinate preparations for shipment, provide casks and equipment for shipping, and transport the canisters from TMI to INEL

- DOE, through the Technical Support Branch (TSB) of EG&G Idaho at INEL, will coordinate receipt of shipping casks, unloading canisters from the casks, and storage of canisters until disposal is arranged.

This plan discusses the project to receive, unload, and store the TMI-2 core debris canisters at INEL.

CANISTER DESIGN AND CONTENT

The TMI-2 core debris will be transported to INEL in the following three types of canisters: (a) fuel canisters, (b) knockout canisters, and (c) filter canisters. Information on the canisters is provided in Appendix A. Final information on the design of the canisters will be made available as soon as it is provided by GPU Nuclear. The exteriors of the three types of canisters are similar; each canister will be 150-in. long and fabricated from 14-in. Schedule 10 pipe. The canisters will have a nominal drained dry weight of <2800 lb; however, 5% of the canisters could weigh as much as 2940 lb. Each canister will have vent, drain, and process ports equipped with Cam-loc and Hansen connectors. The canisters are designed to be lifted with a remotely operated grapple.

Present plans call for GPU Nuclear to package the TMI-2 core debris in 238 canisters. However, the number of canisters used could vary significantly because of operating conditions during core removal. The weight and volume of the TMI-2 core materials is listed in Table 1. Present radioisotope concentrations per gram of startup uranium are listed in Table 2. The concentrations are based on the assumption that all radioisotopes have remained in the debris and none have been removed by subsequent leaching. Heat generation in the debris is $\sim 1.5 \times 10^{-4}$ W/g of startup uranium. The maximum activity loading for each canister will be $\sim 45,000$ Ci. Sufficient criticality analyses will be performed by GPU Nuclear to ensure safety during storage at TMI and transport to INEL. Criticality analyses for receipt and storage at INEL will be performed by EG&G Idaho.

TABLE 1. MATERIALS INVENTORY OF THE TMI-2 ACTIVE CORE REGION[a]

Category	Form[b]	Composition	Weight[c] (lb)	Volume[c] (ft^3)
Fuel	Ceramic pellets	UO_2[d]	205,140	324.3
Absorbers	Metal alloy rod	Ag-In-Cd	6,060	9.55
	Ceramic pellets	B_4C in Al_2O_3	1,380	7.29
	Ceramic pellets	Gd_2O_3-UO_2	290	0.46
Structures	Fuel cladding	Zircaloy-4	44,440	109.7
	Guide tubes	Zircaloy-4	2,690	6.65
	Instrument tubes	Zircaloy-4	250	0.62
	Control cladding	304 SS	1,350	2.70
	Poison rod cladding	Zircaloy-4	1,640	4.04
	Space grids	Inconel-71B	2,670	5.24
	Space sleeves	Zircaloy-4	260	0.64
	Plenum springs	SS	1,550	3.10
	Ceramic spacers	ZrO_2	730	2.13
	Metallic spacers	SS	450	0.90
	End plugs	304 SS	140	0.28
	End plugs	Zircaloy-4	1,490	3.69
	Assembly end boxes	SS	6,730	13.4
Trace Amounts	Self-powered neutron detectors	Rhodium-Inconel	--	--
	Thermocouples	Chromel-Alumel	--	--
	Background detector	Cobalt	--	--
	Neutron source	Am-Be-Cm	--	--
	Instrument thimble clad	Inconel	--	--
	Instrument calibration tube	Inconel	--	--
	Insulation	Ceramic	--	--

a. Reference: NSAC/25 "TMI-2 Accident Core Heatup Analysis" prepared by Nuclear Associates International and Energy, Inc.

b. Form shown is as-loaded. As-received form may be substantially different because of oxidation of structural materials, shattering of ceramic pellets, etc.

c. Estimated uncertainty is <10%.

d. Average core enrichment = 2.57%.

TABLE 2. PRESENT RADIOISOTOPE CONCENTRATIONS PER GRAM OF STARTUP URANIUM FOR THE TMI-2 CORE[a]

		Radioisotope Concentrations[b] (Ci/g)		
Isotope	Half Life	Activation Products	Fission Products	Actinides
H-3	12.33 yr	--	3.6(-5)	--
C-14	5730 yr	2.5(-7)	--	--
Mn-54	312.5 d	6.4(-6)	--	--
Fe-55	2.7 yr	6.5(-4)	--	--
Co-60	5.272 yr	7.5(-4)	--	--
Ni-59	8 x 10^4 yr	8.2(-7)	--	--
Ni-63	100 yr	9.8(-5)	--	--
Kr-85	10.73 yr	--	8.1(-4)	--
Sr-90	29 yr	--	8.0(-3)	--
Y-90	64.0 h	--	8.0(-3)	--
Zr-93	9.5 x 10^5 yr	1.7(-8)	--	--
Nb-94	2.0 x 10^4 yr	1.6(-7)	--	--
Tc-99	2.13 x 10^5 yr	--	1.4(-6)	--
Ru-106	369 d	--	6.6(-4)	--
Rh-106	42 s	--	6.6(-4)	--
Ag-108	2.41 min	3.4(-5)	--	--
Ag-108m	1.3 x 10^2 yr	3.9(-4)	--	--
Ag-110	24.6 s	7.9(-6)	--	--
Ag-110m	252 d	6.0(-4)	7.1(-8)	--
Cd-109	453 d	7.5(-6)	--	--
Cd-113m	14.6 yr	--	2.7(-6)	--
Sn-113	115 d	7.4(-10)	--	--
Sn-119m	245 d	3.7(-6)	8.4(-8)	--
Sn-121m	50 yr	7.2(-8)	--	--
Sn-123	129 d	1.1(-9)	8.9(-9)	--
Sb-125	2.73 yr	6.0(-5)	3.4(-4)	--
Te-125m	58 d	1.5(-5)	8.3(-5)	--
Te-127	9.5 h	--	3.6(-9)	--
Te-127m	109 d	--	3.6(-9)	--
Cs-134	2.06 yr	--	2.8(-4)	--
Cs-137	30.1 yr	--	9.0(-3)	--
Ba-137m	2.55 min	--	8.6(-3)	--
Ce-144	284.4 d	--	1.4(-3)	--
Pr-144	17.28 min	--	1.4(-3)	--
Pr-144m	7.2 min	--	1.7(-5)	--
Pm-147	2.6234 yr	--	7.9(-3)	--
Sm-151	93 yr	--	1.3(-4)	--
Eu-152	13 yr	--	5.3(-7)	--
Eu-154	8.6 yr	2.5(-7)	6.2(-5)	--
Eu-155	4.8 yr	2.6(-8)	1.7(-4)	--
Gd-153	241.5 d	5.9(-7)	--	--
Th-231	25.52 h	--	--	4.8(-8)
Th-234	24.10 d	--	--	3.3(-7)

TABLE 2. (continued)

Isotope	Half Life	Radioisotope Concentrations[b] (Ci/g) Activation Products	Fission Products	Actinides
Pa-234m	1.17 min	--	--	3.3(-7)
U-235	7.04×10^8 yr	--	--	4.8(-8)
U-236	2.342×10^7 yr	--	--	4.1(-8)
U-238	4.47×10^9 yr	--	--	3.3(-7)
Pu-238	87.8 yr	--	--	1.0(-5)
Pu-239	2.439×10^4 yr	--	--	1.1(-4)
Pu-240	6540 yr	--	--	3.1(-5)
Pu-241	15 yr	--	--	1.6(-3)
Am-241	433 yr	--	--	1.8(-5)
Cm-242	163 d	--	--	5.7(-9)
Total		2.6(-3)	4.7(-2)	1.8(-3)

a. Reference: Letter report from B. G. Schnitzler to A. L. Ayers, "TMI-2 Fuel Composition, Activity, and Decay Power," BGS-4-83, EG&G Idaho, Inc., 15 December 1983. Values decayed to March 1985.

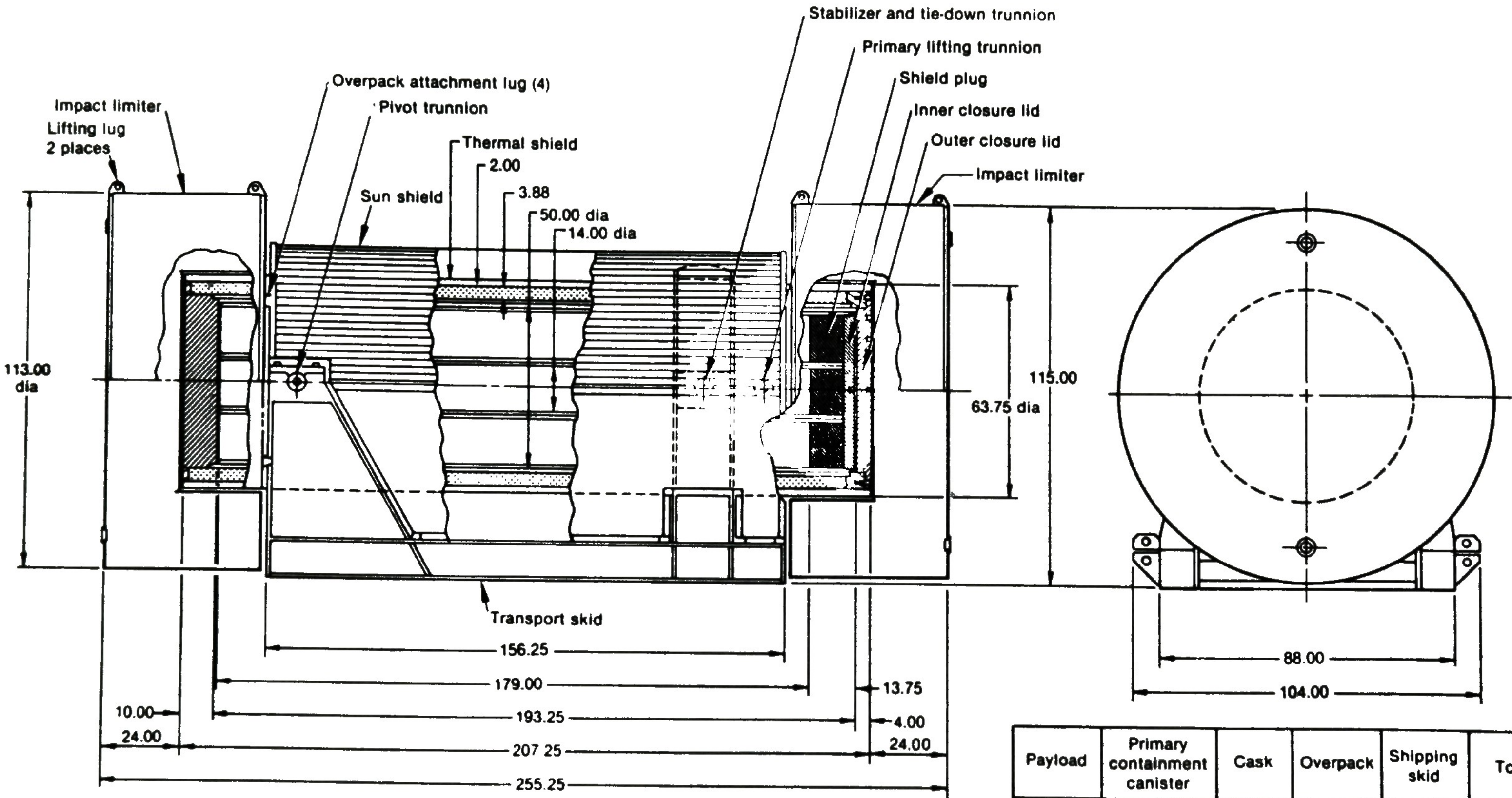
b. Numbers in parentheses are powers of 10.

SHIPPING INFORMATION

As described in the "Introduction," canisters containing core debris and partial fuel assemblies will be loaded into shipping casks at TMI by GPU Nuclear and transported to INEL by rail. Transport of the casks from TMI to INEL will be the responsibility of TIO. Responsibility for receipt of the core at INEL will begin when the railcar containing the loaded cask is disconnected by the railroad company at the Scoville siding near the Central Facilities Area (CFA). That responsibility will continue through all phases of transportation, handling, and unloading, until the empty cask is returned to the Scoville siding ready for receipt by the railroad company. It is anticipated that two casks at a time will be transported to INEL.

Shipping Cask

TIO is responsible for providing the rail shipping cask. Figure 1 shows preliminary weights and dimensions of the Nuclear Packaging, Inc. 125B shipping cask. Figure 2 shows the cask mounted on a railroad flatcar. The cask will have two levels of containment in accordance with 10 CFR 71 requirements, and each cask will accommodate seven canisters. The location in the cask for each canister will have a shield plug to reduce radiation exposure to personnel. Energy absorbing material will be attached to the shield plug to mitigate consequences of shipping incidents. A lid for the inner containment vessel will provide a pressure seal and impact protection for the entire canister section of the cask. A lid for the outer containment vessel (cask body) will provide additional sealing and protection. The outer lid will be attached to the main body of the cask. Impact limiters will be attached to both ends of the cask, limiting damage to the cask and contents in the event of an accident. The cask will be mounted on a skid which can be attached to either a railcar or a special truck transporter. During transport, the cask will be horizontal; however, the skid will allow the cask to be rotated vertically for loading and unloading canisters. Lifting fixtures will be provided by the cask vendor to transfer the cask and its

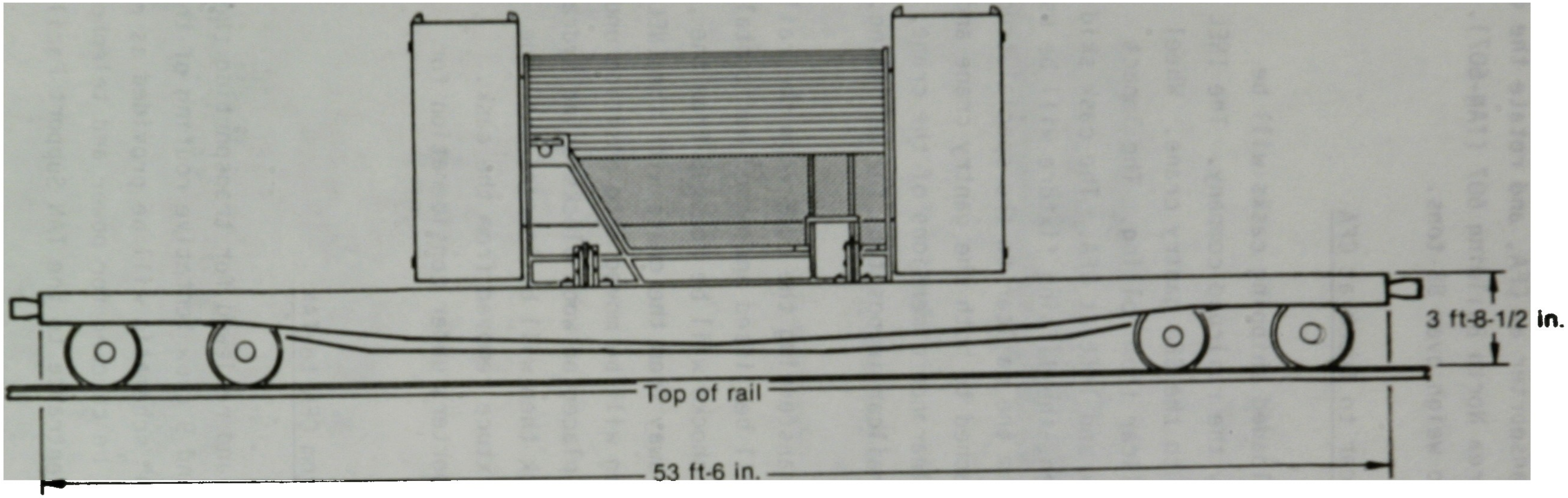


Payload	Primary containment canister	Cask	Overpack	Shipping skid	Total
19,600	24,900	98,200	13,600	20,000	176,300

Weight (lb)

INEL 4 0751

Figure 1. Preliminary weights and dimensions of the Nuclear Packaging, Inc., 125B shipping cask.



4 8100

Figure 2. Schematic of the shipping cask mounted on a railcar.

skid from the railcar to the truck transporter at CFA, and rotate the cask to vertical in the Hot Shop of Test Area North Building 607 (TAN-607). The loaded cask and skid is anticipated to weigh over 88 tons.

Transfer from Railcar to Truck at CFA

The two railcars containing the loaded shipping casks will be disconnected at the Scoville siding by the railroad company. The INEL locomotive then will move one railcar to the CFA gantry crane. Wheel chocks will be used to prevent the railcar from rolling. The impact limiters will be removed from the cask and left at CFA. The cask skid will be disconnected from the railcar. Then, the lifting fixture will be used for transferring the cask and skid from the railcar to the special truck transporter. The fixture will be attached to both the gantry crane and the shipping cask skid. Figure 3 shows clearance dimensions of the crane, and Figure 4 shows the shipping cask and railcar in position for unloading.

Figure 5 shows the sequence of transferring the cask from the railcar to the truck transporter. The cask will be lifted and moved horizontally to clear the end of the railcar. The chocks will be removed from the railcar wheels, and the railcar moved away from the crane with the INEL locomotive. The truck transporter then will be moved into position under the crane. The truck trailer will be placed on wood blocks using hydraulic lifts built into the trailer. The cask then will be lowered onto the trailer, tied down, and the lifting fixture removed from the cask. Figure 6 shows one of the truck transporters under consideration for transporting the cask from CFA to TAN.

Truck Route from CFA to TAN

A Transport Plan will be written and reviewed for transporting the cask from CFA to TAN. Figures 7, 8, and 9 show tentative routing of the truck transporter at INEL. A "tiedown" schematic will be provided as part of the Transport Plan. The route will be checked for power and telephone line interferences, clearances at the entrance to the TAN Support Facility,

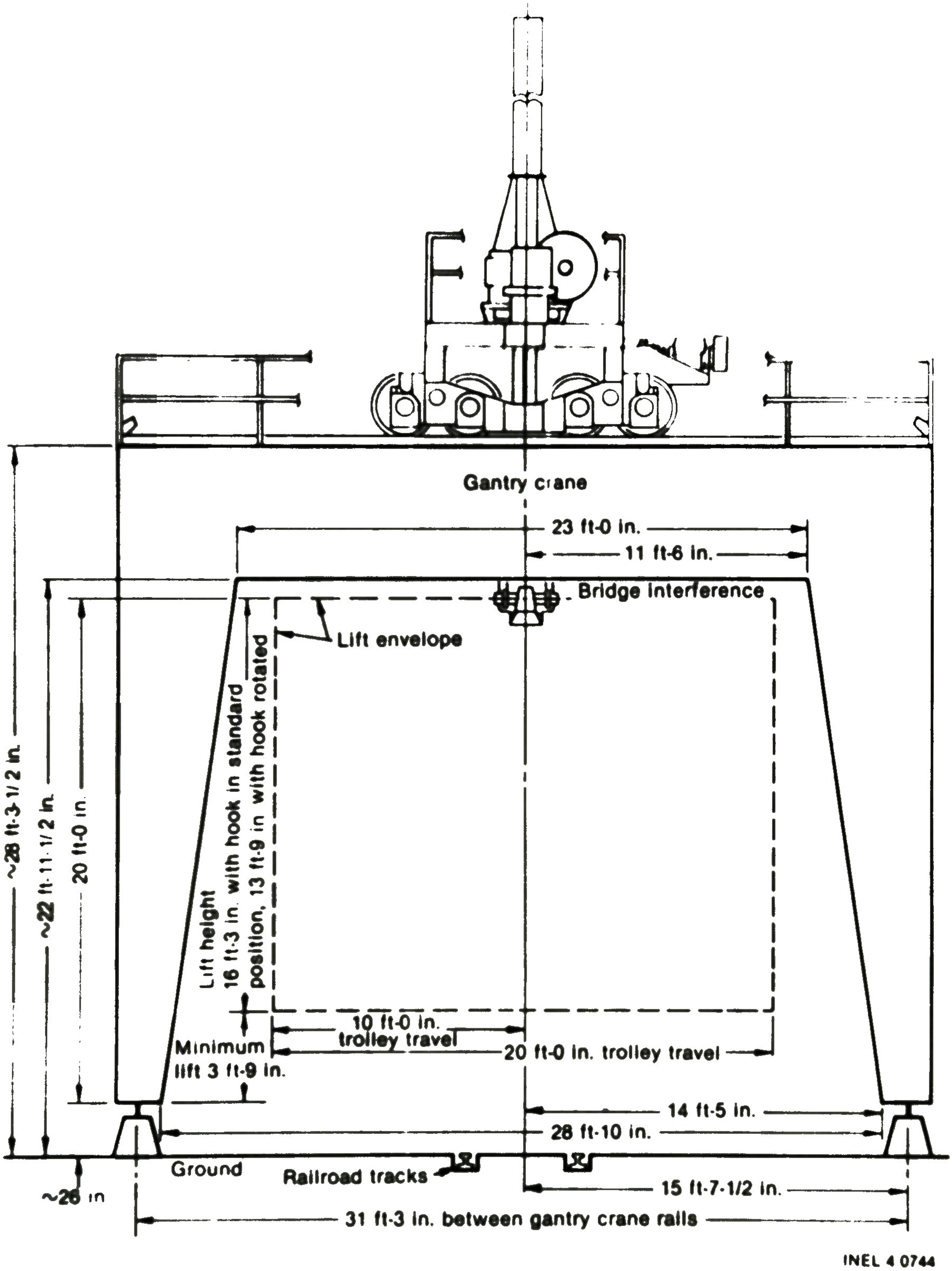


Figure 3. Schematic of the gantry crane at CFA.

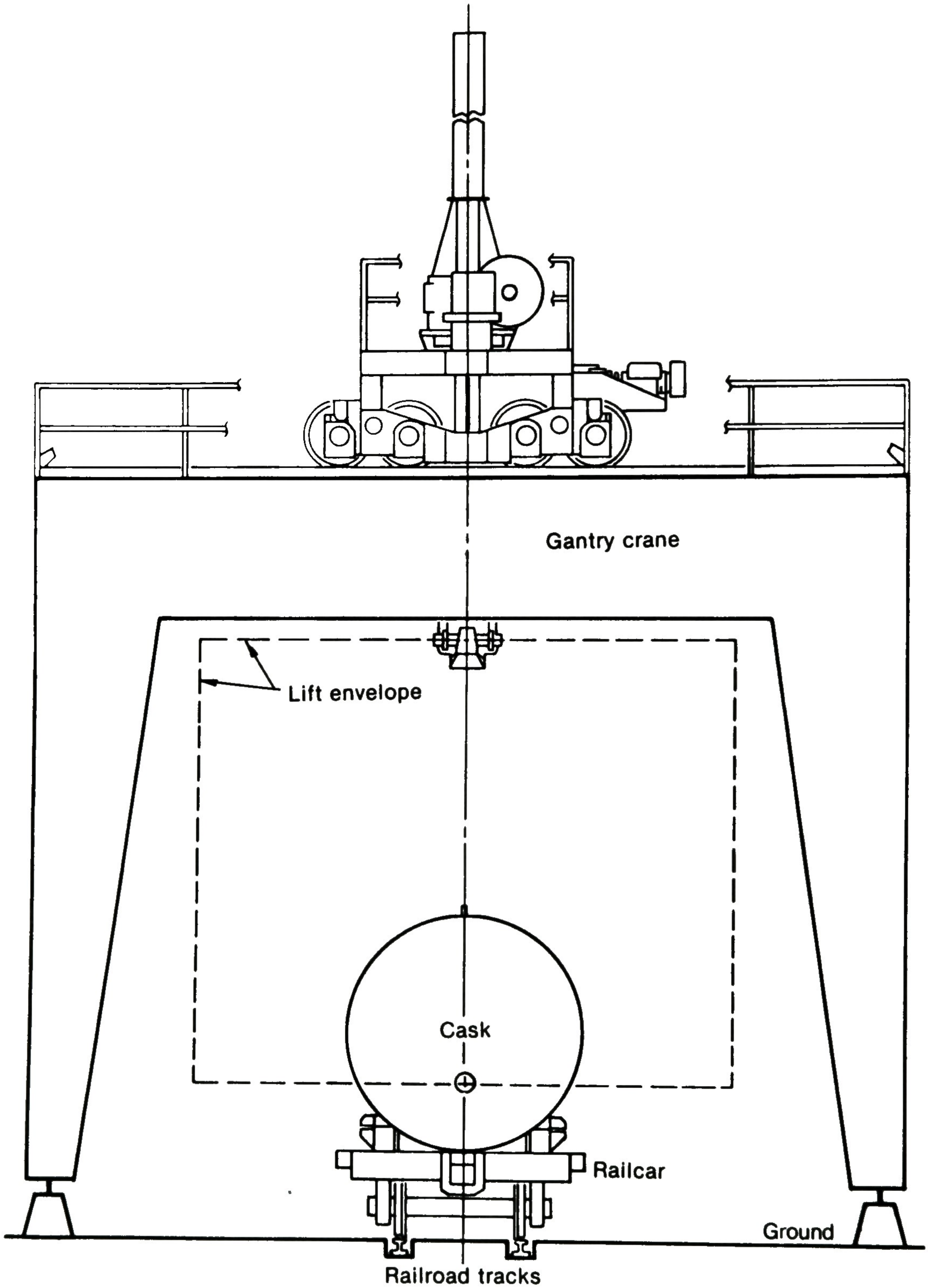


Figure 4. Schematic of the gantry crane at CFA showing the railcar in position for unloading the shipping cask.

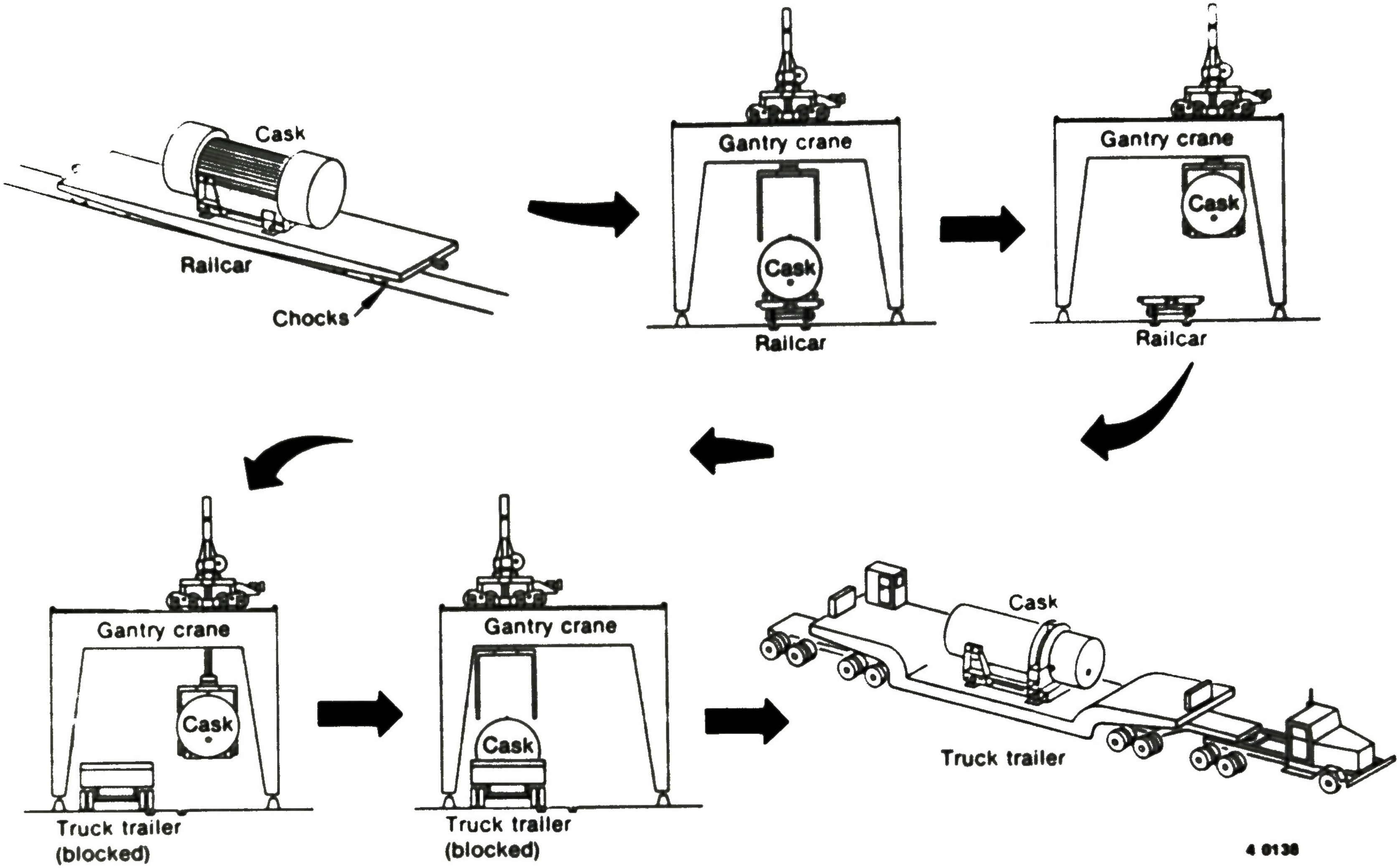


Figure 5. Schematic showing the sequence of events in transferring the shipping cask from the railcar to the truck transporter.

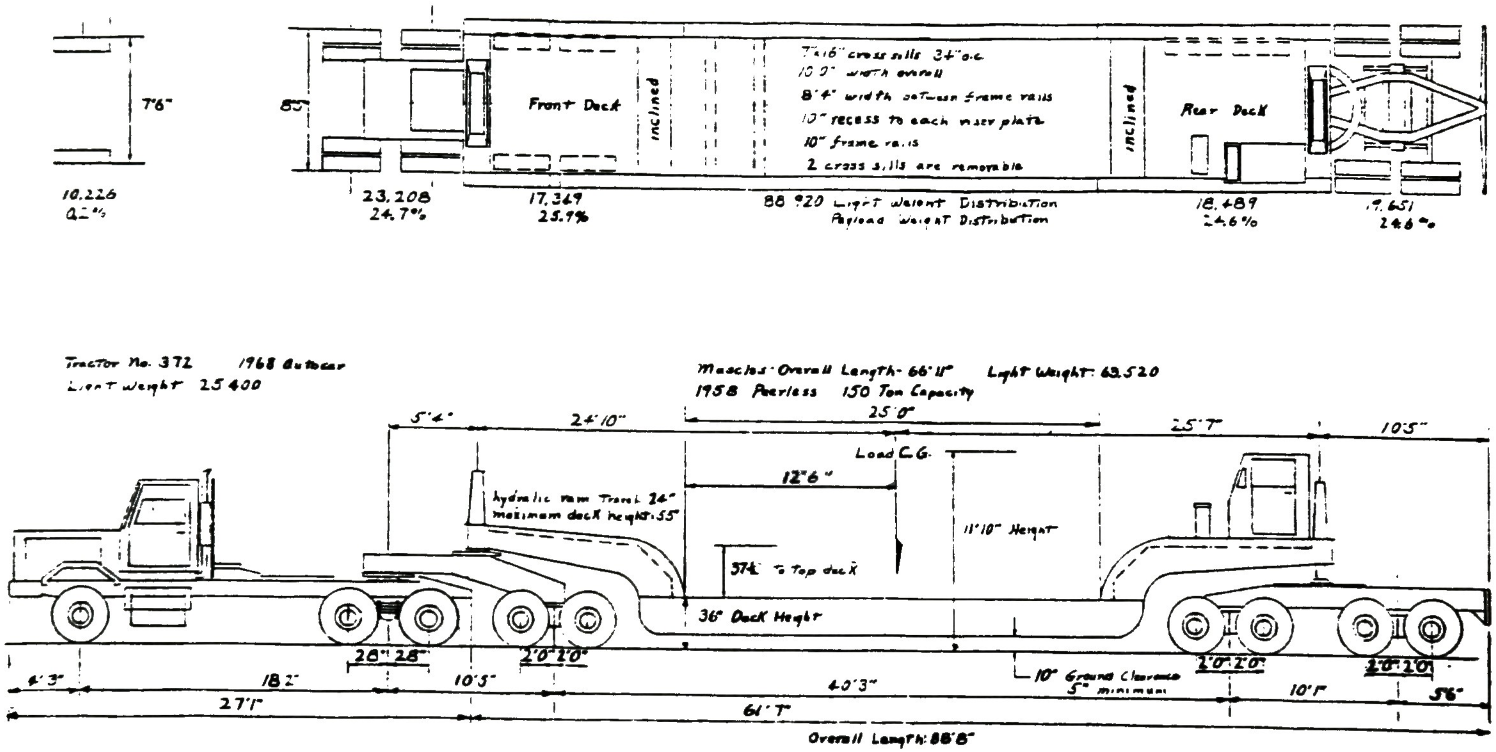


Figure 6. Schematic of one truck transporter being considered for transporting the shipping cask from CFA to TAN.

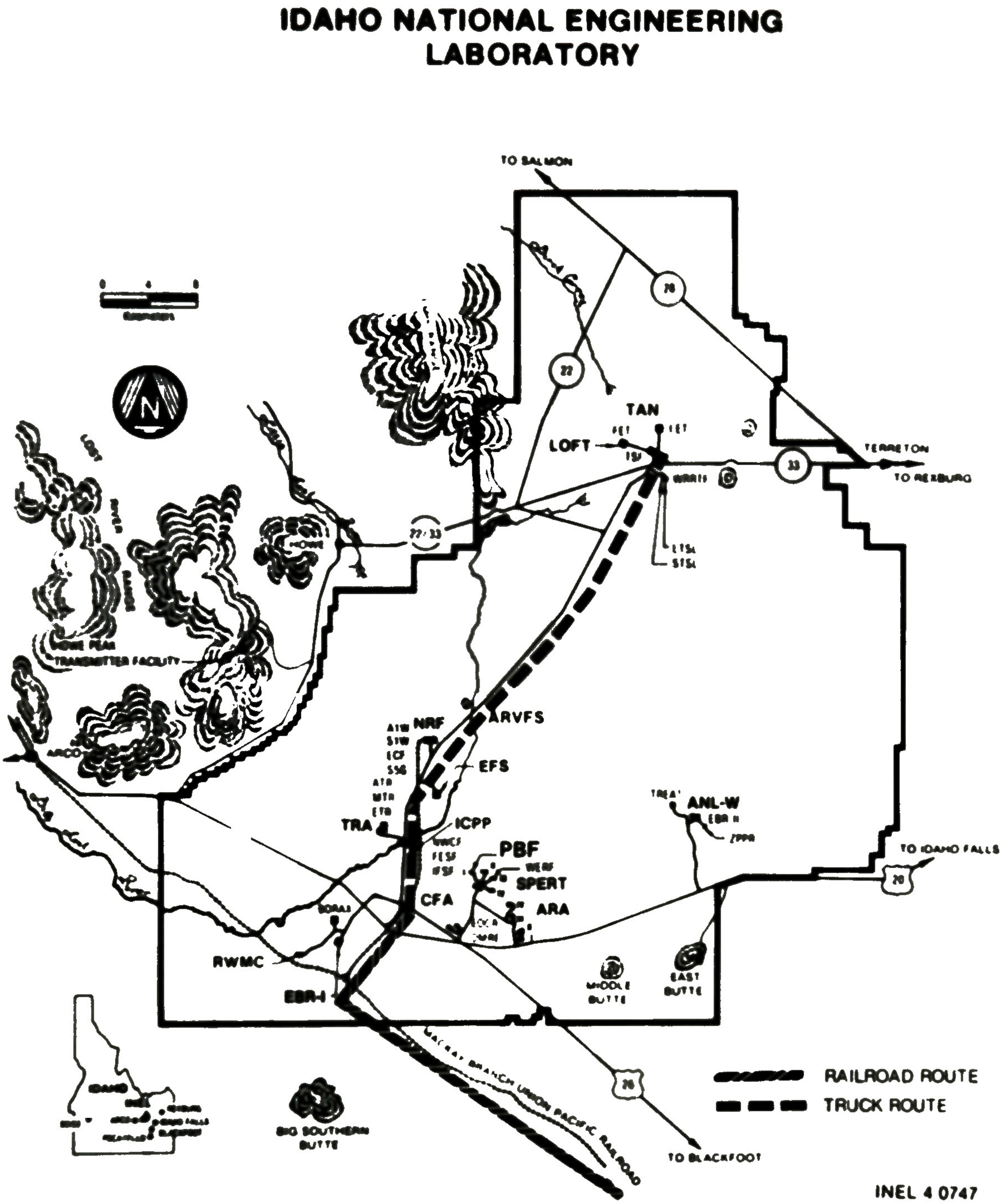


Figure 7. Tentative routing of the railcar and truck transporter at INEL.

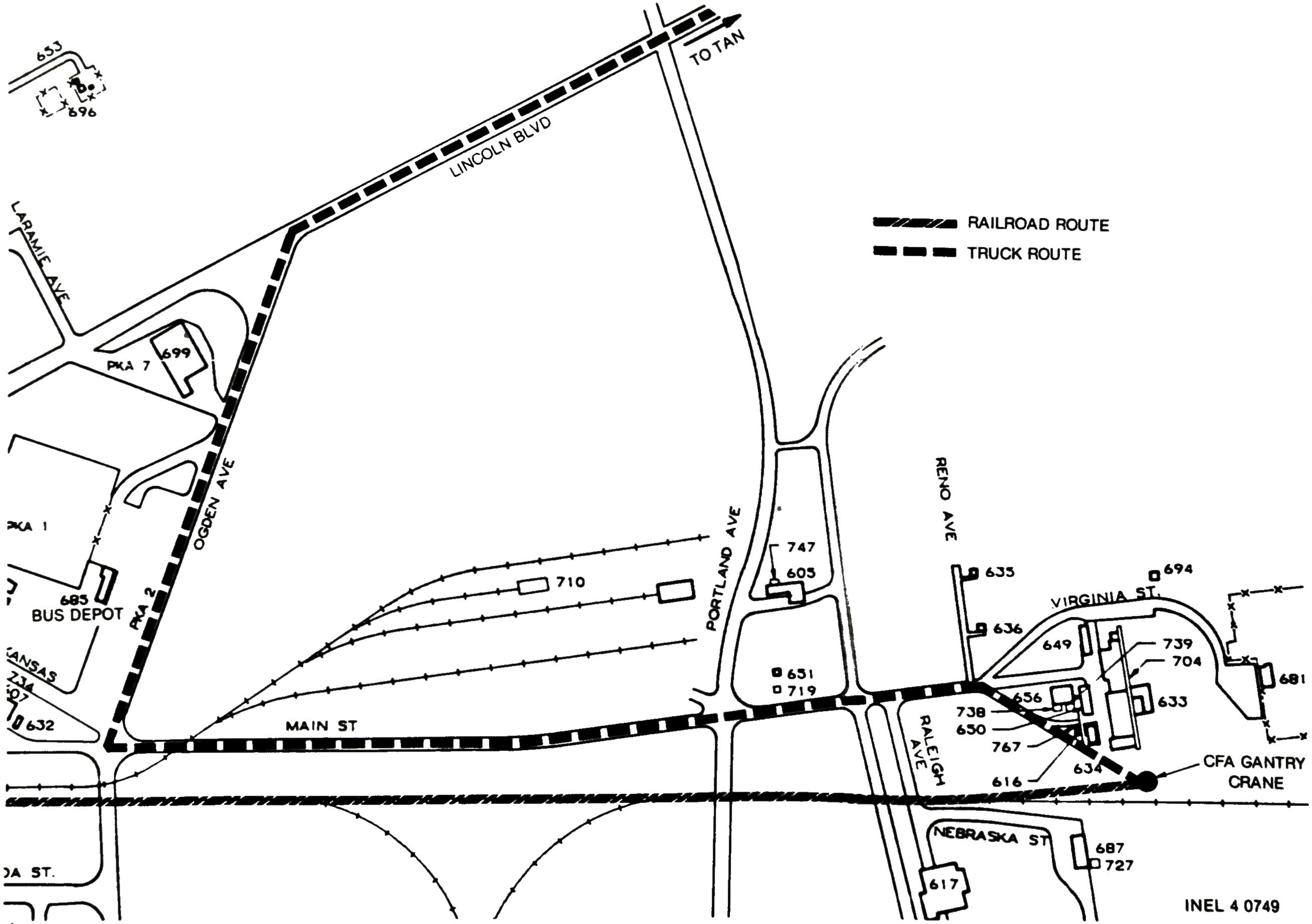


Figure 8. Tentative routing of the railcar and truck transporter in the vicinity of CFA.

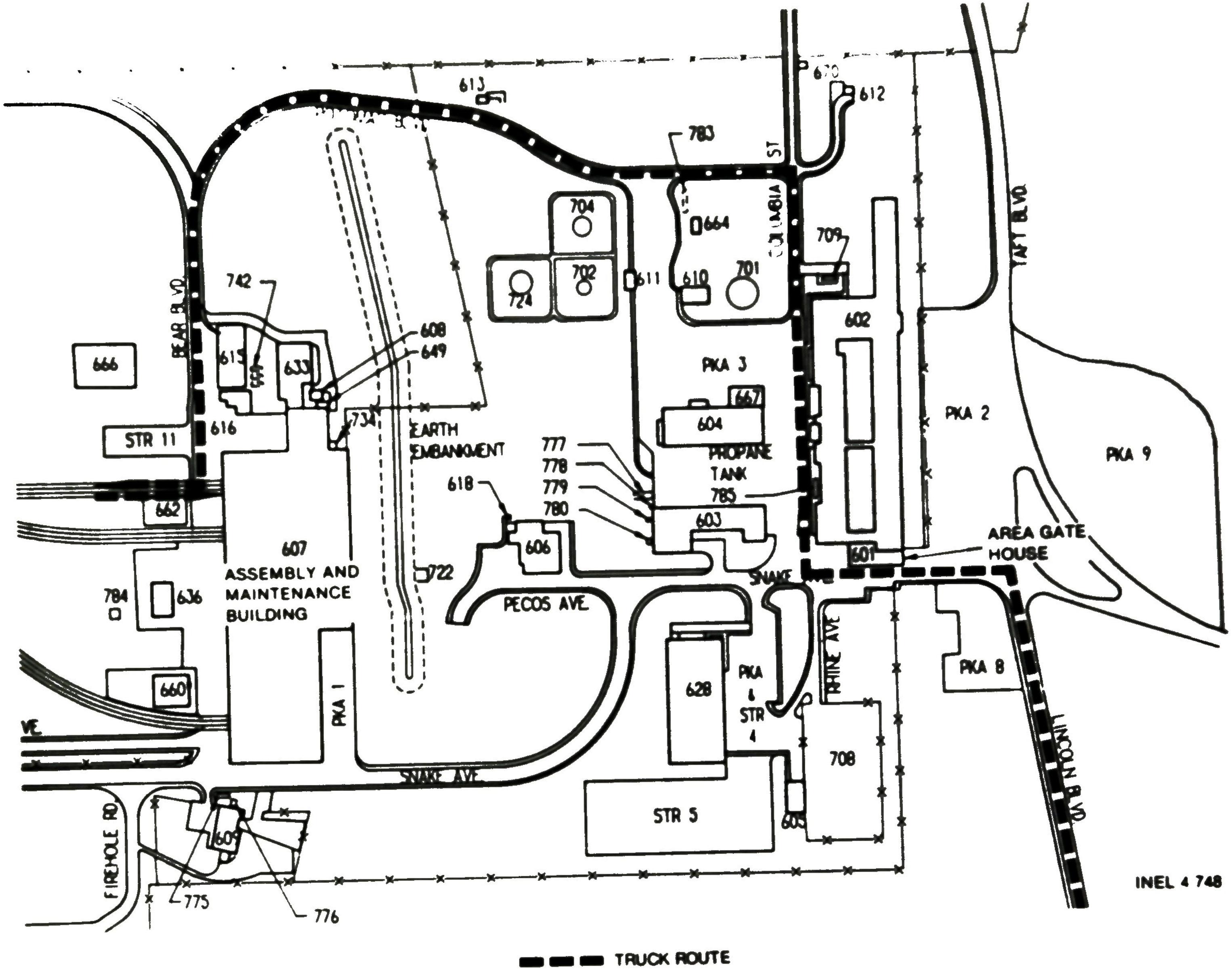


Figure 9. Tentative routing of the truck transporter in the vicinity of TAN.

turning radii and side clearances at major corners, and road surfaces and slopes. Potential damage to the road during the spring months would impact the shipping schedule.

A preliminary survey of the route from CFA to TAN found no significant obstacles to transporting the cask by truck. The road surface over most of the route is asphalt paved and in satisfactory condition to permit truck transport under most weather conditions. Only a few potholes were found on Lincoln Boulevard, and few small repairs were needed in the TAN area. The curvatures of the corners appear adequate for the truck transporter. The area around the gantry crane at CFA has a gravel surface well compacted by many years of service; however, some potholes could use more gravel to provide better stability for the truck transporter. Vertical clearances along the route appear to be in excess of requirements. The lowest clearances are a telephone line near the gantry crane, 16 ft above the ground, and telephone cables near the entrance gate to TAN, 15 ft 10 in. above the ground. Electrical line clearances appear adequate.

RECEIPT AND UNLOADING AT THE TAN-607 HOT SHOP

Receipt Operations

TAN-607 Hot Shop operations begin with arrival of the truck transporter outside the Hot Shop (Figure 10). At the time of receipt, an airlock extension will have been constructed in front of the Hot Shop doors. The truck transporter will be driven down the railroad tracks until the trailer is straight, the doors to the Hot Shop will be opened, and the truck transporter backed into the Hot Shop. Using the hydraulic jacks to lift the trailer, wood blocks will be placed underneath, and the trailer lowered onto the blocks. The truck tractor will be disconnected from the trailer and removed from the Hot Shop, and the Hot Shop doors will be closed. The sunshield could be removed from the cask at this time. The cask will be rotated to a vertical position (Figure 11) using the 100-ton bridge crane and lifting fixture supplied by the cask vendor. Stabilizer bars will be used to hold the cask in the vertical position, and a new working platform placed around the cask. If required, the platform could be designed to provide lateral stability for the cask during unloading. A final draping of the cask and support platform with plastic sheets will assist in controlling contamination.

Unloading of Canisters

Before the cask is opened, gas between its inner and outer containments will be sampled to detect any contamination. A vent port on the outer containment lid will be opened, and a vacuum pump will remove the gas through a filter. After the vacuum pump operates for a period of time, the filter will be removed and inspected for contamination. Then the outer containment lid will be unbolted and removed. Another gas sample will be obtained from a vent port on the inner containment lid, and that lid also will be removed. The 10-ton hoist and associated rigging will be used to remove both lids.

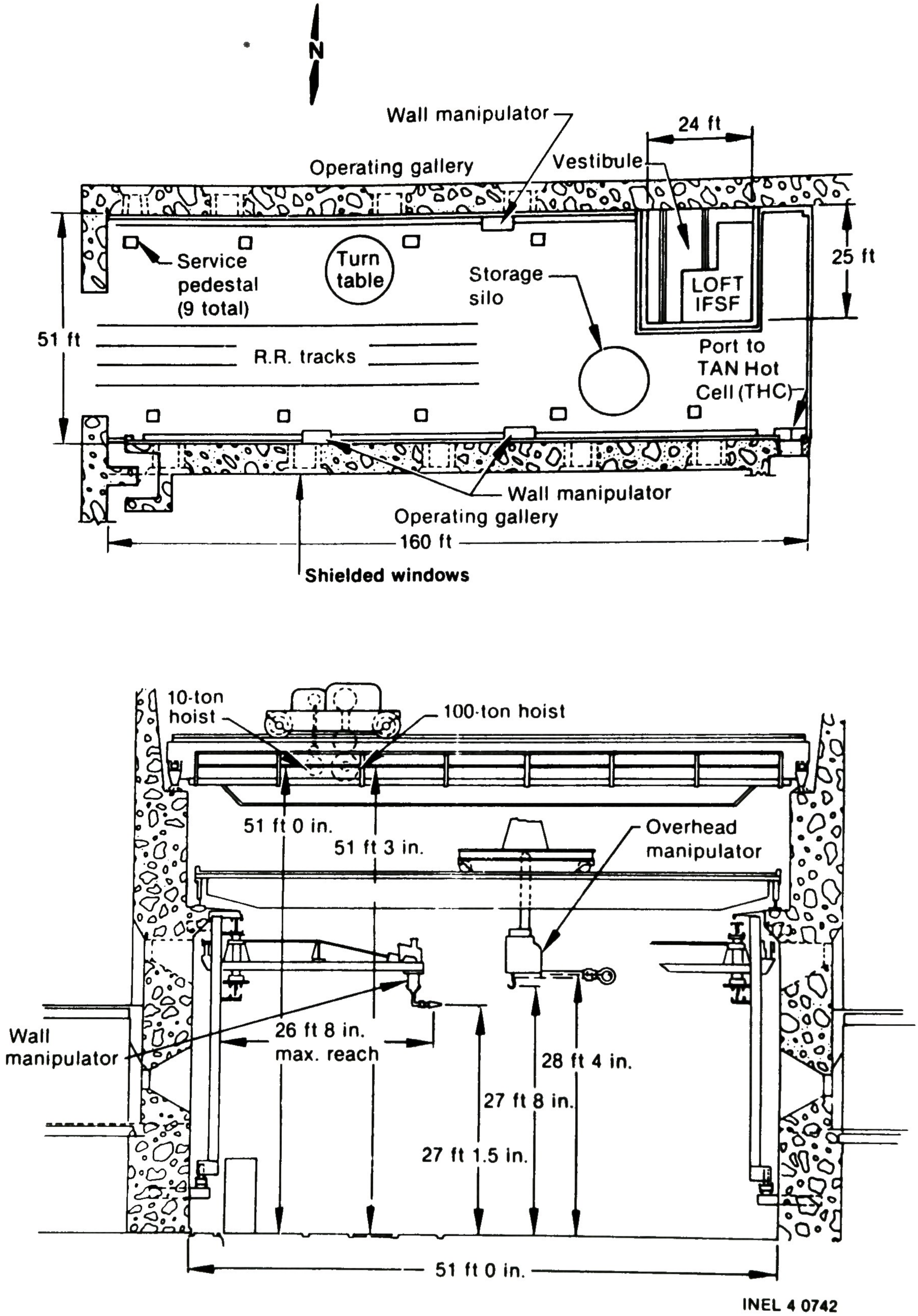


Figure 10. Plan and cross sectional views of the TAN-607 Hot Shop.

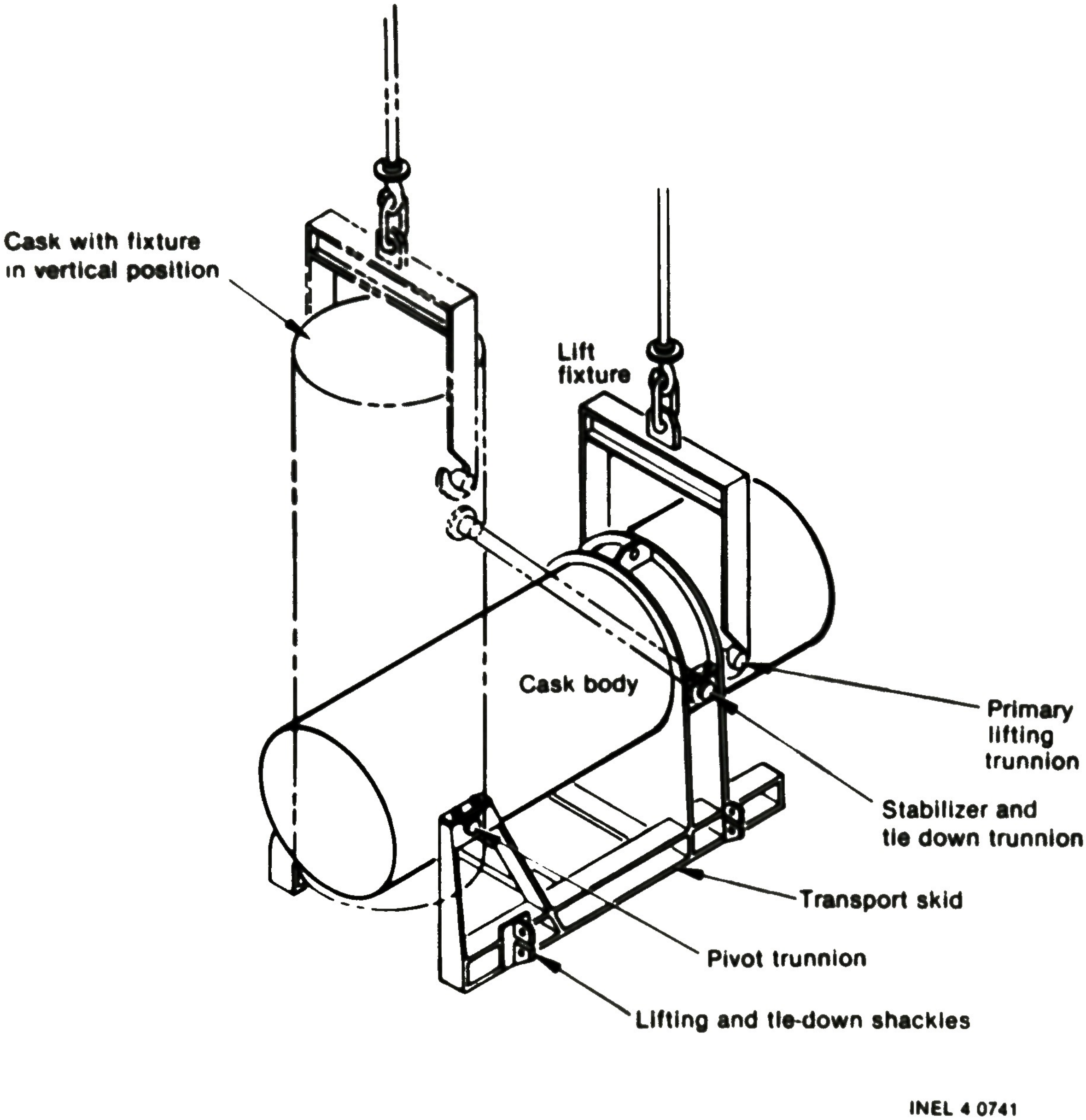


Figure 11. Schematic showing how the shipping cask can be rotated to the vertical position.

Shield plugs and canisters will be removed from the cask using a remotely operated grapple. EG&G Idaho will provide the grapple which is based on a GPU Nuclear design. Modifications will be made to the GPU Nuclear design to allow (a) remote opening and closing of the grapple, (b) use with the Hot Shop 10-ton hoist, and (c) provisions to assist in accident recovery.

Storage of Canisters

Canisters will be stored in a new modular storage rack in the TAN-607 Water Pit. However, the storage modules will be loaded underwater in the Water Pit Vestibule located in the Hot Shop. An empty module will be placed in a new module adaptor which is attached to the pool transfer cart. A new positioning device will be used to align the canister as it is placed in the storage module. The positioning device could be a template through which a canister is lowered, an underwater position indicator, or a method for measuring bridge crane X-Y coordinates.

The sequence for loading canisters into the modular rack begins after all personnel have departed the Hot Shop. Current plans call for removal of a canister shield plug using the 10-ton hoist and canister grapple. The shield plug will be placed on a special location on the working platform. Then the hoist and grapple will be used to remove a canister from the cask. The canister then will be transported to the Vestibule using the bridge crane. The canister will be located properly with the positioning device and lowered into the module. The grapple will be opened to release the canister, the bridge crane will return the grapple to the cask, and the shield plug will be returned to its position in the cask with the grapple. In this manner the cask will be unloaded until either the cask is empty or the module is full. When the cask is empty, the cask will be closed, returned to CFA by truck, transferred to the railcar using the gantry crane, and the railcar will be moved to the Scoville siding. Then, the second cask can be transported to the Hot Shop for unloading.

If the module is only partially full, the stored canister will be vented in the Vestibule. Then, a pressure relief valve will be placed on each canister to prevent overpressurization while the module is in the Vestibule. The module will remain in the Vestibule until completely full. After the module is in the Water Pit, the pressure relief valve can be removed.

When a module is full, it will be moved from the Vestibule into the Water Pit using the pool cart. The Water Pit bridge crane will be used to remove the module from the cart and place the module alongside previously filled modules. Clamps or other mechanical fixtures will connect modules together to form the storage rack. In order to place the storage rack in the Water Pit, an underwater load-spreading platform must be designed and installed to better distribute the weight on the floor.

The canisters will be vented to the exhaust of the heating and ventilation system and filled with water. Then, a vent tube will be attached to each canister to allow gas caused by radiolytic disassociation of water to be vented to the Water Pit room. Modifications to the heating and ventilation system also will be required to remove the vented radiolytic gas from the Water Pit room.

PROJECT MANAGEMENT AND INTERFACES

The TCR&SP has been organized as an element of the TMI-2 Technical Information and Examination Program (TI&EP). TCR&SP is the responsibility of the TSB of EG&G Idaho. TSB was organized as an element of the TI&EP. TIO was established at TMI in accordance with the terms of the GEND[a] Coordination Agreement[3] and functions within guidelines established by the TIO Management Plan.[4] Relationships between TSB, TIO, and other INEL organizations is discussed in the TSB Management Plan.[5]

The functional organization of TCR&SP is shown in Figure 12. The project is responsible for management and control of all INEL activities involving receipt and long-term storage of the TMI-2 core. Activities include obtaining DOE approval, establishing project requirements and criteria, identifying and authorizing tasks, establishing and controlling direct budget and schedule requirements, monitoring and reporting to management of EG&G Idaho and DOE on project performance, and maintaining liaison with TIO. TIO will be responsible for transporting the core debris to INEL in canisters supplied by GPU Nuclear and providing all contacts and interfaces with the cask supplier and GPU Nuclear.

Figure 13 shows the Work Breakdown Structure for the TCR&SP and organizations responsible for performance. Technical management of the project is the responsibility of TSB. TSB also is responsible for the Preparations for Core Receipt Work Package. That package is divided into the following three areas of responsibility:

1. Safety Studies, which will concentrate on such areas as preparation of a Safety Analysis Report, review of criticality, safety review of canister and rack module handling procedures, etc.

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a. The organizations commonly referred to as the GEND Group are GPU Nuclear, Electric Power Research Institute, NRC, and DOE.

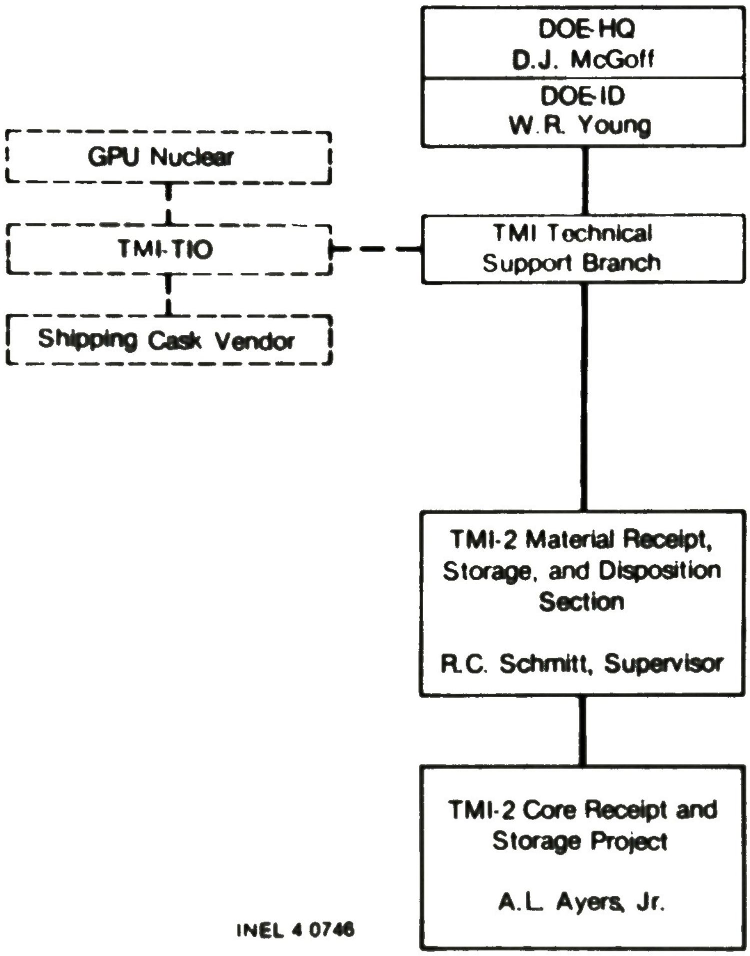

Figure 12. Functional organization of the TMI-2 Core Receipt and Storage Project.

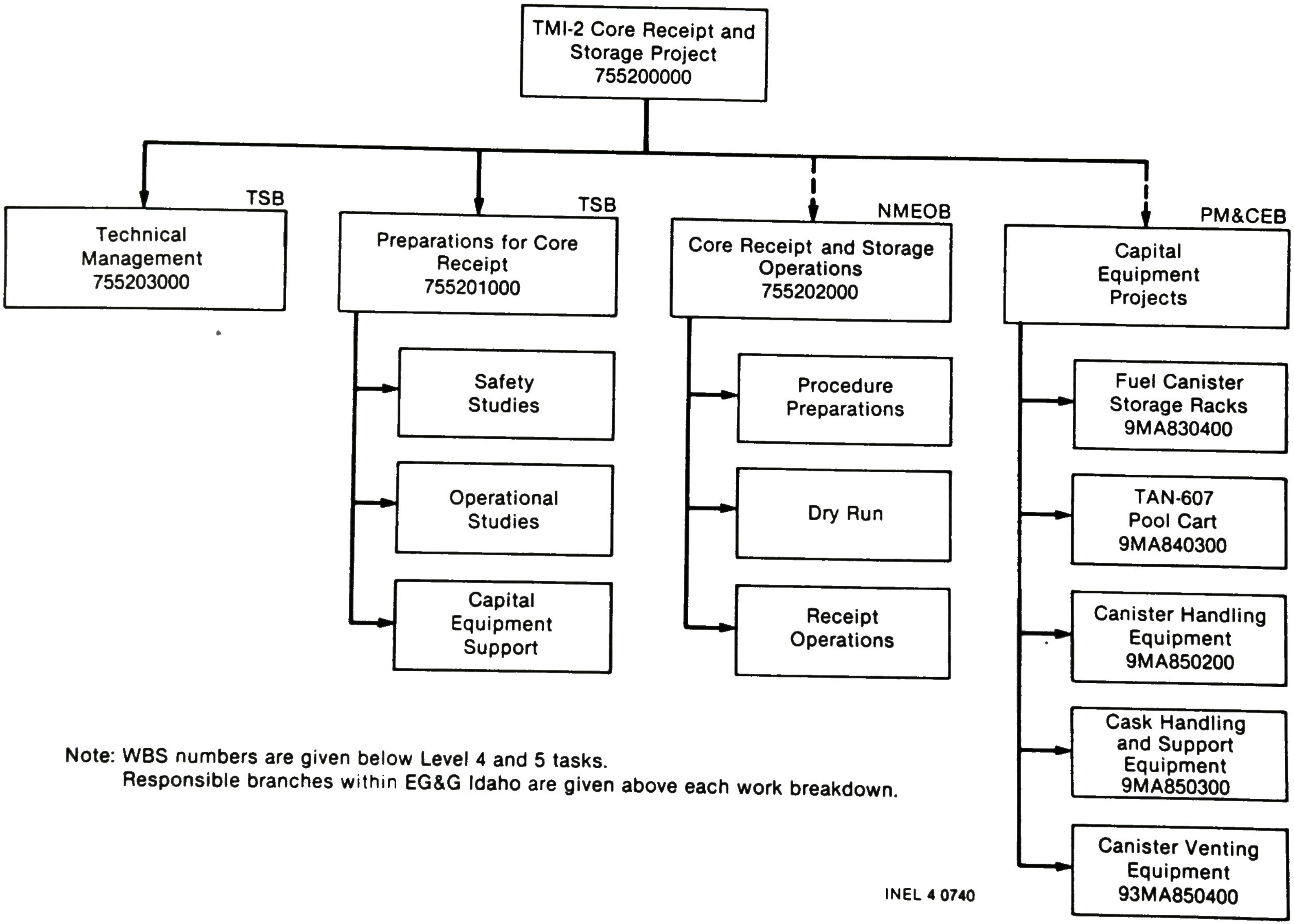

Figure 13. Work Breakdown Structure for the TMI-2 Core Receipt and Storage Project and organizations responsible for performance.

2. Operational Studies, which will provide procedures for operations other than for the TAN Hot Shop, review cask handling sequences, and identify recovery sequences from potential unloading incidents.

3. Capital Equipment Support, which provides operations-funded parts of the Capital Equipment Projects. That support includes developing functional/operational requirements, conceptual designs, and system testing.

The Core Receipt and Storage Operations work package is the responsibility of the Nuclear Materials Evaluation Operations Branch (NMEOB). That work package will provide procedures for TAN Hot Shop operations, a dry run to test the entire unloading sequence, and operational support for routine receipt, unloading, and storage of canisters.

The Capital Equipment Projects are the responsibility of the Project Management and Cost Estimating Branch (PM&CEB) and will provide equipment needed by INEL to receive and store canisters. Table 3 lists all equipment presently identified as being required by TCR&SP. The cask purge system will be required by the Spent Fuel Storage Cask Testing Program before use by TCR&SP. However, some modifications to the system may be required before use by TCR&SP. Several items associated with the cask will be provided by the shipping cask vendor and are being funded through TIO. The items listed as being provided by TCR&SP are the responsibility of PM&CEB. Those items are controlled by work packages as noted on Table 3. A separate document entitled Project Management Plan for the Core Receipt and Storage Capital Equipment Project identifies the organization and activities of the tasks in the Capital Equipment Projects.[5] Also included in that plan are the project Work Breakdown Structure, organization, cost, and schedule.

Resource allocations, as well as management, measurement, and control, will be through project work packages as discussed in the TSB Management Plan.[6] Configuration management, change control, and reporting requirements also will be according to the TSB Management Plan.

TABLE 3. EQUIPMENT FOR TMI-2 CORE RECEIPT AND STORAGE

Item	Supplier
Cask purge system	Spent Fuel Storage Cask Testing Program
Cask lifting fixture for CFA gantry crane	Shipping cask vendor
Cask lifting fixture for TAN	Shipping cask vendor
Specialty tools for the cask at the TAN Hot Shop	Shipping cask vendor
Fuel canister storage racks • Design and initial module procurement[a] • Procurement of remaining modules • Load-spreading platform	TMI-2 Core Receipt and Storage Project (Work Package 9MA830400)
TAN-607 pool cart modification	TMI-2 Core Receipt and Storage Project (Work Package 9MA840300)
Canister handling equipment • Grapple • Positioning device • Accident recovery equipment	TMI-2 Core Receipt and Storage Project (Work Package 9MA850200)
Cask handling and support equipment • Cask safety platform • Support stand for inner containment vessel lid • Support stand for outer containment vessel lid	TMI-2 Core Receipt and Storage Project (Work Package 9MA850300)
Canister venting equipment • Vent lines • Water filling equipment • Dewatering equipment • Heating and ventilation modifications	TMI-2 Core Receipt and Storage Project (Work Package 9MA850400)

a. Includes module handling equipment.

SAFETY, ENVIRONMENT, AND QUALITY

Safety

Safety aspects of TCR&SP will be addressed in accordance with Reference 5 and the EG&G Idaho Safety Manual. A Safety Assessment Report will be written to cover both safety and environmental aspects of the project. Each task will be reviewed for safety before completion of design. All procedures will be reviewed for safety considerations before initial use. The TAN-607 Water Pit is currently a fissile material control area (FMCA). Documentation for the FMCA will be reviewed and updated as required to include TMI-2 core materials. The review will include, but not be limited to, NMEOB Standard Practices, the TAN Hot Shop Final Safety Analysis Report, and the Operational Safety Requirements Document.

Environment

Environmental aspects of the project will be reviewed in accordance with DOE-ID Order 5440.1 and the Environmental Review and Documentation Section of the EG&G Idaho Safety Manual, as outlined in Reference 5. Supporting documentation will be included in the Safety Assessment Report.

Quality

Quality aspects of the project will be addressed in accordance with Reference 5 and the EG&G Idaho Quality Manual. To facilitate interfacing with GPU Nuclear, the overall quality standard will be 10 CFR 50, Appendix B. A Quality Program Plan (QPP) applicable to the TMI-2 Core Receipt and Storage Project has been prepared for TMI activities. The QPP, incorporated in Reference 5, will apply to the TCR&SP. Quality at TMI will be addressed in accordance with the GPU Nuclear Recovery Quality Assurance Plan which has been reviewed by NRC.

SAFEGUARDS AND SECURITY

The TMI-2 core debris contains significant quantities of special nuclear materials (SNM) and will require special safeguards, inventory control, and physical protection.

Safeguards

Requirements governing the EG&G Idaho Safeguards Program are derived from the DOE Order 5630 series. Interpretation of those orders by the Safeguards and Materials Management Branch of EG&G Idaho is given in the Nuclear Materials Custodian Handbook (NMCH). That document (a) establishes safeguards criteria for transport, receipt, and storage of all accountable material in the possession of EG&G Idaho; (b) delineates nuclear material accountability requirements for the Nuclear Material Custodians (NMCs) who have operational control over those materials; and (c) includes methods for internal control, recordkeeping, and physical inventory. Internal control refers to the responsibilities of management and the NMC in areas such as transport, receipt, internal transfer, and notification. Recordkeeping includes retaining reporting units, source documents, and custodian logbooks. Physical inventory refers to techniques used when conducting inventories of the various types of accountable nuclear material.

Receipt of TMI-2 core debris will require (a) reaffirming the existing NMC by the responsible TMI program or branch manager, (b) reviewing the existing Material Balance Area of the TAN-607 Complex, (c) reviewing the existing recordkeeping system for tracking of material, and (d) complying with inventory requirements for that category of material. The review will include NMEOB Standard Practices. The core debris will, in all probability, be considered Category III material (as defined in the NMCH). Therefore, the inventory requirements will necessitate semiannual records checks and verification of the presence of the canisters.

Each shipment containing accountable quantities of SNM will require a DOE/NRC Form 741 Nuclear Material Transaction Report. That document will contain the following information:

- Gross weight of each container
- Net weight of material in each container
- Description of contents of each container
- Estimated total quantity (in grams) of uranium and plutonium per container
- Estimated quantities (in grams) of U-235, Pu-239, and Pu-241 per container
- Percent enrichment of U-235 and Pu-240 after burnup
- Individual identification number for each container.

Security

Requirements for physical protection of SNM are stated in DOE Order 5632.2 "Physical Protection of Special Nuclear Materials." The TMI-2 core debris will contain reportable quantities of SNM and therefore will require physical protection. Most of the SNM is expected to be in the form of intact and crushed fuel pellets, either dispersed in debris or in partially intact fuel assemblies. The maximum fuel enrichment is ~3%.

The core debris will be packaged in canisters of three different designs. Two canister designs will be of all-welded construction with quick disconnects for various process connections (i.e., vent, drain, inlet, and outlet). The third design will have a bolted lid with quick disconnect process connections. The canisters are expected to have a maximum radiation field of ~1500 R/h at 1 cm. The canisters will be placed in a storage rack under at least 10 ft of water in the TAN Water

Pit. The canisters will be held in the rack via a mechanical device. Because of their length, the canisters cannot be removed from the storage rack without exposing personnel to high radiation fields. Each canister will weigh up to 2,800 lb and require a crane with a special grapple for lifting.

Special conditions of DOE Order 5632.2 allow a reduced level of protection for SNM when one or more of the following conditions exist:

a. The SNM is not readily separable from other radioactive material and the combination of the SNM and other radioactive material delivers an external radiation dose of approximately 100 rems per hour or more at 1 meter from any accessible surface without intervening shielding material.

b. The SNM is contained in material that has been declared as waste.

c. The SNM is in a chemical, isotopic, or physical form or is within isolated in-process, or remote inaccessible, containment which provides comparably effective protection, to that specified herein, against malevolent use or theft.

The physical protection of SNM within the canisters meets the requirements of DOE Order 5632.2 for the following reasons:

a. The SNM is contained within debris and partial assemblies that have been operated as a nuclear reactor core. The SNM is not readily separable from other radioactive material. To separate the SNM would require facilities similar to those found in fuel reprocessing plants.

b. Although the TMI-2 core debris has not been declared as waste per se, it certainly is in a form that is no longer useful except for research and development.

c. The SNM is in a chemical and physical form and in a containment system that provides effective protection against malevolent use.

DELIVERABLES

Deliverables of TCR&SP will consist of project documentation, equipment, and services.

Documentation

TCR&SP will generate the following documents:

- A Safety Analysis Report (SAR) will document safety aspects of the project. That document will discuss canister and area radiation levels; monitoring plans; environmental effects; operation aspects; SNM analyses of the Material Balance Area; physical security analyses; criticality analyses of the FMCA; and accidents such as fires, floods, earthquakes, dropping of canisters during transfer, and dropping of casks.

- The Operational Safety Requirements Document (OSRD) will be revised to define safety limits within which the TAN Hot Shop and Water Pit will be operated during core receipt and storage.

- A Transport Plan will be provided for transporting the cask from CFA to TAN, and return.

- Detailed Operating Procedures (DOPs) will be provided for transferring the cask to and from the railcar, transporting the cask to and from TAN, opening the cask, unloading canisters from the cask, and transferring modules loaded with canisters to the Water Pit. Other procedures also will be provided as identified by the project.

- A Radiological Hazards Analysis (RHA) will be performed before unloading canisters from the shipping casks. The RHA will identify expected radiation levels, radiation monitoring requirements, and emergency action levels.

A document file will be provided for TCR&SP. That file will contain [as a minimum] copies of the SAR, OSRD, DOPs, RHA, design documents for all equipment used, and detailed information on each canister. The information for each canister will include copies of all shipping documents; procedures supplied by GPU Nuclear; canister design; radiological/chemical/physical data on the waste; data on accountable quantities of SNM; quality assurance reports; location of the canister in the storage rack; and references to specific procedures used to transfer, unload, and store the canister. The file will be maintained until final disposal of the waste. TSB will establish the file, and NEMOB will maintain the file during the storage period.

Equipment

Table 3 in the "Project Management and Interfaces" section of this plan lists equipment required for core receipt and storage. Included in the table is the supplier for the various items. For those items in TCR&SP, the equipment work package number is included for reference.

Services

Personnel will be provided to plan and perform the following tasks:

1. Transport loaded shipping casks from Scoville siding to CFA

2. Transfer casks from railcar to truck

3. Transport casks from CFA to TAN

4. Unload casks in the TAN Hot Shop

5. Load canisters into the modules

6. Fill canisters with water

7. Attach vent lines

8. Assemble modules into storage rack

9. Return casks on the railcar to the Scoville siding.

COST AND SCHEDULE

Cost estimates for TCR&SP are shown in Table 4. Those costs are based on the schedule shown in Figure 14. The estimates are preliminary based on "best information" available. In order to support both the cost estimates and schedule, the final canister design is needed by November 1984, and the shipping cask details by December 1984. All capital equipment costs are budgetary estimates developed before any design work was completed. The capital equipment estimates will be refined as the designs are developed.

Time estimates for the core receipt and storage operations are based on the receipt of two casks per train, one train available, and a total shipment of 238 canisters. Table 5 lists the time allotted for each operation. As plans develop, these estimates can be refined. The costs are budgetary estimates developed before detailed knowledge of the operating characteristics of speciality equipment. The operating fund estimates will be refined as the project is developed.

The project is expected to require about $5.1 million in operating funds, $2.9 million in capital equipment funds, and extend to mid-FY-89.

TABLE 4. COST ESTIMATES FOR TMI-2 CORE RECEIPT AND STORAGE PROGRAM

	Estimated Costs ($K)						
	FY-1984	FY-1985	FY-1986	FY-1987	FY-1988	FY-1989	Total
OPERATING FUNDS							
Preparations for Core Receipt	88	306	--	--	--	--	394
Core Receipt and Storage Operations	--	83	640	1340	1450	705	4218
Technical Management		105	100	100	50	--	355
Total (Operating funds)	88	494	740	1440	1500	705	4967
CAPITAL EQUIPMENT FUNDS							
Fuel Canister Storage Rack	13	709	1362	--	--	--	2084
TAN-607 Pool Cart Modifications	5	80	--	--	--	--	85
Canister Handling Equipment	--	244	--	--	--	--	244
Cask Handling and Support Equipment	--	138	--	--	--	--	138
Canister Venting Equipment	--	226	160	--	--	--	386
Miscellaneous Equipment	--	--	424	--	--	--	424
Total (Capital Equipment funds)	34	1397	1946	-0-	-0-	-0-	3361

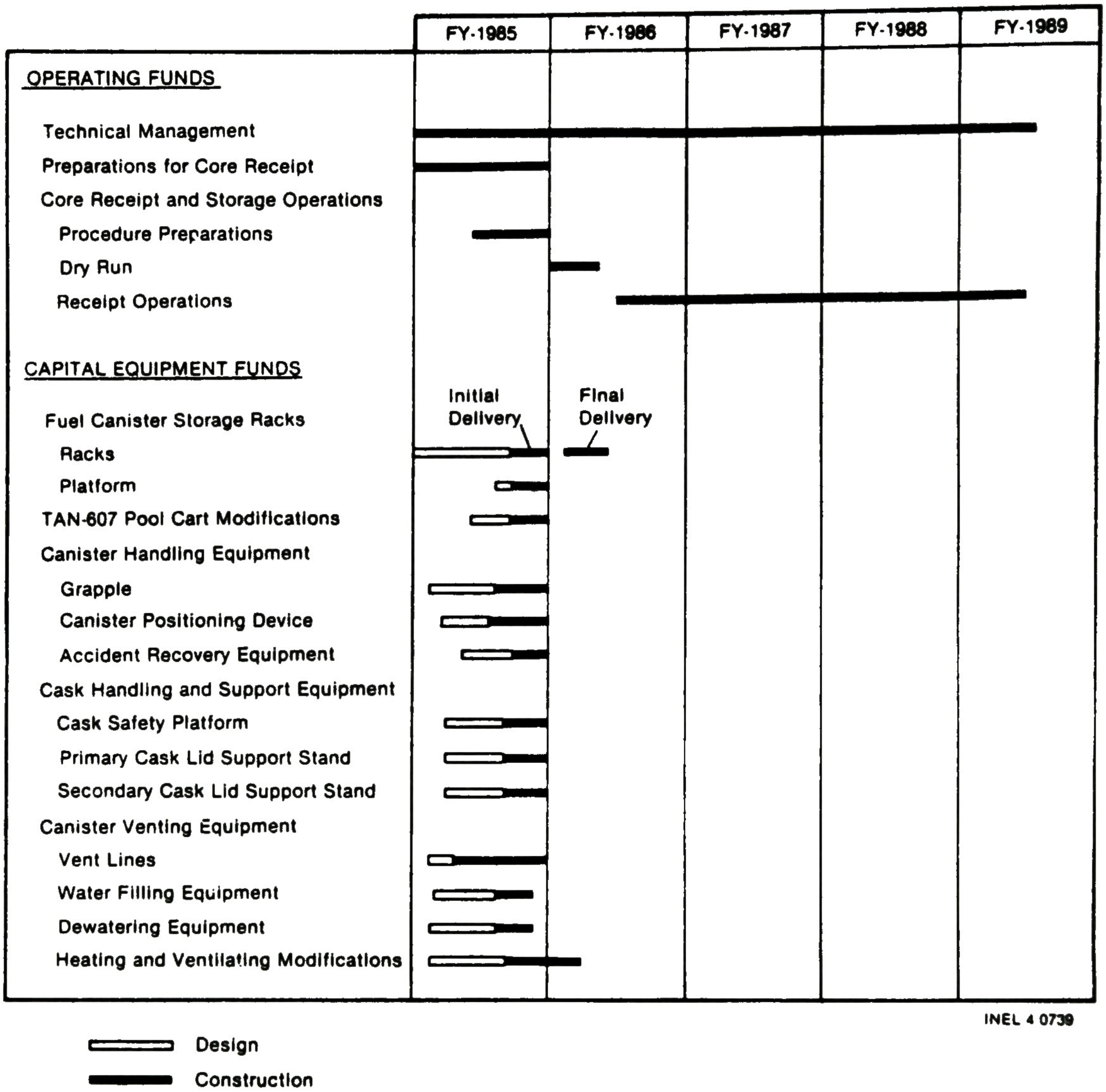

Figure 14. Schedule for the TMI-2 Core Receipt and Storage Project.

TABLE 5. TIME ESTIMATES FOR VARIOUS OPERATIONS IN TRANSPORTING THE TMI-2 CORE DEBRIS

Load 2 casks at TMI	8 days[a]
Transport casks to INEL	14 days[a]
Transfer first cask from railcar to truck	3 days
Transport cask to TAN	1 day
Open cask, unload canisters, and close cask	3 days
Transport cask to CFA	1 day
Transfer cask from truck to railcar	3 days
Transfer, transport, and unload second cask	11 days
Return casks to TMI	14 days[a]

a. Controlled by others (e.g., railroad company).

REFERENCES

1. Final Programmatic Environmental Impact Statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979, Accident Three Mile Island Nuclear Station, Unit 2, NUREG-0683, Vol. 1, p. ii, March 1981.

2. "Memorandum of Understanding Between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy Concerning the Removal and Disposition of Solid Nuclear Wastes from Cleanup of the Three Mile Island Unit 2 Nuclear Plant," 15 March 1982.

3. "Coordination Agreement TMI Unit 2 Information and Examination Program," 26 March 1980.

4. Program Management Plan for the U.S. Department of Energy TMI-TIO Programs, EG&G Idaho, Inc., May 1983.

5. B. J. Lilburn, Project Management Plan for the Core Receipt and Storage Capital Equipment Project, Draft Report, EG&G Idaho, Inc.

6. Management Plan for the Technical Support Branch of the Nuclear Materials Evaluation Programs Division of EG&G Idaho, Inc., EGG-TMI-6504, Rev. 1, August 1984.