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TMI-2 CORE SHIPPING PREPARATIONS

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ABSTRACT

Shipping the damaged core from the Unit 2 reactor of Three Mile Island Nuclear Power Station near Harrisburg, PA, to the Idaho National Engineering Laboratory near Idaho Falls, ID, required development and implementation of a completely new spent fuel transportation system. This paper describes of the equipment developed, the planning and activities used to implement the hardware systems into the facilities, and the planning involved in making the rail shipments. It also includes a summary of recommendations resulting from this experience.

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INTRODUCTION

Subsequent to the accident at Three Mile Island Unit-2 (TMI-2), the U. S. Nuclear Regulatory Commission (NRC) produced an environmental impact statement relating to decontamination and disposal of radioactive waste resulting from the accident[1]. This effort resulted, in part, in a Memorandum of Understanding with the U. S. Department of Energy (DOE) which provided for transportation of the damaged TMI-2 core to a DOE facility for interim storage and research[2]. DOE and GPU Nuclear Corporation (GPU Nuclear) entered into a contract under which DOE agreed to accept the core debris, in canisters, for transport, storage, and core examination. EG&G Idaho, Inc. (EG&G Idaho) was selected by DOE to manage the TMI-2 Program, including accepting the core debris at TMI, transporting it to the Idaho National Engineering Laboratory (INEL) of DOE, and placing it in storage.

The physical condition of the damaged core and the configuration of the TMI-2 plant for support of both reactor defueling and facility cleanup presented special requirements for core packaging, core transport packaging, and facility interfaces. Unique conditions and logistics at INEL also presented special requirements for receiving and storing the core material. This paper describes the planning activities, facility modifications and preparations, equipment development and installation, and coordination effort required to make the TMI-2 fuel shipping campaign a successful reality.

CORE TRANSPORT SYSTEM AND TRANSPORTATION INTERFACES

The extent of the TMI-2 core damage required the fuel to be placed into specially designed canisters for removal from the reactor vessel. The canisters served as confinement for the core material but credit was not taken for leak tight containment. As a result, the core transport packages were required to provide double containment of the canisters to meet current transportation regulations. The requirement for double containment, coupled with the unique geometry and characteristics of the core debris canisters, generated the need for design and fabrication of the NuPac 125-B transport package, a completely new spent fuel transportation system.

The NuPac 125-B transport package developed is a double-containment system, with independent inner and outer "leaktight" vessels. The inner vessel is designed to accept seven core debris canisters, each canister measuring 0.356 meters (14 inches) in diameter and 3.80 meters (12 ft - 5 3/4 in.) in length. Both the canisters and the inner vessel contain neutron absorbing materials for criticality control. The outer vessel provides the bulk of the radiation shielding and physical protection for the core material, utilizing a combination of heavy stainless steel components and lead. High density foam filled overpacks assembled over each end of the outer vessel provide impact and thermal protection in the event of a transportation accident. The package is supported in a specially designed multipurpose transport skid which, in turn, interfaces with a dedicated heavy duty rail car.

Rail service between TMI and INEL is provided by Consolidated Rail Corporation (Conrail) and Union Pacific Railroad (UPRR). Several transportation routes were evaluated but the final route selected involved just the two carriers. Conrail is the carrier from the point of origin at TMI to East St. Louis, Illinois, and UPRR is the carrier from St. Louis to the destination point at INEL. The route selected interfaces with ten states, including Pennsylvania and Idaho.

TMI FACILITY INTERFACES

Special conditions have been established in the TMI-2 reactor and fuel handling buildings to facilitate defueling and cleanup of the plant. Early in the cleanup efforts, a submerged demineralizer system was installed in the "B" spent fuel pool to process the water from the reactor building basement. The demineralizer system utilizes the entire pool, precluding its use for submerged spent fuel cask loading operations. Also, to facilitate reactor defueling, a work platform was established at the top of the reactor vessel. This defueling concept required water levels in the reactor refueling canal and the adjoining fuel handling building spent fuel pool, pool "A", to be lowered and a dry canister handling system to be implemented. The fuel handling bridges for the refueling canal and the "A" spent fuel pool were retrofitted with special canister grappling systems and shielded transfer tubes. The lower water level in pool "A", however, precludes conventional cask handling and loading operations. Additionally, cask lifting restrictions unique to pool "A", necessitated development of a a dry cask loading system for shipping the TMI-2 core debris canisters, utilizing a transfer cask to move canisters from the pool to the shipping cask.

The fuel handling buildings for TMI Units 1 and 2 are joined to form one common hall extending between the two reactor buildings. Each facility has its own fuel pool area but they share a common and centrally located truck bay for fuel shipping and receipt. The truck bay has provisions for both truck and rail service and is utilized for TMI-2 fuel cask loading, on a non-interference basis with the operating Unit 1 facility.

Using the truck bay without effecting operation of Unit 1 requires close coordination between the two facilities. It also imposes special requirements on the use of the common facility, including: No area in TMI-1 may become a Radioactive Work Permit area (>2.5 Mr/hr) as a result of TMI-2 activity; security separation between the two units must be maintained; and the most conservative licensing approaches must be taken, e.g., the cask support equipment had to meet TMI-1 design criteria for seismic restraint requirements because they were more conservative than the TMI-2 requirements.

These restraints imposed special design requirements for the cask handling and support equipment and effect cask loading operations. Both TMI-1 and TMI-2 load handling areas had to be investigated. A result of the investigation was the identification of an "exclusion area" in which no loads may be moved due to redundant safety system cable trays located under a portion of the truck bay floor.

INEL FACILITY INTERFACES

INEL also presented unique interface circumstances. Geographically, the Laboratory covers a large area. The rail siding and the facilities utilized for receipt of the rail casks are located at the south end of this area and the facilities utilized for cask unloading and fuel canister storage are located at the northern end, some 48 kilometers (30 miles) overland from the rail siding. To transport casks from the siding to the unloading facilities, an existing gantry crane is used to off-load each cask from its railcar onto a heavy duty trailer/transporter. The transporter then moves it across the site to the unloading and canister storage facilities.

Cask unloading at INEL is also accomplished as a dry operation. A large existing hot shop facility is utilized for cask unloading and an existing storage pool, which interfaces with the hot shop, is used for storage of the canisters. Special equipment has been developed for handling the cask, for unloading the canisters, and for storing the canisters in the pool.

EARLY PLANNING

It was recognized that close coordination and cooperation of a diverse number of activities and organizations would be absolutely necessary in order to accomplish preparations for core shipping within the time constraints existing. Two important working groups evolved to accomplish this purpose.

A TMI-2 Core Shipping Technical Working Team was established and met regularly on a formal basis. The meetings and team members effected timely, efficient, and accurate exchange of information between program participants and were instrumental in bringing the technical problems to light. Recognition of those who participated cannot be under emphasized for their contribution to the overall success of bringing the shipping campaign to a reality. Examples of issues developed and tracked to satisfactory resolution included the following: Radiolysis and hydrogen gas generation, canister design requirements, canister criticality, cask criticality, cask load drop scenarios, cask leak testing, cask certification, cask handling at TMI, and cask handling at INEL.

Making up the team were representatives from: EG&G Idaho TMI-2 Program Offices, both TMI and INEL; EG&G Idaho Traffic; GPU Nuclear Waste Management, Engineering, and Planning; Babcock & Wilcox, designers of the canisters; Bechtel, providing engineering services to GPU Nuclear; Nuclear Packaging, Inc. (NuPac), designers of the cask and cask loading support equipment; DOE Headquarters; DOE Idaho; Rockwell Hanford Company, providing expertise on hydrogen generation; Sandia National Laboratories, providing expertise on cask drop testing and certification; and the NRC. The team worked closely to coordinate the timely resolution problems and the technical issues.

Aside from the Technical Working Team, GPU Nuclear formed a Fuel Shipping Group to: Identify all on-site requirements for making core debris shipments, plan and carry out the tasks necessary to enable fuel shipments from TMI, coordinate activities with the activities being taken by the Core Shipping Technical Working Team, and ensure on-site preparations occurred as scheduled. The group included members from Security, Safety, Maintenance, Operations, Licensing, Radiological Controls, Field Operations and Engineering, Technical Planning, Program Controls, Site Engineering, and Waste Management. In addition, the group included representation from the NRC, EG&G Idaho, and Bechtel Engineering (Gaithersburg, MD).

The Fuel Shipping Group was effective in identifying requirements, restrictions, and potential problems and in developing tasks for these issues which could then be worked to resolution. The tasks, once identified and assigned, were scheduled and coordinated through Technical Planning, with reporting on a weekly basis. Formation and functioning of the group also developed strong working relationships between the diverse disciplines within GPU Nuclear and with the organizations represented in the Technical Working Team. Many of the issues addressed by the group were "first of a kind" and involved problems that had not been considered at that time within the industry.

TRANSPORT SYSTEM SUPPORT EQUIPMENT

The planning efforts resulted in definition of the support hardware required to implement the rail cask transportation system at each of the facilities. Specialized equipment was required to both load canisters at TMI and to unload the casks at INEL. The following brief functional descriptions are intended to highlight both the equipment developed and provide insight into the operations performed.

TMI Cask Handling Equipment

Restrictions imposed on the Fuel Handling Building bridge crane for critical lifts required its capacity to be downrated to the point where it is not qualified to lift the 125-B shipping cask. Restrictions for using the truck bay also required the cask to be supported in a seismically stable condition when uprighted for loading operations. The following cask handling equipment was developed for operating within these restrictions.

Cask Unloading Station (CUS) An empty rail cask is prepared for loading by first removing its environmental cover (described later) and overpacks using a mobile crane while the railcar is on the TMI siding. It is then moved into the truck bay and positioned under the CUS. This is a portable cask lifting device which straddles the cask and railcar and utilizes four synchronized screw type actuators as the lifting mechanism. The cask and transport skid are lifted from the railcar deck, the railcar is removed from the facility, and the cask and skid are lowered. The skid interfaces with floor brackets positioned on the truck bay floor and is pinned into the brackets after the cask has been fully lowered. The CUS is then moved into storage in the truck bay using the bridge crane.

Cask Hydraulic Lift Assembly (CHLA) The cask transport skid is a multi-purpose cask support device which interfaces with the cask in four places on two sets of trunnions incorporated into the cask outer vessel. The skid includes bearings at the interface with trunnions nearest the closed end of the cask (cask bottom when vertical) and is designed to allow the cask to be rotated from horizontal to vertical on those trunnions. Clevises are attached to the lid end of the cask and the corresponding end of the skid. Telescoping hydraulic cylinders are attached to the clevises, one on either side of the cask for redundancy, and connected to a portable skid mounted hydraulic power unit. The cask is then raised from the horizontal to the vertical loading position in a very controlled manner using this CHLA.

Work Platform A two-piece work platform provides a stable working space around the upper portion of the cask after the cask has been raised to the vertical position. The primary half of this platform is a rigid arched structure which is anchored into the truck bay floor. It is used to stabilize the lid end of the upright cask. The pinned connection of the skid into the truck bay floor in conjunction with this structure combine to support the cask in a seismically stable condition. The platform is positioned in the truck bay so the railcar and cask pass under it and, after setting the cask into position, the cask is raised into the platform. Once the cask is raised into the platform and securely anchored to it, the second half of the platform, a portable working deck, is moved into position with the bridge crane.

TMI Cask Loading Equipment

Dry loading of the cask required development of several pieces of equipment to compliment the rail cask system. Since cask loading is performed "hands on," these devices are designed to provide shielding for the operators. Again, the brief functional descriptions below are intended to both highlight the equipment and to provide insight into the operations performed.

Shipping Cask Loading Collar (SCLC) After the cask is uprighted and the work platform is assembled, the cask outer and inner vessel lids are removed and moved into storage. The inner vessel incorporates stainless steel shield plugs at the upper end of each canister cavity so lid removal and replacement operations may be accomplished without direct exposure from the cavities or canisters. With the lids removed, a shielded loading collar is placed over the top of the cask. The SCLC interfaces with the inner vessel and is designed to rotate on the cask so canisters may be loaded into the center and six periphery canister cavities utilizing two openings. Movable shield doors are provided at the openings to protect operators during canister loading operations. The upper surface of the SCLC provides the interface with the fuel transfer cask, described later.

Mini Hot Cell (MHC) The MHC is a small lead shielded cask used to remove, store, and replace the cask inner vessel shield plugs. It interfaces with the SCLC and, once in place, the shield door in the loading collar is opened over the cavity to be loaded. A grapple in the MHC is then lowered through the collar, engages the shield plug, and withdraws it into the shielded enclosure. After closing the shield door in the SCLC, the MHC is moved to a storage position on the working platform. MHC handling is accomplished using a jib crane mounted on the work platform, leaving the facility bridge crane free for handling the fuel transfer cask. After loading the canister, the process is reversed to replace the shield plug.

Fuel Transfer Cask (FTC) A lead shielded stainless steel transfer cask was developed for moving canisters from the "A" spent fuel pool to the shipping cask. The FTC is transported and maneuvered using the facility bridge crane but is otherwise self-contained, including a canister grapple system to facilitate loading and unloading the canisters. With the FTC positioned at the pool to pick up a canister, shield doors on the bottom of the cask are opened and the grapple is lowered into the pool until it engages a socket in the top of the canister. The canister is raised into the shielded enclosure, the shield doors are closed, and the FTC is prepared to transport the canister to the shipping cask. Redundant operating consoles and power and control umbilical lines are used, one at poolside and the other at the cask loading station, when operating the FTC.

At the cask loading station, the FTC is placed on the loading collar, the shield doors in both the SCLC and the FTC are opened, and the canister is lowered into the cask. The grapple is raised out of the cask and the shield doors in the SCLC and FTC are closed. The cycle is repeated until all seven cask positions are loaded.

TMI Canister Preparation Platforms

Two working platforms were built into the "A" fuel storage pool, just above the lowered pool water level. One is used to dewater and inert the canisters prior to shipment. It is also used for any canister required maintenance or repairs and for sampling the canister gasses just prior to shipment. The gasses are sampled to verify the absence of hydrogen gas buildup.

The second platform interfaces with the FTC. Using the spent fuel pool canister handling bridge, the canister to be loaded is placed in a rack positioned below the platform. The FTC is then positioned over the canister and, using its grapple system, retrieves the canister. A high pressure spray ring installed on the underside of the platform is used to decontaminate the canisters as they are raised from the pool into the FTC.

INEL Cask Handling Equipment

Several equipment items were developed for use in handling and transporting the cask in Idaho. Those items are briefly described below.

Horizontal Lift Fixture The INEL gantry crane utilizes a large screw type actuator as the lifting mechanism. It incorporates a large anchor shaped lifting bar on the end of the screw. A special articulated spreader bar and rigid linkages were developed to adapt the gantry crane lifting bar to the cask and its transport skid. This fixture centers the cask system c.g. under the crane lift and incorporates a pivot point and adjustable linkage (ratchet binder) so the attitude of the cask may be adjusted as required.

When a rail cask arrives at INEL, the environmental cover and overpacks are removed. The railcar is then positioned under the gantry crane and the crane is used to lift the cask and transport skid from the deck of the rail-car. The car is moved out from under the crane and the transporter is moved into place. The crane then positions the cask and skid onto the transporter for the trip to the north end of the Site. The reverse procedure is used to place the empty cask and skid onto the rail car.

Vertical Lift Fixture Upon reaching the large hot shop facility at Test Area North (TAN), the transporter and cask are backed into the hot shop. A special lifting bail is attached to a set of cask trunnions located near the lid end of the of the cask. Using the hot shop bridge crane, the cask is first rotated in the transport skid from the horizontal to the vertical position and is then lifted from the skid and moved into a stationary work platform located in the hot shop. The transporter and skid are removed from the hot shop. The sequence is reversed to return the empty cask to the rail siding.

Cask Work Stand A stationary cask work stand was developed to provide a working platform around the upper end of the upright cask. After the cask has been moved into the work stand, the cask internal cavities are sampled and the lids are removed. At this point in the unloading process, the operators exit the hot shop and the shield plugs and canisters are individually removed remotely.

INEL Canister Handling Equipment

Canister Grapple Remote manipulators are used to assist the cask unloading operations, however, a remotely operated canister grapple was developed to lift the canisters from the cask, move them across the hot shop to the pool interface (vestibule), and place them into the pool. The grapple interfaces with the auxiliary (light duty) crane hook on the hot shop bridge crane and is designed to submerge the canisters in the pool.

Canister Storage Rack Modules Specially designed six pack modular canister storage racks were developed for the TAN storage pool. The racks incorporate neutron poison plates and are designed to maintain a critically safe configuration under worst case canister loading and pool accident scenarios. The storage pool interfaces with hot shop by means of a small vestibule located in the hot shop. A transfer cart is used to shuttle components between the pool and hot shop. In this service, a pair of storage rack modules is placed on the cart. As each six pack module is filled with canisters, the canisters are water filled, the module is moved to the pool, and a continuous vent line is attached to each canister. An empty module is placed on the cart in its place and the process is repeated.

Transportation Equipment

An "environmental cover" was fabricated for each of the cask systems. This is a fabric reinforced vinyl cover which fits over the cask and impact limiters and drapes to the rail car deck. It is tied down to a special rail on the car deck around the perimeter of the cask. A heavy flap at the base of the cover forms a quasi-seal with the deck. The purpose of the cover is to protect the cask from grime and diesel soot during normal transit and from the build up of snow and ice during winter transit.

EQUIPMENT IMPLEMENTATION AND PREPARATION FOR SHIPMENT

The cask systems and all the cask handling and canister loading equipment were conceived, designed, fabricated, tested, and placed into service in an extremely short period of time. The following provides an overview of the effort required to implement this equipment and to prepare for fuel shipping.

Nuclear Packaging, Inc., NuPac, designed and built the casks, all of the cask handling equipment, and the canister loading equipment used at TMI. Fabrication of the individual pieces of equipment occurred in parallel at several subcontractors located in the northwest. Although the system components were individually tested to verify operating requirements were met, complete system testing was not feasible at any single fabrication facility. Therefore, it was decided to utilize an existing facility at the Hanford Engineering Development Laboratory (HEDL) of DOE to perform integrated and formal acceptance testing of the transportation system (cask, skid, and rail car), the TMI cask handling and support systems, and the canister loading equipment. The HEDL location was chosen because it offered a facility equipped to accommodate the assembled equipment. It had the track system required to handle the rail car, it was reasonably close the NuPac technical staff, and it was adjacent to a NuPac fabrication subcontractor located in Pasco, Washington. The fabricator's location was critical, since field modifications were anticipated during equipment interfacing and testing. This arrangement allowed modifications to be made with minimal impact.

Integrated testing was controlled and directed by NuPac but was performed by GPU Nuclear personnel. GPU Nuclear used the testing for training of their operating personnel and for verification of their operating procedures. EG&G Idaho coordinated the efforts and observed the testing and equipment checkout.

Large steel boxes were fabricated to both simulate the Truck Bay parapet configuration and support the rigid work platform structure. Westinghouse Hanford Company, operator of the HEDL facility, provided equipment and personnel to offload and stage the equipment as it arrived on site and to assemble and erect the work platform. GPU Nuclear personnel completed the equipment interfacing tasks and performed functional testing of the equipment systems. Work was controlled by cognizant NuPac engineers and technical staff, utilizing test procedures developed by NuPac. However, GPU Nuclear, through its Fuel Shipping Group planning efforts, had: Developed a test plan of their own to ensure the GPU Nuclear training needs were accomplished; prepared final drafts of their operating procedures for both cask handling and canister loading operations; designated the compliment of operating crew members to send to HEDL for each of the respective operations being performed and the rotation of the crew compliments in order to maximize the training and cross training of their personnel; designated the Site Engineering and Technical Support personnel required to participate and witness the operations; and provided the necessary training and planning and, most importantly, resolved potential craft bargaining agreement concerns. The six week test period accomplished over one-hundred work items on schedule. Cooperation between all parties was excellent.

The HEDL testing program was beneficial and effective in bringing together the equipment, procedures, and people required to implement the fuel shipping program. NuPac, with technical cognizance for the equipment and its operation, benefitted by being able to correct minor deficiencies and interface problems encountered in the equipment setup and testing in an "out of plant" situation, using its own people and subcontractors. Modifications were accomplished little or no impact on the testing program and with minimal effort. GPU Nuclear benefitted by being able to test and improve operating procedures while in draft form so the subsequent formal review and approval was more meaningful. Its Site Engineers were able to verify "as built" dimensions on the assembled equipment configurations to confirm compatibility with modifications being made in the TMI truck bay. Key interfaces were confirmed and dimensional problems discovered were corrected prior to the equipment arrival at TMI. EG&G Idaho, responsible for making the fuel shipments, was able to observe and assist in developing the procedures and methods to be utilized in canister loading, cask leak testing, and preparing the casks for shipment. These are tangible benefits that obviously expedited implementation of the shipping program.

The intangible benefits, i.e., the benefits that are hard to measure or put a value on, are the real story of the HEDL testing. To explain, realize that the GPU Nuclear operating crew sizes in place at HEDL were limited. They were made up of foremen (leadmen) and crafts from a mix of disciplines and were complemented by a technical staff, supervisors, line managers, and engineers.

In this working environment, lines of authority and craft disciplines faded to the point of being almost invisible and the common focus became one of meeting the objectives; assembly and checkout of the equipment as an integrated system and becoming familiar with the operation of the system. Everyone performed the tasks on a quasi-equal basis and everyone participated in the critique of those efforts. Couple with that, the unique situation where the NuPac engineers responsible for the design and proper functioning of the equipment were available to provide "hands-on" guidance, trouble shooting assistance, and explanations to the operating personnel.

What emerged was a unique transfer of ownership from the designer/fabricator to the owner/user during the HEDL tests. Operator suggestions for equipment modifications and miscellaneous support hardware items which would enhance performance and ease operations were actively supported by both NuPac and GPU Nuclear management. Each person there made a positive contribution to the success of the test series and, with visible management and engineering support, was just as dedicated to making the equipment installation at TMI a workable and efficient system. With this support, the modification, installation, and implementation of the equipment in the TMI truck bay went smoothly and with a minimum of delay during startup and testing. It's hard to put a value on this total experience, but everyone involved in the HEDL effort was enlightened by the experience. The payoff, of course, is what would have been a difficult and time consuming ordeal to accomplish at TMI without the HEDL experience, went very well and remained upbeat as a result of the HEDL effort.

TMI Shipping Preparations

Final preparation of the truck bay was being accomplished in parallel with the HEDL testing. This work consisted primarily of installing anchor plates in the floor for the skid tiedown brackets, installing sockets in the floor to properly position the CUS legs with respect to the floor plates, installing the foundations for the rigid work platform structure, reinforcing security barriers between Units 1 and 2, and miscellaneous modification of the utility systems. The seismic requirements imposed on the cask support system required the foundations for the skid anchor plates and work platform to tie into the building structure.

As a result of the HEDL testing, equipment modifications identified that were beyond the scope of NuPac's contract were accomplished after the equipment arrived on site. In addition, several hardware items were designed and fabricated to supplement the equipment supplied by NuPac. Most of these items were also an outgrowth of the experience obtained at HEDL. They included equipment support and maintenance stands, special racks and stands used to organize and store components in the limited space of the truck bay, dedicated special purpose slings and rigging, and special maintenance and equipment calibration tooling. Because the equipment interfaces, alignment, and handling techniques had been verified in the HEDL effort, installation at TMI went relatively well and, once completed, checkout and testing went smoothly. Also, since the operating procedures were refined and the crew training exercises were largely accomplished as a result of the HEDL experience, loading of the first cask occurred as soon as the equipment had been demonstrated to function correctly. The time consuming trial runs and training exercises, critiques, and reviews were not repeated.

INEL Shipping Preparations

Planning and preparations by EG&G Idaho at INEL proceeded in parallel with the efforts at TMI. This work included the hardware and software (documentation) systems required for transport, receipt, and storage of the damaged TMI-2 core. The following highlights were a part of that effort.

The gantry crane at INEL was installed to support the war effort in the forties. It has been used in the years since but, for this service, its condition and installation required verification. The original manufacturer for the crane was located and brought on site to perform an inspection of the equipment. Despite its age, the structure and lift components were in good condition and recertification of the device to its rated 181,500 kg (200 ton) capacity was accomplished. The concrete foundation for the crane rail system had deteriorated somewhat, so it was replaced. The crane was cleaned, painted, and placed into service.

An existing 90,700 kg (100 ton) low boy trailer and a load dividing dolly, or "jeep," were modified for use in transporting the cask. The goose neck at the tractor end of the trailer was extended to accommodate the jeep so the forward trailer load would be distributed between the jeep axles and the axles of an over-the-road tractor. Also, the main support rails in the trailer frame are located under the outboard edges of the trailer deck. To transfer the cask load to those rails, cross beams were designed and fabricated to interface the cask transport skid to the trailer deck and frame rails. The assembled system was then load tested to verify its rated capacity.

Use of the existing TAN pool for storage of the canisters required analyses of the pool floor loading and pool space utilization. Based on this work, specifications for the canister storage rack system were developed and advertised for proposals. The design and fabrication of the unique modular rack system were completed by an outside subcontractor.

In conjunction with design of the grapple system used to move canisters from the cask to the pool vestibule, handling tools and equipment used to vent, water fill, and attach vent lines to the canisters were developed. These items are used to prepare canisters for storage once they have been placed in the storage rack modules.

Design of the hot shop work stand was accomplished as a cooperative effort with another INEL cask development program. The two programs utilize the same stand and share some of the support hardware required to sample and open fuel transport casks.

A transport plan was developed which detailed movement of the cask system from the INEL rail siding to the TAN hot shop and back.[3] This plan sets forth the requirements and restrictions for movement of the cask across the Site, including the exact route to be followed, the precautions to be observed, and the speed and escort requirements. Based on this document and the operating requirements at the receiving and unloading facilities, Detailed Operating Procedures (DOPs) were developed for use in performing the actual operations.

In tests similar to those performed at HEDL, a cask system and the handling equipment required at INEL was assembled at the site for integrated testing.

These tests were conducted by EG&G Idaho Project Engineers using the DOPs developed and the Idaho operating crews. A complete trial run was conducted to verify equipment interfaces and procedure adequacy and to provide "hands on" training for the operating crews. These tests were equally effective in demonstrating both the need for additional support hardware items and for procedure modifications. Also, many of the intangible benefits observed in the HEDL tests were experienced in the INEL testing. With the equipment, procedures, and training in place, a formal readiness review was then completed to provide an independent assessment of the preparation process. Results from all of these actions were very positive.

Transportation Planning

Early discussions between the EG&G Idaho Traffic Branch, responsible for the shipments, and UPRR, the carrier serving INEL, began following the decision to utilize rail casks for transport of the damaged core. Routing and cost information were the primary subjects of these early inquiries. Several carrier and route options, with corresponding costs, were developed by UPRR which ultimately led to the decision to utilize the Conrail/UPRR combination as the preferred carriers and shipping route. Negotiations with Conrail were initiated about six months prior to the start of shipping and a joint meeting with representatives from Conrail, UPRR, DOE, and EG&G Idaho was held about four months prior to the start, to review the railroad proposals. The controversial nature of the TMI shipments required special considerations by both the government and the railroads. Working out the details and the costs for the additional services and special attention associated with the shipments became the focus of negotiations right up to the start of the shipping campaign.

Interface with the states along the route also began about four months before the start of shipping. The "Governor's Designee" in each state was utilized as the official state contact. The Traffic Branch worked with state organizations through these contacts to coordinate planning efforts and to meet requirements of the individual states for routing the hazardous shipments through their jurisdictions. As the planning developed, several states requested special meetings to review details of the shipments, to ensure the safety of the shipments, and to coordinate planning required to meet their state requirements.

As details of the shipments became public knowledge, inquiries from the public and interested local officials along the route became routine. An EG&G Idaho Public and Employee Communications representative was brought onto the Program about four months prior to the start of shipping. This representative was designated as a single point contact to serve as spokesman for all public inquiries. A community relations plan was developed which included an information packet with details about the shipments, including the special nature of the canisters and transport package designed to ensure safe transportation of the core. The spokesman was an important and integral part of the planning, was kept abreast of the negotiations with the railroads and states, and was effective in dealing with the public, the media, and interested local officials.

CONCLUSIONS

The TMI-2 Fuel Shipping Program is a success because of the hard work, dedication, and pride of the people involved. To date, a total of 217 canisters have been transported in 31 cask shipments. Conclusions from that experience are summarized below.

- Early planning and definition of all the requirements is a "must." The words are "Start Now!"

- Organize meaningful working groups. To be effective, identify individuals at the working level to be responsible for developing the shipping program. Identify all the requirements and, equally important, document how each requirement is met or accomplished. Make the participants accountable by meeting regularly and insisting on close coordination between the participants. Index progress to meaningful milestones.

- Establish dedicated working crews to be responsible for the shipping operations and integrate the crew members into the engineering and technical staff during the planning, testing, and implementation phases of the shipping preparations. The experiences at HEDL and at INEL reinforce similar experiences in other industries. The benefits are real.

- Establish positive and professional relationships with key personnel from all involved organizations.

- Take aggressive early actions in negotiating with the railroads for services and contracts. Nuclear hazardous wastes present unusual requirements and can be time consuming and frustrating to resolve.

- Take aggressive positive public relations action both prior to the start of shipping <u>and</u> continue with follow-up throughout the shipping campaign. Establish a single point contact for the dissemination of information to the public, media, and interested local officials. Develop and maintain good communications and relationships with both state and concerned local officials. DOE offers excellent Emergency Response Seminars to local communities concerned with response efforts and responsibilities in the event of a nuclear transport incident. These have been effectively utilized.

- Perform integrated trial runs with the equipment in a time frame that allows follow through on suggested modifications and permits adequate crew training. Provide adequate technical support and guidance throughout these test runs so the dedicated operating crews know and understand the equipment functions and limitations.

REFERENCES

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3. I. E. Stepan, D. H. Janke, I. A. Engen, M. J. Tyacke, "Transportation Plan for Movement of TMI Core Debris Across INEL," EGG-TMI-7877, revised June 1987.