Development of the TMI-2 Fuel Debris Shipment Program: Lessons Learned for Future Spent Fuel Shipments

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INTRODUCTION

On July 20, 1986 the first shipment of TMI-2 Fuel Debris departed Three Mile Island in the NuPac 125-B rail cask. The shipment arrived via exclusive train at the Idaho National Engineering Laboratory five days later for interim storage by the U.S. Department of Energy (DOE). This shipment was a major milestone in the cleanup operations at TMI and represented the culmination of years of joint planning on the part of GPU Nuclear, EG&G Idaho, the DOE and regulatory agencies including the Nuclear Regulatory Commission (NRC) and the Department of Transportation (DOT).

As a result of the accident at TMI-2 in March of 1979, the nuclear fuel, within the reactor vessel, experienced severe damage. The exact extent of this damage was not immediately known but large quantities of both activation products and transuranic materials were spread throughout the plant. After the condition of the plant was stabilized, work began on the decontamination of the facility. The primary objective of this cleanup was to gain access to the reactor vessel so that the nuclear fuel could be removed, packaged, and shipped offsite. As a result of written Memoranda of Understandings between the DOE and the NRC, it was agreed that the DOE would be responsible for the long term storage and eventual disposal of the damaged core.

Early in the cleanup operations, while still in the plant decontamination phase, DOE and GPU Nuclear began negotiations on a commercial contract to outline their respective responsibilities with regard to this material. At the time little was known about the true condition of the fuel within the reactor vessel. These negotiations tended to be more on the commercial lines than technical in nature.

They did, however, establish the operational framework which would guide the future direction of the TMI-2 Fuel Shipping Program. These negotiations ended with the signing of the Damaged Core Contract (DE-SC07-84ID12855) in 1984. This contract assigned specific responsibilities to each of the parties.

GPU Nuclear would provide all of the equipment and manpower necessary to remove, package, and temporarily store on site the damaged core material.

GPU Nuclear would provide fuel canisters, packaging, required inspections, loading activities, and other preparations required to assure compliance with all laws and regulations applicable to the shipment of the core material.

DOE would furnish the NRC certified cask(s) necessary for the transportation of the damaged core material.

DOE would take physical possession and ownership of the material at Three Mile Island and ship it to the DOE facility at INEL

DOE would provide permanent disposal of the core material at the national repository when developed.

These responsibilities are similar to those that are identified between the DOE and the rest of the utilities under the Nuclear Waste Policy Act. It is important that the lessons learned at TMI be included in the planning for the transfer and shipment of future commercial spent fuel.

RADIOACTIVE MATERIAL ACCOUNTABILITY

One of the major concerns that surfaced during contract negotiations was in the area of Special Nuclear Material (SNM) and other radioactive material accountability. This problem was complicated by two major factors. The first, and most obvious, was the condition of the TMI-2 core. The second, was the differences between NRC and DOE requirements in the area of material accountability.

Under NRC regulations TMI, like all nuclear power plants, was required to account for all SNM (Pu, U233, U235) in its possession to the nearest gram. NRC rules and regulations established detailed reporting, inventory and transfer requirements by which its licensees accounted for this material. DOE has similar regulations on gram accountability for SNM in its possession. At TMI this accountability was made even more complicated by DOE's requirement to provide gram accountability of additional isotopes that were not

accountable under NRC regulations.

This additional accountable material included isotopes such as Americium, Neptunium and others. Some isotopes, like Curium, are accountable not by gram but by microgram. At most reactor plants this will be a rather straight forward task. The SNM and the other accountable isotopes are contained in the sealed fuel pellets within the fuel rods. Using approved computer programs the amount of these isotopes which are created as a result of the reactors operation can be mathematically determined. This type of mathematical method for activity determination in fuel assembles is widely used and acceptable to both the NRC and DOE. Although not used as part of the Core Debris Program, this mathematical method has been used by TMI to satisfy these DOE accountability requirements for a number of other shipments sent to the DOE.

The difference in radioactive material accountability is not seen as a large problem. It does, however, identify an area that both the utilities and the DOE must carefully examine in the development of the future programs. There are differences between NRC and DOE regulations and these must be identified and some accommodations made that will not put the utilities in the middle.

SHIPMENT RESPONSIBILITY

As part of the contract between DOE and GPU Nuclear, the DOE would be responsible for providing the cask, accepting title to the fuel debris at Three Mile Island and shipping the material to INEL. GPU Nuclear would be responsible for loading the cask and presenting the DOE with a safe and legal shipment. This arrangement is similar to the way the Nuclear Waste Policy Act is worded. DOT regulations are very specific regarding the responsibilities of the shipper of radioactive material must perform. Furthermore, since the DOE is not a licensee of the NRC, it is exempt from NRC rules and regulations. Since the DOE was the shipper of these shipment it may logically be assumed that the DOE would be responsible for full regulatory compliance with all applicable DOT regulations and that the requirements of the NRC were not applicable. Although this may appear logical it was not, in reality, the case. GPU Nuclear had full and complete responsibility to ensure that each shipment was in full compliance with both the DOT and NRC applicable regulations. For any DOT or NRC regulatory violations found, the NRC would take enforcement action against GPU Nuclear.

The NRC took this position because of the wording of its regulations. Although DOT specifically lists certain responsibilities as belonging to the "shipper" this word does

not appear in NRC regulations. The licensee who delivers to the carrier radioactive material for shipment is, in NRC regulations, responsible for regulatory compliance of both DOT and NRC regulations. GPU Nuclear developed a complete shipment package just as though GPU Nuclear were shipping the material. This package included all of the backup documentation which was required to verify regulatory compliance. This documentation even included the shippers certification required by the DOT. The representative of the DOE would sign the GPU Nuclear Shipping Papers as the material being received. The representative of the DOE would then place a Government Bill of Laden as a cover sheet to TMI's shipping paper package to act as the government shipping papers.

The DOT also held GPU Nuclear responsible for regulatory compliance even though the DOE was the shipper of record. Based on many conversation with DOT representatives, it was determined that although the shipment was being made under a government bill of laden by the DOE, it was GPU Nuclear who was in reality fulfilling all of the regulatory responsibilities of the shipper. It was also the DOT's position that in signing the required shippers certification, DOE was relying on the certification originally signed by GPU Nuclear.

Because of the high visibility of these shipments, a great deal of preparation was devoted not only to the proper and complete documentation but also to the concurrence of the various regulatory agencies at both the federal and state levels. As a result of a joint effort on the part of GPU Nuclear and EG&G Idaho, Inc.,DOE's agent, detailed procedures were developed to ensure that all shipments were made in total compliance with all applicable rules and regulations. These detailed procedures identified each regulatory requirement that needed to be met. Once identified, the procedures outlined how the shipments met the regulatory requirement and how that compliance would in fact be documented.

One area of regulatory compliance did cause some early concern on the part of GPU Nuclear. That was in the area of advanced notification of these shipments to the states through which they would travel. The NRC established detailed notification requirements in 10 CFR Part 73.27 for its licensees to follow. These requirements identified, in detail, who, when, and how notifications would be made. The DOE on the other hand had established notification requirements which are outlined in DOE Orders 5632.1 and 5632.2. These notification requirement are vastly different from those of the NRC. Under the DOE regulations shipments of fuel debris from TMI-2 would not receive the same advanced

notification requirements as they would under NRC regulations. The DOE planned to follow its requirements and did not want GPU Nuclear making any notifications. Because of the exemtion for F. O. B. material, 10 CFR 73.27 offered GPU a way to comply with NRC requirements, while allowing DOE to provide all advanced notification. GPU Nuclear would comply with its responsibilities as the deliverer of the material to the carrier by receiving written certification the advanced notification would be performed in accordance with DOE Order 5632.1 from the DOE.

Each area of DOT and NRC regulations were reviewed and a compliance method was identified that would provide for the appropriate written documentation. Numerous checklists and instructions were developed to provide all personnel in every area with the appropriate quantitative and qualitative guidance needed to ensure compliance. This effort culminated in the development and approval of a TMI-2 Departmental Administrative Procedure 4231-ADM-4450.04 entitled "Shipment and Transfer of the TMI-2 Fuel Canisters to the DOE". A great deal of time and effort went into the development of this procedure on the part of many people in GPU Nuclear, and EG&G Idaho, Inc. It was reviewed and concurred with by the DOE, NRC and the Federal Railroad Administration for the DOT. Its value has been shown by the more than 34 shipments of core material that have been made so far without any material problems.

FUEL SHIPPING CASK

As part of the Core contract the DOE was responsible for providing the shipping cask(s) that would be used to transport the damaged core from TMI to INEL. In the early phase, information on all currently licensed fuel casks was obtained to determine which was suitable for TMI shipments. During this investigation all commercial casks were examined as well as both highway and rail transport. Although DOE's responsibility, GPU Nuclear was directly involved in this examination. What resulted from these examinations was the development of a new cask designed solely for the shipment of TMI Fuel Debris. This new fuel cask was the NuPac 125B Fuel Cask[USA/9200/B(M)F].

Although this cask was licensed by the NRC to the full requirements of 10 CFR Part 71, the original casks were owned by the DOE. Since it was the NRC's position that GPU Nuclear was in fact delivering the shipping cask to the carrier for transport, all operations involving the cask had to be performed in accordance with TMI-2's Quality Assurance Plan. This NRC approved QA plan was a requirement of the General License to use an NRC Certified Container. The QA Plan had

detailed requirements regarding record keeping and QA inspections involving NRC certified containers. To ensure that all aspects of the QA Plan were followed, the DOE cask was handled like any other cask supplied by a commercial vendor.

DOE was required to provide written certification to GPU Nuclear that each cask was designed, manufactured, and maintained in full compliance with the certificate of compliance issued by the NRC. In addition, DOE was required to certify that they were maintaining sufficient quality assurance records to furnish documentary evidence of the quality of cask components which had safety significance and of services affecting quality. As a minimum, the records that must be maintained by the DOE included the results of the preliminary acceptance determination conducted in accordance with 10 CFR 71.85. This preliminary determination was required prior to the first use of the package and required detailed inspections, pressure tests, and durable markings. In addition DOE records must also include reports on the monitoring, inspections and audits of work performed during the design, fabrication, assembly, testing, modification, maintenance, and repair of the cask. Quality assurance records were also required to be available for inspection at INEL upon request.

Cask maintenance for the NUPAC 125B casks, owned by DOE, was also the responsibility of the DOE. It was recognized, however, that most cask maintenance would be performed at TMI. This was especially true in the area of gasket replacement. Gasket defects would most likely be found during receipt inspections prior to loading or as a result of the failure to pass required leak tests. A method was needed to ensure that the required quality assurance records to document this type of onsite maintenance activity were incorporated into the package quality assurance files maintained by the DOE.

The procedure that was developed required GPU Nuclear to perform all maintenance on the cask at TMI in accordance with its NRC approved QA Plan. These activities would be audited by GPU Nuclear QA personnel, who would develop required audit reports. All maintenance activities would also be accomplished using written GPU Nuclear Procedures approved in accordance with QA plan requirements. Copies of all completed procedures and audit reports would be forwarded to the DOE. Spare parts for the cask would be ordered and received by the DOE, who would intern conduct quality assurance inspection on these parts. The parts would be tagged and certified by the DOE as acceptable for use. GPU Nuclear would then control and account of these parts in accordance with its written procedures.

In addition to cask maintenance, inspection and maintenance were required on the rail cars used to transport the NuPac 125B fuel casks. These rail cars were special heavy, duty flat bed cars bought by the DOE specifically for movement of the casks. DOE contracted with the rail carrier in Idaho to provide inspections and maintenance on these cars. Empty casks were to be routed through the carrier's local maintenance facility prior to return to TMI. There, the rail cars would be inspected and repaired as required. Servicing and preventive maintenance would also be scheduled and performed at this facility. Consequently, a detailed maintenance history was developed for each rail car.

CONCLUSION

The DOE is currently developing cask systems that will be used for the shipment of commercial spent fuel. It is also planning maintenance facilities which will provide the required scheduled maintenance on these casks. In the future, it will be developing its plans and procedures for the transfer and shipment of commercial spent fuel to the repository. Utilities will soon begin planing for the shipment of their spent fuel. It is important that the lessons from TMI not be lost. The DOE needs to be sensitive to the utilities requirements as an NRC licensee. Although the DOE itself is not regulated by the NRC all of its requirements must be included into the DOE's planing. For the utilities part, they must be sensitive to those special DOE requirements and must realize that they are ultimately responsible for the shipments. As a result, they need to plan accordingly.

REFERENCES

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