

February 5, 1985

MEMORANDUM FOR: William J. Dircks  
Executive Director for Operations

FROM: Harold R. Denton, Director  
Office of Nuclear Reactor Regulation

SUBJECT: STATUS REPORT ON THE CLEANUP OF THREE MILE ISLAND UNIT 2

#### Background

In your FY 1984 - 1987 Program Guidance (memorandum, dated May 22, 1984) for Nuclear Reactor Regulation (NRR), you requested that NRR monitor the progress of the cleanup of the TMI-2 facility and submit a status report to your office by January 1985.

It has been nearly six years since the accident at Three Mile Island Unit 2 (TMI-2) and despite a slow beginning the licensee, General Public Utilities Nuclear Corporation (GPUNC), has recently made significant progress in completing the cleanup effort. During the past year the polar crane load test was successfully completed, the reactor pressure vessel head was removed and safely stored, a detailed inspection of the upper plenum was conducted, the plenum was raised approximately 7½ inches and all remaining fuel assembly end fittings dislodged, an examination of the reactor building basement was conducted by a remotely operated survey vehicle, samples of the core debris have been analyzed and the licensee's funding situation to pay for the cleanup improved significantly.

Although substantial progress has been made, the most difficult and complex work lies ahead. Such activities as defueling the reactor vessel and primary system, and decontamination of the reactor basement represent significant technical challenges to the licensee with potential safety ramifications as well as scheduler and funding considerations. This paper which provides the present status of the cleanup summarized by major activity or component system, includes an update on scheduling and funding and discusses potential causes of delay. The information provided updates the last status report prepared for you dated May 2, 1983.

#### Reactor Building Activities

On February 29, 1984, the reactor building polar crane was successfully load tested in preparation for reactor pressure vessel head lift. The reactor pressure vessel head studs were detensioned and in July 1984 the head was removed. The head was placed on the head storage stand, the internals indexing fixture was placed on the reactor vessel and filled with approximately six feet of borated water to provide shielding over the

plenum. Core debris samples have been taken and extensive video and sonic mapping of the reactor vessel core void was completed. The volume of the cavity in the damaged area of the core was measured at 330 ft.<sup>3</sup> or 26.5% of the original core volume. The bottom of the cavity ranges from 5 - 6.5 ft. below the top of the core and the cavity extends radially outward to the core forming walls in several areas. Forty-two of the original 177 fuel assemblies appear to contain some full-length fuel rods, but 23 of those 42 have less than 50% of the rods intact. More recently efforts have been centered around preparing for the plenum removal. A detailed inspection of the plenum has been completed. Damaged fuel assemblies hanging from the underside of the plenum have been dislodged from the plenum undersurface, and this past December four jacks were used to raise the plenum approximately 7½ inches. Successful lifting of the plenum dispelled earlier concerns that warpage and distortion of the plenum would hinder or delay its removal. Plenum removal from the reactor vessel and storage in the fuel transfer canal is scheduled to occur in May 1985.

A remote reconnaissance vehicle (RRV) has been used to inspect the basement of the reactor building. This robotic device has provided a video tape and radiological measurements of the southeast half of the basement in areas outside the "D-rings." Considerable amount of silt is present on the floor of the basement and numerous "bathtub" rings up to a height of approximately 8 ft. are seen on the walls indicating previous water levels. Dose rates measured during the inspection confirmed previous measurements that the basement is essentially inaccessible to personnel. General area radiation fields range from 10 to 70 R/hr. One location near the elevator enclosure was measured in excess of 1,100 R/hr. Planning is underway to initiate remote cleanup of this level.

The licensee has continued its program to reduce dose rates to workers within the reactor building. During 1984, decontamination efforts were intensified within the reactor building. Scabbling of the floor reduced dose rates by about 50% at both the building levels for which access is required during defueling. Additionally the internals indexing fixture water processing system was operated to reduce radionuclide concentrations in the reactor coolant.

#### Auxiliary and Fuel Handling Building (AFHB)

The licensee continued decontamination and cubicle recovery activities in the AFHB. The major techniques utilized for decontamination included floor scabbling, high pressure water flushing (hydro-lazing), chemical washing and individual component decontamination with a newly constructed decontamination facility. Significant dose reductions were achieved in the following major areas: the reactor coolant bleed tank cubicles, reactor building spray and decay heat vaults, various tank and valve cubicles, and floor surfaces on the 281 ft. elevation. Improved access to areas previously inaccessible due to ALARA considerations has been accomplished and operational surveillance testing now is being performed on safety-related equipment located in the newly accessible areas. Additionally, an extensive

effort is underway to chemically elute over 11,000 curies from two reactor coolant system purification demineralizers which were heavily contaminated during the accident. As of the end of December 1984, in excess of 30% of the total cesium activity has been removed from these demineralizer vessels. Significant amounts of low specific activity (LSA) waste, including contaminated components, trash and solidified oil waste have been removed from the AFHB.

#### Spent Fuel Pool "A" Refurbishment

During 1984, the licensee made substantial progress on the refurbishment of the "A" Spent Fuel Storage Pool (SFSP). The pool had been modified following the accident to serve as a shielded pit to contain water storage tanks to support waste water processing activities. Refurbishment of the pool is being done to allow reactor defueling and storage of fuel canisters prior to shipment. Sixteen reinforced concrete shield blocks were removed from the top of the "A" SFSP, decontaminated, and stored on site. Two 25,000 gallon tanks and four 15,000 gallon tanks were decontaminated and removed from the pool along with their structural support steel and the inter-connecting piping to the submerged demineralizer system. The pool liner has been decontaminated to allow personnel access for installation of the refurbished and modified fuel handling equipment and completion of the defueling water cleanup system. Both of these activities are scheduled to be complete by July 1985 to support initial defueling operations.

#### Waste Management Activities

More than 90% of the radioactivity that was dispersed within the plant during the accident has been immobilized, packaged and shipped offsite for ultimate disposition. The Submerged Demineralizer System (SDS) and the EPICOR-II System continue to be used to process radioactive water in support of cleanup activities. The SDS has been used primarily to process reactor coolant, reactor building sump water, and water generated during the decontamination of the "A" spent fuel pool. The EPICOR-II System is used to polish some of the effluent from the SDS as well as other effluents. The SDS and EPICOR-II Systems processed approximately 532,000 and 272,000 gallons of water, respectively, during the past year. Solid radioactive wastes generated by SDS and EPICOR-II operations were shipped to Hanford, Washington, during the year in three SDS and 32 EPICOR-II liners.

#### Occupational Exposure

GPUN continues to implement a program for keeping worker exposures as low as reasonably achievable. Their efforts consist of extensive pre-task planning and mock-up training, the use of radiation shielding, and the application of decontamination and dose reduction techniques. The effectiveness of the decontamination and dose reduction methods was demonstrated during the last quarter of FY84. In July, workers entered the reactor building without respiratory protection for the first time since the

accident, and subsequent entries were made without respirators, in accordance with ALARA principles. The head lift operation resulted in a cumulative worker exposure of 15 person-rem compared to the staff's estimate of an exposure range of 60 and 220 person-rem. Dose rates in the reactor building were restored to pre-lift levels following head lift and subsequent internals indexing fixture installation and waterfilling. Since the completion of head lift, scabbling of the reactor building floor has resulted in about a 50 percent reduction in local dose rates.

In January 1984, the TMIPO issued the draft supplement to the Final Programmatic Environmental Impact Statement (NUREG-0683), which revised the staff's earlier estimates of occupational radiation exposure resulting from the cleanup. The total radiation dose to cleanup workers is currently estimated to range between 13,000 and 46,000 person-rem as opposed to earlier estimates of 2,000 to 8,000 person-rem. The higher estimates resulted from a more accurate characterization of radiation fields in the reactor building based on numerous worker entries. Delays in the cleanup complicated decontamination efforts because radiation sources became more deeply entrained in building surfaces; as a result, early dose reduction efforts were less successful than anticipated. After 3 public meetings and 35 comment letters, the Final Supplement 1 was issued in October 1984.

#### Funding

The staff's analysis of TMI-2 funding was provided to the Commission in your memorandum of October 25, 1984. The staff concluded that although no one can predict with certainty that funds of this magnitude and from so many diverse sources will be available at some time in the future, the staff can at least state that all sources of funds originally contemplated by Governor Thornburgh are in place at a level close to what was envisioned. The staff continues to be optimistic about the TMI-2 funding situation. There have been some additional recent developments:

- ° In early January 1985, General Public Utilities (GPU) informed the NRC that GPU received cash payments for TMI-2 cleanup funding on December 28, 1984, from the Edison Electric Institute (EEI) and from the State of New Jersey. The EEI check for \$10.9 million conveys contributions by EEI member utilities to GPU and is the 1985 first quarter payment from the EEI cleanup funding plan. EEI informed GPU that three additional 1985 quarterly payments, each of \$4.7 million, will be made to GPU on April 1, July 1, and October 1, 1985. These three payments are in the form of supplemental research and development grants from six Pennsylvania and New Jersey utilities. The total of the four payments, \$25.0 million, represents the first year's contribution in the industry's \$150 million total six year commitment.
- ° The State of New Jersey provided a check for \$3.7 million representing the State's appropriations for the cleanup for 1984 and 1985. GPU expects that the State of New Jersey will appropriate an additional \$1.8 million per year for four more years after 1985.

- ° Proposed reductions in the Department of Energy budget may have a significant impact on the Federal Government's contribution to the cleanup funding effort. It is too early to predict with any certainty the effects of these proposed reductions on DOE's program.

#### Scheduling

The licensee's most recent schedule for the cleanup was provided to the staff in a May 22, 1984 letter to B. J. Snyder, TMIPO:NRR, from B. K. Kanga, GPUNC, and a July 2, 1984 letter to B. J. Snyder, TMIPO:NRR, from P. R. Clark, GPUNC. The schedular information contained in these two letters is presented in the Enclosure. The staff has requested that the licensee provide an updated schedule through fuel removal. The licensee is expected to provide this schedule shortly.

The staff's review of the most current schedule provided by the licensee was included in your October 25, 1984 memorandum for the Commissioners. The staff found that the schedule is reasonable and is not limited by funding constraints.

#### Potential for Delay in the Cleanup

There are a number of technical and non-technical issues that have the potential for impacting the cleanup schedule. These are briefly discussed below:

##### Technical Issues

The staff recognizes two major areas of potential technical problems both of which have the potential for significantly delaying the cleanup. The first is the condition of the fuel in the bottom of the reactor vessel. If the fuel penetrated the lower support structure and/or fused into a mass that would require extensive underwater cutting, the licensee's current schedule for fuel removal could be lengthened considerably. The potential for this problem causing a delay in fuel removal will not be known until either the DOE sponsored coring of the reactor core is completed and analyzed or the licensee's fuel removal efforts progress past removal of the upper layers of the core. Some indication of the amount of fuel in the bottom of the reactor vessel may be obtained by video inspection within the next two months.

The second technical issue that has the potential for impacting the cleanup schedule is the cleanup of the reactor building basement. Techniques for decontaminating an area as contaminated and as large as the reactor building basement have not been attempted in the past. Although this represents a potential for lengthening the cleanup, the fact that the reactor building basement stays contaminated for a longer period of time

than presently anticipated poses no significant increased risk to the public and certainly does not represent the same level of concern associated with an issue causing delay in fuel removal.

#### Non-Technical Issues

There are three other potential issues that could adversely affect the cleanup schedule that are of a non-technical nature; these are funding, regulatory delays, and availability of fuel shipping casks. As was stated above, the staff continues to be optimistic on the issue of funding; however, it must be recognized that this could change at any time. Regulatory delays in the cleanup have occurred in the past, the most recent resulting from the polar crane allegations. There is no way to predict with any certainty that regulatory delays will not occur in the future; however, the new GPUNC management team has demonstrated a high degree of responsiveness to regulatory issues and it is the staff's opinion that there is a low probability of future delays due to non-compliance with NRC regulations, enforcement actions, allegations and unresponsiveness. The ability of the NRC staff to efficiently review licensee's requests for approval of cleanup procedures may pose some delay in the immediate future. Defueling of the reactor vessel is to begin this summer.

The anticipated work load of the technical staff is expected to increase significantly this spring and be at a sustained high level well through the end of FY85 as the licensee defuels the reactor and begins fuel removal activities in the remainder of the primary system. The anticipated abolishment of the TMIPO Headquarters staff in FY86 will require reordering of NRC priorities for review of GPU cleanup proposals to avoid significant delays in licensee approvals.

There is the potential that sufficient shipping casks will not be available to DOE to complete fuel shipment to INEL by December 1987. DOE is presently attempting to resolve a contract dispute in an effort to make sufficient casks available in time so as to not delay the licensee's cleanup schedule.

Although the potential for significant delay due to technical and non-technical issues exists, circumstances surrounding many of these issues have changed considerably within the last year significantly lessening their probability.

#### Conclusion

The licensee is about to begin a new phase in the cleanup - removal of fuel from the damaged reactor. This represents the beginning of the licensee's efforts to eliminate the major remaining potential risk to the public. The progress made by the licensee in 1984 was encouraging and the optimistic funding situation for the cleanup leads the staff to conclude that satisfactory progress towards the goal of defueling and decontaminating the

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damaged reactor is being made. The staff will continue to monitor the licensee's progress and will advise you of any significant developments as well as provide you with periodic status reports.

Original Signed by  
H. R. Denton

Harold R. Denton, Director  
Office of Nuclear Reactor Regulation

Enclosure:  
As stated

ENCLOSURE

TMI-2 ESTIMATED COMPLETION DATES  
OF IMPORTANT SCHEDULE MILESTONES

MILESTONE	SCHEDULED COMPLETION
Reactor Plenum Removal	May 85*
Start Reactor Fuel Removal	July 85
Complete Fuel Removal from Original Reactor Volume	3rd Quarter 86
Start Reactor Fuel Shipping**	Nov. 85*
Complete Fuel Removal Reactor Vessel	2nd Quarter 87
Complete Fuel Removal from Reactor Plant Systems	3rd Quarter 87
Complete Fuel Shipping**	Dec. 87*
Program Endpoint	Sep. 88*

\*From the July 2, 1984 commitment to the NRC staff and a GPUNC  
TMI-2 Defueling Study dated August 10, 1984

\*\*Actual shipping date dependent upon DOE fuel cask availability