ENCLOSURE

THREE MILE ISLAND PROGRAM OFFICE

SAFETY EVALUATION OF PLENUM ASSEMBLY LIFT AND TRANSFER

I. Introduction

The Plenum Assembly Lift and Transfer Safety Evaluation Report (SER) submitted on January 25, 1985 (Reference 1) and revised on May 1, 1985 (Reference 2), is the GPU evaluation for the safe removal and storage of the TMI-2 plenum assembly (PA), a prerequisite for reactor defueling. Plenum removal preparatory activities were completed in the fall of 1984 and consisted of the dislodging of debris attached to the underside of the plenum and the performance of various video inspections to assure that the necessary clearances were available to jack up and eventually remove the plenum. Plenum jacking was conducted in December of 1984 to assure that binding would not occur between the PA and the reactor vessel. All remaining debris suspended from the plenum was removed after the PA was raised 7 1/4" on four jacks. As a result of these earlier activities, the PA can now be lifted out of the reactor vessel intact without interference and placed on its storage stand in the deep end of the refueling canal.

Our safety evaluation of the proposed PA lift and transfer is based on our review of the following information: 1) the GPU SER on PA lift and transfer, as revised; 2) the April 26, 1985 response by GPU to formal staff questions issued on April 5, 1985; 3) the SER for the handling of heavy loads, submitted by GPU on April 19, 1985; 4) discussions between GPU and the staff in meetings on March 22 and April 30, 1985; 5) direct observation of plenum lift equipment mockup testing by members of the TMIPO staff and an outside expert on April 30, 1985; and 6) previous NRC staff safety evaluations, including those addressing head lift, plenum removal preparatory activities, and the handling of heavy loads. Our conclusions are summarized in Section IV of this safety evaluation.

II. Description of Plenum Assembly Removal

Several prerequisite activities must be completed before the PA can be removed from the reactor vessel. A dam must be installed in the shallow end of the fuel transfer canal (FTC) so that the deep end of the FTC can be filled with borated water to a level which will provide approximately four feet of radiation shielding above the stored plenum. The dam will be constructed using a six foot high stainless steel plate with two inflatable gaskets to provide redundant seals between the plate and the walls and floor of the shallow end of the FTC. The seals will be leak tested prior to filling the deep end of the FTC with borated water. The water level in the deep end of the canal, with the PA on its storage stand, will be at an elevation of 327' 8", or approximately 10 inches below the top of the dam. The water level in the deep end of the FTC will be monitored by a bubbler providing level indication and alarm in the control room. Blind flanges on the fuel transfer tubes will prevent leakage from the fuel transfer canal into spent fuel pool "A." In the event that water leaks through the dam gaskets, the leakage will be collected in the new fuel pit in the shallow end of the fuel transfer canal. A submersible pump installed in the pit will remove collected leakage as necessary.

In addition to the prerequisites of dam installation and filling the deep end of the FTC, the IIF platform must be removed and the defueling work platform support structure must be installed before the plenum can be removed. The horizontal beams of the support structure will accommodate decking to be used as a work platform during PA lift and transfer. Also prior to plenum lift, instrument lines and pumps must be disconnected to allow IIF platform disassembly. The RCS sampling pump and the IIF bubbler, which provides RCS level indication, will be reinstalled following plenum lift. Redundant level indication will be available via the decay heat letdown line and the tygon tube standpipe during the short time that this equipment is disconnected. RCS sampling and processing capability will be available during plenum lift, through batch processing of coolant by letdown to the reactor coolant bleed tanks and operation of the SDS. The IIF processing pump will also be reconnected following plenum lift, to provide additional processing flexibility.

Following the successful completion of the prerequisite activities, the polar crane and special lift rigging will be used to lift and transfer the plenum to its storage stand. The lift rigging will consist of the lifting tripod attached to three pendant assemblies each having a lifting arm assembly to latch and lock on to the underside of the plenum ribs. The ribs were chosen as superior lift points due to uncertainty regarding the condition of the normal lifting lugs due to the environmental and stress conditions experienced during the accident. The PA will be lifted to a maximum elevation of approximately 334', then moved horizontally north approximately 32 feet, then lowered and submerged in the deep end of the FTC to its storage stand with the jacks still attached.

III. Safety Issues

A. Recriticality

The potential for recriticality of the TMI-2 core due to a reconfiguration of damaged fuel is effectively precluded by maintaining a sufficiently high boron concentration in the reactor coolant. In our safety evaluation for reactor vessel head removal, dated July 17, 1984 (Reference 3), we noted that GPU had raised the boron concentration in the reactor coolant to 5000 ppm to maintain the core subcritical for all credible core reconfigurations. GPU has performed analyses showing that, at a reactor coolant concentration of 4350 ppm boron, the core will remain subcritical in any postulated configuration. We concurred in this evaluation in a letter to GPU, dated March 15, 1985 (Reference 4). The present boron concentration in the RCS is approximately 5050 ppm, and the licensee will administratively maintain the boron concentration at this level during and following PA removal.

During plenum lift and transfer, as in earlier cleanup activities, procedures will be in place to prevent, detect and respond to a potential boron dilution event. These procedures include periodic boron sampling and maintenance of all makeup sources at the RCS boron concentration (5000 ppm), periodic checking of double isolation barriers, and level monitoring of the

RCS and potential dilution sources. In our previous safety evaluations for head lift, RCS criticality and plenum removal preparatory activities (References 3, 4 and 5), we concluded that these measures were adequate to minimize the potential for a boron dilution event. In the extremely unlikely event that boron dilution does occur, the large margin provided by the high current RCS boron concentration will allow sufficient time for the detection and mitigation of the dilution. Therefore, we conclude that there is minimal potential for inadvertent criticality of the core due to reconfiguration of the fuel or a boron dilution event during PA lift and transfer.

B. Heavy Load Handling and Accident Analysis

Plenum lift and transfer activities will necessitate the handling of heavy loads over the reactor vessel. The primary safety issues with regard to a load drop accident are the potential for unisolable RCS leakage due to incore instrument tube failure and the potential for disruption of fuel resulting in the release of trapped Kr-85 gas. These issues were addressed by GPU in the SER for heavy load handling over the TMI-2 reactor vessel, dated April 19, 1985 (Reference 6). The NRC staff subsequently approved the GPU SER in a safety evaluation issued May 2, 1985 (Reference 7). This approval specifically address the proposed plenum lift and transfer activities. The staff's approval of the proposed PA removal with respect to heavy load handling considerations is based on the low probability for a plenum drop accident and on GPU's consequence analysis indicating that the maximum RCS leakage resulting from a plenum drop would be well within the capability of available RCS makeup systems.

Several factors minimize the potential for a plenum drop accident. The polar crane and tripod were succcessfully used to remove the reactor vessel head, a load weighing more than twice the weight of the PA and lift rigging (~170 tons vs 73 tons). The lifting pendant assemblies are designed in accordance with NUREG-0612 criteria and applicable industry standards. Each has a design rating of 25 tons, with factors of safety of 3 for yield stress and 5 for ultimate stress, and has been load tested at 150% of rated load. TMIPO staff members, along with an expert consultant, observed the successful mockup testing of the lifting assemblies and verified the operation of the locking and unlocking features of the lifting arm assemblies. In addition, annual preventative maintenance on the polar crane has recently been completed to ensure that the crane is in a satisfactory condition for the lift.

GPU has analyzed the consequences resulting from the unlikely event of a plenum drop accident. In Reference 7, the staff concurred with GPU's assumption that the maximum RCS leakage through damaged incore instrument tubes due to plenum drop would be approximately 20 gpm. In the event of a plenum drop, redundant RCS level monitors would provide early detection of leakage. At the maximum postulated leak rate of 20 gpm, and the minimum RCS level of 321'6", it would take over 14 hours for the core to become uncovered; therefore, operators would have adequate time to initiate RCS makeup. The available makeup methods include gravity flow from the Borated Water Storage Tank (BWST) and recirculation of the reactor building sump water using the decay heat removal pumps or a 25 gpm submersible pump currently installed in the sump. The defueling water cleanup system (DWCS) pumps, rated at 200 gpm, are also available to provide sump recirculation and can be installed within 24 hours. The minimum volume of borated water available for gravity feed from the BWST is approximately 220,000 gallons, based on a minimum BWST inventory of 310,000 gallons. At a makeup flow rate of 20 gpm, gravity feed from the BWST can maintain the RCS at a safe water level for approximately 7.6 days, thereby allowing ample time to select and operate one of the available sump recirculation systems. In the event that a recirculation system is required, sampling capability of the reactor building sump water will be available to assure that a minimum RCS boron concentration of 4350 ppm is maintained.

In Reference 7, the staff also concurred with the licensee's bounding analysis for the potential release of Kr-85 due to fuel disruption resulting from a load drop accident. The licensee concluded that the maximum resulting offsite doses from such an unlikely event would be several orders of magnitude below the limits specified in 10 CFR Part 100.

Based on our safety evaluation of the licensee's analysis of heavy load handling over the reactor vessel (Reference 7), we conclude that the potential for a load drop accident during PA lift and transfer is extremely remote, and that sufficient measures are available to mitigate the consequences of such an unlikely event.

C. Occupational Exposure

GPU will implement appropriate measures to keep worker exposures as low as reasonably achievable (ALARA) during plenum lift and transfer activities. These measures include the use of administrative control points to limit worker doses and continuous monitoring of reactor building dose rates during PA lift and transfer. Radiological reviews will be performed prior to executing individual tasks to determine requirements for protective clothing, respirators, and shielding. Mockup testing of various activities will be conducted to familiarize workers with specific tasks in order to reduce their time spent in radiation fields. The PA lift rigging has been designed to permit remote operation of the load positioners, and to simplify operation of the lifting arm assembly latching and unlatching devices.

Latching prior to the PA lift and unlatching following the transfer will be performed with the PA submerged under several feet of water. Dose rates to rigging personnel during those times will be close to the ambient levels existing in the reactor building at the IIF platform area (less than 35 mrem/hr). The actual lift and transfer, with the PA out of water coverage, will be performed remotely. Personnel will control and monitor the lift and transfer operation from within the lead-curtain shield area.

The licensee has estimated a collective worker exposure of 25 to 50 man-rem for the plenum lift and transfer. This estimate is consistent with the staff's estimated worker exposure for this activity as detailed in the Final Programmatic Environmental Impact Statement (PEIS), NUREG-0683, and we consider the estimate to be reasonable.

The staff and the licensee have calculated the dose rates at various distances from the unshielded PA. In the event that the PA becomes stuck during the transfer, dose calculations indicate that personnel would be able to exit the reactor building without significantly large exposures (about 10 mrem per person depending on the PA stuck position). In addition, calculations indicate that at locations such as the polar crane, the spider lift device would permit personnel access for corrective actions (about 50 mrem per person depending on the stuck position and time required for corrective action). The licensee intends to verify dose estimates by actual surveys. If potential doses to personnel are estimated to be significantly higher than anticipated, the option to flood the Fuel Transfer Canal to the normal refueling level to shield the PA is available.

Based on our review, we concur with the licensee's estimate of worker exposure during PA lift and transfer and find that the measures adopted to maintain worker exposures ALARA are acceptable.

D. 10 CFR 50.59 Evaluation

We have reviewed the licensee's plan for plenum lift and transfer to determine if the proposed activity constitutes an unreviewed safety question according to the criteria of 10 CFR Part 50.59. In Reference 3, the staff concluded that the head lift did not constitute an unreviewed safety question. The plenum lift and transfer involves smaller loads than those lifted during head lift. Like the head lift activities, the PA lift is similar to standard operations conducted at typical nuclear plants. Based on our review and the 10 CFR 50.59 evaluation in Reference 3, we conclude that the proposed PA lift does not: 1) increase the probability of occurrence or the consequences of an accident or malfunction of equipment important-to-safety as previously evaluated; 2) create the possibility of an accident or malfunction of a different type than any previously evaluated; or 3) reduce any existing margin of safety. Therefore, the proposed activity does not represent an unreviewed safety question.

IV. Conclusions

In our review of the proposed plenum assembly lift, transfer and storage activities, the staff has evaluated the safety issues of recriticality, heavy load drop accidents, and occupational exposure. Based on our review, we find that; 1) there is little potential for recriticality from core reconfiguration and the licensee has implemented adequate measures to prevent, detect and mitigate a boron dilution event; consequently, there is little potential for core recriticality; 2) there is little potential for a heavy load drop accident and adequate means are available to mitigate the consequences in the unlikely event of such an accident; and 3) the licensee has adopted appropriate measures to maintain worker exposure ALARA during plenum lift and transfer. We conclude that the proposed plenum assembly lift and transfer falls within the scope of activities previously assessed in the PEIS, and that the planned activities do not present a significant risk to the health and safety of the public or the onsite workforce.

References

1. GPU Plenum Lift and Transfer Safety Evaluation Report, January 25, 1985.

2. GPU Plenum Lift and Transfer Safety Evaluation Report, May 1, 1985.

3. NRC Safety Evaluation for Reactor Pressure Vessel Head Lift, July 17, 1984.

4. NRC Safety Evaluation of Reactor Coolant System Criticality Report, March 15, 1985.

5. NRC Safety Evaluation for Plenum Removal Preparatory Activities, September 14, 1984.

6. GPU Safety Evaluation Report for Heavy Load Handling Over the TMI-2 Reactor Vessel, April 19, 1985.

7. NRC Safety Evaluation for Heavy Load Handling Over the TMI-2 Reactor Vessel, May 1, 1985.