SAFETY EVALUATION FOR PRELIMINARY DEFUELING ACTIVITIES

By letter dated October 24, 1985 (Reference 1), GPUN requested NRC approval to allow movement of debris within the reactor vessel, in preparation for early defueling. GPUN has determined that some rearrangement of debris in the reactor vessel is necessary prior to the actual removal of fuel from the vessel, to allow installation of defueling equipment and to identify core debris samples for later removal for analysis by the Idaho National Engineering Laboratory.

These preliminary defueling activities are part of a larger group of activities proposed by GPUN in the safety evaluation report (SER) for early defueling (Reference 2) which is currently under review by the NRC. The activities proposed by GPUN in Reference 1 are limited to those early defueling activities that can be conducted entirely within the reactor vessel, and as determined by the staff, are similar to and bounded by activities previously approved by the staff.

The safety issues related to the movement of material in the reactor vessel have been identified and addressed in previous NRC safety evaluations of head lift, plenum removal preparatory activities, plenum assembly lift and transfer, and heavy load handling over the TMI-2 reactor vessel (References 3, 4, 5, and 6). This safety evaluation in part, summarizes the conclusions of these earlier NRC safety evaluations as they apply to the proposed preliminary defueling activities. This evaluation is also based on specific relevant information provided in the context of our review of the SER for early defueling.

Safety Issues

Decay Heat Removal

Decay heat from the damaged reactor core continues to be adequately removed from the reactor coolant through the loss-to-ambient cooling mode. In Reference 3, the NRC approved GPUN's analysis demonstrating that decay heat removal via the loss-to-ambient mode was sufficient to maintain the RCS temperature well below the procedural limit of 170°F. The assumptions used in that analysis were more conservative than current conditions, because the proposed activities will be performed at a decreased decay heat level and with the reactor vessel water level at an elevation of approximately 327'6", as opposed to a level of only 314' assumed in the analysis. Temperatures in the reactor vessel currently average about 85°F and are not expected to change significantly. Therefore, we find that the previous analysis is bounding, and that the loss-to-ambient mode of decay heat removal will be adequate during the proposed debris movement activities. The RCS temperature will be monitored in accordance with the TMI-2 Technical Specifications and the Recovery Operations Plan during the proposed activities. In the unlikely event of RCS leakage, sufficient makeup capability will be available to maintain decay heat removal in the loss-to-ambient mode.

Boron Dilution

High concentration of boron in reactor coolant is the primary means used by GPUN to assure against the possibility of a criticality event during

defueling activities. GPUN has recently submitted a revised boron dilution hazards analysis (Reference 7) in support of early defueling. This report provides an evaluation of all potential RCS boron dilution pathways and isolation barriers for these paths. Systems with potential boron concentrations below the current RCS concentration of 4950 ppm will be isolated via multiple barriers to assure that they will not be credible dilution sources. The hydraulic fluid used in the operation of defueling tools, which has been tested to demonstrate its miscibility and compatibility with RCS water, will be borated to eliminate its potential for RCS dilution. Reference 7 also describes sampling locations and frequencies and provisions for level monitoring which will provide the capability for early detection and subsequent mitigation of a potential dilution event. Based on a review of Reference 7, the staff concluded that: the potential for a dilution event is small, early detection of a dilution event is likely, and effective remedial action can be taken if dilution occurs.

The RCS will be maintained at a boron concentration of 4950 ppm during the proposed activities, thereby providing an additional margin above the Technical Specification limit of 4350 ppm, the value used in the analysis of Reference 7. Thus, sufficient time will be available for the detection and mitigation of an unlikely dilution event.

Heavy Load Drop Accident Analysis

Reference 6, the NRC safety evaluation for heavy load handling over the reactor vessel, is applicable to the proposed preliminary defueling activities, which are restricted to the reactor vessel. In that evaluation, the staff determined that the worst case accident resulting from a postulated heavy load drop over the reactor vessel would be the simultaneous failure of the 52 incore instrumentation tubes resulting in a total leakage rate of 20 gpm. In the safety evaluation approving Technical Specification Change Request No. 46 (Reference 8), the staff concluded that reliable sources of borated makeup water will be available via gravity feed from the Borated Water Storage Tank and the operation of the Reactor Building Sump Recirculation System to substantially exceed the worst case RCS leakage rate of 20 gpm. Also in Reference 6, the staff approved a bounding analysis performed by the licensee that assumed an instantaneous release of all unaccounted for Kr-85 from the core due to a heavy load drop. This conservative analysis resulted in a dose of 9.7 millirem to the whole body for an individual located at the site boundary and a whole body dose of 1.8 millirem to an individual located at the Low Population Zone Boundary. These doses are several orders of magnitude below the accident limits of 10 CFR Part 100. In Reference 6, the staff also approved the licensee's proposed lift height/weight matrix which will preclude failure of the defueling work platform due to postulated load drops of certain defueling equipment.

On these bases, we conclude that the potential for a load drop accident during the proposed limited defueling activities is remote, that adequate controls exist restricting lift heights and that measures are available to mitigate the consequences of a postulated accident.

Criticality

By letter dated March 15, 1985 (Reference 9), the NRC approved GPUN's Reactor Coolant System Criticality Report. The report concluded that for an RCS boron concentration of 4350 ppm, the damaged core will remain subcritical with a shutdown margin of at least one percent for any postulated fuel configuration. This conclusion applies to all reactor disassembly and defueling activities, including the proposed preliminary defueling activities. During the proposed activities, the RCS will be maintained at a boron concentration of not less than 4950 ppm, the administrative limit. This concentration will provide an additional margin to preclude the potential for criticality due to a boron dilution event or the introduction of foreign materials into the RCS. GPUN has analyzed the effects of foreign materials (tools, fluids, etc.) on RCS reactivity and will implement administrative controls to limit the potential for the inadvertent introduction of such materials into the RCS throughout defueling. The NRC staff has reviewed GPUN's analysis and concludes that the potential for introduction of foreign materials into the RCS during preliminary defueling activities is very small and that the resulting effects on RCS reactivity would not significantly reduce the existing shutdown margin. In addition, procedures will be in place to prevent the inadvertent grappling of an incore instrumentation tube, which, if damaged, could result in unisolable RCS leakage. In the unlikely event of RCS leakage due to failure of an incore instrumentation tube, adequate makeup capability exists to ensure that subcriticality is maintained.

Release of Radioactivity

The proposed preliminary defueling activities are similar to previous activities performed in the reactor vessel, and as such, are not expected to result in a significant increase in background radiation levels in the reactor building or in a significant off-site release of radioactivity. During the separation of end fittings and partial fuel assemblies from the plenum, radiation levels did not increase significantly, despite the displacement of core debris. During the proposed activities, all gaseous release pathways from the reactor building to the environment will be filtered and monitored to prevent an uncontrolled release. The licensee also has the capability to completely isolate the reactor building from the environment.

The tools and equipment used for the preliminary defueling will be flushed as they are removed from the reactor vessel water to limit the spread of contamination and prevent any uncontrolled removal of fuel. Monitoring of alpha-emitting particulates at potential release points will be performed in compliance with the TMI-2 Environmental Technical Specifications. In Reference 2, GPUN estimated that potential off-site releases of Kr-85 during normal defueling operations would result in doses less than 1% of the limits specified in 10 CFR 50 Appendix I. Potential Kr-85 release points will be monitored and an alarm indicating high levels will be located in the control room. We find these measures adequate to assure that the potential for significant releases of radioactivity will be acceptably low during the proposed activities.

Occupational Exposure

The same measures described in Reference 2 to maintain worker radiation exposures as low as reasonably achievable (ALARA), will be implemented by GPUN during preliminary defueling activities. As for past activities performed in the reactor building, GPUN's Radiological Controls Department will determine monitoring requirements and evaluate the use of respirators for the proposed activities. Worker training has been conducted on the Defueling Test Assembly to simulate the activities to be performed, and thereby improve efficiency and minimize worker exposures. During preliminary defueling both a Radiological Controls Technician and a licensed FHSRO will be stationed on the defueling platform, to provide radiation monitoring and to assess existing radiation protection measures. Typical dose rates on the defueling platform are expected to range from 10-20 mR/hr. A dose rate of 30 mR/hr on the defueling platform has been established as a point for evaluation of radiological conditions prior to the continuation of activities. Activities will be halted if platform dose rates reach 300 mR/hr, except as specified in procedures.

Radiation shielding and other radiation protection measures that will be in place for preliminary defueling were designed to protect workers during the full scope of early defueling activities. Since fuel will not be loaded into canisters nor removed from the reactor vessel during preliminary defueling, dose rates should not increase significantly, and the protective measures taken will provide a high degree of assurance that worker exposures will be maintained ALARA.

The staff has reviewed the radiation monitoring program that will be in place. The staff concludes that this program will provide adequate data and alarm functions. Procedures have been established by Radiation Controls personnel to take appropriate actions should radiation levels be significantly higher than those expected. GPUN also has a program to maintain occupational exposure to ALARA. An integral part of this ALARA program is the management reviews to be performed during these preliminary defueling activities to assure that ALARA objectives are met and feedbacks of ongoing activities are reviewed for improvement.

Conclusions

Our review of the proposed preliminary defueling activities was based on information provided in Reference 1 and in discussions with GPUN staff. Additionally, we evaluated relevant information submitted in the course of our review of proposed early defueling operations. Also, as the proposed preliminary defueling activities are similar to and bounded by previous cleanup activities, the conclusions of earlier NRC safety evaluations were referenced, as appropriate. Based on our review, we find that: (1) adequate decay heat removal is provided in the "loss-to-ambient" mode, (2) there is little potential for core recriticality due to fuel reconfiguration, introduction of foreign materials into the RCS, or boron dilution, (3) there is little potential for a release of radioactivity significantly above the trace amounts discharged routinely as a result of cleanup activities, (4) the potential for a heavy load drop into the reactor vessel has been minimized and adequate measures exist to mitigate the consequences of a potential load drop accident, (5) GPUN has implemented an acceptable

program to maintain worker exposures ALARA during the proposed activities. We further conclude that the proposed activities are within the scope of activities assessed in the PEIS (NUREG-0683). The proposed activities, being similar in nature to previously conducted activities, do not constitute an unreviewed safety issue. They will not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety as previously evaluated. The proposed activities also do not create the possibility for an accident or malfunction of a different type than any evaluated previously or reduce the margin of safety. Therefore, we conclude that the proposed preliminary defueling activities can be safely conducted, thereby protecting the health and safety of the onsite workers and offsite public.

REFERENCES

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3. NRC Safety Evaluation of Reactor Pressure Vessel Head Lift, letter from B. J. Snyder, NRC, to B. K. Kanga, GPU, July 17, 1984.

4. Letter from B. J. Snyder, NRC, to F. R. Standerfer, GPU, Safety Evaluation for Plenum Removal Preparatory Activities, September 14, 1984.

5. NRC Safety Evaluation of Plenum Assembly Lift and Transfer, letter from B. J. Snyder, NRC, to F. R. Standerfer, GPU, May 7, 1985.

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7. GPU Hazards Analysis: Potential for Boron Dilution of Reactor Coolant System, Rev. 2, September 1985.

8. Letter from B. J. Snyder, NRC, to F. R. Standerfer, GPU, transmitting Amendment of Order for Technical Specification Change Request #46, August 8, 1985.

9. Letter from B. J. Snyder, NRC, to F. R. Standerfer, GPU, Review of TMI-2 Reactor Coolant System Criticality Report, March 15, 1985.

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