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September 14, 1984

Docket No. 50-320

Mr. F. R. Standerfer, Director
Three Mile Island Unit 2
GPU Nuclear Corporation
P.O. Box 480
Middletown, PA 17057

Dear Mr. Standerfer:

By letter dated June 18, 1984 (Reference 1), GPU Nuclear submitted the Safety Evaluation Report (SER) for preparatory activities for plenum assembly removal. Following our review of your submittal, we approved some of the proposed activities by letter dated July 31, 1984 (Reference 2). On August 8, 1984, we met with members of your staff to discuss the remaining activities and issued a formal request for additional information on August 15, 1984 (Reference 3). You responded to our information request by letter dated August 28, 1984 (Reference 4) and we have completed our safety evaluation of the remaining proposed plenum removal preparatory activities. This letter documents our safety evaluation. The proposed plenum removal preparatory activities are a prerequisite for plenum removal, which, in turn, is a necessary precondition for defueling, a major cleanup goal. The successful completion of these cleanup activities will serve to enhance the health and safety of the public through the eventual removal of the collected fuel from the site. We find that the described preparatory activities can be conducted safely, with minimal risk to the health and safety of the onsite workforce or offsite public.

DESCRIPTION OF PLENUM REMOVAL PREPARATORY ACTIVITIES

The plenum removal preparatory activities discussed in Reference 1 include the following: (1) video inspection of potential plenum interference areas, (2) video inspection of the core void space, (3) video inspection of the axial power shaping rods (APSR's), (4) measurement of the LOCA restraint boss gaps, (5) measurement of the elevations of the APSR's, (6) cleaning of the plenum and potential interference areas, (7) separation of unsupported fuel assembly end fittings, and (8) movement of the APSR's. In Reference 2, we issued our approval for GPU to conduct activities (1) through (5) above. This evaluation addresses the safety issues related to the remaining proposed plenum removal preparatory activities (activities 6, 7, and 8).

In addition to the planned inspection and measurement activities, GPU proposes to clean the plenum and potential interference areas, separate unsupported fuel assembly end fittings and insert the APSR's into the core, if feasible. The cleaning will be performed as necessary to allow access for tooling into the plenum assembly and to remove debris that could impede the removal of the plenum. The separation of end fittings and APSR's is intended to remove these potential radiation hazards and physical obstructions in order to allow the plenum assembly to be safely removed and placed on its storage stand. Special

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DATE	9/14/84	9/14/84	9/14/84			

long-handled manual tooling and support equipment will be used to perform these activities. Wire brushes and scraping tools will be used for cleaning, and slide hammer impact tools will be used to separate end fittings and APSR assemblies. It is anticipated that impact operations on the unsupported end fittings and the APSR's may well collapse the embrittled elements of any adjacent or nearby full length fuel assemblies. Any such end fittings which become unsupported during these impact operations will also be separated from the plenum.

Support equipment for the above activities includes tool counter balances, to allow manipulation by a single operator, tool storage racks, a load cell, and a tool strong back for upending assembled tools. If the APSR's cannot be knocked loose from the plenum assembly and inserted into the core, GPU plans to use a crane and load cell to withdraw the APSR's back into the plenum where they will be clamped in place. This option was determined by the staff to be acceptable because of radiation source term considerations. The potentially higher radioactive neutron absorber material used in the APSR's is located in the lower three feet of each APSR and physical examination has shown that the accident damaged more than the bottom five feet of each APSR and, therefore, no full length rods are expected to remain on any of the APSR's. The remaining portions of the APSR's are stainless steel. Thus, their dose contribution in the withdrawn position would be negligible compared to that of the plenum assembly. The further handling and final disposition of the APSR's in the withdrawn position will be addressed by GPU in the Safety Evaluation Report on plenum removal, if this option is carried out.

SAFETY ISSUES

Many of the safety issues relevant to plenum removal preparatory activities were addressed in the staff's safety evaluation of the TMI-2 reactor pressure vessel head lift (Reference 5). Those issues included decay heat removal, criticality, boron dilution, heavy load drop accident analyses, and releases of radioactivity. The staff conclusions of the previous safety evaluation of these issues are generally applicable to the proposed plenum removal preparatory activities, as discussed below. Additionally, we have considered the measures provided by GPU to maintain occupational exposures as low as reasonably achievable (ALARA) and have provided estimates of the exposures likely to result from the plenum removal preparatory activities.

DECAY HEAT REMOVAL

The decay heat in the reactor core continues to be removed adequately in the loss-to-ambient cooling mode. The RCS will remain in the drained down, depressurized condition during the proposed activities. Consequently, the coolant temperature (approximately 97 °F) is expected to remain essentially unchanged by these activities. The staff's head removal safety evaluation (Reference 5) describes the existing safety margin and alternative decay heat removal methods that will also be available during the plenum removal preparatory activities. Additionally, heat removal in the loss-to-ambient mode will be enhanced by the recent installation of the reactor building chiller system and by the operation of the internals indexing fixture (IIF) processing system. Therefore, we conclude that adequate heat removal capability exits to accomodate the small amount of decay heat (17.0 kw) in the core.

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CRITICALITY

The potential for recriticality of the damaged reactor core for any fuel reconfiguration resulting from the proposed activities is effectively precluded by maintaining a sufficiently high boron concentration in the reactor coolant. We concluded in Reference 5 that, at the current concentration of 5050 ± 100 ppm, there is virtually no potential for recriticality for any postulated fuel configuration. As such, we agree that unsupported end fittings, including those associated with Batch 3 fuel assemblies, can be dislodged without a sequence constraint.

BORON DILUTION

Dilution of the boron concentration in the RCS could result in a criticality event, if the dilution continued unchecked. The potential for boron dilution during previous TMI-2 cleanup activities was addressed in the staff safety evaluations for head removal and IIF processing system operations (References 5 and 6). We concluded in these evaluations that the licensee's measures for prevention, detection and mitigation of a potential boron dilution event provided adequate assurance that subcriticality would be maintained for all postulated conditions. These measures, which will be in effect during the proposed activities, include prevention of a dilution event through the use of double isolation barriers for all potential dilution sources and the maintenance of all RCS makeup sources at the RCS boron concentration. Methods to detect a dilution event include periodic monitoring of RCS boron concentration and RCS inventory measurements. Potential dilution sources would be identified and isolated and borated makeup water would be injected into the RCS as necessary. Measurement of the boron concentrations at various elevations within the reactor vessel following makeup (or letdown and makeup) operations indicates that there is good mixing within the vessel to generate homogeneous boron solutions and boron does not stratify even under stagnant conditions.

The RCS boron concentration was recently increased to approximately 5000 ppm from 3500 ppm, the value shown in our head removal SER (Reference 5) to be a sufficient concentration to prevent recriticality under all credible postulated conditions. If a dilution event does occur, the frequency of sample collection in conjunction with the large margin provided by the high RCS boron concentration will allow sufficient time for the detection and mitigation of the dilution. We conclude that adequate preventative measures have been implemented to make the occurrence of a boron dilution event during plenum removal preparatory activities extremely unlikely.

RELEASE OF RADIOACTIVITY

Plenum removal preparatory activities will result in the movement of some fuel debris and materials within the reactor vessel. The only potential release of radioactivity to the environment during the proposed activities is via the airborne pathway as the reactor coolant within the vessel will be

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in communication with the reactor building atmosphere. However, the coolant will remain at a temperature around 97 °F and, thus, there is little driving force for evaporation of the coolant and dispersion of any entrained radioactivity. Additionally, the IIF processing system will be operated as necessary to minimize the dissolved or suspended activity in the coolant that may result from the separation of end fittings or disturbance of the core debris bed. Accordingly, we do not expect plenum removal preparatory activities to perturb the already low levels (less than 1×10^{-7} Ci/day) of radioactive particulate material releases to the environment. A ventilation/filtration system will be available for use in the event a significant concentration of airborne activity develops in the air space above the IIF during the proposed activities. This system is designed to create an air flow down into the IIF through the IIF platform and to discharge the air to the reactor building atmosphere through a HEPA filter. The containment purge system will provide additional filtration capability to further reduce the potential for a significant release of radioactivity to the environment. Tritium and noble gas releases to the reactor building and the environment are not expected to deviate from current typical releases because of the low reactor coolant tritium (0.03 uCi/ml) concentration and low dissolved noble gases coupled with the low evaporation rate. Typical tritium releases from the plant are less than 0.1 Ci/day. Typical noble gas releases (Kr-85) from the plant are less than 1 Ci/day. On the basis of the above discussion, we conclude that the proposed activities will not result in significant increases in airborne radioactivity inside the reactor building or in corresponding releases to the environment.

HEAVY LOAD DROP ACCIDENT ANALYSIS

During plenum removal preparatory activities, IIF platform shield plates will be moved to allow access to the plenum. None of these plates weighs more than 2400 pounds; however, we have conservatively assumed that if a shield plate is dropped, it could cause an IIF platform collapse and a corresponding core disruption and release of gaseous radioactivity. The worst-case assumption for this scenario is that all the Kr-85 gas remaining in the fuel is released. The total activity of the remaining Kr-85 gas is conservatively estimated at 3.7×10^4/Ci, a quantity less than the 4.4×10^4/Ci of Kr-85 that was released to the environment in the controlled purge of June 1980. In the unlikely event that a shield plate is dropped, the containment can be isolated and the purge system secured as necessary to contain the release of Kr-85. Any gaseous activity that evolves from the reactor coolant may then be purged in a controlled process as was done in 1980.

We believe that the likelihood of a shield plate drop and subsequent core disruption resulting in a significant Kr-85 release during the proposed activities is extremely small. GPU has indicated that the planned movement of shield plates will be restricted to those areas previously approved for movement of heavy loads (References 5 and 8) and that the number of shield plate movements will be minimized. The postulated IIF platform collapse due to a shield plate drop is bounded by the previously analyzed reactor vessel head drop, since a postulated head drop would impart a greater impact energy

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to the plenum and also result in a more concentrated load. In Reference 5, we concluded that, in the event of a reactor vessel head drop; 1) RCS integrity would be provided, 2) potential gaseous releases of radioactivity to the environment would be well below allowable limits, 3) subcriticality would be maintained, and 4) decay heat removal capability would be assured. These conclusions also apply to the less severe postulated shield plate drop. We conclude that there are adequate measures to mitigate the consequences of postulated accidents during plenum removal preparatory activities.

OCCUPATIONAL EXPOSURE

GPU will implement appropriate measures to keep worker exposures ALARA during plenum removal preparatory activities. As described in Reference 5, shielding of the contaminated plenum is provided by one inch thick lead plates on the IIF work platform and by five feet of water in the IIF. The IIF processing system will be operated to limit activity levels in the reactor coolant thereby limiting the dose contribution of that source. The IIF ventilation/filtration system will be available to remove any airborne activity in the IIF air space resulting from the proposed activities. Detailed planning and personnel training will be conducted to reduce the time needed for completion of identified tasks. Mock-up training will be used extensively and the actual work conditions will be closely modeled to familiarize workers with their assigned tasks.

Practice sessions will be held to instruct workers in the use of the long-handled tools which are designed to allow easy operation. Higher radiation areas will be identified and work planned to avoid those areas as much as possible. GPU has indicated that the use of respirators will be reviewed for each task to ensure that worker exposures are kept ALARA. This review will include examinations of current radiological conditions, the potential for perturbation of those conditions, and previous airborne activity measurements. Detailed exposure estimates will be developed on a task-by-task basis as a normal part of ALARA review of in-containment work to ensure that each activity is performed while minimizing worker exposure. Dose rates in the reactor building will be continuously monitored during the proposed activities, and administrative control points will be established to assure that specified dose limits will not be exceeded. Dose rates in the reactor building did not change appreciably following head lift and placement of the IIF and shield cover and continued dose reduction efforts (i.e., scabbling of floor surfaces) are underway to further reduce worker exposure. GPU has estimated that the total collective exposure to workers during the proposed activities is in the range of 90 to 165 person-rem. This estimate is based on 1035 in-containment person-hours and does not take credit for the the recent dose reduction efforts (i.e., scabbling). We agree with GPU's occupational exposure estimate for plenum removal preparatory activities and conclude that the projected environmental impacts fall within the scope of those previously assessed in the final Programmatic Environmental Impact Statement (PEIS) related to TMI-2 cleanup (Reference 9).

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CONCLUSION

In our review of GPU's proposed plenum removal preparatory activities, we have considered the health and safety issues of decay heat removal, criticality, boron dilution, release of radioactivity, accident analysis, and occupational exposure. Based on our review, we find that; (1) "loss to ambient" cooling of the RCS will be sufficient for decay heat removal and adequate backup heat removal capability is available, (2) there is little potential for core recriticality due to fuel reconfiguration or boron dilution, (3) there is little potential for release of radioactivity in excess of the trace quantities typically discharged, (4) GPU has implemented appropriate measures to minimize the potential for, and consequences of, postulated accidents, and (5) there is little potential for worker overexposure and GPU has taken appropriate measures to maintain occupational exposures ALARA during the proposed activities. Further, the projected environmental impacts of the proposed activities are well within the scope of those previously assessed in the PEIS. Therefore, we conclude that the proposed plenum removal preparatory activities can be safely conducted with minimal risk to the health and safety of the onsite workers and offsite public. These activities may commence following formal NRC approval of the detailed operating procedures.

Sincerely,

/s/ R.A. Weller for
Bernard J. Snyder, Program Director
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Enclosure: List of References

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ENCLOSURE

REFERENCES

1. Letter from B. K. Kanga, GPU, to B. J. Snyder NRC, "SER for Preparatory Activities for Plenum Assembly Removal," June 18, 1984.

2. Letter from B. J. Snyder, NRC, to B. K. Kanga, GPU, "Preparatory Activities for Plenum Assembly Removal," July 31, 1984.

3. Letter from B. J. Snyder, NRC, to B. K. Kanga, GPU, "Plenum Removal Preparatory Activities," August 15, 1984.

4. Letter from F. R. Standerfer, GPU, to B. J. Snyder, NRC, "Plenum Removal Preparatory Activities," August 28, 1984.

5. Letter from B. J. Snyder, NRC, to B.K. Kanga, GPU, "Reactor Pressure Vessel Head Lift Safety Evaluation," July 17, 1984.

6. Letter from P. J. Grant, NRC, to B. K. Kanga, GPU, "IIF Processing System Safety Evaluation," July 24, 1984.

7. Letter from B. K. Kanga, GPU, to B. J. Snyder, NRC, "Head Removal SER," March 9, 1984.

8. Letter from B. J. Snyder, NRC, to B. K. Kanga, GPU, "Control Of Heavy Loads," January 5, 1984.

9. NRC Final Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting from March 28, 1979 Accident at TMI-2 Nuclear Station, Unit 2, March 1981.

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