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TMI-2 Cleanup Project Directorate
Attn: Dr. W. D. Travers
Director
US Nuclear Regulatory Commission
c/o Three Mile Island Nuclear Station
Middletown, PA 17057

Dear Dr. Travers:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Fines/Debris Vacuum System Modifications

Defueling experience to-date has identified the need for added flexibility in the operation of the Fines/Debris Vacuum System currently described in Reference 1. The Fines/Debris Vacuum System utilizes a knockout canister and a filter canister in series to vacuum debris from the top of the core debris bed. The vacuum nozzle design limits the size of vacuumable debris to fuel-pellet-size and the knockout canister is designed to separate debris as small as 140 microns; thus, References 1 and 2 address the range of debris size in the knockout canister from 140 microns up to and including fuel-pellet-size. A full flow outlet screen in the knockout canister ensures that particles greater than 850 microns will not escape the knockout canister; therefore, the downstream filter canisters are not expected to contain significant quantities of fuel particles greater than 850 microns.

Filter canister performance associated with operation of the Defueling Water Cleanup System (DWCS) and the Fines/Debris Vacuum System has been characterized by rapid pressure increases across the filters. Such rapid build-up of pressure across the filter canister in the Fines/Debris Vacuum System significantly reduces the loading rate of the knockout canisters and impacts defueling of the reactor vessel. GPU Nuclear is pursuing various modifications to the Fines/Debris Vacuum System to increase system efficiency.

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The intent of this letter is to show that the modifications currently being considered are bounded by previous safety evaluations and to request NRC concurrence that these modifications do not compromise prior NRC approval for defueling activities and the use of defueling canisters (References 3 and 4).

Modifications to the Fines/Debris Vacuum System are being pursued to increase defueling efficiency and to allow vacuuming of the debris in the lower head of the reactor vessel. The design modifications to the Fines/Debris Vacuum System include the use of a nozzle designed to allow larger debris sizes to be vacuumed into the knockout canister and longer length hose to allow vacuuming of the debris in the lower head region. The modified nozzle, which allows vacuuming of larger debris, could be used in the core and lower head region. Other nozzle modifications that facilitate vacuuming are also addressed below. The operational modification to the Fines/Debris Vacuum System consists of bypassing the filter canister during vacuuming by disconnecting the vacuum system pump discharge from the filter canister and allowing this discharge to flow back into the reactor vessel. Each of these modifications are evaluated below to show that they are bounded by previous evaluations.

Vacuuming of Larger Debris -

A new nozzle, which will allow larger debris particles to be vacuumed into the knockout canister, is evaluated with respect to canister design criterion which requires maintenance of Keff $\leq$0.95 during all phases of defueling operation (i.e., loading, transfer, storage, and shipping) and for postulated canister drops. Reference 2 states that an optimal fuel lump size would increase Keff by approximately 0.07% which is very small relative to the margin between reported values and the Keff criterion of 0.95. Thus, the presence of larger fuel debris sizes in the knockout canister would have minimal impact on existing criticality evaluations and would not compromise the canister criticality design criteria. Criticality evaluations for a dropped knockout canister were based on analytical structural deformations within the canister (later verified in actual drop tests) which are independent of debris size. Therefore, increasing debris size in the knockout canister would have no impact on the structural and criticality evaluations performed for a postulated drop of a knockout canister. In addition, the operation of the Fines/Debris Vacuum System with the new nozzle would not impact the particle size range in the filter canister. The full flow outlet screen in the knockout canister has been designed to withstand the maximum pressure differential across the screen that can be developed by the vacuum system.

GPU Nuclear concludes that restricting the debris size in the knockout canister is not required and that the introduction of debris of unrestricted particle size into the knockout canister is bounded by previous evaluations.

Other Nozzle Modifications -

Other nozzle modifications that are being considered are the use of mechanical probes and water jets attached to the end of the vacuum nozzle. These

additions would be used to loosen or "fluff up" the debris directly before the nozzle, thus expediting the vacuuming process. Water for use by the water jets would be supplied by a closed loop system drawing from the reactor vessel. The system will be powered by a submersible pump and can supply up to 25 gpm of water at a maximum of 150 psig. The water jets and probes can be used separately or combined with any other proposed vacuum system modifications.

The use of this modified nozzle has identified the following safety concerns which are evaluated below.

1. Localized Deboration -

   The water source for the water jet agitation of the debris pile is the discharge of the submersible pump, located below the defueling work platform and within the IIF, which takes suction from the reactor vessel water. Administrative and/or physical controls and compliance with relevant operating procedure shall preclude the connection of any water source other than the discharge of the submersible pump. Proper line-up shall be verified prior to pump operation. Therefore, the introduction of other than reactor vessel water by use of modified nozzle is precluded.

2. Loss of Reactor Vessel Water Inventory -

   A postulated hose rupture or inadvertent operation of the submersible pump has the potential to lower the water level in the reactor vessel. The extent of water level decrease is bounded by the location of the pump suction. The pump suction shall be located within the IIF and, thus, precludes the lowering of the reactor vessel water level below elevation 322'-6". Therefore, the core will remain covered.

Generalized deboration events and drain down below the reactor vessel flange have been addressed in previous safety evaluations (References 5 and 6). By precluding these type events, this modification can be operated within the bounds of previous analyses and, thus, operation does not constitute an unreviewed Safety Question.

Lower Head Vacuuming -

Vacuuming of the debris in the reactor vessel lower head is accomplished by using the existing Fines/Debris Vacuum System with a longer length vacuum hose to reach the lower head. The vacuum nozzle would be positioned and directed by a long-handled manipulator arm. The lower head vacuuming operation would be identical to the core region vacuuming operation except for the use of the long-handled manipulator arm and the longer length hose. Vacuuming of debris in the lower head region does not present any additional safety concerns not previously evaluated in Reference 1, except that the vacuuming could be in the proximity of the incore instrument nozzles which project from the lower head

vessel wall. However, the manipulator arm cannot deliver an impact force which could compromise the integrity of the incore instrument nozzles or of the instrument tube-to-vessel-wall welds which provide the instrument tube penetration seals.

Even though lower head vacuuming is not in the scope of Reference 1, GPU Nuclear considers this operation to be bounded by evaluations given in Reference 1 since this operation could not endanger reactor vessel integrity.

Vacuuming Without Filter Canister -

Bypassing the filter canister during operation of the Fines/Debris Vacuum System is intended to be a "short-term fix" until issues relating to the rapid increase of pressure build-up across the filter canisters are satisfactorily resolved. Operation in the bypass mode is expected to be intermittent to allow the settling of debris following operation. Bypassing the filter canister is accomplished by disconnecting the filter canister inlet from the vacuum system pump discharge. The pump discharge is then free to flow into the reactor vessel water approximately two feet below the water surface in the IIF. A hose may be attached to the pump discharge to direct the flow to specific regions within the reactor vessel. High water turbidity is expected to be the limiting condition and will require periodic cessation of operation to allow particulates to settle out on the debris bed.

The bypass mode of operation may increase the radioactive isotopic concentration in the reactor vessel water, but should not appreciably increase radiation dose levels to the operators because of the shielding afforded by the defueling work platform and the operation of the Defueling Water Cleanup System. Radiation exposure rates inside the reactor building are continuously monitored by Radiological Controls Department (Rad Con) personnel during defueling activities. Upon direction by Rad Con personnel, precautions such as shielding or personnel relocation will be used to minimize worker exposure. In addition, the release of additional particulates into the reactor vessel water is not expected to increase airborne particulates within the Reactor Building due to the "scrubbing" action of the water and the operation, as appropriate, of the off-gas system under the defueling work platform. Short term testing of vacuum operations in the bypass mode confirmed that visibility, although impaired, can be recovered quickly and no increase in radiation levels is expected on the defueling platform. Therefore, bypassing the filter canister during Fines/Debris Vacuum System operation should not significantly impact radiation exposure to personnel nor increase the amount of airborne particulates in the reactor building.

GPU Nuclear considers this flexibility in operating the Fines/Debris Vacuum System to be warranted to ensure continued, effective vacuuming activities in the core region and in the lower head region of the reactor vessel.

GPU Nuclear considers that the planned vacuum system modifications described in this letter are bounded by previous evaluations and requests NRC concurrence in a finding that these modifications do not compromise prior NRC approval of defueling activities or the use of the defueling canisters. A later revision to References 1 and 2 will include these modifications.

Per the requirements of 10 CFR 170, an application fee of $150.00 is enclosed.

Sincerely,

F. R. Standerfer
Vice President/Director, TMI-2

FRS/RES/eml

Attachment

Enclosed: GPU Nuclear Corporation Check No. 00019919

REFERENCES

1. Safety Evaluation Report for Early Defueling of the TMI-2 Reactor Vessel, Revision 4, GPU Nuclear letter 4410-85-L-0200, dated October 10, 1985, from F. R. Standerfer to B. J. Snyder.

2. Technical Evaluation Report for Defueling Canisters, Revision 1, GPU Nuclear letter 4410-85-L-0183, dated September 10, 1985, from F. R. Standerfer to B. J. Snyder.

3. NRC letter NRC/TMI-85-089, dated November 12, 1985, from W. D. Travers to F. R. Standerfer, Safety Evaluation Report for Early Defueling.

4. NRC letter NRC/TMI-85-083, dated November 5, 1985, from W. D. Travers to F. R. Standerfer, Defueling Canister Technical Evaluation Report.

5. Safety Evaluation Report for Heavy Load Handling Inside Containment, Revision 2, GPU Nuclear letter 4410-85-L-0172, dated September 11, 1985, from F. R. Standerfer to B. J. Snyder.

6. Boron Hazards Analysis, Revision 2, GPU Nuclear letter 4410-85-L-0195, dated September 27, 1985, F. R. Standerfer to B. J. Snyder.