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August 6, 1985
NRC/TMI 85-055

Docket No. 50-320

Mr. F. R. Standerfer
Vice President/Director
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GPU Nuclear Corporation
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Middletown, PA 17057

Dear Mr. Standerfer:

Subject: Defueling Water Cleanup System

Reference:
(a) Letter 4410-85-L-0005, F. Standerfer to B. Snyder, Defueling Water Cleanup System Technical Evaluation Report, dated January 14, 1985
(b) Letter 4410-85-L-0099, F. Standerfer to B. Snyder, Technical Evaluation Report for the Defueling Water Cleanup System, dated April 26, 1985
(c) Letter 4410-85-L-0119, F. Standerfer to B. Snyder, Technical Evaluation Report for the Defueling Water Cleanup System, dated May 28, 1985
(d) Letter 4410-85-L-0125, F. Standerfer to B. Snyder, Technical Evaluation Report for the Defueling Water Cleanup System, dated June 13, 1985

This letter is in response to references (a) through (d).

Reference (a) was your initial submittal of the Defueling Water Cleanup System (DWCS) Technical Evaluation Report (TER) for NRC staff review and approval. References (b), (c), and (d) submitted subsequent revisions to the subject TER for staff review. The TER addressed the general design and operation of the system, consequences of various system failures, criticality and decay heat removal considerations, boron dilution, heavy load handling, radioactive releases, and both off-site and on-site radiation dose assessment. Additional information was provided in discussions between members of our technical staffs on April 3, 1985, during which various questions and issues relating to the system were addressed. We have not completed our review of the DWCS filter canister criticality analysis. Our evaluation of this analysis will be presented in our response to your Fuel Canister TER which was submitted for our review in your letter 4410-85-L-0067, dated April 9, 1985. In addition, two other areas relating to DWCS operation require further review. First, we

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have not completed our review of the consequences of heavy load handling over the fuel storage racks when fuel material is present. Our review in this area may affect your plans for replacement of spent filter canisters in the DWCS. Second, our approval of system operating procedures relating to chemistry sampling frequency will be dependent upon your submittal of the revised boron dilution hazards analysis for our review. This letter transmits our safety evaluation and our approval of the proposed design, installation, and testing of the DWCS. Our review was based on your description of the proposed system presented in revision 6 of the TER and revision 3 of the associated system descriptions 15737-2-M72-DWC01 and 1537-2-M72-DWC02. We have determined that the use of this system does not pose a risk to the health and safety of the public, nor does it exceed the scope of activities and the associated environmental impacts which were considered in the staff's Programmatic Environmental Impact Statement (PEIS). Operation of the system to process water from the reactor coolant system will be contingent upon our approval of the fuel canister TER, resolution of heavy load handling issues, review of the boron dilution hazards analysis, and submittal of the related procedures subject to our approval per Technical Specification 6.8.2.

We are aware of your intention to begin partial operation of the DWCS (i.e., reactor vessel filtration) prior to full system installation. We have reviewed the proposed interim processing scheme, as shown on your piping and instrument drawings 15737-2-M75-DWC03 and 15737-2-M75-DWC04, revision 0, and have determined that the conclusions presented in our safety evaluation for the full system are also valid for the partial system operation. We therefore approve the interim processing plans subject to the same conditions discussed above for the complete system.

Sincerely,

William D. Travers
Deputy Program Director
TMI Program Office

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NRC STAFF EVALUATION OF THE DEFUELING

WATER CLEANUP SYSTEM

DESCRIPTION OF SYSTEM

The defueling water cleanup system (DWCS) consists of the necessary pumps, piping, filters, ion exchangers, and controls to process water from the reactor vessel (RV), the fuel transfer canal (FTC), and the 'A' spent fuel pool (SFP) for removal of suspended solids and dissolved fission products. The system is designed to remove suspended solids larger than a nominal size of 0.5 microns, and remove soluble fission products to keep the equivalent Cesium-137 concentration less than 0.02 microcuries per milliliter. This is done to maintain water clarity at 1.0 nephelometric turbidity unit (NTU) or less, and to keep the general area radiation dose rate from the water to less than 20 millirem/hour on the defueling platform. The total system is divided into two major subsystems. One subsystem is designed to process water from the FTC and the 'A' SFP. The other subsystem is designed to process water from the RV. The design bases of the two subsystems, their principle of operation, and the hardware associated with them are similar. They share some common instrument and control panels but have only limited cross-connect potential. Each subsystem is described below.

The FTC/SFP cleanup portion of the system includes two vertical submersible well pumps (P-3A and P-3B) located in the FTC, and two identical pumps (P-4A and P-4B) located in the SFP. Each pump has a net capacity of 200 gpm. The pumps take a suction through surface skimmers in the FTC and the SFP, and discharge to a set of four filters (F-9, F-10, F-11, and F-12) located in the fuel storage racks in the 'A' SFP. The filters are contained in a canister which is described in detail in the Fuel Canister Technical Evaluation Report. The FTC pumps, P-3A/3B, discharge to a common header that communicates from the reactor building to the fuel handling building through existing penetration R-524. After leaving the reactor building, the header splits into two branches with one SFP pump (P-4A/4B) discharging to each branch and each branch supplying two filters. The effluent from the filters can be returned to either source. This arrangement allows flexibility of operation since with a total filtration capacity of 400 gpm the system can process up to 400 gpm from either source or up to 200 gpm from both sources simultaneously. The normal mode of operation will be to process 200 gpm from each source with the total 400 gpm being returned to the SFP and a 200 gpm flow rate through the open fuel transfer tubes from the SFP to the FTC. A portion of the filtrate can, if needed, be taken off through a side stream for further processing rather than being directly returned to the source. Up to 30 gpm can be routed to ion exchanger K-2 for removal of cesium activity. Ion exchanger K-2 is a 4 x 4 liner similar to those used in the EPICOR II system and is filled with a bed of zeolite ion exchange media. It is located on the 347' elevation of the fuel handling building inside a concrete shield vessel. The processing capability of K-2 is augmented by the ability to route up to 15 gpm via a booster pump (DWC-P-5) to the submerged demineralizer system (SDS). The effluent from K-2 or SDS can be returned to either the SFP or the FTC. The

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processing capability is further augmented by the capability to route the return from K-2 to the reactor coolant bleed tanks as a means of SFP/FTC inventory reduction and further batch processing through EPICOR II.

The reactor vessel cleanup portion of the system includes two vertical submersible well pumps, P-2A and P-2B, housed in wells in the fuel storage pit in the shallow end of the FTC. The pumps take suction on the wells which are connected by flexible hose to the RV via connections on the defueling work platform. They discharge a net 200 gpm each to a set of four filter canisters (F-1, F-2, F-3, and F-4) located in the fuel canister storage racks in the deep end of the FTC. The filters are identical to those used in the SFP/FTC cleanup portion of the system. The pumps and filters are arranged such that the system is divided into two trains with one pump and two filters in each train, and each train capable of processing up to 200 gpm. All or a portion of the filter effluent can be returned to the reactor vessel. The portion not returned directly to the RV can be routed to the fuel handling building to ion exchangers K-1 and K-3 for removal of Cesium-137. Each ion exchanger can process up to 30 gpm and they are identical to K-2 used in the FTC/SFP portion of the system. The effluent from K-1 and K-3 is returned directly to the RV, or a portion can be let down to the reactor coolant bleed tanks for RCS inventory reduction or for batch processing through EPICOR II.

Both subsystems are provided with cartridge type particulate filters in the process lines to the ion exchangers. These filters prevent the carryover of fuel fines to the ion exchangers in the event of filter media breakthrough in the main filte canisters. The effluent from the ion exchangers must pass through additional particulate filters to prevent carryover of ion exchanger resin fines back to the RV, FTC, or SFP. The total system interfaces with the standby reactor pressure control system (SPC) by connecting the SPC charging water storage tank as a source of borated water for initial system fill and periodic flushing. The system also interfaces with a new sampling system consisting of two sample boxes in the fuel handling building capable of drawing liquid samples from various points in the system to monitor overall system performance. In addition, the system receives water discharged from filled fuel storage canisters dewatered in the proposed canister dewatering station that will be installed in the 'A' SFP.

GENERAL DESIGN CONSIDERATION

NRC staff review of the licensee's TER determined that the design filtration capability of the system is acceptable. The design basis of maintaining water turbidity at 1.0 NTU or less will assure adequate clarity for underwater operations necessary for defueling and handling of fuel storage canisters in the FTC and SFP. The design ion exchange capability to maintain fission product activity below 0.02 microcuries per milliliter will assure that the worker dose rate contribution from the water is within the values used in the design and safety evaluation for the equipment and procedures used for defueling activities. It is recognized that activity and turbidity levels may periodically exceed these values as a result of core perturbations during defueling. The administrative limits imposed to cope with these situations will be evaluated during NRC staff review of the licensee's procedures.

The engineering codes and standards to which the system is designed and tested have been reviewed in accordance with applicable portions of NRC Standard Review Plan (NUREG-0800) 11.2 and determined to be acceptable by the staff. Portions of the system associated with ion exchange processing have been designed to the applicable requirements of NRC Regulatory Guide 1.143. All piping will be subject to the testing requirements of ANSI B31.1. System tie-ins to existing plant nuclear piping will be subject to the testing requirements of ANSI B31.7.

Equipment layout has made use of locations within the existing plant structure provided with controlled and monitored ventilation. The system design has minimized the number of piping penetrations to the containment and has used existing penetrations by either routing piping through available spare penetrations or by tying into existing plant systems which are no longer in use and penetrate the containment.

The system is designed with suitable instrumentation and controls to adequately monitor and control system performance and integrity. The system includes appropriate process flow instrumentation and level indication to monitor RCS and SFP water inventory by use of dynamic flow balance and static mass balance. Filter and pump performance is monitored by appropriate flow, pressure, and differential pressure measurement. The water chemistry in the RCS is monitored by in-line pH and turbidity meters and an in-line boronometer, and the installed monitors are supplemented by the capability to obtain grab samples from various points within the system. The licensee's chemistry sampling program will be further evaluated during staff review of system operating procedures and during staff review of the licensee's revised boron dilution hazards report.

HEAVY LOAD HANDLING

The staff reviewed the potential need for load handling in the reactor building and fuel handling building in support of DWCS construction work and determined that the potential consequences of these activities are bounded by the safety evaluations previously submitted and approved by the NRC. These evaluations included the SER for fuel pool 'A' refurbishment submitted by the licensee's letter 4410-83-L-0156, dated July 28, 1983, and the SER for reactor building heavy loads submitted by the licensee's letter 4410-84-L-111/, dated November 1, 1984. Lifting of heavy loads around DWCS equipment during its operation and lifting of DWCS components, such as filters and ion exchangers, in support of its operation will be administratively controlled to assure that load handling pathways and potential load drop consequences are within the constraints of the previously approved safety evaluations.

The staff has concluded that heavy load handling necessary to support DWCS installation and operation can be carried out without undue safety consequences when controlled in such a manner that loads handled, lift heights, and load travel pathways are within the bounds of the previously approved safety evaluations. Heavy load handling within the 'A' SFP and FTC is restricted over fuel containing canisters and will require an additional safety evaluation approval prior to the heavy load lifts.

CRITICALITY

Prevention of criticality in the reactor coolant system is assured by maintaining a a high concentration of boron in the system. The minimum boron concentration needed to assure subcriticality was evaluated in the licensee's Reactor Coolant System Criticality Report submitted to the NRC staff by letter 4410-84-L-0199 dated November 8, 1984. The staff review determined that maintaining the RCS chemistry within the constraints specified in that report will provide assurance that the reactor core and piping systems circulating RCS water will remain subcritical. The DWCS filters will remove fuel debris from the RCS. Following their dewatering, the filters will no longer be flooded with borated water. The filter design is such that they could contain up to 1000 pounds of core debris. Subcriticality of the loaded filters is assured by their design, in that the filters are designed with installed boron poison rods and will maintain the debris in a geometrically safe configuration during all conditions for expected operations. The detailed canister criticality analysis is being evaluated as part of the staff review of the licensee's Technical Evaluation Report for Defueling Canisters. The post filters which are intended to prevent carryover of particulate matter to the ion exchangers could also accumulate fuel material. Criticality is prevented in these filters by their physical design. They are designed so that they will reach the operational limits on differential pressure when about four pounds of debris has accumulated. This is well below the most conservatively predicted minimum of 70 kilograms of fuel needed for a critical mass. In addition, the post filters are designed to contain the fuel debris in a critically safe geometry.

The staff has determined that the design of the DWCS is adequate to provide reasonable assurance of preventing criticality during its operation.

RADIOACTIVE RELEASES

The staff evaluated the DWCS design for potential radioactive material releases to the environment and to the building as a result of system leakage, line breaks, or releases of gases.

Process hoses are used in several portions of the system. Connections to the RV sump suctions and discharges, connections to the filters, skimmer connections to the FTC and SFP pumps, connections to the ion exchangers, the return line to the FTC, and connections to existing systems piping at some of the containment penetration use flexible hoses. The hoses are steel armored to minimize the chance of accidental damage or breakage. In the event of breakage, the hose routing is such that leakage will be back into the FTC/SFP where no net loss of water inventory will occur, or to locations where the leakage will be collected in the auxiliary and fuel handling building sumps or the reactor building sump. Loss of water inventory resulting from hose or pipe breaks will be detected by redundant level monitors, which are required by Technical Specifications, in the RV, the SFP, and FTC. The loss of water level will activate alarms and in the case of decreasing level in the RV, the RV pumps will trip on indication of low water level. Siphoning of water from the RV and the FTC/SFP as a result of line breaks is prevented by use of siphon breaks in the RV suction and return lines and by use of check valves in the FTC/SFP return lines.

Spillage of water from the DWCS will result in local contamination of areas of the reactor and fuel handling buildings but will not result in liquid leakage to the environment. The activity levels of the water will be low enough that the contaminated areas will be accessible to conduct cleanup and repair activities without undue hazard to the workers.

Airborne activity resulting frc spills will be contained in areas provided with controlled and monitored ventilation pathways. The potential airborne activity releases to the building atmosphere are within the bounds of those previously analyzed in the IIF processing and SDS processing safety evaluations.

The activity level of the fluids to be handled is less than that of the water initially processed by the SDS and comparable to that handled during IIF processing. The design features of DWCS are such that the probability of significant leakage or spillage from the system is relatively small, and any spills or leaks will be contained within controlled areas. Thus, the staff has determined that the risk of radioactive material releases from the system is low and that the consequences of any release will not pose any undue hazard to the public, the environment, or plant workers.

RADIATION EXPOSURE

The licensee has projected a total occupational dose commitment of less than 125 person rem attributed to DWCS. This includes exposure resulting from construction, installation, operation, maintenance, and dismantling of the system. Procedural controls during these activities will assure that personnel exposure is maintained ALARA. The staff review of the licensee's estimate concluded that it is based on a reasonable estimate of the manhours needed for the task and conservative radiation dose rates determined by review of current survey and exposure data from tasks already performed in the same working areas. The dose commitment due to system operations is based on reasonable estimates of the expected activity levels of the RCS and from experience gained from SDS and other waste processing system operations. The projected occupational exposure is within the scope of considerations made in the staff's Programmatic Environmental Impact Statement.

CONCLUSION

The NRC staff has performed a safety review of the proposed Defueling Water Cleanup System. The system was reviewed against appropriate industrial codes and standards including applicable portions of NRC Regulatory Guide 1.143 and Standard Review Plan (NUREG-0800)11.2. Based on this review, the system does not pose a significant risk to the occupational work force or the public. The system, which is necessary to support planned defueling activities, does not present the possibility of any accident not previously analyzed nor does it change the consequences of, or likelihood of any previously analyzed accident. Margins of safety as previously analyzed are not reduced. The staff concludes that the system does not require additional changes to the plant Technical Specifications and it does not constitute an unreviewed safety question. The scope of activities and the associated environmental impact of DWCS operation are within those previously considered in the PEIS. We therefore approve the DWCS Technical Evaluation Report and the construction, installation, and testing of the DWCS contingent upon our approval of those procedures subject to Technical Specification 6.8.2. Operation of the system to process water containing fuel material will be contingent upon our review and approval of the applicable operating procedures and upon our approval of the fuel canister technical evaluation report.

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