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November 23, 1982
NRC/TMI-82-070

Docket No. 50-320

Mr. B. K. Kanga
Director, TMI-2
GPU Nuclear Corporation
P. O.Box 480
Middletown, PA 17057

Dear Mr. Kanga:

Subject: Submerged Demineralizer System Liner Recombiner and Vacuum Outgassing System

This letter is in response to your letters, 4410-82-L-0022, dated October 13, 1982 and 4410-82-L-0041, dated November 11, 1982, in which you forwarded a safety evaluation with supporting information for the SDS Liner Recombiner and Vacuum Outgassing System (LRVOS). Your safety evaluation assessed both the use of the LRVOS to vacuum dry and insert catalytic material into a SDS liner, as well as the integration of the LRVOS with the existing SDS offgas system. The safety evaluation also referenced the functional testing performed at Rockwell Hanford Operation (RHO) which demonstrated the operation of LRVOS and the feasibility of the catalytic recombiner for controlling radiolytic gas (hydrogen and oxygen) during conditions for normal operation and potential accidents.

The staff has reviewed your safety evaluation and related safety issues associated with, (1) radiological controls, (2) the potential for gas ignition and breach of the SDS liner integrity, (3) the potential release of radioactive material to the Fuel Handling Building environment, and (4) system performance and safety controls. Our review also included supporting documents on the Rockwell Hanford tests and observation of the TMI functional demonstration of the LRVOS System which was completed November 19, 1982.

Radiological Controls

During normal system operation the LRVOS will interconnect and communicate with the spent SDS liner vent line and the SDS off gas filtration system. All potential radionuclide transport pathways via the LRVOS will communicate through a water separator (knockout drum) and two 0.2 micron filters. In reviewing both the LRVOS designs and the SDS HEPA filtration and monitoring systems, the staff concludes that adequate radiological controls (viz., shielding, particulate filters and radiation monitors) will be implemented. The lead shielding on the knockout drum and upstream filter will provide added margin to maintain ambient dose fields to less than 5 mrem/hr. The catalyst loading tool design, which provides remote handling capabilities with the SDS liner being maintained at the normal operating depth of water (24'), also assures operator doses will be low.

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In the unlikely event that significant entrainment and transport of radionuclides occurs (^{137}Cs and ^{90}Sr), system dose rates and liquid samples from the water separator will provide early indications of this occurrance and the vacuum drying operation will be terminated. Small quantities of tritiated water will be transferred through the LRVOS into the SDS off gas filtration system, however this tritium will be negligible compared to the airborne tritium from normal water evaporation in the "B" spent fuel pool (50 Ci/yr), and well within the bounds considered in the staff's Programmatic Environmental Impact Statement. Based on these findings the staff concludes that the operation of the LRVOS should not measurably increase the occupation doses for plant operators and that adequate radiation controls exist.

Gas Ignition and Breach of System Integrity

The radiolytic gas generation rate of hydrogen and oxygen within the SDS vessels is a function of both the curie loadings and the residual water content. To ensure that the gas accumulation and the potential energy source, if ignited, would not cause an SDS liner to fail (i.e., lose integrity), procedures are in effect to limit the internal pressure of spent SDS vessels to less than 10 psig. This is accomplished by continuously venting the spent SDS liner via the vent header to the off-gas separator tank. The operation of the LRVOS when connected to the SDS liners is predominantly at low pressure with the SDS liner and LRVOS pressures ranging from 30 inches of mercury (vacuum) to 5 psig. This pressure range corresponds to the normal operating configurations of LRVOS, including (1) vacuum drying to remove the free water in the SDS liner, (2) insertion of the catalytic recombiner pellets, (3) gas inerting of the liner with nitrogen or argon, and (4) monitoring and sampling the SDS liner to ensure sufficient catalyst exists to recombine the hydrogen and oxygen.

The staff has reviewed all existing SDS gas generation data and pressure buildup rates in conjunction with the LRVOS design criteria and operational configuration, and we conclude that adequate assurance exist that if ignition occurs, system pressures will be maintained such that loss of SDS liner and LRVOS integrity will be maintained. Prior to connecting the LRVOS with a spent liner, the liner will be dewatered and purged with nitrogen, thereby ensuring the hydrogen and oxygen gas inventories will be minimal ($<0.2\%$). The vacuum drying operation of the LRVOS will continue to purge gases and water vapor from the liner which should preclude the collection and accumulation of combustible gas mixtures. Procedural controls are also established to require the nitrogen purging of the SDS liners if the liner is isolated from the SDS vent header or LRVOS for more than five hours. This requirement, which is based on twice the maximum expected gas generation rate, will also ensure that no combustible gas mixtures are created.

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Release of Radioactive Material to the FHB

Your analysis has shown that no measurable releases of radioactive material from the SDS zeolite bed is expected during the vacuum pumping through the LRVOS. The basis for this conclusion is that both the type of water removal (i.e., water vapor transport under vacuum) and the extremely low air flow rates. The staff's review concludes that, during normal system operation minor amounts of particulate entrainment will occur, however, the potential for releases to the Fuel Handling Building are negligible. The two major entrainment controls being the water separator/mechanical filters in the LRVOS and the SDS off gas system, which contains a roughing filter, HEPA filter, charcoal filter and a final HEPA. As part of the functional test, the LRVOS including the catalyst loading tool and vent hose connections are leak tested to ensure the SDS liner gas space does not leak directly to the pool or atmosphere in the Fuel Handling Building. If leakage should occur during operations, early indications would be available to the system operators (e.g., loss of vacuum, increased water level in knockout drum, high flow rate, etc.) and the LRVOS and SDS liner would be isolated as per operating procedures.

Your safety assessment on accidents addressed the event that the catalyst does not recombine the hydrogen and oxygen gases generated, and then liner pressure and combustible gas control will be re-established by use of the SDS off gas header. All other credible accidents were enveloped by your previous SDS Technical Evaluation Report and the staff's Safety Evaluation Report (NUREG 0796). The staff concurs with these analyses and concludes that the additional vacuum drying and recombiner loading as a preparation for shipment does not measurably increase the amount of liner movements and handling operations and, therefore, does not increase the risk of an SDS liner accident. Additionally, a SDS liner loaded with a catalytic recombiner system at sub-atmospheric pressure (<5 psia) provides a lower energy source and potentially smaller consequence than non-recombiner loaded SDS liners. The staff also concludes, based on the LRVOS designs and safety features, the SDS off gas filter and monitoring systems, and the Fuel Handling Building Ventilation filter system that substantial defense-in-depth exists for radioactive material controls and that adequate assurance exists for protection of the health and safety of the public.

System Performance and Safety Controls

The staff has reviewed the LRVOS performance testing which included testing both at Rockwell Hanford Operations (RHO) and TMI. The RHO test demonstrated the operation of LRVOS and the feasibility of the catalytic recombiner for controlling radiolytic gases during conditions for normal operation and potential accidents. The RHO test demonstrated with reasonable assurance that the SDS recombiner systems will safely control hydrogen and oxygen gas on both upright and/or inverted liners with air inleakage. However, to envelope the RHO test conditions, GPU will be required to demonstrate that a maximum residual water content of 120 lbs. remains in the liner and that a minimum of 236 (±1%) grams of catalyst have been added to the SDS liner. The functional test conducted at TMI demonstrated with reasonable assurance that the catalyst can be loaded into the SDS liner remotely at the dewatering station. However,

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contingency procedures were also developed to resolve potential problems with catalyst blockage in the loading tool.

The staff has also reviewed your system safety controls and acceptance criteria for LRVOS operation and catalyst loading. Each SDS liner will be dewatered and pre-weighed before vacuum drying and catalyst loading. The duration of vacuum drying is expected to vary from five to ten days (depending on the curie loading and water removal rates). After catalyst loading and post-weighing the liner will be monitored for pressure changes and gas composition over a minimum of 14 days. Acceptance testing is demonstrated when liner pressure is maintained below 5 psia and hydrogen composition is less than 5% @ STP. Based on this acceptance criteria for assuring noncombustible gas in the SDS liner and the LRVOS safety controls (including vacuum compressor shutdown on high water level in the knockout drum, and shutdown of LRVOS upon loss of SDS off gas or FHB HVAC) the staff concludes adequate safety margin exists.

Based on our review we conclude that the SDS Liner Recombiner and Vacuum Outgassing System can be operated in a safe manner with the controls and acceptance criteria provided. There is reasonable assurance that the LRVOS will safely perform its intended function on spent SDS liners. The staff believes the risk to the health and safety of the public and the occupational work force is minimal. The use of LRVOS does not change the boundary of accidents previously considered in the SDS SER. We therefore, approve your plans for using the LRVOS on spent SDS vessels.

Additionally, the environmental effects from the operation of the LRVOS falls within the scope of conditions previously considered in the PEIS, and therefore is acceptable.

Pursuant to technical specification 6.8.2 we require the submittal of system operating procedures before final approval is given for system operation. We also anticipate your submittal of an additional safety evaluation which addresses the shipment of high curie SDS vessel loaded with catalytic recombiners.

Lake H. Barrett
Deputy Program Director
TMI Program Office

cc: J. J. Barton
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