SAFETY EVALUATION

FOR THE

SUBMERGED DEMINERALIZER SYSTEM

LINER RECOMBINER AND VACUUM OUTGASSING SYSTEM

Revision 0
October 1982

1.0 TITLE:

Safety Evaluation for the Submerged Demineralizer System (SDS) Liner Recombiner and Vacuum Outgassing System.

2.0 PURPOSE:

The Liner Recombiners and Vacuum Outgassing System (LRVOS) is designed to eliminate the potential of a combustible Hydrogen and Oxygen mixture existing in the SDS Liners. This will facilitate the ultimate shipment and burial of the SDS Liners.

3.0 SYSTEMS AFFECTED:

3.1 Installation and operation of the LRVOS will interface with the following systems:

- SDS HVAC
- Miscellaneous power panel MP-CN-2
- Plant Instrument air

3.2 Drawings

Title	Drawing Number
Flow Diagram - SDS System	GPUN 2R-950-21-001, Rev. 3
Flow Diagram - Vacuum Outgassing and Drying System	GPUN 2D-950-21-003, Rev. 0
Flow Diagram - Plant Instrument Air System	B & R 2012, 2 sheets
Electrical Diagram - Vacuum Outgassing and Drying System	HEDL H-348570, 2 sheets
Electrical Diagram - Power Panels	B & R E119 and E 125
SDS Liner Drawing	2D-950-29-001, 2 sheets
Rockwell Tools	RHO H-2-80231, Rev. 1

3.3 Documents

3.3.1 Technical Specifications

The following technical specifications apply to the operation of the LRVOS.

- Limiting Conditions for Operation, Technical Specifications, Sections 3.3.3.1 Radiation Monitoring Instrumentation, and 3.9.12 Fuel Handling/Auxiliary Building Air Cleanup Systems.
- Environmental Technical Specifications, Section 2.1.2 Gaseous Effluents

3.3.2 Submerged Demineralizer System, Technical Evaluation Report

3.3.3 Submerged Demineralizer System, Safety Evaluation

3.3.4 System Descriptions

3.3.4.1 Plant Instrument Air System, refer to Section 9.3.1.2 of the TMI-2 FSAR.

3.3.4.2 Submerged Demineralized System - refer to the Submerged Demineralizer System - System Description.

3.3.4.3 Liner Recombiner and Vacuum Outgassing System, Appendix 16 to the SDS System Description.

3.3.4.3.1 Design Basis

The LRVOS will perform the following operations while maintaining the normal operating depth of water between the operators and the SDS liner.

1) Reduce water in the SDS liner using vacuum outgassing to ensure enhanced operation of the recombiner catalyst.

2) Allow sampling of the liner gas at atmospheric pressures.

3) Provide capability to inert the SDS Liner with Argon or N_2 to approximately 15psig prior to addition of the recombiner catalyst. This will prevent any water instrusion during tool decoupling.

4) Provide a means to remotely insert the recombiner catalyst into the SDS liner vent port. The catalyst is retained inside the liner by the internal vent port screen.

5) Provide sufficient recombiner catalyst to recombine the hydrogen and oxygen produced by radiolosis of the water remaining in the liner.

3.3.4.3.2 System Design

The LRVOS will be designed and installed as an "Important to Safety" (ITS) System. The Vacuum Outgassing and Drying System is a unitized system designed for evacuation of SDS spent liners, thus effecting removal of moisture by evaporation from the zeolite beds. The purpose of the operation is to dry the beds but not remove the water of hydration in the zeolite. Each SDS Liner contains an estimated 170 pounds of water after preliminary bulk dewatering. Heat generation within the beds is estimated in the range of 300 to 350 watts, sufficient to vacuum evaporate approximately a pound of water vapor per hour without excessive cooling of the zeolite beds. In addition, the beds are immersed in a shielding pool held at approximately 60-70^{o}F. Should excessive evaporation occur, tending to overcool the beds, heat would be inputted from the pool, tending to maintain the beds at a relatively uniform temperature. The offgassing rate is expected to proceed at approximately one to two pounds of water vapor per hour, evaporated at a pressure of approximately 30 mm of mercury absolute. It is expected that pressure in the bed will fall, within minutes after initiation of pump operation, from initial conditions (approximately one atmosphere) to an initial quasi-steady state condition of approximately 30 mm of mercury. Thereafter, pressure in the beds should fall very slowly as water is evaporated and as the surface area available for further evaporation slowly decreases.

The vacuum system contains a suction knockout drum to keep any slugs of water from getting to the pump and a suction filter to keep particulate contamination from reaching the pump. Little, if any, contamination is expected. Both these pieces of equipment are lead shielded.

The system also contains an after filter to keep oil aerosol from being discharged into the SDS HVAC system.

The hydrogen/oxygen recombiner catalyst which will be used in the SDS spent liners is made of a platinum/palladium coated alumina formed into tiny cylindrical shapes.

Addition of the recombiner catalyst to the liner is performed after the liner has been vacuum dried to a predetermined value and repressurized with an inert gas. A special tool was developed to allow the recombiner catalyst to be added remotely with the liner pressurized.

3.3.4.3.3 Functional Tests Results

The purpose of the test study was to evaluate the ability to prepare a SDS liner for addition of the recombiner catalyst and to confirm the effectiveness of the catalyst (platinum/palladium) to recombine hydrogen and oxygen to minimize the pressure rise due to radiolytic generation of these gases from the water in the liner.

The major equipment used for testing involved a TMI SDS liner, vacuum pump for water removal, catalyst addition off-gassing tools, and catalyst and hydrogen/oxygen generating unit.

Vacuum testing done by Rockwell Handford Operations (RHO) for GPU showed that in 5 to 10 days per liner, depending on curie loading, sufficient water will be removed from the liner. In order to simulate the heat generated by the radionuclides on the zeolite beds, which is approximately 300 watts for the higher curie liners, 2-150 watt heaters were inserted into the zeolites for testing.

Testing done by Rockwell Hanford Operations for TMI showed that: Even under postulated accident conditions (liner leaks to ½ atmosphere during shipment, liner leaks to ½ or 1 atmosphere and is inverted), the catalyst performed in such a manner as to limit the hydrogen gas concentration to below the detectable limits as analyzed on a gas chromatograph and mass spectrometer by RHO test personnel.

In addition, the rate of H_2/O_2 gas added during the testing was 3 liters per hour which is more than a factor of 2 times the measured rates of the most highly loaded spent liner from the SDS.

3.3.5 Standard Review Plan - Gaseous Waste Management Systems Rev. 2, 11.3, 7/81.

4.0 EFFECTS ON SAFETY

4.1 Documents that define the safety function of the systems listed in Section 3.0 are as follows:

1. For SDS HVAC refer to SDS Technical Evaluation Report.

2. The Plant Instrument Air System and Miscellaneous Power Panel MP-CN-2 do not perform a safety function.

4.2 SAFETY FUNCTIONS

4.2.1 The safety function of the SDS HVAC System is to provide assurance, in addition to the normal plant HVAC, that radioactive releases from SDS operations are well below technical specification limits.

4.3 AFFECT OF LRVOS ON SAFETY FUNCTIONS

4.3.1 System Performance

Based on this type of water removal the Vacuum Outgassing of spent SDS liners is not expected to draw any fission products from the resin beds or pull any resin fines from the liner. In the event (because of extremely low air flow rates) that these contaminants are drawn into the vacuum system, the knockout drum and suction filter should capture them. The suction filter has a rating of .2 microns nominal and is shielded by 1 inch of lead. Any particulate that may be drawn out of the liner should be caught on this filter.

In the unlikely event that the vacuum system filters do not capture the contaminents, the SDS HVAC system will filter 99% of the remaining particulate. There is no estimate available to determine the amount of contaminants that may be vacuum pumped, however, it is not expected to exceed the capacity of the SDS HVAC system. Vacuum pumping of an SDS spent liner is not expected to increase the gaseous effluent of the SDS HVAC to levels exceeding those for normal spent liner dewatering. Flow rates for normal dewatering are bounded by procedure to 25 CFM. This is 2.5 times the maximum flow rate of 10 CFM for the vacuum system main pump; therefore, vacuum system gaseous effluent will be at least a factor of 2.5 below releases due to vessel dewatering which are addressed in the SDS TER.

Vacuum system operation will be terminated upon loss of the `DS HVAC.

The catalyst recombiner has been tested under conditions that were postulated as accident conditions and the recombination of H_2/O_2 gases was accomplished in all cases. The following is a list of those tests:

- liner upright, at the vapor pressure of water
- liner upright, at ½ atmospheres
- liner inverted, at the vapor pressure of water
- liner upright, at atmospheric pressure
- liner inverted, at atmospheric pressure

Although these were accident conditions postulated with respect to liner shipment, the results indicate that the catalyst as used in spent SDS liners in the "B" pool area will perform to eliminate the potential of an explosive condition in any of the SDS liners.

4.3.2 Quality Standards

The vacuum system will be designed, fabricated, and tested to Reg. Guide 1.143.

4.3.3 Natural Phenomena Protection

Not applicable as system is housed in a siesmic I structure.

4.4 INCREASE OF PROBABILITY OF OCCURENCE OR CONSEQUENCES OF AN ACCIDENT

The increase in probability of occurrence or consequences of an accident are not increased. Previous calculations on spent SDS liners have shown that if the H_2/O_2 gas pressure is held below 10 psig and a detonation occurs, the integrity of the vessel is not breached. This is based on the vessel hydro pressure of 530 psig and the peak pressure of a hydrogen detonation being a factor of 20 above the initial vessel absolute pressure. (The actual number is 26.5 psia which is 11.8 psig). During vacuum pumping and catalyst recombining the pressure in the liner will be held below atmospheric. When the catalyst is added, however, a slight positive pressure of N_2 will be used so that water in leakage to the liner is minimized. Once the Hansen disconnect is plugged, liner pressure will be lowered again and the catalyst will be allowed to perform its task. During this stage of operation, the liner pressure will be monitored after isolating the liner. If pressure rises to 5 psia, a sample will be obtained to determine the cause of the pressure increase.

4.5 MODIFICATION OF EQUIPMENT ITS

The installation and operation of LRVOS will not increase the probability of a malfunction of equipment ITS. This is based on the SDS HVAC air handling capabilities as being far in excess of the air flow requirements of the LRVOS, and equipment ITS being operated in a manner for which it was designed.

4.6 ACCIDENT OF DIFFERENT TYPE

In the unlikely event that the catalyst does not work as anticipated, an increase of hydrogen and oxygen can be postulated such that a combustible mixture is present. This situation will be precluded in the following manner:

- SDS spent liners that have catalyst added will be monitored before they are shipped to assure that a failure is detected.

Action taken will be to obtain a gas sample to analyze the cause of the pressure increase. The vessel can then be vented to the SDS offgas header to preclude any further gas build-up or dangerous situation.

4.7 DECREASE IN MARGIN OF SAFETY

The activities associated with the LRVOS will not reduce the margin of safety as defined in the basis of any technical specification. Further information with respect to the Technical Specifications is given in Section 4.8.

4.8 VIOLATION OF ANY TECHNICAL SPECIFICATION

Release of fission products from the zeolite beds due to vacuum pumping is not expected to occur as stated in the system performance section. Release of significant amounts of resin fines to the environment is highly unlikely because of the vacuum system filtering capability and the SDS HVAC system consisting of a roughing filter, HEPA filter, charcoal filter, and another HEPA. In addition, the exhaust of the SDS HVAC is monitored in a PING 1A sampler then sent to the TMI-2 Auxiliary Building HVAC. Since no release of fission products is expected and due to the filtering trains involved, it is assumed that gaseous and particulate releases from the vacuum system operation will be below those activities attributed to normal SDS spent liner dewatering. Therefore, the TMI-2 Technical Specifications will not be violated.

4.9 COMPLIANCE WITH LICENSING REQUIREMENTS AND REGULATIONS

No licensing requirements or regulations are exceeded by this change since all accidents postulated are enveloped by the SDS TER, the SDS Safety Evaluation, and since no technical specifications will be violated.

4.10 RADIOLOGICAL SAFETY

The activities associated with the operation of the LRVOS do not involve an unacceptable radiological safety concern. The basis for this was enveloped by the SDS TER.

5.0 CONCLUSIONS

The activities associated with the operation of the LRVOS do not constitute an Unreviewed Safety Question. Operation of the LRVOS can be performed within existing TMI-2 Technical Specifications and presents no undue risk to the public health and safety. Based on test data and recommendations from Rockwell Hanford Operations and TMI Site Imposed Administrative Controls, this system can be operated safely and effectively.