Met-Ed / GPU

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May 8, 1981
LL2-81-0108

TMI Program Office
Attn: L. H. Barrett, Deputy Director
U. S. Nuclear Regulatory Commission
c/o Three Mile Island Nuclear Station
Middletown, Pennsylvania 17057

Dear Sir:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Submerged Demineralizer System

During discussions with members of your staff, we have been requested to provide you with the following information:

> "Provide the projected processing strategy plan for loading, changing out and waste management of each ion exchange bed in SDS and EPICOR-II as presently planned for clean-up of sump and RCS water. This should include the generic criteria that is the basis for the projected flow volumes, curie contents, and number of units for each liner stage in SDS and EPICOR-II for clean-up of sump and RCS water."

This letter provides the processing strategy plan for radionuclide loading of the ion exchange media and vessel changeout criteria during SDS operations. Waste management strategy of the spent SDS ion exchange vessels is also included as part of this letter, Attachment 1.

All water movements associated with SDS operations will be performed in discrete steps with well defined start/stop/hold points. Water movements from the RB sump to Tank Farm will be performed in approximately 50,000 gallon batches. This quantity was selected since it is convenient, operationally easy to identify and fits well within the 60,000 gallon capacity of the Upper Tank Farm (feed tanks to SDS) and is within the 90% fill limit, thus minimizing the possibility of overflowing the tanks. Filter influent and effluent samples taken during the feed tank fill operation will be used to characterize the inlet water radionuclide content, to determine filter radionuclide loading and to help establish the anticipated curie loadings on the ion exchange media of SDS. Samples sent for off-site analysis will include transuranic (TRU) determinations. It is currently anticipated that insufficient TRU will be deposited on either the Prefilter or Postfilter to exceed the current 10 nanocurie/gm TRU limit for shallow land burial. Pre- and Post- filter performance will be monitored, and the filters will be changed out based on mechanical performance.

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Flow will be established thru SDS initially at 5 GPM through only one (1) train in order to devote maximum technical attention to obtaining greater experience with RB sump water processing through a single on-line train, and to reduce sample and analytical requirements. If at a later time it is determined that dual train processing, or a higher bed flowrate, is acceptable considering all factors, then this mode can easily be implemented. Our intent is to optimize the loading of the four (4) vessels in series in the fuel pool to maximize cesium and strontium deposition in these vessels thereby minimizing the curie loading on down stream vessels. Effluent of SDS will be collected via direct flow path, in one of the Reactor Coolant Bleed Tanks (RCBT). Samples will be taken to characterize vessel and system performance, and to determine individual curie loadings in all ion exchange liners. It is currently not anticipated that the SDS Monitor Tanks will be used to collect effluent water. An alternative to collect a partial batch would be to use the Miscellaneous Waste Holdup Tank (MWHT), which has a 19,000 gallon capacity.

Radionuclide deposition on the first in-line zeolite beds are not intended to exceed the levels recommended by the DOE task force in their report on SDS zeolite loadings (60,000 curies of cesium). While it is recognized that one objective is to minimize the total number of vessels produced, operationally it is important to proceed with caution until greater experience is gained in using SDS with large quantities of actual Reactor Building sump water. Hence, we intend to initially limit zeolite radionuclide loadings to about 40,000 curies total cesium, with extensive sampling throughout, to characterize zeolite performances. Since this radionuclide limit may not be equivalent to a tank farm batch size of 50,000 gallons, continuous tracking (via on-site sample analysis) of radionuclide deposition will be made to assess liner loadings. Final decisions on liner changeouts will be made based upon liner performance, total curies deposited, and operational considerations. In the event that a 50,000 gallon batch deposits less than the total radionuclide loading on the first zeolite bed to justify removal from service, another tank farm batch (either whole, or in part) can be processed through this train before liner changeout. Total curie deposition will be monitored on a real-time basis via on-site sample analysis.

Ion-exchange material for the four (4) in-line SDS vessels have been selected to satisfy the following objectives:

1. Use inorganic ion-exchange material to minimize the effects of ion exchange material degradation under irradiation.

2. Minimize the total volume of spent ion exchange material based on disposal considerations.

3. Use demonstrated ion-exchange technology to ensure a high degree of confidence in the flow sheet.

To accomplish these goals, we intend to use a homogeneous mixture of Ionsiv™ IE-95 and Linde A zeolites in all four SDS liners. Ionsiv™ IE-95 has a high capacity and selectivity for Cs, and used in the sodium form will provide additional capacity for strontium removal. It is our intention to use the IE-95 in the sodium form. Linde A has a high capacity and selectivity for Sr. Combining these two zeolites in the four SDS vessels will load most of the cesium and strontium in the first in-line vessel. Although the exact percentage mixture of these two types of zeolite has not been confirmed, it is anticipated that the first vessel will be loaded to about 60,000 curies Cs, and about 2,000 curies Sr. The remaining three vessels will contain any breakthrough and further polish the water. The Technical Advisory Group (TAG) concurs with the above flowsheet and is performing additional work to define the exact zeolite mixes.

Attachment 2 identifies our expected liner loadings for the vessels in SDS and EPICOR-II, including anticipated changeout criteria and number of liners generated.

When it is determined that a zeolite bed is ready for changeout, as a result of sample analysis, flow through that train will be isolated, and remaining water in the Tank Farm can be directed through the alternate train, if desired. The loaded liner will be flushed with processed water, disconnected and removed from the train to the dewatering station or storage rack.

Regarding liner changeout, the SDS System provides flexibility for adjusting the position of liners in any of several ways. Based on the use of a mixture of Ionsiv-95 and Linde A zeolites in all four vessels, there should not be breakthrough beyond the second liner position. Therefore, one possible mode of liner changeout after each batch will be to replace the lead bed with a fresh one, or alternatively to move the #2 bed into the lead position, and replace it with a fresh one. Other possibilities are to move the vessels #2 and #3, or #2 through #4, forward. The mode selected will be based on two considerations:

1) Providing maximum assurance of no breakthrough beyond the series of four vessels.

2) Minimum number of vessel handling steps and mechanical connections and reconnections.

Experience gained during the first few large batches of Reactor Building sump water processed through SDS will serve as an excellent review for confirmation of the zeolite types selected for the four (4) in-line SDS resin vessels. As a result of our ongoing review, we may elect to modify the SDS zeolite loadings in order to improve overall system performance to achieve the objective of maximizing cesium and strontium deposition on SDS vessels and to implement our desire to minimize overall waste volume generation.

All water processed through SDS will be collected within one of the three in-plant Reactor Coolant Bleed Tanks (RCBT) or the Miscellaneous Waste Holdup Tank (MWHT). The processed water will be recirculated and sampled to determine the overall effectiveness of SDS in removing radionuclides from the water. Dependent upon the activity of the water and operational requirements, it can be directed to three possible locations. These locations are identified below and the logic is graphically depicted in Attachment 3.

1. Recycle: If it is concluded that additional processing through SDS is desirable, the RCBT water can be transferred back to the Tank Farm for reprocessing. This option will ensure the maximum deposition of Cs and Sr on the SDS liners.

2. PWST: The processed water may be transferred to the Processed Water Storage Tanks (PWST) without further cleanup, provided the radionuclide concentrations are within the limitations established for the PWST's. This option would permit temporary storage of lower activity water for use in gross cleanup and reflooding (if desired) of the reactor building or for use as RCS feed without the need for further cleanup at this time.

3. EPICOR-II: The processed water may be used as feed to EPICOR-II for further polishing and removal of trace radionuclides. The objective for this option is to limit the activity in the PWST's.

Polishing of Reactor Building sump water through EPICOR-II is only intended to remove trace quantities of cesium, antimony, strontium and other isotopes. To successfully remove antimony, sodium must first be removed from the water. The first EPICOR-II liner will be loaded with ion exchange material that is specific for sodium removal. EPICOR-II will be configured with two (2) in-line 6 x 6 liners, followed by a 4 x 4 liner. Assuming an 80% utilization of the resin in a 6 x 6 liner for sodium removal, it is calculated that about 25,000 gallons can be processed through EPICOR-II (from the RCBT) with less than 10% sodium breakthrough. Hence, we intend to process through EPICOR-II in 25,000 gallon batches, and changeout liners based on sodium break. Operation of EPICOR-II will not be altered from the method previously used to process approximately 500,000 gallons of accident water. Only minor hardware changes are planned: changing liner sequence and, perhaps, ion exchange media loadings.

Our intention for the operation of EPICOR-II in the polishing mode is to limit radionuclide deposition in the material to permit disposal in commercial shallow land burial sites without solidification of the resins. However, should this intended operation of EPCIOR-II not be met, disposal of the spent liner may dictate solidification of the resins or the use of high integrity containers. It would be our intent to utilize high integrity containers as the preferred option for disposal.

The leakage collection subsystem of SDS will be in operation during SDS processing to cleanup the water in the leakage containment boxes around the SDS liners and to minimize the overall buildup of activity in the "B" Spent Fuel Pool. It is currently planned to load the leakage containment ion exchangers with organic resin to improve resin performance at the high flow rate through the beds (i.e. 50 gpm). It is our objective to operate this system to limit total curie deposition in these beds to permit shallow land burial in a dewatered condition. A key assumption of this total curie deposition is that only isotopes with half-lives greater than 5 years need be considered in determining whether disposal in the dewatered condition is allowable. This is GPU's understanding of current and probable future commercial shallow land disposal site license conditions and the manner in which they are and will be interpreted. Based upon this objective, it appears that a typical leakage containment ion exchange vessel can remain in-service for about 5 weeks without changeout. Samples will be frequently taken to evaluate resin performance and curie loadings. If there is unanticipated pool leakage resulting in higher (i.e., greater than 1 Ci/cc) ion exchange media loading, or if the service life is calculated to be so short that frequent changeout results in increased waste volume, then the ion exchange media will be allowed to load to less than 10 Ci/ft^3 and alternate methods for waste disposal (i.e., high integrity containers or solidification) will be employed.[1] Should inorganic material be used in the leakage containment ion exchanger, higher loadings than the above limit will be permitted.

Reactor Coolant System (RCS) water processing through the SDS is not expected to differ greatly from processing reactor building sump water. Water from the RCS will be held up in the tank farm for SDS processing, and the effluent will be collected in a bleed tank.

We intend to commence processing with radioactively contaminated fluids that are significantly lower in activity than the Reactor Building sump water. Because the lower activity water will have different chemical characteristics, we will not try to relate ion-exchange performance during this initial processing to later RB sump water processinge. However, implementation of this operational philosophy will permit accomplishment of the following objectives:

1. Perform initial processing with low activity water to gain operator familiarity.

2. Permit the collection of data to provide a realistic basis for the prediction of general area radiation levels during processing of the reactor building sump water and the Reactor Coolant System water.

3. Reduce the flushwater inventory to permit water management flexibility.

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1 In the event disposal utilizing high-integrity containers is required, applicable regulations for the disposal of such material will be followed.

This processing strategy and radionuclide loading strategy represents our current plans for SDS operations. Should these plans change, we will inform you. If you have any questions or comments concerning this matter, please contact Mr. L. J. Lehman, Jr. of my staff.

Sincerely,

G. K. Hovey

G. K. Hovey
Vice-President and
Director, TMI-2

GKH:LJL:lh

Attachments

cc: Dr. B. J. Snyder, Program Director - TMI Office

ATTACHMENT 1

SDS WASTE DISPOSAL

Disposal of waste generated from the operation of SDS is expected to be handled in a variety of ways, dependent upon the anticipated use and curie loading of each type liner (vessel) in SDS and Epicor II. The following describes each vessel type along with primary and secondary (i.e. backup) means for disposal. The table on page 3 of this attachment summarizes this information. Vessel numbers used below are the same as on that table.

SDS LINERS 1 THROUGH 4:

These liners will contain a mixture of IE-95 and Linde 'A' zeolites selected for their effectiveness in removing cesium and strontium respectively. The first vessel in the process train is expected to be loaded to about 60,000 Ci of Cesium and 2,000 Ci of Strontium. The cesium limit is based primarily on limitations of the shipping cask planned for use in transporting the liners while the strontium loading is that expected when the indicated cesium loading is reached. The NRC has previously indicated that for material of this activity level the assumption should not be made that these wastes can be disposed of via commercial shallow land burial. (Reference: NRC letter, Denton to Arnold and Dieckamp, dated May 28, 1980.)

The Department of Energy (DOE) has proposed, in their fiscal year 1982 funding request to Congress, a zeolite vitrification research and development program. The DOE has indicated that this program will entail the processing (vitrification) of 15 to 20 highly loaded liners arising from the operation of the submerged demineralizer system. Assuming favorable Congressional action on this DOE funding request, it is the intent of GPU to ship the loaded SDS liners to the DOE for such processing. It is assumed that disposal would be to an ultimate disposal location, probably a geological repository, when such is established by the Federal Government. Interim storage options for the processed (vitrified) product until such an ultimate disposal location is available could either be on-site in the spent fuel storage pools or other engineered storage or possibly at an interim storage location away from TMI. No secondary disposal method has been defined for these liners.

EPICOR II LINERS 5 THROUGH 7:

It is intended that the loadings on these liners will be kept below 1 µci/cc through administrative controls to permit shallow land burial in a dewatered condition without solidification or without use of a high integrity container (HIC). In the event that this is not practical, or results in excessive waste generation, curie loadings will be allowed to increase to less than 10 ci/ft^3, based upon organic resin usage, and burial will be in high integrity containers at shallow-land disposal sites. [1]

LEAKAGE CONTAINMENT LINERS:

It is intended that these liners will be loaded to less than 1 ci/cc via administrative controls to permit dewatered shallow land disposal without solidification or without use of high integrity containers. In the event that this is not practical, or results in excessive waste generation, curie loadings will be allowed to increase to less than 10 ci/ft^3 (if they contain organic resins) and burial will be in high integrity containers at shallow-land disposal sites.[1]

SDS FILTERS:

From current information on suspended solids in the RB sump water, and the elemental and radioisotopic distribution in these suspended solids, we believe that the operating limit on SDS filters will be mechanical performance (i.e., differential pressure) with little radioactivity deposition, including transuranics. It is anticipated that these filters will be suitable for shallow land burial in commercial sites. In the event that sampling or calculations show the contents of any liner intended to be sent to shallow land burial to exceed the limit for transuranic nuclides the filters will be stored on-site until interim storage, possibly under the auspices of the DOE, can be arranged off-site. It is assumed that material exceeding shallow land burial limits for transuranic nuclides will be placed in an ultimate disposal location, probably a geological repository, when such is establiished by the Federal Government.

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1 In the event disposal utilizing high-integrity containers is required, applicable regulations for the disposal of such material will be followed.

Attachment 1 (continued)

SDS WASTE DISPOSAL

SYSTEM	VESSEL POSITION	PRIMARY DISPOSAL MODE	SECONDARY DISPOSAL MODE	CRITERIA FOR PRIMARY MODE
SDS	1	DOE-Immobilization Interim storage until Repository is available	--------	High Cs Loading High Sr. Loading
SDS	2	Same as SDS No. 1	--------	----------------
SDS	3	Same as SDS No. 1	--------	----------------
SDS	4	Same as SDS No. 1	--------	----------------
EPICOR-II	5	SLB	HIC - SLB	
EPICOR-II	6	SLB	HIC - SLB	<1μCi/cc for SLB
EPICOR-II	7	SLB	HIC - SLB	
Leakage Containment		SLB	HIC - SLB	<1μCi/cc for SLB
SDS Filters		SLB	Interim storage until a repository is available if >10μCi/gm TRU	<10nCi/gm TRU

SLB = Dewatered, shallow land burial

HIC = High Integrity Container, required in lieu of solidification for burial.

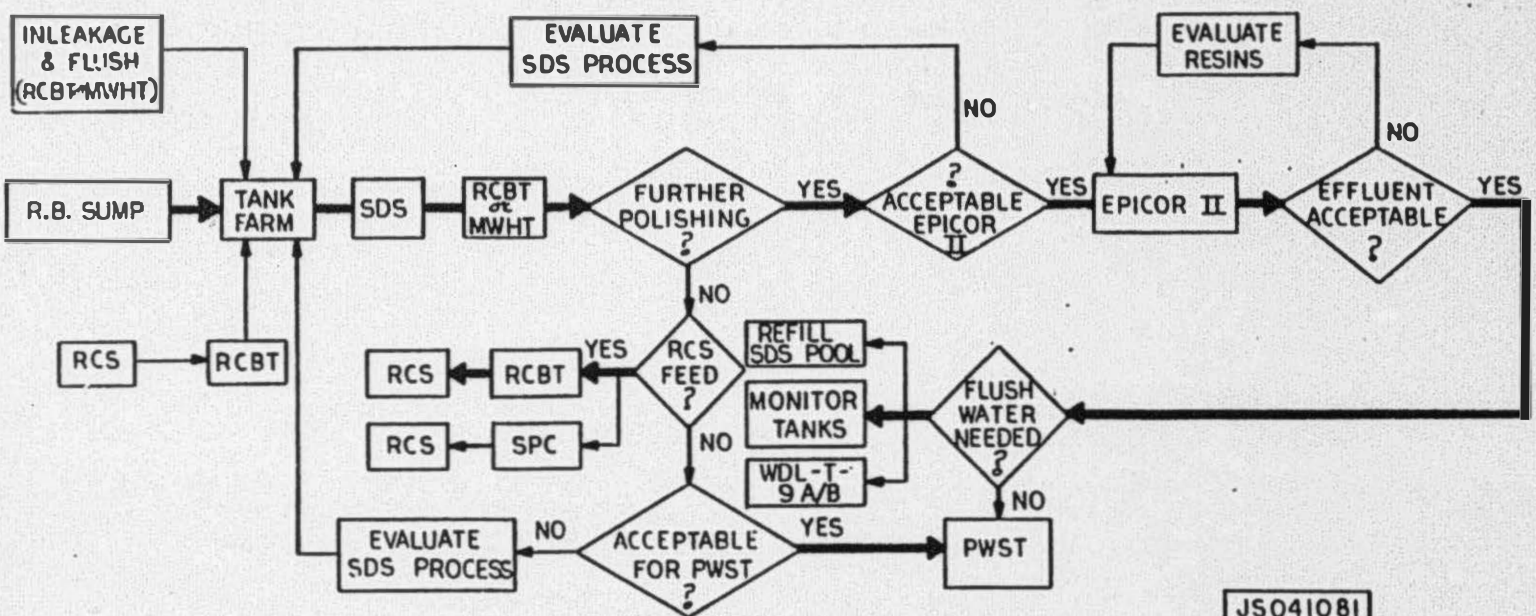
Attachment 2

LINER RADIONUCLIDE LOADING CRITERIA

BASIS: (1) Non-Proprietary Ion-Exchange Material
(2) 600,000 Gallons Sump Water
(3) 90,000 Gallons RCS Water

SYSTEM	VESSEL POSITION	SIZE	FUNCTION	EXCHANGER	CHANGEOUT CRITERIA	REASON FOR CHANGEOUT	CURIES DEPOSITED	No. of LINERS
SDS	1	2 x 4	Cs Removal & Sr Removal	IE-95/ Linde A	60,000 Ci(Cs)	- Zeolite Radiation Stability - Shipping Cask Limit	≈60,000 Curies (Total Cs) ≈2,000 Curies Sr	12-15
SDS	2	2 x 4	Same as SDS No. 1	IE-95/ Linde A	Same as SDS No. 1	- Same as SDS No. 1	N/A	1/train
SDS	3	2 x 4	Same as SDS No. 1	IE-95/ Linde A	Same as SDS No. 1	- Same as SDS No. 1	N/A	1/train
SDS	4	2 x 4	Same as SDS No. 1	IE-95/ Linde A	Same as SDS No. 1	- Same as SDS No. 1	N/A	1/train
EPICOR-II	5	6 x 6	Na Removal	Strong Acid Cation, Mixed Cation/ Anion	25,000 Gals. or 20 Ci γ-emitter Na break	- Minimize Na Breakthrough - Operational Convenience - Liner handling limit (Bare Pick) - Shipping considerations	<20 Curies γ-emitters	20-30
EPICOR-II	6	6 x 6	Polishing	Organic Cation/Anion	20 Ci γ-emitter	Liner Handling limit Shipping Considerations	<20 Curies γ-emitters	<5
EPICOR-II	7	4 x 4	Polishing Backup	Organic Cation/Anion	20 Ci γ-emitter	Same as EPICOR-II 6	<20 Curies γ-emitters	<5

PROCESSING LOGIC PLAN



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