Met-Ed / GPU

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May 29, 1981
LL2-81-0124

TMI Program Office
Attn: Mr. Lake 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)
Operation License No. DPR-73
Docket No. 50-320
Submerged Demineralizer System

During discussions with members of your staff, you requested that we provide our estimate of the number of filters to be generated during SDS operations. You further requested that we estimate the total amount of radioactivity to be deposited in the filter vessel as well as our planned method of disposal. This estimate should include transuranics loading. You requested that we provide you with a description of the filter dewatering technique.

This letter responds to that request and is intended to address those concerns for processing sump water except for transuranics loadings. RCS water processing as it relates to filter loading will be addressed at a later time. Transuranics loading of the filter will be addressed when we address criticality concerns, by May 29, 1981.

The planned method of disposal of the prefilter and final filter is to ship them to shallow land disposal. From current information on suspended solids in the RB sump water, see ORNL/TM-7448, 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. It is anticipated that these filters will be suitable for shallow land burial in commercial sites. The filter dewatering technique is described in the System Description Document, submitted to you on May 11, 1981.

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We have prepared our estimate of filter loadings while processing Reactor Building sump water. Estimates concerning filter loading while processing of Reactor Coolant System water are provided below.

The SDS filtration system is composed of two series filters, a 125 micron filter element preceding a 10 micron filter element. The filters will be installed in the "B" Spent Fuel Pool to take advantage of the radiation shielding provided by the pool water. In the process flow stream, the filters are upstream of the tank farm to preclude the deposition of a significant amount of solids into the tanks.

We intend to provide flow from the Reactor Building sump to the tank farm using a floating pump that takes suction just below the water surface. This flow scheme has many advantages, one of which is that it is expected to provide the capability to fill the tank farm tanks with little solids entrainment in the flow stream. Furthermore, it is estimated that particles greater than 10 microns have settled to the bottom of the sump, leaving small amounts of particulates for entrainment in the SDS processing flow stream. Because of the expected low concentration of particulates in the process flow stream, we estimate that one prefilter and two final filters will be used for filling the feed tanks until the pump nears the bottom of the sump. As the pump nears the bottom of the sump, the influent solids concentration may increase such that an increased number of filters may be required.

It is important to note that the design intent of the SDS filter installation is to protect the downstream ion-exchange media from any possible significant particulate loading. These filters are not intended for use in removing sludge from the sump. Until that sludge can be better characterized, in terms of its quantity and physical and chemical properties, no decision can be made as to adaption of the SDS, or use of any other system, for its removal.

We have performed an analysis of the radiological loading of the expended filter vessels. Using the assumption: that the filter volume completely fills, the contents of the completely filled filter (worst case assumptions) would contain less than 1 curie in either the prefilter or the final filter. This radionuclide loading corresponds to a loading concentration (assuming uniform distribution) of less than 1 µCi/ml in both the prefilter and the final filter; they are suitable for shallow land burial. See attachment 1 to this letter for specific assumptions used and the basis for this estimate.

Our current intended mode of operation for processing RCS water requires that let-down to the RCBT occur prior to initiating influent flow to the SDS. RCS water will then be transferred to the tank farm, on a batch basis, prior to SDS processing.

Using preliminary results of RCS sample analysis for suspended solids provided to GPU we estimate that processing RCS water through the SDS filters will not contribute to the deposition of solids in the filters. This is based on the fact that analysis indicates that there are no particles greater than 5 microns in suspension, 14.7% of the suspended solids are in the size range of 1.2 microns to 5 microns, and 85.3% of the suspended solids are in the size range of 0.45 microns to 1.2 microns.

Based on this information it is anticipated that suspended solids in the RCS will not be deposited on the SDS filters but will be passed through. Some of these solids will remain in the tank farm tanks while it is expected that the remainder of the solids will be retained on the zeolite beds.

We have analyzed the potential for degradation of the zeolite beds as a result of deposition of these small size suspended solids onto the bed. Our analysis indicates that these size solids are too small to contribute to plugging of the top layer of the bed and too large to enter the zeolite pores. It is believed that there is sufficient void space in the first zeolite bed to accommodate the entire quantity of solids estimated (0.129 mg/ml). Attachment 2 to this letter provides the basis for the above statement.

It is to be noted that this analysis is based upon one suspended solids analysis of one RCS sample. It is not known if the sample is representative; the RCS is stagnant. Furthermore, the analysis is performed for solids that are suspended in solution and does not account for non-suspended solids in the RCS let-down flow stream. However, it is believed that non-suspended solids in the RCS flow stream will remain in the RCBT due to the low flowrate from the RCBT to the tank farm; particulate matter will probably not be entrained.

Should you wish to discuss this matter further, 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:be

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

Estimate Filters Which Will Expended if Solids Settling Occurs.

Assume the solids settle according to Stokes Law:

$$V = \frac{2\, ga^2(d_1-d_2)}{9\, n}$$

Where: V= Settling velocity in cm/sec

g= 980.621 cm/sec^2

a= Radius of falling sphere in cm.

d_1= Density of sphere in g/cm^3

d_2= Density of Medium in g/cm^3

n= Coefficient of viscosity in poises (gpm/cm-sec)

Determine Density of Species Which Will Settle Out:

ORNL-7448 states that the precipitates are predominantly Fe, Ni, Al & Cu hydroxides and some finely divided matter.

$Cu(OH)_2$	= 3.368 g/cc	Density
$Al(OH)_3$	= 2.42 "	"
$Ni(OH)_2$	= 4.15 "	"
$Fe(OH)_2$	= 3.4 "	"

Solids content of samples has Sr activity.

SrO	= 4.7 g/cc	Density
$Sr(OH)_2$	= 3.625 g/cc	"
$SrCO_3$	= 3.70 g/cc	"

$SrSO_4$ = 3.96 g/cc Density
$Sr(OH)_2 \cdot 8H_2O$ = 1.90 g/cc Density

Since $Sr(OH)_2 \bullet 8H_2O$ and $Al(OH)_3$ are least dense of species and slowest to settle out, use these two as basis for settling calculations.

Calculate Settling Velocity, V, for 0.1u, 1.0u, 10u, 25u, 50u, 75u, and 125u, Diameter Particles Of 1.90 g/cc and 2.42 g/cc Density.

$$V = \frac{2\ ga^2(d_1-d_2)}{9\ n}$$

a= As Required (See Below)
g= 980.621 cm/Sec^2
d_1= 2.42 or 1.90 g/cm^3
d_2= 1.10 g/cm^3
n= 0.008904 g/cm-sec for H_2O @ 25°C

Values:

Particle Size	Diameter (cm)	Radius (cm)=a
125 μ	0.0125	6.25×10^{-3}
75 μ	0.0075	3.75×10^{-3}
50 μ	0.0050	2.5×10^{-3}
25 μ	0.0025	1.25×10^{-3}
10 μ	0.0010	5.0×10^{-4}
5 μ	0.0005	2.5×10^{-4}
1 μ	0.0001	5.0×10^{-5}
0.1 μ	0.00001	5.0×10^{-6}

SETTLING VELOCITIES FOR 2.42 g/cc PARTICLES:

$$V_{2.42} = \frac{2(980.621)\,(a)^2\,(2.42 - 1.10)}{9\,(8.904 \times 10^{-3})}$$

$$V_{2.42} = 3.23 \times 10^4\,(a)^2$$

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125 μ ; $V_{2.42} = 3.23 \times 10^4 (6.25 \times 10^{-3})^2 = 1.26$ cm/sec

75 μ ; $V_{2.42} = 3.23 \times 10^4 (3.75 \times 10^{-3})^2 = 4.54 \times 10^1$ cm/sec

50 μ ; $V_{2.42} = 3.23 \times 10^4 (2.5 \times 10^{-3})^2 = 2.02 \times 10^{-1}$ cm/sec

25 μ ; $V_{2.42} = 3.23 \times 10^4 (1.25 \times 10^{-3})^2 = 5.05 \times 10^{-2}$ cm/sec

10 μ ; $V_{2.42} = 3.23 \times 10^4 (5.0 \times 10^{-4})^2 = 8.08 \times 10^{-3}$ cm/sec

5 μ ; $V_{2.42} = 3.23 \times 10^4 (2.5 \times 10^{-4})^2 = 2.02 \times 10^{-3}$ cm/sec

1 μ ; $V_{2.42} = 3.23 \times 10^4 (5.0 \times 10^{-5})^2 = 8.08 \times 10^{-5}$ cm/sec

0.1 μ ; $V_{2.42} = 3.23 \times 10^4 (5.0 \times 10^{-6})^2 = 8.08 \times 10^{-7}$ cm/sec

SETTLING VELOCITIES FOR 1.90 g/cc PARTICLES:

$$V_{1.90} = \frac{2(980.621)\ (a)^2\ (1.90 - 1.10)}{9\ (8.904 \times 10^{-3})}$$

$$V_{1.90} = 1.958 \times 10^4\ (a)^2$$

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125 μ ; $V_{1.90} = 1.958 \times 10^4\ (6.25 \times 10^{-3})^2 = 7.65 \times 10^1$ cm/sec

75 μ ; $V_{1.90} = 1.952 \times 10^4\ (2.5 \times 10^{-3})^2 = 1.22 \times 10^1$ cm/sec

50 μ ; $V_{1.90} = 1.958 \times 10^4\ (2.5 \times 10^{-3})^2 = 1.22 \times 10^{-1}$ cm/sec

25 μ ; $V_{1.90} = 1.958 \times 10^4\ (1.25 \times 10^{-3})^2 = 3.06 \times 10^{-2}$ cm/sec

10 μ ; $V_{1.90} = 1.958 \times 10^4\ (5.0 \times 10^{-4})^2 = 4.90 \times 10^{-3}$ cm/sec

5 μ ; $V_{1.90} = 1.958 \times 10^4\ (2.5 \times 10^{-4})^2 = 1.22 \times 10^{-3}$ cm/sec

1 μ ; $V_{1.90} = 1.958 \times 10^4\ (5.0 \times 10^{-5})^2 = 4.90 \times 10^{-5}$ cm/sec

0.1 μ ; $V_{1.90} = 1.958 \times 10^4\ (5.0 \times 10^{-6})^2 = 4.90 \times 10^{-7}$ cm/sec

SETTLING TIME; T= 8.2 ft. (2.54 cm/in.) (12 in/ft)

$$T(\text{hr.}) = \frac{6.94 \times 10^2}{V}$$

Particle Size	$V_{1.90}$	$T_{1.90}$(Hr)	$V_{2.42}$	$T_{2.42}$(Hr)
125 µ	(7.65×10^{-1})	9.07×10^{-2}	(1.26)	5.5×10^{-2}
75 µ	(2.75×10^{-1})	2.52×10^{-1}	(4.54×10^{-1})	1.53×10^{-1}
50 µ	(1.22×10^{-1})	5.69×10^{-1}	(2.02×10^{-1})	3.44×10^{-1}
25 µ	(3.06×10^{-2})	2.27×10^{0}	(5.05×10^{-2})	1.37×10^{0}
10 µ	(4.90×10^{-3})	1.42×10^{1}	(8.08×10^{-3})	8.59×10^{0}
5 µ	(1.22×10^{-3})	5.69×10^{1}	(2.02×10^{-3})	3.44×10^{1}
1 µ	(4.90×10^{-5})	1.42×10^{3}	(8.08×10^{-5})	8.59×10^{2}
0.1 µ	(4.90×10^{-7})	1.42×10^{5}	(8.08×10^{-7})	8.59×10^{5}

Based on the above conservative analysis, using the surface succion pump to pump sump water through the SDS 125µ prefilter and 10 µ final filter for feed tank fill, the majority of the sump water can be filtered using only one prefilter and one final filter until the sump pump nears the RB filter. At this time the possibility exists that additional solids will be entrained in the liquid flow stream for deposition on the SDS filters. Estimates of filter usage under these conditions cannot be made because of the uncertainty of assumptions that might be used.

ƛUME OF SOLIDS IN 90,000 GALLONS OF RCS, BASED ON SUSPENDED SOLIDS RTED BY EXXON OF .129 mg/ml AND ASSUMING (CONSERVATIVELY) A DENSITY 1 g/ml. :

$$\frac{.129\ \text{mg}}{\text{ml}} \times \frac{3785\ \text{ml}}{\text{GAL}} \times 90{,}000\ \text{GAL} \times \frac{1}{10^3\text{mg}} \times \frac{1}{1\text{g/ml}} \times \frac{\text{cm}^3}{\text{ml}} \times \frac{\text{m}^3}{10^6\text{cm}^3}$$

$$= 4.4 \times 10^{-2}\ \text{m}^3$$

THE VOLUME OF VOID SPACE AVAILABLE IN 8 FT^3 OF ZEOLITE, ASSUMING 30% VOID SPACE:

$$8\ \text{FT}^3\ \text{RESIN} \times \frac{.3\ \text{FT}^3\ \text{VOID SPACE}}{\text{FT}^3\ \text{RESIN}} \times \frac{.028317\ \text{m}^3}{\text{FT}^3} = 6.8 \times 10^{-2}\ \text{m}^3$$

NO. OF SDS LINERS REQUIRED:

$$\frac{4.4 \times 10^{-2}\ \text{m}^3}{6.8 \times 10^{-2}\ \text{m}^3} = .65$$