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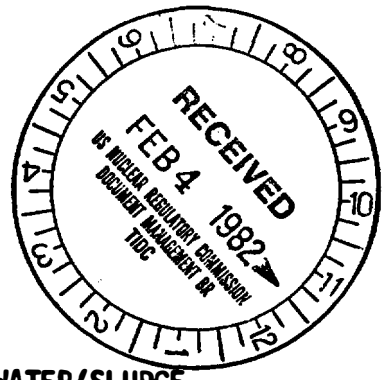

MEMORANDUM FOR: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

FROM: Bernard J. Snyder, Program Director
TMI Program Office
Office of Nuclear Reactor Regulation

SUBJECT: PRELIMINARY RESULTS OF CONTAINMENT SUMP WATER/SLUDGE AND MAKE-UP FILTER RESIDUE ANALYSES - TMI-2

The purpose of this memorandum is to provide you with the latest results of radiochemical analyses of containment sump water/sludge and material obtained from the Make-Up and Purification System (Letdown and Make-Up) filter. These results should be regarded as preliminary as they are based on unpublished data and analyses. Nevertheless, these preliminary results provide additional information regarding damage to the core resulting from the accident and the distribution and location of fission products and core materials. These results supplement the information provided in our paper (Sampling and Analysis of Sump Water From TMI-2 Containment, L.G. Bell, TMIPO) in the NRR Monthly Technical Report for August 1981. A copy of our paper is enclosed for your information.

PRELIMINARY CONCLUSIONS

The results of the containment sump water/sludge analyses indicate the presence of a significant amount of control rod material (Silver and Cadmium) relative to fuel material (U-235 and U-238) in the basement sludge. The results also indicate that current estimates of the total quantity of fissile material in the basement sludge are well below that required for a critical mass.

The results of the make-up filter residue analysis indicate that as much as 75 to 90% of the filter residue could be core debris with the major constituent oxidized fuel cladding (ZrO2).

DISCUSSION

Containment Sump Water/Sludge Analysis

On May 14, 1981, samples of containment sump water were taken during containment entry No. 10 and shipped to EG&G, Idaho for offsite analysis. Samples were collected from the basement (i.e., 282' level) floor and at 5 inches, 48 inches and 85 inches from the basement floor. The samples taken from the basement floor contained sludge as well as liquid. There were no observable particulates in the samples taken at the other positions. A variety of radiochemical analyses were performed on the samples including: (1) Measurement of

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radionuclide specific activities in basement sludge (i.e., filtered insoluble material), (2) Fissile material assay, (3) Neutron activation analysis of basement sludge, (4) Determination of I-129 concentration, and (5) Elemental identification (qualitative analysis only) of basement sludge by X-ray fluorescence. The results of these analyses are summarized below.

1. Specific activity (uCi/g) of filtered, washed and dried basement floor sludge.

Radionuclide	Specific Activity, uCi/g
Mn-54	1.7
Co-60	11.4
Sr-90	780
Ru-106	76
Ag-110m	4.4
Sn-113	2.6
Sb-125	435
Cs-134	179
Cs-137	1290
Ce-144	44

The results indicate that the predominant activity in the sludge consists of cesium and strontium radionuclides.

2. Fissile material assay.

	Sample Location Above Basement Floor				
	85"	48"	5"	0"	
				Liquid	Solid
Radionuclide	ug/ml	ug/ml	ug/ml	ug/ml	ug/g. solids
U-235**	NDA*	NDA	NDA	0.08	104

*no detectable activity (0.01 ug/ml is lower limit of detection).
**all fissile material assumed to be U-235.

The results indicate that, based on an estimated 100*** cubic feet of sludge in the containment sump, the estimated inventory of fissile material in the sludge is well below that required for a critical mass.

***Volume of sludge based on PEIS estimates Pg. 5-30.

3. Neutron activation analysis of basement sludge.

Element	Percent by Weight
Sodium	0.19
Aluminum	1.06
Potassium	0.17
Titanium	1.4
Manganese	0.24
Iron	15
Copper	10.4
Zinc	1.8
Silver	1.6
Cadmium	0.64
Iodine - 129	0.065
Uranium - 235*	0.0104
Uranium - 238	0.39

*Fissile material, assumed to be U-235.

The results indicate the presence of a significant amount of control rod material (Silver and Cadmium) relative to fuel material (U-235 and U-238).

The ratio of control rod material to fuel material would be consistent with the assumed melting of a significant amount of relatively low melting point (i.e., relative to the melting point of fuel) control rod poison (1472^{0} F) and stainless steel cladding (2550^{0} F) and corresponding mass transfer out of the primary system during the blowdown phase of the accident. The melting temperature of the fuel is 5080^{0} F and the fuel would be more capable than the control rod of withstanding the conditions experienced during the accident.

4. Determination of I-129 concentration.

	Sample Location	Above	Basement	Floor
	85"	48"	5"	0"
Radionuclide	Concentration		uCi/ml	
I-129	5.5×10^{-6}	5.4×10^{-6}	3.8×10^{-6}	2.5×10^{-6}

The results indicate a total inventory of approximately 1.2×10^{-2} Ci of I-129 in the unprocessed sump water.

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5. Elemental identification of basement sludge by X-ray fluorescence. The qualitative analysis of basement sludge by X-ray fluorescence yielded the following elements: Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, Pb, U, Zr, Mo, Cd, In, and Sn.

Make-Up Filter Residue Analysis

A 0.5 gram sample of residue from a filter cartridge removed from the Make-Up and Purification System was analyzed by B&W for its chemical constituents as indicated below:

Compound	Weight Percent
ZrO2	35-50
Ag_2O	12
CdO	11
Fe_2O_3	7
UO2	6
SrO	3
SiO2	1.8
Al_2O_3	0.8

The results indicate that as much as 75 to 90% of the make-up filter residue could be core debris with the major constituent oxidized fuel cladding (ZrO2).

The data and analyses obtained to date represent the first of a number of planned efforts to locate and quantify core fission products and materials. Other possible locations where core and fuel debris are expected include the reactor coolant drain tank, reactor coolant bleed tanks, steam generators, pressurizer and components in the letdown system.

I will provide you with updated information on the distribution and location of core fission products and materials as it becomes available.

Bernard J. Snyder, Program Director
TMI Program Office
Office of Nuclear Reactor Regulation

Enclosure: As stated

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ENCLOSURE

SAMPLING AND ANALYSIS OF SUMP WATER FROM TMI-2 CONTAINMENT

TMI Program Office

By Lawrence Bell, Safety Review Section

On May 14, 1981, during containment entry No. 10, samples of containment sump water were taken to provide data for use in processing the water through the Submerged Demineralizer System. The samples were taken from the basement water through a covered equipment hatch by means of a long-handle tool called a sample tree, which was outfitted with sample bombs at various locations along its length. When the sample tree was placed in position, an operator mechanically punctured the evacuated sample bombs to collect the samples. After a prescribed period of time, the operator retracted the puncture tool and the sample bomb resealed itself. Samples were collected at the following approximate heights in inches above the basement floor: 85 (near the surface of the sump water), 48, 5, and 0. The samples taken from the bottom contained sludge as well as liquid. There were no observable particulates in the samples taken at the other positions.

Sample analyses were performed by EG&G, Idaho. The results for the concentrations of the principal fission products and fissile materials are provided below.

	Sample Location Above Basement Floor				
	85"	48"	5"	0"	
				Slurry Particulate	
Nuclide	µCi/ml	µCi/ml	µCi/ml	µCi/ml	µCi/gram of solids
Sr-90	5.4	5.2	5.1	NA	780
Cs-134	18.5	18.4	18.6	18.7	179
Cs-137	143	142	143	144	1290
	µg/ml	µg/ml	µg/ml	µg/ml	mg/gram of solids
U-235	<0.01*	<0.01*	<0.01*	NA	0.085
Pu-239	0.00022	NA	NA	0.0026	0.0029

NA means not analyzed.

* 0.01 is the lower limit of detection for the sample analysis.

The results are consistent with previous analyses of samples of sump water and indicate that there is little, if any, stratification of dissolved activity in the sump water and little dissolved fissile material. Further, based on an estimated volume of 100 cubic feet of sludge in the containment sump, the estimated inventory of fissile material in the sludge is well below that required for a critical mass. The next samples are scheduled to be taken on September 24, 1981, and will include sump sludge in the vicinity of the reactor coolant drain tank.