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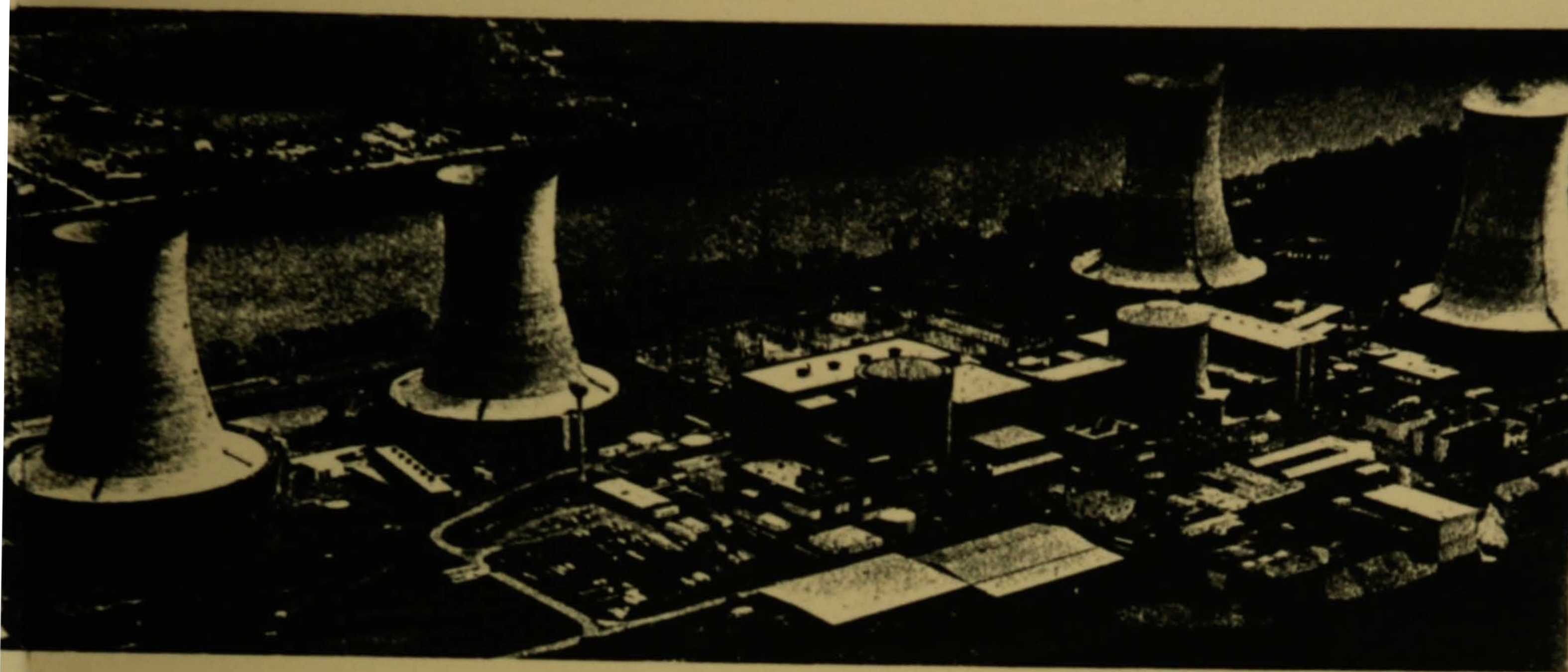

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REACTOR BUILDING BASEMENT RADIONUCLIDE AND SOURCE DISTRIBUTION STUDIES

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Getachew Worku

Prepared for the
U.S. Department of Energy
Three Mile Island Operations Office
Under DOE Contract No. DE-AC07-76ID01570

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ABSTRACT

The Three Mile Island Unit 2 (TMI-2) Reactor Building basement has been sampled several times since August 1979. This report compiles the analytical results and sample history for the liquid and solid samples obtained to date. In addition, basement radiation levels were also obtained using thermoluminescent dosimeters (TLDs). The data obtained will provide information to support ongoing mass balance and source term studies and will aid in characterizing the 282-ft elevation for decontamination planning and dose reduction.

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REACTOR BUILDING BASEMENT RADIONUCLIDE AND SOURCE DISTRIBUTION STUDIES

INTRODUCTION

As a result of the March 1979 accident at TMI-2, a large volume of water was released to the Reactor Building 282-ft elevation. Prior to sampling and examination of this water, it was believed that the basement contained two phases of material, a solids layer on the floor that could be up to several inches thick and a water layer whose radionuclide concentration might be stratified within the liquid.

The basement has been sampled several times beginning in August 1979. The results of this sampling have been reported in GEND INF-011 Vols. I and II. These reports dealt principally with the sampling of accident basement water.

In September 1981, the Submerged Demineralizer System (SDS) began processing the basement water. Some of the process water has been used for Reactor Building decontamination and subsequently returned to the 282-ft elevation through floor drains. This report contains data from earlier samples of accident water and data from samples taken after SDS processing and surface decontamination. The intent is to follow the changes of selected fission product concentrations that resulted from processing and decontamination, and to document attempts to characterize the 282-ft elevation for decontamination planning and dose reduction.

BASEMENT FLOODING

The space between the floors on elevation 282 ft 6 in. and 305 ft in the Reactor Building is referred to as the basement. Before the basement water processing began in September 1981, an estimated volume of 2.42×10^6 L of water had accumulated, rising to a depth of 2.59 m. This water is attributed to three major sources: the Reactor Coolant System, the Reactor Building sprays, and the River Water Cooling System.

Accident Water

The first three sources of basement water were created as a result of the accident and its effects. The breakdown of these follows:

- Reactor Coolant System (RCS)

  RCS water discharge through the pressurizer's pressure-operated relief valve (PORV) and Reactor Coolant Drain Tank (RCDT) rupture disc to the basement accumulated $\sim 1.00 \times 10^6$ L. For over two years following the accident, an average RCS leak rate of 0.49 L/min through the PORV block valve yielded $\sim 6.74 \times 10^5$ L. The total volume of RCS water to the basement was close to 1.68×10^6 L or 69% of basement water volume.

- Reactor Building Sprays

  As a result of the hydrogen burn pressure spike, the Reactor Building sprays activated and remained on for 5 min and 40 s, discharging chemically treated water containing boron and sodium hydroxide to the Reactor Building. Most of this water eventually drained to the basement, increasing the sodium ion concentration of the basement water. This volume was estimated at 6.44×10^3 L or 3% of the basement water volume.

- River Water Cooling System

  An investigation into unaccountable increases of the basement water level attributed the increase to leakage from the Reactor Building air coolers' river water cooling system. The leakage is suspected to have been from a relief valve on the cooling coils. The quantity of water from this source is estimated to be 6.81×10^5 L or 28% of the basement water.

Decontamination Water

After some of the initial accident water had been removed from the basement and processed through the SDS and EPICOR systems, it was recycled for use in Reactor Building decontamination work. The decontamination work added water to the basement when upper levels of the building were sprayed with high-pressure water and when the basement walls were flushed through the seismic gap. This decontamination water carried additional fission products from upper levels to the basement and simultaneously diluted the concentration of fission products already in the basement. To date, this decontamination water has resulted in approximately 1.39×10^6 L of water being added to the basement.

A schematic of the reactor building water level variations from June 1979 to March 1983 are shown in Figure 1. Water level fluctuations shown after March 1982 are due to decontamination flushing and SDS operations.

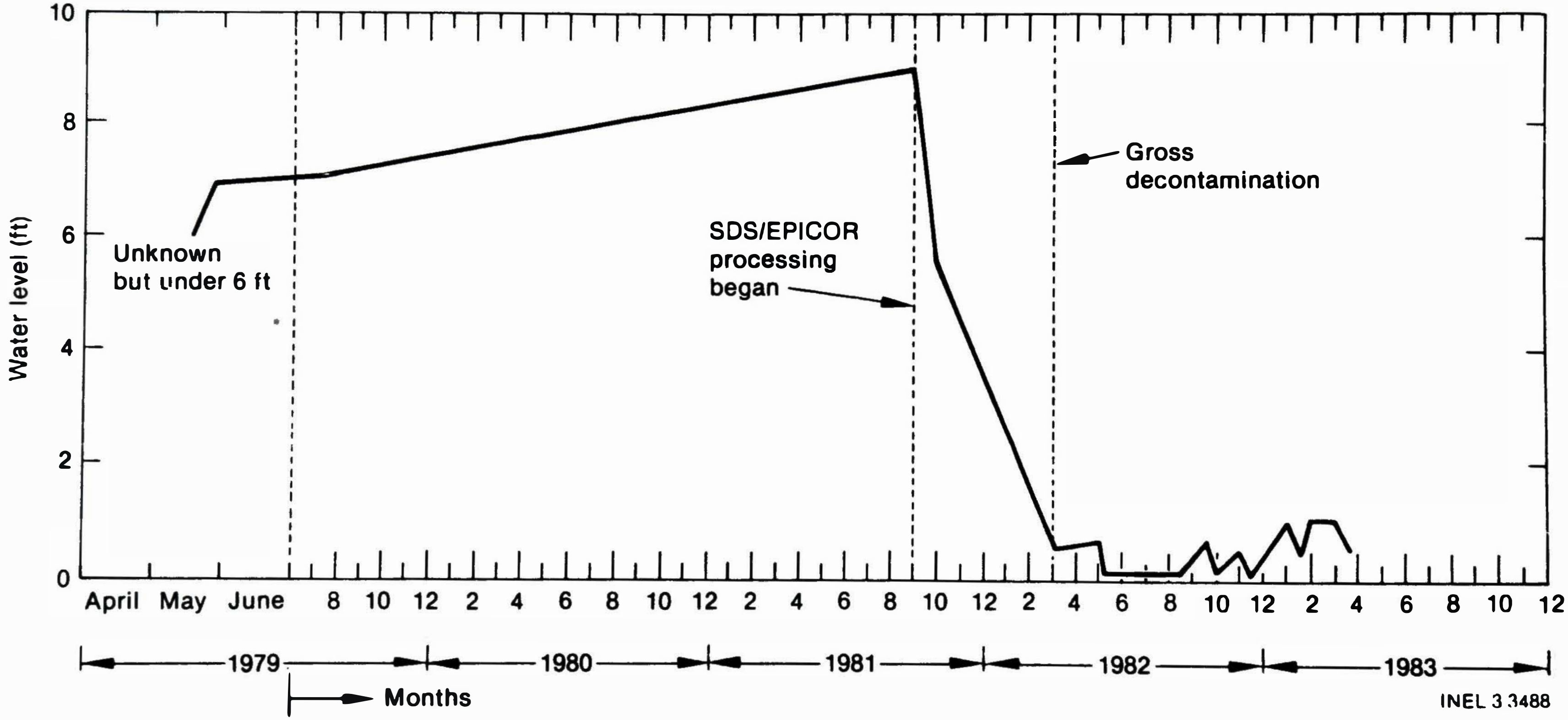

Figure 1. Reactor Building water level.

BASEMENT CHARACTERIZATION

Since August 1979, a number of efforts have been made to characterize the reactor building basement. These efforts have included sampling of the basement water and solids on the floor, radiation measurements using beta-gamma thermoluminescent dosimeters (TLDs), and visual surveys using a closed-circuit television (CCTV) system.

Liquid and Solids Samples

Samples were obtained to cover two areas of interest. Samples of liquids and solids obtained prior to SDS processing were taken to characterize the accident release volumes of radionuclides and to quantify what radionuclide would be encountered during processing. Samples taken after SDS processing have focused on basement solids characterization to determine the extent of the basement solids and to determine the most effective way to remove and process the solids.

Table 1 shows the dates samples were obtained, the sampling locations, the number of samples taken, and the laboratories to which the samples were transported for analysis. The data cover sampling for both liquid and solid samples.

Sampling Techniques

These samples were obtained through a variety of methods. The 8/28/79 and 11/15/79 samples were obtained by inserting flexible tubing through Reactor Building penetration 401 and pumping a quantity of basement water and solids into a sample container.

The 5/14/81 samples were obtained using a vacuum-actuated, plunger-operated sampler called a water and solids sampling device. This sampler obtained 8 samples simultaneously from 3 levels in the water and from the basement floor. Duplicate samples were obtained at each of the four sampling elevations. A detailed description of this sampler is contained in References 1 and 2.

TABLE 1. SAMPLING SCHEDULE

Date	Location	No. of Samples	Analytical Lab[a]
08/28/79	Penetration 401	1	ORNL
11/15/79	Penetration 401	1	ORNL
05/14/81	305-ft elevation (covered equipment hatch)	8	INEL
09/24/81	305-ft elevation (open stairwell)	1	INEL
06/23/82	Bottom of open stairwell	1	INEL, ORNL, WHEDL
01/11/83	305-ft elevation (covered equipment hatch)	1	PNL/TMI
01/11/83	N.E. quadrant Penetration 238	1	PNL/TMI
01/11/83	S.W. quadrant Penetration 225	1	PNL/TMI

a. ORNL--Oak Ridge National Laboratory
INEL--Idaho National Engineering Laboratory
WHEDL--Westinghouse Hanford Engineering Development Laboratory
PNL/TMI--Pacific Northwest Laboratory's mobile response facility at TMI.

The 9/24/81 sample was obtained using a vacuum actuated, plunger operated sampler called a single level sump sampling device. Using this sampler, a single sample from the basement floor was obtained. A detailed description of this sampler is contained in Reference 2.

The 6/23/82 sample was obtained using a metal scoop which was carried to the bottom of the open stairwell and used by entry personnel to scoop solids from the basement floor. An attempt was made to obtain a larger fraction of solids than had been obtained in earlier samples. This attempt was only partially successful because the solids layer was thin and the loosely bound solids tended to slip away from the sampling scoop.

The 1/11/83 sample was obtained using an solenoid actuated sump solids sampling device. This device, shown in Figure 2, was designed after the difficulties encountered in attempting to obtain larger solids samples with the metal scoop. The sampler uses a wide scoop to cover a broader area of sampling surface. The sampler is actuated by electrically opening a solenoid valve with a 24-volt power source The sample is drawn into the sample body by vacuum. The solids sampler volume capacity is ~50 mL when full.

Sample Data

The available data from the sampling efforts are shown in Tables 2 and 3. Analysis of the 1/11/83 samples are continuing, and these results will be published at a later date. The results show that the principal radionuclides present are ^{137}Cs and ^{90}Sr. Also present are fuel, control rod material, cladding, and structural material. The majority of the ^{137}Cs appears to be in the liquid while the ^{90}Sr and reactor materials are in the solids. However, the lack of a definitive mass for the solids makes quantification of the liquid and solids fractions uncertain. Shown in Table 4 are some additional chemical analyses performed on the liquid sample fractions of the samples indicated in the table.

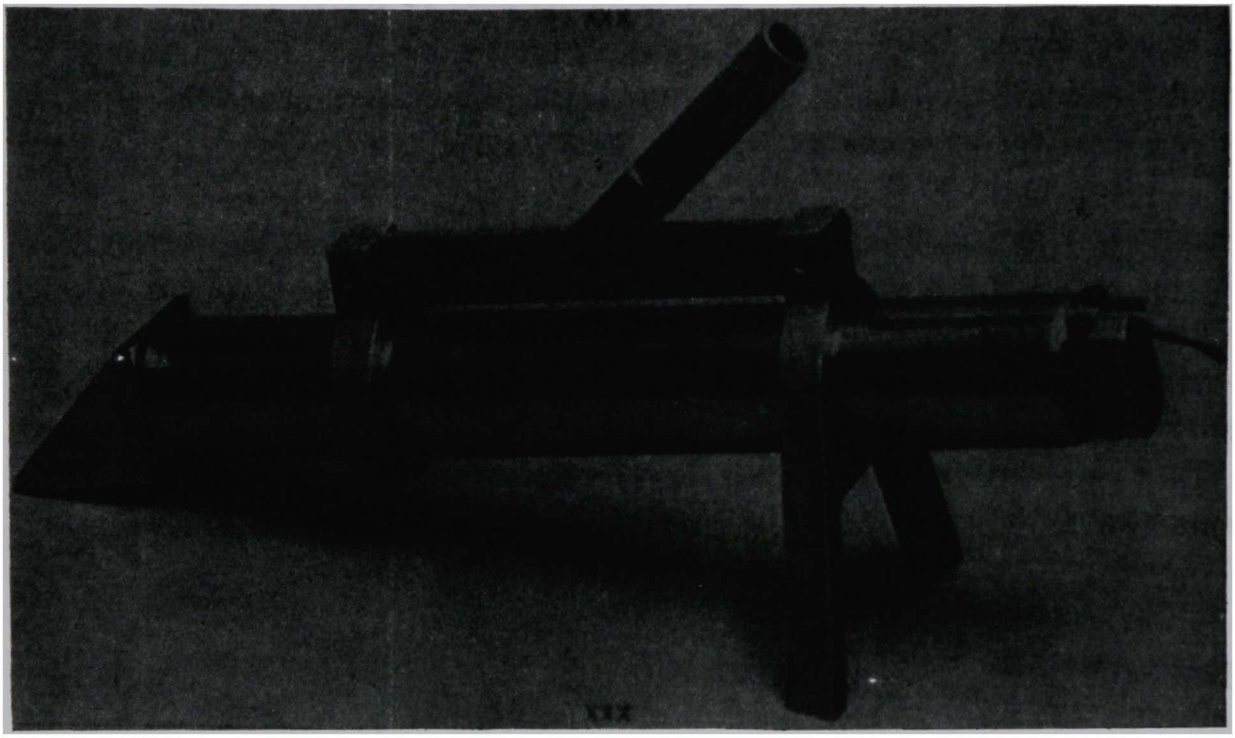

Figure 2. Solenoid-operated sampler used to obtain sludge samples from basement floor.

TABLE 2. SUMMARY OF REACTOR BUILDING BASEMENT ANALYSIS--LIQUID ANALYSIS

	Penetration 401		Entry 10,	Entry 16,	Entry 68, Made 6/23/82		Entry 152, Made 1/11/83		
	Made 8/28/79 by ORNL	Made 11/15/79 by ORNL	Made 5/14/81 by INEL	Made 9/24/81 by INEL	by ORNL	by WHEDL	by PNL-1	by PNL-2	by PNL-3
Activity decay date	8/28/79	7/1/79	5/14/81	9/24/81	10/5/82	8/30/82	2/11/83	2/11/83	2/11/83
Activity of liquid (μCi/mL)									
^{134}Cs	39.6	26	19.3 (1)[a]	16.2 (0.1)	12.7	13.5 (0.1)	0.95	0.65	0.64
^{137}Cs	174	160	144 (1)	137 (3)	150	158 (1)	12.0	8.20	19.2
^{90}Sr	2.83	2.3	5.3 (0.5)	4.8 (0.2)	6.93	5.8	2.49	2.36	3.44
Fuel in liquid									
U (μg/mL)	2.8E-2	--	--	<3E-2	1.6E-2	5E-3	[Analysis being performed]		
Pu (μg/mL)	3.3E-5	--	2.2E-4	--	5.6E-5	<1E-4			
Composition of liquid (ppm)									
B	1900	2000	2290[b]	2300[b]	3000[c]	8000[c]	Analysis being performed		
Ca	8	--	39	41	30	20			
K	4	--	16	20	70	200			
Na	1200	1200	1219	1241	~3000	6000			
Si	--	--	3.3	6.8	20	90			
Mg	<1	--	5.2	7.3	5	80			
Fe	1.8	--	<0.1	0.7	0.6	3			
Cu	10	--	<1	<1	5	5			
Al	3[d]	--	1.2	1.8	3	9			
Ag	<0.3	--	<1	<1	0.3	--			
Zr	--	--	1.9	1.4	<0.4	--			

a. Number in parentheses is for counting statistics only at a 2 sigma level. Absolute errors are probably ±5%.

b. Analyses by emission spectrometry (2k means 2000).

c. Analyses by spark source mass spectrometry.

d. Analyses by atomic absorption.

TABLE 3. SUMMARY OF REACTOR BUILDING BASEMENT ANALYSIS--SOLIDS ANALYSIS

	Penetration 401		Entry 10, Made 5/14/81	Entry 16, Made 9/24/81	Entry 68, Made 6/23/82		Entry 152, Made 1/11/83		
	Made 8/28/79 by ORNL	Made 11/15/79 by ORNL	by INEL	by INEL	by ORNL	by WHEDL	by PNL-1	by PNL-2	by PNL-3
Total solids (mg/mL)	4	0.5	0.9	0.21	0.21	26.1	1.78	0.82	10.6
Activity decay date	8/28/79	7/1/79	5/14/81	9/24/81	10/5/82	8/30/82	2/11/83	2/11/83	2/11/83
Activity of solids (µCi/gm)									
^{60}Co	--	--	12.1 (0.5)[a]	20 (10)	9.2	114.2 (0.2)	0.07	1.42	5.44
^{125}Sb	0.6	1.5	487 (9)	12 (3)	124	136 (1)	1.14	2.03	47.6
^{134}Cs	0.5	0.8	107 (1)	39 (1)	67.5	173 (1)	1.03	9.08	14.1
^{137}Cs	2	4.7	808 (3)	324 (5)	797	2032 (4)	12.3	122.0	192.0
^{144}Ce	0.3	1.4	66 (3)	94 (6)	--	44 (0.4)	Analysis being performed		
^{106}Ru	0.9	0.8	104 (7)	58 (6)	--	35.9 (0.3)	0.13	6.22	19.0
^{90}Sr	70	38	800 (200)	2200 (100)	2360	4900 (200)	0.08	0.50	8.71
^{54}Mn	--	--	2.5 (0.4)	<1		0.53 (0.07)	0.01	1.98	0.39
^{110m}Ag	--	--	7 (0.8)	<3		0.8 (0.3)	ND	ND	ND
^{113}Sn	0.4	0.23	7 (2)	<4		0.14 (0.06)	ND	NO	NO
Fuel in solids									
U (mg/gm)	0.003	0.02	3.9 (0.4)	0.39 (0.05)	2.97	3.9 (0.2)	Analysis being performed		
Pu (µg/gm)	0.004	--	2.9 (0.6)	--	4.41	6.1 (0.6)			
^{235}U (atom%)	--	--	2.7	<4	2.37	2.4			
Composition of solids (ppm)									
Mg	175	150	2k[b]	4k[b]	2k[c]	5k[c]	Analysis being performed		
Al	200	1450	10k	50k	~3k	30k (12k)[d]			
Si	--	650	70k	30k	20k	7k			
Ca	50	450	20k	40k	2k	3k			
Fe	250	850	30k	120k	10k	3k			
Ni	250	2500	30k	25k	10k	8k			
Cu	1400	7500	220k	3k	~40k	20k (49k)			
In	8	30	10k	--	3.5k	300k (3k)			
Zr	--	7	--	--	3k	200			
Sn	--	40	--	--	1.5k	2k (1.4k)			
Ag	200	55	--	--	9k	(25k)			
Cd	--	55	1k	--	10k	1k (5k)			

a. Number in parentheses is for counting statistics only at a 2 sigma level. Absolute errors are probably ±5%.

b. Analyses by emission spectrometry (2k means 2000).

c. Analyses by spark source mass spectrometry.

d. Analyses by atomic absorption.

TABLE 4. ADDITIONAL CHEMICAL ANALYSES PERFORMED ON THE LIQUID SAMPLE FRACTIONS

Date	pH	Specific Gravity	Conductivity
05/14/81	8.55	1.0064 @ 25°C	3.62 mS
09/24/81	--	1.0057 @ 25°C	3.60 mS
06/23/82	8.20	1.0160 @ 25°C	5280 μMho/cm

Basement Solids Quantification

With the data available from sample analysis, the basement water volumes per inch, sampling apparatus parameters, and sample solids concentrations, it is possible to estimate a range of solids mass if the following assumptions and facts are used:

- Assumption--Solids distribution is homogenous on the basement floor.
- Assumption--Sample solids concentration in grams per liter are representative of the sampled water depth.
- Fact--Measurements and calculations have determined that the water volume per centimeter between the 282-ft 6-in. elevation (basement floor) and the 286-ft 0-in. elevation is 9061.1 L/cm.
- Fact--There are some void areas below the basement floor, which must be taken into account when calculating total volume for a particular water depth. These voids are

Reactor Building Sump	10 303 L
Drain pipes	4822 L
Incore Instrument Chase	10 212 L
Elevator pit	2839 L.

For calculational purposes, a volume of 28 200 L will be used. This value will be added to the above-floor volume to determine total volume.

Sample 5/14/81. Because of the way the sampler was constructed, this floor sample was taken at 0.95 cm above the floor and had a solids concentration of 0.9 mg/mL (g/L). The next highest sample was taken at 13.65 cm off the floor and contained no detectable solids or flocculents. Extrapolating through the distance 0 to 13.65 cm with a concentration of 0.9 g/L yields

$$[(13.65 \text{ cm} \times 9061.14 \text{ L/cm}) + 28\,200 \text{ L}]\ 0.9 \text{ g/L} = 136\,696 \text{ g of solids} \quad . \qquad (1)$$

Sample 9/24/81. The sample solids concentration was 0.21 g/L. This sample was obtained at 0.95 cm off the basement floor without a higher reference sample. Assuming the solids concentration is representative for this depth, and using Equation (1), from 0 to 0.95 cm yields 7730 g of solids.

Sample 6/23/82 ORNL Analysis. This sample was obtained from the floor in about 2.54 cm of water by manually scooping. From a visual inspection, the solids were described as "thin," perhaps millimeters thick, and homogeneous. If the sample concentration of 21.6 g/L is representative of the solids in 2.54 cm of water, using Equation (1) yields 1.12×10^6 g of solids.

Sample 6/23/82 WHEDL Analysis. This is a fraction of the same sample shown above. Using the analysis value of 26.1 g/L and Equation (1), the fraction yields 1.34×10^6 g of solids.

Sample 1/11/83. These samples were taken at three different locations; position 1 had solids concentrations of 1.78 g/L, position 2 had 0.82 g/L, and position 3 had 10.6 g/L. The basement water level was about 10.16 cm when these samples were taken. If the sample concentrations are taken as representative of this depth, using Equation (1), position 1 suggests 2.14×10^5 g of solids; position 2 suggests 9.86×10^4 g of solids; and position 3 suggests 1.28×10^6 g of solids.

Each liquid sample was filtered through a 0.45-micron millipore filter paper for total solids determination. A photograph of the total filtered solids for each sample is presented in Figure 3. Photographs of the solids reveal that the solid composition apparently varies. Each filter is numbered designating the appropriate sample location. Samples 1 and 2 are both brownish in color and similar in consistancy. Sample 3, on the other hand, is greyish in color and contained three large particle agglomerations.

The variance in solids mass is 7.71 to 1338.09 kg, with an average value for all measurements of 598.74 kg. These calculations indicate that the solids are apparently very hetergeneous in distribution on the basement floor.

From the data in Table 2 for U, Pu, and ^{90}Sr, and the solid weights determined here, estimates for minimum, maximum, and average values for these materials in the solids can be determined. These values are as follows:

Material	Minimum	Maximum	Average
U	2.3E-2 g	11.5 g	2.4 g
Pu	3.1E-5 g	1.8E-1 g	4.3E-2 g
^{90}Sr	2.9E-1 Ci	14.5 Ci	2.4 Ci

Basement Liquids Quantification

Table 3 shows that the principal nuclides in the liquid are ^{134}Cs, ^{137}Cs, and ^{90}Sr. If the values for sample 9/24/81 are used as typical at the commencement of SDS processing, then the total curies of these nuclides in the 2.42 x 10^6 L of water are

$$^{134}Cs = 16.2\ \mu Ci/mL \times 2.42 \times 10^6\ L \times \frac{10^3\ mL}{L} \times \frac{Ci}{10^6\ \mu Ci}$$

$$= 39{,}243\ Ci$$

$$^{137}Cs = 331{,}869\ Ci$$

$$^{90}Sr = 11{,}628\ Ci\ .$$

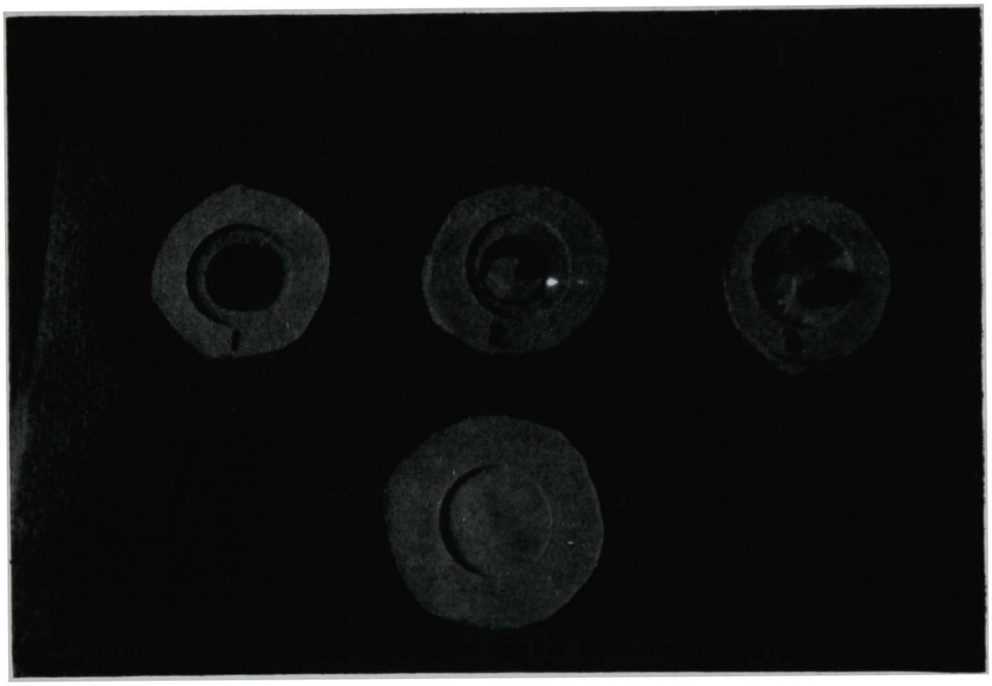

Figure 3. Reactor Building basement filtered solid sampler obtained January 11, 1983. The filters are numbered according to sample location, the blank filter is for comparison.

For uranium and plutonium, there are no sample results from 9/24/81 that can be applied. However, comparison of all the results in Table 3 show that the 6/23/82 ORNL results are typical. Using these values yields an estimate of the total grams of U and Pu in the water:

$$U = 1.6 \times 10^{-2}\ \mu g/mL \times 2.42 \times 10^{6}\ L \times \frac{10^{3}\ mL}{L}$$

$$= 3.88 \times 10^{7}\ \mu g$$

$$= 38.8\ g$$

$$Pu = 1.36 \times 10^{5}\ \mu g$$

$$= 0.14\ g\ .$$

Radiological Characterization

Since June 1982, several efforts have been made to measure basement radiation levels using thermoluminescent dosimeters (TLDs). Two types of multielement beta-gamma TLDs have been used for this work. A Panasonic TLD is currently used at the TMI-2 site for personnel monitoring. A Battelle Pacific Northwest Laboratories TLD is intended as a space or area monitor. Table 5 shows selected TLD placements.

At each of these locations, the TLDs were suspended from the upper levels into the basement on strings called "trees." All of the PNL trees were suspended from the 305-ft elevation. The Panasonic TLDs were suspended from the 367-ft elevation. Each PNL TLD tree consisted of 4 TLDs spaced 1.52 m apart and placed with the bottom TLD 0.76 m from the basement floor. These trees were oriented so that the direction of the front and back in relation to the basement area was known to give directionality to the survey. The only variation to this placement was that the front of the bottom TLD on the 6/23/82 trees faced outward toward the horizontal plane, whereas the 1/11/83 front of the bottom TLD faced the floor. The 6/23/83

TABLE 5. TLD PLACEMENTS

Date	Location	TLD Type	Number of TLDs	Number of TLD Trees
06/23/82	East wall of refueling canal under Core Flood Tank A	PNL	4	1
06/23/82	Below 305-ft equipment hatch	PNL	4	1
06/23/82	North side of reactor coolant drain tank cubicle	PNL	4	1
06/23/82	Cable chase area	PNL	4	1
11/05/82	Inside D-ring B	Panasonic	45	5
01/11/83	Below 305-ft equipment hatch	PNL	4	1
01/11/83	N.E. corner of Reactor Building Penetration 238	PNL	4	1
01/11/83	S.W. corner of Reactor Building Penetration 225	PNL	4	1

TLDs were placed prior to water flushing of the basement walls, and the 1/11/83 TLDs were placed in conjunction with basement solids samples obtained on that date.

The 11/5/82 Panasonic TLDs were placed in 5 trees of 9 TLDs each around D-ring B at several elevations. No effort was made to determine the Panasonic TLD orientations.

<u>6/23/82 TLD Trees' Results</u>

An average of the TLD front and back results are shown in Table 6. A complete set of front and back TLD results for the area under core flood tank A and the reactor coolant drain tank cubicle are shown in Figures 4 and 5.

As Table 6 shows, with the exception of a high beta reading by the RCDT position 3, the readings show a regular reduction from a high near the floor to a low at the upper positions. The gamma readings however suggest

TABLE 6. TLD MEASUREMENTS OF REACTOR BUILDING BASEMENT ENVIRONMENT (rad/h)

	Position 1[a]		Position 2[b]		Position 3[c]		Position 4[d]	
TLD Location	Beta	Gamma	Beta	Gamma	Beta	Gamma	Beta	Gamma
East wall of refueling canal	0.10	1.13	3.45	3.35	73.62	17.17	107.46	18.51
Beneath basement equipment hatch	2.34	10.48	6.52	25.78	12.03	53.72	74.38	75.65
North area of RCDT room	0.72	6.48	6.31	9.80	339.38	21.02	104.20	16.57
In the cable area	0.19	1.29	1.81	2.98	53.75	10.00	96.77	18.58

a. Position 1 denotes a TLD hanging 5.3 m above the basement floor (282-ft 6-in. elevation).

b. Position 2 is 3.9 m above.

c. Position 3 is 2.3 m above.

d. Position 4 is 0.8 m above.

Pt	A		B	
	γ rem/h	β rad/h	γ rem/h	β rad/h
1	1.090	0.048	1.160	0.144
2	3.420	5.180	3.285	1.711
3	16.600	54.300	17.700	92.900
4	17.500	122.400	19.500	92.500

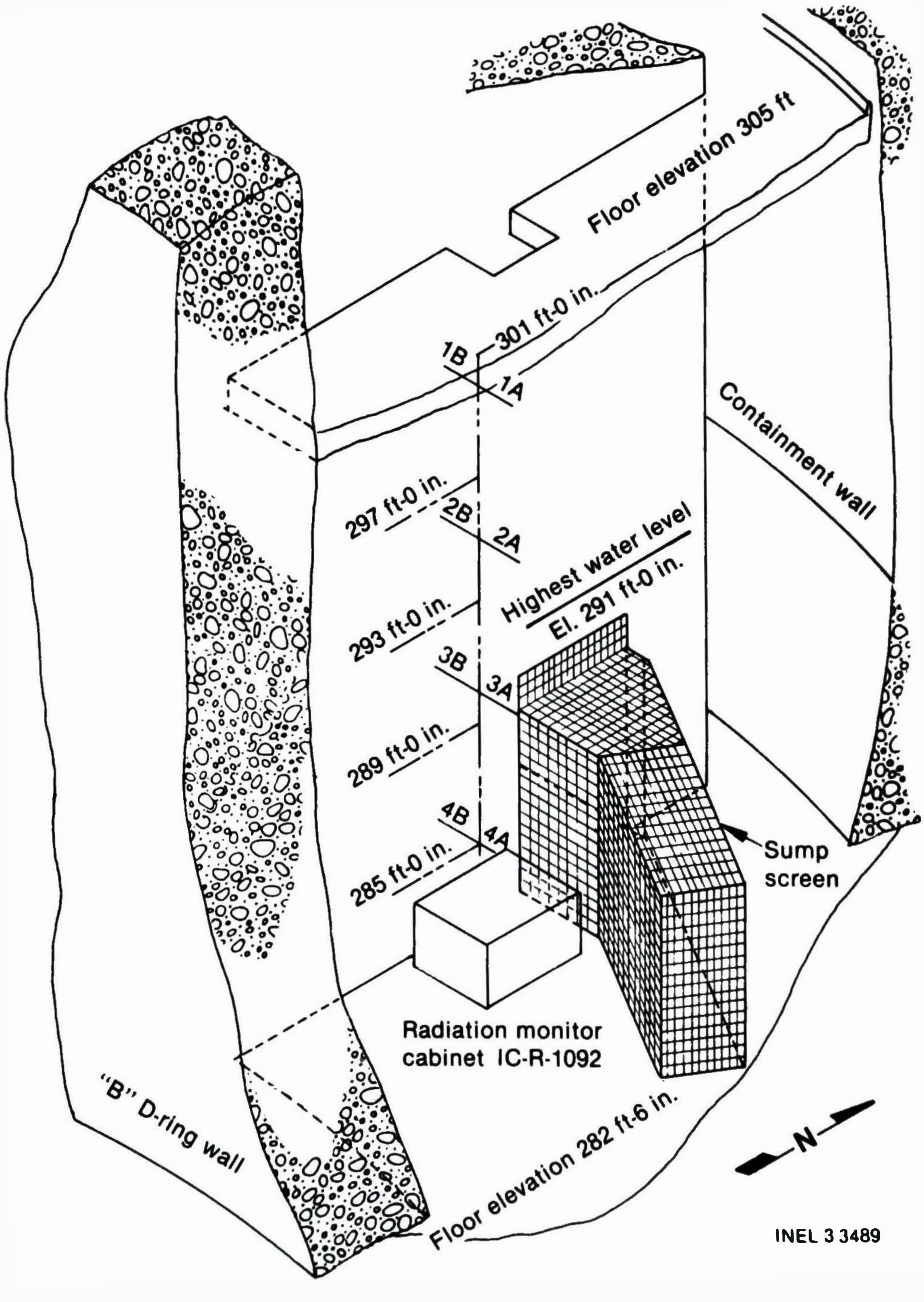

Figure 4. TLD tree analysis beneath core-flood tank.

Pt	A		B	
	γ rem/h	β rad/h	γ rem/h	β rad/h
1	6.214	0.906	6.753	0.553
2	9.744	5.682	9.857	6.942
3	20.200	31.400	21.800	647.300
4	17.700	175.600	15.400	32.800

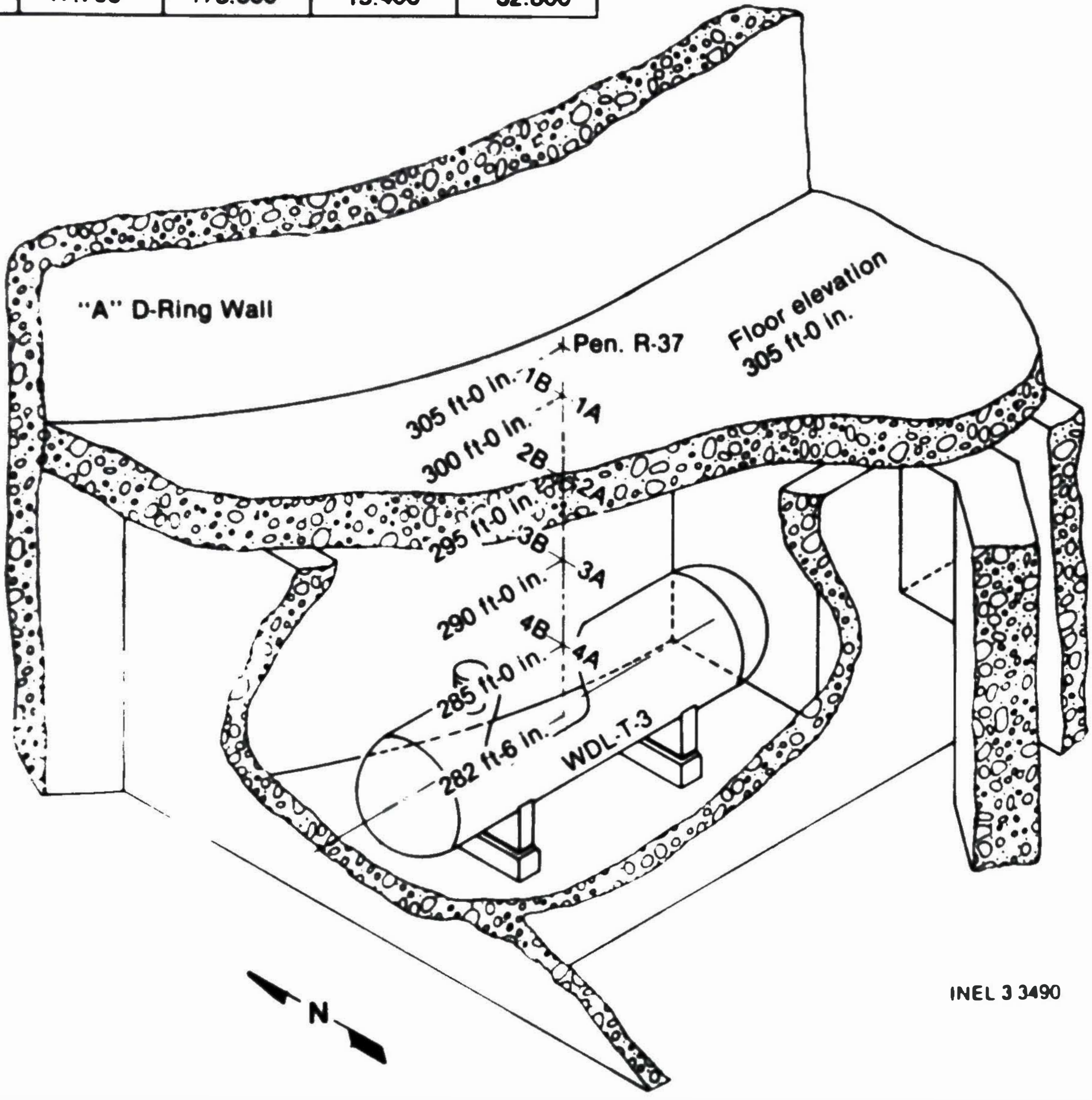

Figure 5. TLD tree analysis of reactor coolant drain tank cubicle.

that the floor is not the only source of radiation because the drop off in source intensity is too large, suggesting a large planar source such as walls. The total source of radiation is probably a combination of floors and walls.

1/5/82 TLD Trees' Results

The data for the 5 TLD strings placed inside D-ring B are shown in Figure 6. Nine TLDs were attached to each of five 25.9-m long strings and suspended around inside of the D-ring walls from the 367-ft elevation. These data indicate that the readings closer to the floor are significantly lower than those presented in Figures 4 and 5. A possible explanation is the low-pressure warm-water decontamination of the D-ring walls. This is suspected to have resulted in washing the solids into the incore instrumentation chase, which is 0.3 m lower than the 282-ft 6-in. floor elevation, thereby eliminating contribution from this source in the basement. The data also indicate that there seem to be high beta sources at the top of the D-ring above reactor coolant pumps RC-P-2A and 2B. Also, lower sections of OTSG-B and suction lines of the pumps appear to be high gamma sources. Finally, the upper section of RC-P-2B appears to be a high gamma source.

1/11/83 TLD Trees

These TLD trees were placed in conjunction with sump solids samples obtained on this date to determine radiation readings for the areas where sump solids was obtained. An average of the TLD front and back results for each location and position are shown in Table 7.

These measurements are on the average only slightly less than the 6/23/82 results. Much of this reduction is probably a result of radioactive decay. It is notable that the measured variance between the top and bottom TLDs is less than earlier measurements. This may be a reflection of source material being flushed down from higher levels.

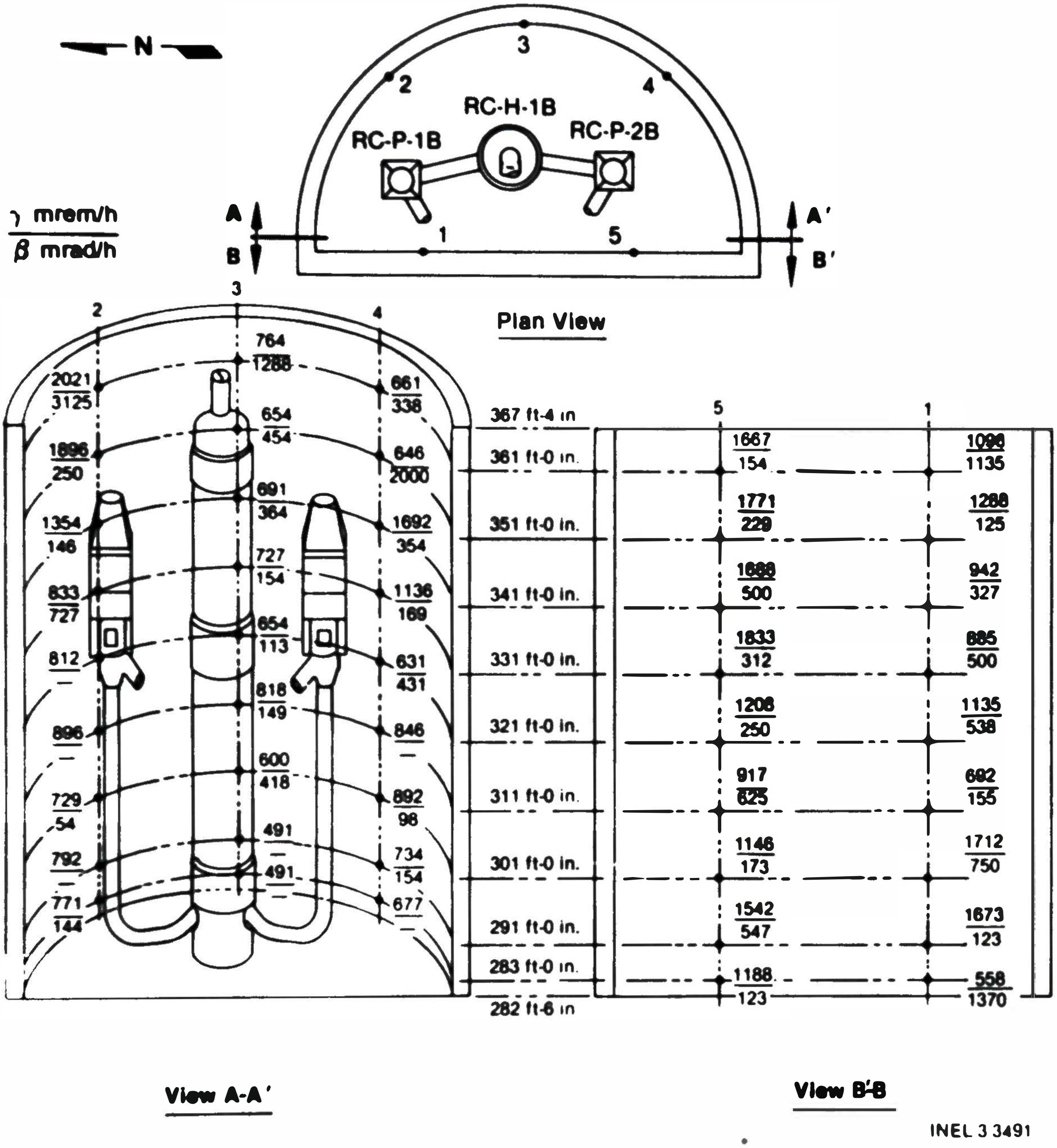

Figure 6. TLD tree analysis of D-ring B.

TABLE 7. TLD MEASUREMENTS DURING BASEMENT SLUDGE (rad/h)

TLD Location	Position 1[a] Beta	Position 1[a] Gamma	Position 2[b] Beta	Position 2[b] Gamma	Position 3[c] Beta	Position 3[c] Gamma	Position 4[d] Beta	Position 4[d] Gamma
Below 305-ft el. equipment hatch	3.3	23.2	4.6	18.4	9.6	32.5	4.5	26.3
N.E. corner of Reactor Building Penetration 238	0.1	0.3	0.5	1.5	7.4	3.0	15.0	3.0
S.W. corner of Reactor Building Penetration 225	4.0	12.9	18.3	24.1	25.7	27.2	--[e]	--[e]

a. Position 1 denotes a TLD hanging 5.3 m above the basement floor (282-ft 6-in. elevation).

b. Position 2 is 3.9 m above.

c. Position 3 is 2.3 m above.

d. Position 4 is 0.8 m above.

e. TLD lost in Reactor Building.

Visual Surveys

Basement visual surveys have been provided by Reactor Building work crews and by television cameras lowered into the basement from the 305-ft elevation. These surveys have shown the following:

- Bathtub rings at several elevations on the basement walls.

- In June and October 1982, solids was observed to be spread evenly in a thin layer over the basement floor.

- By April 1983 large areas of the basement floor were apparently bare with no visible solids deposit.

- There is a great deal of surface paint bubbling and corrosion, especially on galvanized and bare metal surfaces.

- Some of the cables in the basement overhead appear discolored, perhaps as a result of heat damage to the insulation.

- There is a lot of particulate matter lying on top of overhead cables and supports. A great deal of this material appears to be boric acid crystals.

REFERENCES

1. D. H. Meikrantz et al., First Results of TMI-2 Sump Samples Analyses-Entry 10, GEND-INF 011, July 1981.

2. T. E. Cox, J. T. Horan, C. V. McIsaac, Reactor Building Basement Radionuclide Distribution Studies, GEND-INF-011, Vol. II, October 1982.