50-289/320
RADIOLOGICAL ENVIRONMENTAL
MONITORING REPORT
For the
THREE MILE ISLAND NUCLEAR STATION
1975 SEMI-ANNUAL REPORT II
JULY 1 THROUGH DECEMBER 31

Recieved With Ltr. Dtd 3/1/76 CN#2145

RMC-TR-76-01

3-1-76

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

For The

THREE MILE ISLAND NUCLEAR STATION

50-289/320

1975 SEMI-ANNUAL REPORT II

JULY 1 THROUGH DECEMBER 31

Prepared for

METROPOLITAN EDISON COMPANY

BY

RADIATION MANAGEMENT CORPORATION

FEBRUARY 1976

A 215

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

During the period July 1 to December 31, 1975, Radiation Management Corporation (RMC) participated in the operational radiological environmental monitoring program (REMP) conducted by Metropolitan Edison Company at Three Mile Island Nuclear Station (TMINS).

The RMC portion of this program is designed to aid in meeting the obligations of the Environmental Technical Specifications for TMINS Unit #1 (TMI-1)(1).

A total of 924 analyses were performed on 554 samples during the period covered by this report. These samples were taken from the aquatic, atmospheric, and terrestrial environments and included direct radiation measurements. Additional samples and analyses beyond those required by the environmental technical specifications were performed as noted in the data tables of Appendix B.

Surface water (4 locations, 23 samples) was analyzed for H-3 and gamma emitting nuclides. Untreated drinking water (2 locations, 12 samples) was analyzed for H-3, Sr-89, Sr-90 and gamma emitting nuclides. Fish (2 locations, 9 samples) and sediment (3 locations, 6 samples) were also taken from the aquatic environment and analyzed for Sr-89, Sr-90 and gamma emitting nuclides.

The atmospheric environment sampling program included air particulates, air iodine, and precipitation. Air particulates (10 locations, 263 samples) were analyzed for gross beta activity and gamma emitting nuclides. Charcoal cartridges (4 locations, 106 samples) were analyzed for I-131. Precipitation, primarily rain water, (4 locations, 24 samples) was analyzed for gross beta activity, H-3, Sr-89, Sr-90, and gamma emitting nuclides.

Milk (6 locations, 27 samples) was taken from the terrestrial environment and analyzed for I-131, Sr-89, Sr-90, and gamma emitting nuclides. In accordance with environmental technical specifications, an update on the milking animal census was performed during this period. A distribution of 1095 milking cows at 35 locations was determined, a decrease of 19 cows since June 1975. Green leafy vegetables (4 locations, 4 samples) were taken and analyzed for gamma emitting nuclides.

In addition, 320 analyses for immersion dose (21 locations, 80 packets) using TLDs were made during this period.

All radionuclide concentrations were similar to those normally found in local unaffected areas, except for H-3, Co-60 and I-131 in surface water and Co-58 in sediment.

The H-3 concentrations in surface water at the downstream indicator locations (0.5 and 1.5 miles downstream) showed elevated levels relative to the upstream samples twice during the reporting period. No increase in the H-3 levels at the downstream locations where river water is used as a drinking water source was observed. Therefore, no measurable dose can be attributed to the release of H-3 from TMINS.

During July Co-58 was detected in 2 sediment samples; probably the result of station operation. Since no Co-58 was detected in surface water or fish, the only significant dose pathway resulting from this Co-58 would

be from standing on the shoreline. A highly conservative dose estimated yields an insignificant dose to a hypothetical maximum individual of 0.08 mrem/year.

Co-60 was detected during July at station 8E1 and during August at station 9A2 in surface water samples. The maximum level observed was 2.4 pCi/l. A maximum individual drinking 2 l/day of this water for a 30 day period could receive an insignificant dose of <0.006 mrem. I-131 was detected in surface water from station 9A2 during August at a level of 50 pCi/l, but was undetected in all drinking water samples. Therefore, no measurable dose can be attributed to this level of I-131.

It is therefore concluded that station operation produced only insignificant and temporary changes in the observed environmental levels of radioactivity. These temporary changes could have resulted in an insignificant dose to a hypothetical maximum individual of <0.1 mrem.

INTRODUCTION

A complete radiological environmental monitoring program (REMP) for Three Mile Island Nuclear Station (TMINS) has been conducted by Metropolitan Edison Company since June 1969. Radiation Management Corporation has participated in this program since February 21, 1974. Results of the preoperational phase of the REMP up to June 5, 1974, and of the operational phase (June 5, 1974 to June 30, 1975) were reported in previous RMC documents(2,3,4). This report continues the operational series with coverage of the second six months of 1975. It presents in detail the type and number of samples analyzed, the analyses performed and the data generated by RMC during the period July 1 to December 31, 1975. Interpretation of the data and conclusions are presented.

Three Mile Island is the site of an operating nuclear power unit of the pressurized water reactor (PWR) type. When complete the station will consist of two reactor units. Unit 1, rated at 871 MWe, achieved criticality on June 5, 1974. This marked the beginning of the operational phase of the REMP. Unit 2, rated at 959 MWe, is under construction and scheduled for commercial operation in 1978.

The station is located on Three Mile Island in the Susquehanna River, in Dauphin County, ten miles southeast of Harrisburg, Pennsylvania. The average flow of the river at this point is 34,000 cfs(5). The site consists of an 814 acre tract on Three Mile Island and several smaller adjacent islands. General climatic conditions are characterized by a mild continental-type climate with little severe weather. Agriculture is the largest land usage in the area (48%), with the empnasis on poultry, dairy cattle and field crops(6).

The census of milking cows located within five miles of TMINS(6) was updated in the previous semi-annual report(4) and again during this report period. The distribution and approximate locations of these animals are given in table B-19 (appendix B).

More specific information on the demography, meteorology and land use characteristics of the local area may be found in the Environmental Report(7), Environmental Statement(8), Final Safety Analysis Report for TMI-2(9), and the Environmental Report Supplement II(10).

PROGRAM

In the operational phase of the REMP, radioanalytical data are collected for comparison to that generated in the preoperational phase. Differences between these two periods are examined statistically to determine whether any station effects exist based on the magnitude and fluctuations of radioactivity levels determined in the preoperational phase.

Objectives

The objectives of the operational radiological environmental program are:

1. To fulfill the obligations of the Radiological Surveillance-Environmental sections of the Environmental Technical Specifications for TMI-1.

2. To determine whether any statistically significant increase occurs in the concentration of radionuclides in critical pathways.

3. To detect any buildup of long-lived radionuclides in the environment.

4. To detect any change in ambient gamma radiation levels.

5. To verify that radioactive releases are within allowable limits and that TMI-1 operations have no detrimental effects on the health and safety of the public or on the environment.

This report provides information for the Metropolitan Edison Company, regulatory agencies and the public record toward these objectives.

Design

In order to meet the stated objectives, an appropriate operational REMP was developed by RMC in cooperation with Metropolitan Edison Company. Samples for the operational REMP were taken from the aquatic, atmospheric, and terrestrial environments. Samples of various media were selected to obtain data for the evaluation of the radiation dose to man and important organisms. Sample types were based on (1) established critical pathways for the transfer of radionuclides through the environment to man, and (2) experience gained during the preoperational and initial operational phases. Sampling locations were determined from site meteorology, Susquehanna River hydrology, local demography and land uses.

Sampling locations were divided into two classes--indicator and control. Indicator stations are those which are expected to manifest station effects, if any exist; control samples are collected at locations which are believed to be unaffected by station operations. Fluctuations in the levels of radionuclides and direct radiation at indicator stations are evaluated with respect to analogous fluctuations at control stations, which are unrelated to station operation. Indicator station data are also evaluated relative to background characteristics established prior to station operation. Additional samples beyond those required by the Environmental Technical Specifications were collected and analyzed; they are listed as management audit samples in the data tables (Appendix B).

The analysis of samples and the analytical data generated during the program are routinely evaluated by the RMC project leader who is the liaison with Metropolitan Edison Company personnel. Further review of REMP design and analytical data is performed by RMC and Metropolitan Edison Company RS-EE professional staff in light of current regulatory trends and operating experience. The analytical procedures and quality control methods utilized by RMC(11) meet or exceed the minimum sensitivities required by the Environmental Technical Specifications(1).

Table 1 summarizes information on the Three Mile Island Nuclear Station operational REMP as performed by RMC. Appendix A explains the RMC sample coding system which specifies sample type and relative locations at a glance. Table A-1 gives the pertinent information on individual sampling locations, while Maps A-1, -2 and -3 show their geographic locations.

Exceptions

The operational REMP was conducted in accordance with the Environmental Technical Specifications for TMI-1(1). Deviations from the program as described in table 3 of these specifications occurred during this period. Because aquatic plants are very scarce in the vicinity of TMINS, none were available for sampling during this report period. This problem was aggravated by heavy floods on the Susquehanna in the fall when a record flow rate of 73,900 cfs was established at Harrisburg for the month of September.

Milk samples were not available at station 5A3 for the months of July, August and September since the single cow at that location was not producing during these months. However, samples were collected and analyzed routinely during those months at station 5B1, only 0.1 mile further from the site in the same easterly direction. This second farm (70 cows) adequately covered the need for samples.

Pump outages resulted in the loss of 5 air particulate and air iodine samples. Flooding conditions in late September resulted in the loss of 2 additional air particulate and one air iodine samples. However, the overall air sample recovery rate was greater than 96%.

RESULTS AND DISCUSSION

The averages and ranges of analytical results are summarized in tables 2 and 3. Table 2 is a summary of gross beta, H-3, Sr-89 and Sr-90, I-131 and gamma spectrometric results for various samples. Table 3 is a summary of ambient radiation levels as measured by thermoluminescent dosimeters. Results for each type of sample were grouped according to the analysis performed. Means and standard deviations of these results were calculated when applicable. These standard deviations represent sample population variability rather than analytical variability. For this calculation, all results below the MDL were considered to be at the MDL.

The data for individual samples are presented in tabular form in appendix B, tables B-1 through B-18. Within the data tables a 95% (± 2 sigma) confidence interval is supplied. These intervals represent the range of values into which 95% of repeated analyses of the sample would fall. All results occurring at or below the relevant minimum detectable level were reported as being "less than" the MDL value.

TABLE 1

SYNOPSIS OF THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM FOR TMINS

JULY 1 THROUGH DECEMBER 31, 1975

SAMPLE TYPE	SAMPLING			ANALYSIS		
	FREQUENCY	LOCATIONS	NUMBER	TYPE	FREQUENCY	NUMBER
Surface Water	M	6	35	H-3	M*	30
				Sr-89	Q	6
				Sr-90	Q	6
				Gamma	M	35
Fish	SA	2	9	Sr-89	SA	9
				Sr-90	SA	9
				Gamma	SA	9
Sediment	SA	3	6	Sr-89	SA	6
				Sr-90	SA	6
				Gamma	SA	6
Air Particulates	W	10	263	Beta	W	263
				Gamma	M	12
Air Iodine	W	4	106	I-131	W	106
Precipitation	M	4	24	H-3	Q	8
				Beta	M	24
				Sr-89	SA	4
				Sr-90	SA	4
				Gamma	Q	8
Milk	M**	6	27	I-131	M	27
				Sr-89	Q	11
				Sr-90	Q	11
Green Leafy Vegetables	A	4	4	Gamma	A	4
Dosimeters	M***	21	80	Gamma	M	320

* November and December samples composited
** Samples discontinued in December during nongrazing season
*** Quarterly for October, November and December

TABLE 2

SUMMARY OF RADIONUCLIDE CONCENTRATIONS IN ENVIRONMENTAL SAMPLES FROM TMI-2

JULY 1 THROUGH DECEMBER 31, 1975

SAMPLE TYPE	ANALYSIS PERFORMED	NO. OF SAMPLES ANALYZED	NO. ABOVE MDL	MINIMUM	MAXIMUM	AVERAGE ± 2 SIGMA	UNITS
Surface Water	H-3(upstream)	10	10	96±64	540±61	250±230	pCi/l
	H-3(downstream)	20	20	150±64	3900±90	860±2400	pCi/l
	Sr-89	6	0	0.1	0.8	-	pCi/l
	Sr-90	6	1	0.2	0.4±0.4	-	pCi/l
	Gamma	35					
	Be-7		2	<MDL	12±6	-	pCi/l
	K-40		2	6	32±10	-	pCi/l
	Co-60		2	0.6	2.4±1.1	-	pCi/l
	I-131		1	2	50±9.4	-	pCi/l
Fish	Sr-89	9	1	3.0	4.6±4.5	-	pCi/Kg
	Sr-90	9	6	3.2	17±4	6.0±6.2	pCi/Kg
	Gamma	9					
	K-40		9	3000±300	6100±610	3900±4600	pCi/Kg
	Cs-137		8	9	32±8	19±20	pCi/Kg
Sediment	Sr-89	6	0	0.1	0.2	-	pCi/g(dry)
	Sr-90	6	2	0.05±0.03	0.1±0.1	-	pCi/g(dry)
	Gamma	6					
	Be-7		3	<MDL	1.9±0.2	0.5±1.0	pCi/g(dry)
	K-40		6	9±1	22±2	16±9	pCi/g(dry)
	Mn-54		1	0.02	0.04±0.02	-	pCi/g(dry)
	Co-58		2	0.02	0.47±0.05	-	pCi/g(dry)
	Zr-95		1	0.03	0.15±.04	-	pCi/g(dry)
	Nb-95		2	0.03	0.25±.03	-	pCi/g(dry)
	Ru-106		1	0.2	0.5±0.2	-	pCi/g(dry)
	Sb-125		1	<MDL	0.13±0.05	-	pCi/g(dry)
	Cs-137		6	0.19±0.03	0.83±0.08	0.49±0.46	pCi/g(dry)
	Ce-144		1	0.08	0.9±0.2	-	pCi/g(dry)
	Ra-226		6	0.1±0.1	1.3±0.1	1.0±0.9	pCi/g(dry)
	Th-232		6	0.86±.08	1.3±0.1	1.1±0.3	pCi/g(dry)

TABLE 2 (Cont.)

SUMMARY OF RADIONUCLIDE CONCENTRATIONS IN ENVIRONMENTAL SAMPLES FROM THINS

JULY 1 THROUGH DECEMBER 31, 1975

SAMPLE TYPE	ANALYSIS PERFORMED	NO. OF SAMPLES ANALYZED	NO. ABOVE MDL	MINIMUM	MAXIMUM	AVERAGE ± 2 SIGMA	UNITS
Air Particulates	Beta	263	259	10±5	99±42	29±33	10^{-3} pCi/m^3
	Gamma	12					
	Be-7		12	21±2	150±15	65±44	10^{-3} pCi/m^3
	Mn-54		2	0.1	0.3±0.2	-	10^{-3} pCi/m^3
	Zr-95		5	0.2	2.1±0.5	0.5±1.1	10^{-3} pCi/m^3
	Nb-95		11	<MDL	4.3±0.5	0.8±2.4	10^{-3} pCi/m^3
	Ru-106		3	0.6	10±3	3±5	10^{-3} pCi/m^3
	Sb-125		6	<MDL	2.1±0.7	0.5±0.6	10^{-3} pCi/m^3
	Cs-137		12	0.1±0.1	4.3±0.5	0.8±1.4	10^{-3} pCi/m^3
	Ce-141		1	<MDL	0.6±0.3	-	10^{-3} pCi/m^3
	Ce-144		10	0.5	22±2	4.0±7.9	10^{-3} pCi/m^3
	Na-22		1	0.3	2.1±0.6	-	10^{-3} pCi/m^3
Air Iodine	I-131	106	0	7	29	-	10^{-3} pCi/m^3
Precipitation	H-3	8	3	80	120±61	87±27	pCi/l
	Beta	24	17	3	12±5	6.7±6.0	pCi/l
	Sr-89	4	0	0.4	0.5	-	pCi/l
	Sr-90	4	0	0.3	0.4	-	pCi/l
	Be-7 (gamma)	8	5	<MDL	23±7	17±9	pCi/l
Milk	I-131	27	0	0.04	0.09	-	pCi/l
	Sr-89	11	0	0.9	3	-	pCi/l
	Sr-90	11	10	0.7	7.9±1.7	3.9±4.2	pCi/l
Green Leafy Vegetables	Gamma	4					
	K-40		4	1.6±0.4	4.2±0.4	3.2±2.2	pCi/g(wet)

TABLE 3

SUMMARY OF DIRECT RADIATION MEASUREMENTS AT TMINS

JULY 1 THROUGH DECEMBER 31, 1975

SAMPLE	NO. OF SAMPLES	SAMPLING PERIOD	NO. ABOVE MDL	MINIMUM	MAXIMUM	AVERAGE ± 2 SIGMA	UNITS
CONTROL LOCATIONS							
Monthly TLD Dose Rate	96	6-28-75 to 12-24-75	96	4.7±0.8	7.7±0.2	6.0±0.4	mrem/standard month
INDICATOR LOCATIONS							
Monthly TLD Dose Rate	224	6-28-75 to 12-24-75	224	4.2±0.2	5.9±0.2	5.0±0.4	mrem/standard month

Aquatic Environment

face Water

Monthly surface water samples were collected at 6 locations on the dates shown in table B-1. Weekly grab samples from stations 1C3, 9A2 and 9B1 were taken and composited monthly. Samples from stations 8E1, 15F1 and 7G1 were taken on a semi-continuous basis and composited to monthly samples. Beginning with the November samples, H-3 analyses were reduced from monthly to quarterly. Hence, the November and December samples were composited prior to H-3 analysis in accordance with TMI-1 ETS table 3. Each sample was analyzed for H-3 and gamma emitting nuclides by RMC procedures HXH and TGC, respectively. Samples from 8E1, 15F1 and 7G1 (drinking water treatment facilities) were also analyzed for Sr-89 and Sr-90. A new upstream sampling location (1C3) was established on Swatara Creek in January 1975 for assessment of any radionuclides which may be added by that tributary. The results therefrom are included in this report.

Results of H-3 analyses are presented in table B-2 and figure 1. Concentrations of H-3 were observed to increase in August, September and October at one or both of the two downstream indicator stations 9A2 and 9B1. No increase was observed at these times at station 7G1 (Columbia). These concentrations returned to background levels in the November-December composite at all downstream locations. The dose implications of these H-3 levels and a comparison with liquid effluent data are discussed under "Assessment of Impact".

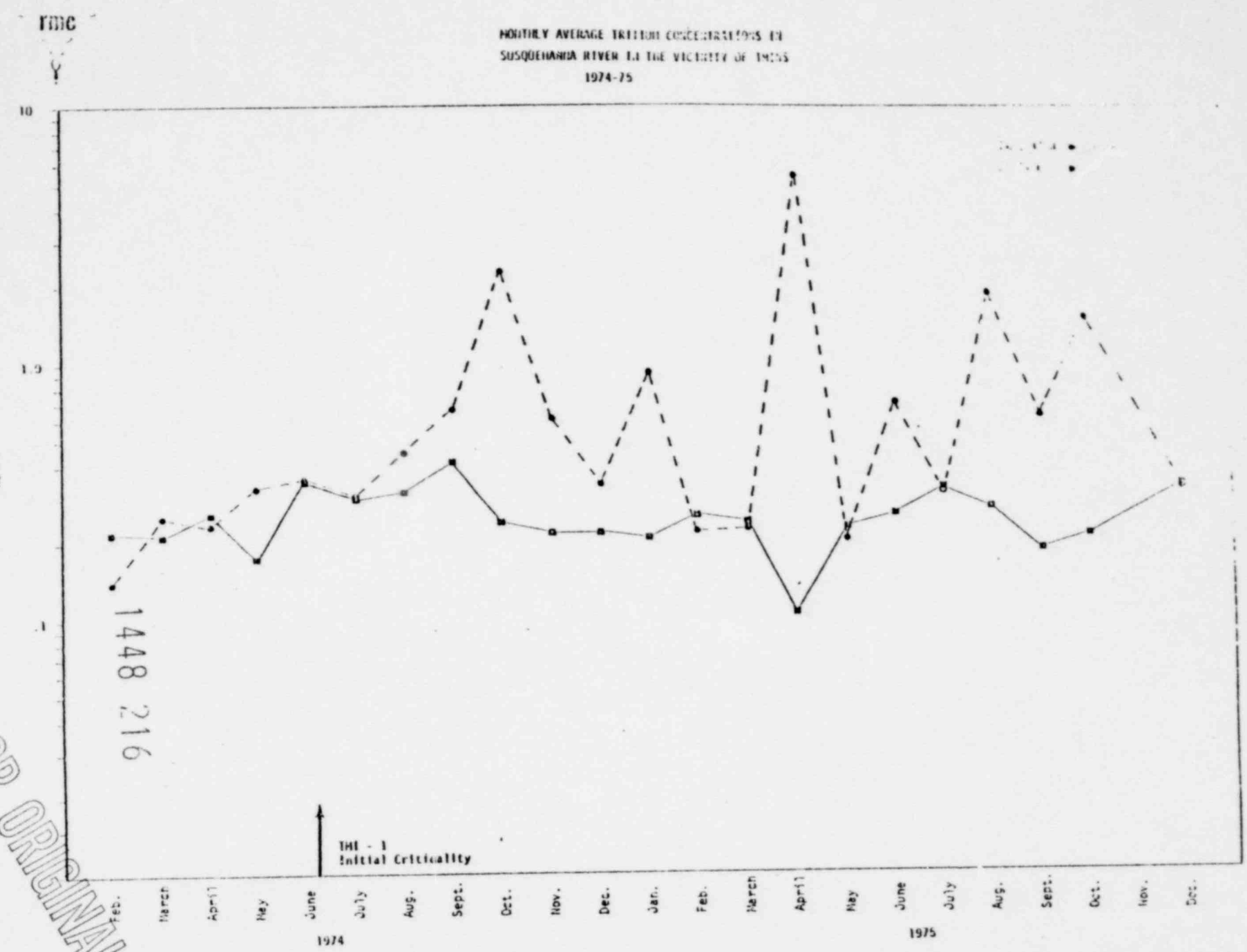
Results of analyses of surface water for Sr-89 and Sr-90 are presented in table B-3. These analyses were made on untreated water from the Brunner Island water treatment facility (8E1), the Steelton municipal water works (15F1) and the Columbia water treatment plant(7G1). All Sr-89 concentrations were below the MDL (0.8 pCi/l); Sr-90 concentrations were at or below MDL (1.0 pCi/l) in all of the samples analyzed.

Gamma spectrometric analysis of surface water samples (table B-4) showed that the naturally occurring nuclides K-40 and Be-7 were present at concentrations above their respective MDLs in 2 samples each. The gamma emitting nuclides Co-60 and I-131 were detected in the surface water sample from station 9A2 during August at concentrations of 2.4 and 50 pCi/l, respectively. Since I-131 was not found in any of the drinking water samples or in any other aquatic pathway, no significant dose can be attributed to this nominal level. The maximum dose implications of the observed Co-60 concentrations are discussed under "Assessment of Impact".

Fish

Fish samples were collected at 2 locations each in July and October of this reporting period. Only adult fish were taken for samples. These were separated into classes of bottom feeder versus predator-game species; fillets were analyzed. Gamma spectrometry (TGC) and Sr-89 and Sr-90 analyses (SRB, SRD) were performed on subdivided fish samples. The results of these analyses are given in table B-5. Sr-89 was detected in one of the 9 samples. Sr-90 was detected in 6 of the 9 samples with the highest value of 4.2 pCi/Kg detected in the upstream sample(16B1).

FIGURE 1



The gamma [illegible] natural K-40 and fallout Cs-137 present in all [illegible] Cs-137 concentration was 19 [illegible] /Kg(wet). [illegible] were detected. Typical MDLs by this method are [illegible].

Sediment

Three sediment [illegible] were taken in July and again in October. All samples were analyzed for Sr-89 and Sr-90 and gamma emitting nuclides, by RMC analytical procedures SRD, SRB and TGC, respectively.

Strontium in sediment results are given in table B-6. Sr-89 was not detected in any of the samples. Sr-90 was detected in two samples.

The results of the gamma analyses are given in table B-7. The naturally occurring radionuclides (K-40, Ra-226 and Th-232) were found in all 6 sediment samples. In October, Cs-137 was detected in a sample from Station 11A1 at a level of 0.33 pCi/g. This level was greater than 4 times the control station value of 0.19 pCi/g but not significantly different from those values observed during the preoperational period. A number of radionuclides typically found in fallout also were present in detectable amounts. These included Nb-95, Zr-95, Ru-106, Sb-125 and Ce-144, all of which were present in 20-30% of the samples. Except for Co-58, all nuclides found were detected in both upstream and downstream samples and no significant variations in concentration were apparent.

Co-58 was detected in 2 downstream samples during July, but not in October. The fact that Co-58 was detected in July and not in October, is probably the result of the September flood which removed the normal sediment load in this reach of the river. The highest concentration observed in July was 0.47 pCi/g. This, when compared to upstream values of <0.02 pCi/g and TMINS discharge data, can be attributed to station operation. The implications of these Co-58 levels are discussed under "Assessment of Impact".

Atmospheric Environment

The atmospheric environment around TMINS was examined by analyzing air particulate filters, charcoal cartridges and precipitation. Air particulate samples were collected at 10 locations with low volume air samplers using Hollingsworth and Voss HV-70 gauze backed filters. At 4 of these locations, air iodine samples were collected on Cesco "B" charcoal flow through cartridges connected in series following the air particulate filters. Air volumes sampled were measured with temperature compensated dry gas meters and recorded. Both air particulate and air iodine samples were collected weekly.

Precipitation was collected by using a 12 inch diameter funnel draining into a 5 gallon polyethylene bottle. The accumulated samples were collected and composited for monthly analysis. The amount of precipitation which fell during the sampling period was measured and recorded.

1448 217

Air Particulates

All air particulate samples were analyzed weekly for gross beta activity by RMC procedure TBD and monthly composites of all indicator and of all control samples were examined for gamma emitting nuclides by RMC procedure TGC.

Results of the gross beta analyses are listed in table B-8. Gross concentrations of beta emitters in air decreased slightly from July through December. This decrease was similar to the preoperational trend. The indicator and control monthly averages plotted in figure 2 demonstrate these annual trends and show similar behavior at both indicator and control locations. Monthly gross beta activity in all samples averaged 0.029 pCi/m3.

The gamma spectrometric results on monthly composites of air particulate filters are presented in table B-9. Prominent nuclides found in most samples were naturally occuring Be-7 and the probable fallout nuclides, Ce-144, Cs-137, Zr-95 and Nb-95. In addition, Mn-54 and Sb-125 were detected in 3 of 12 and 6 of 12 samples, respectively. The short-lived fallout nuclide Ce-141 was detected in 1 of 12 samples. No significant differences were observed between indicator and control composites and previously obtained data. Typical MDLs for gamma spectrometric analysis of air particulate samples are listed in table B-18.

Air Iodine

Gaseous iodine was collected on charcoal cartridges at 4 locations. The resulting samples were analyzed weekly for I-131 by RMC procedure IXB. Results are listed in table B-10. All results were less than the respective MDLs which were of the order of 0.01 pCi/m3.

Precipitation

Monthly precipitation samples were analyzed for gross beta activity by RMC procedure TBA. The RMC analytical procedures nXH and TGC were utilized for the analysis of H-3 and gamma emitting nuclides, respectively, in quarterly composites of precipitation from each station. Concentrations of Sr-89 and Sr-90 (RMC procedures SRC, SRA) were determined in semi-annual composites from each station. The results of gross beta activity measurements in precipitation samples are presented in table B-11.

The data for this period ranged from 3.3 to 14 pCi/l while averaging 6.7 pCi/l. The wet desposition of beta activity averaged 0.6 nCi/m2, ranging from 0.2 to 1.7 nCi/m2. No significant differences between indicator and control locations were observed.

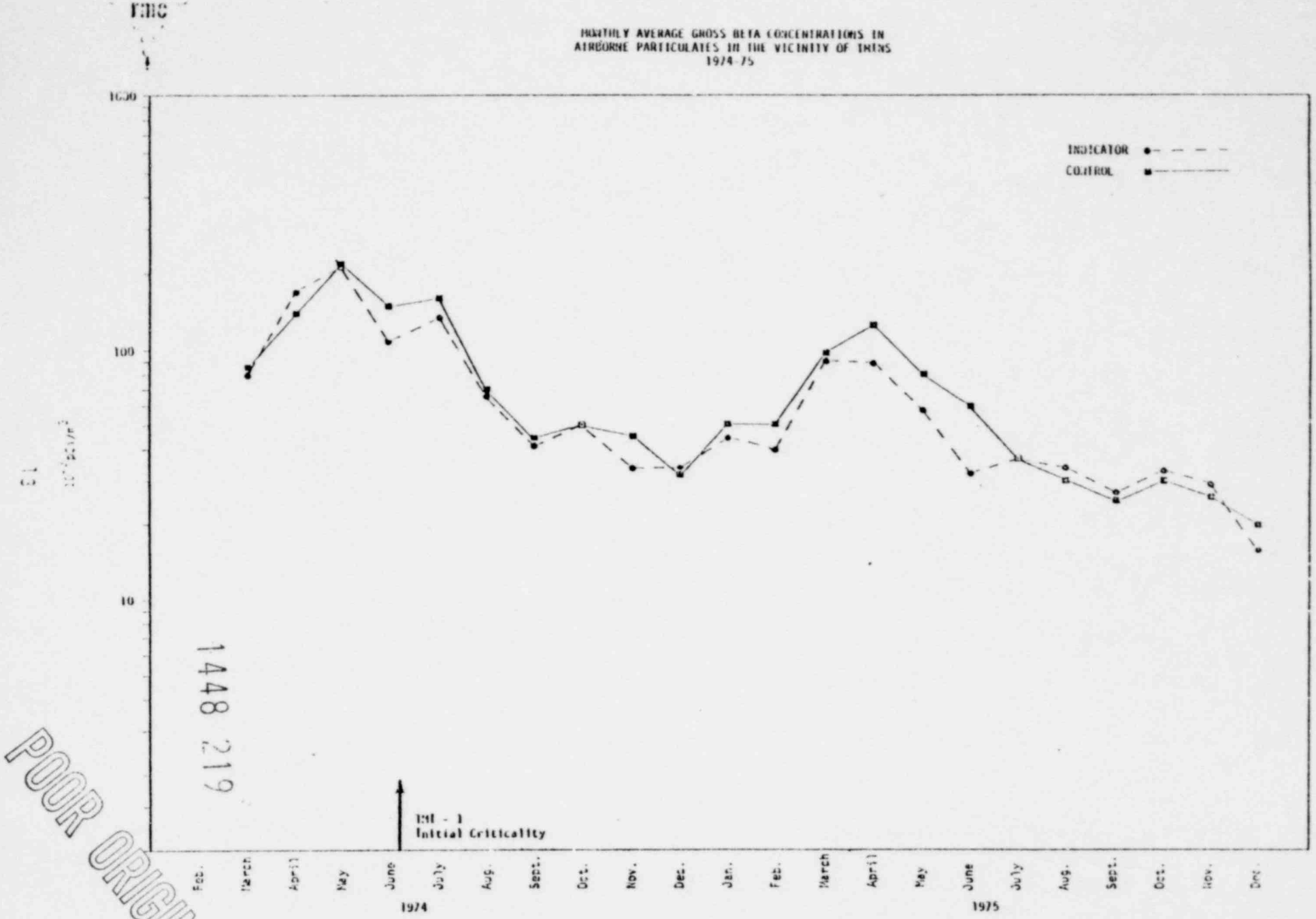
The results of analyses of quarterly composites of precipitation for H-3 and gamma emitting nuclides are presented in table B-12. Tritium concentrations averaged 87 pCi/l slightly lower than pre-operational levels. The gamma emitting nuclides Be-7 and Zr-Nb-95 were the only ones detected in precipitation. The observed levels of these nuclides were similar at both indicator and control locations. Typical MDLs for gamma spectrometric analyses of precipitation are listed in table B-18.

Semi-annual composites of precipitation samples from each station were analyzed for Sr-89 and Sr-90 and the results are presented in table B-13. Of the 4 samples analyzed, Sr-89 and Sr-90 were below MDL in all.

Terrestrial Environment

The terrestrial environment around TMINS was examined by analyzing samples of milk from 6 locations on a monthly basis and green leafy

FIGURE 2



vegetables on an annual basis. Two gallon milk samples were collected and shipped fresh to RMC. Each sample was analyzed for I-131 using RMC procedure IXD. Quarterly composites from each station were analyzed Sr-89 (SRC) and Sr-90 (SRA). Green leafy vegetables (cabbage) were taken in July at 4 stations. Each sample was analyzed for gamma emitters by RMC procedure TGC.

The results of I-131 analyses are presented in table B-14. None of the 27 milk samples analyzed showed detectable levels of I-131. Concentrations of Sr-89 and Sr-90 in quarterly composites of milk samples are listed in table B-15. Of the 12 samples analyzed, Sr-89 was not detected while Sr-90 was detected in 9. Results from indicator stations were similar to those from the control station and all results were similar to preoperational levels.

The results of gamma spectrometric analysis of green leafy vegetable samples (table B-16) showed detectable levels of natural K-40 only. No other gamma emitters were detected.

Direct Radiation

The ambient radiation levels in the area of Three Mile Island Nuclear Station were determined with energy compensated calcium sulfate (Tm) thermoluminescent dosimeters. A total of 80 monthly TLD packets (4 TLDs each) were placed at 21 locations around TMINS. The results of the TLD measurements are presented in table B-18. All TLD results presented in this report have been normalized to a standard month (30.4 days) to eliminate the differences in exposure periods. The resulting e rate was similar to preoperational levels averaging 5.3 mrad/standard month.

The projected annual dose computed from results for this reporting period is 64 mrads, or 64 mrem assuming a quality factor of 1. An annual dose equivalent of 82 mrem was computed for the Harrisburg area and published by the EPA(12). The difference between this calculated value and the measured RMC value is not considered significant because of the differences in technique and the statistical variability of each. The average monthly ambient radiation dose rates for indicator and control stations are plotted in figure 3. No trends in ambient gamma radiation levels as a result of TMI-1 operations are apparent from this graph.

ASSESSMENT OF IMPACT

The gaseous and liquid effluent streams from TMI-1 were continously sampled and/or monitored for the presence of radioactive materials by Metropolitan Edison Company. The REMP was designed and conducted in a manner to permit identification of the radionuclides actually released from the station.

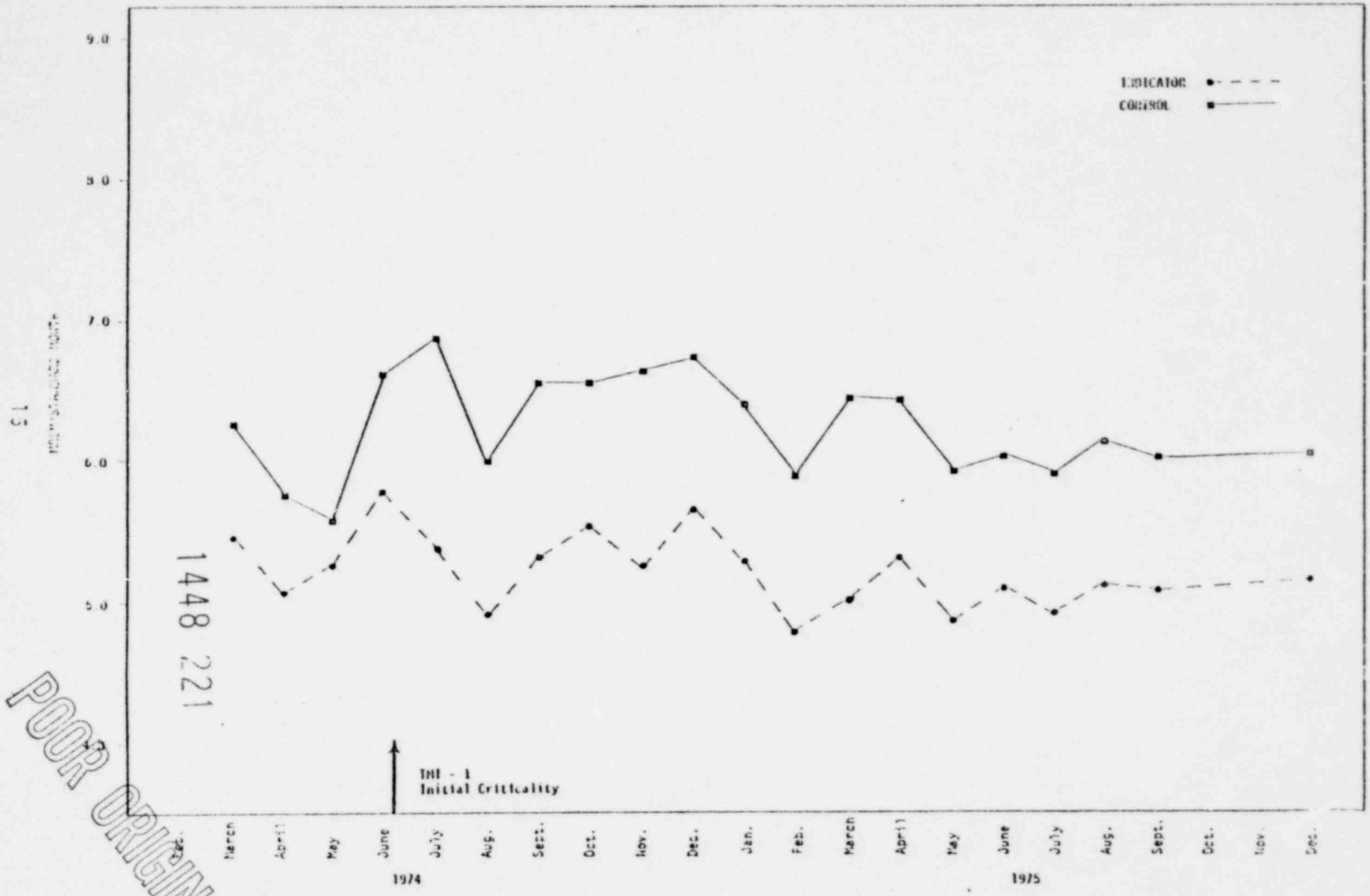
1448 220

Of the radioactive materials released from TMI-1 to the environs, only H-3, Co-60, and I-131 in surface water and Co-58 in sediment showed a statistically significant contribution from TMI-1. Those samples showing concentrations statistically different from preoperational or control station values are listed in table 4. Thus, the only pathways

FIGURE 3

FMIC

MONTHLY AVERAGE GAMMA DOSE RATES AT THIRS
1974-75



1448 221

POOR ORIGINAL

JULY - DECEMBER 1975 ENVIRONMENTAL SAMPLE [illegible]

SAMPLE TYPE	STATION NO.	SAMPLING DATES	ANALYSIS	[illegible]		
Surface Water	9A2	August	H-3	3566±96	pCi/l	
		October	H-3	3490±96	pCi/l	[illegible]
		August	Gamma			
			Co-60	2.4±0.4	pCi/l	NPR-30
			I-131	50±9.4	pCi/l	NPR-30
	9B1	August	H-3	2720±81	pCi/l	NRP-7
		September	H-3	1200±76	pCi/l	NRP-30
		October	H-3	1930±76	pCi/l	NRR-30
Sediment	11A1	July	Gamma			
			Co-58	0.47±0.05	pCi/g	NPR-30
		October	Gamma			
			Cs-137	0.83±0.08	pCi/g	NRR-30
	9B1	July	Gamma			
			Co-58	0.34±0.03	pCi/g	NRP-30

for potential exposure of individuals or of a segment of the population to radioactive materials from station operation is from consumption of river water or from shoreline deposits. Table 5 compares TMINS discharge data for H-3 and Co-58 with mean river flow. Since the H-3, Co-60, and I-131 were not detected in any other aquatic pathways (e.g. fish or sediment) except surface water, no significant dose can be atrributed to these other potential pathways.

Untreated river water is monitored as part of the TMINS REMP at 2 locations (Brunner Island, 8E1, and Columbia, 7G1) in the downstream vicinity which use treated river water continuously for human consumption. At no time during the reporting period did H-3 or I-131 levels at these stations differ statistically from those at the upstream station. It can then be concluded that these H-3 and I-131 levels did not result in a significant dose to man.

On one occasion during the reporting period (July) Co-60 was detected at a concentration of 2.1 pCi/l in untreated drinking water from station 8E1. The maximum dose which could be attributed to this level is 0.005 mrem to the GI tract or 0.0006 mrem to the total body from consumption of this untreated water for one month. In addition, a similarly small dose (0.08 mrem) could have been received from standing 500 hours on the sediment in which 0.47 pCi/g of Co-58 was detected during July. These dose calculations were performed using the basic equations employed in WASH-1258(15). These insignificant doses are the maxima which could be attributed to the radionuclides released to the Susquehanna River by TMI-1.

TABLE 5

COMPARISON OF SPECIFIC RADIONUCLIDES IN SURFACE WATER WITH STATION EFFLUENT DATA

	JUL	AUG	SEP	OCT	NOV	DEC
Mean River Flow at Harrisburg (CFS)	15,500	8,600	73,900	61,700	35,400	32,800
Total Liquid Tritium Releases for Month (curies)	22.5	67.0	42.8	45.6	15.4	20.3
Estimated Addition of H-3 as Monthly Average (pCi/l)	20	110	7.9	10	5.9	8.4
Total Liquid Co-58 Release for Month (curies)	1.6E-2	3.4E-3	3.5E-3	5.0E-3	4.2E-3	6.1E-3

CONCLUSIONS

The preoperational Radiological Environmental Monitoring Program (REMP) conducted by RMC and Metropolitan Edison Company was continued as the operational program after TMI-1 initial criticality on June 5, 1974. The REMP (from July 1 through December 31, 1975) described in this report was conducted according to the Environmental Technical Specifications for TMINS which permitted the objectives of the program to be met. Additional sampling and analyses beyond those required by the Technical Specifications were performed. All results therefrom were reviewed by RMC and Metropolitan Edison to assess all possible environmental pathways.

Although other possible dose pathways to man were considered in the environs of the TMINS site, tritium, Co-60, I-131 and Co-58 were the only radionuclides of TMINS origin detected above background levels with only Co-58 and Co-60 potentially contributing to dose. The radiation dose to people from ambient gamma radiation, as measured by thermoluminescent dosimeters, averaged 5.3 mrem/month and showed no evidence of a TMINS contribution during this operational period of TMI-1. The radiation dose to people in the TMINS environs is compared with the exposure from other artificial and natural sources in the following table:

Source of Exposure	Annual Dose in mrem
Medical	72(14)
Ambient Gamma (TLD)	64
Radionuclides in body (primarily K-40)	18(14)
Global fallout	4(14)
TMINS (Co-58 in sediment, Co-60 in water)	<0.1

Even though the TMI-1 contribution to population exposure is very small (approximately 0.1% of that from other sources), the TMINS has a continuing program to improve operating techniques and to maintain equipment directed toward reducing releases of radioactive materials to the environment. Therefore, it can be concluded that operation of TMI-1 did not significantly alter the radiological characteristics of the TMINS environs. The radionuclides and radiation levels observed were principally due to natural radioactivity and global fallout.

REFERENCES

(1) Metropolitan Edison Company. "Three Mile Island Nuclear Station-Technical Specifications." Appendix B. DPR 50, 1972.

(2) Radiation Management Corporation. "Three Mile Island Nuclear Generating Station-Preoperational Radiological Environmental Monitoring Program". RMC-TR-75-17, 1975.

(3) Radiation Management Corporation. "Three Mile Island Nuclear Station-Radiological Environmental Monitoring Program-First Operational Period." RMC-TR-75-02, 1975.

(4) Radiation Management Corporation. "Three Mile Island Nuclear Station-1975 Semi-annual Report". RMC-TR-75-13, 1975.

(5) United States Department of the Interior-Geological Survey. "Water Resources Data for Pennsylvania, Part-1." 1973

(6) Radiation Management Corporation. "Three Mile Island Nuclear Generating Station-Agricultural Land Use Survey". RMC-TR-75-1, 1975.

(7) Metropolitan Edison Company. "Environmental Report, Operating License Stage-Three Mile Island Nuclear Station Unit 1 and Unit 2", 1971.

(8) United States Atomic Energy Commission. "Final Environmental Statement-Three Mile Island Nuclear Generating Station Units 1 and 2". Docket Nos. 50-289 and 50-320, 1972.

(9) Metropolitan Edison Company, Jersey Central Power and Light Company, Pennsylvania Electric Company. "Final Safety Analysis Report, Three Mile Island Nuclear Station-Unit 2". Docket No. 50-320, 1974

(10) Metropolitan Edison Company, Jersey Central Power and Light Company, Pennsylvania Electric Company. "Environmental Report Supplement II, Three Mile Island Nuclear Station." Docket No. 50-320, February 1975.

(11) Radiation Management Corporation "Analytical and Quality Control Program." RMC-TM-75-3, 1975.

(12) Donald T. Oakley, "Natural Radiation Exposure in the United States," U.S. Environmental Protection Agency, ORP/SID 72-1, June 1972.

REFERENCES (Cont.)

(13) S. E. Thompson, C. A. Burton, D. J. Quinn and T. C. Ng, "Concentration Factors of Chemical Elements in Aquatic Organisms." UCRL-50564 (Rev. 1), October 1972.

(14) "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation" (BEIR REPORT). National Academy of Sciences, 1972.

(15) United States Atomic Energy Commission. "Final Environmental Statement-ALAP WASH-1258," 1972.

APPENDIX A

APPENDIX A Sampling Locations

Sample Identification

RMC identifies samples by a three part code. The first two letters are the power station identification code, in this case TM. The next one to three letters are for the media sampled.

AI	= Air Iodine	FPL	= Green Leafy Vegetables
AP	= Air Particulates		
AQF	= Fish	ID	= Immersion Dose (TLD)
AQP	= Aquatic Plants	M	= Milk
AQS	= Sediment	RW	= Precipitation
E	= Soil	SW	= Surface Water

The last four symbols are a location code based on direction and distance from the site. Of the last four symbols, the first two represent each of the sixteen angular sectors of 22-1/2 degrees centered about the reactor site. Sector one is divided evenly by the north axis and other sectors are numbered in a clockwise direction; i.e., 2=NNE, 3=NE, 4=ENE, 5=E, etc. The next digit is a letter which represents the radial distance from the plant:

S = On-site location	E = 4-5 miles off-site
A = 0-1 miles off-site	F = 5-10 miles off-site
B = 1-2 miles off-site	G = 10-20 miles off-site
C = 2-3 miles off-site	H = >20 miles off-site
D = 3-4 miles off-site	

The last number is the station numerical designation within each sector and zone; e.g. 1, 2, . . .

The location portions of these codes (i.e. 1S1, 3A1, etc.) are shown in the attached table along with more detailed information and a map coordinate number used to indicate the sampling locations. This sample identification system is used to designate the individual samples in the analytical result tables, Appendix B.

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

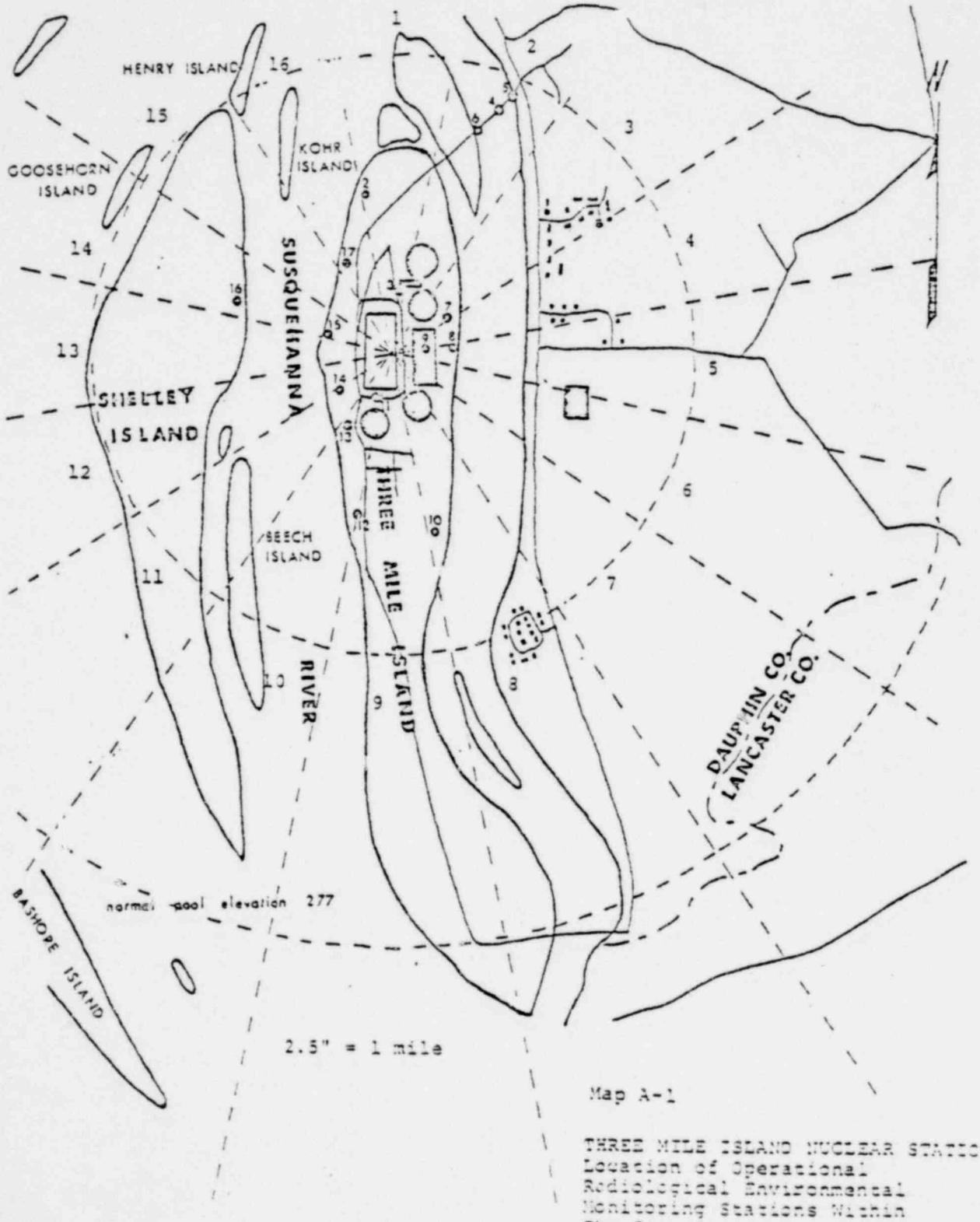
LOCATION CODE	MAP NO.	DESCRIPTION*
1S2	2	0.4 miles N of site
2S2	4	0.7 miles NNE of site on light pole in middle of North Bridge
2S3	5	0.7 miles NNE of site beside guard house at North Gate
4S2	7	0.3 miles ENE of site on top of dike, East Fence
5S3	9	0.2 miles E of site on top of dike, East Fence
8S1	10	0.5 miles SSE of site at South Weather Station
9S2	12	0.4 miles S of site at South Beach of Three Mile Island
11S1	14	0.1 miles SW of site, west of Mechanical Draft Towers on dike.
14S2	16	0.4 miles WNW of site at Shelly's Island picnic area
16S1	17	0.2 miles NNW of site at gate in fence on west side of Three Mile Island
1A2	19	0.7 miles N of site at north tip of Three Mile Island
4A1	21	0.5 miles ENE of site on Laurel Rd., Met. Ed. Pole #668-01
5A1	22	0.4 miles E of site on north side of Observation Center Building
5A3	28	0.9 miles E of site on Hoover Farm
9A2	27	0.5 miles S of site below Discharge Pipe
11A1	29	0.2 miles SW of site off Discharge Pipe
16A1	31	0.4 miles NNW of site on Kohr Island
4B1	33	1.1 miles ENE of site, west of Gingrich Road
5B1	34	1.0 mile E of site on Peck Road

TABLE A-1 (Cont.)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

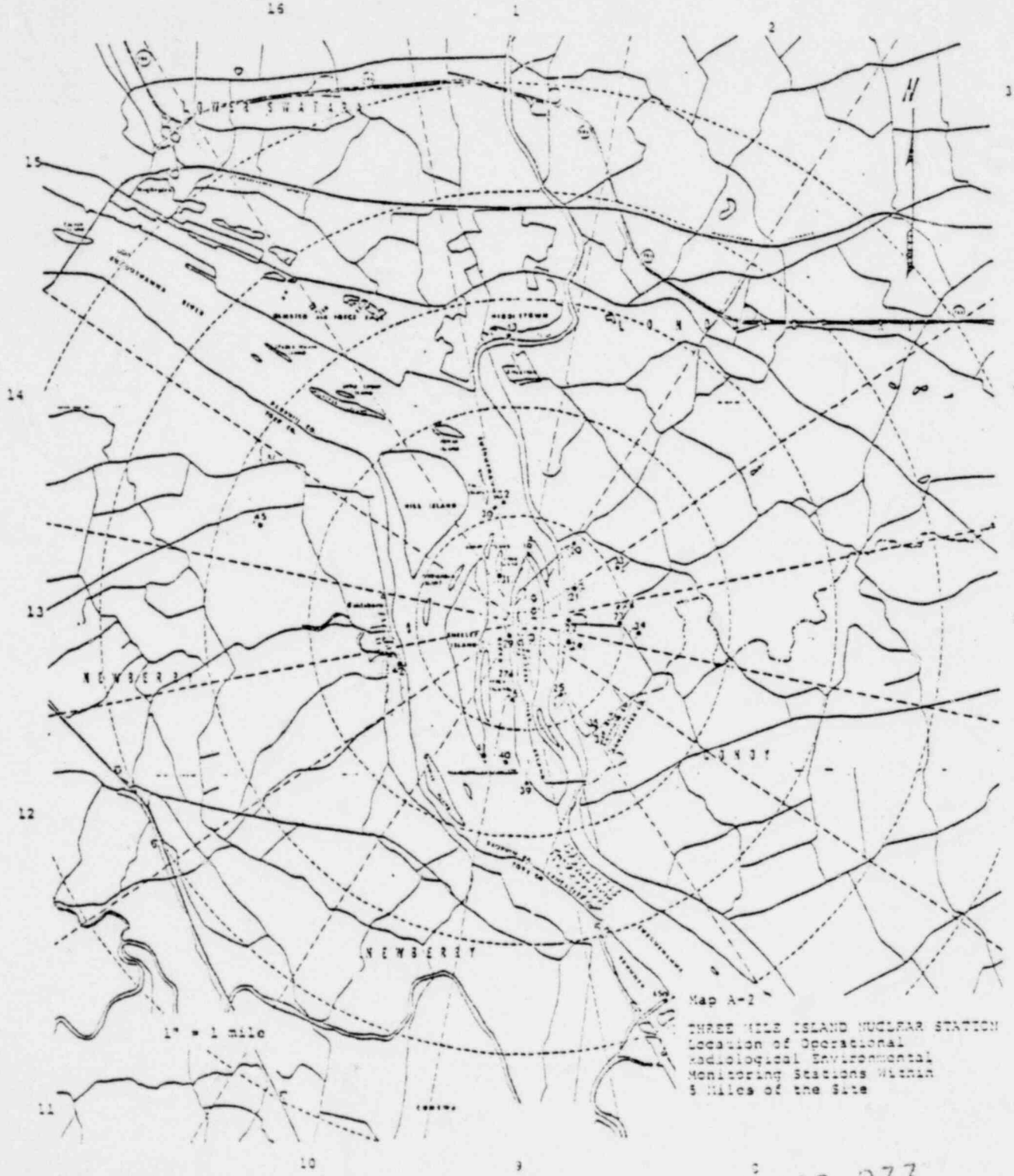
LOCATION CODE	MAP NO.	DESCRIPTION*
7B3	37	1.6 miles SE of site on east side of Conewago Creek
9B1	39	1.5 miles S of site, above York Haven Dam
10B1	41	1.1 miles SSW of site on south beach of Shelly's Island
12B1	42	1.6 miles WSW of site adjacent to Fishing Creek
16B1	30	1.1 miles WNW of site below Fall Island
1C1	43	2.6 miles N of site at Middletown Substation
14C2	45	2.7 miles WNW of site near Intersection of Routes 262 and 392
8E1	45a	4.1 miles SSE of site at Brunner Island
1F1	47	6 miles N of site at Hummelstown Substation on Fiddler's Elbow Road
1F2	48	9 miles N of site on Union Deposite Road, west of Hoernerstown
5F1	49	9 miles E of site on East Ridge and Greentree Roads
7F1	51	9 miles SE of site at Drager Farm off Engle's Tollgate Road
15F1	53	8.7 miles NW of site at Steelton Municipal Water Works
4G1	54	10 miles ENE of site at Lava - Met. Ed. Pole #J1813
7G1	55	15 miles SE of site at Columbia Water Treatment Plant
9G1	56	13 miles S of site in Met. Ed. York Load Dispatch Station
15G1	58	15 miles NW of site at West Fairview Substation
5H1	60	80 miles E of site on RMC roof in Philadelphia
5H2	61	80 miles E of site on RMC roof in Philadelphia

* All distances are measured from a point that is midway between the Reactor Buildings of Units One and Two



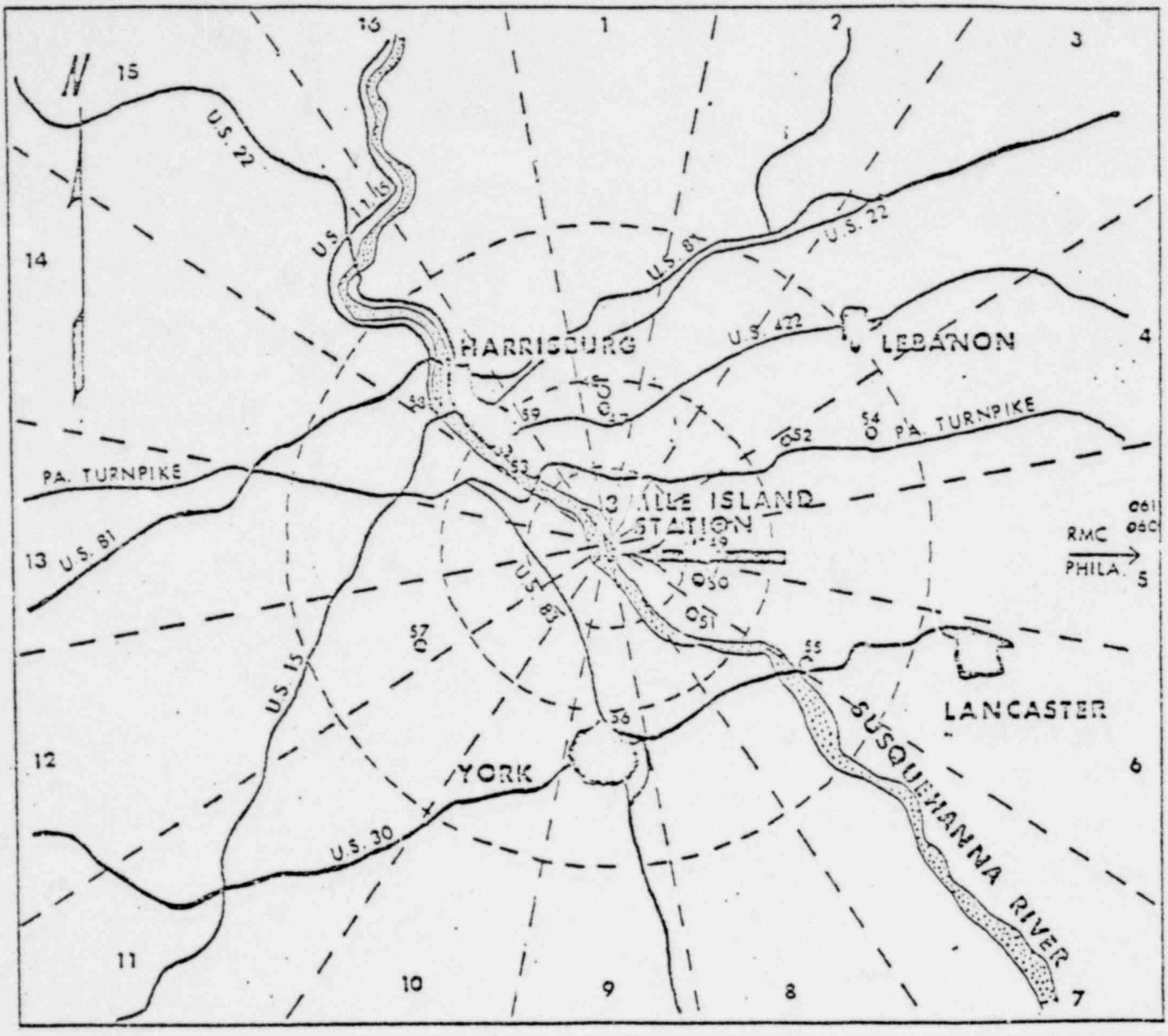
Map A-1

THREE MILE ISLAND NUCLEAR STATION
Location of Operational
Radiological Environmental
Monitoring Stations Within
The Site Boundries



Map A-2

THREE MILE ISLAND NUCLEAR STATION
Location of Operational
Radiological Environmental
Monitoring Stations Within
5 Miles of the Site



1" = APPR. 10 MILES

1448 234

Map A-3

THREE MILE ISLAND NUCLEAR STATION
Location of Operational
Radiological Environmental
Monitoring Stations Greater
Than 5 Miles from the Site

APPENDIX B

APPENDIX B Data Tables

Appendix B is a presentation of the results of the TMINS Radiological Environmental Monitoring Program.

APPENDIX B Data Tables (Cont.)

TABLE B-1

SAMPLING PERIODS FOR SURFACE WATER SAMPLES

STATION NO.	JUL	AUG	SEP	OCT	NOV	DEC
TH-SW-1C3*	7-05-75 to 7-26-75	8-02-75 to 8-30-75	9-06-75 to 9-27-75	10-04-75 to 11-01-75	11-06-75 to 11-26-75	12-03-75 to 12-31-75
TH-SW-1SF1	6-29-75 to 7-26-75	7-27-75 to 8-30-75	8-31-75 to 9-29-75	9-30-75 to 11-01-75	11-02-75 to 11-26-75	12-03-75 to 12-31-75
TH-SW-9A2	7-05-75 to 7-26-75	8-02-75 to 8-30-75	9-06-75 to 9-27-75	10-04-75 to 11-01-75	11-06-75 to 11-26-75	12-03-75 to 12-31-75
TH-SW-9B1	7-05-75 to 7-26-75	8-02-75 to 8-30-75	9-06-75 to 9-20-75	10-04-75 to 11-01-75	11-06-75 to 11-26-75	12-03-75 to 12-31-75
TH-SW-9E1*	6-28-75 to 7-26-75	7-26-75 to 8-30-75	8-30-75 to 9-28-75	9-29-75 to 11-01-75	11-01-75 to 11-26-75	11-26-75 to 12-31-75
TH-SW-7C1	6-23-75 to 7-26-75	7-26-75 to 8-30-75	8-30-75 to 9-26-75	9-26-75 to 10-25-75	10-25-75 to 12-03-75**	12-03-75 to 12-31-75

* Management audit samples
** Composite sampler inoperative; composite of weekly grabs

TABLE B-2

CONCENTRATIONS OF TRITIUM IN SURFACE WATER

Results in Units of pCi/l ± 2 sigma

STATION NO.	JUL	AUG	SEP	OCT	NOV + DEC*	AVERAGE
UPSTREAM LOCATIONS						
TM-SW-1C3**	430±66	250±61	170±60	150±58	120±64	240±250
TM-SW-15F1	220±63	290±61	200±60	96±64	540±61	270±330
UPSTREAM AVERAGE	320±300	270±56	180±45	120±7[illegible]	330±580	250±280
DOWNSTREAM LOCATIONS						
TM-SW-9A2	90±63	3900±90	420±67	3490±96	300±66	1660±3700
TM-SW-9B1	170±63	2720±81	1200±76	1930±76	380±59	1280±2100
TM-SW-8E1**	200±63	270±59	200±60	120±60	200±57***	200±110
TM-SW-7G1	480±66	260±61	410±66	150±64	220±65	300±270
DOWNSTREAM AVERAGE	260±290	1800±3600	560±880	1450±3200	280±160	860±2400

* Monthly samples were composited prior to analysis (future analyses to be quarterly only)
** Management audit samples
*** December sample only

TABLE F-1

CONCENTRATIONS OF SR-89 AND SR-90 IN UNTREATED DRINKING WATER

Results in Units of pCi/l

STATION NO.	START DATE	STOP DATE	SR-89	SR-90
TM-SW-15F1	6-29-75	9-29-75	<0.2	<0.2
	9-30-75	12-31-75	<0.8	0.4±0.4
TM-SW-8E1*	6-28-75	9-28-75	<0.1	<1.0
	9-29-75	12-31-75	<0.7	<0.5
TM-SW-7G1	6-28-75	9-26-75	<0.1	<1.0
	10-05-75	12-31-75	<0.8	<0.6

* Management audit sample

TABLE B-4

CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER

Results in Units of pCi/l ± 2 sigma

STATION NO.	NUCLIDE* FOUND	JUL	AUG	SEP	OCT	NOV	DEC
TM-SW-1C3**	K-40	8	17±10	6	7	7	7
TM-SW-15F1	Be-7	<MDL	<MDL	8.4±6.6	<MDL	<MDL	<MDL
TM-SW-9A2	K-40	32±10	7	6	6	9	7
	Co-60	0.7	2.4±0.4	0.6	0.6	0.8	0.7
	I-131***	2	50±9.4	2	20	6	4
TM-SW-9B1	K-40	7	17±11	8	7	7	8
TM-SW-6E1**	Co-60	2.1±1.1	0.6	0.7	0.6	+	0.6
TM-SW-7G1	Be-7	<MDL	<MDL	12±6	<MDL	<MDL	<MDL

* All other gamma emitters <MDL

** Management audit samples

*** Results corrected for decay to midpoint of sampling period

\+ Results delayed in laboratory

TABLE B-5

CONCENTRATIONS OF SR-89 AND SR-90 AND GAMMA EMITTERS IN FISH

Results in Units of pCi/kg ± 2 sigma

STATION NO.	SAMPLE TYPE*	SAMPLING MONTH	SR-89	SR-90	K-40**	CS-137**
UPSTREAM SAMPLES						
TM-AOF-16B1	Catfish Brown Bullhead	July	<3.0	3.4±2.0	3500±350	9±7
TM-AOF-16B1	S. Mouth Bass Rock Bass	July	<4.1	5.0±3.4	3700±370	32±8
TM-AOF-16B1	Rock Bass	October	<5.6	3.9±2.6	4600±460	30±16
TM-AOF-16B1	Catfish	October	<8.8	4.9±4.6	3200±320	12±8
DOWNSTREAM SAMPLES						
TM-AOF-9B2	Catfish S. Mouth Bass	July	<4.5	<3.2	3100±310	10±8
TM-AOF-9B2	Rock Bass	July	<7.5	8.9±3.4	6100±610	29±11
TM-AOF-9B2	Catfish	October	<6.4	<5.7	3700±370	11±8
TM-AOF-9B2	S. Mouth Bass Rock Fish	October	<7.7	17±4	3600±360	21±9

* Bottom feeders - catfish, brown bull head; predator/game - small mouth bass, rock bass

** All other gamma emitters <MDL

TABLE B-6

CONCENTRATIONS OF SR-89 AND SR-90 IN SEDIMENT

Results in Units of pCi/g(dry) ± 2 sigma

STATION NO.	SAMPLING DATE	SR-89	SR-90
TM-AOS-1A2	7-30-75	<0.2	<0.1
	10-23-75	<0.07	<0.06
TM-AOS-9B1	7-30-75	<0.2	0.1±0.1
TM-AOS-11A1	7-30-75	<0.2	<0.1
	10-23-75	<0.1	<0.1
TM-AOS-11A2	10-23-75	<0.1	0.05±0.03

TABLE F-7

CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT

Results in Units of pCi/g(dry) ± 2 sigma

NUCLIDE*	TM-AQS-1A2 7-30-75	TM-AQS-1A2 10-23-75	TM-AQS-9B1 7-30-75	TM-AQS-11A1 7-30-75	TM-AQS-11A1 10-23-75	TM-AQS-11A2 10-23-75
Be-7	<MDL	0.4±0.1	1.9±0.2	0.2±0.1	<MDL	<MDL
K-40	18±2	9±1	22±2	14±1	18±2	14±1
Mn-54	<0.02	<0.02	0.04±0.02	<0.02	<0.06	<0.02
Co-58	<0.02	<0.02	0.34±0.03	0.47±0.05	<0.02	<0.02
Zr-95	<0.03	<0.03	0.15±0.04	<0.04	<0.04	<0.04
Nb-95	<0.03	<0.03	0.25±0.03	0.06±0.02	<0.04	<0.04
Ru-106	<0.2	<0.2	0.5±0.2	<0.2	<0.2	<0.2
Sb-125	<MDL	<MDL	0.13±0.05	<MDL	<MDL	<MDL
Cs-137	0.52±0.05	0.19±0.03	0.62±0.06	0.37±0.04	0.83±0.08	0.32±0.03
Ce-144	<0.2	<0.03	0.9±0.2	<0.2	<0.1	<0.1
Ra-226	1.3±0.1	0.1±0.1	1.2±0.1	1.0±0.1	1.2±0.1	1.3±0.1
Th-232	1.2±0.1	0.86±0.08	1.3±0.1	1.0±0.1	1.1±0.1	1.2±0.1

* All other gamma emitters < MDL

TABLE P-8

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

START DATE	STOP DATE	STATION NO. TM-AP-1F1	TM-AP-5F1	TM-AP-7F1	TM-AP-9F1	TM AP-15G1
6-28-75	7-05-75	63±8	61±7	NS*	44±6	51±7
7-05-75	7-12-75	4 ±7	46±6	NS*	44±6	55±7
7-12-75	7-19-75	26±6	37±6	NS*	32±6	18±4
7-19-75	7-26-75	21±5	22±6	<10	21±5	24±5
7-26-75	8-02-75	34±7	36±7	30±6	34±6	42±7
8-02-75	8-09-75	25±6	33±7	26±6	29±6	35±7
8-09-75	8-16-75	36±7	42±7	46±7	41±7	50±9
8-16-75	8-23-75	27±6	27±6	32±6	26±6	15±5
8-23-75	8-30-75	26±6	19±6	27±6	28±6	22±6
8-30-75	9-06-75	18±5	22±7	13±5	20±6	18±5
9-06-75	9-13-75	26±6	NS*	21±6	17±5	22±6
9-13-75	9-20-75	15±4	72±5	18±5	18±4	12±4
9-20-75	9-27-75	96±39	20±5	11±4	18±5	17±5
9-27-75	10-04-75	23±5	25±5	17±5	24±5	18±5

* No sample, pump inoperative

TABLE B-8 (Cont.)

CONCENTRATIONS OF ALPHA EMITTERS IN AIR PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

START DATE	STOP DATE	STATION NO. TM-AP-1F1	TM-AP-5F1	TM-AP-7F1	TM-AP-9G1	TM-AP-15G1
10-04-75	10-21-75	24±6	27±6	14±4	26±5	22±5
10-11-75	10-18-75	22±6	18±6	30±6	29±6	31±6
10-18-75	10-25-75	19±5	28±6	20±5	26±6	27±6
10-25-75	11-01-75	15±4	15±5	97±43	12±4	17±5
11-01-75	11-06-75	23±7	27±8	27±8	22±7	19±7
11-06-75	11-13-75	18±6	17±6	17±5	16±5	18±5
11-13-75	11-20-75	28±6	23±5	14±4	27±5	46±7
11-20-75	11-26-75	24±6	22±6	22±6	23±5	25±6
11-26-75	12-03-75	29±6	25±6	85±37	24±7	29±5
12-03-75	12-01-75	13±5	22±6	17±5	34±10	17±5
12-10-75	12-17-75	26±6	19±5	22±5	28±8	21±6
12-17-75	12-24-75	23±6	22±6	17±6	22±5	21±6
12-24-75	12-31-75	16±6	12±5	17±5	18±5	21±6
AVERAGE		28±34	29±28	28±43	26±16	26±24

TABLE B-8(Cont.)

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

START DATE	STOP DATE	STATION NO. TM-AP-1S2	TM-AP-2S3	TM-AP-3S1	TM-AP-5A1	TM-AP-12B1	AVERAGE
6-28-75	7-05-75	61±7	56±7	53±7	50±9	63±8	56±12
7-05-75	7-12-75	16±4	62±8	46±7	42±6	27±7	42±28
7-12-75	7-19-75	35±6	31±6	18±4	32±6	30±7	29±14
7-19-75	7-26-75	11±4	20±6	26±5	84±36	12±6	27±41
7-26-75	8-02-75	16±5	32±8	42±14	39±7	35±8	32±15
8-02-75	8-09-75	31±6	26±8	30±6	99±42	27±6	30±45
8-09-75	8-16-75	34±6	21±7	30±6	34±7	44±7	33±17
8-16-75	8-23-75	24±6	21±7	30±7	26±6	30±6	26±10
8-23-75	8-30-75	14±5	26±7	19±6	90±42	28±6	30±43
8-30-75	9-06-75	21±5	20±4	24±6	10±4	20±5	19±8
9-06-75	9-13-75	16±5	20±5	20±6	18±5	22±5	20±6
9-13-75	9-20-75	89±36	86±29	20±5	60±36	20±5	41±64
9-20-75	9-27-75	16±5	20±6	17±6	16±4	15±4	25±50
9-27-75	10-04-75	NS*	NS*	15±4	19±5	22±7	20±7

* No sample, pump inoperative

TABLE B-8 (Cont.)

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

START DATE	STOP DATE	STATION NO. TM-AP-1S2	TM-AP-2S3	TM-AP-6S1	TM-AP-5A1	TM-AP-13B1	AVERAGE
10-04-75	10-11-75	73±39	25±16	19±5	94±37	26±5	35±53
10-11-75	10-18-75	22±4	21±6	25±6	19±4	17±5	21±10
10-18-75	10-25-75	15±4	24±6	13±5	26±6	22±5	22±10
10-25-75	11-01-75	90±40	84±52	77±44	10±4	26±5	43±76
11-01-75	11-06-75	33±10	20±9	22±7	14±7	22±7	22±13
11-06-75	11-13-75	13±4	12±6	17±5	13±9	23±6	17±6
11-13-75	11-20-75	26±5	94±50	14±4	22±5	26±5	32±57
11-20-75	11-26-75	20±8	26±7	22±6	90±42	23±6	30±52
11-26-75	12-03-75	NS*	16±6	85±38	21±5	17±5	37±75
12-03-75	12-10-75	17±7	<5**	11±4	<3**	16±5	20±15
12-10-75	12-17-75	20±5	15±10	10±5	10±4	24±5	20±22
12-17-75	12-24-75	13±5	21±3	17±6	26±6	26±6	21±8
12-24-75	12-30-75	16±5	12±7	14±5	<4**	11±5	15±8
AVERAGE		30±46	32±48	28±37	39±59	25±21	29±39

* No sample, pump inoperative

** Result not included in average; sample volume in question

TABLE P-9

CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO.	NUCLIDE*	6-28-75 to 8-02-75	8-02-75 to 8-30-75	8-30-75 to 9-27-75	9-27-75 to 11-01-75	11-01-75 to 12-03-75	12-03-75 to 12-31-75
TH-AP-BACKGROUND	Be-7	150±15	84±8	49±5	70±7.9	95±10	93±8
	Na-22	<0.3	2.1±0.6	<0.3	<0.3	<0.5	<0.3
	Mn-54	0.3±0.2	<0.3	<0.4	<0.3	<0.3	<0.3
	Zr-95	2.1±0.5	<0.7	<0.6	<0.5	<0.7	<0.4
	Nb-95	4.3±0.5	1.2±0.4	0.3±0.2	0.2±0.2	0.4±0.3	0.3±0.3
	Ru-106	10±3	<3.0	<4.0	<3.0	<4.0	<3.0
	Sb-125	2.1±0.7	1.1±0.8	1.2±1.0	<MDL	<MDL	<MDL
	Cs-137	4.3±0.5	0.7±0.3	0.4±0.3	0.5±0.2	0.4±0.3	1.2±0.5
	Ce-141	0.6±0.3	<MDL	<MDL	<MDL	<MDL	<MDL
	Ce-144	22±2	5.0±1.5	1.3±1.1	2.5±1.5	6.5±3.4	3.0
TH-AP-INDICATOR	Be-7	21±2	60±6	27±3	38±4	51±5	40±4
	Mn-54	<0.1	0.2±0.1	<0.1	<0.1	0.05±0.04	0.1
	Zr-95	0.2±0.1	0.2±0.1	<0.2	<0.2	0.1±0.1	0.2±0.1
	Nb-95	0.7±0.1	0.6±0.2	0.1±0.1	0.2±0.1	0.1±0.1	MDL
	Ru-106	1.9±1.0	<1.0	2.0±1.1	<1.0	<1.0	0.6
	Sb-125	<MDL	0.7±0.5	0.3±0.2	0.2±0.2	<MDL	MDL
	Cs-137	0.6±0.1	0.6±0.2	0.3±0.1	0.1±0.1	0.2±0.1	0.2±0.1
	Ce-144	3.0±1.0	3.0±1.0	<0.5	1.6±0.8	0.6±0.4	0.9±0.7

*All other gamma emitters <MDL

TABLE F-10

CONCENTRATIONS OF I-131 IN FILTERED AIR

Results* in Units of 10^{-3} pCi/m^3

START DATE	STOP DATE	STATION NO. TM-AI-1S2	TM-AI-3S1	TM-AI-5A1	TM-AI-15G1
6-28-75	7-05-75	<8	<8	<13	<8
7-05-75	7-12-75	<8	<8	<7	<8
7-12-75	7-19-75	<8	<8	<8	<7
7-19-75	7-26-75	<8	<8	<8	<8
7-26-75	8-02-75	<9	<29	<10	<9
8-02-75	8-09-75	<8	<9	<8	<10
8-09-75	8-17-75	<10	<10	<16	<20
8-16-75	8-23-75	<11	<5	<10	<8
8-23-75	8-30-75	<8	<9	<7	<7
8-30-75	9-06-75	<7	<7	<7	<7
9-06-75	9-13-75	<7	<3	<7	<7
9-13-75	9-20-75	<7	<10	<8	<7
9-20-75	9-27-75	<10	<10	<7	<8
9-27-75	10-04-75	NS**	<7	<7	<

* Results corrected for decay to sampling stop date

** No sample, pump inoperative

TABLE B-10 (Cont.)

CONCENTRATIONS OF I-131 IN FILTERED AIR

Results* in Units of 10^{-3} pCi/m^3

START DATE	STOP DATE	STATION NO. TM-AI-1S2	TM-AI-8S1	TM-AI-5A1	TM-AI-15G1
10-04-75	10-11-75	<8	<7	<7	<8
10-11-75	10-18-75	<7	<9	<7	<9
10-18-75	10-25-75	<7	<9	<7	<7
10-25-75	11-01-75	<7	<8	<7	<7
11-01-75	11-06-75	<16	<12	<12	<12
11-06-75	11-13-75	<6	<6	<6	<8
11-13-75	11-20-75	<8	<8	<3	<8
11-20-75	11-26-75	<15	<12	<9	<6
11-26-75	12-03-75	NS**	<5	<5	<7
12-03-75	12-10-75	<13	<8	<10	<10
12-10-75	12-17-75	<6	<7	<6	<6
12-17-75	12-24-75	<7	<7	<9	<9
12-24-75	12-31-75	<10	<13	<10	<12

* Results corrected for decay to sampling stop date

** No sample, pump inoperative

TABLE P-11

CONCENTRATIONS OF BETA EMITTERS IN PRECIPITATION

Results in Units of pCi/l ± 2 sigma

STATION NO.	6-28-75 to 7-26-75	7-26-75 to 8-30-75	8-30-75 to 9-27-75	9-27-75 to 11-01-75	11-01-75 to 11-26-75	11-26-75 to 12-31-75	AVERAGE
TH-HW-8S1	11±4	6.7±4.3	<4	3.8±2.4	<3	7.1±3.1	6.0±5.8
TH-HW-5A1	7.7±3.5	12±5	<4	4.1±2.4	<4	12±3	7.3±7.7
TH-HW-7F1	9.4±3.7	5.0±4.2	<4	5.5±2.5	5.8±3.5	12±3	7.0±6.0
TH-HW-15G1	11±4	8.0±4.4	<4	6.4±2.6	<3	5.9±3.0	6.5±5.5
AVERAGE	9.8±3.2	7.9±6.0	-	5.0±2.4	-	9.2±6.4	6.7±6.0

BETA EMITTER DEPOSITION

Results in Units of nCi/m^2 ± 2 sigma

STATION NO.	6-28-75 to 7-26-75	7-26-75 to 8-30-75	8-30-75 to 9-27-75	9-27-75 to 11-01-75	11-01-75 to 11-26-75	11-26-75 to 12-31-75	AVERAGE
TH-HW-8S1	0.9±0.3	0.2±0.1	<1.5	0.3±0.2	<0.3	0.4±0.2	0.6±1.0
TH-HW-5A1	0.5±0.2	0.4±0.2	<1.2	0.2±0.1	<0.2	0.6±0.2	0.5±0.7
TH-HW-7F1	0.8±0.3	0.2±0.2	<1.7	0.3±0.1	0.5±0.3	0.6±0.2	0.7±1.1
TH-HW-15G1	0.9±0.3	0.6±0.4	<1.7	0.4±0.2	<0.2	0.4±0.2	0.7±1.1
AVERAGE	0.8±0.4	0.4±0.4	-	0.3±0.2	-	0.5±0.2	0.6±0.9

TABLE B-12

CONCENTRATIONS OF TRITIUM AND GAMMA EMITTERS IN PRECIPITATION

Results in Units of pCi/l ± 2 sigma

STATION NO.	START DATE	STOP DATE	H-3	Be-7	OTHERS
TM-RV-8S1	6-28-75	9-27-75	86±64	<MDL	<MDL
	9-27-75	12-31-75	<80	<MDL	<MDL
TM-RV-5A1	6-28-75	9-27-75	120±61	16±7	<MDL
	9-27-75	12-31-75	<80	13±7	<MDL
TM-RV-15G1	6-28-75	9-27-75	<80	23±7	<MDL
	9-27-75	12-31-75	<80	19±7	<MDL
TM-RV-7F1	6-28-75	9-27-75	88±64	14±7	<MDL
	9-27-75	12-31-75	<80	<MDL	<MDL

TABLE E-13

CONCENTRATIONS OF SR-89 AND SR-90 IN PRECIPITATION

Results in Units of pCi/l

STATION NO.	START DATE	STOP DATE	SR-89	SR-90
TM-RW-1S2	6-28-75	12-31-75	<0.4	<0.3
TM-RW-8S1	6-28-75	12-31-75	<0.5	<0.4
TM-RW-7F1	6-28-75	12-31-75	<0.5	<0.4
TM-RW-15G1	6-28-75	12-31-75	<0.5	<0.3

TABLE B-14

CONCENTRATIONS OF I-131 IN MILK

Results* in Units of pCi/l

STATION NO.	JUL	AUG	SEP	OCT	NOV	DEC**
TM-M-4B1	<0.06	<0.06	<0.07	<0.05	<0.05	
TM-M-5B1	<0.05	<0.06	<0.06	<0.05	<0.04	
TM-M-7B3	<0.06	<0.08	<0.08	<0.05	<0.04	
TM-M-14C1	<0.06	<0.06	<0.08	<0.06	<0.04	
TM-M-1F2	<0.06	<0.08	<0.07	<0.05	<0.04	
TM-M-5A3+	++	++	++	<0.06	<0.04	

* Results corrected for decay to sampling date
** No samples in December; non-grazing season
\+ Management audit sample
++ Cow dry - no sample available

TABLE B-15

CONCENTRATIONS OF SR-89 AND SR-90 IN MILK

Results in Units of pCi/l ± 2 sigma

STATION NO.	START DATE	STOP* DATE	SR-89	SR-90
TM-M-4B1	7-26-75	9-27-75	<2.1	3.9±1.1
	11-02-75	12-01-75	<1.5	2.7±0.7
TM-M-5B1	7-26-75	9-27-75	<1.4	1.8±0.7
	11-01-75	12-01-75	<1.5	2.5±0.7
TM-M-7B3	7-26-75	9-27-75	<2.1	4.3±1.1
	11-01-75	12-01-75	<0.9	<0.7
TM-M-14C1	7-26-75	9-27-75	<1.9	4.7±1.0
	11-01-75	12-01-75	<1.8	4.3±0.9
TM-M-1F2	7-26-75	9-27-75	<3.3	7.9±1.7
	11-01-75	12-01-75	<2.0	6.9±0.9
TM-M-5A3**	11-01-75***	12-01-75***	<1.4	2.8±0.7

* No samples in December; non-grazing season
** Management audit sample
*** Cow dry July to September - no sample available

TABLE B-16

CONCENTRATIONS OF GAMMA EMITTERS IN
GREEN LEAFY VEGETABLES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NO.	SAMPLING DATE	K-40	OTHERS
TM-FPL-5A4	8-30-75	1.6±0.4	<MDL
TM-FPL-7B3	8-30-75	3.4±0.4	<MDL
TM-FPL-14C1	8-30-75	4.2±0.4	<MDL
TM-FPL-1F2	8-30-75	3.4±0.5	<MDL

TABLE B-17

TLD DOSE RATE

Results in Units of mrem/standard month

STATION NO.	6-28-75 to 7-26-75	7-26-75 to 8-30-75	8-30-75 to 10-04-75	10-04-75* to 12-24-75	AVERAGE
CONTROL LOCATIONS					
TM-ID-1F1	6.0±0.6	6.2±0.2	6.4±0.3	6.2±0.3	6.2±0.3
TM-ID-7F1	7.2±0.2	7.7±0.2	7.4±0.4	7.4±0.2	7.4±0.4
TM-ID-4G1	5.5±0.2	5.8±0.3	5.7±0.8	5.8±0.3	5.7±0.3
TM-ID-9G1	5.7±0.1	6.2±0.7	6.2±0.4	6.0±0.7	6.0±0.5
TM-ID-15G1	5.4±0.2	5.8±0.3	5.6±0.5	5.7±0.2	5.6±0.4
TM-ID-5H1	5.5±0.4	5.1±0.4	4.7±0.8	5.2±0.4	5.1±0.7
INDICATOR LOCATIONS					
TM-ID-1S2	4.9±0.4	5.2±0.6	5.4±0.3	5.5±0.5	5.3±0.5
TM-ID-2S2	4.7±0.4	4.4±0.2	4.7±0.4	4.6±0.5	4.6±0.3
TM-ID-4S1	5.0±0.5	5.2±0.4	5.4±0.2	5.3±0.3	5.2±0.3
TM-ID-5S2	4.6±0.1	4.8±0.2	4.9±0.3	5.1±0.3	4.8±0.4
TM-ID-8S1	5.3±0.2	5.6±0.1	5.1±0.2	5.3±0.4	5.3±0.4
TM-ID-9S2	5.0±0.4	5.6±0.4	5.5±0.5	5.4±0.3	5.4±0.5
TM-ID-11S1	5.4±0.4	5.7±0.6	5.6±0.6	5.9±0.2	5.6±0.4
TM-ID-14S2	**	4.3±0.4	5.1±0.5	***	4.7±1.1
TM-ID-16S1	5.2±0.2	5.5±0.1	5.4±0.3	5.8±0.3	5.5±0.5
TM-ID-4A1	4.9±0.5	5.2±0.6	5.0±0.5	5.1±0.2	5.0±0.3
TM-ID-5A1	5.0±0.5	5.2±0.2	5.2±0.5	5.1±0.3	5.1±0.2
TM-ID-16A1	4.4±0.3	4.7±0.1	4.5±0.7	***	4.5±0.3
TM-ID-10B1	5.7±0.1	5.9±0.4	5.7±0.5	***	5.8±0.2
TM-ID-12B1	4.2±0.2	4.5±0.5	4.4±0.2	4.1±0.4	4.3±0.4
TM-ID-1C1	4.3±0.3	4.7±0.2	4.3±0.3	4.7±0.2	4.5±0.5
AVERAGE	5.2±1.4	5.4±1.5	5.3±1.4	5.5±1.4	5.3±1.4

* Changed to quarterly exposure periods
** TLD stolen
*** TLD not collected due to river freezing

TABLE B-18

TYPICAL MDLS* FOR GAMMA SPECTROMETRY

NUCLIDE	SURFACE WATER (pCi/l)	AIR PARTICULATES (10-3 pCi/m3)	PRECIPITATION (pCi/l)	FISH (pCi/Kg)	SEDIMENT (pCi/g)
Na-22	0.3	0.4	0.3	3	0.02
K-40	9.0	10.0	9.0	10	1.0
Cr-51	4.0	4.0	4.0	4	0.2
Mn-54	0.6	0.6	0.6	7	0.02
Co-58	0.7	0.6	0.6	7	0.02
Fe-59	0.7	0.7	0.7	20	0.03
Co-60	0.7	0.5	0.7	9	0.02
Zn-65	2.0	1.0	2.0	10	0.04
Zr-Nb-95	0.6	0.3	0.6	6	0.04
Mo-99	5.0	3.0	5.0	50	0.2
Ru-Rh-106	3.0	1.5	3.0	30	0.2
Ag-110m	0.6	0.6	0.6	6	0.06
Te-129m	9.0	9.0	9.0	10	0.3
I-131	0.5	0.5	0.5	5	0.02
Te-132	0.5	0.1	0.4	4	0.02
I-133	0.6	0.6	0.6	5	0.02
Cs-134	0.6	0.6	0.6	6	0.02
Cs-136	0.8	0.8	0.8	10	0.02
Cs-137	0.6	0.3	0.6	8	0.02
Ba-La-140	0.8	1.0	0.8	7	0.02
Ce-144	4.0	2.0	4.0	30	0.04
Ra-226	1.0	1.0	1.0	10	0.5
Th-232	2.0	2.0	2.0	20	0.5

* At time of counting

TABLE E-19

DISTRIBUTION OF MILKING COWS WITHIN FIVE MILES OF TWINS

FARM DIRECTION	FARM DISTANCE	NUMBER OF COWS	FARM DIRECTION	FARM DISTANCE	NUMBER OF COWS
N	3.1	70	ESE	3.8	45
N	4.9	1	ESE	4.3	23
NE	2.3	17	ESE	4.5	34
NE	4.4	45	SE	1.4	43
NE	4.1	85	SE	4.0	42
ENE	1.0	35	SE	4.1	69
ENE	2.5	1	SE	4.7	48
ENE	4.2	36	SE	4.8	18
ENE	4.4	80	SSW	4.9	29
ENE	4.5	40	SW	4.7	1
ENE	4.8	63	WSW	4.0	2
E	0.8	2	WSW	4.4	1
E	1.0	70	WNW	2.7	25
E	3.5	20	WNW	2.9	6
ESE	2.3	29	WNW	3.1	5
ESE	3.1	1	WNW	3.6	35
ESE	3.2	34	WNW	4.2	1
ESE	3.6	33			

Total Number of Farms 35
Total Number of Milk Cows 1095