EXECUTIVE SUMMARY

Three Mile Island Nuclear Station Unit 2
Effluent and Off Site Dose Report
for the Period of July 1, 1990 through September 30, 1990

This report summarizes the radioactive liquid and gaseous releases (effluents) from Three Mile Island Unit 2 and the calculated maximum hypothetical radiation exposure to the public resulting from these releases. This report covers the period of operation from July 1 through September 30, 1990.

Radiological releases from the plant are monitored by installed plant radiation monitors which survey the plant stack for gaseous releases and liquid discharges to the Susquehanna River. These monitors and associated sample analyses provide a means to accurately determine the type and quantities of radioactive materials being released to the environment.

Calculations of the maximum hypothetical dose to an individual and the total population around Three Mile Island due to radioactive releases from the plant are made utilizing environmental conditions existing at the time of the release. Susquehanna River flow data are used to calculate the maximum hypothetical doses to an individual and the population downstream of TMI due to liquid releases. Actual or "real-time" meteorological data from an onsite tower is used to determine the doses resulting from gaseous releases from the plant. The use of real-time meteorological information permits the determination of both the direction in which the release traveled and the dispersion of radioactive material in the environment.

Utilizing gaseous effluent data and real-time meteorology, the maximum hypothetical dose to any individual and to the total population within 50 miles of the plant is calculated. Similarly, Susquehanna River flow and liquid effluent data are used to calculate a maximum hypothetical dose to an individual and a population dose from liquid effluents for any shoreline exposure down to the Chesapeake Bay. Exposure to the public from consumption of water and fish withdrawn from the Susquehanna River downstream of the plant is also calculated.

Dose calculations for liquid and gaseous effluents are performed using a mathematical model which is based on the methods defined by the U.S. Nuclear Regulatory Commission.

The maximum hypothetical doses are conservative overestimates of the actual off site doses which are likely to occur. For example, the dose does not take into consideration the removal of radioactive material from the river water by precipitation of insoluble salts, absorption onto river sediment, biological removal, or removal during processing by water companies prior to distribution and consumption.

Liquid discharges made during the reporting period July 1 through September 30, 1990 consisted of 0.0002 curies of tritium, 0.00002 curies of cesium-137, and 0.000009 curies of strontium-90. The quantities of effluents are consistent with results of previous quarters. The quantities of each radionuclide released are actually up to 1 million times smaller than the normal existing environmental quantities that flowed past the plant during the same time period.

During the reporting period July 1 through September 30 of 1990, the maximum hypothetical calculated whole body dose to an individual due to liquid effluents from Three Mile Island Unit 2 was 0.00042 millirem. The maximum hypothetical calculated dose to any organ of an individual was 0.00071 millirem to the bone.

Airborne discharges made during this same time period consisted of 2.9 curies of tritium, 0.000003 curies of Cs-137 and 0.00000004 curies of strontium-90. These quantities are also consistent with the results from previous reporting periods. The maximum hypothetical calculated organ dose to any individual due to gaseous effluents was about 0.0005 millirem to the liver of a child. The maximum hypothetical calculated whole body dose to any individual due to gaseous effluents was 0.0005 mrem.

The total maximum hypothetical whole body dose received by any individual from effluents from the Three Mile Island Nuclear Station Unit 2 for the reporting period is 27,200 times lower than the dose the average individual in the Three Mile Island area receives from natural background during the same time period. Natural background averages about 25 millirem whole body per quarter in the Three Mile Island area. In addition, average equivalent dose to the total body from natural radon is about 50 millirem per quarter.

The doses which could be received by the maximum hypothetical individual are each less than 0.02 percent of the annual guidelines established by the Nuclear Regulatory Commission.

EFFLUENT SUMMARY

THREE MILE ISLAND UNIT 2 LIQUID AND GASEOUS EFFLUENTS

(SUMMARY OF ALL RELEASES)

TYPE EFFLUENT — 3RD QUARTER 1990

I. LIQUID EFFLUENTS:	JULY	AUGUST	SEPTEMBER	TOTAL 3RD QUARTER
A. FISSION AND ACTIVATION PRODUCTS (NOT INCLUDING H-3, GASES, & ALPHA)				
1. TOTAL RELEASE (Ci)	1.14E-05	1.46E-05	7.56E-06	3.35E-05
2. CONCENTRATION (uCi/cc)	3.50E-12	4.43E-12	2.05E-12	3.28E-12
B. TRITIUM				
1. TOTAL RELEASE (Ci)	3.53E-06	2.06E-05	1.56E-04	1.80E-04
2. CONCENTRATION (uCi/cc)	1.08E-12	6.27E-12	4.23E-11	1.76E-11
C. DISSOLVED AND ENTRAINED GASES				
1. TOTAL RELEASE (Ci)	<LLD	<LLD	<LLD	<LLD
2. CONCENTRATION uCi/cc)	N/A	N/A	N/A	N/A
D. GROSS ALPHA ACTIVITY				
1. TOTAL RELEASE (Ci)	<LLD	<LLD	<LLD	<LLD
E. VOLUME OF WASTE RELEASED PRIOR TO DILUTION (LITERS)	7.74E+04	6.57E+04	2.73E+04	1.70E+05
F. VOLUME OF DILUTION WATER (FLOW TO RIVER IN LITERS FROM NPDES REPORT)	3.26E+09	3.29E+09	3.68E+09	1.02E+10
G. NUMBER OF BATCH RELEASES	19	23	9	51

1990 UNIT 2 LIQUID RADIONUCLIDE RELEASES BY ISOTOPE (Ci)

RADIONUCLIDE	JULY	AUGUST	SEPTEMBER	3RD QUARTER 1990
FISSION AND ACTIVATION PRODUCTS (NOT INCLUDING ALPHA, H-3 & GASES	<LLD	<LLD	<LLD	<LLD
AG-110M	<LLD	<LLD	<LLD	<LLD
CE-144	<LLD	<LLD	<LLD	<LLD
CO-58	<LLD	<LLD	<LLD	<LLD
CO-60	<LLD	<LLD	<LLD	<LLD
CS-134	<LLD	<LLD	<LLD	<LLD
CS-137	7.47E-06	1.12E-05	6.17E-06	2.49E-05
I-131	<LLD	<LLD	<LLD	<LLD
SR-90	3.95E-06	3.35E-06	1.39E-06	8.69E-06
TOTAL	1.14E-05	1.46E-05	7.56E-06	3.35E-05
H-3	3.53E-06	2.06E-05	1.56E-04	1.80E-04

EFFLUENT SUMMARY

THREE MILE ISLAND UNIT 2 LIQUID AND GASEOUS EFFLUENTS

(SUMMARY OF ALL RELEASES)

TYPE EFFLUENT — 3RD QUARTER 1990

	JULY	AUGUST	SEPTEMBER	TOTAL 3RD QUARTER
II. GASEOUS EFFLUENTS:				
A. FISSION AND ACTIVATION GASES				
1. TOTAL RELEASE (Ci)	<LLD	<LLD	<LLD	<LLD
2. RELEASE RATE (uCi/sec)	N/A	N/A	N/A	N/A
B. IODINE 131 RELEASED (Ci)	<LLD	<LLD	<LLD	<LLD
C. PARTICULATES WITH HALF-LIVES >8 DAYS				
1. TOTAL RELEASES (NOT INCLUDING ALPHA) (Ci)	3.96E-08	3.48E-06	<LLD	3.52E-06
2. RELEASE RATE (uCi/sec)	1.48E-08	1.30E-06	N/A	4.43E-07
3. GROSS ALPHA RADIO-ACTIVITY (Ci)	<LLD	<LLD	<LLD	<LLD
D. TRITIUM				
1. TOTAL RELEASE (Ci)	6.40E-01	7.12E-01	1.53E+00	2.89E+00
2. RELEASE RATE (uCi/sec)	2.39E-01	2.66E-01	5.92E-01	3.63E-01
E. SECONDS IN PERIOD REPORTED	2.68E+06	2.68E+06	2.59E+06	7.95E+06
F. NUMBER OF BATCH RELEASES	0	0	0	0

UNIT 2 GASEOUS RADIONUCLIDE RELEASES BY ISOTOPE (Ci)

RADIONUCLIDE	JULY	AUGUST	SEPTEMBER	3RD QUARTER 1990
FISSION AND ACTIVATION GASES				
KR-85	<LLD	<LLD	<LLD	<LLD
TOTAL				
PARTICULATES (HALF-LIVES >8 DAYS)				
CS-137	<LLD	3.48E-06	<LLD	3.48E-06
CS-134	<LLD	<LLD	<LLD	<LLD
SR/Y-90	3.96E-08	<LLD	<LLD	3.96E-08
C-14	<LLD	<LLD	<LLD	<LLD
SB-125	<LLD	<LLD	<LLD	<LLD
CO-60	<LLD	<LLD	<LLD	<LLD
GROSS ALPHA	<LLD	<LLD	<LLD	<LLD
TOTAL (INCLUDING ALPHA)	3.96E-08	3.48E-06	<LLD	3.52E-06
TOTAL (MINUS ALPHA)	3.96E-08	3.48E-06	<LLD	3.52E-06
TRITIUM (H-3)	6.40E-01	7.12E-01	1.53E+00	2.89E+00

TABLE 1

TYPICAL LIQUID EFFLUENT LLD (Lower Limit of Detection) VALUES

ASSUMPTIONS: Sample volume = 1 liter = 1000 cc
Sample counting time = 1000 sec
Sample counted with a 25% Ge(Li) for Gamma Emitters

ISOTOPE		uCi/cc LLD	NOTES
Gross Alpha	α	4E-9	Counted with proportional counter
Gross Beta	β	7E-8	Counted with proportional counter
Tritium	H-3	4E-6	Counted with liquid scintillation counter
Krypton-85	Kr-85	1E-4	
Xenon-131m	Xe-131m	2E-5	
Xenon-133	Xe-133	1E-6	
Xenon-135	Xe-135	3E-7	
Chromium-51	Cr-151	3E-6	
Manganese-54	Mn-54	4E-7	
Cobalt-58	Co-58	4E-7	
Iron-59	Fe-59	9E-7	
Cobalt-60	Co-60	6E-7	
Zinc-65	Zn-65	1E-6	
Zirconium-95	Zr-95	7E-7	
Niobium-95	Nb-95	4E-7	
Molybdenum-99	Mo-99	3E-7	
Technetium-99m	Tc-99m	3E-7	
Silver-110m	Ag-110m	6E-7	
Antimony-125	Sb-125	9E-7	
Cesium-134	Cs-134	5E-7	
Cesium-136	Cs-136	4E-7	
Cesium-137	Cs-137	5E-7	
Barium-140	Ba-140	1E-6	
Lanthanum-140	La-140	7E-7	
Cerium-141	Ce-141	5E-7	
Cerium-144	Ce-144	3E-6	
Iodine-131	I-131	3E-7	
Iodine-133	I-133	4E-7	
Phosphorus-32	P-32	1E-6	These LLD values for liquid sample analyses of gross alpha, P-32, Fe-55, Sr-89, and Sr-90 are the same as Unit 1 which are offsite vendor LLD values.
Iron-55	Fe-55	5E-8	
Strontium-89	Sr-89	5E-8	
Strontium-90	Sr-90	5E-8	
Gross Alpha		1E-7	

TABL !

TYPICAL GASEOUS EFFLUENT LLD (Lower Limit of Detection) VALUES

ASSUMPTIONS:

Sample volume (Marinelli)	1640cc
Sample volume(Particulate & Charcoal Filters)	5.7E8cc
Sampling Rate	2 cfm or 5.66E4cc/min
Sampling Time	1 week or 1E4 min
Sample volume (tritium bubbled thru water)	7.56E5cc
Sampling Rate	75cc/min
Sampling Time	1E4 min
Sample Counting Time: α & H-3 =20min; β =10min; γ =1000sec	
Sample Counters: γ emitters	25% Ge(Li)
α or β	Proportional Counter
H-3	Liquid Scintillation Counter

ISOTOPE		μCi/cc LLD	NOTES
Gross Alpha	α	1E-15	Particulate Filter Paper
Gross Beta	β	1E-14	"
Tritium	H-3	1E-10	Air bubbled thru water by a fritted disc or Fisher Milligan gas washer
Krypton-85	Kr-85	5E-6	Marinelli
Krypton-85m	Kr-85m	2E-8	"
Krypton-87	Kr-87	6E-8	"
Krypton-88	Kr-88	5E-8	"
Xenon-133	Xe-133	4E-8	"
Xenon-133m	Xe-133m	1E-7	"
Xenon-135	Xe-135	2E-8	"
Xenon-135m	Xe-135m	3E-7	"
Xenon-138	Xe-138	3E-7	"
Iodine-131	I-131	2E-8	"
Iodine-133	I-133	3E-8	"
Iodine-135	I-135	2E-7	"
Iodine-131	I-131	3E-14	Charcoal Filter
Iodine-133	I-133	4E-14	"
Iodine-135	I-135	3E-13	"
Manganese-54	Mn-54	3E-14	Particulate filter Paper
Iron-59	Fe-59	8E-14	"
Cobalt-58	Co-58	3E-14	"
Cobalt-60	Co-60	5E-14	"
Zinc-65	Zn-65	9E-14	"
Strontium-89	Sr-89	2E-14	"
Strontium-90	Sr-90	2E-14	"
Molybdenum-99	Mo-99	2E-14	"
Ruthenium-103	Ru-103	2E-14	"
Silver-110m	Ag-110m	3E-14	"
Cesium-134	Cs-134	4E-14	"
Cesium-137	Cs-137	3E-14	"
Cerium-141	Ce-141	3E-14	"
Cerium-144	Ce-144	9E-14	"

TABLE 1

UNIT 2
Third Quarter Dose Report

SUMMARY OF MAXIMUM INDIVIDUAL DOSES FOR UNIT 2 FROM
July 1, 1990 through September 30, 1990

Effluent	Applicable Organ	Estimated Dose (mrem)	Age Group	Location Dist (m)	Location Dir (toward)	% of Applicable Limit Quarterly	% of Applicable Limit Annual	Limits (mrem) 10 CFR 50 Appendix I Quarterly	Limits (mrem) 10 CFR 50 Appendix I Annual
(1) Liquid	Total Body	4.2E-4	Adult	Receptor 1		---	1.4E-2	---	3.0
(2) Liquid	Bone	7.1E-4	Child	Receptor 1		---	7.1E-3	---	10.0
(3) Noble Gas	Air Dose (gamma-mrad)	0	---	---	---	---	0	---	10.0
(4) Noble Gas	Air Dose (beta-mrad)	0	---	---	---	---	0	---	20.0
(5) Noble Gas	Total Body	0	All	---	---	---	0	---	5.0
(6) Noble Gas	Skin	0	All	---	---	---	0	---	15.0
(7) Iodine & Particulates	Liver	5.1E-4	Child	2000	SE	---	3.4E-3	---	15.0

SUMMARY OF MAXIMUM POPULATION DOSES FOR UNIT 2 FROM
July 1, 1990 through September 30, 1990

Effluent	Applicable Organ	Estimated Population Dose (person-rem)
(8) Liquid	Total Body	2.0E-3
(9) Liquid	Bone	7.6E-3
(10) Gaseous	Total Body	1.0E-2
(11) Gaseous	Liver	1.1E-2

INTERPRETATION OF DOSE SUMMARY TABLE

The Dose Summary Table presents the maximum hypothetical doses to an individual and the general population resulting from the release of gaseous and liquid effluents from TMI-2 during the third quarter reporting period of 1990.

A. Liquid (Individual)

The first two lines present the maximum hypothetical dose to an individual. Presented are the whole body and critical organ doses. Calculations are performed on the four age groups and eight organs recommended in Regulatory Guide 1.109. The pathways considered for TMI-2 are drinking water, consumption of fish, and standing on the shoreline influenced by TMI effluents. The latter two pathways are considered to be the primary recreational activities associated with the Susquehanna River in the vicinity of TMI. The "receptor" would be that individual who consumes water from the Susquehanna River and fish residing in the plant discharge, while occupying an area of shoreline influenced by the plant discharge.

For the third quarter of 1990 the calculated maximum whole body dose received by anyone would have been 4.2E-4 mrem to an adult. Similarly, the maximum organ dose would have been 7.1E-4 mrem to the bone of a child.

B. Gaseous (Individual)

There are seven major pathways considered in the dose calculations for gaseous effluents. These are: (1) plume, (2) inhalation, consumption of (3) cow milk, (4) goat milk, (5) vegetables, (6) meat, and (7) standing on contaminated ground.

Lines 3 and 4 present the maximum plume exposure at or beyond the site boundary. The notation of "air dose" is interpreted to mean that these doses are not to an individual, but are considered to be the maximum dose that would have occurred at or beyond the site boundary. The Dose Summary Table presents the distance in meters to the location in the affected sector (compass point) where the theoretical maximum plume exposure occurred. It should be noted that real-time meteorology was used in all dose calculations for gaseous effluents. Direct noble gas plume dose to the maximum individual is shown on lines 5 and 6.

Since there were no noble gases released in the third quarter, the doses are zero.

The Iodines and Particulates section described in line 7 represents the maximum exposed organ due to iodine and particulates. This does not include any plume exposure which is separated out by lines 5 and 6. The doses presented in this section again reflect the maximum exposed organ for the appropriate age group.

The third quarter 1990 iodines and particulates would have resulted in a maximum dose of 5.1E-4 mrem to the liver of a child residing 2000 meters from the site in the SE sector. No other organ of any age group would have received a greater dose.

C. Liquid and Gaseous (Population)

Lines 8 - 11 present the person-rem doses resulting from the liquid and gaseous effluents. These doses are summed over all pathways and the affected populations. The person-rem values from liquid effluents are based upon the population encompassed within the region from the TMI outfall extending down to the Chesapeake Bay. The person-rem values from gaseous effluents are based upon the 1980 population and consider the population out to a distance of 50 miles around TMI. Population doses are summed over all distances and sectors to give an aggregate dose.

Based upon the calculations performed for the third quarter, liquid effluents resulted in a whole body population dose of 2.0E-3 person-rem. The maximum critical organ population dose to the bone was 7.6E-3 person rem. Gaseous effluents resulted in a whole body population dose of 1.0E-2 person-rem. Maximum organ population dose was 1.1E-2 person-rem to the liver.