THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

PERRY NUCLEAR POWER PLANT
UNIT 1

SEMIANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

1988: QUARTERS 1 & 2

Approved By:

Steven F. Kensicki
Plant Technical Director

General Manager of Operations

IE48
1/1

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INTRODUCTION

This Semiannual Radioactive Effluent Release Report (SRERR), covering the period of January 1 through June 30, 1988, is submitted in accordance with Section 6.9.1.7 of Appendix "A" (Technical Specifications) to Perry Nuclear Power Plant (PNPP) License No. NPF-58. It is designed to meet requirements of Regulatory Guide 1.21, as applicable to the PNPP Technical Specifications. Portions of the Technical Specifications applicable to this report, Sections 3/4.3.7.9, 3/4.3.7.10, 3/4.11, 3/4.12, 6.13.2, 6.14.2, and 6.15.1, are known as the Radiological Effluent Technical Specifications (RETS).

During quarters 1 and 2 the plant produced 3,214,679 Megawatt Hours Electric Gross. The reactor capacity averaged 60 percent while the reactor was critical a total of 3056 hours.

Liquid and gaseous radioactive effluent releases to the environment during this reporting period were sampled and analyzed in accordance with the requirements of the Technical Specifications. All radioactive effluent releases were within the concentration and release limits specified in the RETS.

Calculations and terms utilized in this report are those outlined in the PNPP Offsite Dose Calculation Manual (ODCM).

RADIOLOGICAL IMPACT ON MAN

Sampling and analysis of liquid and gaseous effluents were performed in accordance with the frequencies, types of analysis, and Lower Limit of Detection (LLD) outlined in the PNPP Unit 1 Technical Specifications.

Radioactive material was detected in some of the liquid and gaseous effluent samples analyzed. Dose calculations, using measured effluent flow and meteorological data, resulted in dose to individuals at levels below 10CFR20 and 10CFR50, Appendix I limits. Direct radiation resulting from plant operation, as measured by environmental thermoluminescent dosimeters located around the plant, did not contribute any measurable dose to members of the public for the reporting period and, as there are no other nearby fuel cycle sources, 40CFR190 limits were not exceeded.

Summaries of maximum individual and population doses resulting from liquid and gaseous radioactive effluent releases are given, in Regulatory Guide 1.21 format, in Attachment 1.

Technical Specification 6.9.1.7 requires assessment of radiation doses from radioactive liquid and gaseous effluent to members of the public while onsite. These onsite doses are assessed relative to offsite dose values, and are adjusted for appropriate dilution, dispersion, and occupancy factors.

ONSITE DOSE FOR LIQUID EFFLUENTS

The onsite liquid effluent pathway of concern for members of the public is shore exposure while fishing along the Lake Erie coast. Occupancy is assumed to be 60 hours per year and the dilution factor for the point of exposure is 10. Ratioing this exposure pathway to doses calculated for offsite locations yields the following onsite dose values.

	Total Body	Organ
Quarters 1 & 2	2.3 E-04 mrem	2.7 E-04 mrem (skin)
Quarter 1	1.0 E-04 mrem	1.2 E-04 mrem (skin)
Quarter 2	1.3 E-04 mrem	1.5 E-04 mrem (skin)

ONSITE DOSE FOR GASEOUS EFFLUENTS

Several cases are considered for onsite gaseous effluent exposure to members of the public including traversing a public road within the site boundary, shoreline fishing, non-plant related training, car pooling, and job interviews. The onsite activity with the highest dose potential, relative to gaseous effluents, is shoreline fishing. Occupancy is again assumed to be 60 hours per year. Accounting for this and the difference between annual average dispersion values for the onsite point of concern, 6.6 E-05 s/m^3, (a unity occupancy factor is assumed for this calculation), the following maximum onsite dose values are generated.

	Total Body	Organ
Quarters 1 & 2	1.1 E-01 mrem	4.9 E-01 mrem(thyroid)
Quarter 1	1.1 E-03 mrem	3.6 E-03 mrem(thyroid)
Quarter 2	1.1 E-01 mrem	4.9 E-01 mrem(thyroid)

AVERAGE INDIVIDUAL TOTAL BODY DOSES

Average total body dose to individual members of the public is determined for the population that lives within fifty miles of the plant for gaseous effluents (2.42 E+06 persons) and the population that receives drinking water from intakes within fifty miles for liquid effluents (2.37 E+06 persons). These doses are calculated using the total population dose figures found in Attachment 1.

	Gases	Liquids
Quarters 1 & 2	9.9 E-05 mrem	3.3 E-05 mrem
Quarter 1	1.2 E-07 mrem	1.1 E-05 mrem
Quarter 2	9.9 E-05 mrem	2.2 E-05 mrem

Gaseous and Air Dose calculations at the site boundary were performed for two cases. Attachment 1 provides the calculated maximum site boundary dose values for all sectors including those sectors which are totally over water in which no member of the public resides (These are the W, WNW, NW, NNW, N AND NNE SECTORS). Attachment 2 provides the calculated maximum site boundary dose values for the land based sectors in which members of the public reside.

SUPPLEMENTAL INFORMATION

Regulatory Limits

Technical Specifications 3/4.11.1 and 3/4.11.2 outline requirements for release of radioactive liquid and gaseous effluents, respectively. Concentration of radioactive material in liquid effluents and dose or dose commitment resultant thereof are limited in unrestricted areas. Dose and dose rate due to radioactive materials released in gaseous effluents are limited in areas at or beyond the site boundary. Technical Specification limits are listed in Attachment 3.

Maximum Permissible Concentrations

The Maximum Permissible Concentrations (MPCs) in liquids are those outlined in Technical Specification 3.11.1.1 (10CFR20, Appendix B, Table II, Column 2, with the lower of the soluble and insoluble MPC being used; for dissolved and entrained noble gases, concentrations are limited to 2 E-04 μCi/ml). PNPP Unit 1 Technical Specifications do not contain a concentration requirement for gaseous releases, therefore, MPCs are not used to calculate maximum release rates for radioactive gaseous effluents.

Average Energy

Average energy requirements for radioactive effluent mixtures do not apply to PNPP Unit 1 Technical Specifications or Off-site Dose Calculation Manual.

Measurements and Approximations of Total Radioactivity

Analyses of specific radionuclides in effluent samples are used with effluent path flow measurements to evaluate the radioactive composition and concentration of effluents.

Batch Releases

Liquid effluent releases were considered continuous (r , (Emergency Service Water [ESW] Loops A and B) as well as batc (Liquid Radwaste [LRW] discharges). Although the ESW s ntem is considered to be a continuous release path when in service, it is not run continuously.

All gaseous effluent releases from Perry Nuclear Power Plant were considered continuous.

LIQUID RELEASES

January 1 - March 31, 1988

	Batch	Continuous
Number of Releases	78	25
Total Time of Releases (min)	1.4 E+04	2.2 E+05*
Minimum Time for a Release (min)	5.0 E+00	1.3 E+01
Average Time for a Release (min)	1.8 E+02	9.0 E+03
Maximum Time for a Release (min)	2.7 E+02	8.6 E+04
Average Effluent Stream Flow During Periods of Release (l/min)	2.3 E+05	2.4 E+05

* - The total of ESW Loop A (1.2 E+05 min) and ESW Loop B (1.0 E+05 min)

April 1 - June 30, 1988

	Batch	Continuous
Number of Releases	47	43
Total Time of Releases (min)	8.5 E+03	1.7 E+05*
Minimum Time for a Release (min)	2.0 E+00	3.7 E+01
Average Time for a Release (min)	1.8 E+02	4.0 E+03
Maximum Time for a Release (min)	2.8 E+02	7.1 E+04
Average Effluent Stream Flow During Periods of Release (l/min)	2.4 E+05	2.2 E+05

* - The total of ESW Loop A (4.0 E+04 min) and ESW Loop B (1.3 E+05 min)

LIQUID EFFLUENTS

For the first quarter of 1988 there were 78 batch and 25 continuous releases. Batch release total waste volume for the first quarter was 7.3 E+06 liters; total continuous release waste volume was 7.9 E+09 liters; total plant discharge during periods of release was 5.3 E+10 liters.

For the second quarter of 1988 there were 47 batch and 43 continuous releases. Batch release total waste volume for the second quarter was 4.4 E+06 liters; total continuous release waste volume was 6.3 E+09 liters; total plant discharge during periods of release was 3.8 E+10 liters.

Summaries of the radionuclide total curie activities, average diluted concentrations, and percentage of MPC (in Regulatory Guide 1.21 format) are included in Attachment 4.

If a radionuclide was not detected, zero activity was used for that isotope in dose calculations. A zero activity indicates that the radionuclide was not present at a level greater than the Lower Level of Detection (LLD) of the instrumentation used. In all cases, these LLDs were less than the levels required by Technical Specifications. The following are typical LLDs.

Radionuclide	LLD (μCi/ml)
Mn-54	2.4 E-08
Fe-59	5.8 E-08
Co-58	1.9 E-08
Co-60	3.4 E-08
Zn-65	4.6 E-08
Mo-99	2.1 E-07
I-131	2.3 E-08
Cs-134	2.3 E-08
Cs-137	2.6 E-08
Ce-141	3.2 E-08
Ce-144	1.3 E-07
Sr-89	3.0 E-08
Sr-90	3.7 E-08
Fe-55	5.7 E-09
H-3	4.6 E-06
Gross Alpha	6.0 E-08

Estimates of error associated with sample analysis, discharge volume, and dilution volume follow. Analytical error terms are based on split sample analysis results, the majority of which are confirmatory measurements, the others are inter-laboratory comparison results. Discharge and dilution volume (flow rate instrumentation) error is assessed using loop instrumentation accuracy terms.

Gamma Analysis	10%
H-3 Analysis	8%
Sr-89/90 Analysis	10%
Fe-55 Analysis	21%
Gross Alpha Analysis	4%
Service Water Volume (Dilution)	31%
Emergency Service Water Volume (Discharge)	25%
Liquid Radwaste Volume	1%

GASEOUS EFFLUENTS

Summaries of the radionuclide total curie activities, average release rates (in Regulatory Guide 1.21 format) are included in Attachment 5.

If a radionuclide was not detected, zero activity was used for that isotope in dose calculations. A zero activity indicates that the radionuclide was not present at a level greater than the Lower Level of Detection (LLD) of the instrumentation used. In all cases, these LLDs were less than the levels required by Technical Specifications. The following are typical LLDs.

Radionuclide	LLD (μCi/ml)
Kr-87	1.7 E-08
Kr-88	2.3 E-08
Xe-133	1.8 E-08
Xe-133m	5.3 E-08
Xe-135	6.4 E-09
Xe-138	1.0 E-07
Mn-54	2.7 E-13
Fe-59	5.6 E-13
Co-58	3.2 E-13
Co-60	4.6 E-13
Zn-65	7.7 E-13
Mo-99	2.1 E-12
Cs-134	2.1 E-12
Cs-137	3.1 E-13
Ce-141	3.2 E-13
Ce-144	1.5 E-12
I-131	2.8 E-13
I-133	4.9 E-13
Sr-89	3.8 E-14
Sr-90	6.8 E-14
H-3	3.0 E-10
Gross Alpha	5.4 E-12

Estimates of error associated with sample analysis, sample flow rate, and effluent flow rate follow. Analytical error terms are based on split sample analysis results, the majority of which are confirmatory measurements, the others are interlaboratory comparison results. Flow rate instrumentation error is assessed using loop instrumentation accuracy terms.

Noble Gas Analysis	11%
Particulate Analysis	9%
Iodine Analysis	12%
H-3 Analysis	8%
Sr-89/90 Analysis	10%
Gross Alpha Analysis	4%
Sample Flow Rate	10%
Effluent Flow Rate	9%

SOLID WASTE

There were 22 solid radioactive waste shipments transported from PNPP for the period covered by this report. In The 22 shipments, there were 14 dewatered liners and 11 solidified liners. There was no irradiated fuel transported from site. See Attachment 6 for volume and activity values.

METEOROLOGICAL DATA

Cumulative joint frequency distribution (JFD) tables of wind speed and direction for each stability class, as well as for all stability classes combined, are given in Attachment 7 for the semiannual period and for each annual quarter of the time period covered by this report.

These JFD tables are the results obtained from the processing of hourly average meteorological data collected at the PNPP site met tower. It should be noted that the 1-3 mph JFD column includes wind speeds down to 0.1 mph and that hours of 0 wind speed appear only in the totals columns. The separate tallies of periods of calm include wind speeds from 0.0 to 0.7 mph. Differential temperature (ΔT 60 - 10 meters) is generally used for atmospheric stability classification.

ABNORMAL RELEASES

There were no abnormal liquid or gaseous effluent releases during the reporting period.

APPLICABLE TECHNICAL SPECIFICATION REQUIREMENTS

Per PNPP Technical Specifications, certain noncompliance items, changes, and findings are reportable in the Semiannual Radioactive Effluent Release Report.

Radioactive Liquid Effluent Monitoring Instrumentation noncompliance (PNPP Technical Specification 3.3.7.9, Action b.):

There were four cases in which liquid effluent monitoring instrumentation was not restored to an operable condition within the time period required by Technical Specifications.

The Emergency Service Water-A Loop discharge radiation monitor (1D17K604) was declared inoperable on May 16, 1988. Work on the system consisted of replacing carbon steel piping with stainless steel piping to improve flow to the monitor and install a temporary shield to reduce background radiation levels. The monitor was declared operable on August 5, 1988.

The Emergency Service Water-B Loop discharge radiation monitor (1D17K605) was declared inoperable on May 8, 1988. Work on the system consisted of replacing carbon steel piping with stainless steel piping to improve flow to the monitor. The system was declared operable on July 19, 1988.

The Service Water (0P41K444) flow monitor was inoperable on November 7, 1987. Work on the system consisted of replacing and calibrating the monitor. The system was declared operable March 7, 1988.

The Emergency Service Water (1P45K272) flow monitor was inoperable on November 7, 1987. Work on the system consisted of replacing and calibrating the monitor. The system was declared operable on March 6, 1988. On April 25, 1988 the system was declared inoperable due to a channel check failure. A new calibration curve was developed and as of August 26, 1988 the system was declared operable.

Radioactive Gaseous Effluent Monitoring Instrumentation noncompliance (PNPP Technical Specification 3.3.7.10, Action b.):

There were no occurrences of inability to restore inoperable radioactive gaseous effluent monitoring instrumentation, listed in Technical Specification Table 3.3.7.10-1, to the minimum channels operable within the time period specified in the applicable action note.

Liquid Holdup Tanks noncompliance (PNPP Technical Specification 3.11.1.4, Action a.):

There were no outside temporary tanks containing radioactive liquid on the PNPP site during the reporting period, therefore, the applicable Technical Specification limit was not exceeded.

Radiological Environmental Monitoring Program (REMP) changes (PNPP Technical Specification 3.12.1, Action c.):

For the reporting period, samples were obtained at their respective locations as required by the specified collection frequencies.

The program underwent minor changes during the reporting period. Milk sampling location 61 was added so goat milk could be sampled year round. Milk sampling location 30 was reinstated. Water sampling locations 59 and 60 were changed to make easy access for personnel.

Land Use Census findings (PNPP Technical Specification 3.12.2, Actions a and b.):

The Land Use Census had two minor changes during the reporting period. The first was occupancy of the house at 3121 Center Road and the resident's garden in the S sector. The second was in the WSW sector in regards to the nearest garden, it changed o 1.9 miles from 1.2 miles. See attachment 9.

Process Control Program (PCP) changes (PNPP Technical Specification 6.13.2):

There were no changes made to the Process Control Program during the reporting period.

Offsite Dose Calculation Manual (ODCM) changes (PNPP Technical Specification 6.14.2):

The Offsite Dose Calculation Manual was revised for the third time and was effective February 24, 1988. The scope of the revision was: Incorporation of Temporary Change Notice(TCN)-2 through 8 to revision 2; Deletion of atmospheric dispersion and deposition parameters for the nearest residence with animal and garden locations because this information is available in the Annual Enviromental Operating Report; Incorporate Radiological Environmental Sampling Program changes. Changes to thc third revision were made through TCN-1 and 2. These changes were made to reflect Radiological Environmental Monitoring Program changes. See Attachment 8.

Page	Change
80,87,88,89, 90	REMP location changes and additions.

Major Changes to Radioactive Waste Treatment Systems (PNPP Technical Specification 6.15.1):

There were no major changes to radioactive waste treatment systems during this SRERR period.

Attachment 1

Radiological Impact on Man (Dose Summaries)

Radiological Impact on Man (Dose Summaries)
1988: Quarters 1 & 2

SUMMARY OF MAXIMUM INDIVIDUAL DOSES

LIQUID 88 1 1 1-88 63024
GASEOUS 88 1 1 1-88 63024
AIR 88 1 1 1-88 63024

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (MREM)	AGE GROUP	LOCATION DIST (M)	LOCATION DIR (TOWARD)	% OF APPLICABLE LIMIT	LIMIT (MREM)
LIQUID	TOTAL BODY	3.40E-04	TEEN	RECEPTOR 1		1.1E-02	3.0E+00
LIQUID	THYROID	2.05E-03	CHILD	RECEPTOR 1		2.1E-02	1.0E+01
NOBLE GAS	AIR DOSE (GAMMA-MRAD)	1.70E+00		294.	N	1.7E+01	1.0E+01
NOBLE GAS	AIR DOSE (BETA-MRAD)	2.39E+00		294.	N	1.2E+01	2.0E+01
NOBLE GAS	T.BODY	1.00E+00	ALL	294.	N	2.0E+01	5.0E+00
NOBLE GAS	SKIN	2.29E+00	ALL	294.	N	1.5E+01	1.5E+01
IODINE& PARTICULATES	THYROID	4.56E+00	INFANT	294.	N	3.0E+01	1.5E+01

SUMMARY OF POPULATION DOSES

LIQUID 88 1 1 1-88 63024
GASEOUS 88 1 1 1-88 63024

EFFLUENT	APPLICABLE ORGAN	ESTIMATED POPULATION DOSE (PERSON-REM)
LIQUID	TOTAL BODY	7.8E-02
LIQUID	THYROID	3.0E-01
GASEOUS	TOTAL BODY	2.4E-01
GASEOUS	THYROID	1.2E+00

Radiological Impact on Man (Dose Summaries)
1988: Quarter 1

SUMMARY OF MAXIMUM INDIVIDUAL DOSES

LIQUID 88 1 1 1-88 33124
GASEOUS 88 1 1 1-88 33124
AIR 88 1 1 1-88 33124

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (MREM)	AGE GROUP	LOCATION DIST (M)	LOCATION DIR (TOWARD)	% OF APPLICABLE LIMIT	LIMIT (MREM)
LIQUID	TOTAL BODY	1.43E-04	TEEN	RECEPTOR 1		4.8E-03	3.0E+00
LIQUID	GI-TRACT	5.58E-04	ADULT	RECEPTOR 1		5.6E-03	1.0E+01
NOBLE GAS	AIR DOSE (GAMMA-MRAD)	2.26E-03		294.	N	2.3E-02	1.0E+01
NOBLE GAS	AIR DOSE (BETA-MRAD)	2.80E-03		294.	N	1.4E-02	2.0E+01
NOBLE GAS	T.BODY	1.46E-03	ALL	294.	N	2.9E-02	5.0E+00
NOBLE GAS	SKIN	3.77E-03	ALL	294.	N	2.5E-02	1.5E+01
IODINE& PARTICULATES	THYROID	3.48E-02	CHILD	280.	NNW	2.3E-01	1.5E+01

SUMMARY OF POPULATION DOSES

LIQUID 88 1 1 1-88 33124
GASEOUS 88 1 1 1-88 33124

EFFLUENT	APPLICABLE ORGAN	ESTIMATED POPULATION DOSE (PERSON-REM)
LIQUID	TOTAL BODY	2.6E-02
LIQUID	THYROID	8.5E-03
GASEOUS	TOTAL BODY	3.0E-04
GASEOUS	THYROID	2.9E-03

Radiological Impact on Man (Dose Summaries)
1988: Quarter 2

SUMMARY OF MAXIMUM INDIVIDUAL DOSES

LIQUID 88 4 1 1-88 63024
GASEOUS 88 4 1 1-88 63024
AIR 88 4 1 1-88 63024

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (MREM)	AGE GROUP	LOCATION DIST (M)	LOCATION DIR (TOWARD)	% OF APPLICABLE LIMIT	LIMIT (MREM)
LIQUID	TOTAL BODY	1.97E-04	TEEN	RECEPTOR 1		6.6E-03	3.0E+00
LIQUID	THYROID	1.99E-03	CHILD	RECEPTOR 1		2.0E-02	1.0E+01
NOBLE GAS	AIR DOSE (GAMMA-MRAD)	1.70E+00		294.	N	1.7E+01	1.0E+01
NOBLE GAS	AIR DOSE (BETA-MRAD)	2.39E+00		294.	N	1.2E+01	2.0E+01
NOBLE GAS	T.BODY	1.00E+00	ALL	294.	N	2.0E+01	5.0E+00
NOBLE GAS	SKIN	2.29E+00	ALL	294.	N	1.5E+01	1.5E+01
IODINE& PARTICULATES	THYROID	4.53E+00	INFANT	294.	N	3.0E+01	1.5E+01

SUMMARY OF POPULATION DOSES

LIQUID 88 4 1 1-88 63024
GASEOUS 88 4 1 1-88 63024

EFFLUENT	APPLICABLE ORGAN	ESTIMATED POPULATION DOSE (PERSON-REM)
LIQUID	TOTAL BODY	5.2E-02
LIQUID	THYROID	3.0E-01
GASEOUS	TOTAL BODY	2.4E-01
GASEOUS	THYROID	1.2E+00

Attachment 2

Radiological Impact on Man (Land Based Sectors)

Attachment 2 (Page 1 of 1)

Radiological Impact on Man (Land Based Sectors)

Quarters 1 & 2

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (MREM)	AGE GROUP	LOCATION DIST (M)	LOCATION DIR (TOWARD)	% OF APPLICABLE LIMIT	LIMIT (MREM)
NOBLE GAS	AIR DOSE (GAMMA-MRAD)	3.07E-01		678.	NE	3.1E+00	1.0E+01
NOBLE GAS	AIR DOSE (BETA-MRAD)	3.49E-01		1452.	SSW	1.7E+00	2.0E+01
NOBLE GAS	T.BODY	1.77E-01	ALL	678.	NE	3.5E+00	5.0E+00
NOBLE GAS	SKIN	3.73E-01	ALL	678.	NE	2.5E+00	1.5E+01
IODINES & PARTICULATES	THYROID	3.40E+00	INFANT	900.	WSW	2.3E+01	1.5E+01

Quarter 1

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (MREM)	AGE GROUP	LOCATION DIST (M)	LOCATION DIR (TOWARD)	% OF APPLICABLE LIMIT	LIMIT (MREM)
NOBLE GAS	AIR DOSE (GAMMA-MRAD)	1.04E-03		678.	NE	1.0E-02	1.0E+01
NOBLE GAS	AIR DOSE (BETA-MRAD)	6.46E-04		678.	NE	3.2E-03	2.0E+01
NOBLE GAS	T.BODY	5.85E-04	ALL	678.	NE	1.2E-02	5.0E+00
NOBLE GAS	SKIN	1.14E-03	ALL	678.	NE	7.6E-03	1.5E+01
IODINES & PARTICULATES	THYROID	4.08E-03	CHILD	900.	WSW	2.7E-02	1.5E+01

Quarter 2

EFFLUENT	APPLICABLE ORGAN	ESTIMATED DOSE (MREM)	AGE GROUP	LOCATION DIST (M)	LOCATION DIR (TOWARD)	% OF APPLICABLE LIMIT	LIMIT (MREM)
NOBLE GAS	AIR DOSE (GAMMA-MRAD)	3.06E-01		678.	NE	3.1E+00	1.0E+01
NOBLE GAS	AIR DOSE (BETA-MRAD)	3.49E-01		1452.	SSW	1.7E+00	2.0E+01
NOBLE GAS	T.BODY	1.77E-01	ALL	678.	NE	3.5E+00	5.0E+00
NOBLE GAS	SKIN	3.74E-01	ALL	678.	NE	2.5E+00	1.5E+01
IODINES & PARTICULATES	THYROID	3.40E+00	INFANT	900.	WSW	2.3E+01	1.5E+01

Attachment 3

Technical Specification Limits

Attachment 3 (Page 1 of 1)
Technical Specification Limits

LIQUID EFFLUENTS:

→ Concentration ≤ 10CFR20 Appendix B, Table II, Column 2	→ release rate limit TS 3.11.1.1
→ ≤ 1.5 mrem total body ≤ 5 mrem any organ	→ quarterly dose limit per TS 3.11.1.2
→ ≤ 3 mrem total body ≤ 10 mrem any organ	→ annual dose limit per TS 3.11.1.2

GASEOUS EFFLUENTS:

Noble Gases

→ ≤ 500 mrem/yr total body ≤ 3000 mrem/yr any organ	→ dose rate limit per TS 3.11.2.1
→ ≤ 5 mrad air gamma ≤ 10 mrad air beta	→ quarterly air dose limit per TS 3.11.2.2
→ ≤ 10 mrad air gamma ≤ 20 mrad air beta	→ annual air dose limit per TS 3.11.2.2

I-131, I-133, H-3, Particulates with Halflives >8 Days

→ ≤ 1500 mrem/yr any organ	→ dose rate limit per TS 3.11.2.1
→ ≤ 7.5 mrem any organ	→ quarterly dose limit per TS 3.11.2.3
→ ≤ 15 mrem any organ	→ annual dose limit per TS 3.11.2.3

* - Dissolved or entrained noble gas concentration is limited to ≤ 2 E-4 μCi/ml.

Attachment 4

Liquid Effluents

Attachment 4 (Page 1 of 2)
Liquid Effluents

QUARTER 1 : START DATE 88010101 END DATE 88033124
QUARTER 2 : START DATE 88040101 END DATE 88063024

LIQUID EFFLUENTS --

	UNITS	QUARTER 1	QUARTER 2
A. FISSION AND ACTIVATION PRODUCTS			
1. TOTAL RELEASE (EXCL. TRIT., GASES, ALPHA)	CI	1.72E-02	1.42E-02
2. AVERAGE DILUTED CONC. DURING PERIOD	UCI/ML	3.25E-10	3.75E-10
3. PERCENT OF APPLICABLE LIMIT	%	0.00E+00	0.00E+00
B. TRITIUM			
1. TOTAL RELEASE	CI	1.72E+00	1.41E+00
2. AVERAGE DILUTED CONC. DURING PERIOD	UCI/ML	3.24E-08	3.70E-08
3. PERCENT OF APPLICABLE LIMIT	%	1.08E-03	1.23E-03
C. DISSOLVED AND ENTRAINED GASES			
1. TOTAL RELEASE	CI	5.10E-03	1.00E-02
2. AVERAGE DILUTED CONC. DURING PERIOD	UCI/ML	9.62E-13	2.64E-10
3. PERCENT OF APPLICABLE LIMIT	%	4.81E-07	1.32E-04
D. GROSS ALPHA RADIOACTIVITY			
1. TOTAL RELEASE	CI	0.00E+00	0.00E+00
E. VOLUME WASTE RELEASED (PRIOR TO DILUTION)	LITERS	7.90E+09	6.29E+09
F. VOLUME DILUTION WATER USED DURING PERIOD	LITERS	5.30E+10	3.80E+10

Attachment 4 (Continued - Page 2 of 2)
Liquid Effluents

LIQUID EFFLUENTS

QUARTER 1 : START DATE 88010101 END DATE 88033124
QUARTER 2 : START DATE 88040101 END DATE 88063024

NUCLIDES RELEASED	UNITS	CONTINUOUS MODE QUARTER 1	CONTINUOUS MODE QUARTER 2	BATCH MODE QUARTER 1	BATCH MODE QUARTER 2
H3	CI	0.00E+00	0.00E+00	1.72E+00	1.41E+00
NA24	CI	0.00E+00	0.00E+00	1.49E-04	0.00E+00
CR51	CI	0.00E+00	0.00E+00	6.81E-03	5.17E-03
MN54	CI	0.00E+00	0.00E+00	3.82E-03	2.76E-03
MN56	CI	0.00E+00	0.00E+00	3.93E-04	0.00E+00
FE59	CI	0.00E+00	0.00E+00	7.93E-04	6.10E-04
CO58	CI	0.00E+00	0.00E+00	2.94E-03	1.06E-03
CO60	CI	0.00E+00	0.00E+00	2.08E-03	2.57E-03
TC99M	CI	0.00E+00	0.00E+00	2.02E-05	7.51E-05
AG110M	CI	0.00E+00	0.00E+00	2.44E-05	2.49E-04
I131	CI	0.00E+00	0.00E+00	0.00E+00	1.66E-03
I133	CI	0.00E+00	0.00E+00	0.00E+00	2.07E-05
CS137	CI	0.00E+00	0.00E+00	0.00E+00	2.62E-05
AS76	CI	0.00E+00	0.00E+00	2.02E-04	0.00E+00
SB124	CI	0.00E+00	0.00E+00	0.00E+00	2.37E-05
TOTAL FOR PERIOD (ABOVE)	CI	0.00E+00	0.00E+00	1.73E+00	1.42E+00
XE133	CI	0.00E+00	0.00E+00	4.83E-05	9.49E-03
XE135	CI	0.00E+00	0.00E+00	2.72E-06	3.13E-04
XE135M	CI	0.00E+00	0.00E+00	0.00E+00	1.36E-04
XE133M	CI	0.00E+00	0.00E+00	0.00E+00	8.67E-05

Attachment 5

Gaseous Effluents

Attachment 5 (Page 1 of 2)

Gaseous Effluents

QUARTER 1 : START DATE 88010101 END DATE 88033124
QUARTER 2 : START DATE 88040101 END DATE 88063024

EFFLUENT AND WASTE DISPOSAL REPORT

GASEOUS EFFLUENTS -- SUMMATION OF ALL RELEASES

	UNITS	QUARTER 1	QUARTER 2
A. FISSION AND ACTIVATION GASES			
1. TOTAL RELEASE	CI	8.70E-01	9.97E+02
2. AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	1.11E-01	1.27E+02
3. PERCENT OF TECHNICAL SPECIFICATION LIMIT	%	0.00E+00	0.00E+00
B. IODINES			
1. TOTAL IODINE-131	CI	8.43E-04	3.37E-02
2. AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	1.07E-04	4.29E-03
3. PERCENT OF TECHNICAL SPECIFICATION LIMIT	%	0.00E+00	0.00E+00
C. PARTICULATES			
1. PARTICULATES WITH HALF-LIVES >8 DAYS	CI	1.22E-05	3.00E-04
2. AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	1.56E-06	3.81E-05
3. PERCENT OF TECHNICAL SPECIFICATION LIMIT	%	0.00E+00	0.00E+00
4. GROSS ALPHA RADIOACTIVITY	CI	2.24E-04	1.43E-03
D. TRITIUM			
1. TOTAL RELEASE	CI	3.62E+00	0.00E+00
2. AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	4.61E-01	0.00E+00
3. PERCENT OF TECHNICAL SPECIFICATION LIMIT	%	0.00E+00	0.00E+00

Attachment 5 (Continued - Page 2 of 2)

Gaseous Effluents

GASEOUS EFFLUENTS

QUARTER 1 : START DATE 88010101 END DATE 88033124
QUARTER 2 : START DATE 88040101 END DATE 88063024
DATE OF REPORT: AUG. 25, 1988
PREPARED BY:

CONTINUOUS MODE

NUCLIDES RELEASED	UNITS	QUARTER 1	QUARTER 2
1. FISSION AND ACTIVATION GASES			
H3	CI	3.62E+00	0.00E+00
AR41	CI	2.24E-02	0.00E+00
KR85M	CI	4.64E-01	1.19E+01
KR87	CI	0.00E+00	1.57E+00
KR88	CI	0.00E+00	3.77E+00
XE131M	CI	0.00E+00	6.96E-01
XE133M	CI	0.00E+00	1.39E+01
XE133	CI	0.00E+00	8.80E+02
XE135M	CI	0.00E+00	1.11E+02
XE135	CI	1.32E-01	1.92E+02
XE138	CI	2.19E-01	2.45E+00
TOTAL FOR PERIOD (ABOVE)	CI	4.49E+00	9.97E+02
2. IODINES			
I131	CI	8.43E-04	3.37E-02
I133	CI	1.35E-03	1.79E-02
I132	CI	0.00E+00	6.64E-05
I135	CI	0.00E+00	4.93E-04
TOTAL FOR PERIOD (ABOVE)	CI	2.19E-03	5.22E-02
3. PARTICULATES			
SR89	CI	1.22E-05	3.00E-04
TOTAL FOR PERIOD (ABOVE)	CI	1.22E-05	3.00E-04

Attachment 6

Solid Waste

Attachment 6 (Page 1 of 2)
Solid Waste

Solid Waste Shipped Offsite for Disposal During Period from January 1 to June 30, 1988

WASTE STREAM:
Resins, Filters, & Evap. Bottoms

Waste Class	Cu. Feet	Cu. Meters	Curies Shipped	% Error (Ci)
A	4345.4	123.0	2.25E+2	± 25%
B	0	0	0	N/A
C	0	0	0	N/A
ALL	4345.4	123.0	2.25E+2	± 25%

WASTE STREAM:
Dry Active Waste

Waste Class	Cu. Feet	Cu. Meters	Curies Shipped	% Error (Ci)
A	0	0	0	N/A
B	0	0	0	N/A
C	0	0	0	N/A
ALL	0	0	0	N/A

WASTE STREAM:
Irradiated Fuel

Waste Class	Cu. Feet	Cu. Meters	Curies Shipped	% Error (Ci)
A	0	0	0	N/A
B	0	0	0	N/A
C	0	0	0	N/A
ALL	0	0	0	N/A

WASTE STREAM:
Other Waste

Waste Class	Cu. Feet	Cu. Meters	Curies Shipped	% Error (Ci)
A	0	0	0	N/A
B	0	0	0	N/A
C	0	0	0	N/A
ALL	0	0	0	N/A

Solid Waste

Estimates of Major Radionuclides by Waste Type
WASTE TYPE: Resins, Filters, & Evap. Bottoms

Waste Class	Nuclide Name	Percent Abundance	Curies
A	Cr-51	45.293	1.02 E+2
	Mn-54	22.462	5.05 E+1
	Co-58	10.351	2.33 E+1
	Co-60	7.965	1.79 E+1
	Fe-55	6.831	1.54 E+1
	Fe-59	1.904	4.28 E+0
	Pu-241	1.738	3.91 E+0
	Zn-65	0.786	1.77 E+0
	Ag-110m	0.649	1.46 E+0
	Ce-144	0.498	1.12 E+0
	H-3	0.332	7.47 E-1
	Ni-63	0.311	7.00 E-1
	Zr-95	0.299	6.73 E-1
	Nb-95	0.193	4.35 E-1
	Cs-137	0.148	3.32 E-1
	Sb-124	0.105	2.37 E-1
	Sb-125	0.075	1.69 E-1
	Co-57	0.033	7.47 E-2
	Ce-141	0.009	2.13 E-2
	Cs-134	0.006	1.44 E-2
	Ni-59	0.006	1.26 E-2
	Sr-90	0.005	1.08 E-2
	Tc-99	0.001	1.19 E-3
	C-14	0.000	9.80 E-4
	Nb-94	0.000	2.60 E-4
	I-129	0.000	9.91 E-5
	Pu-239/40	0.000	2.80 E-7
	Pu-238	0.000	1.31 E-7
	Cm-242	0.000	0.00 E+0

Solid Waste Disposal Summary

No. of Shipments	Mode of Transportation	Destination
22	Truck	Barnwell
0	N/A	Richland
0	N/A	Beatty
0	N/A	Other

Attachment 7

Meteorological Data

Joint Frequency Distribution Tables - 1988: Quarters 1 & 2

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88063024
STABILITY CLASS: ALL DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	17	66	93	10	0	0	187
NNE	17	77	87	3	0	0	184
NE	28	97	112	36	0	0	275
ENE	43	98	61	8	0	0	214
E	83	65	6	0	0	0	154
ESE	67	44	19	3	0	0	133
SE	68	62	42	5	0	0	177
SSE	48	77	54	22	5	0	206
S	71	132	134	39	5	0	384
SSW	41	181	151	80	12	3	469
SW	25	98	118	64	4	0	308
WSW	28	74	136	152	27	0	417
W	19	83	192	175	23	1	493
WNW	21	112	140	37	2	0	312
NW	19	81	93	38	0	0	231
NNW	19	77	96	23	0	0	215
TOTAL	614	1424	1534	694	76	4	4368

PERIODS OF CALM(HOURS): 32
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88063024
STABILITY CLASS: A DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	6	8	0	0	0	14
NNE	0	3	27	1	0	0	31
NE	0	5	40	2	0	0	47
ENE	0	3	3	3	0	0	9
E	0	2	0	0	0	0	2
ESE	0	0	2	0	0	0	2
SE	0	0	1	0	0	0	1
SSE	1	1	2	1	0	0	5
S	0	0	2	1	0	0	3
SSW	0	0	3	0	0	0	3
SW	0	0	1	2	0	0	3
WSW	1	1	0	4	1	0	7
W	0	3	15	19	1	0	38
WNW	0	2	21	5	0	0	28
NW	0	4	10	2	0	0	16
NNW	0	3	3	1	0	0	7
TOTAL	2	34	137	61	4	0	238

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarters 1 & 2

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88063024
STABILITY CLASS: B DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	7	8	0	0	0	16
NNE	0	9	13	0	0	0	22
NE	0	10	15	1	0	0	26
ENE	0	0	5	0	0	0	5
E	0	1	1	0	0	0	2
ESE	0	2	4	0	0	0	6
SE	0	0	2	0	0	0	2
SSE	0	0	0	0	0	0	0
S	0	2	5	2	1	0	10
SSW	0	3	4	0	0	0	7
SW	1	0	1	1	0	0	3
WSW	1	3	6	11	2	0	23
W	0	5	3	17	3	0	28
WNW	0	14	20	3	0	0	37
NW	1	4	14	3	0	0	22
NNW	0	9	10	3	0	0	22
TOTAL	4	68	136	41	5	0	254

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88063024
STABILITY CLASS: C DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	9	5	1	0	0	16
NNE	1	12	13	0	0	0	26
NE	0	11	10	4	0	0	25
ENE	0	3	2	0	0	0	5
E	0	4	2	0	0	0	6
ESE	0	3	1	0	0	0	4
SE	1	0	1	0	0	0	2
SSE	0	0	0	0	0	0	0
S	1	3	6	7	0	0	17
SSW	0	2	1	0	0	0	3
SW	0	4	7	3	0	0	14
WSW	1	3	0	0	0	0	4
W	1	6	2	1	0	0	11
WNW	0	2	1	1	0	0	4
NW	1	1	1	4	0	0	7
NNW	0	11	5	1	0	0	17
TOTAL	7	106	128	57	8	0	306

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarters 1 & 2

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88063024
STABILITY CLASS: D DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	11	33	65	9	0	0	118
NNE	7	37	29	1	0	0	74
NE	13	53	43	9	0	0	118
ENE	8	39	43	5	0	0	95
E	11	28	1	0	0	0	40
ESE	2	13	9	1	0	0	25
SE	8	9	17	4	3	0	41
SSE	5	20	22	8	0	0	56
S	3	38	51	17	2	0	111
SSW	2	49	79	47	7	3	187
SW	4	32	80	46	0	0	162
WSW	6	38	103	109	21	0	276
W	11	50	107	123	19	1	311
WNW	12	38	81	39	3	0	183
NW	11	50	53	29	0	0	143
NNW	11	36	69	17	0	0	133
TOTAL	125	583	851	454	54	4	2072

PERIODS OF CALM(HOURS): 2
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88063024
STABILITY CLASS: E DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	2	10	7	0	0	0	19
NNE	3	13	5	0	0	0	21
NE	9	13	4	0	0	0	26
ENE	11	42	8	0	0	0	61
E	20	17	2	0	0	0	39
ESE	17	11	4	1	0	0	33
SE	7	20	21	1	0	0	49
SSE	8	28	28	8	0	0	72
S	8	54	66	12	2	0	142
SSW	15	79	54	30	3	0	181
SW	6	52	29	8	0	0	95
WSW	8	20	26	15	0	0	74
W	6	18	8	3	1	0	36
WNW	9	13	3	0	0	0	24
NW	4	10	3	1	0	0	18
NNW	5	17	8	1	0	0	31
TOTAL	138	422	275	80	5	0	921

PERIODS OF CALM(HOURS): 5
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88063024
STABILITY CLASS: F DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	2	1	0	0	0	0	4
NNE	5	1	0	0	0	0	6
NE	2	3	0	0	0	0	5
ENE	9	7	0	0	0	0	16
E	22	8	0	0	0	0	30
ESE	9	9	0	0	0	0	18
SE	11	22	0	0	0	0	33
SSE	10	14	0	0	0	0	24
S	12	21	4	0	0	0	37
SSW	9	40	0	0	0	0	49
SW	7	9	0	0	0	0	17
WSW	5	5	0	0	0	0	10
W	0	0	0	0	0	0	0
WNW	0	2	1	0	0	0	3
NW	1	1	0	0	0	0	2
NNW	2	1	1	0	0	0	4
TOTAL	106	144	6	0	0	0	260

PERIODS OF CALM(HOURS): 5
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88063024
STABILITY CLASS: G DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	0	0	0	0	0	0
NNE	1	0	0	1	0	0	2
NE	4	2	0	0	0	0	6
ENE	17	5	0	0	0	0	22
E	30	5	0	0	0	0	35
ESE	39	6	0	0	0	0	45
SE	41	11	0	0	0	0	52
SSE	24	14	0	0	0	0	38
S	47	14	0	0	0	0	61
SSW	15	8	0	0	0	0	23
SW	5	1	0	0	0	0	6
WSW	6	0	0	0	0	0	6
W	1	1	0	0	0	0	2
WNW	0	0	1	0	0	0	1
NW	1	0	0	0	0	0	1
NNW	1	0	0	0	0	0	1
TOTAL	232	67	1	1	0	0	317

PERIODS OF CALM(HOURS): 20
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88033124
STABILITY CLASS: ALL DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	10	28	36	3	0	0	77
NNE	5	19	39	1	0	0	64
NE	9	29	41	1	0	0	80
ENE	20	42	20	3	0	0	85
E	33	36	5	0	0	0	61
ESE	20	31	15	2	0	0	68
SE	21	34	37	8	0	0	100
SSE	20	29	36	20	0	0	105
S	29	73	97	33	4	0	236
SSW	12	84	115	67	11	0	289
SW	5	44	98	44	1	0	192
WSW	5	27	83	114	22	0	251
W	11	25	95	132	23	1	287
WNW	5	40	72	14	3	0	134
NW	6	31	44	16	0	0	97
NNW	6	22	32	4	0	0	64
TOTAL	207	594	852	458	67	4	2184

PERIODS OF CALM(HOURS): 6
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88033124
STABILITY CLASS: A DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	2	1	0	0	0	3
NNE	0	1	10	0	0	0	11
NE	0	1	8	1	0	0	10
ENE	0	1	1	1	0	0	3
E	0	1	0	0	0	0	1
ESE	0	0	2	0	0	0	3
SE	0	0	1	0	0	0	1
SSE	0	1	2	1	0	0	4
S	0	0	1	1	0	0	2
SSW	0	0	2	0	0	0	2
SW	0	0	1	0	0	0	1
WSW	0	0	0	3	0	0	3
W	0	3	4	6	1	0	14
WNW	0	2	8	0	0	0	10
NW	0	3	1	0	0	0	4
NNW	0	1	0	0	0	0	1
TOTAL	0	16	42	13	1	0	72

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarter 1

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88033124
STABILITY CLASS: B DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	2	1	0	0	0	4
NNE	0	3	5	0	0	0	8
NE	0	0	4	0	0	0	4
ENE	0	0	3	0	0	0	3
E	0	1	0	0	0	0	1
ESE	0	1	2	0	0	0	3
SE	0	0	0	0	0	0	0
SSE	0	0	0	2	0	0	2
S	0	1	4	0	0	0	5
SSW	0	1	1	0	0	0	2
W	1	0	1	1	0	0	3
WSW	0	1	2	4	1	0	8
W	0	2	10	7	0	0	19
WNW	0	2	11	0	0	0	13
NW	1	1	4	0	0	0	6
NNW	0	2	0	1	0	0	3
TOTAL	3	17	48	15	1	0	84

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88033124
STABILITY CLASS: C DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	4	2	0	0	0	6
NNE	0	3	5	0	0	0	8
NE	0	2	5	0	0	0	7
ENE	0	3	0	0	0	0	3
E	0	3	1	0	0	0	4
ESE	0	3	1	0	0	0	4
SE	0	0	1	0	0	0	1
SSE	0	0	0	0	0	0	0
S	0	1	4	5	0	0	10
SSW	0	0	4	5	0	0	9
W	0	3	5	7	3	0	18
WSW	0	1	1	7	3	0	12
W	0	1	9	10	3	0	23
WNW	0	6	6	0	0	0	12
NW	0	7	5	1	0	0	13
NNW	0	1	2	1	0	0	4
TOTAL	0	33	53	37	8	0	131

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarter 1

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88033124
STABILITY CLASS: D DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	7	20	32	3	0	0	62
NNE	4	13	19	0	0	0	36
NE	7	16	24	0	0	0	47
ENE	5	18	15	1	0	0	39
E	4	21	1	0	0	0	26
ESE	3	11	4	1	0	0	19
SE	8	7	13	4	3	0	35
SSE	1	17	15	8	0	0	41
S	0	32	42	15	2	0	91
SSW	0	36	69	41	6	3	155
SW	1	21	69	33	0	0	124
WSW	3	19	68	88	20	0	198
W	5	15	68	107	19	1	215
WNW	3	26	49	14	2	0	94
NW	3	15	34	15	0	0	67
NNW	4	16	30	2	0	0	52
TOTAL	51	305	552	332	52	4	1296

PERIODS OF CALM(HOURS): 1
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88033124
STABILITY CLASS: E DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	0	0	0	0	0	1
NNE	1	0	0	0	0	0	1
NE	1	5	0	0	0	0	6
ENE	5	14	1	0	0	0	20
E	5	4	0	0	0	0	9
ESE	5	8	3	1	0	0	17
SE	6	13	12	1	0	0	32
SSE	3	4	19	6	0	0	32
S	6	30	46	16	2	0	100
SSW	9	41	37	22	3	0	112
SW	4	19	22	6	0	0	51
WSW	2	4	12	12	0	0	30
W	2	4	4	6	1	0	17
WNW	2	3	1	0	0	0	6
NW	2	4	0	0	0	0	6
NNW	2	2	0	0	0	0	4
TOTAL	60	155	157	60	5	0	438

PERIODS OF CALM(HOURS): 3
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarter 1

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88033124
STABILITY CLASS: F DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	0	0	0	0	0	1
NNE	0	0	0	0	0	0	0
NE	0	2	0	0	0	0	2
ENE	1	4	0	0	0	0	5
E	9	4	0	0	0	0	13
ESE	6	6	0	0	0	0	12
SE	8	11	0	0	0	0	19
SSE	7	6	0	0	0	0	13
S	9	5	0	0	0	0	14
SSW	3	6	0	0	0	0	9
SW	1	2	0	0	0	0	3
WSW	0	2	0	0	0	0	2
W	0	0	0	0	0	0	0
WNW	0	1	0	0	0	0	1
NW	0	1	0	0	0	0	1
NNW	0	0	0	0	0	0	0
TOTAL	45	50	0	0	0	0	95

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88010101-88033124
STABILITY CLASS: G DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	0	0	0	0	0	0
NNE	0	0	0	1	0	0	1
NE	1	1	0	0	0	0	2
ENE	9	3	0	0	0	0	12
E	5	3	0	0	0	0	8
ESE	4	3	0	0	0	0	7
SE	5	3	0	0	0	0	8
SSE	10	1	0	0	0	0	11
S	12	4	0	0	0	0	16
SSW	0	0	0	0	0	0	0
SW	1	0	0	0	0	0	1
WSW	0	0	0	0	0	0	0
W	1	0	0	0	0	0	1
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
TOTAL	48	18	0	1	0	0	68

PERIODS OF CALM(HOURS): 2
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarter 2

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88040101-88063024
STABILITY CLASS: ALL DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	7	38	57	7	0	0	110
NNE	13	38	48	3	0	0	102
NE	19	68	71	35	0	0	193
ENE	25	56	41	6	0	0	129
E	60	29	4	0	0	0	94
ESE	47	13	7	0	0	0	68
SE	47	28	15	0	0	0	94
SSE	28	48	18	2	0	0	101
S	42	59	37	9	1	0	148
SSW	29	97	36	13	1	0	176
SW	18	54	20	20	3	0	115
WSW	23	47	53	38	4	0	165
W	8	58	97	43	0	0	206
WNW	16	72	65	26	0	0	179
NW	13	50	49	23	0	0	135
NNW	13	55	64	19	0	0	151
TOTAL	407	830	682	236	9	0	2184

PERIODS OF CALM(HOURS): 26
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88040101-88063024
STABILITY CLASS: A DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	4	7	0	0	0	11
NNE	0	1	17	1	0	0	19
NE	0	4	32	21	0	0	57
ENE	0	1	3	1	0	0	5
E	0	1	0	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	1	0	0	0	0	0	1
S	0	0	1	0	0	0	1
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	1	1	0	1	0	0	3
W	0	0	11	13	0	0	24
WNW	0	0	13	5	0	0	18
NW	0	1	9	3	0	0	13
NNW	0	2	3	1	0	0	6
TOTAL	2	18	95	48	3	0	166

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarter 2

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88040101-88063024
STABILITY CLASS: A DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	5	7	0	0	0	12
NNE	0	6	8	0	0	0	14
NE	0	14	11	1	0	0	26
ENE	0	0	2	0	0	0	2
E	0	0	1	0	0	0	1
ESE	0	1	1	0	0	0	2
SE	0	0	2	0	0	0	2
SSE	0	0	0	0	0	0	0
S	0	1	1	3	0	0	5
SSW	0	2	1	1	0	0	4
SW	0	0	0	3	0	0	3
WSW	1	1	7	1	0	0	11
W	0	3	23	10	0	0	36
WNW	0	12	9	2	0	0	23
NW	0	1	10	2	0	0	15
NNW	0	1	10	2	0	0	13
TOTAL	1	51	88	26	4	0	170

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88040101-88063024
STABILITY CLASS: C DT/DZ
ELEVATION: SPEED:SPD10F DIRECTION:DIR10F LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	5	3	1	0	0	10
NNE	1	10	8	0	0	0	19
NE	0	9	5	4	0	0	18
ENE	0	1	3	0	0	0	4
E	0	3	1	2	0	0	6
ESE	0	1	0	3	0	0	4
SE	1	0	0	0	0	0	1
SSE	0	0	2	0	0	0	2
S	1	2	2	2	0	0	7
SSW	0	2	7	0	0	0	9
SW	0	3	2	0	0	0	4
WSW	1	2	4	6	0	0	13
W	1	5	20	3	0	0	29
WNW	0	17	8	1	0	0	26
NW	1	5	8	3	0	0	17
NNW	0	10	3	0	0	0	13
TOTAL	7	73	75	20	0	0	175

PERIODS OF CALM(HOURS): 0
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarter 2

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88040101-88063024
STABILITY CLASS: D DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	4	13	23	6	0	0	56
NNE	3	24	10	1	0	0	38
NE	6	35	19	9	0	0	69
ENE	5	21	28	4	0	0	58
E	7	7	0	0	0	0	14
ESE	0	2	5	0	0	0	7
SE	5	2	4	0	0	0	11
SSE	4	3	7	1	0	0	15
S	3	6	9	2	0	0	20
SSW	3	13	10	6	1	0	33
SW	1	11	11	11	0	0	34
WSW	6	9	34	21	1	0	71
W	6	15	39	16	0	0	96
WNW	10	25	29	25	0	0	89
NW	8	25	19	14	0	0	76
NNW	7	20	39	15	0	0	81
TOTAL	74	278	299	122	2	0	776

PERIODS OF CALM(HOURS): 1
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD = 88040101-88063024
STABILITY CLASS: E DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND SPEED(MPH)

WIND DIRECTION	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	10	7	0	0	0	18
NNE	3	13	5	0	0	0	21
NE	8	8	4	0	0	0	20
ENE	6	28	7	0	0	0	41
E	15	11	3	0	0	0	30
ESE	2	7	4	0	0	0	13
SE	2	7	6	0	0	0	15
SSE	6	24	9	2	0	0	41
S	0	24	20	0	0	0	44
SSW	5	14	17	7	0	0	43
SW	5	13	7	5	0	0	30
WSW	6	21	14	3	0	0	44
W	1	14	4	1	0	0	20
WNW	6	10	1	0	0	0	17
NW	2	6	4	1	0	0	13
NNW	3	15	8	1	0	0	27
TOTAL	78	267	118	20	0	0	483

PERIODS OF CALM(HOURS): 2
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Joint Frequency Distribution Tables - 1988: Quarter 2

HOURS AT EACH WIND SPEED AND DIRECTION
PERIOD OF RECORD = 88040101-88063024
STABILITY CLASS: F DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	1	0	0	0	0	3
NNE	5	1	0	0	0	0	6
NE	2	1	0	0	0	0	3
ENE	8	3	0	0	0	0	11
E	13	4	0	0	0	0	17
ESE	3	3	0	0	0	0	6
SE	3	11	0	0	0	0	14
SSE	3	8	0	0	0	0	11
S	3	16	4	0	0	0	24
SSW	6	34	0	0	0	0	40
SW	6	7	0	0	0	0	14
WSW	5	3	0	0	0	0	8
W	0	0	0	0	0	0	0
WNW	0	1	1	0	0	0	2
NW	1	0	0	0	0	0	1
NNW	2	1	1	0	0	0	4
TOTAL	61	94	6	0	0	0	165

PERIODS OF CALM(HOURS): 5
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

HOURS AT EACH WIND SPEED AND DIRECTION
PERIOD OF RECORD = 88040101-88063024
STABILITY CLASS: G DT/DZ
ELEVATION: SPEED:SPD10P DIRECTION:DIR10P LAPSE:DT50M

WIND DIRECTION	WIND SPEED(MPH) 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	0	0	0	0	0	0
NNE	1	0	0	0	0	0	1
NE	4	1	0	0	0	0	6
ENE	8	2	0	0	0	0	11
E	25	2	0	0	0	0	28
ESE	5	3	0	0	0	0	9
SE	6	8	0	0	0	0	14
SSE	14	13	0	0	0	0	31
S	35	10	0	0	0	0	47
SSW	15	8	0	0	0	0	23
SW	4	1	0	0	0	0	5
WSW	6	0	0	0	0	0	6
W	0	1	0	0	0	0	1
WNW	0	0	1	0	0	0	1
NW	1	0	0	0	0	0	1
NNW	1	0	0	0	0	0	1
TOTAL	184	49	1	0	0	0	249

PERIODS OF CALM(HOURS): 18
VARIABLE DIRECTION 0
HOURS OF MISSING DATA: 0

Attachment 8

Offsite Dose Calculation Manual (ODCM) Changes

PNPP No. 7309
Rev 5/88
PAP-0522-1

NON-INTENT
INSTRUCTION TEMPORARY CHANGE

TEMPORARY CHANGE NO.
TCN- 2

INSTRUCTION NO.	REV.	INSTRUCTION TITLE
0AI.2D: ODCM	3	OFFSITE DOSE CALCULATION MANUAL

CANCELS TCN(S):
N/A

LIST PAGE NO. OF EACH ATTACHED PAGE:
80, 88, 89, 90

ADMIN. USE ONLY

REASON

(1) REVISION TO RADIOLOGICAL ENVIRONMENTAL MONITORING WATER SAMPLING LOCATIONS #59 AND #60. PREV. LOCATIONS WERE NOT EASILY ACCESSIBLE AND POSED A SAFETY HAZARD.

(2) ADDITION OF RADIOLOGICAL ENVIRONMENTAL MONITORING MILK SAMPLING LOCATION #61.

PROCESS FOR: ☐ CONDITIONAL APPROVAL ☒ FINAL APPROVAL ONLY

EFFECTIVE DATE
7-21-88

ORIGINATOR: [signature] DATE: F.M. COCHRAN 6-14-88

CONDITIONAL APPROVAL/IN DEPTH REVIEW (Plant Management Staff): [signature] DATE: 6-14-88

CONDITIONAL APPROVAL (SS or US): NA DATE:

FINAL APPROVAL

NPORE: APPROVED RESPONSIBLE MANAGER DATE:

PORC: PORC MTG. NO. 88-062 RECOMMENDED FOR: ☑ APPROVAL ☐ DISAPPROVAL
DIRECTOR, PPTD / GENERAL MANAGER PPOD: Steven F. Hensick DATE: 7/19/88
DATE:

DISAPPROVAL

REASON FOR DISAPPROVAL:

DATE:

RECORDS: BY: [signature] DATE: 7-21-88

PNPP No. 7309
Rev 2/87
PAP-0522-1

NON-INTENT
INSTRUCTION TEMPORARY CHANGE

TEMPORARY CHANGE NO. TCN- 1

INSTRUCTION NO.	REV.	INSTRUCTION TITLE
OM 12D: ODCM	3	OFFSITE DOSE CALCULATION MANUAL
CANCELS TCN(S): N/A		

ORIGINATOR: R.M. COCHNAR — DATE: 4-18-88 — LIST EACH ATTACHED PAGE: 87, 90, 80

PROCESS FOR: ☐ CONDITIONAL APPROVAL ☒ FINAL APPROVAL ONLY

ADMIN. USE ONLY

REASON

REINCLUSION OF RADIOLOGICAL ENVIRONMENTAL MILK SAMPLING LOCATION #30; EDITORIAL CHANGES TO MORE ACCURATELY REFLECT THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM.

CONDITIONAL APPROVAL/IN DEPTH REVIEW

(Plant Management Staff) — DATE: 4-18-88

CONDITIONAL APPROVAL

(SS or US): N/A — DATE:

EFFECTIVE DATE: 5-16-88

FINAL APPROVAL

NON PORC — APPROVED — RESPONSIBLE GS/GSE: N/A — DATE:

PORC — PORC MTG. No.: 88-051 — RECOMMENDED FOR: ☒ APPROVAL ☐ DISAPPROVAL

MANAGER PPTD: T R Stead — DATE: 5-16-88

MANAGER PROD: N/A — DATE:

DISAPPROVAL

REASON FOR DISAPPROVAL

DATE:

BY:

DATE:

PC RECORD — DATE: 5-16-88

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

PERRY NUCLEAR POWER PLANT OPERATIONS MANUAL

TITLE: OFFSITE DOSE CALCULATION MANUAL

REVISION: 3 EFFECTIVE DATE: 2-24-88 ~~2-22-88~~ KLT pkg 2/24/88

PREPARER REVIEW

		DATE
PREPARER:	Richard M. Cochnar	1-25-88
REVIEWER:	SJWorton	2/3/88
PORC MEETING NO.:	88-022	2/11/88

IN PLANT VALIDATION

********** NOTE: Complete this block only if in-plant validation is desired **********		
APPROVAL FOR VALIDATION:	N/A	
VALIDATION COMPLETE:	N/A	
VALIDATION TC'S INCORPORATED:	BY:	

APP

APPROVED:	F. R. STEAD SJWorton 2/19/88 Designated Alternate During Absence — Date	

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10CFR50.59 Applicability Check

	Yes	No
Is there a change to the plant as described in the FSAR? Reason: There is no change to the plant that affects the design, function, etc of components, systems or structures as described in the FSAR	☐	☑
Is there a change to a procedure/instruction as described in the FSAR? Reason: The ODCM is not an instruction or procedure; it is a manual outlining the methodology used to calculate offsite doses. Other instructions and procedures implement this methodology.	☐	☑
Is there a test or experiment not described in the FSAR? Reason: This is not a test or experiment and therefore does not have an adverse effect on safety-related systems.	☐	☑
Is there a change to the Technical Specifications?	☐	☑
Is there an effect on the environment or change to the Environmental Protection Plan? Reason: There is no adverse effect on the environment or change to the EPP	☐	☑

☑ Answers to all questions are "No", no potential for an Unreviewed Safety or Environmental Question exists, no further review required.

☐ Answers to one or more questions is "Yes", further review required. Safety Evaluation Number _____
Environmental Evaluation Number _____

Prepared/Date	Revieved/Date	Approved/Date
[signature] 2-2-88	[signature] 2/3/88	[signature] 2/3/88

SCOPE OF REVISION:

Rev. 3 -
1. TC's from previous revision that were evaluated for incorporation - TCN-002 through TCN-008.
2. Deletion of Atmospheric dispersion and deposition parameters for nearest residence with animal and garden locations as this information is subject to change and is available in the Annual Environmental Operating Report.
3. Radiological Environmental Sampling Program changes: precipitation sampling added to locations 3 and 4; precipitation sampling deleted from locations 1, 44, and 48; revision TLD station 8 location.
4. Revritten to include editorial changes, often too insignificant and too profuse to warrant demarcation.
5. This Instruction was been revised in its entirety. D22368

1.0 INTRODUCTION

This Offsite Dose Calculation Manual (ODCM) contains information and methodologies to be used by the Perry Nuclear Power Plant (PNPP), Unit 1, to ensure compliance with PNPP Radiological Effluent Technical Specifications. The Technical Specifications are written to satisfy 10CFR20, 10CFR50.36 and Appendix I, and 40CFR190 requirements.

Sections 2 and 3 of this manual deal with liquid and gaseous radiological effluents, respectively. Each of these sections contain alarm setpoint determination, radiation dose and dose rate calculation methodologies, as well as limits and requirements. Section 4 covers uranium fuel cycle related radiation dose limits including direct dose.

Also included in this manual, in Section 5, is information relating to the Radiological Environmental Monitoring Program (REMP). The figures and tables contained therein designate specific sample types and locations currently used to satisfy the Technical Specification requirements for the REMP as well as sampling reporting and detection capability limits. The sample types and locations are subject to change based on factors including the results of the annual Land Use Census.

The ODCM has been prepared, as generally as possible, in order to minimize future revisions. However, any such changes will be reviewed and approved as per the Administrative Control Section of the PNPP Technical Specifications.

Supplemental information needed to support calculations, both in this document and in the accompanying Radiological Effluent Technical Specifications is contained in the appendices at the end of this manual. Appendix A contains atmospheric dispersion and deposition parameters and Appendix B presents the methodology for determining the lower limit of detection (LLD).

2.0 LIQUID EFFLUENTS

2.1 Batch Releases

A batch release is the discharge liquid radioactive waste of a discrete volume. Batch releases from the liquid radwaste system may occur from any of the following tanks: waste sample tank, floor drain sample tank, chemical waste distillate tank, and detergent drain tank. (See Figure 2.1-1). The maximum release rate possible, due to pump capacity, is 200 gallons per minute from all release tanks except the detergent drain tanks, which have a maximum release rate of 50 gallons per minute. All of the above liquid radwaste releases go to the Emergency Service Water discharge which is then released through the discharge tunnel after mixing with Service Water effluent, and blowdown from Circulating Water system if present.

The type and frequency of sampling and analysis required by the PNPP Technical Specifications is given in T.S. Table 4.11.1.1.1-1. Prior to sampling for analysis, each batch should be isolated, and thoroughly mixed to assure representative sampling. For mixing, the contents of the tank are recirculated by isolating the tank and turning on equipment that takes suction from and discharges back into the tank. Recycle lines are provided with one or more mixing eductors located near the bottom of the tanks to promote better mixing as well as reducing recirculation time. This ensures that the water in the tank will be mixed and will be representative of the activity in the tank. The minimum recirculation performed is the equivalent of two volumes of the tank contents.

Monitor alarm setpoints will be determined in order to ensure compliance with 10CFR20. The radioactive content of each batch release will be determined prior to release in accordance with Table 4.11.1.1.1-1 of the PNPP Technical Specifications. Concentrations for tritium and other non-gamma emitting isotopes will be those most recently determined (previous month/quarter).

2.1.1 Monitor Alarm Setpoint Determination

The following methodology is used to calculate the setpoints for the Radwaste Discharge Radiation Monitor - ESW Discharge and Liquid Radwaste Adjustable High Flow Trip Unit to ensure that liquid radwaste effluent releases from the site to unrestricted areas are below the concentrations specified in 10CFR20, Appendix B, Table II, Column 2 for radionuclides other than noble gases. An MPC of 2.0E-4 μCi/ml has been established for dissolved and entrained noble gases. The Radwaste Discharge Radiation Monitor - ESW Discharge provides alarm and automatic termination of releases prior to exceeding these limits.

NOTE: Liquid radwaste discharge flow rate shall be verified at least once per four hours, whenever the flow rate measuring device(s) is inoperable during actual releases.

2.1.1.1 Determination of the Minimum Acceptable Dilution Factor

$$DF_o = \sum_i \frac{C_i}{MPC_i} \qquad (2.1\text{-}1)$$

Where:

DF_o = the minimum acceptable dilution factor determined from analysis of the liquid effluent to be released;

C_i = the concentration of radionuclide "i" in the batch to be released, in µCi/ml;

MPC_i = the limiting maximum permissible concentration of radionuclide "i", from Appendix B, Table II, Column 2 of 10CFR20, in µCi/ml adn (2.0E-4 µCi/ml for noble gases).

$$DF = 10\ DF_o \qquad (2.1\text{-}2)$$

Where:

DF = the conservative dilution factor used by PNPP to calculate the maximum release rate prior to release in order to ensure compliance with 10CFR20;

DF_o = the minimum acceptable dilution factor, as per equation 2.1-1;

10 = a factor of ten less than 10CFR20 limits as specified in Appendix B, Table II, Column 2; this factor represents an order of magnitude of conservatism for liquid radwaste releases from PNPP.

NOTE: If the concentration of a radionuclide is below the lower limit of detection the radionuclide shall not be included as a source term in the setpoint calculation.

2.1.1.2 Determination of the Maximum Allowable Radwaste Tank Discharge Flow Rate

$$f_{max} = \frac{(0.64)(\ mdf)}{DF} \qquad (2.1\text{-}3)$$

Where:

f_{max} = the maximum allowable radwaste tank discharge flow rate for the batch to be released, in gpm;

DF = the conservative dilution factor, per equation 2.1-2;

mdf = the minimum dilution flow - supplied by the Service Water system, i.e., the low flow alarm setpoint of the Service Water Flow Transmitter P41-N443 = 30,000 gpm;

0.64 = an engineering factor to prevent spurious alarms.

2.1.1.3 Liquid Radwaste Discharge Flow Monitor Alarm Setpoint

Monitor alarm setpoints are determined to ensure that the concentration of radionuclides in the liquid radwaste effluent released from PNPP to unrestricted areas does not exceed the limits specified in 10CFR20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. An MPC of 2.0E-4 µCi/ml has been established for noble gases dissolved and entrained in liquid effluents.

$$SP_f = (1.25)(f_{act}) \qquad (2.1\text{-}4)$$

Where:

SP_f = Liquid Radwaste Adjustable High Flow Trip Unit (G50-K805A/B or G50-K926/7) alarm setpoint, in gpm;

f_{act} = the actual allowable radwaste tank discharge flow rate for the batch to be released, not to exceed the maximum allowable radwaste discharge flow rate (f_{max}) as defined in equation 2.1-3;

1.25 = the engineering safety factor to prevent spurious alarms.

The liquid radwaste tank discharge flow should be maintained at or below this f_{act} value by proper regulation of the high volume or low volume discharge throttle valves (G50-F153 or G50-F155).

2.1.1.4 Liquid Radwaste Discharge Radiation Monitor Alarm/Trip Setpoint

Monitor alarm/trip setpoints are determined to ensure that the concentration of radionuclides in the liquid radwaste effluent released from PNPP to unrestricted areas does not exceed the limits specified in 10CFR20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. An MPC of 2.0E-4 µCi/ml has been established for noble gases dissolved and entrained in liquid effluents.

$$CR_c = \sum_i (C_i)(E_i) \qquad (2.1\text{-}5)$$

Where:

CR_c = the calculated monitor count rate above background, in cpm;

C_i = the concentration of radionuclide "i" in the batch to be released, in µCi/ml;

E_i = the detector efficiency of the monitor for radionuclide "i" in cpm/(µCi/ml).

OR

$$CR_x = (R_s)(F_x)\Sigma C_i \qquad (2.1\text{-}6)$$

Where:

CR_x = the cross-calibrated monitor count rate above background, in cpm;

F_x = the cross-calibration factor used to ratio the Liquid Radwaste Discharge Radiation Monitor actual response to the Cs-137 calibrated response;

R_s = the response of the Liquid Radwaste Discharge Radiation Monitor to a Cs-137 calibrated standard, in cpm/(µCi/ml).

$$SP_r = (1.25)\ (f_{max}/f_{act})\ (CR_n) + BG \qquad (2.1\text{-}7)$$

Where:

SP_r = the Radwaste Discharge Radiation Monitor - ESW Discharge (0D17K0606) alarm/trip setpoint, in cpm;

BG = the background count rate due to internal contamination and radiation levels in the area of the monitor;

CR_n = the monitor net count rate, either CR_c or CR_x, as per equation 2.1-5 or 2.1-6;

1.25 = the engineering safety factor to prevent spurious alarms;

$\frac{f_{max}}{f_{act}}$ = an adjustment factor (to account for the difference between an actual radwaste discharge flow rate to be used for the discharge and maximum allowable radwaste discharge flow rate) to allow operational flexibility and to minimize spurious alarms;

Where:

f_{act} = the actual radwaste discharge flow rate; this value must always be less than or equal to f_{max};

f_{max} = the maximum allowable radwaste discharge flow rate, per equation 2.1-3.

2.1.2 Compliance with 10CFR20 - Liquid Effluent Concentration

In order to show compliance with 10CFR20, the concentrations of radionuclides in liquid effluents will be determined and compared with the limiting maximum permissible concentrations (MPC) as defined in Appendix B, Table II, Column 2 of 10CFR20 (2.0E-4 µCi/ml for entrained and dissolved noble gases). Concentrations of radioactivity in effluents prior to dilution will be determined. Concentration in diluted effluent will be calculated using these results prior to each batch release, and following each batch release. PNPP has no continuous releases.

2.1.2.1 Concentration of radionuclides in Prerelease

The radioactivity content of each batch release will be determined prior to release. PNPP will show compliance with 10CFR20 in the following manner:

The concentration of the various radionuclides in batch releases prior to dilution is divided by the minimum dilution flow to obtain the concentration at the unrestricted area. This calculation is shown in the following equation:

$$Conc_i = \frac{(C_i)(f)}{mdf} \qquad (2.2\text{-}1)$$

Where:

$Conc_i$ = the concentration of radionuclide "i" at the unrestricted area, in µCi/ml;

C_i = the concentration of radionuclide "i" in the batch to be released, in µCi/ml;

f = the radvaste tank discharge flow rate for the batch to be released, in gpm;

mdf = the minimum dilution flow, per equation 2.1-3, in gpm.

The projected radionuclide concentrations in the unrestricted area are compared to the maximum permissible concentrations in Appendix B, Table II, Column 2 of 10CFR20 (2.0E-4 µCi/ml for dissolved and entrained noble gases) in order to give a final 10CFR20 compliance check, i.e., the following equation must be met:

$$\sum_i \frac{Conc_i}{MPC_i} \leq 1 \qquad (2.2\text{-}2)$$

Where:

$Conc_i$ = the concentration of radionuclide "i" at the unrestricted area, in µCi/ml;

MPC_i = the limiting maximum permissible concentration of radionuclide "i", from Appendix B, Table II, Column 2 of 10CFR20 (2.0E-4 µCi/ml for dissolved and entrained noble gases), in µCi/ml.

2.1.2.2 Post Release

The actual radioactivity content of each batch release will be determined following release to show final compliance with 10CFR20.

The concentration of the various radionuclides in batch releases prior to dilution is divided by the actual dilution to obtain the concentration at the unrestricted area. This calculation is shown in the following equation:

$$Conc_i = \frac{(C_i)(V_{lrt})}{V_{dil}} \qquad (2.2\text{-}3)$$

Where:

$Conc_i$ = the actual concentration of radionuclide "i" at the unrestricted area for the release, in µCi/ml;

C_i = the concentration of radionuclide "i" in the batch released, in µCi/ml;

V_{dil} = the actual volume of dilution water during the release (total plant discharge flow, including Service Water, Emergency Service Water, and cooling tower blowdown), in gallons;

V_{lrt} = the actual volume of the liquid radwaste tank discharged for the batch, in gallons.

The concentrations in the unrestricted area are compared to the maximum permissible concentrations in Appendix B, Table II, Column 2 of 10CFR20 (2.0E-4 µCi/ml for dissolved and entrained noble gases). In order to demonstrate final compliance with 10CFR20, the following equation must be met:

$$\sum_i \frac{Conc_i}{MPC_i} \leq 1 \qquad (2.2\text{-}4)$$

Where:

$Conc_i$ = the concentration of radionuclide "i" at the unrestricted area, in µCi/ml;

MPC_i = the limiting maximum permissible concentration of radionuclide "i", from Appendix B, Table II, Column 2 of 10CFR20, in µCi/ml.

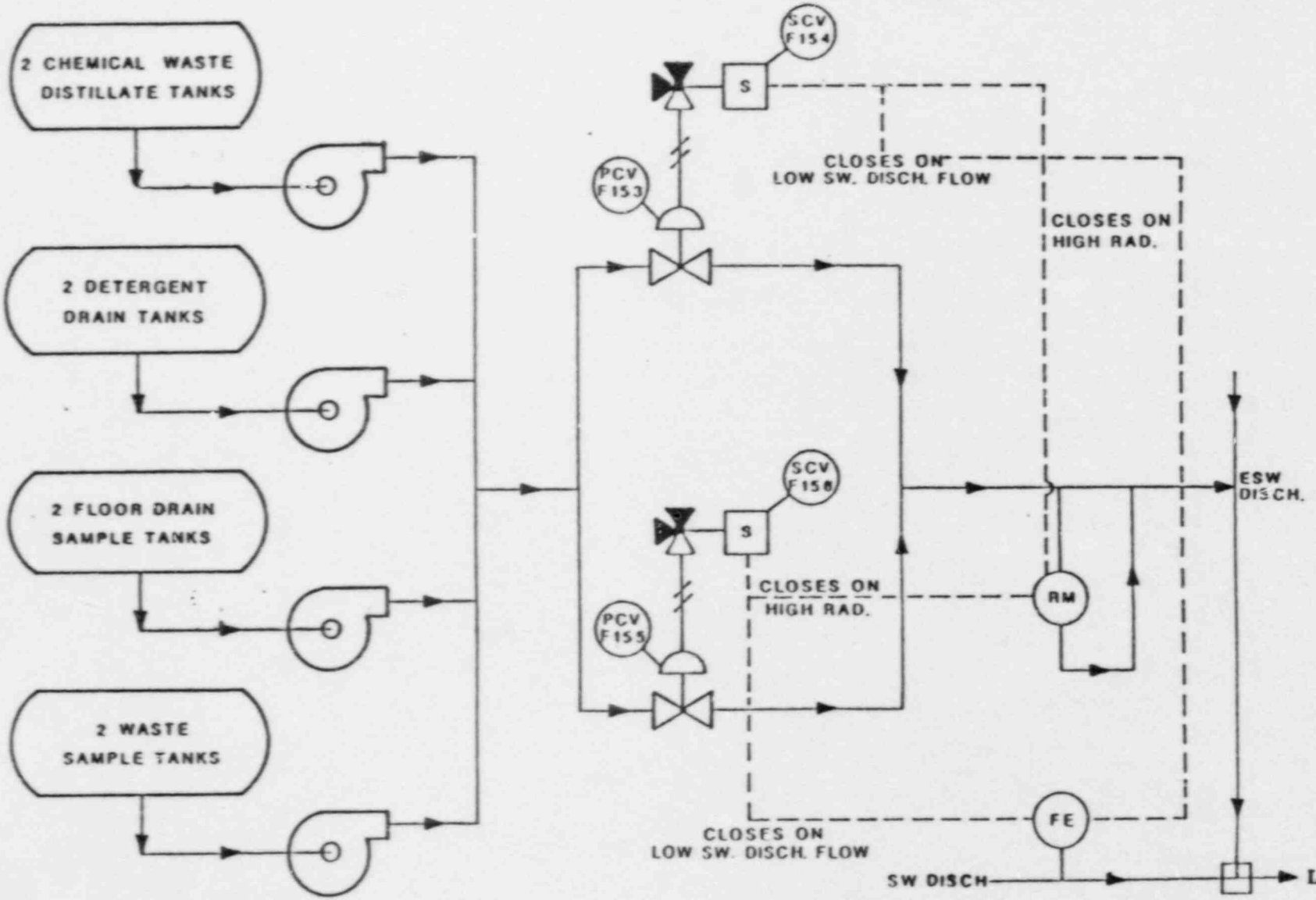
2.2 Continuous Releases

A continuous release is the discharge of fluid wastes of a non-discrete volume, i.e., from a volume or system that has an input flow during the continuous release. Continuous radioactive releases are not planned for PNPP although the potential does exist for RHR heat exchanger leakage into the Emergency Service Water system.

Potentially contaminated dicharges from the ESW are monitored by an installed radiation monitoring system. This system consists of two channels, one for monitoring downstream of equipment in Emergency Service Water System Loop A and the other for Emergency Service Water Loop B. Monitors are set to alarm at three times background level. If radiation is detected, the affected Emergency Service Water line can be manually isolated. The decision of whether to isolate or not is dependent upon other conditions. The PNPP staff will take appropriate action to limit release.

The Emergency Service Water discharged will be sampled and analyzed in accordance with PNPP Technical Specification Table 4.11.1.1.1-1. To show compliance with 10CFR20, the sum of the concentrations of radionuclide "i" in unrestricted areas due to both continuous and batch releases divided by that isotope's MPC must again be less than 1.

Figure 2.1-1 LIQUID RADIOACTIVE WASTE (LRW) DISCHARGE SYSTEM



2.3 Compliance With 10CFR50, Appendix I - Liquid Effluent Dose

Doses resulting from liquid effluents will be calculated at least monthly to show compliance with 10CFR50, Appendix I. A cumulative summation of total body and organ doses for each calendar quarter and calendar year will be maintained. Additionally, doses due to liquid releases are projected monthly.

2.3.1 Dose Calculations

Radiation doses due to liquid radioactive effluents from PNPP are calculated based on three main dose pathways: potable water, aquatic foods (namely fresh water fish ingestion), and exposure to shoreline deposits. Irrigated food pathways, as discussed in Regulatory Guide 1.109, will not be of concern at PNPP as little or no water from Lake Erie is used for irrigation in the nearby Ohio counties of Lake, Ashtabula, Cuyahoga and Lorain. Nursery businesses and other agricultural activities that require supplemental water generally rely on water drawn from small ponds and streams.

Radiation dose to members of the public for liquid radioactive releases from PNPP will be calculated for the potable water, aquatic food, and shoreline deposit pathways using the following equations:

1. Potable Water:

$$R_{ajp} = 1100 \frac{U_{ap}}{(M_p)(F)} \sum_i (Q_i)(D_{aipj}) \exp(-\lambda_i t_p) \quad (2.3\text{-}1)$$

2. Aquatic Foods:

$$R_{ajp} = 1100 \frac{U_{ap}}{(M_p)(F)} \sum_i (Q_i)(B_{ip})(D_{aipj}) \exp(-\lambda_i t_p) \quad (2.3\text{-}2)$$

3. Shoreline Deposits:

$$R_{ajp} = 110{,}000 \frac{(U_{ap})(W)}{(M_p)(F)} \sum_i (Q_i)(T_i)(D_{aipj}) * [\exp(-\lambda_i t_p)] * [1 - \exp(-\lambda_i t_b)] \quad (2.3\text{-}3)$$

Where:

R_{ajp} = the dose to individuals of age group "a" to organ "j" from all the radionuclides in pathway "p", in mrem;

B_{ip} = the equilibrium biaccumulation factor for radionuclide i in pathway p, expressed as the ratio of the concentration in biota (in pCi/kg) to the radionuclide concentration in water (in pCi/l), from Table 2.3-4, in l/kg;

D_{aipj} = the dose factor, specific to a given age group "a", radionuclide "i", pathway "p", and organ "j", which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi; or from exposure to a given concentration of a radionuclide in sediment, expressed as a ratio of the dose rate, in mrem/h, and the areal radionuclide concentration, in pCi/m^2, from Tables 2.3-5 through 2.3-9;

F = the flow rate of the liquid effluent in ft^3/s;

M_P = the dilution factor at the midpoint of exposure (or the point of withdrawal of drinking water or point of harvest of aquatic food), from Table 2.3-10, dimensionless;

Q_i = the release of radionuclide "i", in Ci;

t_b = the period of time for which the sediment or soil is exposed to the contaminated water, 1.75×10^5 h (20 years);

T_i = the halflife of radionuclide "i", in days;

t_p = the average transit time required for radionuclides to reach the point of exposure, from Table 2.3-11; for internal dose, t_p is the total time elapsed between release of the radionuclides and the ingestion of food or water, in h;

U_{ap} = the usage factor that specifies the exposure time or intake rate for an individual of age group a associated with pathway "p", from Table 2.3-12, in h/yr, l/hr, or kg/hr;

W = the shoreline width factor, 0.3 (from Regulatory Guide 1.109);

λ_i = the radioactive decay constant of radionuclide "i", in h^{-1};

1100 = a factor to convert from (Ci/yr)/(ft^3/s) to pCi/l;

110,000 = a factor to convert from (Ci/yr)/(ft^3/s) to pCi/l and to account for the proportionality constant used in the sediment radioactivity model.

2.3.2 Cumulation of Doses

The dose contribution from liquid effluents will be calculated at least monthly. Calculations will be performed to determine the maximum total body as well as the maximum organ dose to an individual. These dose calculations will be summed for comparison with quarterly and annual limits. These results will be summed with the doses cumulated from the other months in the quarter of interest and in the year of interest. To assure compliance with the dose limits of 10CFR50, Appendix I the following relationships shall hold:

for the quarter:

Dose $\leq$ 1.5 mrems total body;

Dose $\leq$ 5 mrems any organ;

for the calendar year:

Dose $\leq$ 3 mrems total body;

Dose $\leq$ 10 mrems any organ.

The quarterly limits given above represent one-half of the annual design objective. If these quarterly or annual limits are exceeded, a special report will be submitted to the NRC, in accordance with PNPP Technical Specifications, stating the reason and corrective action to be taken.

2.3.3 Projection of Doses

Anticipated doses resulting from the release of liquid effluents will be projected monthly. The doses calculated for the present month will be used as the projected doses unless information exists indicating that actual releases could differ significantly in the next month.

If the projected dose, when averaged over 31 days, exceeds 0.06 mrem to the total body or 0.2 mrem to any organ, the liquid radwaste system will be used to process waste. The values for the projected dose impact levels correspond to approximately one forty-eighth of the Appendix I design objective. If continued at this rate for one year, the projected impact would correspond to less than one-fourth of the Appendix I limit. The projected doses will be calculated using Equations 2.3-1, 2.3-2, and 2.3-3.

In this case, the source term will be adjusted to reflect this information and the justification for the adjustment noted. This adjustment should account for any radwaste equipment which was operated during the previous month that could be out of service in the coming month.

2.3.4 Population Dose

PNPP's Semiannual Radioactive Effluent Release Reports, as required by Regulatory Guide 1.21, will include total population dose and average individual doses calculated for radioactive effluent releases. The total population dose and average individual doses will be calculated using average individual transit times and usage factors, Table 2.3-12, (as compared to maximum exposed individual factors used for individual doses). The total population dose will be calculated by dose pathway and organ, with pathway doses being corrected for the fraction of the population assumed to be in each age group (adult, teen, child and infant: 0.71, 0.11, 0.18, 0.0 respectively).

Table 2.3-1

Organs used for Liquid Effluent Dose Calculations

1. Bone
2. GI Tract
3. Kidney
4. Liver
5. Lung
6. Thyroid
7. Total Body
8. Skin

Table 2.3-2

Age Groups used for Liquid Effluent Dose Calculations

1. Adult (17 yrs. and older)
2. Teen (11 - 17 yrs)
3. Child (1 - 11 yrs)
4. Infant (0 - 1 yr)

Table 2.3-3

Liquid Effluent Dose Pathways

1. Water Ingestion
2. Shore Exposure
3. Fresh Water Fish Ingestion

Table 2.3-4

Bioaccumulation Factors (B_{ip}) (pCi/kg per pCi/liter)

Element	Fish
H	9.0E-01
C	4.6E+03
Na	1.0E+02
P	1.0E+05
Cr	2.0E+02
Mn	4.0E+02
Fe	1.0E+02
Co	5.0E+01
Ni	1.0E+02
Cu	5.0E+01
Zn	2.0E+03
Br	4.2E+02
Rb	2.0E+03
Sr	3.0E+01
Y	2.5E+01
Zr	3.3E+00
Nb	3.0E+04
Mo	1.0E+01
Tc	1.5E+01
Ru	1.0E+01
Rh	1.0E+01
Te	4.0E+02
I	1.5E+01
Cs	2.0E+03
Ba	4.0E+00
La	2.5E+01
Ce	1.0E+00
Pr	2.5E+01
Nd	2.5E+01
W	1.2E+03
Np	1.0E+01

Table 2.3-5

Ingestion Dose Factors for Adult (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR 51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	NO DATA	4.97E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN 56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO 58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO 60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU 64	NO DATA	8.33E-08	3.91E-08	NO DATA	3.10E-07	NO DATA	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR 83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR 84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR 85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB 88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB 89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR 89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR 90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR 91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR 92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y 90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y 91M	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y 91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y 92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y 93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB 95	8.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO 99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07

Table 2.3-5 (Cont.)
Ingestion Dose Factors for Adult (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG110M	1.60E-07	1.48E-07	8.49E-08	NO DATA	2.91E-07	NO DATA	6.24E-05
TE125M	2.69E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE129	1.14E-08	1.18E-08	7.63E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE131	1.97E-08	8.23E-09	6.22E-09	1.42E-08	8.63E-08	NO DATA	2.79E-09
TE132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS134	6.32E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	7.59E-05	2.59E-06
CS136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.45E-08	4.18E-05
BA141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA140	2.50E-09	1.26E-09	8.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE143	1.65E-07	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE144	4.88E-07	2.00E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-13	NO DATA	4.33E-18
ND147	6.29E-09	7.47E-09	4.35E-10	NO DATA	4.35E-09	NO DATA	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-09	NO DATA	NO DATA	NO DATA	2.82E-05
NP239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

Table 2.3-6

Ingestion Dose Factors for Teenager (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	NO DATA	NO DATA	NO DATA	2.32E-05
CR 51	NO DATA	NO DATA	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	NO DATA	5.70E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05
MN 56	NO DATA	1.98E-07	2.81E-08	NO DATA	2.00E-07	NO DATA	1.04E-05
FE 55	3.78E-06	2.66E-06	6.25E-07	NO DATA	NO DATA	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05
CO 58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05
CO 60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	NO DATA	NO DATA	NO DATA	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	NO DATA	NO DATA	NO DATA	5.19E-06
CU 64	NO DATA	1.15E-07	5.41E-08	NO DATA	2.91E-07	NO DATA	8.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06
ZN 69	1.47E-08	2.80E-08	1.96E-09	NO DATA	1.83E-08	NO DATA	5.16E-08
BR 83	NO DATA	NO DATA	5.74E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	7.22E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	3.05E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.99E-05	1.40E-05	NO DATA	NO DATA	NO DATA	4.41E-06
RB 88	NO DATA	8.52E-08	4.54E-08	NO DATA	NO DATA	NO DATA	7.30E-15
RB 89	NO DATA	5.50E-08	3.89E-08	NO DATA	NO DATA	NO DATA	8.43E-17
SR 87	4.40E-04	NO DATA	1.26E-05	NO DATA	NO DATA	NO DATA	5.24E-05
SR 90	8.30E-03	NO DATA	2.05E-03	NO DATA	NO DATA	NO DATA	2.33E-04
SR 91	8.07E-06	NO DATA	3.21E-07	NO DATA	NO DATA	NO DATA	3.66E-05
SR 92	3.05E-06	NO DATA	1.30E-07	NO DATA	NO DATA	NO DATA	7.77E-05
Y 90	1.37E-08	NO DATA	3.69E-10	NO DATA	NO DATA	NO DATA	1.13E-04
Y 91M	1.29E-10	NO DATA	4.93E-12	NO DATA	NO DATA	NO DATA	6.09E-09
Y 91	2.01E-07	NO DATA	5.39E-09	NO DATA	NO DATA	NO DATA	8.24E-05
Y 92	1.21E-09	NO DATA	3.50E-11	NO DATA	NO DATA	NO DATA	3.32E-05
Y 93	3.83E-09	NO DATA	1.05E-10	NO DATA	NO DATA	NO DATA	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	NO DATA	7.11E-10	NO DATA	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05
MO 99	NO DATA	6.03E-06	1.19E-06	NO DATA	1.38E-05	NO DATA	1.08E-05
TC 99M	6.42E-10	9.26E-10	4.20E-08	NO DATA	1.38E-08	5.14E-10	4.08E-07

Table 2.3-6 (Cont.)

Ingestion Dose Factors for Teenager (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	3.60E-10	5.12E-10	5.01E-09	NO DATA	9.26E-09	3.12E-10	8.75E-17
RU103	2.55E-07	NO DATA	1.09E-07	NO DATA	8.99E-07	NO DATA	2.13E-05
RU105	2.18E-08	NO DATA	8.46E-09	NO DATA	2.75E-07	NO DATA	1.76E-05
RU106	3.92E-06	NO DATA	4.94E-07	NO DATA	7.56E-06	NO DATA	1.88E-04
AG110M	2.05E-07	1.94E-07	1.18E-07	NO DATA	3.70E-07	NO DATA	5.45E-05
TE125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	NO DATA	NO DATA	1.13E-05
TE127M	9.67E-06	3.43E-06	1.15E-06	3.30E-06	3.92E-05	NO DATA	2.41E-05
TE127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	NO DATA	1.22E-05
TE129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	NO DATA	6.12E-05
TE129	4.48E-08	1.67E-08	1.07E-08	3.20E-08	1.88E-07	NO DATA	2.45E-07
TE131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	NO DATA	9.39E-05
TE131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	NO DATA	2.29E-09
TE132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	NO DATA	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	NO DATA	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06
I 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	NO DATA	3.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	NO DATA	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	NO DATA	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	NO DATA	1.74E-06
CS134	3.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06
CS136	8.59E-06	3.38E-05	2.27E-05	NO DATA	1.84E-05	2.90E-06	2.72E-06
CS137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06
CS138	7.76E-08	1.49E-07	7.45E-08	NO DATA	1.10E-07	1.28E-08	6.76E-11
BA139	1.39E-07	9.78E-11	4.05E-09	NO DATA	9.22E-11	6.74E-11	1.24E-06
BA140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05
BA141	6.71E-08	5.01E-11	2.24E-09	NO DATA	4.65E-11	3.43E-11	1.43E-13
BA142	2.99E-08	2.99E-11	1.84E-09	NO DATA	2.53E-11	1.99E-11	9.18E-20
LA140	3.48E-09	1.71E-09	4.55E-10	NO DATA	NO DATA	NO DATA	9.82E-05
LA142	1.79E-10	7.95E-11	1.98E-11	NO DATA	NO DATA	NO DATA	2.42E-06
CE141	1.33E-08	8.88E-09	1.02E-09	NO DATA	4.18E-09	NO DATA	2.54E-05
CE143	2.35E-09	1.71E-06	1.91E-10	NO DATA	7.67E-10	NO DATA	5.14E-05
CE144	6.96E-07	2.88E-07	3.74E-08	NO DATA	1.72E-07	NO DATA	1.75E-04
PR143	1.31E-08	5.23E-09	6.52E-10	NO DATA	3.04E-09	NO DATA	4.31E-05
PR144	4.30E-11	1.76E-11	2.18E-12	NO DATA	1.01E-11	NO DATA	4.74E-14
ND147	9.38E-09	1.02E-08	6.11E-10	NO DATA	5.99E-09	NO DATA	3.68E-05
W 187	1.46E-07	1.19E-07	4.17E-08	NO DATA	NO DATA	NO DATA	3.22E-05
NP239	1.76E-09	1.66E-10	9.22E-11	NO DATA	5.21E-10	NO DATA	2.67E-05

Table 2.3-7

Ingestion Dose Factors for Child (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	2.03E-07	2.01E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.75E-04	3.86E-05	3.18E-05	NO DATA	NO DATA	NO DATA	2.28E-05
CR 51	NO DATA	NO DATA	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06
MN 56	NO DATA	3.34E-07	7.54E-08	NO DATA	4.04E-07	NO DATA	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	NO DATA	NO DATA	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05
CO 58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05
CO 60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	NO DATA	NO DATA	NO DATA	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	NO DATA	NO DATA	NO DATA	2.56E-05
CU 64	NO DATA	2.45E-07	1.48E-07	NO DATA	5.92E-07	NO DATA	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	8.41E-06
ZN 69	4.38E-08	6.93E-08	5.85E-09	NO DATA	3.84E-08	NO DATA	3.99E-06
BR 83	NO DATA	NO DATA	1.71E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	1.98E-07	NO DATA	NO DATA	NO DATA	LT E-24
RB 85	NO DATA	NO DATA	9.12E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	6.70E-05	4.12E-05	NO DATA	NO DATA	NO DATA	4.31E-06
RB 88	NO DATA	1.90E-07	1.32E-07	NO DATA	NO DATA	NO DATA	9.32E-09
RB 89	NO DATA	1.17E-07	1.04E-07	NO DATA	NO DATA	NO DATA	1.02E-09
SR 89	1.32E-03	NO DATA	3.77E-05	NO DATA	NO DATA	NO DATA	5.11E-05
SR 90	1.70E-02	NO DATA	4.31E-03	NO DATA	NO DATA	NO DATA	2.29E-04
SR 91	2.40E-05	NO DATA	9.[illegible]E-07	NO DATA	NO DATA	NO DATA	5.30E-05
SR 92	9.03E-06	NO DATA	3.[illegible]-07	NO DATA	NO DATA	NO DATA	1.71E-04
Y 90	4.11E-08	NO DATA	1.10E-09	NO DATA	NO DATA	NO DATA	1.17E-04
Y 91M	3.82E-10	NO DATA	1.37E-11	NO DATA	NO DATA	NO DATA	7.48E-07
Y 91	6.02E-07	NO DATA	1.61E-08	NO DATA	NO DATA	NO DATA	8.02E-05
Y 92	3.60E-09	NO DATA	1.03E-10	NO DATA	NO DATA	NO DATA	1.04E-04
Y 93	1.14E-08	NO DATA	3.13E-10	NO DATA	NO DATA	NO DATA	1.70E-04
ZR 95	1.16E-07	2.95E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05
ZR 97	6.99E-09	1.01E-09	5.96E-10	NO DATA	1.45E-09	NO DATA	1.53E-04
NB 95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05
MO 99	NO DATA	1.33E-05	3.29E-06	NO DATA	2.84E-05	NO DATA	1.10E-05
TC 99M	9.23E-10	1.81E-09	3.03E-08	NO DATA	2.63E-08	9.19E-10	1.03E-06

Table 2.3-7 (Cont.)

Ingestion Dose Factors for Child (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	1.07E-09	1.12E-09	1.42E-08	NO DATA	1.91E-08	9.92E-10	8.56E-09
RU103	7.31E-07	NO DATA	2.81E-07	NO DATA	1.84E-06	NO DATA	1.89E-05
RU105	6.45E-08	NO DATA	2.34E-08	NO DATA	5.67E-07	NO DATA	4.21E-05
RU106	1.17E-05	NO DATA	1.46E-06	NO DATA	1.58E-05	NO DATA	1.82E-04
AG110M	5.39E-07	3.64E-07	2.91E-07	NO DATA	6.78E-07	NO DATA	4.33E-05
TE125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	NO DATA	NO DATA	1.10E-05
TE127M	3.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	NO DATA	2.24E-05
TE127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	NO DATA	1.84E-05
TE129M	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	NO DATA	5.94E-05
TE129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	NO DATA	8.34E-06
TE131M	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	NO DATA	1.01E-04
TE131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	NO DATA	4.36E-07
TE132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	NO DATA	4.50E-05
I 130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	NO DATA	2.76E-06
I 131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06
I 132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	NO DATA	1.73E-06
I 133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	NO DATA	2.95E-06
I 134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	NO DATA	5.16E-07
I 135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	NO DATA	2.40E-06
CS134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06
CS136	2.35E-05	6.46E-05	4.18E-05	NO DATA	3.44E-05	5.13E-06	2.27E-06
CS137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06
CS138	2.28E-07	3.17E-07	2.01E-07	NO DATA	2.23E-07	2.40E-08	1.46E-07
BA139	4.14E-07	2.21E-10	1.20E-08	NO DATA	1.93E-10	1.30E-10	2.39E-05
BA140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05
BA141	2.00E-07	1.12E-10	6.51E-09	NO DATA	9.69E-11	6.58E-10	1.14E-07
BA142	8.74E-08	6.29E-11	4.88E-09	NO DATA	5.09E-11	3.70E-11	1.14E-09
LA140	1.01E-08	3.53E-09	1.17E-09	NO DATA	NO DATA	NO DATA	9.44E-05
LA142	5.74E-10	1.67E-10	5.23E-11	NO DATA	NO DATA	NO DATA	3.31E-05
CE141	3.97E-08	1.98E-08	2.94E-09	NO DATA	8.68E-09	NO DATA	2.47E-05
CE143	6.99E-09	3.79E-06	5.49E-10	NO DATA	1.59E-09	NO DATA	5.55E-05
CE144	2.08E-06	6.52E-07	1.11E-07	NO DATA	3.61E-07	NO DATA	1.70E-04
PR143	3.93E-08	1.18E-08	1.95E-09	NO DATA	6.39E-09	NO DATA	4.24E-05
PR144	1.29E-10	3.99E-11	6.49E-12	NO DATA	2.11E-11	NO DATA	8.59E-08
ND147	2.79E-08	2.26E-08	1.75E-09	NO DATA	1.24E-08	NO DATA	3.58E-05
W 187	4.29E-07	2.54E-07	1.14E-07	NO DATA	NO DATA	NO DATA	3.57E-05
NP239	5.25E-09	3.77E-10	2.65E-10	NO DATA	1.09E-09	NO DATA	2.79E-05

Table 2.3-8

Ingestion Dose Factors for Infant (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	NO DATA	NO DATA	NO DATA	2.30E-05
CR 51	NO DATA	NO DATA	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06
MN 56	NO DATA	8.18E-07	1.41E-07	NO DATA	7.03E-07	NO DATA	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE 59	3.08E-05	5.28E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO 58	NO DATA	3.60E-06	8.98E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO 60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI 65	4.70E-05	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU 64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN 65	1.34E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	NO DATA	6.98E-08	NO DATA	1.37E-05
BR 83	NO DATA	NO DATA	3.63E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	3.82E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	1.94E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.70E-04	8.40E-05	NO DATA	NO DATA	NO DATA	4.35E-06
RB 88	NO DATA	4.98E-07	2.73E-07	NO DATA	NO DATA	NO DATA	4.85E-07
RB 89	NO DATA	2.86E-07	1.97E-07	NO DATA	NO DATA	NO DATA	5.74E-08
SR 89	2.51E-03	NO DATA	7.20E-05	NO DATA	NO DATA	NO DATA	5.16E-05
SR 90	1.85E-02	NO DATA	4.71E-03	NO DATA	NO DATA	NO DATA	2.31E-04
SR 91	5.00E-05	NO DATA	1.81E-06	NO DATA	NO DATA	NO DATA	5.92E-05
SR 92	1.92E-05	NO DATA	7.13E-07	NO DATA	NO DATA	NO DATA	2.07E-04
Y 90	8.69E-08	NO DATA	2.33E-09	NO DATA	NO DATA	NO DATA	1.20E-04
Y 91M	8.10E-10	NO DATA	2.76E-11	NO DATA	NO DATA	NO DATA	2.70E-06
Y 91	1.13E-06	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	8.10E-05
Y 92	7.65E-09	NO DATA	2.15E-10	NO DATA	NO DATA	NO DATA	1.46E-04
Y 93	2.43E-08	NO DATA	6.62E-10	NO DATA	NO DATA	NO DATA	1.92E-04
ZR 95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05
ZR 97	1.48E-08	2.56E-09	1.16E-09	NO DATA	2.56E-09	NO DATA	1.62E-04
NB 95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05
MO 99	NO DATA	1.40E-05	6.63E-06	NO DATA	5.08E-05	NO DATA	1.12E-05
TC 99M	1.92E-09	3.96E-09	5.10E-08	NO DATA	4.26E-08	2.07E-09	1.15E-06

Table 2.3-8 (Cont.)

Ingestion Dose Factors for Infant (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
SC101	2.27E-09	2.86E-09	2.83E-08	NO DATA	3.40E-08	1.56E-09	4.86E-07
RU103	1.48E-06	NO DATA	4.95E-07	NO DATA	3.08E-06	NO DATA	1.80E-05
RU105	1.36E-07	NO DATA	4.58E-08	NO DATA	1.00E-06	NO DATA	5.41E-05
RU106	7.41E-05	NO DATA	3.01E-06	NO DATA	2.85E-05	NO DATA	1.83E-04
AG110M	5.96E-07	7.27E-07	4.81E-07	NO DATA	1.04E-06	NO DATA	3.77E-05
TE125M	2.33E-05	7.79E-06	3.15E-06	7.84E-06	NO DATA	NO DATA	1.11E-05
TE127M	8.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	NO DATA	2.36E-05
TE127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	NO DATA	2.10E-05
TE129M	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	NO DATA	5.97E-05
TE129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	NO DATA	2.27E-05
TE131M	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	NO DATA	1.03E-04
TE131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	NO DATA	7.11E-06
TE132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	NO DATA	3.81E-05
I 130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	NO DATA	2.83E-06
I 131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-06
I 132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	NO DATA	2.73E-06
I 133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	NO DATA	3.08E-06
I 134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	NO DATA	1.84E-06
I 135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	NO DATA	2.62E-06
CS134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06
CS136	4.59E-05	1.35E-04	5.04E-05	NO DATA	5.38E-05	1.10E-05	2.05E-06
CS137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06
CS138	4.81E-07	7.82E-07	3.79E-07	NO DATA	3.90E-07	6.09E-08	1.25E-06
BA139	8.81E-07	5.84E-10	2.55E-08	NO DATA	3.51E-10	3.54E-10	5.58E-05
BA140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-05
BA141	4.25E-07	2.91E-10	1.34E-08	NO DATA	1.75E-10	1.77E-10	5.19E-06
BA142	1.84E-07	1.53E-10	9.06E-09	NO DATA	8.81E-11	9.26E-11	7.59E-07
LA140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.86E-05
CE141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE143	1.48E-08	9.82E-06	1.12E-09	NO DATA	2.56E-09	NO DATA	5.73E-05
CE144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-01	NO DATA	1.71E-04
PR143	8.13E-08	3.04E-08	4.03E-09	NO DATA	1.13E-08	NO DATA	4.29E-05
PR144	2.74E-10	1.06E-10	1.38E-11	NO DATA	3.84E-11	NO DATA	4.93E-06
ND147	5.53E-08	5.68E-08	3.48E-09	NO DATA	2.19E-08	NO DATA	3.60E-05
W 187	9.03E-07	6.28E-07	2.17E-07	NO DATA	NO DATA	NO DATA	3.69E-05
NP239	1.11E-08	9.93E-10	5.61E-10	NO DATA	1.98E-09	NO DATA	2.87E-05

Table 2.3-9

External Dose Factors for Standing on Contaminated Ground

(mrem/h per pCi/m^2)

Element	Total Body	Skin
H-3	0.0	0.0
C-14	0.0	0.0
NA-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Nr-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91M	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99M	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110M	1.80E-08	2.10E-08
Te-125M	3.50E-11	4.80E-11
Te-127M	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129M	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131M	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-09
Te-132	1.70E-09	2.00E-09

Table 2.3-9 (Cont.)

External Dose Factors for Standing on Contaminated Ground

(mrem/h per pCi/m^2)

Element	Total Body	Skin
I-130	1.40E-08	1.70E-08
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.9[illegible]-09	[illegible].00E-09
La-140	1.50E-08	1.[illegible]E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

Table 2.3-10
Liquid Effluent Dilution Factors (M_p)

Maximum Individual Dilution Factors

Pathway	Location	M_p
Potable Water Ingestion	3.9 mile WSW of site	31.5
Fresh Water Fish Ingestion	Near Discharge Structure	10.9
Shoreline Exposure	0.7 mile ENE of Site	14.5

Population Dose Dilution Factors*

Pathway	Location	M_p
Potable Water Ingestion	Population Weighted Average	316
Fresh Water Fish Ingestion	Near Discharge Structure	10.9
Shoreline Exposure	7.7 mile WSW of site	162

Table 2.3-11

Transit Times Required for Nuclides to Reach the Point of Exposure (t_p)

	Maximum Exposed Individual	Average Exposed Individual*
Eventual transit time for water ingestion	12 h	24 h
Eventual transit time for fish ingestion	24 h	168 h
Eventual transit time for shore exposure	0 h	0 h

*for total population and average individual dose calculations

Table 2.3-12

Usage Factors (U_{ap})

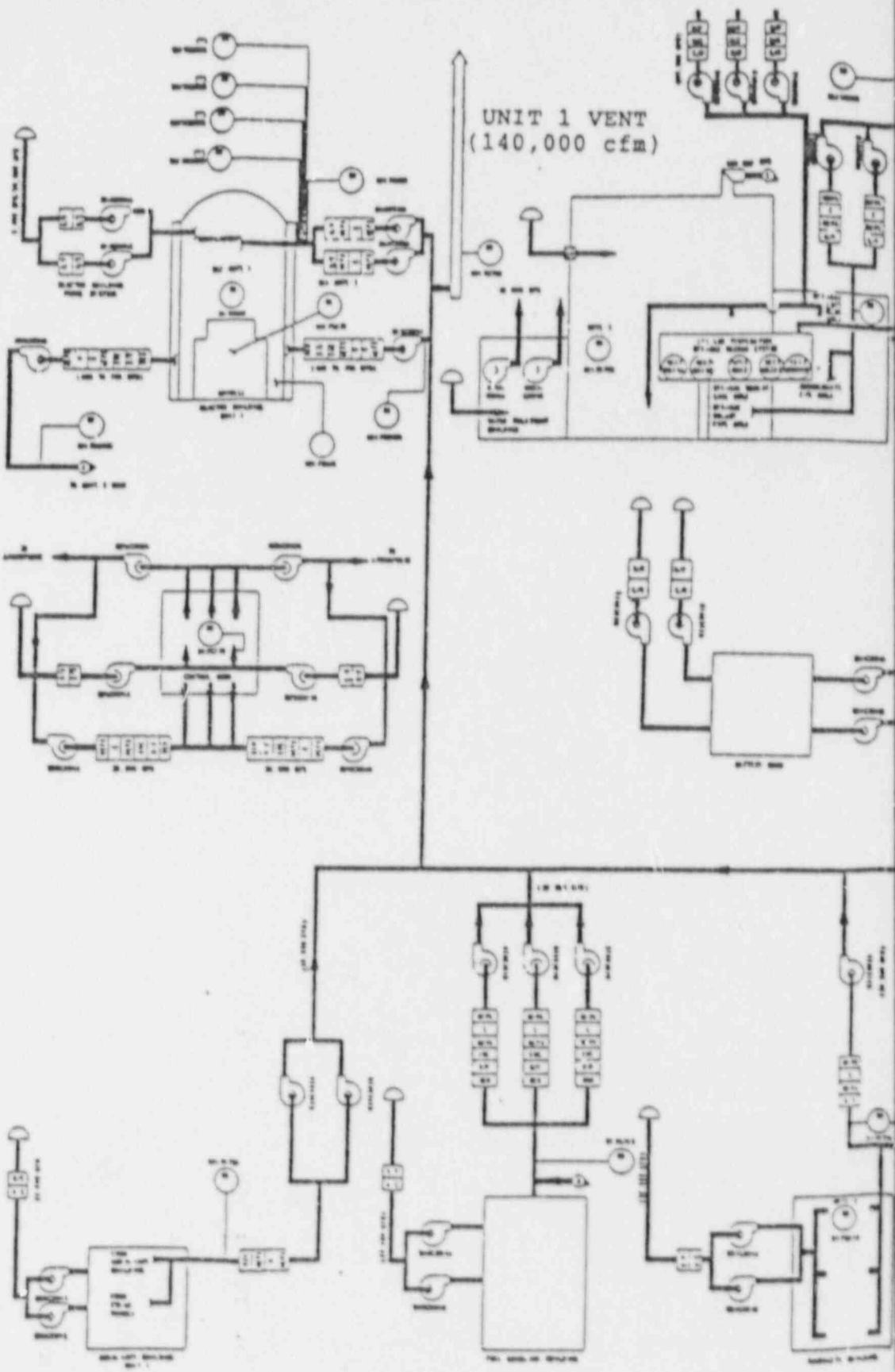
	Maximum Exposed Individual	Average Exposed Individual*
Water ingestion (l/yr) Adult	730	370
Water ingestion (l/yr) Teen	510	260
Water ingestion (l/yr) Child	510	260
Water ingestion (l/yr) Infant	330	--
Fresh water fish ingestion (kg/yr) Adult	21	6.9
Fresh water fish ingestion (kg/yr) Teen	16	5.2
Fresh water fish ingestion (kg/yr) Child	6.9	2.2
Fresh water fish ingestion (kg/yr) Infant	--	--
Shore exposure (h/yr) Adult	12	8.3
Shore exposure (h/yr) Teen	67	47
Shore exposure (h/yr) Child	14	9.5
Shore exposure (h/yr) Infant	--	--

*for total population and average individual dose calculations

3.0 GASEOUS EFFLUENTS

There are four environmental release points for gaseous effluents used for Unit 1 operation of the Perry Nuclear Power Plant: Heater Bay/Turbine Building Vent, Offgas Vent Pipe, Unit 1 Vent, and Unit 2 Vents. (See Figure 3.0-1). The Unit 1 and Unit 2 Vents are located on the top of the Intermediate Building, Elevation 753'9". The Heater Bay/Turbine Building Vent is located on the top of the Heater Bay Buildng, Elevation 722'0". The Offgas Vent Pipe is located on the top of the Offgas Building, Elevation 723'0". Site ground level elevation is 620'0". Radiological releases from each vent are monitored by a noble gas radiation monitor.

All gaseous effluent releases from PNPP will be continuous releases. Containment/drywell purges and vents will be considered periods of increased radiological release as they are vented through the Unit 1 Vent concurrent with normal, continuous releases. All releases are considered to be long-term, i.e., greater than 500 hours per year, and ground level.


UNIT 1 VENT
(140,000 cfm)

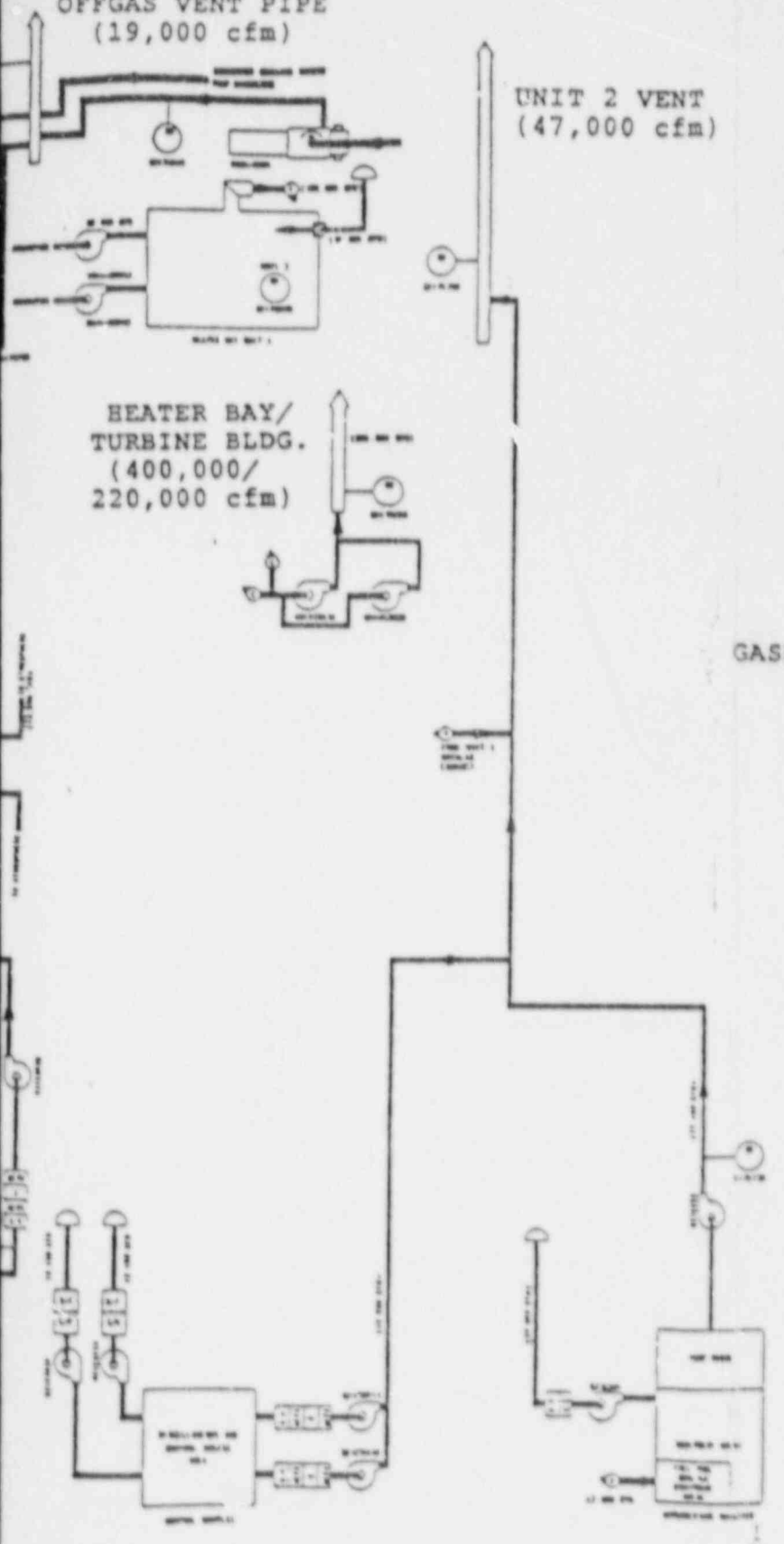


Figure 3.0-1
GASEOUS EFFLUENT SYSTEM
FLOW DIAGRAM

3.1 Monitor Alarm Setpoint Determination

The following calculation methods provide a means of determining the high alarm setpoint (HSP) and the alert setpoint (ASP) to ensure compliance with 10CFR20 dose rate limits to areas at or beyond the site boundary for the following noble gas monitors:

1. Heater Bay/Turbine Building Vent radiaton monitor (1D17K0856)

2. Offgas Vent Pipe radiation monitor (1D17K0836)

3. Unit 1 Vent radiation monitor (1D17K0786)

4. Unit 2 Vent radiation monitor (2D17K0786).

The Unit 2 Vent Radiation Monitor is included for the operation of Unit 1 of the Perry Nuclear Power Plant because the second train of the Unit 1 Annulus Exhaust and the Control Complex and Intermediate Building ventilations are exhausted through the Unit 2 Vent.

The High Alarm Setpoint (HSP) for each release point radiation monitor will be set at 70 percent of the 10CFR20 dose rate limits and the Alert Setpoint (ASP) will be set at 10 percent of these limits.

This procedure determines the monitor alarm setpoints that indicate if the dose rate beyond the site boundary due to noble gas radionuclides in gaseous effluent released from the site exceeds 500 mrem/year to the total body or 3000 mrem/year to the skin.

NOTE: The values of 70 percent for the HSP and 10 percent for the ASP are set as fractions of the total activity that may be released via the monitored pathways to ensure that the site boundary dose rate limits are not exceeded. Any single ASP can be exceeded without the 10CFR20 limits being exceeded. Upon receipt of an alert alarm a sample from the alarming effluent path will be obtained and analyzed. If two or more monitors exceed the ASP, or any one monitor exceeds the HSP, it is possible that the limits have been exceeded. In this case all four effluent paths will be sampled and analyzed. Appropriate action will be taken to limit gaseous releases to below 10CFR20 limits.

NOTE: If an HSP or two or more ASP's continue to be exceeded, verification shall be made at least once per 4 hours via the gaseous effluent radiation monitors that plant releases are below Technical Specification 3.11.2.1 dose rate limits, and sampling and analysis shall be performed on the four gaseous effluent release points at least once per 12 hours.

3.1.1 Determination of the "Mix" (Noble Gas Radionuclide Composition) of the Gaseous Effluent

a. The gaseous source terms that are representative of the "mix" of the gaseous effluent are determined. Gaseous source terms are the concentrations of the noble gas radionuclides in the effluent as determined by analysis of the various sources of gaseous effluents. During the early period of plant operation, before a sufficient operational effluent source term data base has been obtained, source terms will be those generated by the GALE code, Revision 0 for PNPP (FSAR Tables 11.3-9 and 11.3-10).

b. Determination of the fraction of the total radioactivity in the gaseous effluent for each noble gas radionuclide in the gaseous effluent.

$$S_i = \frac{A_i}{\sum_i A_i} \qquad (3.1\text{-}1)$$

Where:

S_i = the fraction of the total for radionuclide "i" in the effluent;

A_i = the activity of radionuclide "i" in the gaseous effluent.

NOTE: If the activity of a noble gas radionuclide is below the lower limit of detection the noble gas radionuclide is not included as a source term in this setpoint calculation.

3.1.2 Determination of the Maximum Acceptable Total Activity Release Rate of Noble Gas Radionuclides in Gaseous Effluent Based on Total Body Dose Rate Limit

$$Q_b = \frac{500}{(X/Q) \sum_i (K_i)(S_i)} \qquad (3.1\text{-}2)$$

Where:

Q_b = the maximum acceptable total activity release rate of all noble gas radionuclides in the effluent (for total body exposure), in μCi/s;

K_i = the total body dose factor for a semi-infinite cloud of radionuclide "i" (includes the attenuation of 5g/cm^2 of tissue) from Table 3.1-1, in (mrem/yr)/(μCi/m^3);

S_i = the fraction of the total for radionuclide "i", as per equation 3.1.1;

χ/Q = the highest annual average relative dispersion factor for areas at the site boundary = 5.8×10^{-6} s/m^3 (from Appendix A, NE direction at the site boundary);

NOTE: The dispersion parameters (χ/Q) used in these calculations are the highest calculated site boundary values for any of the land-based sectors only. At PNPP the site boundary locations in the following sectors are totally over water: N, NNE, NNW, NW, W, WNW.

500 = the total body dose rate limit, in mrem/yr.

3.1.3 Determination of the Maximum Acceptable Total Activity Release Rate of Noble Gas Radionuclides in Gaseous Effluent Based on Skin Dose Rate Limit

$$Q_s = \frac{3000}{\overline{(\chi/Q)} \sum_i (L_i + 1.11\, M_i)\,(S_i)} \qquad (3.1\text{-}3)$$

Where:

Q_s = the maximum acceptable total activity release rate of all noble gas radionuclides in the effluent (for skin exposure), in μCi/s;

L_i = the beta skin dose factor for a semi-infinite cloud of radionuclide "i" (includes attenuation by the outer "dead" layer of skin), in (mrem/yr)/($\mu Ci/m^3$);

M_i = the gamma air dose factor for a uniform semi-infinite cloud of radionuclide "i", in (mrad/yr)/($\mu Ci/m^3$);

S_i = the fraction of the total for radionuclide "i", per Equation 3.1.1;

χ/Q = the highest annual average relative dispersion factor = 5.8×10^{-6} s/m^3, per Equation 3.1-2

1.11 = the air dose to tissue dose equivalent conversion factor, in mrem/mrad;

3000 = the skin dose rate limit, in mrem/yr.

$(L_i + 1.11\, M_i)$ values are shown in Table 3.1-1.

3.1.4 Determination of the Maximum Acceptable Total Radioactivity Concentration of all Noble Gas Radionuclides in the Gaseous Effluent

$$C_t = \frac{(2.12 \times 10^{-3})(Q_t)}{f} \qquad (3.1\text{-}4)$$

Where:

C_t = the maximum acceptable total radioactivity concentration of all noble gas radionuclides in the effluent, in µCi/cc;

f = the flow rate for the release point from the respective flow rate recorders, in ft^3/min;

NOTE: Design flow rate may be used in lieu of actual flow rate. These design flow rate values incorporate a 10% flow rate inaccuracy correction.

Release Path	Flow Rate (cfm)
- Heater Bay/Turbine Building Vent	400,000 (summer) 220,000 (winter)
- Offgas Vent Pipe	19,000
- Unit 1 Vent	140,000
- Unit 2 Vent	47,000

Q_t = the smaller of Q_b and Q_s, calculated in equations 3.1-2 and 3.1-3, respectively, in µCi/s;

2.12×10^{-3} = the conversion factor to convert (µCi/s) ft^3/min) to µCi/cc.

3.1.5 Determination of the Maximum Acceptable Monitor Count Rate Above Background Attributed to Noble Gas Radionuclides

$$CR_c = (0.8)\ (C_t)\ (E_m) \qquad (3.1\text{-}5)$$

Where:

CR_c = the calculated monitor count rate above background attributed to noble gas radionuclides, in cpm;

C_t = the maximum acceptable radioactivity concentration, per equation 3.1-4, in µCi/cc;

E_m = the detector efficiency of the monitor for the "mix" of noble gas radionuclides in the effluent, in cpm/(µCi/cc);
= the total µCi/cc concentration divided into the net monitor count rate taken at the time the sample was taken; during the early period of operation, before a sufficient operational effluent source term data base has been obtained, the value will be calculated using monitor calibration data;

0.8 = an engineering safety factor.

3.1.5.1 Determination of the Monitor High Alarm Setpoint

$$HSP = (0.70)(CR_c) + BG \qquad (3.1\text{-}6)$$

Where:

HSP = the high alarm setpoint (including background), in cpm;

BG = the background count rate due to internal contamination and radiation levels in the area in which the monitor is installed when the monitor chamber is filled with uncontaminated air, in cpm;

CR_c = the calculated monitor net count rate, per equation 3.1-5, in cpm;

0.70 = the fraction of the maximum acceptable activity that may be released from the vent to ensure that the site boundary dose rate limits are not exceeded during concurrent releases from several pathways.

3.1.5.2 Determination of the Monitor Alert Setpoint

$$ASP = (0.10)(CR_c) + BG \qquad (3.1\text{-}7)$$

Where:

ASP = the alert setpoint (including background), in cpm;

BG = the background count rate due to internal contamination and radiation levels in the area in which the monitor is installed when the monitor chamber is filled with uncontaminated air, in cpm;

CR_c = the calculated monitor net count rate, per equation 3.1-5, in cpm;

0.10 = the fraction of the maximum acceptable activity that may be released from the vent to ensure that the site boundary dose rate limits are not exceeded during concurrent releases from several pathways.

Table 3.1-1

Total Body and Skin Dose Factors

Radionuclide	Total Body Dose Factor (K_i)(mrem/yr/μCi/m^3)	Total Skin Dose Factor (L_i+1.11 M_i) (mrem/yr/μCi/m^3)
Kr-83m	7.56E-02	2.14E+01
Kr-85m	1.17E+03	2.82E+03
Kr-85	1.61E+01	1.36E+03
Kr-87	5.92E+03	1.66E+04
Kr-88	1.47E+04	1.92E+04
Kr-89	1.66E+04	2.93E+04
Xe-131m	9.15E+01	6.49E+02
Xe-133m	2.51E+02	1.36E+03
Xe-133	2.94E+02	6.97E+02
Xe-135m	3.12E+03	4.44E+03
Xe-135	1.81E+03	3.99E+03
Xe-137	1.42E+03	1.39E+04
Xe-138	8.83E+03	1.44E+04
Ar-41	8.84E+03	1.30E+04

3.2 Compliance With 10CFR20 - Gaseous Effluent Dose Rate

Dose rates resulting from the release of noble gases, radioiodines, tritium, and radionuclides in particulate form must be calculated to show compliance with 10CFR20. The limits of 10CFR20 are conservatively applied for the release period at the controlling location.

3.2.1 Noble Gases

The dose rate in unrestricted areas resulting from noble gas effluents is limited, by PNPP Technical Specifications, to 500 mrem/yr to the total body and 3000 mrem/yr to the skin. Only the external dose pathway will be considered for noble gases. Because all gaseous effluent releases from PNPP are considered ground level, the controlling location for these dose rate limits is the site boundary location (see Figure 3.2-1) with the highest relative dispersion factor (X/Q). (See Appendix A for elaboration on atmospheric dispersion.)

The alarm setpoint determinations discussed in the previous section should ensure compliance with these dose rate limits. However, if any one high alarm or two or more alert alarms occur, the dose rates in unrestricted areas resulting from the release of noble gas radionuclides from all vents will be calculated. The calculations will be based on the results of analyses obtained pursuant to the PNPP Technical Specifications.

3.2.2 Radionuclides, Particulates, and Other Radionuclides

The dose rate in unrestricted areas resulting from the release of iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than eight days is limited, by PNPP Technical Specifications, to 1500 mrem/yr to any organ. The calculation of dose rate from these radionuclides will be performed weekly based on results of analyses obtained persuant to those Technical Specificatons. The controlling location for this limit is the location of the highest relative deposition (D/Q) for the period of release as well as the actual receptor pathway. The receptor pathway locations will be revieved once per year following the performance of the Land Use Census to include consideration of nearest residences, garden, and farm animal locations in each sector.

3.1.1 Determination of the "Mix" (Noble Gas Radionuclide Composition) of the Gaseous Effluent

a. The gaseous source terms that are representative of the "mix" of the gaseous effluent are determined. Gaseous source terms are the concentrations of the noble gas radionuclides in the effluent as determined by analysis of the various sources of gaseous effluents. During the early period of plant operation, before a sufficient operational effluent source term data base has been obtained, source terms will be those generated by the GALE code, Revision 0 for PNPP (FSAR Tables 11.3-9 and 11.3-10).

b. Determination of the fraction of the total radioactivity in the gaseous effluent for each noble gas radionuclide in the gaseous effluent.

$$S_i = \frac{A_i}{\sum_i A_i} \qquad (3.1\text{-}1)$$

Where:

S_i = the fraction of the total for radionuclide "i" in the effluent;

A_i = the activity of radionuclide "i" in the gaseous effluent.

NOTE: If the activity of a noble gas radionuclide is below the lower limit of detection the noble gas radionuclide is not included as a source term in this setpoint calculation.

3.1.2 Determination of the Maximum Acceptable Total Activity Release Rate of Noble Gas Radionuclides in Gaseous Effluent Based on Total Body Dose Rate Limit

$$Q_b = \frac{500}{(X/Q) \sum_i (K_i)(S_i)} \qquad (3.1\text{-}2)$$

Where:

Q_b = the maximum acceptable total activity release rate of all noble gas radionuclides in the effluent (for total body exposure), in μCi/s;

K_i = the total body dose factor for a semi-infinite cloud of radionuclide "i" (includes the attenuation of 5g/cm^2 of tissue) from Table 3.1-1, in (mrem/yr)/(μCi/m^3);

S_i = the fraction of the total for radionuclide "i", as per equation 3.1.1;

X/Q = the highest annual average relative dispersion factor for areas at the site boundary = 5.8×10^{-6} s/m^3 (from Appendix A, NE direction at the site boundary);

NOTE: The dispersion parameters (X/Q) used in these calculations are the highest calculated site boundary values for any of the land-based sectors only. At PNPP the site boundary locations in the following sectors are totally over water: N, NNE, NNW, NW, W, WNW.

500 = the total body dose rate limit, in mrem/yr.

3.1.3 Determination of the Maximum Acceptable Total Activity Release Rate of Noble Gas Radionuclides in Gaseous Effluent Based on Skin Dose Rate Limit

$$Q_s = \frac{3000}{(X/Q) \sum_i (L_i + 1.11\ M_i)\ (S_i)} \qquad (3.1\text{-}3)$$

Where:

Q_s = the maximum acceptable total activity release rate of all noble gas radionuclides in the effluent (for skin exposure), in μCi/s;

L_i = the beta skin dose factor for a semi-infinite cloud of radionuclide "i" (includes attenuation by the outer "dead" layer of skin), in $(mrem/yr)/(\mu Ci/m^3)$;

M_i = the gamma air dose factor for a uniform semi-infinite cloud of radionuclide "i", in $(mrad/yr)/(\mu Ci/m^3)$;

S_i = the fraction of the total for radionuclide "i", per Equation 3.1.1;

X/Q = the highest annual average relative dispersion factor = 5.8×10^{-6} s/m^3, per Equation 3.1-2

1.11 = the air dose to tissue dose equivalent conversion factor, in mrem/mrad;

3000 = the skin dose rate limit, in mrem/yr.

$(L_i + 1.11\ M_i)$ values are shown in Table 3.1-1.

3.1.4 Determination of the Maximum Acceptable Total Radioactivity Concentration of all Noble Gas Radionuclides in the Gaseous Effluent

$$C_t = \frac{(2.12 \times 10^{-3})(Q_t)}{f} \qquad (3.1\text{-}4)$$

Where:

C_t = the maximum acceptable total radioactivity concentration of all noble gas radionuclides in the effluent, in µCi/cc;

f = the flow rate for the release point from the respective flow rate recorders, in ft^3/min;

NOTE: Design flow rate may be used in lieu of actual flow rate. These design flow rate values incorporate a 10% flow rate inaccuracy correction.

Release Path	Flow Rate (cfm)
- Heater Bay/Turbine Building Vent	400,000 (summer) 220,000 (winter)
- Offgas Vent Pipe	19,000
- Unit 1 Vent	140,000
- Unit 2 Vent	47,000

Q_t = the smaller of Q_b and Q_s, calculated in equations 3.1-2 and 3.1-3, respectively, in µCi/s;

2.12×10^{-3} = the conversion factor to convert (µCi/s) ft^3/min) to µCi/cc.

3.1.5 Determination of the Maximum Acceptable Monitor Count Rate Above Background Attributed to Noble Gas Radionuclides

$$CR_c = (0.8)\ (C_t)\ (E_m) \qquad (3.1\text{-}5)$$

Where:

CR_c = the calculated monitor count rate above background attributed to noble gas radionuclides, in cpm;

C_t = the maximum acceptable radioactivity concentration, per equation 3.1-4, in µCi/cc;

E_m = the detector efficiency of the monitor for the "mix" of noble gas radionuclides in the effluent, in cpm/(µCi/cc);
= the total µCi/cc concentration divided into the net monitor count rate taken at the time the sample was taken; during the early period of operation, before a sufficient operational effluent source term data base has been obtained, the value will be calculated using monitor calibration data;

0.8 = an engineering safety factor.

3.1.5.1 Determination of the Monitor High Alarm Setpoint

$$HSP = (0.70)(CR_c) + BG \qquad (3.1\text{-}6)$$

Where:

HSP = the high alarm setpoint (including background), in cpm;

BG = the background count rate due to internal contamination and radiation levels in the area in which the monitor is installed when the monitor chamber is filled with uncontaminated air, in cpm;

CR_c = the calculated monitor net count rate, per equation 3.1-5, in cpm;

0.70 = the fraction of the maximum acceptable activity that may be released from the vent to ensure that the site boundary dose rate limits are not exceeded during concurrent releases from several pathways.

3.1.5.2 Determination of the Monitor Alert Setpoint

$$ASP = (0.10)(CR_c) + BG \qquad (3.1\text{-}7)$$

Where:

ASP = the alert setpoint (including background), in cpm;

BG = the background count rate due to internal contamination and radiation levels in the area in which the monitor is installed when the monitor chamber is filled with uncontaminated air, in cpm;

CR_c = the calculated monitor net count rate, per equation 3.1-5, in cpm;

0.10 = the fraction of the maximum acceptable activity that may be released from the vent to ensure that the site boundary dose rate limits are not exceeded during concurrent releases from several pathways.

Table 3.1-1

Total Body and Skin Dose Factors

Radionuclide	Total Body Dose Factor (K_i)(mrem/yr/μCi/m^3)	Total Skin Dose Factor $(L_i+1.11\ M_i)_3$ (mrem/yr/μCi/m^3)
Kr-83m	7.56E-02	2.14E+01
Kr-85m	1.17E+03	2.82E+03
Kr-85	1.61E+01	1.36E+03
Kr-87	5.92E+03	1.66E+04
Kr-88	1.47E+04	1.92E+04
Kr-89	1.66E+04	2.93E+04
Xe-131m	9.15E+01	6.49E+02
Xe-133m	2.51E+02	1.36E+03
Xe-133	2.94E+02	6.97E+02
Xe-135m	3.12E+03	4.44E+03
Xe-135	1.81E+03	3.99E+03
Xe-137	1.42E+03	1.39E+04
Xe-138	8.83E+03	1.44E+04
Ar-41	8.84E+03	1.30E+04

3.2 Compliance With 10CFR20 - Gaseous Effluent Dose Rate

Dose rates resulting from the release of noble gases, radioiodines, tritium, and radionuclides in particulate form must be calculated to show compliance with 10CFR20. The limits of 10CFR20 are conservatively applied for the release period at the controlling location.

3.2.1 Noble Gases

The dose rate in unrestricted areas resulting from noble gas effluents is limited, by PNPP Technical Specifications, to 500 mrem/yr to the total body and 3000 mrem/yr to the skin. Only the external dose pathway will be considered for noble gases. Because all gaseous effluent releases from PNPP are considered ground level, the controlling location for these dose rate limits is the site boundary location (see Figure 3.2-1) with the highest relative dispersion factor (X/Q). (See Appendix A for elaboration on atmospheric dispersion.)

The alarm setpoint determinations discussed in the previous section should ensure compliance with these dose rate limits. However, if any one high alarm or two or more alert alarms occur, the dose rates in unrestricted areas resulting from the release of noble gas radionuclides from all vents will be calculated. The calculations will be based on the results of analyses obtained pursuant to the PNPP Technical Specifications.

3.2.2 Radionuclides, Particulates, and Other Radionuclides

The dose rate in unrestricted areas resulting from the release of iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than eight days is limited, by PNPP Technical Specifications, to 1500 mrem/yr to any organ. The calculation of dose rate from these radionuclides will be performed weekly based on results of analyses obtained persuant to those Technical Specificatons. The controlling location for this limit is the location of the highest relative deposition (D/Q) for the period of release as well as the actual receptor pathway. The receptor pathway locations will be reviewed once per year following the performance of the Land Use Census to include consideration of nearest residences, garden, and farm animal locations in each sector.

3.2.3 Dose Rate Calculations

The following is the equation used to calculate the dose rate resultant from the release of radioactive materials in gaseous effluents to areas at or beyond the site boundary for the purpose of showing compliance with PNPP Technical Specification as related to 10CFR20.

$$D_{ajp} = (3.15 \times 10^{1})\ (X/Q \text{ or } D/Q)\ \Sigma\ (DF_{aijp})\ (Q_i) \qquad (3.2\text{-}1)$$

Where:

D_{ajp} = the organ "j" dose rate as a function of age group "a" and pathway "p", in mrem/yr;

DF_{aijp} = the dose factor for organ type "j", age group "a", pathway "p" for isotope "i" (see Tables 3.2-1 through 3.2-3); units and equations used (equations 3.2-2 through 3.2-6) are provided later in this section;

X/Q or D/Q = the normal or depleted relative dispersion factor (X/Q), in s/m^3, or relative deposition (D/Q), in m^{-2}, at the receptor distance (see Appendix A);

3.15×10^{1} = the conversion factor to convert (mrem * µCi)/(Ci * s) to mrem/yr;

Q_i = the annual average release rate of isotope "i", in µCi/s

$= (472)(C_i)(f)$

Where:

C_i = the concentration of radionuclide "i" in the gaseous effluent, in µCi/cc;

f = the gaseous effluent flow rate during the release, in ft^3/min;

472 = the conversion factor $(cc/ft^3)/(s/min)$.

The following relationships are used to derive the dose factors (DF_{aijp}) for noble gases, tritium, radioiodines and particulates used in equation 3.2-1.

a. Total Body Dose Factors from Exposure to a Semi-Inifinite Plume

$$DF_i^T = (S_F)\ (X_i)\ (DFB_i) \qquad (3.2\text{-}2)$$

Where:

DF_i^T = the total body factor due to immersion in a semi-infinite cloud of radionuclide "i", in $(mrem * m^3)/(Ci * s)$;

DFB_i = the total body gamma dose factor for a semi-infinite cloud of radionuclide "i" which includes the attenuation of $5 g/cm^2$ of tissue from Table 3.2-4, in mrem/yr per pCi/m^3;

S_F = the attenuation factor that accounts for the dose reduction due to the shielding provided by residential structures, optional, dimensionless: maximum exposed individual = 0.7, population dose 0.5 (Regulatory Guide 1.109);

X_i = the annual average concentration of radionuclide "i" in air (pCi/m^3), for a unit release rate (Ci/yr) and a unit χ/Q (s/m^3), in $(pCi/m^3)/(Ci/yr)(s/m^3)$.

b. Skin Dose Factors for Exposure to a Semi-Infinite Plume

$$DF_i^S = (X_i)\ [(1.11)\ (S_F)\ (DF_i^\gamma) + (DFS_i)] \qquad (3.2\text{-}3)$$

Where:

DF_i^S = the skin dose factor due to immersion in a semi-infinite cloud of radionuclide "i", in $(mrem * m^3)/(Ci * s)$;

DF_i^γ = the gamma air dose factor for a uniform semi-infinite cloud of radionuclide "i", from Table 3.2-4, in mrad/yr per pCi/m^3;

DFS_i = the beta skin dose factor for a semi-infinite cloud of radionuclide "i" (includes attenuation by the outer "dead" layer of skin), from Table 3.2-4 in mrem/yr per pCi/m^3;

S_F = the attenuation factor that accounts for the dose reduction due to the shielding provided by residential structures, optional, dimensionless: maximum exposed individual = 0.7, population dose = 0.5 (Regulatory Guide 1.109);

χ_i = the annual average concentration of radionuclide "i" in air (pCi/m^3), for a unit release rate (Ci/yr) and a unit χ/Q (s/m^3), in $(pCi/m^3)/(Ci/yr)(s/m^3)$;

1.11 = the air dose to tissue dose equivalent conversion factor, in mrem/mrad.

c. Dose Factors from External Irradiation from Radionuclides Deposited onto the Ground Surface

$$DF_{ij}^{G} = (8760)\ (C_i^{G})\ (DFG_{ij})\ (S_F) \qquad (3.2\text{-}4)$$

Where:

DF_{ij}^{G} = the dose factor for radionuclide "i" to organ "j" resulting from exposure to radionuclides deposited onto the ground surface, in $(mrem * m^2)/Ci$;

C_i^{G} = the ground plane concentration (pCi/m^2) of radionuclide "i" for a unit release rate (Ci/yr) and a unit D/Q, relative gound deposition (m^{-2}), in $(pCi/m^2)/(Ci/yr)(m^{-2})$;

DFG_{ij} = the open field ground plane dose conversion factor for organ "j" from radionuclide "i", from Table 3.2-5, in mrem/yr per pCi/m^2;

S_F = the attenuation factor that accounts for the dose reduction due to the shielding provided by residential structures, optional, dimensionless: maximum exposed individual = 0.7, population dose = 0.5 (Regulatory Guide 1.109),

8760 = the number of hours in a year.

d. Dose Factors from Inhalation of Radionuclides in Air

$$DF_{aij}^{A} = (DFA_{aij})\ (R_a)\ (\chi_i) \qquad (3.2\text{-}5)$$

Where:

DF^{A}_{aij} = the dose factor for radionuclide "i" to organ "j" of an individual in age group "a" due to inhalation, in (mrem * m^3)/(Ci * s) [-- equivalent to (mrem/yr)(yr/Ci)(m^3/s)];

DFA_{aij} = the inhalation dose factor for radionuclide "i", organ "j", and age group "a" (the value for skin is assumed to be 0), from Tables 3.2-6 through 3.2-9, in mrem/pCi;

R_a = the annual air intake for individuals in age group "a", from Table 3.2-14, in m^3/yr;

X_i = the annual average concentration of radionuclide "i" in air (pCi/m^3), for a unit release rate (Ci/yr) and a unit X/Q (s/m^3), in (pCi/m^3)/(Ci/yr)(s/m^3).

e. Dose Factors from the Ingestion of Atmospherically Released Radionuclides in Food

$$DF^{D}_{aij} = DFI_{aij}\left[(U^{F}_{a})(C^{F}_{i}) + (U_a)(f_L)(C^{L}_{i}) + (U_a)(C^{M}_{i}) + (U^{V}_{a})(f_V)(C^{V}_{i})\right] \quad (3.2\text{-}6)$$

Where:

DF^{D}_{aij} = the dose factor for radionuclide "i" to organ "j" of an individual in age group "a" from the ingestion of meat, leafy vegetables, milk, and produce (non-leafy vegetables, fruits, and grains) in (mrem * m^2)/Ci, or in the cases of H-3 and C-14 in (mrem * m^3)/(Ci * s);

C^{F}_{i}, C^{L}_{i}, C^{M}_{i}, C^{V}_{i} = the concentrations of radionuclide "i" in meat, leafy vegetables, milk, and produce, respectively (pCi/kg or pCi/l) for a unit release rate (Ci/yr) and a unit D/Q, relative ground deposition (m^{-2}), or in cases of H-3 and C-14, a unit X/Q, relative ground-level concentration (s/m^3), in (pCi/kg)(Ci/yr)(m^{-2}) or (pCi/kg)/(Ci/yr)(s/m^3) or (pCi/l)/(Ci/yr)(m^{-3}) or (pCi/l)(yr/Ci)(s/m^3);

DFI_{aij} = the ingestion dose factor for radionuclide "i", organ "j", and age group "a", from Tables 3.2-10 through 3.2-13, in mrem/pCi;

f_L, f_V = the respective fractions of the ingestion rates of leafy vegetables and produce that are produced in the garden of interest, 1.0 and 0.76 respectively (Regulatory Guide 1.109);

U_a^F, U_a^L, U_a^M, U_a^V = the annual intake (usage) of meat, leafy vegetables, milk, and produce respectively, for individuals in age group "a", from Table 3.2-14, in kg/yr or l/yr.

Table 3.2-1

Organ used for Gaseous Effluent Dose Calculations

1. Bone
2. GI Tract
3. Kidney
4. Liver
5. Lung
6. Thyroid
7. Total Body
8. Skin

Table 3.2-2

Age Groups Used for Gaseous Effluent Dose Calculations

1. Adult (17 yr and older)
2. Teen (11-17 yr)
3. Child (1-11 yr)
4. Infant (0-1 yr)

Table 3.2-3

Gaseous Effluent Dose Pathways

1. Plume
2. Ground Shine
3. Vegetables
4. Meat
5. Cow Milk
6. Goat Milk
7. Inhalation

Table 3.2-4

Dose Factors for Exposure to a Semi-Infinite Cloud of Noble Gases

Nuclide	Total Body* Gamma Dose Factor (DFB_i)	Beta Skin* Dose Factor (DFS_i)	Gamma Air** Dose Factor (DF_i^γ)
Kr-83m	7.56E-08	---	1.93E-05
Kr-85m	1.17E-03	1.46E-03	1.23E-03
Kr-85	1.61E-05	1.34E-03	1.72E-05
Kr-87	5.92E-03	9.73E-03	6.17E-03
Kr-88	1.47E-02	2.37E-03	1.52E-02
Kr-89	1.66E-02	1.01E-02	1.73E-02
Kr-90	1.56E-02	7.29E-03	1.63E-02
Xe-131m	9.15E-05	4.76E-04	1.56E-04
Xe-133m	2.51E-04	9.94E-04	3.27E-04
Xe-133	2.94E-04	3.06E-04	3.53E-04
Xe-135m	3.12E-03	7.11E-04	3.36E-03
Xe-135	1.81E-03	1.86E-03	1.92E-03
Xe-137	1.42E-03	1.22E-02	1.51E-03
Xe-138	8.83E-03	4.13E-03	9.21E-03
Ar-41	8.84E-03	2.69E-03	9.30E-03

* mrem/yr per pCi/m^3
** mrad/yr per pCi/m^3

Table 3.2-5
External Dose Factors for Standing on Contaminated Ground
(mrem/h per pCi/m^2)

Element	Total Body	Skin
H-3	0.0	0.0
C-14	0.0	0.0
NA-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Nr-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91M	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99M	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110M	1.80E-08	2.10E-08
Te-125M	3.50E-11	4.80E-11
Te-127M	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129M	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131M	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-09
Te-132	1.70E-09	2.00E-09

Table 3.2-5 (Cont.)
External Dose Factors for Standing on Contaminated Ground
(m-rem/h per pCi/m^2)

Element	Total Body	Skin
I-130	1.40E-08	1.70E-08
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

Table 3.2-6
Inhalation Dose Factors for Adult (mrem/pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C 14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA 24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P 32	1.65E-04	9.64E-06	6.26E-06	NO DATA	NO DATA	NO DATA	1.08E-05
CR 51	NO DATA	NO DATA	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN 54	NO DATA	4.95E-06	7.87E-07	NO DATA	1.23E-06	1.75E-04	9.67E-06
MN 56	NO DATA	1.55E-10	2.29E-11	NO DATA	1.63E-10	1.18E-06	2.53E-06
FE 55	3.07E-06	2.12E-06	4.93E-07	NO DATA	NO DATA	9.01E-06	7.54E-07
FE 59	1.47E-06	3.47E-06	1.32E-06	NO DATA	NO DATA	1.27E-04	2.35E-05
CO 58	NO DATA	1.98E-07	2.59E-07	NO DATA	NO DATA	1.16E-04	1.33E-05
CO 60	NO DATA	1.44E-06	1.85E-06	NO DATA	NO DATA	7.46E-04	3.56E-05
NI 63	5.40E-05	3.93E-06	1.81E-06	NO DATA	NO DATA	2.23E-05	1.67E-06
NI 65	1.92E-10	2.62E-11	1.14E-11	NO DATA	NO DATA	7.00E-07	1.54E-06
CU 64	NO DATA	1.83E-10	7.69E-11	NO DATA	5.78E-10	8.48E-07	6.12E-06
ZN 65	4.05E-06	1.29E-05	9.82E-06	NO DATA	8.62E-06	1.08E-04	6.68E-06
ZN 69	4.23E-12	8.14E-12	5.65E-13	NO DATA	5.27E-12	1.15E-07	2.04E-09
BR 83	NO DATA	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	2.90E-08
BR 84	NO DATA	NO DATA	3.91E-08	NO DATA	NO DATA	NO DATA	2.05E-13
BR 85	NO DATA	NO DATA	1.60E-09	NO DATA	NO DATA	NO DATA	6.71E-24
RB 86	NO DATA	1.69E-05	7.37E-06	NO DATA	NO DATA	NO DATA	2.08E-06
RB 88	NO DATA	4.84E-08	2.41E-08	NO DATA	NO DATA	NO DATA	4.18E-19
RB 89	NO DATA	3.20E-08	2.12E-08	NO DATA	NO DATA	NO DATA	1.16E-21
SR 89	3.90E-05	NO DATA	1.09E-06	NO DATA	NO DATA	1.75E-04	4.37E-05
SR 90	1.[illegible]E-02	NO DATA	7.62E-04	NO DATA	NO DATA	1.20E-03	9.02E-05
SR 91	7.74E-09	NO DATA	3.13E-10	NO DATA	NO DATA	4.36E-06	2.39E-05
SR 92	8.43E-10	NO DATA	3.64E-11	NO DATA	NO DATA	2.06E-06	5.38E-06
Y 90	2.61E-07	NO DATA	7.01E-09	NO DATA	NO DATA	2.12E-05	6.32E-05
Y 91M	3.26E-11	NO DATA	1.27E-12	NO DATA	NO DATA	2.40E-07	1.66E-10
Y 91	5.78E-05	NO DATA	1.55E-06	NO DATA	NO DATA	2.13E-04	4.81E-05
Y 92	1.29E-09	NO DATA	3.77E-11	NO DATA	NO DATA	1.96E-06	9.19E-06
Y 93	1.18E-08	NO DATA	3.26E-10	NO DATA	NO DATA	6.06E-06	5.27E-05
ZR 95	1.34E-05	4.30E-06	2.91E-06	NO DATA	6.77E-06	2.21E-04	1.88E-05
ZR 97	1.21E-08	2.45E-09	1.13E-09	NO DATA	3.71E-09	9.84E-06	6.54E-05
NB 95	1.76E-06	9.77E-07	5.26E-07	NO DATA	9.67E-07	6.31E-05	1.30E-05
MO 99	NO DATA	1.51E-08	2.87E-09	NO DATA	3.64E-08	1.14E-05	3.10E-05
TC 99M	1.29E-13	3.64E-13	4.63E-12	NO DATA	5.52E-12	9.55E-08	5.20E-07

Table 3.2-6 (Cont.)
Inhalation Dose Factors for Adult (mrem/pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	5.22E-15	7.52E-15	7.38E-14	NO DATA	1.35E-13	4.99E-08	1.36E-21
RU103	1.91E-07	NO DATA	8.23E-08	NO DATA	7.29E-07	6.31E-05	1.38E-05
RU105	9.88E-11	NO DATA	3.89E-11	NO DATA	1.27E-10	1.37E-06	6.02E-06
RU106	8.64E-06	NO DATA	1.03E-06	NO DATA	1.67E-05	1.17E-03	1.14E-04
AG110M	1.35E-06	1.25E-06	7.43E-07	NO DATA	2.46E-06	5.79E-04	3.78E-05
TE125M	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE127M	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE129M	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE131M	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I 130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	NO DATA	9.61E-07
I 131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	NO DATA	7.85E-07
I 132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	NO DATA	5.08E-08
I 133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	NO DATA	1.11E-06
I 134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	NO DATA	1.26E-10
I 135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	NO DATA	6.56E-07
CS134	4.66E-05	1.06E-04	9.10E-05	NO DATA	3.59E-05	1.22E-05	1.30E-06
CS136	4.88E-06	1.83E-05	1.38E-05	NO DATA	1.07E-05	1.50E-06	1.46E-06
CS137	5.98E-05	7.76E-05	5.35E-05	NO DATA	2.78E-05	9.40E-06	1.05E-06
CS138	4.14E-08	7.76E-08	4.05E-08	NO DATA	6.00E-08	6.07E-09	2.33E-13
BA139	1.17E-10	8.32E-14	3.42E-12	NO DATA	7.78E-14	4.70E-07	1.12E-07
BA140	4.88E-06	6.13E-09	3.21E-07	NO DATA	2.09E-09	1.59E-04	2.73E-05
BA141	1.25E-11	9.41E-15	4.20E-13	NO DATA	8.75E-15	2.42E-07	1.45E-17
BA142	3.29E-12	3.38E-15	2.07E-13	NO DATA	2.86E-15	1.49E-07	1.96E-26
LA140	4.30E-08	2.17E-08	5.73E-09	NO DATA	NO DATA	1.70E-05	5.73E-05
LA142	8.54E-11	3.88E-11	9.69E-12	NO DATA	NO DATA	7.91E-07	2.64E-07
CE141	2.49E-06	1.69E-06	1.91E-07	NO DATA	7.83E-07	4.52E-05	1.50E-05
CE143	2.33E-08	1.72E-08	1.91E-09	NO DATA	7.60E-09	9.97E-06	2.83E-05
CE144	4.29E-04	1.79E-04	2.30E-05	NO DATA	1.06E-04	9.72E-04	1.02E-04
PR143	1.17E-06	4.69E-07	5.80E-08	NO DATA	2.70E-07	3.51E-05	2.50E-05
PR144	3.76E-12	1.56E-12	1.91E-13	NO DATA	8.81E-13	1.27E-07	2.69E-18
ND147	6.59E-07	7.62E-07	4.56E-08	NO DATA	4.45E-07	2.76E-05	2.16E-05
W 187	1.06E-09	8.85E-10	3.10E-10	NO DATA	NO DATA	3.63E-06	1.94E-05
NP239	2.87E-08	2.82E-09	1.55E-09	NO DATA	8.75E-09	4.70E-06	1.49E-05

Table 3.2-7
Inhalation Dose Factors for Teenager (mrem/pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C 14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA 24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P 32	2.36E-04	1.37E-05	8.95E-06	NO DATA	NO DATA	NO DATA	1.16E-05
CR 51	NO DATA	NO DATA	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN 54	NO DATA	6.39E-06	1.05E-06	NO DATA	1.59E-06	2.48E-04	8.35E-06
MN 56	NO DATA	2.12E-10	3.15E-11	NO DATA	2.24E-10	1.90E-06	7.18E-06
FE 55	4.18E-06	2.98E-06	6.93E-07	NO DATA	NO DATA	1.55E-05	7.99E-07
FE 59	1.79E-06	4.62E-06	1.79E-06	NO DATA	NO DATA	1.91E-04	2.23E-05
CO 58	NO DATA	2.59E-07	3.47E-07	NO DATA	NO DATA	1.68E-04	1.19E-05
CO 60	NO DATA	1.87E-06	2.48E-06	NO DATA	NO DATA	1.09E-03	3.24E-05
NI 63	7.25E-05	5.43E-06	2.47E-06	NO DATA	NO DATA	3.84E-05	1.77E-06
NI 65	2.73E-10	3.66E-11	1.59E-11	NO DATA	NO DATA	1.17E-06	4.59E-06
CU 64	NO DATA	2.54E-10	1.06E-10	NO DATA	8.01E-10	1.39E-06	7.68E-06
ZN 65	4.82E-06	1.67E-05	7.80E-06	NO DATA	1.08E-05	1.55E-04	5.83E-06
ZN 69	6.04E-12	1.15E-11	8.07E-13	NO DATA	7.53E-12	1.98E-07	3.56E-08
BR 83	NO DATA	NO DATA	4.30E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	5.41E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	2.29E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.38E-05	1.05E-05	NO DATA	NO DATA	NO DATA	2.21E-06
RB 88	NO DATA	6.82E-08	3.40E-08	NO DATA	NO DATA	NO DATA	3.65E-15
RB 89	NO DATA	4.40E-08	2.91E-08	NO DATA	NO DATA	NO DATA	4.22E-17
SR 89	5.43E-05	NO DATA	1.56E-06	NO DATA	NO DATA	3.02E-04	4.64E-05
SR 90	1.35E-02	NO DATA	8.35E-04	NO DATA	NO DATA	2.06E-03	9.56E-05
SR 91	1.10E-08	NO DATA	4.39E-10	NO DATA	NO DATA	7.59E-06	3.24E-05
SR 92	1.19E-09	NO DATA	5.08E-11	NO DATA	NO DATA	3.43E-06	1.49E-05
Y 90	3.73E-07	NO DATA	1.00E-08	NO DATA	NO DATA	3.66E-05	6.99E-05
Y 91M	4.63E-11	NO DATA	1.77E-12	NO DATA	NO DATA	4.00E-07	3.77E-09
Y 91	8.26E-05	NO DATA	2.21E-06	NO DATA	NO DATA	3.67E-04	5.11E-05
Y 92	1.84E-09	NO DATA	5.36E-11	NO DATA	NO DATA	3.35E-06	2.06E-05
Y 93	1.69E-08	NO DATA	4.65E-10	NO DATA	NO DATA	1.04E-05	7.24E-05
ZR 95	1.82E-05	5.73E-06	3.94E-06	NO DATA	8.42E-06	3.36E-04	1.86E-05
ZR 97	1.72E-08	3.40E-09	1.57E-09	NO DATA	5.15E-09	1.62E-05	7.88E-05
NB 95	2.32E-06	1.29E-06	7.08E-07	NO DATA	1.25E-06	9.39E-05	1.21E-05
MO 99	NO DATA	2.11E-08	4.03E-09	NO DATA	5.14E-08	1.92E-05	1.36E-05
TC 99M	1.73E-13	4.83E-13	6.24E-12	NO DATA	7.20E-12	1.44E-07	7.66E-07

Table 3.2-7 (Cont.)
Inhalation Dose Factors for Teenager (mrem/pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	7.40E-15	1.05E-14	1.03E-13	NO DATA	1.90E-13	8.34E-08	1.09E-16
RU103	2.63E-07	NO DATA	1.12E-07	NO DATA	9.29E-07	9.79E-05	1.36E-05
RU105	1.40E-10	NO DATA	5.42E-11	NO DATA	1.76E-10	2.27E-06	1.13E-05
RU106	1.23E-05	NO DATA	1.55E-06	NO DATA	2.38E-05	2.01E-03	1.20E-04
AG110M	1.73E-06	1.64E-06	9.99E-07	NO DATA	3.13E-06	8.44E-04	3.41E-05
TE125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	NO DATA	6.70E-05	9.38E-06
TE127M	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE129M	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE131M	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I 130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	NO DATA	1.14E-06
I 131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	NO DATA	8.11E-07
I 132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	NO DATA	1.59E-07
I 133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	NO DATA	1.29E-06
I 134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	NO DATA	2.55E-09
I 135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	NO DATA	8.69E-07
CS134	6.28E-05	1.41E-04	6.86E-05	NO DATA	4.69E-05	1.83E-05	1.22E-06
CS136	6.44E-06	2.42E-05	1.71E-05	NO DATA	1.38E-05	2.22E-06	1.36E-06
CS137	8.38E-05	1.06E-04	3.89E-05	NO DATA	3.80E-05	1.51E-05	1.06E-06
CS138	5.82E-08	1.07E-07	5.58E-08	NO DATA	8.28E-08	9.84E-09	3.38E-11
BA139	1.67E-10	1.18E-13	4.87E-12	NO DATA	1.11E-13	8.08E-07	8.06E-07
BA140	6.84E-06	8.38E-09	4.40E-07	NO DATA	2.85E-09	2.54E-04	2.86E-05
BA141	1.78E-11	1.32E-14	5.93E-13	NO DATA	1.23E-14	4.11E-07	9.33E-14
BA142	4.62E-12	4.63E-15	2.84E-13	NO DATA	3.92E-15	2.39E-07	5.99E-20
LA140	5.99E-08	2.95E-08	7.82E-09	NO DATA	NO DATA	2.68E-05	6.09E-05
LA142	1.20E-10	5.31E-11	1.32E-11	NO DATA	NO DATA	1.27E-06	1.50E-06
CE141	3.55E-06	2.37E-06	2.71E-07	NO DATA	1.11E-06	7.67E-05	1.58E-05
CE143	3.32E-08	2.42E-08	2.70E-09	NO DATA	1.08E-08	1.63E-05	3.19E-05
CE144	6.11E-04	2.53E-04	3.28E-05	NO DATA	1.51E-04	1.67E-03	1.08E-04
PR143	1.67E-06	6.64E-07	8.28E-08	NO DATA	3.86E-07	6.04E-05	2.67E-05
PR144	5.37E-12	2.20E-12	2.72E-13	NO DATA	1.26E-12	2.19E-07	2.94E-14
ND147	9.83E-07	1.07E-06	6.41E-08	NO DATA	6.28E-07	4.65E-05	2.28E-05
W 187	1.50E-09	1.22E-09	4.29E-10	NO DATA	NO DATA	5.92E-06	2.21E-05
NP239	4.23E-08	3.99E-09	2.21E-09	NO DATA	1.25E-08	8.11E-06	1.65E-05

Table 3.2-8
Inhalation Dose Factors for Child (mrem/pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C 14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA 24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P 32	7.04E-04	3.09E-05	2.67E-05	NO DATA	NO DATA	NO DATA	1.14E-05
CR 51	NO DATA	NO DATA	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN 54	NO DATA	1.16E-05	2.57E-06	NO DATA	2.71E-06	4.26E-04	6.19E-06
MN 56	NO DATA	4.48E-10	8.43E-11	NO DATA	4.52E-10	3.55E-06	3.33E-05
FE 55	1.28E-05	6.80E-06	2.10E-06	NO DATA	NO DATA	3.00E-05	7.75E-07
FE 59	5.59E-06	9.04E-06	4.51E-06	NO DATA	NO DATA	3.43E-04	1.91E-05
CO 58	NO DATA	4.79E-07	8.55E-07	NO DATA	NO DATA	2.99E-04	9.29E-06
CO 60	NO DATA	3.55E-06	6.12E-06	NO DATA	NO DATA	1.91E-03	2.60E-05
NI 63	2.22E-04	1.25E-05	7.56E-06	NO DATA	NO DATA	7.43E-05	1.71E-06
NI 65	8.08E-10	7.99E-11	4.44E-11	NO DATA	NO DATA	2.21E-06	2.27E-05
CU 64	NO DATA	5.39E-10	2.90E-10	NO DATA	1.63E-09	2.59E-06	9.92E-06
ZN 65	1.15E-05	3.06E-05	1.90E-05	NO DATA	1.93E-05	2.69E-04	4.41E-06
ZN 69	1.81E-11	2.61E-11	2.41E-12	NO DATA	1.58E-11	3.84E-07	2.75E-06
BR 83	NO DATA	NO DATA	1.28E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	1.48E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	6.84E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	5.36E-05	3.09E-05	NO DATA	NO DATA	NO DATA	2.16E-06
RB 88	NO DATA	1.52E-07	9.90E-08	NO DATA	NO DATA	NO DATA	4.66E-09
RB 89	NO DATA	9.33E-08	7.03E-08	NO DATA	NO DATA	NO DATA	5.11E-10
SR 89	1.62E-04	NO DATA	4.66E-06	NO DATA	NO DATA	5.83E-04	4.52E-05
SR 90	2.73E-02	NO DATA	1.74E-03	NO DATA	NO DATA	3.99E-03	9.28E-05
SR 91	3.28E-08	NO DATA	1.24E-09	NO DATA	NO DATA	1.44E-05	4.70E-05
SR 92	3.54E-09	NO DATA	1.42E-10	NO DATA	NO DATA	6.49E-06	6.55E-05
Y 90	1.11E-06	NO DATA	2.99E-08	NO DATA	NO DATA	7.07E-05	7.24E-05
Y 91M	1.37E-10	NO DATA	4.98E-12	NO DATA	NO DATA	7.60E-07	4.64E-07
Y 91	2.47E-04	NO DATA	6.59E-06	NO DATA	NO DATA	7.10E-04	4.97E-05
Y 92	5.50E-09	NO DATA	1.57E-10	NO DATA	NO DATA	6.46E-06	6.46E-05
Y 93	5.04E-08	NO DATA	1.38E-09	NO DATA	NO DATA	2.01E-05	1.05E-04
ZR 95	5.13E-05	1.13E-05	1.00E-05	NO DATA	1.61E-05	6.03E-04	1.65E-05
ZR 97	5.07E-08	7.34E-09	4.32E-09	NO DATA	1.05E-08	3.06E-05	9.49E-05
NB 95	6.35E-06	2.48E-06	1.77E-06	NO DATA	2.33E-06	1.66E-04	1.00E-05
MO 99	NO DATA	4.66E-08	1.13E-08	NO DATA	1.06E-07	3.66E-05	1.42E-05
TC 99M	4.81E-13	9.41E-13	1.56E-11	NO DATA	1.37E-11	2.57E-07	1.30E-06

Table 3.2-8 (Cont.)
Inhalation Dose Factors for Child (mrem/pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	2.19E-14	2.30E-14	2.91E-13	NO DATA	3.92E-13	1.58E-07	4.41E-09
RU103	7.55E-07	NO DATA	2.90E-07	NO DATA	1.90E-06	1.79E-04	1.21E-05
RU105	4.13E-10	NO DATA	1.50E-10	NO DATA	3.63E-10	4.30E-06	2.69E-05
RU106	3.68E-05	NO DATA	4.57E-06	NO DATA	4.97E-05	3.87E-03	1.16E-04
AG110M	4.56E-06	3.08E-06	2.47E-06	NO DATA	5.74E-06	1.48E-03	2.71E-05
TE125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	NO DATA	1.29E-04	9.15E-06
TE127M	6.72E-06	2.31E-06	8.10E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE129M	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE131M	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I 130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	NO DATA	1.38E-06
I 131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	NO DATA	7.68E-07
I 132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	NO DATA	8.65E-07
I 133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	NO DATA	1.48E-06
I 134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	NO DATA	2.58E-07
I 135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	NO DATA	1.20E-06
CS134	1.76E-04	2.74E-04	6.07E-05	NO DATA	8.93E-05	3.27E-05	1.04E-06
CS136	1.76E-05	4.62E-05	3.14E-05	NO DATA	2.58E-05	3.93E-05	1.13E-06
CS137	2.45E-04	2.23E-04	3.47E-05	NO DATA	7.63E-05	2.81E-05	9.78E-07
CS138	1.71E-07	2.27E-07	1.50E-07	NO DATA	1.68E-07	1.84E-08	7.29E-08
BA139	4.98E-10	2.66E-13	1.45E-11	NO DATA	2.33E-13	1.56E-06	1.56E-05
BA140	2.00E-05	1.75E-08	1.17E-06	NO DATA	5.71E-09	4.71E-04	2.75E-05
BA141	5.29E-11	2.95E-14	1.72E-12	NO DATA	2.56E-14	7.89E-07	7.44E-08
BA142	1.35E-11	9.73E-15	7.54E-13	NO DATA	7.87E-15	4.44E-07	7.41E-10
LA140	1.74E-07	6.08E-08	2.04E-08	NO DATA	NO DATA	4.94E-05	6.10E-05
LA142	3.50E-10	1.11E-10	3.49E-11	NO DATA	NO DATA	2.35E-06	2.05E-05
CE141	1.06E-05	5.28E-06	7.83E-07	NO DATA	2.31E-06	1.47E-04	1.53E-05
CE143	9.89E-08	5.37E-08	7.77E-09	NO DATA	2.26E-08	3.12E-05	3.44E-05
CE144	1.83E-03	5.72E-04	9.77E-05	NO DATA	3.17E-04	3.23E-03	1.05E-04
PR143	4.99E-06	1.50E-06	2.47E-07	NO DATA	8.11E-07	1.17E-04	2.63E-05
PR144	1.61E-11	4.99E-12	8.10E-13	NO DATA	2.64E-12	4.23E-07	5.32E-08
ND147	2.92E-06	2.36E-06	1.84E-07	NO DATA	1.30E-06	8.87E-05	2.22E-05
W 187	4.41E-09	2.61E-09	1.17E-09	NO DATA	NO DATA	1.11E-05	2.46E-05
NP239	1.26E-07	9.04E-09	6.35E-09	NO DATA	2.63E-08	1.57E-05	1.73E-05

Table 3.2-9
Inhalation Dose Factors for Infant (mrem/pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C 14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA 24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P 32	1.45E-03	8.03E-05	5.55E-05	NO DATA	NO DATA	NO DATA	1.15E-05
CR 51	NO DATA	NO DATA	6.37E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN 54	NO DATA	1.81E-05	3.56E-06	NO DATA	3.56E-06	7.14E-04	5.04E-06
MN 56	NO DATA	1.10E-09	1.58E-10	NO DATA	7.86E-10	8.95E-06	5.12E-05
FE 55	1.41E-05	8.39E-06	2.38E-06	NO DATA	NO DATA	6.21E-05	7.82E-07
FE 59	9.69E-06	1.68E-05	6.77E-06	NO DATA	NO DATA	7.25E-04	1.77E-05
CO 58	NO DATA	8.71E-07	1.30E-06	NO DATA	NO DATA	5.55E-04	7.95E-06
CO 60	NO DATA	5.73E-06	8.41E-06	NO DATA	NO DATA	3.22E-03	2.28E-05
NI 63	2.42E-04	1.46E-05	8.29E-06	NO DATA	NO DATA	1.49E-04	1.73E-06
NI 65	1.71E-09	2.03E-10	8.79E-11	NO DATA	NO DATA	5.80E-06	3.58E-05
CU 64	NO DATA	1.34E-09	5.53E-10	NO DATA	2.84E-09	6.64E-06	1.07E-05
ZN 65	1.38E-05	4.47E-05	2.22E-05	NO DATA	2.32E-05	4.62E-04	3.67E-05
ZN 69	3.85E-11	6.91E-11	5.13E-12	NO DATA	2.87E-11	1.05E-06	9.44E-06
BR 83	NO DATA	NO DATA	2.72E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	2.86E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	1.46E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.36E-04	6.30E-05	NO DATA	NO DATA	NO DATA	2.17E-06
RB 88	NO DATA	3.98E-07	2.05E-07	NO DATA	NO DATA	NO DATA	2.42E-07
RB 89	NO DATA	2.29E-07	1.47E-07	NO DATA	NO DATA	NO DATA	4.87E-08
SR 89	2.84E-04	NO DATA	8.15E-06	NO DATA	NO DATA	1.45E-03	4.57E-05
SR 90	2.92E-02	NO DATA	1.85E-03	NO DATA	NO DATA	8.03E-03	9.36E-05
SR 91	6.83E-08	NO DATA	2.47E-09	NO DATA	NO DATA	3.76E-05	5.24E-05
SR 92	7.50E-09	NO DATA	2.79E-10	NO DATA	NO DATA	1.70E-05	1.00E-04
Y 90	2.35E-06	NO DATA	6.30E-08	NO DATA	NO DATA	1.92E-04	7.43E-05
Y 91M	2.91E-10	NO DATA	9.90E-12	NO DATA	NO DATA	1.99E-06	1.68E-06
Y 91	4.20E-04	NO DATA	1.12E-05	NO DATA	NO DATA	1.75E-03	5.02E-05
Y 92	1.17E-08	NO DATA	3.29E-10	NO DATA	NO DATA	1.75E-05	9.04E-05
Y 93	1.07E-07	NO DATA	2.91E-09	NO DATA	NO DATA	5.46E-05	1.19E-04
ZR 95	8.24E-05	1.99E-05	1.45E-05	NO DATA	2.22E-05	1.25E-03	1.55E-05
ZR 97	1.07E-07	1.83E-08	8.36E-09	NO DATA	1.85E-08	7.88E-05	1.00E-04
NB 95	1.12E-05	4.59E-06	2.70E-06	NO DATA	3.17E-06	3.42E-04	9.05E-06
MO 99	NO DATA	1.18E-07	2.31E-08	NO DATA	1.89E-07	9.63E-05	3.48E-05
TC 99M	9.98E-11	2.06E-12	2.66E-11	NO DATA	2.22E-11	5.79E-07	1.45E-06

Table 3.2-9 (Cont.)
Inhalation Dose Factors for Infant (mrem/pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	4.65E-14	5.98E-14	5.80E-13	NO DATA	6.99E-13	4.17E-07	6.03E-07
RU103	1.44E-06	NO DATA	4.85E-07	NO DATA	3.03E-06	3.94E-04	1.15E-05
RU105	8.74E-10	NO DATA	2.93E-10	NO DATA	6.42E-10	1.12E-05	3.46E-05
RU106	6.20E-05	NO DATA	7.77E-06	NO DATA	7.61E-05	8.26E-03	1.17E-04
AG110M	7.13E-06	5.16E-06	3.57E-06	NO DATA	7.80E-06	2.62E-03	2.36E-05
TE125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	NO DATA	3.19E-04	9.22E-06
TE127M	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE127	1.59E-09	6.51E-10	3.47E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE129M	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.30E-03	4.93E-05
TE129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE131M	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I 130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	NO DATA	1.42E-06
I 131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	NO DATA	7.56E-07
I 132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	NO DATA	1.36E-06
I 133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	NO DATA	1.54E-06
I 134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	NO DATA	9.21E-07
I 135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	NO DATA	1.31E-06
CS134	2.83E-04	5.02E-04	5.32E-05	NO DATA	1.36E-04	5.69E-05	9.53E-07
CS136	3.45E-05	9.61E-05	3.78E-05	NO DATA	4.03E-05	8.40E-06	1.02E-06
CS137	3.92E-04	4.37E-04	3.25E-05	NO DATA	1.23E-04	5.09E-05	9.53E-07
CS138	3.61E-07	5.58E-07	2.84E-07	NO DATA	2.93E-07	4.67E-08	6.26E-07
BA139	1.06E-09	7.03E-13	3.07E-11	NO DATA	4.73E-13	4.25E-06	3.64E-05
BA140	4.00E-05	4.00E-08	2.07E-06	NO DATA	9.59E-09	1.14E-03	2.74E-05
BA141	1.12E-10	7.70E-14	3.55E-12	NO DATA	4.64E-14	2.12E-06	3.39E-06
BA142	2.84E-11	2.36E-14	1.40E-12	NO DATA	1.36E-14	1.11E-06	4.95E-07
LA140	3.01E-07	1.43E-07	3.68E-08	NO DATA	NO DATA	1.20E-04	6.06E-05
LA142	7.36E-10	2.69E-10	6.46E-11	NO DATA	NO DATA	5.87E-06	4.25E-05
CE141	1.98E-05	1.19E-05	1.42E-06	NO DATA	3.73E-06	3.69E-04	1.54E-05
CE143	2.09E-07	1.98E-07	1.58E-08	NO DATA	4.03E-08	8.30E-05	3.55E-05
CE144	2.28E-03	8.65E-04	1.26E-04	NO DATA	3.84E-04	7.03E-03	1.06E-04
PR143	1.00E-05	3.74E-06	4.99E-07	NO DATA	1.41E-06	3.09E-04	2.66E-05
PR144	3.42E-11	1.32E-11	1.72E-12	NO DATA	4.80E-12	1.15E-06	3.06E-06
ND147	5.67E-06	5.81E-06	3.57E-07	NO DATA	2.25E-06	2.30E-04	2.23E-05
W 187	9.26E-09	6.44E-09	2.23E-09	NO DATA	NO DATA	2.83E-03	2.54E-05
NP239	2.65E-07	2.37E-08	1.34E-08	NO DATA	4.93E-08	4.25E-05	1.78E-05

Table 3.2-10
Ingestion Dose Factor for Adult (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR 51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN 56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO 58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO 60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU 64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR 83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR 84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR 85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB 88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB 89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR 89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR 90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR 91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR 92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y 90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y 91M	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y 91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y 92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y 93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO 99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07

Table 3.2-10 (Cont.)
Ingestion Dose Factor for Adult (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG110M	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE125M	2.69E-06	9.71E-07	3.59E-07	9.06E-07	1.09E-05	NO DATA	1.07E-05
TE127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE129M	1.15E-05	4.29E-06	1.42E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE129	3.14E-08	1.18E-08	7.63E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09
TE132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA140	3.50E-09	1.26E-09	8.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

Table 3.2-11
Ingestion Dose Factors for Teenager (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	NO DATA	NO DATA	NO DATA	2.32E-05
CR 51	NO DATA	NO DATA	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	NO DATA	5.70E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05
MN 56	NO DATA	1.58E-07	2.81E-08	NO DATA	2.00E-07	NO DATA	1.04E-05
FE 55	3.78E-06	2.68E-06	6.25E-07	NO DATA	NO DATA	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05
CO 58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05
CO 60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	NO DATA	NO DATA	NO DATA	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	NO DATA	NO DATA	NO DATA	5.19E-06
CU 64	NO DATA	1.15E-07	5.41E-08	NO DATA	2.91E-07	NO DATA	6.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06
ZN 69	1.47E-08	2.60E-08	1.96E-09	NO DATA	1.83E-08	NO DATA	5.16E-08
BR 83	NO DATA	NO DATA	5.74E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	7.22E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	3.05E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.98E-05	1.40E-05	NO DATA	NO DATA	NO DATA	4.41E-06
RB 88	NO DATA	8.52E-08	4.54E-08	NO DATA	NO DATA	NO DATA	7.30E-15
RB 89	NO DATA	5.50E-08	3.89E-08	NO DATA	NO DATA	NO DATA	8.43E-17
SR 89	4.40E-04	NO DATA	1.26E-05	NO DATA	NO DATA	NO DATA	5.24E-05
SR 90	8.30E-03	NO DATA	2.05E-03	NO DATA	NO DATA	NO DATA	2.33E-04
SR 91	8.07E-06	NO DATA	3.21E-07	NO DATA	NO DATA	NO DATA	3.66E-05
SR 92	3.05E-06	NO DATA	1.30E-07	NO DATA	NO DATA	NO DATA	7.77E-05
Y 90	1.37E-08	NO DATA	3.69E-10	NO DATA	NO DATA	NO DATA	1.13E-04
Y 91M	1.29E-10	NO DATA	4.93E-12	NO DATA	NO DATA	NO DATA	6.09E-09
Y 91	2.01E-07	NO DATA	5.39E-09	NO DATA	NO DATA	NO DATA	8.24E-05
Y 92	1.21E-09	NO DATA	3.50E-11	NO DATA	NO DATA	NO DATA	3.32E-05
Y 93	3.83E-09	NO DATA	1.05E-10	NO DATA	NO DATA	NO DATA	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	NO DATA	7.11E-10	NO DATA	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05
MO 99	NO DATA	6.03E-06	1.19E-06	NO DATA	1.38E-05	NO DATA	1.08E-05
TC 99M	3.32E-10	9.26E-10	1.20E-08	NO DATA	1.38E-08	5.14E-10	6.08E-07

Table 3.2-11 (Cont.)
Ingestion Dose Factor for Teenager (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
FC101	3.60E-10	5.12E-10	5.03E-09	NO DATA	9.26E-09	3.12E-10	8.75E-17
RU103	2.55E-07	NO DATA	1.09E-07	NO DATA	8.99E-07	NO DATA	2.13E-05
RU105	2.18E-08	NO DATA	8.46E-09	NO DATA	2.75E-07	NO DATA	1.76E-05
RU106	3.92E-06	NO DATA	4.94E-07	NO DATA	7.56E-06	NO DATA	1.88E-04
AG110M	2.05E-07	1.94E-07	1.18E-07	NO DATA	3.70E-07	NO DATA	5.45E-05
TE125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	NO DATA	NO DATA	1.13E-05
TE127M	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	NO DATA	2.41E-05
TE127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	NO DATA	1.22E-05
TE129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	NO DATA	6.12E-05
TE129	4.48E-08	1.67E-08	1.07E-08	3.20E-08	1.88E-07	NO DATA	2.45E-07
TE131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	NO DATA	9.39E-05
TE131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	NO DATA	2.29E-09
TE132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	NO DATA	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	NO DATA	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06
I 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	NO DAT	.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	NO DAT_	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	NO DATA	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	NO DATA	1.74E-06
CS134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06
CS136	8.59E-06	3.38E-05	2.27E-05	NO DATA	1.84E-05	2.90E-06	2.72E-06
CS137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06
CS138	7.76E-08	1.49E-07	7.45E-08	NO DATA	1.10E-07	1.28E-08	6.76E-11
BA139	1.39E-07	9.78E-11	4.05E-09	NO DATA	9.22E-11	6.74E-11	1.24E-06
BA140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05
BA141	6.71E-08	5.01E-11	2.24E-09	NO DATA	4.65E-11	3.43E-11	1.43E-13
BA142	2.99E-08	2.99E-11	1.84E-09	NO DATA	2.53E-11	1.99E-11	9.18E-20
LA140	3.48E-09	1.71E-09	4.55E-10	NO DATA	NO DATA	NO DATA	9.82E-05
LA142	1.79E-10	7.95E-11	1.98E-11	NO DATA	NO DATA	NO DATA	2.42E-06
CE141	1.33E-08	8.88E-09	1.02E-09	NO DATA	4.18E-09	NO DATA	2.54E-05
CE143	2.35E-09	1.71E-06	1.91E-10	NO DATA	7.67E-10	NO DATA	5.14E-05
CE144	6.96E-07	2.88E-07	3.74E-08	NO DATA	1.72E-07	NO DATA	1.75E-04
PR143	1.31E-08	5.23E-09	6.52E-10	NO DATA	3.04E-09	NO DATA	4.31E-05
PR144	4.30E-11	1.76E-11	2.18E-12	NO DATA	1.01E-11	NO DATA	4.74E-14
ND147	9.38E-09	1.02E-08	6.11E-10	NO DATA	5.99E-09	NO DATA	3.68E-05
W 187	1.46E-07	1.19E-07	4.17E-08	NO DATA	NO DATA	NO DATA	3.22E-05
NP239	1.76E-09	1.66E-10	9.22E-11	NO DATA	5.21E-10	NO DATA	2.67E-05

Table 3.2-12
Ingestion Dose Factors for Child (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	2.03E-07	2.01E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.75E-04	3.86E-05	3.10E-05	NO DATA	NO DATA	NO DATA	2.28E-05
CR 51	NO DATA	NO DATA	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06
MN 56	NO DATA	3.34E-07	7.54E-08	NO DATA	4.04E-07	NO DATA	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	NO DATA	NO DATA	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05
CO 58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05
CO 60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	NO DATA	NO DATA	NO DATA	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	NO DATA	NO DATA	NO DATA	2.56E-05
CU 64	NO DATA	2.45E-07	1.48E-07	NO DATA	5.92E-07	NO DATA	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06
ZN 69	4.38E-08	6.53E-08	5.85E-09	NO DATA	3.84E-08	NO DATA	3.99E-06
BR 83	NO DATA	NO DATA	1.71E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	1.98E-07	NO DATA	NO DATA	NO DATA	LT E-24
RB 85	NO DATA	NO DATA	9.12E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	6.70E-05	4.12E-05	NO DATA	NO DATA	NO DATA	4.31E-06
RB 88	NO DATA	1.90E-07	1.32E-07	NO DATA	NO DATA	NO DATA	9.32E-09
RB 89	NO DATA	1.17E-07	1.04E-07	NO DATA	NO DATA	NO DATA	1.02E-09
SR 89	1.32E-03	NO DATA	3.77E-05	NO DATA	NO DATA	NO DATA	5.11E-05
SR 90	1.70E-02	NO DATA	4.31E-03	NO DATA	NO DATA	NO DATA	2.29E-04
SR 91	2.40E-05	NO DATA	9.06E-07	NO DATA	NO DATA	NO DATA	5.30E-05
SR 92	9.03E-06	NO DATA	3.62E-07	NO DATA	NO DATA	NO DATA	1.71E-04
Y 90	4.11E-08	NO DATA	1.10E-09	NO DATA	NO DATA	NO DATA	1.17E-04
Y 91M	3.82E-10	NO DATA	1.37E-11	NO DATA	NO DATA	NO DATA	7.48E-07
Y 91	6.02E-07	NO DATA	1.61E-08	NO DATA	NO DATA	NO DATA	8.02E-05
Y 92	3.60E-09	NO DATA	1.03E-10	NO DATA	NO DATA	NO DATA	1.04E-04
Y 93	1.14E-08	NO DATA	3.13E-10	NO DATA	NO DATA	NO DATA	1.70E-04
ZR 95	1.16E-07	2.35E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05
ZR 97	6.99E-09	1.01E-09	9.96E-10	NO DATA	1.45E-09	NO DATA	1.53E-04
NB 95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05
MO 99	NO DATA	1.33E-05	3.29E-06	NO DATA	2.84E-05	NO DATA	1.10E-05
TC 99M	9.23E-10	1.81E-09	3.00E-08	NO DATA	2.63E-08	9.19E-10	1.03E-06

Table 3.2-12 (Cont.)
Ingestion Dose Factors for Child (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	1.07E-09	1.12E-09	1.42E-08	NO DATA	1.91E-08	5.92E-10	3.56E-09
RU103	7.31E-07	NO DATA	2.81E-07	NO DATA	1.84E-06	NO DATA	1.89E-05
RU105	6.45E-08	NO DATA	2.34E-08	NO DATA	5.67E-07	NO DATA	4.21E-05
RU106	1.17E-05	NO DATA	1.46E-06	NO DATA	1.58E-05	NO DATA	1.82E-04
AG110M	5.39E-07	3.64E-07	2.91E-07	NO DATA	6.78E-07	NO DATA	4.33E-05
TE125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	NO DATA	NO DATA	1.10E-05
TE127M	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	NO DATA	2.34E-05
TE127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	NO DATA	1.84E-05
TE129M	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	NO DATA	5.94E-05
TE129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	NO DATA	8.34E-06
TE131M	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	NO DATA	1.01E-04
TE131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	NO DATA	4.36E-07
TE132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	NO DATA	4.50E-05
I 130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	NO DATA	2.76E-06
I 131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06
I 132	8.00E-07	1.47E-06	8.76E-07	6.82E-05	2.25E-06	NO DATA	1.73E-06
I 133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	NO DATA	2.95E-06
I 134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	NO DATA	5.16E-07
I 135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	NO DATA	2.40E-06
CS134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06
CS136	2.35E-05	6.46E-05	4.18E-05	NO DATA	3.44E-05	5.13E-06	2.27E-06
CS137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06
CS138	2.28E-07	3.17E-07	2.01E-07	NO DATA	2.23E-07	2.40E-08	1.46E-07
BA139	4.14E-07	2.21E-10	1.20E-08	NO DATA	1.93E-10	1.30E-10	2.39E-05
BA140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05
BA141	2.00E-07	1.12E-10	6.51E-09	NO DATA	9.69E-11	6.58E-10	1.14E-07
BA142	8.74E-08	6.29E-11	4.88E-09	NO DATA	5.09E-11	3.70E-11	1.14E-09
LA140	1.01E-08	3.53E-09	1.19E-09	NO DATA	NO DATA	NO DATA	9.84E-05
LA142	5.24E-10	1.17E-10	5.23E-11	NO DATA	NO DATA	NO DATA	3.31E-05
CE141	3.97E-09	1.18E-08	2.94E-09	NO DATA	8.68E-09	NO DATA	2.47E-05
CE143	6.99E-09	3.71E-06	5.49E-10	NO DATA	1.59E-09	NO DATA	5.55E-05
CE144	2.08E-06	6.51E-07	1.11E-07	NO DATA	3.61E-07	NO DATA	1.70E-04
PR143	3.93E-08	1.18E-08	1.95E-09	NO DATA	6.39E-09	NO DATA	4.24E-05
PR144	1.29E-10	3.99E-11	6.49E-12	NO DATA	2.11E-11	NO DATA	8.59E-08
ND147	2.79E-08	2.26E-08	1.75E-09	NO DATA	1.24E-08	NO DATA	3.58E-05
W 187	4.29E-07	2.54E-07	1.14E-07	NO DATA	NO DATA	NO DATA	3.57E-05
NP239	5.25E-09	3.77E-10	2.65E-10	NO DATA	1.09E-09	NO DATA	2.79E-05

Table 3.2-13
Ingestion Dose Factors for Infant (mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	NO DATA	NO DATA	NO DATA	2.30E-05
CA 51	NO DATA	NO DATA	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06
MN 56	NO DATA	8.18E-07	1.41E-07	NO DATA	7.03E-07	NO DATA	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO 58	NO DATA	3.60E-06	8.98E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO 60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU 64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN 65	1.34E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	NO DATA	6.98E-08	NO DATA	1.37E-05
BR 83	NO DATA	NO DATA	3.63E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	3.82E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	1.94E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.70E-04	8.40E-05	NO DATA	NO DATA	NO DATA	4.35E-06
RB 88	NO DATA	4.98E-07	2.73E-07	NO DATA	NO DATA	NO DATA	4.85E-07
RB 89	NO DATA	2.86E-07	1.97E-07	NO DATA	NO DATA	NO DATA	9.74E-08
SR 89	2.51E-03	NO DATA	7.20E-05	NO DATA	NO DATA	NO DATA	5.16E-05
SR 90	1.85E-02	NO DATA	4.71E-03	NO DATA	NO DATA	NO DATA	2.31E-04
SR 91	5.00E-05	NO DATA	1.81E-06	NO DATA	NO DATA	NO DATA	5.92E-05
SR 92	1.92E-05	NO DATA	7.13E-07	NO DATA	NO DATA	NO DATA	2.07E-04
Y 90	8.69E-08	NO DATA	2.33E-09	NO DATA	NO DATA	NO DATA	1.20E-04
Y 91M	8.10E-10	NO DATA	2.76E-11	NO DATA	NO DATA	NO DATA	2.70E-06
Y 91	1.13E-06	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	8.10E-05
Y 92	7.65E-09	NO DATA	2.15E-10	NO DATA	NO DATA	NO DATA	1.46E-04
Y 93	2.43E-08	NO DATA	6.62E-10	NO DATA	NO DATA	NO DATA	1.92E-04
ZR 95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05
ZR 97	1.48E-08	2.54E-09	1.16E-09	NO DATA	2.56E-09	NO DATA	1.62E-04
NB 95	4.20E-08	1.73E-08	1.09E-08	NO DATA	1.74E-08	NO DATA	1.46E-05
MO 99	NO DATA	5.40E-05	6.63E-06	NO DATA	5.08E-05	NO DATA	1.12E-05
TC 99M	1.92E-09	3.96E-09	5.10E-08	NO DATA	4.26E-08	2.07E-09	1.15E-06

Table 3.2-13 (Cont.)
Ingestion Dose Factors for Infant

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	2.27E-09	2.86E-09	2.83E-08	NO DATA	3.40E-08	1.56E-09	4.86E-07
RU103	1.48E-06	NO DATA	4.95E-07	NO DATA	3.08E-06	NO DATA	1.80E-05
RU105	1.36E-07	NO DATA	4.58E-08	NO DATA	1.00E-06	NO DATA	5.41E-05
RU106	2.41E-05	NO DATA	3.01E-04	NO DATA	2.85E-05	NO DATA	1.83E-04
AG110M	9.96E-07	7.27E-07	4.81E-07	NO DATA	1.04E-06	NO DATA	3.77E-05
TE125M	2.33E-05	7.79E-06	3.15E-06	7.84E-06	NO DATA	NO DATA	1.11E-05
TE127M	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	NO DATA	2.36E-05
TE127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	NO DATA	2.10E-05
TE129M	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	NO DATA	5.97E-05
TE129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	NO DATA	2.27E-05
TE131M	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	NO DATA	1.03E-04
TE131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	NO DATA	7.11E-06
TE132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	NO DATA	3.81E-05
I 130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	NO DATA	2.83E-06
I 131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-06
I 132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	NO DATA	2.73E-06
I 133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	NO DATA	3.08E-06
I 134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	NO DATA	1.84E-06
I 135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	NO DATA	2.62E-06
CS134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06
CS136	4.59E-05	1.35E-04	5.04E-05	NO DATA	5.38E-05	1.10E-05	2.05E-06
CS137	5.22E-04	8.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06
CS138	4.81E-07	7.82E-07	3.79E-07	NO DATA	3.90E-07	6.09E-08	1.25E-06
BA139	8.81E-07	5.84E-10	2.55E-08	NO DATA	3.51E-10	3.54E-10	5.58E-05
BA140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-03
BA141	4.25E-07	2.91E-10	1.34E-08	NO DATA	1.75E-10	1.77E-10	5.19E-06
BA142	1.84E-07	1.53E-10	9.06E-09	NO DATA	8.81E-11	9.26E-11	7.59E-07
LA140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.66E-05
CE141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE143	1.48E-08	9.82E-06	1.12E-09	NO DATA	2.96E-09	NO DATA	5.73E-05
CE144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-07	NO DATA	1.71E-04
PR143	8.13E-08	3.04E-08	4.03E-09	NO DATA	1.13E-08	NO DATA	4.29E-05
PR144	2.74E-10	1.04E-10	1.38E-11	NO DATA	3.84E-11	NO DATA	4.93E-06
ND147	5.53E-08	5.68E-08	3.48E-09	NO DATA	2.19E-08	NO DATA	3.60E-05
W 187	9.03E-07	6.28E-07	2.17E-07	NO DATA	NO DATA	NO DATA	5.69E-05
NP239	1.11E-08	9.93E-10	5.61E-10	NO DATA	1.98E-09	NO DATA	2.87E-05

Table 3.2-14
Annual Usage Factors for the Maximum Exposed Individual

Pathway	Infant	Child	Teen	Adult
Fruits, vegetables & grain (kg/yr)*	--	520	630	520
Leafy vegetables (kg/yr)	--	26	42	64
Milk (l/yr)	330	330	400	310
Meat & poultry (kg/yr)	--	41	65	110
Inhalation (m^3/yr)	1400	3700	8000	8000

*Consists of the following (on a mass basis): 22% fruit, 54% vegtables (including leafy vegetables), and 24% grain.

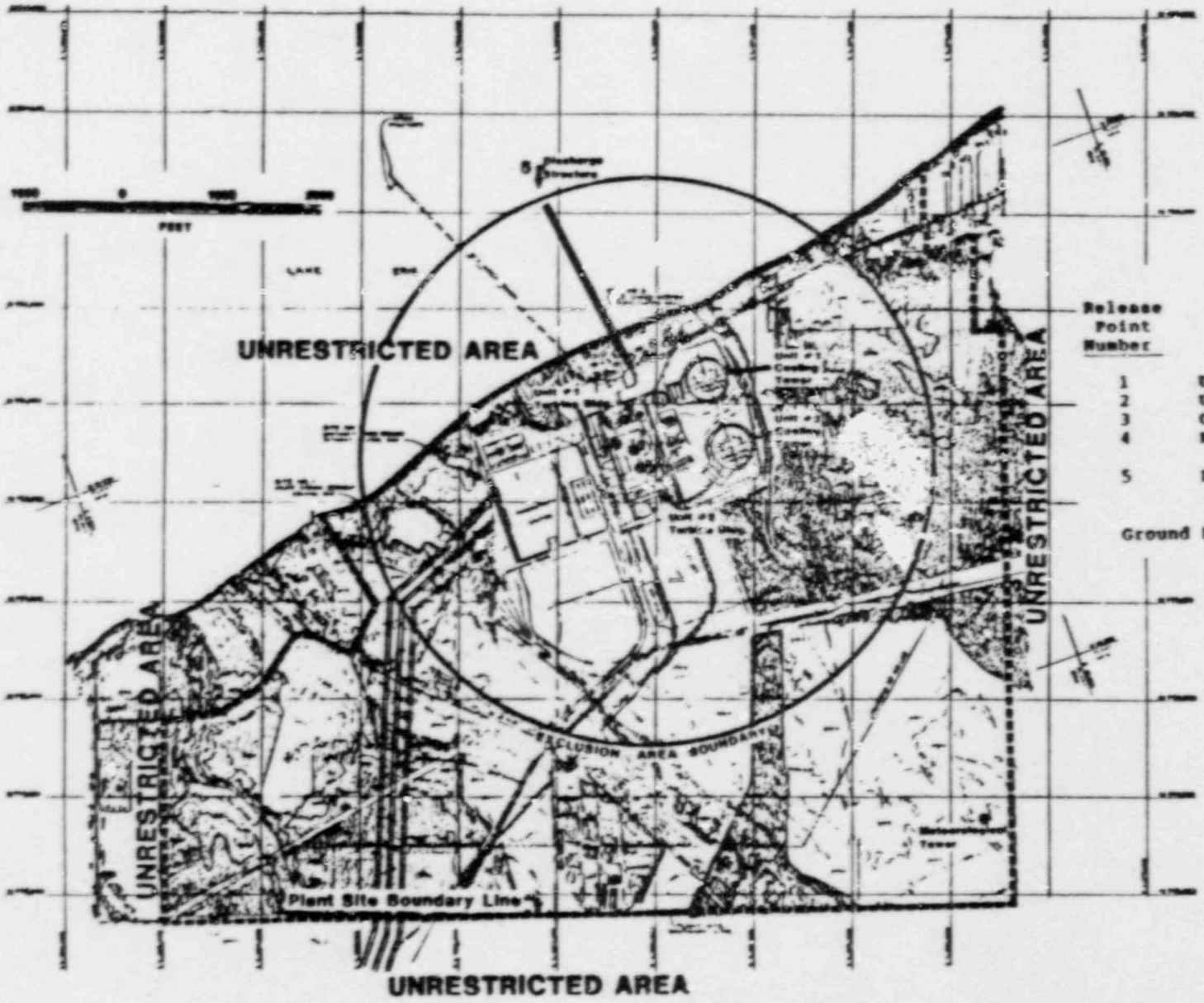
Table 3.2-15
Annual Usage Factors for the Average Individual**

Pathway	Child	Teen	Adult
Fruits, vegetables, & grain (kg/yr)*	200	240	190
Milk (l/yr)	170	200	110
Meat & poultry (kg/yr)	37	59	95
Inhalation (m^3/yr)	3700	8000	8000

* Consists of the following (on a mass basis): 22% fruit, 54% vegetables (including leafy vegetables), and 24% grain.

**For total population and average individual dose calculations.

Figure 3.2-1
PNPP SITE BOUNDARY AND UNRESTRICTED AREA



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3.3 Compliance With 10CFR50 Appendix I - Gaseous Effluent Dose

Doses resulting from the release of noble gases, radioiodines, tritium and radionuclides in particulate form must be calculated to show compliance with Appendix I of 10CFR50. The calculations will be performed at least monthly for all gaseous effluents.

3.3.1 Noble Gases

Section II.B.1 of Appendix I of 10CFR50 limits the releases of gaseous effluents from each reactor to unrestricted areas such that the estimated annual gamma air dose is limited to 10 millirads and the beta air dose is limited to 20 millirads. The external dose pathway only will be considered for noble gases. The controlling location for the above stated dose limits is the site boundary location with the highest relative dispersion factor (χ/Q) for the period of release.

PNPP Technical Specifications limit the dose resulting from the release of noble gas radionuclides in gaseous effluents to the following:

a. For gamma radiation, during any calendar quarter:

$D_{air} \leq 5$ mrads,

b. For beta radiation, during any calendar quarter:

$D_{air} \leq 10$ mrads,

c. For gamma radiation, during any calendar year:

$D_{air} \leq 10$ mrads,

d. For beta radiation, during any calendar year:

$D_{air} \leq 20$ mrads.

3.3.2 Radioiodines, Particulates, and Other Radionuclides

Section II.C of Appendix I of 10CFR50 limits the release of radioiodines and radioactive materials in particulate form from each reactor such that estimated dose or dose commitment to an individual in an unrestricted area from all pathways of exposure is not in excess of 15 mrem to any organ. The controlling location for this organ dose limit is the location of the highest relative deposition (D/Q) for the period of release, as well as the actual receptor pathway. Receptor pathway locations will be revieved once per year following the performance of the Land Use Census to include consideration of nearest residences, garden, and farm animal locations in each sector.

PNPP Technical Specifications limit the dose resultant from the release of iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than eight days to the following:

a. During any calendar quarter:

Dose to Any Organ $\leq$ 7.5 mrems

b. During any calendar year:

Dose to Any Organ $\leq$ 15 mrems.

3.3.3 Dose Calculations

The following calculations are used to determine gamma and beta air doses resultant from noble gas release to areas at or beyond the site boundary for purpose of showing compliance with 10CFR50, Appendix I. The equations used to calculate organ doses resultant from the release of iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than eight days are those found in Section 3.2.3. The dose rate obtained is integrated over the appropriate surveillance or sampling time period.

a. Gamma Air Dose from Noble Gas Releases

$$D_{air}^{\gamma} = (3.15)\ (10^{1})\ (\chi/Q)\ \sum_{i}\ (Q_i)\ (DF_i^{\gamma}) \qquad (3.3\text{-}1)$$

Where:

D_{air}^{γ} = the annual gamma air dose due to noble gas radionuclides, in mrad/yr;

DF_i^{γ} = the gamma air dose factor for a uniform semi-infinite cloud of radionuclide "i", from Table 3.3-1, in mrad/s per Ci/m^3;

Q_i = the release rate of radionuclide "i", in µCi/s;

χ/Q = the normal relative dispersion factor, in s/m^3;

3.15×10^{1} = the conversion factor to convert (mrad * µCi)/(Ci * s) to mrad/yr.

b. Beta Air dose from Noble Gas Releases

$$D_{air}^{\beta} = (3.15 \times 10^{1})\ (\chi/Q)\ \sum_{i}\ (Q_i)\ (DF_i^{\beta})$$

Where:

D_{air}^{β} = the annual beta air dose due to noble gas radionuclides, in mrad/yr;

DF_i^{β} = the beta air dose factor for a uniform semi-infinite cloud of radionuclide "i", from Table 3.3-1, in mrad/s per Ci/m^3;

Q_i = the release rate of radionuclide "i", in µCi/s;

χ/Q = the normal relative dispersion factor, in s/m^3;

3.15×10^{1} = the conversion factor to convert (mrad * µCi)/(Ci * s) to mrad/yr.

3.3.4 Cumulation of Doses

The dose contribution from gaseous effluents will be calculated at least monthly. Calculations will be performed to determine the maximum air dose as well as the maximum organ dose to an individual. These dose calculations will be summed for comparison with quarterly and annual limits. To assure

compliance with 10CFR50, Appendix I, the dose limits for air dose and organ dose are those found in Sections 3.3.1 and 3.3.2, respectively. The quarterly limits specified in those sections represent one half of the annual design objectives. If these limits are exceeded, a special report will be submitted to the NRC in accordance with PNPP Technical Specifications.

3.3.5 Projection of Doses

Anticipated doses resulting from the release of gaseous effluents will be projected monthly. The doses calculated for the present month will be used as the projected doses unless information exists indicating that actual releases could differ significantly in the next month. In this case the source term will be adjusted to reflect this information and the justification for the adjustment noted.

If the sum of the projected doses for the 31-day period exceeds 0.3 mrem to any organ, appropriate portions of the ventilation exhaust treatment system will be operated to reduce releases. The values for the projected dose impact levels correspond to about one forty-eighth of the Appendix I limits. If continued for a year, these values would correspond to less than one-fourth of the Appendix I limits.

3.4 Population Dose

PNPP's Semiannual Radioactive Effluent Release Reports, as required by Regulatory Guide 1.21, will include total population dose and average individual doses calculated for all radioactive gaseous effluent releases. The total population dose and average individual dose will be computed, taking into account geographical population distribution and pathway(s) using the equations in Section 3.2. However, the dose factors, DF_{aijp}, differ; total population and average individual doses are calculated in a manner similar to that used for maximum individuals except that Regulatory Guide 1.109, Revision 1 assumptions for average individuals are used rather than for maximum exposed individuals and they are averaged over all age groups after weighting by the fraction of population in each age group.

Figure 3.3-1

Gamma and Beta Air Dose Factors for Semi-Infinite Plume

($mrad/s$ per Ci/m^3)

Nuclide	Gamma Air Dose Factor (DF_i^γ)	Beta Air Dose Factor (DF_i^β)
Ar-41	2.95+2	1.04+2
Kr-83m	6.12-1	9.13+0
Kr-85m	3.90+1	6.24+1
Kr-85	5.45-1	6.18+1
Kr-87	1.96+2	3.27+2
Kr-88	4.82+2	9.29+1
Kr-89	5.48+2	3.36+2
Kr-90	5.14+2	2.48+2
Xe-131m	4.95+0	3.53+1
Xe-133m	1.04+1	4.69+1
Xe-133	1.12+1	3.33+1
Xe-135m	1.07+2	2.34+1
Xe-135	6.09+1	7.80+1
Xe-137	4.79+1	4.03+2
Xe-138	2.92+2	1.51+2

4.0 TOTAL DOSE

4.1 Compliance With 40CFR190 - Uranium Fuel Cycle Dose

Annual dose contributions from liquid and gaseous effluent releases, as discussed in Sections 2.3.2 and 3.3.4, are summed to evaluate compliance with the 40CFR190 annual limit of 25 mrem total body or any organ (except the thyroid, which is 75 mrem).

PNPP does not intend to exceed 40CFR190 limits during normal operation. However, if such a situation should occur, violations would be handed as per Technical Specification 3/4.11.4., which requires the following:

With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specification 3.11.1.2a., 3.11.1.2b., 3.11.2.2a., 3.11.2.2b., 3.11.2.3a. or 3.11.2.3b., calculations shall be made including direct radiation contributions from the reactor units and from outside storage tanks to determine whether the above limits of Specification 3.11.4 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10CFR20.405c, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentratiosn of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40CFR190 has not alredy been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40CFR190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

This Special Report shall contain:

1. A determination of which fuel cycle facilities or operations, in addition to the nuclear power reactor unit(s) at the site, contribute to the annual dose to the maximum exposed individual. Nuclear fuel facilities over five miles from PNPP need not be considered in this determination.

2. A determination of the maximum exposed individual.

3. A determination of the total annual dose to this person from all existing pathways and sources of radioactive effluents and direct radiation using the methodologies described in this ODCM. Where additional information on pathways and nuclides is needed, the best available information will be used and documented.

4. A determination of the dose resulting from direct radiation from the plant and storage facilities.

The total body and organ doses resulting from liquid effluents from the PNPP will be summed with the doses resulting from gaseous releases of noble gases, radioiodines, tritium, and particulates with half-lines greater than eight days when any of the dose limits outlined in Sections 2.3.2, 3.3.1 or 3.3.2 are exceeded by a factor of two. The doses from the PNPP will be summed with the dose to the maximum exposed individual contributed from other operations of the uranium fuel cycle.

4.2 Direct Radiation Dose From PNPP

Potential direct radiation dose to individuals outside PNPP will arise from (a) skyshine and direct dose from the turbines, (b) direct dose from the external surfaces of buildings, and (c) direct dose from stored radwaste.

Coolant activation by high energy neutrons, the O^{16} $(n,p)N^{16}$ reaction, is of interest in boiling water reactors, like PNPP, because it can result in turbine skyshine and direct dose. The N-16 present in the steam of a direct cycle BWR is carried with the steam into the turbine moisture separators, and associated equipment. Although N-16 has a 7.13 second half-life, its gamma emission can present a radiation dose problem to the site boundary as a result of the high energy gamma scatter from structures and the atmosphere.

All external walls of buildings at PNPP have been designed to attenuate radiation sources from within the plant to maximum of 0.5 mrem/h outside, with an expected radiation dose not to exceed 0.25 mrem/h.

Projected direct radiation dose assessment for normal operations was performed, based on 80% load factor and 100% occupancy, for the closest site boundary location (WSW sector). Direct dose from turbine skyshine was calculated to be 1.3 mrem/yr and direct dose from the surface of buildings was calculated to be 2.2 E-3 mrem/yr.

Direct radiation doses at PNPP will be measured by self-contained dosimeters encircling the site located in the general area of the site boundary. These self-contained dosimeters will be of the thermoluminescent variety (TLDs) with analyses performed quarterly and annually.

4.3 Dose to Members of the Public While Onsite

PNPP Technical Specification 6.9.1.7 requires "assessment of the radiation doses from radioactive liquid and gaseous effluents to members of the public due to their activities inside the site boundary". This assessment is included in Semiannual Radioactive Effluent Release Reporting.

A member of the public is defined in Technical Specifications to include anyone who is not occupationally associated with the plant, i.e., not a utility employee, contractor or vendor. Also excluded from this category is any person who enters the site to service equipment or make deliveries.

Maximum dose to member of the public while onsite is conservatively assessed relative to offsite dose values. The assessment methodology incorporates use of appropriate dilution, dispersion, and occupancy factors for onsite activities.

The only liquid effluent dose pathway affecting members of the public while onsite is shore exposure. Fishing on the Lake Erie shoreline is the assumed activity for this exposure. Onsite dose assessment is made via ratio to the maximum calculated offsite shore exposure dose incorporating adjustments for occupancy factor and liquid effluent dilution.

Several cases are considered for gaseous effluent dose assessment to member of the public while onsite including: traversing a public road within the site boundary, lakeshore fishing, non-PNPP related training sessions at the Training and Education Center, car pooling to the Primary Access Control Point (PACP) parking lot, and job applicant interviews. This evaluation is made using "relative χ/Q" (atmospheric dispersion) values. "Relative χ/Q" values are the product of the highest annual average χ/Q for the point of concern, and occupancy factor for the case. An adjustment factor is derived by ratioing this highest onsite "relative χ/Q" to the highest site boundary "relative χ/Q". (A unity occupancy factor is used in the determination of the highest site boundary "relative χ/Q"). Conservative onsite dose determination is made by applying the "relative χ/Q" adjustment factor for the highest potential onsite dose activity to the highest calculated gaseous effluent offsite dose.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

5.1 Monitoring Program

Environmental samples shall be collected and analyzed according to Table 5.1-1 at locations shown in Figures 5.1-1 and 5.1-2. Table 5.1-4 describes sample locations, associated media, and approximate distances and directions from the site. Analytical techniques used shall ensure that the detection capabilities in Table 5.1-3 are achieved.

Ground water sampling will not be conducted as part of PNPP's REMP because this source is not tapped for drinking or irrigation purposes in the area of the plant and the hydraulic gradient is not suitable for useful groundwater contamination. The position of the plant and the underdrain system with respect to the hydraulic gradient is such that any leakage or overflow from the underdrain system will flow north towards Lake Erie. Local domestic wells outside the exclusion area boundary are up-gradient from the plant. As part of the REMP, samples will be routinely collected from the closest potable water intakes on Lake Erie.

The results of the radiological environmental monitoring program are intended to supplement the results of the radiological effluent monitoring by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. Thus, the specified environmental monitoring program provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures of individuals resulting from the station operation. The initial radiological environmental monitoring program should be conducted for the first three years of commercial operation; following this period, program changes may be proposed based on operational experience.

Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every reasonable effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the annual report.

5.2 Land Use Census Program

A Land Use Census will be conducted annually to identify, within a distance of 8 km (5 miles), the location in each of the meteorological sectors of the nearest residence, the nearest vegetable garden greater than 50m^2 (500 ft^2) producing broad leaf vegetation and the nearest milk-producing animal in each of the 22 1/2° meteorological sectors within a distance of five miles.

If a Land Use Census identifies a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at the location from which samples are currently being obtained the new location(s) will be added to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from this monitoring program after October 31 of the year in which this Land Use Census was conducted. Any location from which milk can no longer be obtained may be dropped from the surveillance program after notifying the NRC in writing that they are no longer obtainable at that location.

The Land Use Census shall be conducted during the growing season at least once per 12 months using that information that will provide the best results, such as by a door-to-door survey, aerial survey, general observations, or by consulting local agriculture authorities. The results of the Land Use Census shall be included in the Annual Radiological Environmental Operating Report.

5.3 Inter Laboratory Comparison Program

The laboratories of the licensee and/or licensee's contractors which perform analyses shall participate in the Environmental Protection Agency's (EPA) Environmental Radioactivity Laboratory Intercomparisons Studies (Crosscheck) Program or equivalent program. This participation shall include all of the determinations (sample medium-radionuclide combinations) that are offered by EPA and that also are included in the monitoring program. The results of analysis of these crosscheck samples shall be included in the Annual Radiological Environmental Operating Report.

* Broad leaf vegetation sampling of at least three different types of vegetation may be performed at the site boundary in each of two different sectors with the highest predicted D/Qs in lieu of the garden census. Specifications for broad leaf vegetation sampling in Table 5.1-1 shall be followed, including analysis of control samples.

If the results of a determination in the EPA crosscheck program (or equivalent program) are outside the specified control limits, the laboratory shall investigate the cause of the problem and take steps to correct it. The results of this investigation and corrective action shall be included in the Annual Radiological Environmental Operating Report.

Table 5.1-1

PNPP Radiological Environmental Monitoring Program

Sample Media	Locations*	Sampling Frequency	Analysis Type	Analysis Frequency
Airborne radioiodine and particulates	1, 3, 4, 5, 6, 7, 35	Continuous sampler operation with collection weekly or as required by dust loading, loading, whichever is more frequent	Radioiodine I-131	Weekly following canister change
			Particulates Gross Beta(a)	Weekly following filter change
			Gamma Isotpic(b)	Composite, by location quarterly
Direct Radiation (3 TLDs/location)	1 through 24, 35, 36 41, 42, 43, 45, 53, 54, 55, 56, 58	Continuous sampling, one TLD exchanged quarterly	Gamma Dose	Quarterly
		Continuous sampling, one TLD exchanged annually	Gamma Dose	Annually
		Continuous sampling, one TLD exchanged quarterly or under emergency situations	Gamma Dose	Quarterly or under emergency situations
Waterborne surface	28, 34, 59, 60	Composite(c)	H-3	Composite, by location, quarterly
drinking(d)	36		Gross Beta	Monthly
			Gamma Isotopic	Monthly
Sediment from shoreline	25, 26, 27, 32	Semiannually -- Spring and Fall as weather permits	Gamma Isotopic	Semiannually
Soil(e)	1, 2, 4, 6, 12, 14, 18, 20	Quarterly	Gamma Isotopic Sr-89/90	Quarterly

See footnotes at end of table.

Table 5.1-1 (Cont.)
PNPP Radiological Environmental Monitoring Program

Sample Media	Locations*	Sampling Frequency	Analysis Type	Analysis Frequency
Ingestion				
Milk[i]	29, 30, 31, 47 51, 52, 57, 61	Monthly when animals are not on pasture	I-131, Gamma Isotopic	Monthly
		Semimonthly when animals are on pasture	I-131, Gamma Isotopic	Semimonthly
Fish	25, 32	Semiannually -- Spring and Fall as weather permits	Gamma Isotopic (edible portion)	Semiannually
Food Products				
Human Consumption	38, 39, 49, 50	Annually	I-131, Gamma Isotopic	Annualy
Animal Consumption	29, 31, 47, 51, 52, 57	Annually, location determined by annual milk animal and garden census	I-131, Gamma Isotopic	Annually
Vegetation	6, 7, 35, 44, 48	Monthly during growing season	I-131, Gamma Isotopic	Monthly during growing season
Precipitation[e]	3, 4, 6, 7, 12, 35	Monthly	Gamma Isotopic, Gross Beta, Tritium	Monthly

Sampling locations were selected on the basis of local ecology, meteorology, physical charactizations of the region, and demographic and land use features of the site vicinity. Other factors considered were applicable regulatory guidelines (Appendix I to 10CFR50, Regulatory Guides 4.1, 4.2, and 4.8), population distribution (from environmental report), ease of access to sampling stations, security, future program integrity (e.g., not placing TLD's near areas under construction or where the potential for vandalism is high, and the NRC Radiological Assessment Branch Technical Position on radiological environmental monitoring as revised in Revision 1, November 1979 (reference 1). In addition, certain locations where PNPP operations are unlikely to affect levels of radiation or radioactivity were selected as control locations.

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Footnotes to Table 5.1-1 (Cont.)

(a) Particulate sample filters will be analyzed for gross beta 24 hours or more after sampling to allow for radon and thoron daughter decay.

(b) Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility. If gross beta activity in air or water is greater than ten times the mean of control samples for any medium, gamma isotopic analysis will be performed on the individual samples.

(c) Composite samples will be collected with equipment that is capable of collecting an aliquot at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly).

(d) Biweekly (2 week period) I-131 analysis on each composite is to be performed when the dose calculated from the consumption of water is greater than 1 mrem/year (using ODCM methodology for maximum organ and age group).

(e) Not Technical Specification required sample medium.

(f) When milk sampling is not performed, samples of three kinds of broad leaf vegetation grown nearest each of the two different offsite locations of highest predicted annual average ground level D/Q and one sample of each of similar broad leaf vegetation grown 15 to 30 km distant in the least prevalent wind direction shall be performed.

Table 5.1-2
Reporting Levels for Radioactivity Concentrations in Environmental Samples

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)
H-3	2×10^4(a)				
Mn-54	1×10^3		3×10^4		
Fe-59	4×10^2		1×10^4		
Co-58	1×10^3		3×10^4		
Co-60	3×10^2		1×10^4		
Zn-65	3×10^2		2×10^4		
Zr-Nb-95	4×10^2				
I-131	2×10^0	9×10^{-1}		3×10^0	1×10^2
Cs-134	3×10^1	1×10^1	1×10^3	6×10^1	1×10^3
Cs-137	5×10^1	2×10^1	2×10^3	7×10^1	2×10^3
Ba-La-140	2×10^2			3×10^2	

(a) For drinking water samples. The value given is the 40CFR141 value.

Table 5.1-3

Detection Capabilities for Environmental Sample Analysis and Lower Limit of Detection (LLD) (a) (b)

ANALYSIS[c]	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
Gross Beta	4×10^0	1×10^{-2}				
H-3	2×10^{3}[d]					
Mn-54	1.5×10^1		1.3×10^2			
Fe-59	3×10^1		2.6×10^2			
Co-58, 60	1.5×10^1		1.3×10^2			
Zn-65	3×10^1		2.6×10^2			
Nb-95	3×10^1					
Zr-95	1.5×10^1					
I-131	1×10^{0}[e]	7×10^{-2}		1×10^0	6×10^1	
Cs-134	1.5×10^1	5×10^{-2}	1.3×10^2	1.5×10^1	6×10^1	1.5×10^2
Cs-137	1.8×10^1	6×10^{-2}	1.5×10^2	1.8×10^1	6×10^1	1.8×10^2
Ba-140	6×10^1			6×10^1		
La-140	1.5×10^1			1.5×10^1		

Table 5.1-3 (Cont.)

Table Notations

[a]Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13, except for specification regarding energy dependence. Correction factors shall be provided for energy ranges not meeting the energy dependence specification.

[b]The methodology for determining the LLD is contained in Appendix B.

[c]This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.6. For these radionuclides in Technical Specification Table 4.12-1 which are not detected, the typical LLDs for the measurement system will be separately reported in the annual report.

[d]If no drinking water pathway exists, a value of 3×10^3 pCi/l may be used.

[e]If no drinking water pathway exists, a value of 1.5×10^1 pCi/l may be used.

Table 5.1-4

Sampling Locations and Media for Environmental Monitoring
Perry Nuclear Power Plant

	Description	Distance (Miles)	Direction	Media[1]
1	Redacted (Haines Road, North of West Chapel Road) On pole 3303609; first pole south of first driveway of left	3.4	ENE	APT, AI, TLD, SO
2	Site Boundary; Tree line Ash tree 1000 feet NNW of second transmission tower from road	0.7	E	TLD, SO
3	Meteorological Tower On fence surrounding the equipment shelter	1.0	SE	APT, AI, TLD, PR
4	On pole #W79/SPG5-30; inside auxiliary road gate of Parmly Road	0.7	S	APT, AI, TLD, PR, SO
5	Site Boundary, Quincy Substation On pole #L1283/9300, east side of substation	0.6	SW	APT, AI, TLD
6	Concord Service Center (Control) Auburn Road south of Rt. 90; on inside rear fence next to gate	11.0	SSW	APT, AI, TLD, PR, SO, VL
7	Site Boundary; Lockwood Road Bus turnaround, on the right, 100 feet past the turnaround on tree with white dot.	0.6	NE	APT, AI, TLD, VL, PR
8	Site Boundary; Tree Line, behind nursery off Antioch Road	0.8	E	TLD
9	Site Boundary; Transmission Line Tower Third tower from Antioch Road toward the plant	0.7	ESE	TLD
10	South-southeast Corner Security Fence On pole at turn in the fence	0.8	SSE	TLD
11	Transmission Line Tower On tower at SW corner of Center and Parmly Roads	0.6	SSW	TLD
12	Site Boundary; Transmission Line Tower Access road from N side of Parmly just W of location #5	0.6	WSW	TLD, PR, SO

Table 5.1-4 (Cont.)
Sampling Locations and Media for Environmental Monitoring
Perry Nuclear Power Plant

Location No.	Description	Distance (Miles)	Direction	Media(1)
13	Madison-on-the-Lake At end of Whitewood Drive, N of Chapel Road, NW side of turnaround on pole #835803	4.7	ENE	TLD
14	Hubbard Road (South of North Ridge Road) On pole #28974 on W side of road, S side of McMackin Creek	4.9	E	TLD, SO
15	Madison Substation (Eagle Street) On utility pole inside substation fence	5.1	ESE	TLD
16	Dayton Road (North of Interstate 90) On pole #572203 on left after dirt driveway which is just after the sharp left on Dayton	5.0	SE	TLD
17	Chadwick Road (Cul de Sac South of Interstate 90) On pole #276222/1182011; last pole on left	5.2	SSE	TLD
18	Blair Road On pole on left just after road makes 90 degree left curve down hill heading towards river	5.0	S	TLD, SO
19	Lane Road and South Ridge Road On pole #PC5648, 100 feet north of intersection	5.3	SSW	TLD
20	Nursery Road at Route 2 Overpass On pole #828976 across from entrance to Route 2	5.3	SW	TLD, SO
21	Hardy Road at Painesville Township Park On pole #378345, east of park entrance	5.1	WSW	TLD
22	Painesville On S side of Main Street across from Evergreen Cemetery on tree with white dot 60 feet west of pole #DBPG296	6.9	SW	TLD

Table 5.1-4 (Cont.)

Sampling Locations and Media for Environmental Monitoring
Perry Nuclear Power Plant

Location No.	Description	Distance (Miles)	Direction	Media[1]
23	Fairport Harbor (High Street and New Street) On pole on rear substation facing street	7.9	WSW	TLD
24	St. Clair Ave. Substation (Control) In Mentor; on rear fence corner near railroad tracks	15.1	SW	TLD
25	PNPP Discharge	0.6	NNW	SED, PSH
26	Offshore at Redbird, vicinity of Ohio Water Service Company Intake	4.2	ENE	SED
27	Offshore, vicinity of Fairport Harbor Water Supply System Intake	7.9	WSW	SED
28	Ashtabula (Control), CEI Generating Station Intake	22.0	ENE	WTR
29	Milk Farm, Waites residence, Antioch Road, Perry	1.3	ESE	MLK, PS
30	Milk Farm, Manley residence, North Ridge Road, Perry	2.3	SSW	MLK, PS
31	Milk Farm, Boffer residence, Antioch Road, Perry	1.4	ESE	MLK, PS
32	Mentor-on-the-Lake (Control)	15.8	WSW	PSH, SED
33	Deleted			
34	PNPP Intake	0.7	NW	WTR
35	Site Boundary; north of transmission line, next to transformer, follow tree line	0.6	E	APT, AI, TLD, VL, PR
36	Painesville Water Supply Intake	3.9	WSW	WTR, TLD
37	Deleted			
38	Seith Farm, 2861 Antioch Road, 0.5 miles from North Ridge Road	1.1	E	PD
39	Goldings Farm Stand 3515 North Ridge Road	1.8	SSW	PD

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Table 5.1-4 (Cont.)
Sampling Locations and Media for Environmental Monitoring
Perry Nuclear Power Plant

Location No.	Description	Distance (Miles)	Direction	Media[1]
40	Deleted			
41	Clark Road One-half mile from Center Road, on pole No. 561969, south side of road	1.1	SW	TLD
42	Parmly Road One-half mile from Center Road, located on utility pole No. 582923 near southwest corner of plant fence	0.8	S	TLD
43	Parmly Road Approximately 0.6 miles from Center Road next to stream, tree with white dot 50 feet from road, left of stream	1.0	SS	TLD
44	Parmly Road	1.0	SSE	VL
45	Clark Road Approximately 0.2 miles from Center Road on Pole No. 561960, south side of road	0.9	SSW	TLD
46	Deleted			
47	Milk Farm, Zoldak residence, Middle Ridge Road, Madison	6.5	E	MLK, FS
48	Antioch Road	1.1	ENE	VL
49	Garden, 4385 Lockwood Road	0.8	NE	PD
50	Garden, 13271 Radcliffe Road	10.9	S	PD
51	Rettger Farm, 13863 Painesville-Warren Road	9.2	S	MLK, FS
52	Milk Farm, Pollack residence, Wood Rd.	4.5	SE	MLK, FS
53	Neff Perkins, Co., southeast fence corner	0.5	WSW	TLD
54	Hale Rd. School, pole No. 395910, 2nd from corner on Lee	4.6	SW	TLD
55	Perry School District Offices - On pine in tree line by baseball diamond	2.5	S	TLD
56	Madison High School, 1st clump of pine trees from library	4.0	ESE	TLD
57	Butler Residence, 6244 N. Ridge Road	8.5	E	MLK, FS
58	On tree in NW corner of Losely Nursery off Antioch Road, approximately 100 yards north of location #8	0.8	ENE	TLD
59	Lake shoreline at the north end of Green Road	4.0	ENE	WTR
60	Lake shoreline at the retired boat launch area in Perry Park	1.0	WSW	WTR
61	Milk Farm, Keller residence, Dewey Road, Madison	7.4	SE	MLK, FS

(1) AI - Air Iodine; APT - Air Particulate; FS - Feed/Silage; FSH - Fish; MLK - Milk; PD - Produce; PR - Precipitation; SED - Sediment; SO - Soil; TLD - Ambient Gamma Dose Rate; VL - Vegetation; WTR - Water

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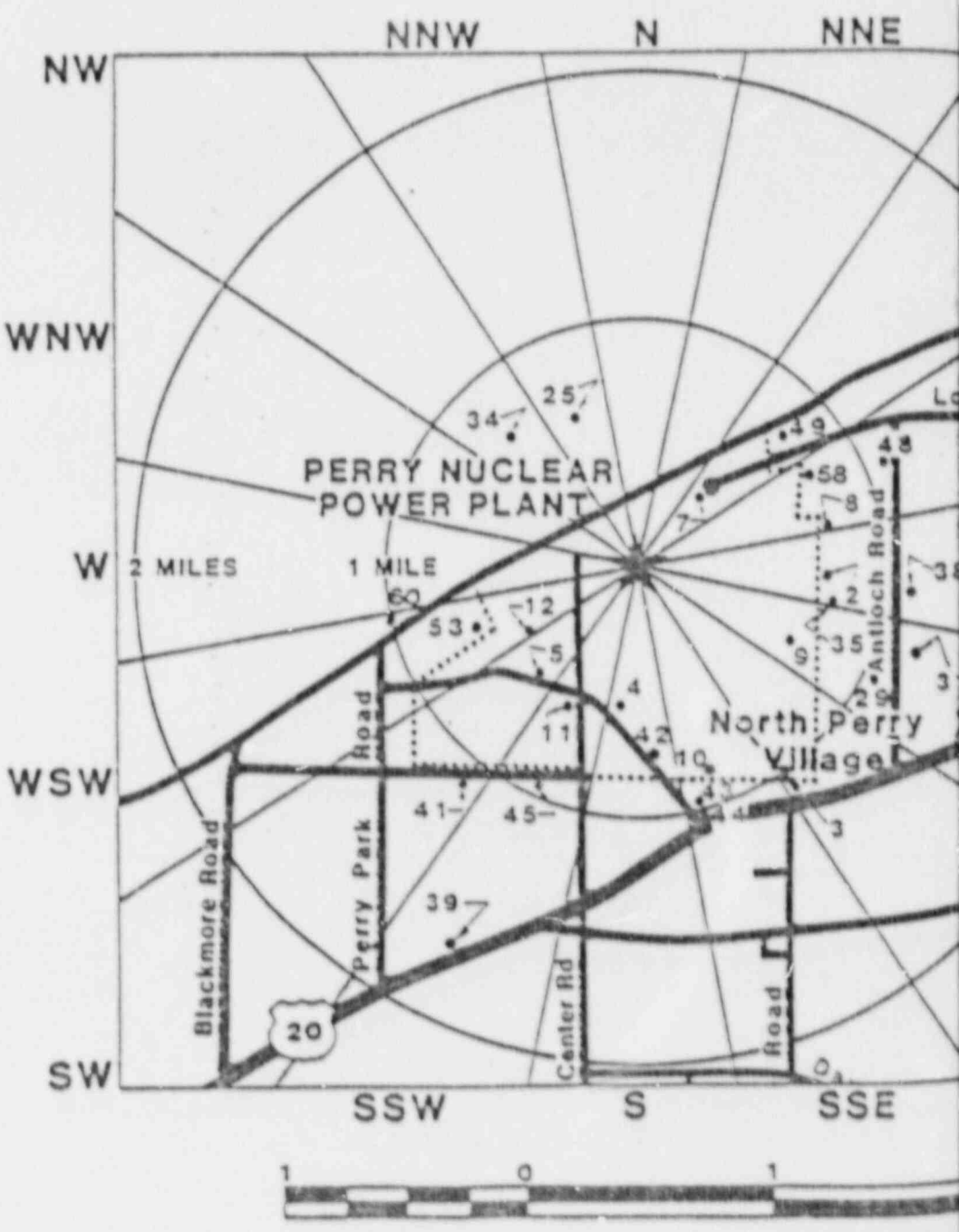

Figure 5.1-1
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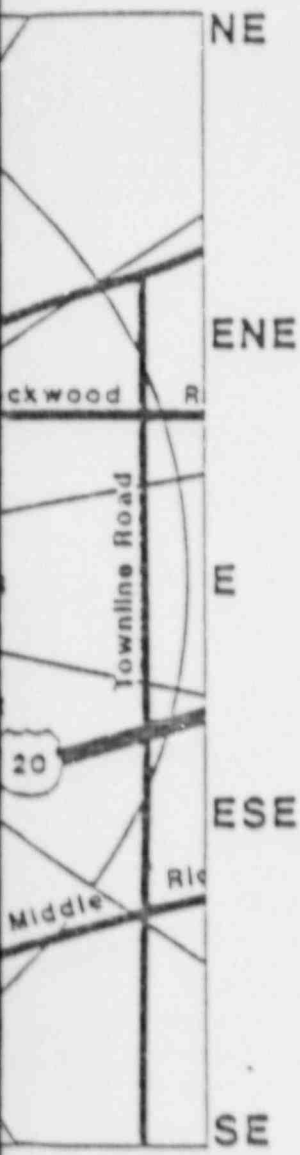
S APPROXIMATELY 2 MILES FROM SITE



LEGEND

Location Number	Media	Direction
2	TLD,SO	E
3	APT,AI,TLD,PR	SE
4	APT,AI,TLD,PR,SO	S
5	APT,AI,TLD	SW
7	APT,AI,TLD,VL	NE
8	TLD	ENE
9	TLD	ESE
10	TLD	SSE
11	TLD	SSW
12	TLD,PR,SO	WSW
25	SED,FSH	NNW
29	MLK,FS	ESE
31	MLK,FS	ESE
34	WTR	NW
35	APT,AI,TLD,PR,VL	E
38	PD	E
39	PD	SSW
41	TLD	SW
42	TLD	S
43	TLD	SSE
44	VL	SSE
45	TLD	SSW
48	VL	ENE
49	PD	NE
53	TLD	WSW
58	TLD	ENE
60	WTR	WSW

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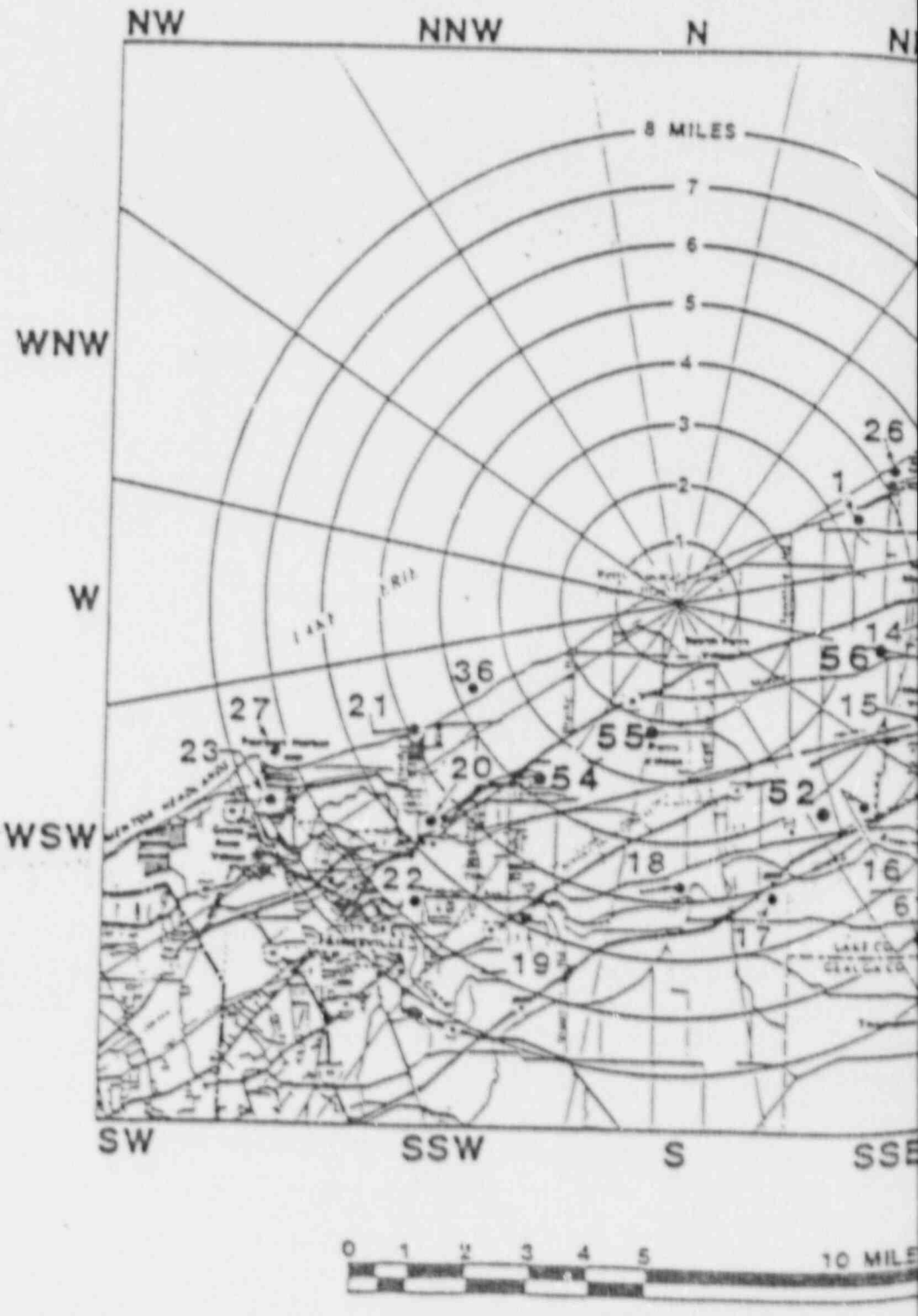

Figure 5.1-2
AL ENVIRONMENTAL MONITORING PROGRAM
TIONS APPROXIMATELY 8 MILES FROM SITE

LEGEND

Location Number	Media	Direction	
1	APT,AI,TLD,SO	ENE	
13	TLD	ENE	
14	TLD,SO	E	
15	TLD	ESE	
16	TLD	SE	
17	TLD	SSE	
18	TLD,SO	S	
19	TLD	SSW	
20	TLD,SO	SW	
21	TLD	WSW	
22	TLD	SW	
23	TLD	WSW	
26	SED	ENE	
27	SED	WSW	
30	MLK,FS	SSW	TC-1
36	WTR,TLD	WSW	
47	MLK,FS	E	
52	MLK,FS	SE	
54	TLD	SW	
55	TLD	S	
56	TLD	ESE	
57	MLK,FS	E	TC-1
59	WTR	ENE	
61	MLK,FS	SE	TC-2

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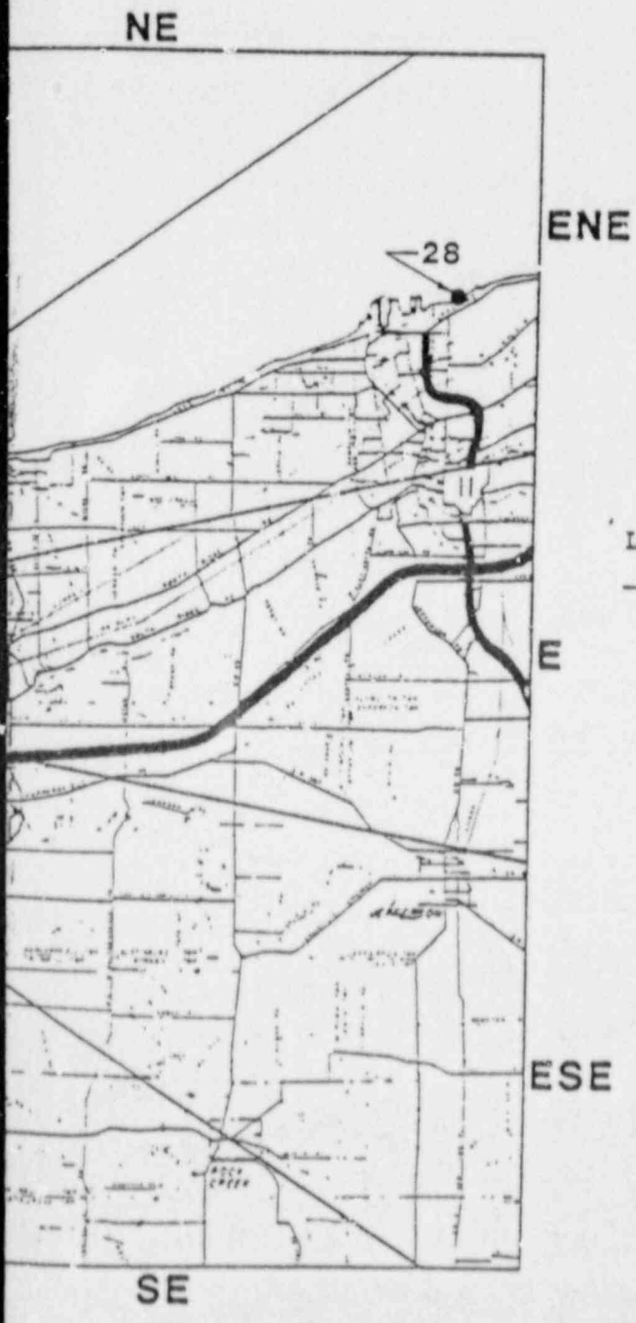
Fig
RADIOLOGICAL ENVIRONMENTAL MO
CONTROL LOCATIONS GRE

ure 5.1-3
NITORING PROGRAM SAMPLING LOCATIONS
ATER THAN 10 MILES FROM SITE



Location Number
6
24
28
32
50
51

LEGEND

Media	Direction
APT,AI,TLD,PR,SO,VL	SSW
TLD	SW
WTR	ENE
FSH,SED	WSW
PD	S
MLK,FS	S

ES

Appendix A

Atmospheric Dispersion and Deposition Parameters

The atmospheric dispersion and deposition parameters used to calculate gaseous effluent doses will be calculated using the following equations. Dose calculations will be performed using hourly meteorological and effluent data. All atmospheric releases at PNPP are considered to be ground-level releases.

a. Constant Mean Wind Direction Relative Dispersion Factor

$$X/Q = \frac{(2.32)\ (T_f)}{(\bar{u})\ (x)\ (\sigma)} \qquad \text{(A-1)}$$

Where:

X/Q = the relative dispersion factor at ground level, in s/m^3;

T_f = the terrain correction factor, from FSAR Table 2.3-26, dimensionless;

$\bar{u}$ = the wind speed (measured at 10m), in m/s;

x = the distance of calculation, in m;

2.032 = $(2/\pi)^{1/2}$ divided by the width in radians of a 22.5° sector

σ = the lesser of $\left(\sigma_z^2 + \frac{H_c^2}{2\pi}\right)^{1/2}$ or $(\sigma_z)\ (3^{1/2})$

Where:

H_c = the building height (44.8m);

σ_z = the vertical dispersion coefficient, per Regulatory Guide 1.111, in m.

b. Depleted Relative Dispersion Factor

$$X/Q_d = (X/Q)(DPL_j) \qquad \text{(A-2)}$$

Where:

X/Q_d = the depleted relative dispersion factor (for airborne halogens and particulates), in s/m^3;

DPL_j = the ground depletion factor for the "j"th distance, interpolated from Table A-1, dimensionless;

X/Q = the relative dispersion factor, per equation A-1.

c. Ground Deposition

$$D/Q = \frac{(DEP_j)(T_f)}{(0.3927)\ (x)} \qquad \text{(A-3)}$$

Where:

D/Q = the relative deposition per unit area (for halogens and particulates), in m^{-2};

DEP_j = the ground deposition factor for the "j"th distance, interpolated from Table A-1, in m^{-1};

T_f = terrain correction factor, from FSAR Table 2.3-26, dimensionless;

x = the "j"th distance, in m;

0.3927 = radians per 22.5° sector

Table A-1

Atmospheric Depletion and Deposition Factors

	Pasquill Stability Class	Distance (meters)									
		200	500	1,000	2,000	3,000	6,000	10,000	30,000	50,000	80,000
Depletion Factors (DPL_j)	All	0.970	0.936	0.900	0.860	0.832	0.770	0.714	0.590	0.517	0.440
Deposition Factors (DEP_j)(m^{-1})	All	1.25E-4	8.0E-5	5.4E-5	3.2E-5	2.6E-5	1.5E-5	9.9E-6	4.5E-6	3.0E-6	2.0E-6

The following tables contain annual average atmospheric dispersion and deposition parameters for long-term releases at PNPP. Long-term releases are those that occur greater than 500 hours per year. The highest annual average relative concentration (χ/Q) value at the site boundary for sectors over land shall be used for radioactive gaseous effluent monitor setpoint calculations. The dispersion model used was XOQDOQ, with PNPP FSAR site-specific terrain adjustment factors included. Dispersion values are based on seven years of meteorological data (May 1, 1972 through April 30, 1974 and September 1, 1977 through August 31, 1982), ground-level releases, sector spread for purge calculations, and twelve wind speed classes.

Table A-2
Site Boundary Atmospheric Dispersion (X/Q) and Deposition Parameters (D/Q) for PNPP Unit 1

SECTOR	DISTANCE (MILES)	X/Q (SEC./CUB. METER)	D/Q (PER SQ. METER)
N	0.18	3.7E-05	1.6E-07
NNE	0.25	1.8E-05	7.9E-08
NE	0.42	5.8E-06	3.1E-08
ENE	0.67	2.1E-06	1.6E-08
E	0.67	2.2E-06	1.8E-08
ESE	0.67	1.6E-06	1.3E-08
SE	0.79	1.4E-06	1.1E-08
SSE	0.82	2.2E-06	1.4E-08
S	0.81	2.7E-06	1.6E-08
SSW	0.80	1.3E-06	6.8E-09
SW	0.65	2.3E-06	1.1E-08
WSW	0.56	4.2E-06	1.5E-08
W	0.27	2.5E-05	4.6E-08
WNW	0.18	5.9E-05	8.4E-08
NW	0.17	6.6E-05	1.1E-07
NNW	0.17	5.9E-05	1.2E-07

Table A-3
Atmospheric Dispersion (X/Q) as a Function of Distance (s/m^3)

SECTOR	0.2 (MILES)	0.3 (MILES)	0.4 (MILES)	0.5 (MILES)	0.6 (MILES)
N	4.904E-05	2.453E-05	1.525E-05	1.057E-05	7.918E-06
NNE	2.656E-05	1.360E-05	8.640E-06	6.082E-06	4.612E-06
NE	1.859E-05	9.760E-06	6.293E-06	4.460E-06	3.383E-06
ENE	1.327E-05	7.129E-06	4.636E-06	3.293E-06	2.490E-06
E	1.363E-05	7.362E-06	4.760E-06	3.367E-06	2.538E-06
ESE	1.025E-05	5.566E-06	3.602E-06	2.547E-06	1.916E-06
SE	1.113E-05	6.061E-06	3.935E-06	2.788E-06	2.100E-06
SSE	1.894E-05	1.022E-05	6.647E-06	4.718E-06	3.560E-06
S	2.288E-05	1.227E-05	7.932E-06	5.615E-06	4.238E-06
SSW	1.142E-05	6.079E-06	3.925E-06	2.777E-06	2.097E-06
SW	1.449E-05	7.663E-06	4.928E-06	3.479E-06	2.622E-06
WSW	2.151E-05	1.111E-05	7.031E-06	4.934E-06	3.733E-06
W	4.184E-05	2.081E-05	1.281E-05	8.833E-06	6.606E-06
WNW	4.669E-05	2.298E-05	1.401E-05	9.573E-06	7.093E-06
NW	4.908E-05	2.423E-05	1.482E-05	1.015E-05	7.521E-06
NNW	4.580E-05	2.266E-05	1.390E-05	9.541E-06	7.083E-06

SECTOR	0.7 (MILES)	0.8 (MILES)	0.9 (MILES)	1.0 (MILES)	1.1 (MILES)
N	6.138E-06	4.968E-06	4.203E-06	3.636E-06	1.949E-06
NNE	3.622E-06	2.947E-06	2.481E-06	2.132E-06	1.278E-06
NE	2.662E-06	2.165E-06	1.815E-06	1.552E-06	9.269E-07
ENE	1.957E-06	1.588E-06	1.325E-06	1.129E-06	6.710E-07
E	1.991E-06	1.613E-06	1.343E-06	1.141E-06	6.768E-07
ESE	1.501E-06	1.215E-06	1.010E-06	8.571E-07	5.080E-07
SE	1.647E-06	1.334E-06	1.108E-06	9.402E-07	4.456E-07
SSE	2.796E-06	2.266E-06	1.885E-06	1.601E-06	5.524E-07
S	3.327E-06	2.697E-06	2.247E-06	1.911E-06	7.340E-07
SSW	1.646E-06	1.335E-06	1.114E-06	9.486E-07	5.223E-07
SW	2.053E-06	1.664E-06	1.391E-06	1.188E-06	5.667E-07
WSW	2.927E-06	2.380E-06	2.002E-06	1.719E-06	8.671E-07
W	5.110E-06	4.135E-06	3.504E-06	3.036E-06	1.630E-06
WNW	5.434E-06	4.378E-06	3.719E-06	3.235E-06	1.845E-06
NW	5.764E-06	4.643E-06	3.941E-06	3.425E-06	1.952E-06
NNW	5.439E-06	4.385E-06	3.720E-06	3.230E-06	1.839E-06

Table A-3 (Cont.)
Atmospheric Dispersion (X/Q) as a Function of Distance (s/m^3)

SECTOR	1.2 (MILES)	1.3 (MILES)	1.4 (MILES)	1.5 (MILES)	1.6 (MILES)
N	1.729E-06	1.549E-06	1.399E-06	1.273E-06	1.166E-06
NNE	1.128E-06	1.006E-06	9.050E-07	8.202E-07	7.485E-07
NE	8.150E-07	7.243E-07	6.494E-07	5.867E-07	5.340E-07
ENE	5.878E-07	5.205E-07	4.652E-07	4.190E-07	3.803E-07
E	5.917E-07	5.230E-07	4.667E-07	4.197E-07	3.804E-07
ESE	4.437E-07	3.919E-07	3.494E-07	3.140E-07	2.843E-07
SE	3.891E-07	3.436E-07	3.062E-07	2.751E-07	2.491E-07
SSE	4.829E-07	4.267E-07	3.807E-07	3.423E-07	3.102E-07
S	6.424E-07	5.684E-07	5.076E-07	4.569E-07	4.145E-07
SSW	4.576E-07	4.054E-07	3.624E-07	3.266E-07	2.965E-07
SW	4.976E-07	4.417E-07	3.955E-07	3.570E-07	3.246E-07
WSW	7.648E-07	6.814E-07	6.125E-07	5.547E-07	5.060E-07
W	1.449E-06	1.299E-06	1.175E-06	1.070E-06	9.809E-07
WNW	1.644E-06	1.479E-06	1.341E-06	1.224E-06	1.124E-06
NW	1.739E-06	1.563E-06	1.416E-06	1.292E-06	1.186E-06
NNW	1.637E-06	1.471E-06	1.332E-06	1.214E-06	1.115E-06

SECTOR	1.7 (MILES)	1.8 (MILES)	1.9 (MILES)	2.0 (MILES)	2.1 (MILES)
N	1.074E-06	9.931E-07	9.226E-07	8.604E-07	8.052E-07
NNE	6.967E-07	6.331E-07	5.864E-07	5.453E-07	5.090E-07
NE	4.886E-07	4.494E-07	4.153E-07	3.854E-07	3.263E-07
ENE	3.471E-07	3.184E-07	2.936E-07	2.718E-07	2.526E-07
E	3.467E-07	3.177E-07	2.925E-07	2.705E-07	2.283E-07
ESE	2.590E-07	2.371E-07	2.182E-07	2.017E-07	1.871E-07
SE	2.268E-07	2.076E-07	1.910E-07	1.765E-07	1.637E-07
SSE	2.827E-07	2.590E-07	2.384E-07	2.205E-07	1.407E-07
S	3.780E-07	3.466E-07	3.194E-07	2.955E-07	1.373E-07
SSW	2.706E-07	2.494E-07	2.290E-07	2.121E-07	1.409E-07
SW	2.968E-07	2.727E-07	2.518E-07	2.335E-07	2.173E-07
WSW	4.439E-07	4.275E-07	3.957E-07	3.678E-07	5.303E-07
W	9.037E-07	8.365E-07	7.777E-07	7.258E-07	1.050E-06
WNW	1.038E-06	9.622E-07	8.960E-07	8.375E-07	1.142E-06
NW	1.055E-06	1.015E-06	9.445E-07	8.826E-07	8.275E-07
NNW	1.028E-06	9.527E-07	8.865E-07	8.281E-07	7.761E-07

Table A-3 (Cont.)
Atmospheric Dispersion (X/Q) as a Function of Distance (s/m^3)

SECTOR	2.2 (MILES)	2.3 (MILES)	2.4 (MILES)	2.5 (MILES)	2.6 (MILES)
N	7.560E-07	7.118E-07	6.720E-07	6.359E-07	6.033E-07
NNE	4.766E-07	4.477E-07	4.217E-07	3.982E-07	3.770E-07
NE	3.050E-07	2.859E-07	2.688E-07	2.534E-07	2.395E-07
ENE	2.356E-07	2.205E-07	2.069E-07	1.947E-07	1.837E-07
E	2.127E-07	1.988E-07	1.864E-07	1.752E-07	1.652E-07
ESE	1.743E-07	1.628E-07	1.525E-07	1.433E-07	1.351E-07
SE	1.524E-07	1.424E-07	1.334E-07	1.253E-07	1.181E-07
SSE	1.311E-07	1.225E-07	1.149E-07	1.080E-07	1.018E-07
S	1.280E-07	1.197E-07	1.123E-07	1.056E-07	9.963E-08
SSW	1.314E-07	1.230E-07	1.154E-07	1.087E-07	1.025E-07
SW	2.030E-07	1.902E-07	1.787E-07	1.683E-07	1.590E-07
WSW	4.964E-07	4.661E-07	4.388E-07	4.142E-07	3.920E-07
W	9.867E-07	9.296E-07	8.780E-07	8.313E-07	7.891E-07
WNW	1.079E-06	1.014E-06	9.587E-07	9.088E-07	8.636E-07
NW	7.782E-07	7.339E-07	6.939E-07	6.576E-07	6.247E-07
NNW	7.297E-07	6.879E-07	6.502E-07	6.161E-07	5.852E-07

SECTOR	2.7 (MILES)	2.8 (MILES)	2.9 (MILES)	3.0 (MILES)	3.1 (MILES)
N	5.734E-07	5.460E-07	5.208E-07	4.976E-07	4.762E-07
NNE	3.576E-07	3.398E-07	3.235E-07	3.086E-07	2.948E-07
NE	2.268E-07	2.152E-07	2.046E-07	1.949E-07	1.859E-07
ENE	1.737E-07	1.645E-07	1.562E-07	1.485E-07	1.415E-07
E	1.560E-07	1.477E-07	1.401E-07	1.331E-07	1.267E-07
ESE	1.275E-07	1.207E-07	1.144E-07	1.087E-07	9.399E-08
SE	1.113E-07	1.054E-07	9.996E-08	9.493E-08	9.031E-08
SSE	9.613E-08	9.099E-08	8.630E-08	8.200E-08	7.805E-08
S	9.415E-08	8.917E-08	8.462E-08	8.044E-08	7.661E-08
SSW	9.697E-08	9.189E-08	8.725E-08	8.299E-08	7.907E-08
SW	1.505E-07	1.428E-07	1.357E-07	1.291E-07	1.231E-07
WSW	3.716E-07	3.531E-07	3.360E-07	3.204E-07	2.520E-07
W	7.503E-07	7.147E-07	6.820E-07	6.519E-07	5.874E-07
WNW	8.220E-07	7.838E-07	7.487E-07	7.164E-07	7.722E-07
NW	5.945E-07	5.668E-07	5.413E-07	5.178E-07	5.412E-07
NNW	5.567E-07	5.307E-07	5.067E-07	4.846E-07	4.642E-07

Table A-3 (Cont.)
Atmospheric Dispersion (X/Q) as a Function of Distance (s/m^3)

SECTOR	3.2 (MILES)	3.3 (MILES)	3.4 (MILES)	3.5 (MILES)	3.6 (MILES)
N	4.563E-07	4.379E-07	4.208E-07	4.047E-07	3.899E-07
NNE	2.820E-07	2.702E-07	2.592E-07	2.489E-07	2.395E-07
NE	1.777E-07	1.700E-07	1.629E-07	1.562E-07	1.501E-07
ENE	1.350E-07	1.290E-07	1.234E-07	1.182E-07	1.135E-07
E	1.208E-07	1.154E-07	1.103E-07	1.056E-07	1.013E-07
ESE	8.958E-08	8.550E-08	8.173E-08	7.821E-08	7.499E-08
SE	8.606E-08	8.213E-08	7.849E-08	7.510E-08	7.200E-08
SSE	7.441E-08	7.105E-08	6.794E-08	6.503E-08	6.237E-08
S	7.307E-08	6.980E-08	6.678E-08	6.395E-08	6.136E-08
SSW	7.546E-08	7.212E-08	6.902E-08	6.613E-08	6.348E-08
SW	1.176E-07	1.125E-07	1.077E-07	1.033E-07	9.922E-08
WSW	2.410E-07	2.308E-07	2.214E-07	2.125E-07	2.044E-07
W	5.631E-07	5.406E-07	5.196E-07	4.999E-07	4.818E-07
WNW	7.409E-07	7.118E-07	6.848E-07	6.593E-07	6.359E-07
NW	5.192E-07	4.987E-07	4.797E-07	4.618E-07	4.454E-07
NNW	4.452E-07	4.276E-07	4.112E-07	3.958E-07	3.817E-07

SECTOR	3.7 (MILES)	3.8 (MILES)	3.9 (MILES)	4.0 (MILES)	4.1 (MILES)
N	3.759E-07	3.628E-07	3.504E-07	3.388E-07	2.981E-07
NNE	2.306E-07	2.222E-07	2.144E-07	2.070E-07	1.819E-07
NE	1.441E-07	1.390E-07	1.339E-07	1.292E-07	1.247E-07
ENE	1.090E-07	1.048E-07	1.009E-07	9.718E-08	9.373E-08
E	9.722E-08	9.342E-08	8.987E-08	8.653E-08	8.341E-08
ESE	7.196E-08	6.912E-08	6.647E-08	6.399E-08	6.166E-08
SE	6.908E-08	6.635E-08	6.380E-08	6.140E-08	5.378E-08
SSE	5.987E-08	5.753E-08	5.537E-08	5.328E-08	5.135E-08
S	5.892E-08	5.664E-08	5.451E-08	5.251E-08	5.063E-08
SSW	6.098E-08	5.865E-08	5.646E-08	5.441E-08	5.248E-08
SW	9.537E-08	9.178E-08	8.841E-08	8.525E-08	8.228E-08
WSW	1.967E-07	1.896E-07	1.828E-07	1.765E-07	1.462E-07
W	4.646E-07	4.485E-07	4.334E-07	4.191E-07	3.043E-07
WNW	6.137E-07	5.929E-07	5.733E-07	5.548E-07	4.180E-07
NW	4.298E-07	4.151E-07	4.013E-07	3.883E-07	3.761E-07
NNW	3.682E-07	3.556E-07	3.438E-07	3.326E-07	2.928E-07

Table A-3 (Cont.)

Atmospheric Dispersion (X/Q) as a Function of Distance (s/m^3)

SECTOR	4.2 (MILES)	4.3 (MILES)	4.4 (MILES)	4.5 (MILES)	4.6 (MILES)
N	2.887E-07	2.798E-07	2.714E-07	2.634E-07	2.559E-07
NNE	1.759E-07	1.703E-07	1.650E-07	1.599E-07	1.552E-07
NE	1.205E-07	1.166E-07	1.128E-07	1.093E-07	1.059E-07
ENE	9.047E-08	8.740E-08	8.451E-08	8.176E-08	7.921E-08
E	8.046E-08	7.769E-08	7.508E-08	7.260E-08	7.030E-08
ESE	5.946E-08	5.740E-08	5.545E-08	5.361E-08	5.189E-08
SE	5.186E-08	5.005E-08	4.835E-08	4.673E-08	4.523E-08
SSE	4.954E-08	4.783E-08	4.622E-08	4.469E-08	4.327E-08
S	4.886E-08	4.719E-08	4.562E-08	4.413E-08	4.274E-08
SSW	5.067E-08	4.896E-08	4.735E-08	4.581E-08	4.439E-08
SW	7.949E-08	7.684E-08	7.435E-08	7.198E-08	6.978E-08
WSW	1.413E-07	1.368E-07	1.325E-07	1.284E-07	1.246E-07
W	2.948E-07	2.858E-07	2.773E-07	2.691E-07	2.616E-07
WNW	4.051E-07	3.930E-07	3.815E-07	3.706E-07	3.603E-07
NW	3.649E-07	3.536E-07	3.432E-07	3.333E-07	3.241E-07
NNW	2.837E-07	2.752E-07	2.671E-07	2.593E-07	2.521E-07

SECTOR	4.7 (MILES)	4.8 (MILES)	4.9 (MILES)	5.0 (MILES)
N	2.487E-07	2.419E-07	2.354E-07	2.292E-07
NNE	1.507E-07	1.464E-07	1.423E-07	1.384E-07
NE	1.028E-07	9.975E-08	9.689E-08	9.416E-08
ENE	7.676E-08	7.443E-08	7.223E-08	7.014E-08
E	6.809E-08	6.600E-08	6.402E-08	6.214E-08
ESE	5.025E-08	4.869E-08	4.722E-08	4.582E-08
SE	4.379E-08	4.244E-08	4.115E-08	3.992E-08
SSE	4.191E-08	4.063E-08	3.941E-08	3.825E-08
S	4.141E-08	4.015E-08	3.896E-08	3.782E-08
SSW	4.302E-08	4.173E-08	4.050E-08	3.934E-08
SW	6.767E-08	6.567E-08	6.377E-08	6.196E-08
WSW	1.210E-07	1.175E-07	1.142E-07	1.110E-07
W	2.543E-07	2.474E-07	2.408E-07	2.345E-07
WNW	3.505E-07	3.411E-07	3.322E-07	3.237E-07
NW	3.152E-07	3.068E-07	2.987E-07	2.910E-07
NNW	2.452E-07	2.386E-07	2.323E-07	2.263E-07

Table A-4
Atmospheric Dispersion (D/Q) as a Function of Distance (m^{-2})

SECTOR	0.2 (MILES)	0.3 (MILES)	0.4 (MILES)	0.5 (MILES)	0.6 (MILES)
N	1.396E-07	7.578E-08	4.836E-08	3.383E-08	2.516E-08
NNE	1.107E-07	6.008E-08	3.834E-08	2.682E-08	1.995E-08
NE	9.733E-08	5.284E-08	3.372E-08	2.359E-08	1.755E-08
ENE	1.067E-07	5.795E-08	3.698E-08	2.587E-08	1.924E-08
E	1.184E-07	6.429E-08	4.103E-08	2.870E-08	2.135E-08
ESE	8.865E-08	4.813E-08	3.071E-08	2.149E-08	1.598E-08
SE	9.402E-08	5.105E-08	3.258E-08	2.279E-08	1.695E-08
SSE	1.338E-07	7.266E-08	4.637E-08	3.244E-08	2.413E-08
S	1.429E-07	7.757E-08	4.951E-08	3.463E-08	2.576E-08
SSW	6.094E-08	3.309E-08	2.111E-08	1.477E-08	1.099E-08
SW	7.267E-08	3.945E-08	2.518E-08	1.761E-08	1.310E-08
WSW	7.117E-08	3.864E-08	2.466E-08	1.725E-08	1.283E-08
W	7.129E-08	3.870E-08	2.470E-08	1.728E-08	1.285E-08
WNW	6.970E-08	3.784E-08	2.415E-08	1.689E-08	1.256E-08
NW	8.904E-08	4.834E-08	3.085E-08	2.158E-08	1.605E-08
NNW	9.623E-08	5.225E-08	3.334E-08	2.332E-08	1.735E-08

SECTOR	0.7 (MILES)	0.8 (MILES)	0.9 (MILES)	1.0 (MILES)	1.1 (MILES)
N	1.954E-08	1.560E-08	1.277E-08	1.068E-08	5.545E-09
NNE	1.549E-08	1.237E-08	1.013E-08	8.465E-09	4.945E-09
NE	1.362E-08	1.088E-08	8.907E-09	7.445E-09	4.350E-09
ENE	1.494E-08	1.193E-08	9.768E-09	8.164E-09	4.770E-09
E	1.658E-08	1.323E-08	1.084E-08	9.058E-09	5.292E-09
ESE	1.241E-08	9.905E-09	8.112E-09	6.781E-09	3.961E-09
SE	1.316E-08	1.051E-08	8.605E-09	7.192E-09	3.361E-09
SSE	1.874E-08	1.496E-08	1.225E-08	1.024E-08	3.480E-09
S	2.000E-08	1.597E-08	1.308E-08	1.093E-08	4.128E-09
SSW	8.531E-09	6.810E-09	5.577E-09	4.662E-09	2.521E-09
SW	1.017E-08	8.120E-09	6.651E-09	5.559E-09	2.598E-09
WSW	9.963E-09	7.953E-09	6.513E-09	5.444E-09	2.678E-09
W	9.980E-09	7.966E-09	6.524E-09	5.453E-09	2.832E-09
WNW	9.757E-09	7.788E-09	6.379E-09	5.332E-09	2.932E-09
NW	1.246E-08	9.949E-09	8.148E-09	6.811E-09	3.745E-09
NNW	1.347E-08	1.075E-08	8.807E-09	7.361E-09	4.047E-09

Table A-4 (Cont.)
Atmospheric Deposition (D/Q) as a Function of Distance (m^{-2})

SECTOR	1.2 (MILES)	1.3 (MILES)	1.4 (MILES)	1.5 (MILES)	1.6 (MILES)
N	4.777E-09	4.163E-09	3.664E-09	3.252E-09	2.910E-09
NNE	4.260E-09	3.713E-09	3.268E-09	2.900E-09	2.595E-09
NE	3.747E-09	3.265E-09	2.874E-09	2.551E-09	2.283E-09
ENE	4.109E-09	3.581E-09	3.151E-09	2.797E-09	2.503E-09
E	4.559E-09	3.973E-09	3.497E-09	3.104E-09	2.777E-09
ESE	3.413E-09	2.974E-09	2.617E-09	2.323E-09	2.079E-09
SE	2.896E-09	2.524E-09	2.221E-09	1.971E-09	1.764E-09
SSE	2.998E-09	2.612E-09	2.299E-09	2.041E-09	1.826E-09
S	3.556E-09	3.099E-09	2.727E-09	2.421E-09	2.166E-09
SSW	2.172E-09	1.892E-09	1.666E-09	1.478E-09	1.323E-09
SW	2.238E-09	1.950E-09	1.717E-09	1.524E-09	1.363E-09
WSW	2.307E-09	2.011E-09	1.770E-09	1.571E-09	1.406E-09
W	2.440E-09	2.126E-09	1.871E-09	1.661E-09	1.486E-09
WNW	2.525E-09	2.201E-09	1.937E-09	1.719E-09	1.538E-09
NW	3.226E-09	2.811E-09	2.474E-09	2.196E-09	1.965E-09
NNW	3.487E-09	3.039E-09	2.674E-09	2.374E-09	2.124E-09

SECTOR	1.7 (MILES)	1.8 (MILES)	1.9 (MILES)	2.0 (MILES)	2.1 (MILES)
N	2.619E-09	2.371E-09	2.158E-09	1.973E-09	1.812E-09
NNE	2.336E-09	2.115E-09	1.925E-09	1.760E-09	1.616E-09
NE	2.055E-09	1.860E-09	1.693E-09	1.547E-09	1.292E-09
ENE	2.253E-09	2.040E-09	1.856E-09	1.697E-09	1.558E-09
E	2.500E-09	2.263E-09	2.059E-09	1.883E-09	1.572E-09
ESE	1.871E-09	1.694E-09	1.542E-09	1.410E-09	1.294E-09
SE	1.588E-09	1.437E-09	1.308E-09	1.196E-09	1.098E-09
SSE	1.644E-09	1.488E-09	1.354E-09	1.238E-09	7.816E-10
S	1.950E-09	1.765E-09	1.606E-09	1.469E-09	6.743E-10
SSW	1.191E-09	1.078E-09	9.810E-10	8.969E-10	5.883E-10
SW	1.227E-09	1.111E-09	1.011E-09	9.244E-10	8.488E-10
WSW	1.265E-09	1.145E-09	1.042E-09	9.530E-10	1.352E-09
W	1.338E-09	1.211E-09	1.102E-09	1.008E-09	1.430E-09
WNW	1.385E-09	1.254E-09	1.141E-09	1.043E-09	1.393E-09
NW	1.769E-09	1.601E-09	1.457E-09	1.333E-09	1.223E-09
NNW	1.912E-09	1.731E-09	1.575E-09	1.440E-09	1.322E-09

Table A-4 (Cont.)
Atmospheric Deposition (D/Q) as a Function of Distance (m^{-2})

SECTOR	2.2 (MILES)	2.3 (MILES)	2.4 (MILES)	2.5 (MILES)	2.6 (MILES)
N	1.670E-09	1.544E-09	1.433E-09	1.334E-09	1.245E-09
NNE	1.489E-09	1.377E-09	1.278E-09	1.189E-09	1.110E-09
NE	1.191E-09	1.101E-09	1.022E-09	9.511E-10	8.879E-10
ENE	1.436E-09	1.328E-09	1.233E-09	1.147E-09	1.071E-09
E	1.449E-09	1.340E-09	1.243E-09	1.157E-09	1.080E-09
ESE	1.193E-09	1.103E-09	1.024E-09	9.528E-10	8.895E-10
SE	1.012E-09	9.362E-10	8.687E-10	8.085E-10	7.548E-10
SSE	7.204E-10	6.663E-10	6.183E-10	5.754E-10	5.372E-10
S	6.215E-10	5.749E-10	5.334E-10	4.964E-10	4.634E-10
SSW	5.422E-10	5.015E-10	4.653E-10	4.331E-10	4.043E-10
SW	7.823E-10	7.236E-10	6.714E-10	6.249E-10	5.834E-10
WSW	1.246E-09	1.153E-09	1.070E-09	9.956E-10	9.294E-10
W	1.318E-09	1.219E-09	1.131E-09	1.053E-09	9.827E-10
WNW	1.284E-09	1.188E-09	1.102E-09	1.026E-09	9.575E-10
NW	1.128E-09	1.043E-09	9.678E-10	9.007E-10	8.409E-10
NNW	1.219E-09	1.127E-09	1.046E-09	9.735E-10	9.089E-10

SECTOR	2.7 (MILES)	2.8 (MILES)	2.9 (MILES)	3.0 (MILES)	3.1 (MILES)
N	1.163E-09	1.092E-09	1.026E-09	9.666E-10	9.120E-10
NNE	1.039E-09	9.742E-10	9.155E-10	8.621E-10	8.134E-10
NE	8.307E-10	7.789E-10	7.320E-10	6.893E-10	6.504E-10
ENE	1.002E-09	9.396E-10	8.830E-10	8.315E-10	7.845E-10
E	1.011E-09	9.477E-10	8.906E-10	8.387E-10	7.913E-10
ESE	8.322E-10	7.804E-10	7.334E-10	6.906E-10	5.923E-10
SE	7.061E-10	6.622E-10	6.223E-10	5.860E-10	5.529E-10
SSE	5.026E-10	4.713E-10	4.429E-10	4.171E-10	3.935E-10
S	4.336E-10	4.066E-10	3.821E-10	3.598E-10	3.395E-10
SSW	3.782E-10	3.547E-10	3.333E-10	3.139E-10	2.961E-10
SW	5.458E-10	5.118E-10	4.810E-10	4.529E-10	4.273E-10
WSW	8.693E-10	8.154E-10	7.663E-10	7.216E-10	5.607E-10
W	9.194E-10	8.621E-10	8.102E-10	7.630E-10	6.775E-10
WNW	8.958E-10	8.400E-10	7.894E-10	7.434E-10	7.890E-10
NW	7.867E-10	7.377E-10	6.933E-10	6.528E-10	6.719E-10
NNW	8.503E-10	7.973E-10	7.493E-10	7.056E-10	6.657E-10

Table A-4 (Cont.)
Atmospheric Deposition (D/Q) as a Function of Distance (m^{-2})

SECTOR	3.2 (MILES)	3.3 (MILES)	3.4 (MILES)	3.5 (MILES)	3.6 (MILES)
N	8.620E-10	8.161E-10	7.739E-10	7.347E-10	6.991E-10
NNE	7.688E-10	7.279E-10	6.902E-10	6.552E-10	6.235E-10
NE	6.147E-10	5.820E-10	5.518E-10	5.239E-10	4.985E-10
ENE	7.413E-10	7.020E-10	6.657E-10	6.320E-10	6.014E-10
E	7.479E-10	7.081E-10	6.714E-10	6.374E-10	6.066E-10
ESE	5.598E-10	5.300E-10	5.026E-10	4.771E-10	4.541E-10
SE	5.225E-10	4.947E-10	4.691E-10	4.454E-10	4.238E-10
SSE	3.719E-10	3.521E-10	3.339E-10	3.170E-10	3.016E-10
S	3.209E-10	3.038E-10	2.880E-10	2.735E-10	2.602E-10
SSW	2.799E-10	2.650E-10	2.513E-10	2.386E-10	2.270E-10
SW	4.039E-10	3.824E-10	3.626E-10	3.442E-10	3.276E-10
WSW	5.299E-10	5.017E-10	4.757E-10	4.516E-10	4.298E-10
W	6.403E-10	6.062E-10	5.749E-10	5.458E-10	5.193E-10
WNW	7.457E-10	7.060E-10	6.695E-10	6.356E-10	6.048E-10
NW	6.351E-10	6.013E-10	5.702E-10	5.413E-10	5.151E-10
NNW	6.272E-10	5.957E-10	5.649E-10	5.363E-10	5.103E-10

SECTOR	3.7 (MILES)	3.8 (MILES)	3.9 (MILES)	4.0 (MILES)	4.1 (MILES)
N	6.657E-10	6.347E-10	6.059E-10	5.791E-10	5.036E-10
NNE	5.937E-10	5.661E-10	5.404E-10	5.165E-10	4.492E-10
NE	4.747E-10	4.526E-10	4.321E-10	4.129E-10	3.951E-10
ENE	5.727E-10	5.460E-10	5.212E-10	4.981E-10	4.766E-10
E	5.776E-10	5.507E-10	5.257E-10	5.024E-10	4.807E-10
ESE	4.324E-10	4.122E-10	3.935E-10	3.761E-10	3.598E-10
SE	4.036E-10	3.848E-10	3.673E-10	3.510E-10	3.053E-10
SSE	2.872E-10	2.739E-10	2.614E-10	2.498E-10	2.390E-10
S	2.478E-10	2.363E-10	2.255E-10	2.155E-10	2.062E-10
SSW	2.162E-10	2.061E-10	1.968E-10	1.880E-10	1.799E-10
SW	3.119E-10	2.974E-10	2.839E-10	2.713E-10	2.596E-10
WSW	4.093E-10	3.902E-10	3.725E-10	3.560E-10	2.919E-10
W	4.945E-10	4.715E-10	4.501E-10	4.302E-10	3.087E-10
WNW	5.759E-10	5.491E-10	5.242E-10	5.010E-10	3.728E-10
NW	4.905E-10	4.677E-10	4.464E-10	4.266E-10	4.082E-10
NNW	4.859E-10	4.633E-10	4.423E-10	4.227E-10	3.676E-10

Table A-4 (Cont.)
Atmospheric Deposition (D/Q) as a Function of Distance (m^{-2})

SECTOR	4.2 (MILES)	4.3 (MILES)	4.4 (MILES)	4.5 (MILES)	4.6 (MILES)
N	4.823E-10	4.624E-10	4.437E-10	4.260E-10	4.097E-10
NNE	4.302E-10	4.124E-10	3.957E-10	3.800E-10	3.654E-10
NE	3.784E-10	3.627E-10	3.480E-10	3.342E-10	3.214E-10
ENE	4.564E-10	4.375E-10	4.198E-10	4.031E-10	3.877E-10
E	4.603E-10	4.413E-10	4.234E-10	4.066E-10	3.910E-10
ESE	3.446E-10	3.303E-10	3.170E-10	3.044E-10	2.927E-10
SE	2.924E-10	2.803E-10	2.690E-10	2.583E-10	2.484E-10
SSE	2.289E-10	2.195E-10	2.106E-10	2.022E-10	1.944E-10
S	1.975E-10	1.893E-10	1.817E-10	1.744E-10	1.677E-10
SSW	1.723E-10	1.652E-10	1.585E-10	1.522E-10	1.463E-10
SW	2.486E-10	2.383E-10	2.287E-10	2.196E-10	2.112E-10
WSW	2.796E-10	2.690E-10	2.572E-10	2.469E-10	2.375E-10
W	2.956E-10	2.834E-10	2.719E-10	2.611E-10	2.511E-10
WNW	3.570E-10	3.422E-10	3.284E-10	3.153E-10	3.032E-10
NW	3.909E-10	3.747E-10	3.596E-10	3.453E-10	3.320E-10
NNW	3.521E-10	3.375E-10	3.239E-10	3.110E-10	2.991E-10

SECTOR	4.7 (MILES)	4.8 (MILES)	4.9 (MILES)	5.0 (MILES)
N	3.941E-10	3.795E-10	3.656E-10	3.525E-10
NNE	3.515E-10	3.384E-10	3.261E-10	3.144E-10
NE	3.092E-10	2.977E-10	2.868E-10	2.765E-10
ENE	3.729E-10	3.591E-10	3.460E-10	3.336E-10
E	3.762E-10	3.622E-10	3.489E-10	3.364E-10
ESE	2.816E-10	2.711E-10	2.612E-10	2.519E-10
SE	2.389E-10	2.300E-10	2.216E-10	2.137E-10
SSE	1.871E-10	1.801E-10	1.735E-10	1.673E-10
S	1.614E-10	1.554E-10	1.497E-10	1.443E-10
SSW	1.408E-10	1.355E-10	1.306E-10	1.259E-10
SW	2.031E-10	1.956E-10	1.884E-10	1.817E-10
WSW	2.285E-10	2.199E-10	2.119E-10	2.043E-10
W	2.415E-10	2.326E-10	2.241E-10	2.160E-10
WNW	2.917E-10	2.809E-10	2.706E-10	2.609E-10
NW	3.194E-10	3.075E-10	2.963E-10	2.857E-10
NNW	2.877E-10	2.770E-10	2.669E-10	2.573E-10

Appendix B

Lower Limit of Detection

The lower limit of detection (LLD) is the smallest concentration of radioactive material in a sample that will be detected with a 95 percent probability with a 5 percent probability of falsely concluding that a blank observation represents a "real" signal.

For a measurement system (which may include radiochemical separation) based on gross beta, gross alpha, liquid scintillation, or other analyses where a background count determined by a separate measurement with no sample (or blank sample) is subtracted from the gross sample count to obtain a net count due to sample activity:

$$LLD = \frac{3.3 \left(\frac{r_b}{t_s} + \frac{r_b}{t_b} \right)^{\frac{1}{2}}}{(C)(E)(V)(Y_c) \exp(-\lambda \Delta t)} \qquad \text{(B-1)}$$

Where:

LLD = the "apriori" lower limit of detection, as defined above;

C = the conversion factor of transformations per unit time per uCi or pCi;

E = the detector efficiency;

r_b = the background count rate in units of transformations per unit time;

t_b = the counting time of background;

t_s = the counting time of the sample;

V = the sample size, in units of mass or volume;

Y_c = the fractional radiochemical sample collection or concentration yield (when applicable);

Δt = for plant effluents, the elapsed time between the midpoint of sample collection and time of counting; for environmental samples, the elapsed time between sample collection (or end of the sample collection period) and time of counting;

λ = the radioactive decay constant for the radionuclide in question.

For the purpose of routine analyses, count times for both the sample(s) and background(s) are equal. This satisfies the given Technical Specification lower limit of detection definition, as the numerator of equation B-1 simplifies to 4.66 S_b, where S_b is the standard deviation of the background count rate or the count rate of a blank sample as appropriate.

The LLD is defined as an "apriori" (before the fact) limit representing the capability of a measurement system and not as an "a posteriori" (after the fact) limit for a particular measurement.

For gamma ray spectroscopy analyses (Canberra Spectran - F Version 2):

$$LLD = \frac{L_D \exp(0.693\ \Delta t / t_{1/2})}{(C)(E)(t)(V)(Y_c)(Y_\gamma)} \qquad (B\text{-}2)$$

Where:

LLD = the lower limit of detection, in μCi or pCi per unit mass or volume;

C = the conversion factor of transformations per unit time per μCi or pCi;

E = the detector efficiency for the energy in question;

t = the data collection (counting) time of sample;

$t_{1/2}$ = the half-life of the radionuclide in question;

V = the sample size, in units of mass or volume;

Y_c = the fractional radiochemical, sample collection, or concentration yield (when applicable);

Y_γ = the yield of the gamma ray in question;

Δt = for plant effluents the elapsed time between midpoint of sample collection and time of counting; for environmental samples, the elapsed time between sample collection (or end of the sample collection period) and the time of counting;

L_D = the detection limit

$$= k^2 + 2k\left(\frac{N}{2n}\left(1 + \frac{N}{2n}\right)(B_1 + B_2) + I + \sigma_I^2\right)^{1/2} \qquad (B\text{-}2a)$$

Where:

B_1 = the number of counts in "n" background channels below the peak due to Compton scattering, etc., determined at the same time a photopeak is measured;

B_2 = the number of counts in the "n" background channels above the peak;

k = an abscissa of the normal distribution corresponding to confidence level,

= 1.645 at a confidence level of 95%;

I = the measured value of interference in the photopeak of interest due to environmental background, detector contamination, etc., determined by a separate measurement with no sample;

N = the number of channels in the photopeak of interest;

n = the number of background channels on each side of the photopeak of interest;

σ_I = the standard deviation of I.

Typical values of E, V, Y, and Δt shall be used in the calculation.

In calculating the LLD for a radionuclide determined by gamma-ray spectrometry, the background shall include the typical contributions of other radionuclides normally present in the samples (e.g., potassium-40 in milk samples).

Analyses shall be performed in such a manner that the LLD's listed in Tables 4.11.1.1.1-1, 4.11.2.1.2-1, and 4.12.1-1 of the Radiological Effluent Technical Specifications for the Perry Nuclear Power Plant will be achieved under routine conditions. Occasionally, background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report or the Semiannual Radioactive Effluent Release Report.

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Attachment 9

Annual Land Use Census

ANNUAL

LAND-USE REPORT

1988

Prepared by: John A. Lepo — Date: 7/26/88

Reviewed by: Richard R. Bowers — Date: 7/26/88

Ray F. Zucker — Date: 7/26/88

THE PERRY NUCLEAR POWER PLANT

LAND USE SURVEY

1988

I. INTRODUCTION

The Perry Nuclear Power Plant is a twin unit BWR plant with a capacity to generate 1205 MWe Net per unit. The main condenser circulating water is cooled by a closed-loop natural draft cooling tower system. The plant is located on Lake Erie, on approximately 1100 acres about thirty-five miles northeast of Cleveland, Ohio.

The Unit 1 reactor has accumulated 5799.2 GWHr of operating capacity as of June 30th of this year. The construction of Unit 2 is on indefinite hold.

All nuclear facilities have the potential of releasing radioactive material to the environment. To assess the impact of this release, it is important to understand site-specific parameters within the communities around the plant. Some of these parameters include residents themselves and food products. The people who live, work, and farm within a community have a great influence on how the land is used.

The purpose of the land use survey is to determine the use of land within the vicinity of the plant and to identify any changes. The information obtained in this survey can be used in future dose pathway assessments.

This survey was conducted in accordance with 10 CFR 50 Appendix I, "Domestic Licensing of Production and Utilization Facilities", and the PNPP Technical Specifications, Section 12, "Radiological Environmental Monitoring Program".

II. METHODOLOGY

The procedure for conducting the Land Use Survey is PNPP REMP Instructions 0017, "Land Use Survey For Residence, Gardens and Milk-Producing Animals" Revision 0. The 1988 survey was conducted from June 3rd to June 14th.

The land use survey was conducted by traveling over major roads within the five mile radius of the plant. In residential areas (i.e., sub-divisions, small communities, and trailer parks), roads were selected at random for the survey.

The nearest resident and the nearest garden were determined by visual inspection. A map with 16 equal sectors (22.5 degrees per sector) was used to determine the nearest resident and nearest garden by sector.

Dairy cows, milking goats, and non-dairy animals were identified by visual roadside inspection, previous years Land Use information and information obtained from local residents.

Agricultural growers were identified by commercial roadside signs. A visual inspection of the area as well as the description on the roadside advertisement was used to determine the nature of the product grown on the property. This report includes a section covering general observations of the area during the survey.

III. RESULTS AND DISCUSSION

This survey reports the findings of the nearest resident and nearest garden by sector, as well as dairy animals and non-dairy animals within the five mile radius of the plant. The survey included agricultural growers within the five mile vicinity of the plant. Figure 1 is a map showing these locations by symbols.

The surveillance of dairy animals, non-dairy animals that consume vegetation, and agricultural growers will allow close monitoring of the food-chain pathway.

The dispersion and deposition values used in this report are taken from Appendix A of the PNPP Offsite Dose Calculation Manual (ODCM). These values represent the seven year annual average based on the seven year onsite meteorological data base. (REF. 1)

1. Nearest Resident

The nearest residents are shown in Table 1 which includes direction, address and distance, dispersion value (X/Q) and map locator for easy reference to Figure 1.

The resident at 3121 Center Road was identified as having the most restrictive dispersion value (X/Q) as a function of distance with respect to other sectors.

The historical trend of the nearest residents, by sector, since 1984, shows that only the residents in the South sector and the Northeast sector have changed.

2. Nearest Garden

The nearest gardens are shown in Table 2 which includes direction, address and distance, deposition value (D/Q) and map locator for easy reference to Figure 1.

The nearest garden with the highest deposition value as a function of distance with respect to other sectors was 3121 Center Rd. Last year the garden at 3119 Parmly Road had the highest D/Q value. The residence at 3121 was vacant last year and did not have a garden.

The historical review of PNPP Land Use Surveys since 1984 shows that several gardens have changed over this period. The owners of these gardens have occasionally chosen not to grow a garden during a particular year for personal reasons or the property has been vacant.

3. Dairy Animals

Dairy animals were confirmed from last year's annual land use survey and a search was made within the five mile radius of the plant to identify new locations.

The dairy animals are listed in Table 3 by direction, location, deposition (D/Q) value, number/type of animals, map locator, and comments.

The location at 3291 Parmly Rd., N. Perry was identified as having the highest deposition value as a function of distance with respect to other sectors. This location has been contacted for participation in the PNPP Radiological Environmental Monitoring Program for milk sampling on several occasions. The owners at this residence declined to participate. (Table 3)

The locations at map locator 23, 24, and 28 have been the most consistent in the past few years in supplying milk samples.

A new location in the SE sector, 7.4 miles from the plant on 5888 Dewey Road in Madison was added to the milk sampling program this year.

4. Non-Dairy Animals

Non-Dairy Animals, such as rabbits, cattle and pigs, are animals that consume vegetation (including pasture grass) as their main staple diet and can be consumed by man. The major food chain pathway is the air-to-pasture grass-to-animal-to-man.

Table 4 shows these animals by direction, location, deposition value, number/type of animal and map locator. This table is updated every year to reflect new locations, as well as locations that no longer have their livestock. The number of animals and type of animals change from year-to-year as owners purchase and sell their livestock.

A total of 24 locations were identified in the 1988 Land Use Survey. This is the same number of locations that were identified in the 1987 Land Use Survey.

5. Agricultural Growers

Agricultural growers are commercial businesses that grow crops or plants. These businesses are identified by roadside signs within the five mile vicinity of the plant. The two major pathways are: 1) air-to-crop-to-man and 2) air-to-soil-to-crop-to-man.

The identification of agricultural growers within the vicinity of PNPP will help in determining how the land is being used in the area.

The agricultural growers are depicted in Table 5. They are listed by name, address, city, sector/distance, deposition value, type of grower and map locator. Some agricultural growers have very large properties. In some cases, this property extends over many acres which crosses into other sectors. Also, the owners have property scattered over the Lake County area. The deposition value assigned to these locations only represent the point at where the property was identified during the survey.

A total of 45 agricultural growers were identified in this survey. Some of these locations may be owned by the same person or corporation or may be separate family entities (i.e., brother ownership--see map locator 55 and 84).

The majority of these locations are nurseries, with some nurseries also selling produce or fruit. The number of nurseries in this survey represented 73% of the total agricultural growers.

6. General Observations

All major roads within the five mile radius of the plant were covered during this survey. It should be noted that the land use within this radius varied quite differently in some areas.

For example, areas between 4 miles and 5 miles in the ENE, WSW, SW, and SSW sectors from the plant, are highly populated residential areas.

The area between 3 miles and 4 miles in the WSW sector is primarily heavy industrial. The land along Route 20 or N. Ridge Rd. is used mainly for commercial operations. This area is considered to be moderate to light in land use.

The remaining area within the five mile radius of the plant is rural farm land with moderate to low population density areas. No major residential, commercial or industrial development under construction was observed during this survey. Some single homes in different areas in the process of being built were observed in this survey.

IV. CONCLUSION

It can be concluded from this survey that the land within the five mile radius of the plant has not changed significantly since 1984. The changes noted in this report can be considered minor and subject to normal fluctuations in the methodology.

The major land use within the area is considered to be commercial nurseries, which includes wholesale and retail.

LAND USE SURVEY
1988
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TABLE 1

NEAREST RESIDENT BY SECTOR

AND DISPERSION (X/Q) VALUE

Direction	Nearest Resident (1)(2) (Distance/Address)	X/Q Value (Sec/m^3)	Map Locator
S	0.9 miles/3121 Center Road	2.25 E-6	1
NE	0.8 miles/4384 Lockwood Road	2.17 E-6	2
SSE	0.9 miles/3119 Parmly Road	1.89 E-6	3
ENE	1.0 miles/4602 Lockwood Road	1.13 E-6	4
SSW	0.9 miles/3850 Clark Road	1.11 E-6	5
WSW	1.1 miles/3462 Parmly Road	8.67 E-7	6
E	1.2 miles/2684 Antioch Road	5.92 E-7	7
SW	1.2 miles/3440 Clark Road	4.98 E-7	8
ESE	1.2 miles/2774 Antioch Road	4.44 E-7	9
SE	1.2 miles/4495 North Ridge Road	3.89 E-7	10

(1) The following sectors extend over water: W, WNW, NW, NNW, N, and NNE.

(2) All residents are located in the North Perry Township.

TABLE 2

NEAREST GARDEN BY SECTOR

AND DEPOSITION (D/Q) VALUE

Direction	Nearest Resident (1)(2) (Distance/Address)	D/Q Value (Per m^2)	Map Locator
S	0.9 miles/3121 Center Road	1.31 E-8	11
NE	0.8 miles/4384 Lockwood Road	1.09 E-8	12
SSE	0.9 miles/3119 Parmly Road	1.23 E-8	13
ENE	1.2 miles/4650 Lockwood Road	4.11 E-9	14
SSW	1.5 miles/3513 North Ridge Road	1.48 E-9	15
WSW	1.9 miles/Corner of Blackmore and Clark Roads (3)	2.31 E-9	16
E	1.1 miles/2674 Antioch Road	5.29 E-9	17
SW	1.2 miles/3440 Clark Road	2.24 E-9	18
ESE	1.3 miles/2846 Antioch Road	2.97 E-9	19
SE	1.2 miles/4521 North Ridge Road (4)	2.90 E-9	20

(1) The following sectors extend over water: W, WNW, NW, NNW, N, and NNE.

(2) All gardens are located in the North Perry Township.

(3) Cultivated corn field on south side of Clark Road; no address of owner of this field was available.

(4) This property belongs to Golding's Farm on 3515 North Ridge Road. The property extends north from North Ridge Road and turns west to Perry Park Road. This property is used for growing produce and fruits for public consumption.

TABLE 3

MILK ANIMAL BY SECTOR

AND DEPOSITION (D/Q) VALUE

Direction	Location (Distance/Address)	D/Q Value (Per m^2)	Number/Type of Animals	Map Locator	Comments
SSE	1.0 miles/ 3291 Parmly Road North Perry	1.02 E-8	1 Goat	21	Resident declined to participate in milk-sampling program.
ESE	1.3 miles/ Antioch Road North Perry	2.97 E-9	19 Goats	22	Waites residence (milk samples).
ESE	1.4 miles/ 2897 Antioch Road North Perry	2.62 E-9	8 Goats	23	Hofer residence (milk samples).
SW	2.3 miles/ 3202 North Ridge Road North Perry	7.24 E-10	30 Goats	24	Manley residence (milk samples).
SE	3.6 miles/ 5230 South Ridge Road Perry	4.24 E-10	4 Dairy Cows	25	Resident declined to participate in milk-sampling program.
SE	4.5 miles/ 4566 Wood Road Madison	2.58 E-10	2 Dairy Cows	26	Pollack residence (milk samples).

Direction	Location (Distance/Address)	D/Q Value (Per m^2)	Number/Type of Animals	Map Locator	Comments
SSE	4.1 miles/ 4676 Elberta Road Perry	2.39 E-10	2 Goats	27	
E	6.5 miles/ (1) Middle Ridge Road Madison	2.07 E-10	15 Goats	28	Zoldak residence (milk samples).
SSE	4.6 miles/ 3588 River Road Madison	1.94 E-10	1 Dairy Cow	29	
E	8.5 miles (1) North Ridge Road Geneva	1.35 E-10	10 Goats	30	Butler residence (milk samples).
SE	7.4 miles (1) 5888 Dewey Road Madison	1.07 E-10	14 Goats	100	Keller residence (milk samples). New location

(1) This location is not on map in Figure 1.

TABLE 4

NON-DAIRY ANIMALS

BY SECTOR AND DEPOSITION (D/Q)

Direction	Location (Distance/Address)	D/Q Value (Per m^2)	Number/Type of Animals	Map Locator
ESE	1.3 miles/ 2821 Antioch Road North Perry	2.97 E-9	3 Cattle 4 Pigs	31
E	2.0 miles/ 2620 Townline Road North Perry	1.88 E-9	3 Cows	32
S	1.8 miles/ 3590 Center Road Perry	1.77 E-9	1 Bull 2 Steer	33
E	2.1 miles/ 2541 Townline Road Madison	1.57 E-9	1 Goat 1 Cow 350 Rabbits	34
E	2.1 miles/ 2447 Townline Road Madison	1.57 E-9	1 Goat	35
SSE	2.0 miles/ 3608 Call Road Perry	1.24 E-9	10 Cattle	36

Direction	Location (Distance/Address)	D/Q Value (Per m^2)	Number/Type of Animals	Map Locator
ESE	2.6 miles/ 3234 McMackin Road Madison	8.90 E-10	18 Cattle	37
SW	2.2 miles/ 3340 Blackmore Road North Perry	7.82 E-10	6 Cattle	38
E	3.7 miles/ 6008 North Ridge Road Green Farm, Madison	5.78 E-10	8 Cattle	39
SE	3.1 miles/ 3941 Townline Road Perry	5.53 E-10	8 Cattle	40
SSE	2.8 miles/ 4686 Davis Road Perry	4.71 E-10	6 Cows	41
SE	3.7 miles/ 5320 South Ridge Road Perry	4.04 E-10	55 Cattle 4 Dairy Cows	42
E	4.6 miles/ 6401 Middle Ridge Woodworth Farm, Madison	3.91 E-10	49 Cattle	43
ESE	4.0 miles/ 3587 Dayton Road Madison	3.76 E-10	8 Cattle	44
ESE	4.5 miles/ 5960 Middle Ridge Madison	3.04 E-10	13 Cattle	45

Direction	Location (Distance/Address)	D/Q Value (Per m^2)	Number/Type of Animals	Map Locator
SE	4.4 miles/ 4260 Wood Road Madison	2.69 E-10	2 Cows	46
SE	4.5 miles/ 4566 Wood Road Madison	2.58 E-10	4 Cattle 1 Dairy Cow	47
SE	4.6 miles/ 4145 Dayton Road Madison	2.48 E-10		48
SSE	4.1 miles/ 4676 Elberta Road Perry	2.39 E-10	12 Cattle 2 Goats	49
SSE	4.6 miles/ 5278 River Road Madison	1.94 E-10	15 Cattle	50
SSE	4.6 miles/ 3588 River Road Perry	1.94 E-10	14 Cattle 1 Dairy Cow	51
SSE	4.8 miles/ 5551 River Road Madison	1.80 E-10	6 Cattle	52
S	4.7 miles/ 3920 River Road Perry	1.61 E-10	30 Cattle	53

Direction	Location (Distance/Address)	D/Q Value (Per m^2)	Number/Type of Animals	Map Locator
SSW	4.9 miles/ 3082 South Ridge Road Perry	1.31 E-10	8 Cattle	54

NOTE: The number of livestock may vary from time to time due to sale or slaughter.

TABLE 5

AGRICULTURAL GROWERS

WITHIN VICINITY OF PNPP

Name	Address	City	Sector/Distance	D/Q (Per m^2)	Type of Grower	Map Locator
Losely Nursery	Lockwood Road Antioch Road	North Perry	NE/0.9 miles E/1.0 miles	8.91 E-9 9.06 E-9	Nursery	55
Rutland Farm	Haines Road	Madison	ENE/3.1 miles	7.84 E-10	Strawberry Field	56
Twins Creek Farm	Haines Road	Madison	ENE/3.2 miles	7.41 E-10	Strawberry Field	57
Roe-Mer Nurseries	Green Road	Madison	E/3.6 miles	6.07 E-10	Nursery	58
Secor Nursery	North Ridge Road	Perry	ESE/1.8 miles	1.69 E-9	Nursery/ Strawberry Field	59
Rainbow Farms	Townline Road	Perry	ENE/1.9 miles	1.86 E-9	Strawberry Field	60
Antioch Farm	Antioch Road	North Perry	ESE/1.4 miles	2.62 E-9	Produce	61
Ridge Manor Nurseries Inc. (Reigert Farm)	North Ridge Road	Madison	E/2.9 miles	8.91 E-10	Nursery	62
Green Farm	North Ridge Road	Madison	E/3.7 miles	5.78 E-10	Straw/Hay/Rye	63
Ridge Manor Nurseries Inc. (Reigert Farm)	Hubbard Road	Madison	ENE/5.0 miles	3.34 E-10	Nursery	64
Great Lakes Evergreens (Dayton Farm #1)	Dayton Road	Madison	ESE/4.0 miles	3.76 E-10	Nursery	65

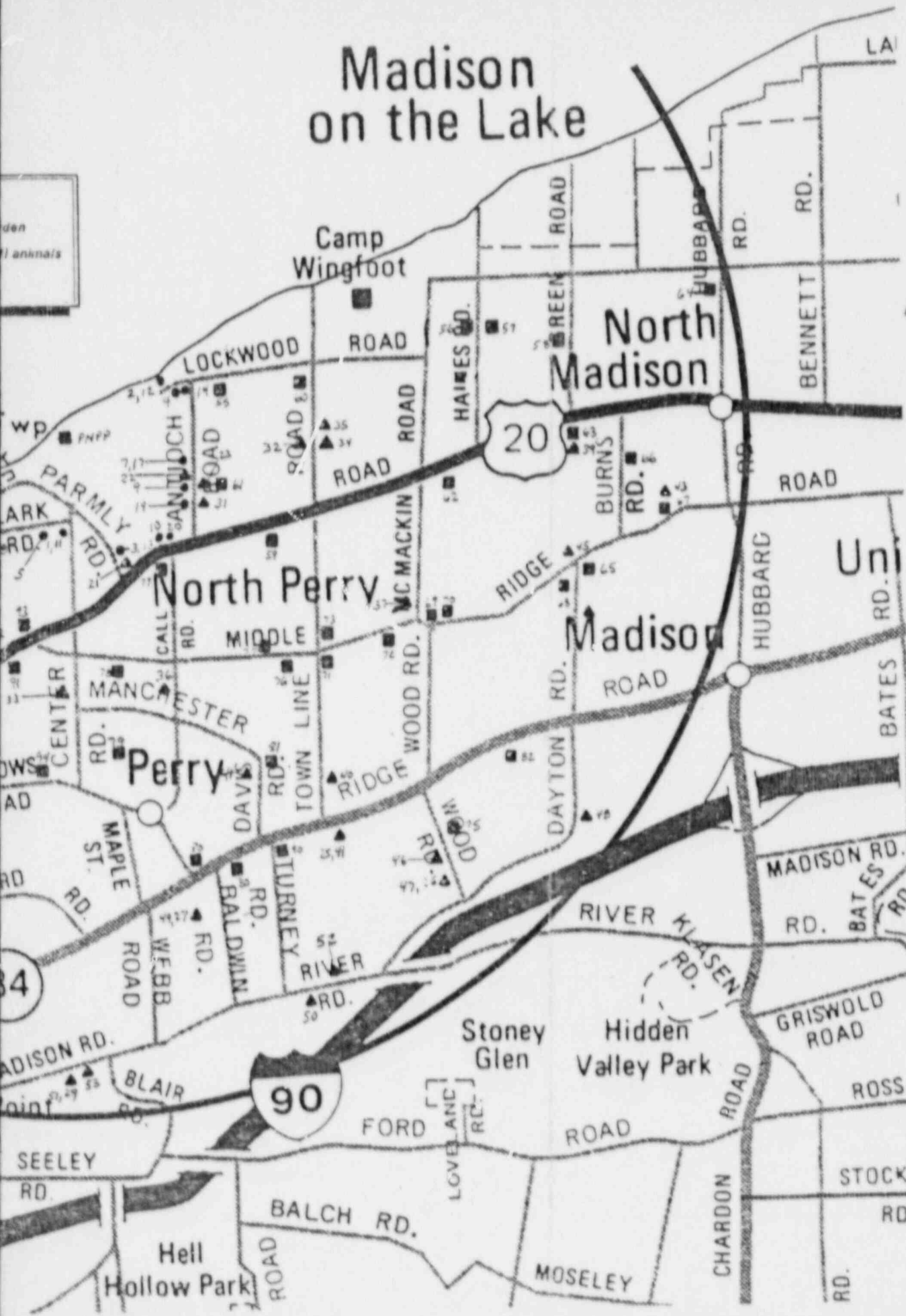
Name	Address	City	Sector/Distance	D/Q (Per m^2)	Type of Grover	Map Locator
Kingwood Nurseries	Burns Road	Madison	E/4.1 miles	4.81 E-10	Nursery	66
Woodworth Farm	Middle Ridge Road	Madison	E/4.6 miles	3.91 E-10	Produce	67
Great Lakes Evergreen (Hejduk Farm)	Middle Ridge Road	Madison	ESE/3.7 miles	4.32 E-10	Nursery	68
Sunleaf Nursery	Middle Ridge Road	Madison	ESE/3.0 miles	6.91 E-10	Nursery	69
Lake County Nursery (Kohanke Farm)	Middle Ridge Road	Madison	ESE/3.4 miles	5.03 E-10	Nursery	70
D. L. Crawford Nursery Inc.	Middle Ridge Road(1)	Madison	ESE/2.6 miles	8.89 E-10	Nursery	71
J. Turkenburg Nurseries	Middle Ridge Road	Madison	ESE/2.7 miles	8.32 E-10	Nursery	72
Means Nursery	Middle Ridge Road	Madison	ESE/2.7 miles	8.32 E-10	Nursery	73
Dugan Nurseries	North Ridge Road Manchester Road	Perry	SSE/1.3 miles S/1.7 miles	2.61 E-9 1.95 E-9	Nursery	74
Turkenburg Nurseries	Wood Road	Madison	SE/4.1 miles	3.05 E-10	Nursery	75
The Cottage Gardens	Middle Ridge Road	Perry	SE/1.7 miles	1.58 E-9	Nursery	76
D. E. Stallards/ Daughter Nursery	Middle Ridge Road	Perry	SE/1.9 miles	1.31 E-9	Nursery	77
Brookside Fruit Farm	Middle Ridge Road	Perry	S/1.7 miles	1.95 E-9	Fruits	78
Landscape Industries	Green Road	Perry	S/2.4 miles	5.33 E-10	Nursery	79

Name	Address	City	Sector/Distance	D/Q (Per m^2)	Type of Grower	Map Locator
Lake County Nursery	Narrows/South Ridge Roads	Perry	SSE/3.4 miles	3.34 E-10	Nursery	80
	South Ridge Road		SSE/3.5 miles	3.17 E-10		
	Turnkey/South Ridge Roads		SSE/3.6 miles	3.02 E-10		
Willowbend Nursery	Davis Road	Perry	SSE/2.6 miles	5.37 E-10	Nursery	81
Garnett Farm	South Ridge Road	Madison	SE/4.0 miles	3.51 E-10	Produce	82
Klyn Nurseries	South Ridge Road	Madison	SSW/4.8 miles	1.35 E-10	Nursery	83
Herman Losely/Sons Nurseries	Shepard Road	Perry	SSW/3.8 miles	2.06 E-10	Nursery	84
Perry Lake Nursery	Shepard/Lane Roads	Perry	SSW/4.3 miles	1.65 E-10	Nursery	85
Great Lakes Evergreen	Maine/Lane Roads	Perry	SSW/3.9 miles	1.97 E-10	Nursery	86
	North Ridge Road		SSW/1.7 miles	1.19 E-9		
Norris Garden Center	North Ridge Road	Perry	SW/2.8 miles	5.12 E-10	Nursery	87
West Orchard Fruit Market	North Ridge Road	Perry	SW/2.7 miles	5.46 E-10	Fruits	88
	Perry Park/Clark Roads		SW/1.6 miles	1.36 E-9	Produce	
Gilson Gardens	North Ridge Road	Perry	SW/2.5 miles	6.25 E-10	Nursery	89
Blackacre Farm	North Ridge Road	Perry	SW/2.3 miles	7.24 E-10	Produce	90
Martin's Nursery	North Ridge Road	Perry	SSW/1.9 miles	9.81 E-10	Nursery	91
Golding Farm	North Ridge Road	North Perry	SSW/1.7 miles	1.19 E-9	Fruits	92
	Perry Park Road		SW/1.5 miles	1.52 E-9	Produce	

Name	Address	City	Sector/Distance	D/Q (Per m^2)	Type of Grower	Map Locator
Lake County Nursery	North Ridge Road	North Perry	SSW/1.5 miles	1.48 E-9	Nursery	93
Lake County Nursery Inc.	Narrows Road	Perry	SSW/2.4 miles	4.65 E-10	Nursery	94
Frank Square Nursery	Narrows Road	Perry	SSW/2.9 miles	3.33 E-10	Nursery	95
Beardslee Nursery	Blackmore Road	Perry	SW/2.2 miles	7.82 E-10	Nursery	96
Penn-Ohio Gardens	Park Avenue	Painesville	SSW/5.0 miles	1.26 E-10	Nursery	97
Ralph T. Norman Nursery	Park Avenue	Painesville	SSW/5.0 miles	1.26 E-10	Nursery	98
Lester T. Square Farm	Blase-Nemeth Road	Painesville	SW/4.0 miles	2.71 E-10	Produce	99

(1) D. L. Crawford Nursery on both N & S sides of road.


N
KEY
· Nearest resident and/or ga
· Dairy and/or non-dairy (Bee
· Agricultural growers
LAKE ERIE
Perry
Par
Camp
Roosevelt
airport
Harbor
Painesville
Twp. Park
LAKE RD.
BACON RD.
BLACK MOORE
RIDGE
PERRY
PARK RD.
NARR
RO
HARDY RD.
Marine
Museum
535
HALE
RD.
SHEPA
KENNER
RD.
Grand
River
STATE
Casement
Airport
BOWHALL
RD.
PARK RD.
LANE RD.
Lake Co.
Hosp. East
MADISON
RD.
ST. RT.
MENTOR AVE.
Paines-
ville
Indian
Park
Lake Erie
College



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NUCLEAR GROUP

August 30, 1988
PY-CEI/NRR-0906 L

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Perry Nuclear Power Plant
Docket No. 50-440
Semiannual Radioactive
Effluent Release Report

Gentlemen:

We are hereby submitting the Semiannual Radioactive Effluent Release Report for the Perry Nuclear Power Plant, Unit 1, for the period of January 1 through June 30, 1988. This report meets the requirements of the Regulatory Guide 1.21, as applicable to the Perry Technical Specification, Section 6.9.1.7. All effluent releases were within the concentration and release limits specified in the Radiological Effluent Technical Specifications.

If you have any questions, please feel free to call.

Very truly yours,

A. Kaplan

Al Kaplan
Vice President
Nuclear Group

AK:njc

cc: T. Colburn
K. Connaughton
USNRC, Region III

IE48
1/1