NINE MILE POINT NUCLEAR STATION UNIT 1

DOCKET 50-220

COMPLIANCE WITH 10 CFR50 APPENDIX I

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE, NEW YORK

COMPLIANCE WITH 10CFR50 APPENDIX I

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FOREWORD

This report is submitted in response to a letter dated February 17, 1976, from George Lear, Chief of Operating Reactors Branch No. 3, Division of Operating Reactors, U.S. Nuclear Regulatory Commission to Mr. Gerald K. Rhode, Vice President-Engineering, Niagara Mohawk Power Corporation.

This report supersedes and replaces the earlier interim submittal made on June 4, 1976. The data contained in the earlier submittal have been incorporated into this report. The system design on which these analyses are based is identical to that described in the Petition for Conversion from Provisional Operating License to Full-Term Operating License and the Environmental Report and their associated amendments. The mathematical models used to calculate liquid and gaseous radioactive releases were obtained from the Nuclear Regulatory Commission's Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," April, 1976 and the referenced document specific to Boiling Water Reactors, NUREG-0016, April, 1976. No design changes have been made to cause increases in source terms. Any changes in releases between this report and those previously reported in the Petition for Conversion from Provisional Operating License to Full-Term Operating License and Environmental Report are caused by the new mathematical models and revised flow rates for the liquid radioactive waste system to be consistent with Regulatory Guide 1.112 and NUREG-0016 and are not caused by any change to the radioactive waste system components themselves.

All calculated dose rates resulting from releases from Nine Mile Point Unit 1 are shown to be within the design objectives set forth in Sections II.A, II.B, and II.C of 10CFR50 Appendix I. The calculated doses to the population residing within a radius of 50 miles are 0.18 man-rem and 6.3 man-thyroid-rem from liquid effluents and 0.23 man-rem and 3.3 man-thyroid-rem from gaseous effluents. Cost-benefit analyses are presented in accordance with Section II.D of 10CFR50 Appendix I. In performing these analyses, radwaste augments which are judged to be the most cost effective have been considered, based on the lists of potential augments presented in Regulatory Guide 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors," March, 1976. These analyses demonstrate (Tables 1.1.2-11 and -12) that additional radwaste equipment of reasonably demonstrated technology cannot be justified on a cost-benefit basis.

1.1 Compliance with 10CFR50 Appendix I, Section II

This section is divided into two parts. The first (Section 1.1.1) deals with the demonstration of compliance with the requirements set forth in Paragraphs A, B, and C of Section II of Appendix I to 10CFR Part 50. The second (Section 1.1.2) presents the results of a cost/benefit analysis performed in accordance with the requirements set forth in Paragraph D of Section II.D of Appendix I.

1.1.1 Compliance with Section II.A, II.B, and II.C

A comparison of the Appendix I design objectives and the calculated annual dose rates for individuals in the unrestricted area adjacent to Nine Mile Point Unit 1 is presented in Table 1.1.1-1.

This comparison demonstrates that all design objectives set forth in Sections II.A, II.B, and II.C are met. The calculated dose rates for individual pathways, from which the Table 1.1.1-1 summary has been prepared, are presented in Tables 1.1.1-2 through 1.1.1-12.

Table 1.1.1-2 presents the maximum calculated annual doses from noble gas effluents at the location of highest dose rate level (6,300 ft east, at the boundary of the restricted area). Tables 1.1.1-3 through 1.1.1-6 present maximum calculated dose rates in the adult, teen, child and infant age groups resulting from radioiodine and particulate gaseous effluents. The dose rate to the total body and various body organs is reported on the following bases: The individuals are assumed to be located at the least favorable location in the unrestricted area (i.e., 6,300 ft east) relative to contributions to the dose rate from inhalation and deposition on the ground. These individuals are assumed to consume fresh leafy vegetables grown at the nearest actual vegetable garden (7,300 ft east) and stored vegetables from the nearest developed orchard (7,000 ft east). They are further assumed to consume meat from the nearest actual location of meat animals (8,900 ft east-southeast). These are intentionally conservative assumptions.

Tables 1.1.1-7 and 1.1.1-8 present calculated annual thyroid doses at the nearest milk cow location (8,900 ft east-southeast) and goat location (19,000 ft south-southeast). The infant thyroid dose at the cow location is seen to be the largest calculated value, i.e., 0.75 mrem/yr.

The calculated maximum annual doses for individuals in the adult, teen, child and infant age groups resulting from liquid effluents are reported in Tables 1.1.1-9 through 1.1.1-12. For the purposes of these analyses, these individuals are conservatively assumed to receive contributions to their annual doses from: ingestion of potable water from the nearest public

water intake; ingestion of fish caught near the discharge; ingestion of aquatic invertibrates taken near the discharge; and a combination of exposures to the liquid effluents in water-related sports activities at the most conservative locations for which such activities could be postulated to occur. The resulting calculated maximum annual doses are 0.089 mrem/yr to the total body for an individual adult and 0.22 mrem/yr to the thyroid of an infant as summarized in Table 1.1.1-1.

1.1.2 Compliance with Section II.D - Cost/Benefit Analyses

This section presents the results of cost/benefit analyses performed in accordance with Section II.D of Appendix I to 10CFR50.

The estimated costs of the radwaste augments are arrived at by use of the data contained in Regulatory Guide 1.110. All costs are in terms of 1975 dollars. The benefit associated with each radwaste augment is calculated by multiplying the change in population dose by a conversion factor of $1,000 per man-rem and $1,000 per man-thyroid-rem.

The dose to the population residing within a radius of 50 miles is calculated with the plant systems and equipment as described in Sections 1.2 and 2.1 in this report. These population doses are for the same base case used to calculate the individual doses reported in Section 1.1.1. The resulting population doses are presented in Table 1.1.2-1.

The resultant population exposures are 0.18 and 6.3 man-rem and man-thyroid-rem, respectively, from liquid effluents and 0.23 and 3.3 man-rem and man-thyroid-rem, respectively, from gaseous effluents. These data form the base case from which the cost/benefit analyses are performed.

The potential dose from the ingestion of aquatic invertebrates is considered in computing doses to individuals (see Table 1.1.1-9). However, this is considered to be an inconsequential pathway relative to large population groups and is not considered in the population man-rem calculations. It is a small fraction of the fish contribution which has been shown to be an extremely small population dose consideration (see Table 1.1.2-1).

As can be seen in Tables 1.1.2-2 through 1.1.2-6, which present the detailed calculations from which Summary Table 1.1.2-1 is constructed, all potential pathways have been considered. No additional significant pathways which could contribute 10 percent or more to either individual or population doses are known to exist in the region around the site.

The following radwaste augments are considered in these analyses:

Gaseous Augment No. 1 - Addition of 100 percent filtration of the reactor building effluent with HEPA/charcoal filters.

Gaseous Augment No. 2 - Addition of 100 percent filtration of the condenser vacuum pump effluent with HEPA/charcoal filters.

Liquid Augment No. 1 - Addition of a 2 gpm reverse osmosis system in the detergent waste stream.

These augments were judged to be potentially the most cost-beneficial of the potential augments listed in Regulatory Guide 1.110, based on the calculated releases and doses for the base case. None of these augments is shown to be cost-beneficial. As these are the most promising of the potential augments, no additional augments are considered to be cost-beneficial.

1.1.2.1 Effluent Treatment Systems

The following Cost Estimate Sheets, Tables 1.1.2-7, -8, and -9, explain the cost of the augments to the gaseous and liquid radwaste systems. Table 1.1.2-10 summarizes the estimated annualized costs. The augments were analyzed using Regulatory Guide 1.110. They are as follows:

GASEOUS AUGMENTS

1. One hundred percent filtration of the reactor building gaseous effluent (see Table 1.1.2-7).

2. One hundred percent filtration of the condenser vacuum pump effluent (see Table 1.1.2-8).

LIQUID AUGMENT

1. Addition of a 2 gpm reverse osmosis system to the discharge of the laundry drain tanks (see Table 1.1.2-9).

Cost/Benefit

The potential reductions to the annual population exposure based on the items of augmentation described above are shown in Table 1.1.2-11. This table also shows the "benefit" of each augment, calculated by multiplying the dose reduction by $1,000 per man-rem or $1,000 per man-thyroid-rem as appropriate. As shown in Tables 1.1.2-10, -11, and -12, the "benefit" of each augment is much less than the corresponding annualized cost, resulting in cost/benefit ratios of much greater than one. Therefore, any addition of items of reasonably demonstrated technology which have the potential of reducing population dose would not be cost/benefit effective.

1.1.2.2 Cost of Money

The Niagara Mohawk Power Corporation has established that the annual cost of money is 11.5 percent. This represents the annual cost of money for 1975.

1.1.2.3 Cost/Benefit Parameters and Methods

Decontamination Factors and "On-Line" Time

Gaseous Augments

A decontamination factor of 10 for iodine and 100 for particulates was used in each gaseous augment. These are consistent with Regulatory Guide 1.112 and NUREG—0016.

The "on-line" time is conservatively assumed to be 100 percent for the purpose of this analysis.

Liquid Augment

A decontamination factor of 10 for Anions, 10 for Cesium and Rubidium, and 10 for other nuclides was used for the liquid augment, which is consistent with Regulatory Guide 1.112 as referenced above.

The "on-line" time is conservatively assumed to be 100 percent for the purpose of this analysis.

Parameters and Methods

The Indirect Cost Factor (ICF) is based on a three-unit site and separate, nonshared radwaste systems. Using the formula presented in Table A—5 of Regulatory Guide 1.110, a value of 1.58 is obtained for the ICF for Nine Mile Point Unit 1.

The Capital Recovery Factor (CRF) was determined using 11.5 percent as the cost of borrowed money and a service life of 25 years. Using these parameters and the formula presented in Table A—6 of Regulatory Guide 1.110, a value of 0.1231 is obtained for the CRF for Nine Mile Point Unit 1.

TABLE 1.1.1-1
COMPARISON OF CALCULATED ANNUAL DOSES
WITH
APPENDIX I DESIGN OBJECTIVES

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

CRITERION	APPENDIX I DESIGN OBJECTIVE	CALCULATED DOSE
Gaseous Effluents		
Gamma Air Dose	10 mrad/yr	0.11 mrad/yr
Beta Air Dose	20 mrad/yr	0.067 mrad/yr
Noble Gas - Total Body	5 mrem/yr	0.074 mrem/yr
Noble Gas - Skin	15 mrem/yr	0.14 mrem/yr
Iodines and Particulates Any Organ (Thyroid)	15 mrem/yr	0.75 mrem/yr*
Liquid Effluents		
Total Body	3 mrem/yr	0.089 mrem/yr
Any Organ	10 mrem/yr	0.22 mrem/yr**

* Infant thyroid dose for cow location (8,900 ft ESE)

**The infant thyroid dose is calculated to be the highest organ dose

TABLE 1.1.1-2

ANNUAL DOSES FROM NOBLE GAS EFFLUENTS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

CRITERION	LOCATION OF DOSE EVALUATION	CALCULATED DOSE
Gamma dose in air (mrad/yr)	Boundary of restricted area - 6300 ft East	$1.1x10^{-1}$
Beta dose in air (mrad/yr)	Boundary of restricted area - 6300 ft East	$6.7x10^{-2}$
Dose to total body of an individual (mrem/yr)	Boundary of restricted area - 6300 ft East	$7.4x10^{-2}$
Dose to skin of an individual (mrem/yr)	Boundary of restricted area - 6300 ft East	$1.4x10^{-1}$

TABLE 1.1.1-3

ANNUAL DOSES TO MAXIMUM INDIVIDUAL IN ADULT AGE GROUP FROM RADIOIODINE AND PARTICULATE GASEOUS EFFLUENTS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

	ANNUAL DOSE (mrem/yr)							
Pathway and Location	Total Body	Skin	Bone	Liver	Thyroid	Kidney	Lung	GI Tract
Inhalation - 6300 ft East	1.4×10^{-4}	N.A.	3.4×10^{-4}	2.6×10^{-4}	2.2×10^{-2}	2.5×10^{-4}	3.7×10^{-4}	1.5×10^{-4}
Deposition on Ground - 6300 ft East	1.2×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}
Ingestion of Leafy* Vegetables - 7300 ft East	1.3×10^{-3}	N.A.	3.4×10^{-3}	1.7×10^{-3}	2.2×10^{-1}	1.8×10^{-3}	5.3×10^{-4}	1.0×10^{-3}
Ingestion of Stored* Vegetables - 7000 ft East	7.0×10^{-3}	N.A.	2.2×10^{-2}	7.9×10^{-3}	1.4×10^{-2}	5.2×10^{-3}	4.3×10^{-3}	5.9×10^{-3}
Ingestion of Meat* - 8900 ft ESE	4.0×10^{-4}	N.A.	1.7×10^{-3}	4.3×10^{-4}	3.8×10^{-3}	3.8×10^{-4}	3.4×10^{-4}	4.4×10^{-4}
Total of Above Pathways	2.0×10^{-2}	1.4×10^{-2}	3.9×10^{-2}	2.2×10^{-2}	2.7×10^{-1}	2.0×10^{-2}	1.8×10^{-2}	2.0×10^{-2}

*Leafy vegetables, stored vegetables, and meat from these locations are conservatively assumed to be consumed by individuals located at the boundary of the restricted area, 6,300 ft east.

TABLE 1.1.1-4

ANNUAL DOSES TO MAXIMUM INDIVIDUAL IN TEENAGE GROUP FROM RADIOIODINE AND PARTICULATE GASEOUS EFFLUENTS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Pathway and Location	ANNUAL DOSE (mrem/yr) Total Body	Skin	Bone	Liver	Thyroid	Kidney	Lung	GI Tract
Inhalation - 6300 ft East	$1.1x10^{-4}$	N.A.	$1.1x10^{-4}$	$2.2x10^{-4}$	$1.9x10^{-2}$	$1.7x10^{-4}$	$3.5x10^{-4}$	$1.1x10^{-4}$
Deposition on Ground - 6300 ft East	$1.2x10^{-2}$	$1.4x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$
Ingestion of Leafy* Vegetables - 7300 ft East	$9.6x10^{-4}$	N.A.	$1.4x10^{-3}$	$1.5x10^{-3}$	$1.7x10^{-1}$	$1.2x10^{-3}$	$4.6x10^{-4}$	$7.3x10^{-4}$
Ingestion of Stored* Vegetables - 7000 ft East	$9.1x10^{-3}$	N.A.	$1.2x10^{-2}$	$1.2x10^{-2}$	$2.0x10^{-2}$	$6.4x10^{-3}$	$6.8x10^{-3}$	$8.2x10^{-3}$
Ingestion of Meat* - 8900 ft ESE	$2.9x10^{-4}$	N.A.	$3.0x10^{-4}$	$3.3x10^{-4}$	$2.7x10^{-3}$	$2.2x10^{-4}$	$2.6x10^{-4}$	$3.1x10^{-4}$
Total of Above Pathways	$2.2x10^{-2}$	$1.4x10^{-2}$	$2.6x10^{-2}$	$2.6x10^{-2}$	$2.2x10^{-1}$	$2.0x10^{-2}$	$2.0x10^{-2}$	$2.1x10^{-2}$

*Leafy vegetables, stored vegetables, and meat from these locations are conservatively assumed to be consumed by individuals located at the boundary of the restricted area, 6,300 ft east.

TABLE 1.1.1-5

ANNUAL DOSES TO MAXIMUM INDIVIDUAL IN CHILD AGE GROUP FROM RADIOIODINE AND PARTICULATE GASEOUS EFFLUENTS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

	ANNUAL DOSE (mrem/yr)							
Pathway and Location	Total Body	Skin	Bone	Liver	Thyroid	Kidney	Lung	GI Tract
Inhalation - 6300 ft East	$1.0x10^{-4}$	N.A.	$1.8x10^{-4}$	$2.3x10^{-4}$	$2.7x10^{-2}$	$9.2x10^{-5}$	$3.5x10^{-4}$	$2.6x10^{-4}$
Deposition on Ground - 6300 ft East	$1.2x10^{-2}$	$1.4x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$
Ingestion of Leafy* Vegetables - 7300 ft East	$9.9x10^{-4}$	N.A.	$2.5x10^{-3}$	$2.1x10^{-3}$	$2.5x10^{-1}$	$7.5x10^{-4}$	$8.0x10^{-4}$	$9.4x10^{-4}$
Ingestion of Stored* Vegetables - 7000 ft East	$1.8x10^{-2}$	N.A.	$2.9x10^{-2}$	$2.5x10^{-2}$	$4.3x10^{-2}$	$5.2x10^{-3}$	$1.6x10^{-2}$	$1.6x10^{-2}$
Ingestion of Meat* - 8900 ft ESE	$5.1x10^{-4}$	N.A.	$5.6x10^{-4}$	$5.7x10^{-4}$	$4.1x10^{-3}$	$1.4x10^{-4}$	$4.9x10^{-4}$	$5.1x10^{-4}$
Total of Above Pathways	$3.2x10^{-2}$	$1.4x10^{-2}$	$4.4x10^{-2}$	$4.0x10^{-2}$	$3.4x10^{-1}$	$1.8x10^{-2}$	$3.0x10^{-2}$	$3.0x10^{-2}$

*Leafy vegetables, stored vegetables, and meat from these locations are conservatively assumed to be consumed by individuals located at the boundary of the restricted area, 6,300 ft east.

TABLE 1.1.1-6
ANNUAL DOSES TO MAXIMUM INDIVIDUAL IN INFANT AGE GROUP
FROM RADIOIODINE AND PARTICULATE GASEOUS EFFLUENTS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

PATHWAY AND LOCATION	ANNUAL DOSE (mrem/yr)							
	TOTAL BODY	SKIN	BONE	LIVER	THYROID	KIDNEY	LUNG	GI TRACT
Inhalation-6300 ft East	2.0×10^{-4}	N.A.	2.6×10^{-4}	3.5×10^{-4}	4.6×10^{-2}	6.5×10^{-5}	5.2×10^{-4}	1.5×10^{-4}
Deposition on Ground-6300 ft East	1.2×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}
Ingestion of Leafy vegetables - 7300 ft East	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Ingestion of Stored vegetables - 7000 ft East	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Ingestion of Meat-8900 ft ESE	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Total of Above Pathways	1.2×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	5.8×10^{-2}	1.2×10^{-2}	1.3×10^{-2}	1.2×10^{-2}

TABLE 1.1.1-7

ANNUAL THYROID DOSES TO MAXIMUM INDIVIDUAL IN ALL AGE GROUPS FROM RADIOIODINE AND PARTICULATE GASEOUS EFFLUENTS COW LOCATION - 8900 FEET ESE

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

PATHWAY	ANNUAL THYROID DOSE (mrem/yr)			
	ADULT	TEEN	CHILD	INFANT
Inhalation	$1.2x10^{-2}$	$1.1x10^{-2}$	$1.5x10^{-2}$	$2.5x10^{-2}$
Deposition on Ground	$6.6x10^{-3}$	$6.6x10^{-3}$	$6.6x10^{-3}$	$6.6x10^{-3}$
Leafy Vegetables*	$5.9x10^{-2}$	$4.6x10^{-2}$	$6.9x10^{-2}$	N.A.
Stored Vegetables*	$3.8x10^{-3}$	$5.5x10^{-3}$	$1.2x10^{-2}$	N.A.
Cow's Milk	$1.0x10^{-1}$	$1.5x10^{-1}$	$3.0x10^{-1}$	$7.2x10^{-1}$
Meat*	$3.8x10^{-3}$	$2.7x10^{-3}$	$4.1x10^{-3}$	N.A.
Total of Above Pathways	$1.9x10^{-1}$	$2.2x10^{-1}$	$4.1x10^{-1}$	$7.5x10^{-1}$

*Conservatively assumed to exist at cow location

TABLE 1.1.1-8
ANNUAL THYROID DOSES TO MAXIMUM INDIVIDUAL IN ALL AGE GROUPS
FROM RADIOIODINE AND PARTICULATE GASEOUS EFFLUENTS
GOAT LOCATION - 19,000 FEET SSE

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

PATHWAY	ANNUAL THYROID DOSE (mrem/yr)			
	ADULT	TEEN	CHILD	INFANT
Inhalation	$1.9x10^{-3}$	$1.6x10^{-3}$	$2.3x10^{-3}$	$3.9x10^{-3}$
Deposition on Ground	$9.5x10^{-4}$	$9.5x10^{-4}$	$9.5x10^{-4}$	$9.5x10^{-4}$
Leafy Vegetables*	$7.0x10^{-3}$	$5.4x10^{-3}$	$8.1x10^{-3}$	N.A.
Stored Vegetables*	$4.5x10^{-4}$	$6.6x10^{-4}$	$1.4x10^{-3}$	N.A.
Goat's Milk	$1.4x10^{-2}$	$2.1x10^{-2}$	$4.3x10^{-2}$	$1.0x10^{-1}$
Meat*	$4.5x10^{-4}$	$3.2x10^{-4}$	$4.9x10^{-4}$	N.A.
Total of Above Pathways	$2.5x10^{-2}$	$3.0x10^{-2}$	$5.6x10^{-2}$	$1.0x10^{-1}$

*Conservatively assumed to exist at goat's location

TABLE 1.1.1-9

ANNUAL DOSES TO MAXIMUM INDIVIDUAL IN ADULT AGE GROUP FROM LIQUID EFFLUENTS UNDER EQUILIBRIUM CONDITIONS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

PATHWAY AND LOCATION	ANNUAL DOSE (mrem/yr)							
	TOTAL BODY	SKIN	BONE	LIVER	THYROID	KIDNEY	LUNG	GI
Ingestion of Potable Water -8 miles West	$1.6x10^{-3}$	N.A.	$9.7x10^{-4}$	$2.0x10^{-3}$	$4.6x10^{-2}$	$1.3x10^{-3}$	$7.6x10^{-4}$	$1.2x10^{-3}$
Ingestion of Fish - near discharge	$8.4x10^{-2}$	N.A.	$2.0x10^{-1}$	$1.2x10^{-1}$	$3.3x10^{-2}$	$3.7x10^{-2}$	$1.2x10^{-2}$	$2.9x10^{-2}$
Ingestion of Aquatic Invertebrates - near discharge	$2.2x10^{-3}$	N.A.	$8.3x10^{-3}$	$5.0x10^{-3}$	$2.9x10^{-3}$	$3.5x10^{-3}$	$1.4x10^{-3}$	$1.5x10^{-2}$
Swimming - 100 hrs/yr near discharge	$1.8x10^{-4}$	$2.1x10^{-4}$	$1.8x10^{-4}$	$1.8x10^{-4}$	$1.8x10^{-4}$	$1.8x10^{-4}$	$1.8x10^{-4}$	$1.8x10^{-4}$
Fishing and Boating - 500 hrs/yr near discharge	$4.5x10^{-4}$	$5.2x10^{-4}$	$4.5x10^{-4}$	$4.5x10^{-4}$	$4.5x10^{-4}$	$4.5x10^{-4}$	$4.5x10^{-4}$	$4.5x10^{-4}$
Water Skiing - 100 hrs/yr near discharge	$9.0x10^{-5}$	$1.0x10^{-4}$	$9.0x10^{-5}$	$9.0x10^{-5}$	$9.0x10^{-5}$	$9.0x10^{-5}$	$9.0x10^{-5}$	$9.0x10^{-5}$
Shoreline Recreation Lakeview Summer Camp (0.8 mile SW)	$1.3x10^{-4}$	$1.5x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$
Total of Above Pathways	$8.9x10^{-2}$	$9.8x10^{-4}$	$2.1x10^{-1}$	$1.3x10^{-1}$	$8.3x10^{-2}$	$4.3x10^{-2}$	$1.5x10^{-2}$	$4.6x10^{-2}$

TABLE 1.1.1-10

ANNUAL DOSES TO MAXIMUM INDIVIDUAL IN TEEN AGE GROUP FROM LIQUID EFFLUENTS UNDER EQUILIBRIUM CONDITIONS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

PATHWAY AND LOCATION	ANNUAL DOSE (mrem/yr)							
	TOTAL BODY	SKIN	BONE	LIVER	THYROID	KIDNEY	LUNG	GI
Ingestion of Potable Water -8 miles West	8.9×10^{-4}	N.A.	9.0×10^{-4}	1.6×10^{-3}	3.7×10^{-2}	8.9×10^{-4}	5.0×10^{-4}	7.2×10^{-4}
Ingestion of Fish - near discharge	4.8×10^{-2}	N.A.	1.7×10^{-1}	1.2×10^{-1}	3.0×10^{-2}	2.8×10^{-2}	1.4×10^{-2}	2.1×10^{-2}
Ingestion of Aquatic Invertebrates - near discharge	1.5×10^{-3}	N.A.	6.6×10^{-3}	4.2×10^{-3}	2.6×10^{-3}	2.7×10^{-3}	1.1×10^{-3}	1.1×10^{-2}
Swimming - 100 hrs/yr near discharge	1.8×10^{-4}	2.1×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	1.8×10^{-4}
Fishing and Boating - 500 hrs/yr near discharge	4.5×10^{-4}	5.2×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}
Water Skiing - 100 hrs/yr near discharge	9.0×10^{-5}	1.0×10^{-4}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}
Shoreline Recreation Lakeview Summer Camp (0.8 Mile SW)	7.4×10^{-4}	8.6×10^{-4}	7.4×10^{-4}	7.4×10^{-4}	7.4×10^{-4}	7.4×10^{-4}	7.4×10^{-4}	7.4×10^{-4}
Total of Above Pathways	5.2×10^{-2}	1.7×10^{-3}	1.8×10^{-1}	1.3×10^{-1}	7.1×10^{-2}	3.3×10^{-2}	1.7×10^{-2}	3.4×10^{-2}

TABLE 1.1.1-11

ANNUAL DOSES TO MAXIMUM INDIVIDUAL IN CHILD AGE GROUP FROM LIQUID EFFLUENTS UNDER EQUILIBRIUM CONDITIONS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

PATHWAY AND LOCATION	ANNUAL DOSE (mrem/yr)							
	TOTAL BODY	SKIN	BONE	LIVER	THYROID	KIDNEY	LUNG	GI
Ingestion of Potable Water -8 miles West	1.1×10^{-3}	N.A.	2.5×10^{-3}	3.2×10^{-3}	9.0×10^{-2}	8.9×10^{-4}	9.1×10^{-4}	1.0×10^{-3}
Ingestion of Fish - near discharge	1.9×10^{-2}	N.A.	1.3×10^{-1}	9.8×10^{-2}	3.2×10^{-2}	1.2×10^{-2}	1.1×10^{-2}	8.5×10^{-3}
Ingestion of Aquatic Invertebrates - near discharge	7.4×10^{-4}	N.A.	4.1×10^{-3}	2.6×10^{-3}	2.8×10^{-3}	1.2×10^{-3}	5.6×10^{-4}	5.1×10^{-3}
Swimming - 100 hrs/yr near discharge	1.8×10^{-4}	2.1×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	1.8×10^{-4}
Fishing and Boating - 500 hrs/yr near discharge	4.5×10^{-4}	5.2×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}
Water Skiing - 100 hrs/yr near discharge	9.0×10^{-5}	1.0×10^{-4}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}
Shoreline Recreation Lakeview Summer Camp (0.8 Mile SW)	1.5×10^{-4}	1.8×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}
Total of Above Pathways	2.2×10^{-2}	1.0×10^{-3}	1.4×10^{-1}	1.0×10^{-1}	1.3×10^{-1}	1.5×10^{-2}	1.3×10^{-2}	1.5×10^{-2}

TABLE 1.1.1-12

ANNUAL DOSES TO MAXIMUM INDIVIDUAL IN INFANT AGE GROUP
FROM LIQUID EFFLUENTS UNDER EQUILIBRIUM CONDITIONS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

PATHWAY AND LOCATION	ANNUAL DOSE (mrem/yr)							
	TOTAL BODY	SKIN	BONE	LIVER	THYROID	KIDNEY	LUNG	GI
Ingestion of Potable Water -8 miles West	$1.8x10^{-3}$	N.A.	$5.1x10^{-3}$	$7.0x10^{-3}$	$2.2x10^{-1}$	$8.9x10^{-4}$	$1.6x10^{-3}$	$1.3x10^{-3}$
Ingestion of Fish - near discharge	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Ingestion of Aquatic Invertebrates - near discharge	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Swimming - 100 hrs/yr near discharge	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Fishing and Boating - 500 hrs/yr near discharge	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Water Skiing - 100 hrs/yr near discharge	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Shoreline Recreation Lakeview Summer Camp (0.8 Mile SW)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Total of Above Pathways	$1.8x10^{-3}$	N.A.	$5.1x10^{-3}$	$7.0x10^{-3}$	$2.2x10^{-1}$	$8.9x10^{-4}$	$1.6x10^{-3}$	$1.3x10^{-3}$

TABLE 1.1.2-1

CALCULATED ANNUAL DOSES
FOR
POPULATION WITHIN 50 MILE RADIUS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

	POPULATION MAN-REM WHOLE BODY	THYROID
Liquid Effluents		
Ingestion of potable water	$1.7x10^{-1}$	$6.3x10^{0}$
Ingestion of fish	$5.0x10^{-5}$	$1.1x10^{-5}$
Fishing	$7.2x10^{-6}$	$7.2x10^{-6}$
Boating	$4.4x10^{-4}$	$4.4x10^{-4}$
Swimming	$3.9x10^{-4}$	$3.9x10^{-4}$
Shoreline recreation	$1.2x10^{-2}$	$1.2x10^{-2}$
Total	$1.8x10^{-1}$	$6.3x10^{0}$
Gaseous Effluents		
Plume immersion	$9.2x10^{-2}$	N.A.
Inhalation	$1.3x10^{-3}$	$2.2x10^{-1}$
Deposition on ground	$6.7x10^{-2}$	$6.7x10^{-2}$
Ingestion of milk	$2.7x10^{-2}$	$2.0x10^{0}$
Ingestion of vegetation	$4.4x10^{-2}$	$9.2x10^{-1}$
Ingestion of meat	$4.1x10^{-3}$	$3.2x10^{-2}$
Total	$2.3x10^{-1}$	$3.3x10^{0}$

TABLE 1.1.2-2

POPULATION MAN-REM DOSE ASSESSMENT FROM INGESTION OF POTABLE WATER AND FISH

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Pathway and Location	Dilution Factor	Decay Time (hrs)	Age Group	Usage Factor (1/yr or kg/yr)	Bases	ANNUAL DOSE (man-rem) Total Body	Thyroid
Potable water Oswego City and Onondega County	7.7	53	Adult	370	190,000 consumers in 1970 incr. by Pop. growth to 240,000	1.2×10^{-1}	3.2×10^{0}
	7.7	53	Teen	260	Same as above	1.5×10^{-2}	6.0×10^{-1}
	7.7	53	Child	260	Same as above	3.8×10^{-2}	2.5×10^{0}
Potable Water Subtotal						1.7×10^{-1}	6.3×10^{0}
Fish within 50 miles	1×10^{4}	240	Adult	6.9	Total fish catch of 6.0×10^{6} Kg/yr	4.1×10^{-5}	6.9×10^{-6}
	1×10^{4}	240	Teen	5.2	Same as above	5.2×10^{-6}	1.4×10^{-6}
	1×10^{4}	240	Child	2.2	Same as above	3.4×10^{-6}	2.4×10^{-6}
Fish Subtotal						5.0×10^{-5}	1.1×10^{-5}
Total of above pathways						1.7×10^{-1}	6.3×10^{0}

TABLE 1.1.2-3

POPULATION MAN-REM DOSE FROM FISHING AND BOATING

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Activity	Dilution Factor	Dose Rate (rem/hr)	Bases	Population Usage (person-hrs/yr)	Annual Population Dose (man-rem)*
Fishing	$1x10^{4}$	$4.5x10^{-13}$	$6.4x10^{6}$ fisherman days @ 2.5 hr/day	$1.6x10^{7}$	$7.2x10^{-6}$
Boating	6.1	$7.4x10^{-10}$	1,000 people/day @ 2 hr/day 10,000 people/wknd. @ 4 hr/wknd. for 12 wks	$6.0x10^{5}$	$4.4x10^{-4}$
Total of above pathways					$4.5x10^{-4}$

*Dose estimate is not dependent on age group.

TABLE 1.1.2-4

POPULATION MAN-REM DOSE ASSESSMENT FROM SWIMMING

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

LOCATION	DILUTION FACTOR	DOSE RATE (rem/hr)	AGE GROUP	PER CAPITA USAGE (hrs/day)	NUMBER OF PERSON-DAYS	BASES	ANNUAL POPULATION DOSE (man-rem)
Lakeview Summer Camp	5.0	$1.8x10^{-9}$	Adult	2	11,200	500 pers/wkday 1,500 pers/wkend or 800 pers/day avg. for 10 wk season	$4.0x10^{-5}$
	5.0	$1.8x10^{-9}$	Teen	4	22,400	Same as above	$1.6x10^{-4}$
	5.0	$1.8x10^{-9}$	Child	4	22,400	Same as above	$1.6x10^{-4}$
Camp Subtotal							$3.6x10^{-4}$
Selkirk State Park	8.4	$1.1x10^{-9}$	Adult	2	6,200	1,000 swimmers/ wk for 10 wk season	$1.4x10^{-5}$
	8.4	$1.1x10^{-9}$	Teen	4	1,400	Same as above	$6.2x10^{-6}$
	8.4	$1.1x10^{-9}$	Child	4	2,400	Same as above	$1.1x10^{-5}$
Park Subtotal							$3.1x10^{-5}$
Vicinity of Mixing Zone	5.0	$1.8x10^{-9}$	Teen	4	200	Conservative Estimate	$1.4x10^{-6}$
Total of above pathways							$3.9x10^{-4}$

TABLE 1.1.2-5
POPULATION MAN-REM DOSE ASSESSMENT FROM SHORELINE RECREATION

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

LOCATION	DILUTION FACTOR	AGE GROUP	PER CAPITA USAGE FACTOR	NUMBER OF PERSONS	BASES	ANNUAL POPULATION DOSE (man-rem)
Lakeview Summer Camp	5.0	Adult	2 hr/day	11,200	500 pers/wkday 1,500 pers/wkend or 800 pers/day avg. for 10 wk season	$2.6x10^{-4}$
	5.0	Teen	4 hr/day	22,400	Same as above.	$1.0x10^{-3}$
	5.0	Child	4 hr/day	22,400	Same as above	$1.0x10^{-3}$
Camp Subtotal						$2.3x10^{-3}$
Selkirk State Park	8.4	Adult	8.3 hr/year	62,000	10,000 pers/ wkend for 10 wk season	$3.5x10^{-3}$
	8.4	Teen	47.0 hr/year	14,000	Same as above	$4.5x10^{-3}$
	8.4	Child	9.5 hr/year	24,000	Same as above	$1.6x10^{-3}$
Park Subtotal						$9.6x10^{-3}$
Total from Above Pathways						$1.2x10^{-2}$

TABLE 1.1.2-6

POPULATION MAN-REM DOSE ASSESSMENT FROM GASEOUS EFFLUENTS

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

PATHWAY	AGE GROUP	ANNUAL POPULATION DOSE TOTAL BODY (man-rem)	ANNUAL POPULATION DOSE THYROID (Thyroid man-rem)
Inhalation	Adult	8.3×10^{-4}	1.3×10^{-1}
	Teen	1.5×10^{-4}	2.5×10^{-2}
	Child	3.4×10^{-4}	6.0×10^{-2}
Deposition on ground	*	6.7×10^{-2}	6.7×10^{-2}
Submersion	*	9.2×10^{-2}	N.A.
Ingestion of milk	Adult	8.6×10^{-3}	6.3×10^{-1}
	Teen	3.9×10^{-3}	3.0×10^{-1}
	Child	1.4×10^{-2}	1.1×10^{0}
Ingestion of meat	Adult	2.4×10^{-3}	2.0×10^{-2}
	Teen	4.1×10^{-4}	3.3×10^{-3}
	Child	1.3×10^{-3}	8.7×10^{-3}
Ingestion of vegetation	Adult	2.0×10^{-2}	3.7×10^{-1}
	Teen	5.9×10^{-3}	1.2×10^{-1}
	Child	1.8×10^{-2}	4.3×10^{-1}
Total of above pathways		2.3×10^{-1}	3.3×10^{0}

*Dose estimate is not dependent on age group.

TABLE 1.1.2-7

TOTAL DIRECT COST ESTIMATE SHEET OF RADWASTE TREATMENT SYSTEM
NINE MILE POINT NUCLEAR STATION-UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Description of Augment GASEOUS AUGMENT No.1-100% FILTRATION OF REACTOR BUILDING GASEOUS EFFLUENT

DIRECT COST (1975-$1000)

ITEM	* LABOR	EQUIPMENT/MATERIALS	TOTAL	BASIS FOR COST ESTIMATE
1. PROCESS EQUIPMENT	72	351	423	3-30,000 CFM CHARCOAL/HEPA FILTRATION SYSTEM, PREFILTER /4" CHARCOAL/HEPA, GIVEN IN REG. GUIDE 1.110, P.44
2. BUILDING ASSIGNMENT	96	40.8	136.8	28'x20'x12' AT $5/ft.^{3} (NON-SHIELDED AREA) GIVEN IN REG. GUIDE 1.110, P.44
3. ASSOCIATED PIPING SYSTEMS	24	9	33	BASIS GIVEN IN REG. GUIDE 1.110, P.44
4. INSTRUMENTATION & CONTROLS	—	—	—	IN ITEM 1
5. ELECTRICAL SERVICE	28.8	12	40.8	ALLOWANCE GIVEN IN REG. GUIDE 1.110, P.44
6. SPARE PARTS	—	15	15	GIVEN IN REG. GUIDE 1.110, P.44
SUBTOTAL	220.8	427.8	648.6	
7. CONTINGENCY	22	42.8	64.8	10%-GIVEN IN REG. GUIDE 1.110
8. TOTAL DIRECT COSTS	242.8	470.6	713.4	

* LABOR COST INCLUDES THE LABOR COST CORRECTION FACTOR OF 1.6 GIVEN IN TABLE A-4 OF REG. GUIDE 1.110

TABLE I.I.2-7 (CONT'D)

ANNUAL OPERATING & MAINTENANCE COST ESTIMATE SHEET OF RADWASTE TREATMENT SYSTEM

NINE MILE POINT NUCLEAR STATION-UNIT I

NIAGARA MOHAWK POWER CORPORATION

Description of Augment: GASEOUS AUGMENT No.1 -100% FILTRATION OF REACTOR BUILDING GASEOUS EFFLUENT

COST (1975-$1000)

ITEM	LABOR	OTHER	TOTAL	BASIS FOR COST ESTIMATE
I. OPERATING LABOR, SUPERVISION, AND OVERHEAD			II.4	I5 MIN./SHIFT + 40 HR. ANNUAL TEST TIMES 3 UNITS (REG. GUIDE I.II0)
2. MAINTENANCE MATERIAL AND LABOR			54	60 HEPA OR PREFILTERS AT $I50 EACH & CHARCOAL FILTERS AT $900 EACH EVERY 2 YEARS (REG. GUIDE I.II0)
3. CONSUMABLES, CHEMICALS AND SUPPLIES			—	IN ITEMS 2 AND 4
4. UTILITIES AND SERVICES				
WASTE DISPOSAL			9	$50/HEPA OR PREFILTER, $I00/CHARCOAL FILTER
WATER				
STEAM				
ELECTRICITY			7.8	I6 KW ADDITIONAL FAN HP FOR FILTER AT 0.018 #/KW-HR
BUILDING SERVICES				
OTHER				
5. TOTAL O AND M ANNUAL COST			82.2	

TABLE 1.1.2-8

TOTAL DIRECT COST ESTIMATE SHEET OF RADWASTE TREATMENT SYSTEM
NINE MILE POINT NUCLEAR STATION-UNIT I
NIAGARA MOHAWK POWER CORPORATION

Description of Augment GASEOUS AUGMENT No. 2 - 100% FILTRATION OF THE CONDENSER VACUUM PUMP EFFLUENT

DIRECT COST (1975-$1000)

ITEM	* LABOR	EQUIPMENT/MATERIALS	TOTAL	BASIS FOR COST ESTIMATE
1. PROCESS EQUIPMENT	3.2	32.5	35.7	2000 CFM PREFILTER/4" CHARCOAL BED/HEPA @ $15/CFM, 10Kw HEATER @ $250/Kw GIVEN IN REG. GUIDE 1.110, P.28
2. BUILDING ASSIGNMENT	4.9	1.5	6.4	TURBINE BUILDING 8'x16'x12' @ $3/FT^3 (NONSHIELDED AREA) GIVEN IN REG. GUIDE 1.110, P.28
3. ASSOCIATED PIPING SYSTEMS	2.1	0.7	2.8	ALLOWANCE GIVEN IN REG. GUIDE 1.110, P.28
4. INSTRUMENTATION & CONTROLS	—	—	—	IN ITEM 1
5. ELECTRICAL SERVICE	1.6	1.5	3.1	ALLOWANCE GIVEN IN REG. GUIDE 1.110, P.28
6. SPARE PARTS	—	0.5	0.5	GIVEN IN REG. GUIDE 1.110, P.28
SUBTOTAL	11.8	36.7	48.5	
7. CONTINGENCY	1.2	3.7	4.9	10%
8. TOTAL DIRECT COSTS	13.0	40.4	53.4	

* LABOR COST INCLUDES THE LABOR COST CORRECTION FACTOR OF 1.6 GIVEN IN TABLE A-4 OF REG. GUIDE 1.110

TABLE 1.1.2-8 (CONT'D)

ANNUAL OPERATING & MAINTENANCE COST ESTIMATE SHEET OF RADWASTE TREATMENT SYSTEM
NINE MILE POINT NUCLEAR STATION-UNIT I
NIAGARA MOHAWK POWER CORPORATION

Description of Augment GASEOUS AUGMENT No.2 - 100% FILTRATION OF THE CONDENSER VACUUM PUMP EFFLUENT

COST (1975 - $1000)

ITEM	LABOR	OTHER	TOTAL	BASIS FOR COST ESTIMATE
1. OPERATING LABOR, SUPERVISION, AND OVERHEAD			NEG	USED ONLY DURING STARTUP AND SHUTDOWN
2. MAINTENANCE MATERIAL AND LABOR			1.2	4 HEPA FILTERS @ $150 AND 2 CHARCOAL FILTERS @ $900, CHANGE EVERY 2 YEARS
3. CONSUMABLES, CHEMICALS AND SUPPLIES			—	IN ITEMS 2 AND 4
4. UTILITIES AND SERVICES				
WASTE DISPOSAL			0.2	$50/HEPA FILTER, $100/CHARCOAL FILTER
WATER				
STEAM				
ELECTRICITY				
BUILDING SERVICES				
OTHER				
5. TOTAL O AND M ANNUAL COST			1.4	

TABLE 1.1.2-9

TOTAL DIRECT COST ESTIMATE SHEET OF RADWASTE TREATMENT SYSTEM
NINE MILE POINT NUCLEAR STATION-UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Description of Augment LIQUID AUGMENT No.1-2GPM REVERSE OSMOSIS (DETERGENT WASTES)

DIRECT COST (1975-$1000)

ITEM	* LABOR	EQUIPMENT/MATERIALS	TOTAL	BASIS FOR COST ESTIMATE
1. PROCESS EQUIPMENT	9.6	60	69.6	SKID MOUNTED W/500GAL. S.S. FEED TANK, ASME VIII (GIVEN IN REG. GUIDE 1.110, P.81)
2. BUILDING ASSIGNMENT	30.7	9.6	40.3	12'x25'x16' AT $6/ft.³ (GIVEN IN REG. GUIDE 1.110)
3. ASSOCIATED PIPING SYSTEMS	4.8	2.0	6.8	ALLOWANCE GIVEN IN REG. GUIDE 1.110
4. INSTRUMENTATION & CONTROLS	—	—	—	IN ITEM 1
5. ELECTRICAL SERVICE	11.2	13.0	24.2	ALLOWANCE GIVEN IN REG. GUIDE 1.110
6. SPARE PARTS	—	6.0	6.0	(GIVEN IN REG. GUIDE 1.110)
SUBTOTAL	56.3	90.6	146.9	
7. CONTINGENCY	5.6	9.0	14.6	(10% - GIVEN IN REG. GUIDE 1.110)
8. TOTAL DIRECT COSTS	61.9	99.6	161.5	

* LABOR COST INCLUDES THE LABOR COST CORRECTION FACTOR OF 1.6 GIVEN IN TABLE A-4 OF REG. GUIDE 1.110

TABLE 1.1.2-9 (CONT'D)

ANNUAL OPERATING & MAINTENANCE COST ESTIMATE SHEET OF RADWASTE TREATMENT SYSTEM
NINE MILE POINT NUCLEAR STATION-UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Description of Augment LIQUID AUGMENT No.1 - 2GPM REVERSE OSMOSIS (DETERGENT WASTES)

COST (1975 - $1000)

ITEM	LABOR	OTHER	TOTAL	BASIS FOR COST ESTIMATE
1. OPERATING LABOR, SUPERVISION, AND OVERHEAD			3.1	160,000GPY, 1300HRS/YR AT 20% ATTENDANCE - GIVEN IN REG. GUIDE 1.110
2. MAINTENANCE MATERIAL AND LABOR			8.8	4% LESS BLDG + 24 MODULE W/3YR. LIFE AT $600 EACH
3. CONSUMABLES, CHEMICALS AND SUPPLIES			NEG.	
4. UTILITIES AND SERVICES				
WASTE DISPOSAL			4.3	100:1 VOL. REDUCTION AT $20/FT^3 DISPOSAL COST
WATER				
STEAM				
ELECTRICITY			NEG.	
BUILDING SERVICES				
OTHER				
5. TOTAL O AND M ANNUAL COST			16.2	

SUMMARY OF ANNUALIZED COSTS
NINE MILE POINT NUCLEAR STATION-UNIT 1
NIAGARA MOHAWK POWER CORPORATION

	AUGMENTS		
	GASEOUS		LIQUID
	1	2	1
A TOTAL DIRECT COSTS (TDC)	713.4	53.4	161.5
B TOTAL CAPITAL COSTS (TCC)*	1,127.2	84.4	255.2
C. ANNUAL FIXED COST (AFC)*	138.8	10.4	31.4
D. TOTAL OPERATION AND MAINTENANCE ANNUAL COST	82.2	1.4	16.2
E. TOTAL ANNUALIZED COST (TAC)*	221.0	11.8	47.6

NOTES:
1. ALL VALUES ARE IN THOUSANDS OF 1975 DOLLARS
2. *FOR EXPLANATION OF THESE TERMS, SEE SHEET 2 OF 2 OF THIS TABLE

TABLE 1.1.2-10 (Cont'd)

A. Total Direct Costs

See Sheet 1 of Cost-Analysis Sheets

B. Total Capital Cost

Total Capital Costs = Total Direct Costs x Indirect Cost Factor
(TCC) = (TDC) (ICF)

where:

Indirect Cost Factor (ICF) = 1.58 (From Reg. Guide 1.110, Table A-5) Assume Multi-unit site, unitized radwaste systems - 3 units

$$ICF = \frac{1.75 + (n-1)\,1.5}{n} = \frac{1.75 + 2(1.5)}{3} = \frac{1.75 + 3}{3} = \frac{4.75}{3}$$

$$ICF = \underline{1.58}$$

C. Annual Fixed Cost

Annual fixed cost = Total Capital Costs x Capital Recovery Factor
(AFC) = (TCC) (CRF)

where:

CAPITAL RECOVERY FACTOR (CRF) = 0.1231 (From Reg. Guide 1.110, Table A-6)

$$CRF = \frac{i\ (1+i)^{25}}{(1+i)^{25}-1},$$

i = cost of money, % per year = 11.5%
25 = service life of NMP-1 as defined by Niagara Mohawk

$$CRF = \frac{.115(1.115)^{25}}{(1.115)^{25}-1} = \frac{.115(15.20098338)}{14.20098338} = \frac{1.748113088}{14.20098338} = 0.12309$$

$$CRF = 0.1231$$

D. Total Operation and Maintenance Annual Cost

See Sheet 2 of Cost-Analysis Sheets

E. Total Annualized Cost (TAC) (From Reg. Guide 1.110, Appendix A, page 2)

(TAC) = (AFC) + (AOC) + (AMC)

Table 1.1.2-11
SUMMARY OF COST-BENEFITS

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Augments	Man-Rem Reduction		Benefit (at $1,000 per Man-Rem)	
	Total Body	Thyroid	Total Body	Thyroid
Gaseous Augment No. 1	0.083	1.6	$83	$1,600
Gaseous Augment No. 2	0.0	0.16	NA	$ 160
Liquid Augment No. 1	0.081	4.3	$81	$4,300

Table 1.1.2-12
COST-BENEFIT COMPARISON

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Augments	Annualized Cost (Dollars)	Benefit (at $1,000 per man-rem)		Cost-Benefit Ratio	
		Whole Body	Thyroid	Whole Body	Thyroid
Gaseous Augment No. 1	221,000	$83	$1,600	2,660	138
Gaseous Augment No. 2	11,800	NA	$ 160	NA	74
Liquid Augment No. 1	47,500	$81	$4,300	586	11

1.2 Radioactive Source Terms

This section discusses radioactive effluent releases which are calculated using the basic approach and assumptions contained in Regulatory Guide 1.112 and NUREG—0016. The code used in these analyses conforms to the methodology of NUREG—0016. Values of parameters are based on NUREG—0016 data, Nine Mile Point Unit 1 design data, or Nine Mile Point Unit 1 operating data. Section 2.1 lists additional source term data requested in Chapter 4 of NUREG—0016.

The licensee has previously reported expected liquid and gaseous release values in both the Nine Mile Point Nuclear Station FSAR and ER. The data described herein represent an attempt to analyze the releases using the NRC model and assumptions and conform to the actual plant configuration as closely as possible.

Additional data are provided, relative to radioactive source terms, in Section 2.1 (i.e., the information requested in Appendix D to Chapter 4 of NUREG—0016).

1.2.1 Coolant Activities

The coolant activities are obtained using the methodology described in NUREG-0016. The plant dependent parameters and method for determining the coolant activities are discussed below.

The plant dependent data, regulatory guide reference plant parameters, and applicable ranges are shown in Table 1.2.1-1. As the Nine Mile Point Unit 1 power level of 1,850 MWt is outside the range given in Table 1.2.1-1, the NRC references of plant coolant activities shown in Table 2-2 of NUREG-0016 have been adjusted. The method of adjustment of the reference coolant activities is shown in Tables 1.2.1-2 and 1.2.1-3. Table 1.2.1-4 lists the resultant Nine Mile Point Unit 1 coolant activities using these adjustment factors.

TABLE 1.2.1-1

NUREG-0016 (TABLE 2-3)

PARAMETERS USED TO DESCRIBE THE REFERENCE BOILING WATER REACTOR

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Parameter	Symbol	Units	Reference Plant Value	Range Maximum	Range Minimum	Nine Mile Point 1 Value
Thermal Power	P	MWt	3,400	3,800	3,000	1,850
Weight of Water in the Reactor Vessel	WP	lb	3.8(5)*	4.2(5)	3.4(5)	4.0(5)
Cleanup Demineralizer Flow Rate	FA	lb/hr	1.3(5)	1.5(5)	1.1(5)	1.8(5)
Steam Flow Rate	FS	lb/hr	1.5(7)	1.7(7)	1.3(7)	7.3(6)
Ratio of Condensate Demineralizer Flow Rate to Steam Flow Rate	NC	-	1.0	1.0	0.8	1.0

*3.8(5) = 3.8×10^5

TABLE 1.2.1-2

NUREG-0016 (TABLE 2-4)

VALUES USED IN DETERMINING ADJUSTMENT FACTORS FOR BOILING WATER REACTORS

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Symbol	Description	Noble Gases	Halogens	Cs,Rb	Water Activation Products	Tritium	Other Nuclides
NA	Fraction of material removed in the reactor water clean-up system	0.0	0.9	0.5	0.0	0.0	0.9*
NB	Fraction of material removed by the condensate demineralizers	0.0	0.9	0.5	0.0	0.0	0.9*
NS	Ratio of concentration in reactor steam to the concentration in reactor water	(a)	0.02	0.001	(b)	1.0	0.00
R	Removal rate from the reactor water (hr^{-1}) (d)	(a)	1.0	0.19	(b)	(c)	0.34

(a) All noble gases released from the core are transported rapidly out of the reactor water to the reactor steam and are stripped from the system in the main condenser; therefore, the concentration in the reactor water is negligible and the stream concentration is approximately equivalent to the ratio of the release rate to the steam flow rate.

Table 1.2.1-2 (Cont'd)

(b) Water activation products exhibit varying chemical and physical properties in reactor coolant which are not well defined. However, most are stripped off as gases which are not effectively removed by the demineralizers of the systems but their concentrations are controlled by decay.

(c) The tritium concentration in the reactor water and steam is expected to be equal and is controlled by the losses of water from the main coolant system by evaporation or leakage. The concentration is therefore given by the ratio of the appearance rate in the coolant, which is about 120 Ci/yr, to the total loss from the system.

(d) These values of R whose parameters are given in Table 2-3 apply to the reference BWR and have been used in developing Table 2-5. For BWRs not included in Table 2-3, the appropriate value for R may be determined by the following equation:

$$R = \frac{FA\ NA + NC\ FS \cdot NS\ NB}{WP}$$ for Halogens, Cs, Rb, and other nuclides

where the symbols are defined in Tables 2-3 and 2-4 and Figure 2-1. The values for R for noble gases and water activation products are not used in the adjustment factors of Table 2-5.

*These represent effective removal terms and include other mechanisms such as plateout. Plateout would be applicable to nuclides such as Molybdenum (Mo) and corrosion products.

TABLE 1.2.1-3

NUREG-0016 (TABLE 2-5)

ADJUSTMENT FACTORS FOR BOILING WATER REACTORS

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Nuclide	Reactor Water	Reactor Steam
Noble Gases (a)	1.0	1.0
Halogens (b)	$.51 \times \left[\frac{1.0 + \lambda}{R + \lambda}\right]$	$.51 \times \left[\frac{1.0 + \lambda}{R + \lambda}\right]$
Cs, Rb	$.51 \times \left[\frac{0.19 + \lambda}{R + \lambda}\right]$	$.51 \times \left[\frac{0.19 + \lambda}{R + \lambda}\right]$
Water Activation Products	1.0	1.0
Tritium (c)	-	-
Other Nuclides	$.51 \times \left[\frac{0.34 + \lambda}{R + \lambda}\right]$	$.51 \times \left[\frac{0.34 + \lambda}{R + \lambda}\right]$

(a) Assumes that the ratio of power to steam flow is essentially the same for all BWRs.

(b) λ is the isotopic decay constant (hr^{-1}).

(c) See note (c) Table 1.2.1-2.

TABLE 1.2.1-4

RADIONUCLIDE CONCENTRATIONS IN BOILING WATER REACTOR COOLANT AND MAIN STEAM (μCi/gm)

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

NOBLE GASES

ISOTOPE	REACTOR STEAM	DECAY CONSTANT (1/SECOND)
KR-83M	1.1E-03	1.04E-04
KR-85M	1.9E-03	4.30E-05
KR-85	6.0E-06	2.05E-09
KR-87	6.6E-03	1.52E-04
KR-88	6.6E-03	6.88E-05
KR-89	4.1E-02	3.66E-03
KR-90	9.0E-02	2.15E-02
KR-91	1.1E-01	7.70E-02
KR-92	1.1E-01	3.77E-01
KR-93	2.9E-02	5.46E-01
KR-94	7.2E-03	3.30E+00
KR-95	6.6E-04	1.39E+00
KR-97	4.4E-06	6.93E+09
XE-131M	4.7E-06	6.69E-07
XE-133M	9.0E-05	3.60E-06
XE-133	2.6E-03	1.52E-06
XE-135M	8.4E-03	7.55E-04
XE-135	7.2E-03	2.10E-05
XE-137	4.7E-02	3.01E-03
XE-138	2.8E-02	8.14E-04
XE-139	9.0E-02	1.75E-02
XE-140	9.6E-02	5.10E-02
XE-141	7.8E-02	4.03E-01
XE-142	2.3E-02	5.68E-01
XE-143	3.8E-03	2.31E+00
XE-144	1.8E-04	6.93E-01

Table 1.2.1-4 (Cont'd)

ISOTOPE	REACTOR WATER	REACTOR STEAM	DECAY CONSTANT (1/SECOND)
	HALOGENS		
BR-83	1.9E-03	3.9E-05	8.02E-05
BR-84	2.9E-03	5.8E-05	3.66E-04
BR-85	1.6E-03	3.1E-05	4.03E-03
I-131	3.5E-03	6.9E-05	9.98E-07
I-132	1.9E-02	3.8E-04	8.43E-05
I-133	1.4E-02	2.7E-04	9.26E-06
I-134	4.2E-02	6.0E-05	2.20E-04
I-135	1.3E-02	2.7E-04	2.92E-05
	CS, RB		
RB-89	2.5E-03	2.5E-06	7.60E-04
CS-134	1.2E-05	1.2E-08	1.07E-08
CS-136	8.3E-06	8.3E-09	6.17E-07
CS-137	2.9E-05	2.9E-08	7.30E-10
CS-138	5.0E-03	5.0E-06	3.59E-04
	WATER ACTIVATION PRODUCTS		
N-13	5.0E-02	7.0E-03	1.16E-03
N-16	6.0E+01	5.0E+01	9.75E-02
N-17	9.0E-03	2.0E-02	1.67E-01
O-19	7.0E-01	2.0E-01	2.58E-02
F-18	4.0E-03	4.0E-03	1.05E-04
	TRITIUM		
H-3	1.0E-02	1.0E-02	1.79E-09
	OTHER NUCLIDES		
NA-24	3.8E-03	3.8E-06	1.28E-05
P-32	8.2E-05	8.2E-08	5.60E-07
CR-51	2.1E-03	2.1E-06	2.88E-07
MN-54	2.5E-05	2.5E-08	2.56E-08
MN-56	2.3E-02	2.3E-05	7.46E-05
FE-55	4.1E-04	4.1E-07	8.14E-09
FE-59	1.2E-05	1.2E-08	1.78E-07
CO-58	8.2E-05	8.2E-08	1.12E-07
CO-60	1.6E-04	1.6E-07	4.18E-09

Table 1.2.1-4 (Cont'd)

NI-63	4.1E-07	4.1E-10	2.39E-10
NI-65	1.4E-04	1.4E-07	7.55E-05
CU-64	1.3E-02	1.3E-05	1.51E-05
ZN-65	8.2E-05	8.2E-08	3.29E-08
ZN-69M	8.4E-04	8.4E-07	1.38E-05
SR-89	4.1E-05	4.1E-08	1.59E-07
SR-90	2.5E-06	2.5E-09	7.58E-10
SR-91	1.7E-03	1.7E-06	2.03E-05
SR-92	4.5E-03	4.5E-06	7.11E-05
Y-91	1.6E-05	1.6E-08	1.37E-07
Y-92	2.7E-03	2.7E-06	5.45E-05
Y-93	1.7E-03	1.7E-06	1.89E-05
ZR-95	2.9E-06	2.9E-09	1.23E-07
ZR-97	2.1E-06	2.1E-09	1.15E-05
NB-95	2.9E-06	2.9E-09	2.29E-07
NB-98	1.9E-03	1.9E-06	2.26E-04
MO-99	8.3E-04	8.3E-07	2.92E-06
TC-99M	8.7E-03	8.7E-06	3.20E-05
TC-101	4.5E-02	4.5E-05	8.14E-04
TC-104	4.0E-02	4.0E-05	6.42E-04
RU-103	8.2E-06	8.2E-09	2.03E-07
RU-105	8.8E-04	8.8E-07	4.34E-05
RU-106	1.2E-06	1.2E-09	2.17E-08
AG-110M	4.1E-07	4.1E-10	3.18E-08
TE-129M	1.6E-05	1.6E-08	2.40E-07
TE-131M	4.2E-05	4.2E-08	6.42E-06
TE-132	4.1E-06	4.1E-09	2.47E-06
BA-139	4.7E-03	4.7E-06	1.39E-04
BA-140	1.6E-04	1.6E-07	6.27E-07
BA-141	5.0E-03	5.0E-06	6.31E-04
BA-142	3.0E-03	3.0E-06	1.08E-03
LA-142	2.3E-03	2.3E-06	1.25E-04
CE-141	1.2E-05	1.2E-08	2.47E-07
CE-143	1.2E-05	1.2E-08	5.83E-06
CE-144	1.2E-06	1.2E-09	2.82E-08
PR-143	1.6E-05	1.6E-08	5.91E-07
ND-147	1.2E-06	1.2E-09	7.33E-07
W-187	1.3E-04	1.3E-07	8.06E-06
NP-239	2.9E-03	2.9E-06	3.41E-06

NOTE: The reactor water concentration is specified at the nozzle where reactor water leaves the reactor vessel; similarly, the reactor steam concentration is specified at time t= 0.

1.2.2 Gaseous Releases

The main stack is the only release point for the gaseous effluents which consist of the reactor building, turbine building, and radwaste building exhausts, turbine gland seal condenser, mechanical vacuum pump, and off-gas system releases. The methodology for determining the releases is given in Regulatory Guide 1.112 and NUREG-0016. The individual release point descriptions are given below. A simplified flow diagram is shown on Figure 1.2.2-1. A more detailed listing of the parameters is given in Section 2.1.

1.2.2.1 Reactor Building

The reactor building has two separate ventilation systems. One system is used during normal operation while the other is a standby to be used under accident conditions.

The normal ventilation system supply fans ordinarily provide filtered air to various parts of the building at a rate of approximately one change per hour. However, when conditions warrant, a higher speed operating mode is available which will provide approximately two changes per hour. Unit coolers using service water are installed locally where necessary for additional cooling.

During normal operation the pressure inside the building is held slightly negative, approximately 0.1 in. of water (gage) relative to the outside to minimize out-leakage. Exhaust fans discharge all ventilating air to the stack. Exhaust ductwork is arranged to draw air from areas where contamination is most likely to occur, thus preventing its spread into relatively cleaner areas. Both supply and exhaust ducts are provided with two quick-closing (less than 60 seconds) leak-tight valves in series which trip closed automatically on high radiation level signal within the building.

The normal ventilating flow rates are about 35,000 and 70,000 cfm, respectively, for normal flow and high-speed purging. The appropriate rate is manually selected by means of a two-speed control on the ventilation fan motors. The air supply equipment consists of a fresh air intake, filter, electric heating units which will automatically control to a set temperature, and two full-capacity fans equipped with inlet vane dampers. Since either fan is capable of the 70,000 cfm rate, one will normally be a full-capacity standby. Supply ductwork with dampers is provided to distribute the air to various areas throughout the building. Two 70,000 cfm exhaust fans (one normally on standby) are provided with connecting ductwork which draws the air mainly from areas of highest potential contamination and exhausts to the stack.

Both the main supply and exhaust ducts are equipped with two leak-tight isolation valves in series which close automatically upon detection of high radiation levels within the building. They also may be controlled manually from the main control room. The inlet and outlet duct penetrations through the building walls are sealed against leakage. A steel pipe sleeve is integrally cast in the concrete and the outer end of the sleeve has a gasketed flange which connects to the first isolation valve. The reactor building atmosphere is automatically held at a slight negative pressure (0.1 to 0.2 in. water, gage) by regulation of the supply dampers, to prevent or reduce exfiltration to the outside, even under high wind conditions.

1.2.2.2 Waste Disposal Building

The waste disposal building releases are those reported in Table 2-9 of NUREG-0016 on page C-56. The particulate releases have been reduced to account for HEPA filtration of exhaust ventilation air prior to release to the environment.

The waste disposal building heating and ventilating system is designed to supply filtered and heated air at approximately 9,000 cu. ft per min and exhaust it after filtration. This corresponds to about one change of air per hour. Building exhaust is through the stack.

The supply fans, exhaust fans, and exhaust filters are provided in full-capacity duplicates. Either supply fan and either exhaust fan can then be used to operate the system while the others are standby.

Outside air is drawn into the system through a fixed louver housed above the roof of the building and protected by bird and insect screening. The air is drawn through a filter designed to remove dust, and an electric heater of 200 kw capacity. The heater is thermostatically controlled to warm the air to maintain at least 70 F in accessible areas and 50 F in inaccessible areas. Beyond the heater section, the supply duct is split with each half routed through a supply fan of 9,000 cfm capacity. Each fan is isolated in its section of duct by a butterfly valve damper on both inlet and discharge sides. Beyond the fan discharge control dampers, the ducts rejoin into a common manifold from which supply ducts convey fresh air to various areas of the building. At or near the discharge point of each of these ducts, a manually set damper determines the fraction of air delivered at that particular point.

The fresh air supply points are located where the rate of air contamination is lowest while the exhaust ducts are located where the rate of contamination is likely to be the highest.

An air outlet is located in each room and at each piece of equipment or other place where radioactive contamination in the form of dust, gas, or vapor could be released. Ducts from these areas lead to an exhaust air manifold with each duct having a manually set control damper.

A shunt circuit draws air from the exhaust manifold and monitors its airborne radioactivity. The circuit is located so that it monitors building air conditions and not exhaust from equipment vents. High activity is alarmed in both the waste building control room and the Station main control room.

Beyond this point, the exhaust duct divides into two branches, each of which contains a roughing filter followed by a high-efficiency filter and an exhaust fan. Butterfly valves in the ducts, before the filters, between filters and fans and following the fans determine which of the alternate routes the exhaust will take and regulate the amount of air exhausted. From here on the ducts are reunited and discharge to the plenum leading to the stack. Backflow from other systems is prevented by interlocks which require valves to close if the exhaust fans are not in operation.

Each high-efficiency particulate filter in the exhaust system has a minimum removal efficiency of 99.97 percent based on the 0.3 micron "DOP" (dioctylphthalate smoke) test.

Supplementing this exhauster system is a 300 cfm capacity auxiliary system which exhausts air directly from the hydraulic baler through a roughing filter and a high-efficiency filter by means of a small exhauster fan and discharges directly into the ventilation breeching. Also, a 500 cfm capacity auxiliary system exhausts directly from the drum filling area through a roughing filter by means of a small exhauster fan and discharges to the exhaust duct of the building ventilating system. Equipment vents and the sample station hood discharge directly to the exhaust duct.

Supplementing the heat supplied by the main intake air heater, small heating units are provided locally to maintain desired temperatures for comfort of personnel and protection of equipment.

1.2.2.3 Turbine Building

The turbine building releases are those reported in Table 2-9 of NUREG-0016, since there is no treatment of the exhaust ventilation air.

The turbine building ventilating system is designed to provide filtered and heated air at an approximate rate of one change per hour, corresponding to 170,000 cfm. Two independent air supply systems are provided, each consisting of a fresh air

intake, filter, electric heating unit, flow control damper, two fans, dampers, and ductwork to distribute air to various areas in the turbine building. Each fan system is capable of supplying one-half of the required air, and either of the two fans in each system is considered an installed spare. The air duct electrical heating units are automatically controlled to maintain the supply air temperature at the desired level.

The exhaust air system consists of two full-capacity fans, with one fan considered an installed spare, and connecting ductwork designed to induce flow of air through areas of progressively higher contamination potential prior to final discharge to the stack.

An air inlet is located in each room and at each piece of equipment or other place where radioactive contamination in the form of dust, gas, or vapor could be released. Ducts from these areas lead to an exhaust air manifold with each duct having a manually set control damper.

The radiation protection and laboratory facilities ventilating system discharges directly to the turbine building exhaust duct.

A shunt circuit draws air from the exhaust manifold and monitors its airborne radioactivity. The circuit is located so that it monitors building air conditions and not the exhaust from equipment vents. High activity causes alarm in the Station main control room.

The exhaust system discharges into a plenum which also receives air from the containment and other buildings. Backflow from other systems to the turbine building is prevented by interlocks which require valves to be closed if the exhaust fans are not in operation.

The turbine building atmosphere is automatically controlled at a negative pressure of about 0.1 in. of water relative to the outside by modulating the flow control dampers on the air supply systems. This is to control release of contaminated air and prevent out-leakage.

1.2.2.4 Stack

The stack is a free-standing reinforced-concrete chimney, 350 ft high, located 100 ft east of the northeast corner of the reactor building.

The height of the stack and the velocity of discharge are designed to provide a high degree of dilution for routine or accidental Station effluents.

It is a tapered monolithic reinforced-concrete tube resting on a massive concrete base which extends to sound rock. From this base, it rises through the turbine auxiliaries building extension from which it is completely isolated structurally. The top of the stack is at El. 611, or 212 ft and 6 in. above the top of the reactor building, the next highest structure in the Station.

The top of the stack is in effect an 8 ft-6 in. inside diameter nozzle. For normal gas flows of 216,000 cfm, the corresponding velocity of the discharge jet is 63 ft per sec. This relatively high velocity assures that the turbulence generated will thoroughly mix, dilute, and disperse the discharged gas even at times of low wind velocity. The exit temperature for these gases is normally between 85 F and 100 F.

1.2.2.5 Mechanical Vacuum Pump

The mechanical vacuum pump releases are as reported on page 2-27 of NUREG-0016 since there is no treatment of this gaseous release source except for a 1.75 min hold-up time before being sent to the stack.

1.2.2.6 Turbine Gland Seal System

Two full-capacity steam packing exhausters pull a slight vacuum at the turbine shaft packing. Duplicate exhausters provide added protection in the event one becomes inoperative. Main reactor steam is used for the turbine gland seal system.

Although a larger volume of gases is handled by this system than by the off-gas system, the total activity discharged is considerably less because of the relatively small amount of steam leaking through the gland seals. The large volume results from dilution of the steam with room air. Since the activities are low, the steam packing exhaust gases are held up for 1.75 min (to allow N-16 and 0-19 to decay) and then exhausted to the stack.

1.2.2.7 Off-Gas System

The off-gas system releases are based on a charcoal delay bed process. The charcoal delay beds provide a holdup time of 50 hr for Krypton and 890 hr for Xenon prior to release to the environment as calculated using the equation given on page 2-28 of NUREG-0016. It is assumed that only noble gases are released from the delay beds.

Figure 1.2.2-1 illustrates a simplified schematic of the gaseous release system and Table 1.2.2-1 lists the gaseous releases.

1.2.2.8 Provisions to Reduce Radioactive Releases

Two of the systems described above should also be mentioned as "provisions to reduce radioactive releases." They are the turbine gland seal system and the off-gas system. In addition to the descriptions above, the off-gas system includes the equipment described below.

Catalytic Recombiner

The process off-gas from the main condenser air ejectors is diluted with steam to a hydrogen concentration of less than 4 percent by volume at all power levels. Radiolytic hydrogen and oxygen catalytically react in the recombiner to form water, thus eliminating the hydrogen hazard and reducing the volume of gas handled in the rest of the off-gas system. The hydrogen concentration downstream of the recombiner is less than 0.1 percent at a low airflow condition of 4 scfm at all power levels.

Condenser

The off-gas system condenser is designed to provide the following functions:

a. Condense out the excess steam from the steam jet air ejectors and for hydrogen dilution

b. Condense out the water of reaction formed in the catalytic recombiner

c. Remove the exothermic heat of reaction which takes place in the recombiner

Delay Pipe

The first two-thirds of the original delay pipe is used to provide 2 1/2 hr delay after the recombiners.

Dehumidification System

The discharge from the 2 1/2 hr delay pipe flows through freeze-out chillers. In passing through this dehumidification system, the moisture content of the gas stream is reduced so that essentially a "dry" gas is produced before it reaches the charcoal adsorbers.

Pre-Adsorber

The discharge from the freeze-out chillers flows through pre-adsorbers which remove solid decay products.

Charcoal Adsorbers

The discharge from the pre-adsorber flows through the charcoal adsorbers which provide for selective adsorption of the xenon and krypton isotopes from the bulk carrier gas (essentially air). This permits the xenon and krypton isotopes to decay thereby reducing activity releases.

Vacuum Pump

The liquid ring type vacuum pump is installed to pull the off-gas through the recombiner charcoal adsorber system. This allows the system to operate at a negative pressure which prevents the leakage of any radioactive gases into the building. Afterfilters remove any solid particulates or charcoal fines carried out of the charcoal adsorbers before they reach the vacuum pumps. The effluent from the vacuum pumps discharges to the stack.

1.2.2.9 Primary Containment System

A pressure suppression containment system consisting of a drywell, suppression chamber (torus), and interconnecting vent piping is the primary containment for the main coolant system. When the reactor is hot and pressurized, the reactor building containing the pressure suppression system provides a secondary containment barrier. When the reactor is shut down for refueling or maintenance, the drywell head is removed, and the reactor building provides the principal containment.

The volumes for the primary containment-pressure suppression system are as follow:

	Drywell and Vents	Suppression Chamber
Total Volume (No Equipment)	242,700 cu ft	209,000 cu ft
Approximate Free Volume	180,000 cu ft	120,000 cu ft

The Nine Mile Point Nuclear Station Unit 1 does not have a containment building internal recirculation system nor pressurized storage tanks.

TABLE 1.2.2-1

RELEASES VIA MAIN STACK

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

GASEOUS RELEASES (Ci/yr)

NUCLIDE	REACTOR BUILDING	TURBINE BUILDING	RADWASTE BUILDING	TURBINE GLAND SEAL SYSTEM	OFF-GAS SYSTEM	MECHANICAL VACUUM PUMP	TOTAL
KR-83M	0.0	0.0	0.0	2.5E+01	0.0	0.0	2.5E+01
KR-85M	6.0E+00	6.8E+01	0.0	4.4E+01	1.7E+01	0.0	1.3E+02
KR-85	0.0	0.0	0.0	0.0	1.4E+02	0.0	1.4E+02
KR-87	6.0E+00	1.9E+02	0.0	1.5E+02	0.0	0.0	3.5E+02
KR-88	6.0E+00	2.3E+02	0.0	1.5E+02	0.0	0.0	3.9E+02
KR-89	0.0	0.0	0.0	6.5E+02	0.0	0.0	6.5E+02
XE-131M	0.0	0.0	0.0	0.0	1.3E+01	0.0	1.3E+01
XE-133M	0.0	0.0	0.0	2.1E+00	0.0	0.0	2.1E+00
XE-133	1.3E+02	2.8E+02	1.0E+01	6.0E+01	4.7E+02	2.3E+03	3.2E+03
XE-135M	9.2E+01	6.5E+02	0.0	1.8E+02	0.0	0.0	9.2E+02
XE-135	6.8E+01	6.3E+02	4.5E+01	1.7E+02	0.0	3.5E+02	1.3E+03
XE-137	0.0	0.0	0.0	8.0E+02	0.0	0.0	8.0E+02
XE-138	1.4E+01	1.4E+03	0.0	6.0E+02	0.0	0.0	2.1E+03
I-131	3.4E-01	1.9E-01	4.6E-02	1.6E-02	0.0	3.0E-02	6.2E-01
I-133	1.4E+00	7.6E-01	1.8E-01	6.3E-02	0.0	0.0	2.4E+00
CO-60	2.0E-02	2.0E-03	9.0E-04	0.0	0.0	0.0	2.3E-02
CO-58	1.2E-04	6.0E-03	4.5E-05	0.0	0.0	0.0	1.8E-03
CR-51	6.0E-04	1.3E-02	9.0E-05	0.0	0.0	0.0	1.4E-02
MN-54	6.0E-03	6.0E-04	3.6E-04	0.0	0.0	0.0	7.0E-03
FE-59	8.0E-04	5.0E-04	1.5E-04	0.0	0.0	0.0	1.5E-03
ZN-65	4.0E-03	2.0E-04	1.0E-05	0.0	0.0	0.0	4.2E-03
ZR-95	8.0E-04	1.0E-04	5.0E-07	0.0	0.0	0.0	9.0E-04
SR-89	1.8E-04	6.0E-03	5.0E-06	0.0	0.0	0.0	6.2E-03
SR-90	1.0E-05	2.0E-05	3.0E-06	0.0	0.0	0.0	3.3E-05
SB-124	4.0E-04	3.0E-04	5.0E-07	0.0	0.0	0.0	7.0E-04
CS-134	8.0E-03	3.0E-04	4.5E-05	0.0	0.0	0.0	8.3E-03
CS-136	6.0E-04	5.0E-05	4.5E-06	0.0	0.0	0.0	6.5E-04
CS-137	1.0E-02	6.0E-04	9.0E-05	0.0	0.0	0.0	1.1E-02
BA-140	8.0E-04	1.1E-02	1.0E-06	0.0	0.0	0.0	1.2E-02
CE-141	2.0E-04	6.0E-04	2.6E-05	0.0	0.0	0.0	8.3E-04
C-14	0.0	0.0	0.0	0.0	9.5E+00	0.0	9.5E+00
AR-41	2.5E+01	0.0	0.0	0.0	0.0	0.0	2.5E+01
H-3	--	--	--	--	--	--	2.3E+01

NOTES:
1. 6.8E+01 = 6.8 x 10^1
2. The reactor building is equal to the combined NUREG-0016 containment building and auxiliary building releases
3. For noble gases, 0 is printed if the release is less than 1 curie/yr
4. The tritium proportionment by release stream is not specified

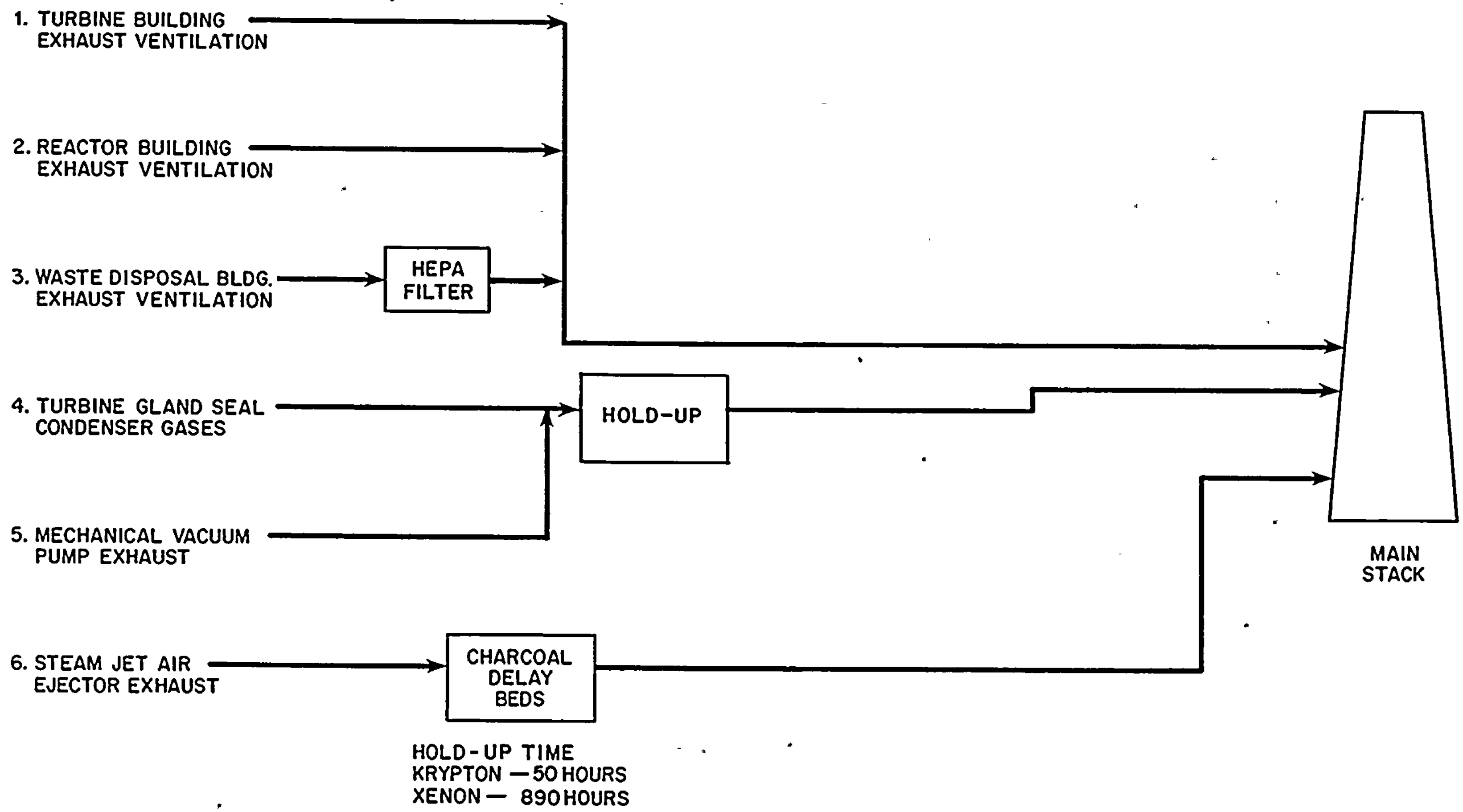

FIGURE 1.2.2-1
GASEOUS RELEASES
SIMPLIFIED FLOW DIAGRAM
NORMAL OPERATION
NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

1.2.3 Liquid Releases

The liquid radwaste system, shown in Figure 1.2.3-1, is composed of four substreams. Figure 1.2.3-2 depicts the liquid radwaste treatment used in the analyses. A fraction ranging between 0.1 to 1.0 of each substream flow is assumed to be discharged to Lake Ontario via the once-through cooling system. This assumption and the others used to determine the liquid releases are based on Regulatory Guide 1.112 and NUREG-0016.

The pertinent recommendations taken from NUREG-0016 are summarized below:

Plant capacity factor - 0.8

Decay times

Collection time:	Volume of Tank ÷ Average input flow rate x.4
Process time:	Volume of Tank ÷ Processing capacity flow rate x.4
Discharge time:	O, if capacity of first tank is less than or equal to last tank
Condensate demineralizer regeneration frequency:	1/7 days

Decontamination factors

Detergent evaporators:	100 - all isotopes
Radwaste demineralizer:	2-Cs, Rb; 100 - others
Polishing demineralizer:	10 - all isotopes

Anticipated annual operation occurrences:	0.15 curies/year

The treatment assumed for each liquid radwaste stream is discussed below.

1.2.3.1 Laundry Wastes

The laundry wastes feed into the laundry drain tanks at a rate of 450 gal per day. This analysis then assumes the total tank volume is discharged without treatment.

The source terms and flow rates for the laundry drain wastes discharged to Lake Ontario are taken directly from NUREG-0016, Table 2-32 (see Table 2.1.5-1).

1.2.3.2 Regenerant Chemicals

NUREG-0016 assumes that, for each condensate demineralizer regeneration, a volume of 11,900 gallons is sent to the waste neutralizer tank. This number is also assumed for the reactor water clean-up demineralizer and waste demineralizer regeneration.

The feed rate into the regenerant chemical stream consists of condensate, reactor water cleanup, and radwaste demineralizer regenerations as well as decontamination drains and chemical laboratory wastes for a total of 5,300 gal per day.

The regenerant chemical stream feeds into the regenerant neutralizer tank, filling this tank to 40 percent capacity in 27 hr. The tank volume is then processed via the regenerant chemical waste concentrator (20 gal per minute) with the distillate routed to the waste collector tank for process and release via the high purity system (Section 1.2.3.4).

The decontamination factors used on this stream are based on a detergent waste evaporator (DF=100) and a polishing demineralizer (DF=10) in series for an overall DF equal to 1,000 on all isotopes.

In the event the waste concentrator is inoperable for two consecutive days per week (according to NUREG-0016), there is sufficient tank capacity (i.e. two days collection time by the waste neutralizer tank and waste surge tank when allowed to fill to 80 percent of capacity) so that there is no discharge of the chemical regenerant stream directly to the environment.

1.2.3.3 Low Purity Waste

The low purity waste stream consists of the floor drains feeding into the floor drain collector tank. The feed rate is 18,500 gal per day.

The low purity stream feeds into the floor drain collector, filling this tank to 40 percent capacity in 5.3 hr. The tank volume is then processed in the exact same manner as the regenerant chemicals (Section 1.2.3.2).

In the event the waste concentrator is inoperable for two consecutive days per week (according to NUREG-0016), there is sufficient tank capacity (i.e. two days collection time by the Floor Drain Collector Tank, Floor Drain Sample Tanks, and the Waste Surge Tank when allowed to fill to 80 percent of capacity) so that alternate processing by the Waste Demineralizer is not required.

1.2.3.4 <u>High Purity Waste</u>

The feed rate into the high purity waste stream consists of the drywell floor drains, the equipment drains, condensate demineralizer resin rinse and backwash, and waste concentrator distillate for a total of 87,000 gal per day.

The high purity stream feeds into the waste collector tank, filling this tank to 40 percent capacity in 2.7 hr. The stream is then processed via the radwaste demineralizer at 300 gal per minute, with the demineralized water routed to the waste sample tanks. The decontamination factors used on this stream are 2 for Cs and Rb and 100 for all others. It is assumed that 10 percent of this stream is discharged to Lake Ontario.

1.2.3.5 <u>Liquid Radioactive Effluents</u>

The liquid releases are listed in Table 1.2.3-1. A total of 1.3 Ci/yr of non-tritium radioisotopes is calculated to be released. This includes 0.15 Ci/yr to account for operational occurrences. Tritium releases are estimated to be 23 Ci/yr.

TABLE 1.2.3-1

TOTAL LIQUID RELEASES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Isotope	Annual Activity (μCi/gm)	Released (Ci)
Na-24	5.3E-11	2.6E-02
P-32	1.7E-12	8.4E-04
Cr-51	4.9E-11	2.4E-02
Mn-54	2.9E-12	1.4E-03
Mn-56	2.1E-10	1.0E-01
Fe-55	1.2E-11	5.9E-03
Fe-59	3.0E-13	1.5E-04
Co-58	1.0E-11	5.1E-03
Co-60	2.3E-11	1.1E-02
Ni-63	1.2E-14	6.0E-06
Ni-65	1.3E-12	6.1E-04
Cu-64	1.8E-10	8.6E-02
Zn-65	5.5E-12	2.5E-03
Zn-69M	1.2E-11	5.6E-03
Sr-89	1.1E-12	5.3E-04
Sr-90	7.5E-14	3.7E-05
Sr-91	2.2E-11	1.1E-02
Sr-92	4.2E-11	2.0E-02
Y-91	4.7E-13	2.3E-04
Y-92	4.4E-11	2.1E-02
Y-93	2.2E-11	1.1E-02
Zr-95	7.6E-14	3.7E-05
Zr-97	2.9E-14	1.4E-05
Nb-95	4.1E-12	2.0E-03
Nb-98	7.2E-12	3.5E-03
Mo-99	1.3E-11	6.5E-03
Tc-99M	1.0E-10	5.1E-02
Tc-101	1.6E-11	8.0E-03
Tc-104	2.6E-11	1.3E-02
Ru-103	2.0E-13	9.8E-05
Ru-105	9.8E-12	4.8E-03
Ru-106	4.9E-12	2.4E-03
Ag-110M	9.3E-11	4.5E-04
Te-129M	3.8E-13	1.9E-04
Te-131M	6.2E-13	3.0E-04
Te-132	6.8E-14	3.3E-05
Ba-139	2.9E-11	1.4E-02
Ba-140	3.3E-12	1.6E-03
Ba-141	3.4E-12	1.6E-03
Ba-142	4.8E-13	2.3E-04

TABLE 1.2.3-1 (Cont'd)

Isotope	Annual Activity (μCi/gm)	Released (Ci)
La-142	1.8E-11	8.7E-03
Ce-141	2.9E-13	1.4E-04
Ce-143	1.8E-13	8.8E-05
Ce-144	1.0E-11	5.0E-03
Pr-143	3.4E-13	1.7E-04
Nd-147	2.4E-14	1.2E-05
W-187	1.9E-12	9.2E-04
Np-239	4.6E-11	2.2E-02
Br-83	1.7E-11	8.1E-03
Br-84	5.6E-12	2.7E-03
Br-85	1.9E-16	9.3E-08
I-131	2.6E-10	1.3E-01
I-132	1.6E-10	7.9E-02
I-133	2.6E-10	1.3E-01
I-134	1.6E-10	8.0E-02
I-135	1.7E-10	8.1E-02
Rb-89	5.4E-11	2.6E-02
Cs-134	3.5E-11	1.7E-02
Cs-136	6.2E-12	3.0E-03
Cs-137	7.0E-11	3.5E-02
Cs-138	5.0E-10	2.4E-01
H-3	4.7E-08	2.3E+01
Grams Released		4.9E+14

Notes:

1. 2.3E-11 = $2.3X10^{-11}$
2. Isotope releases of less than 1.0E-10 curies/year are set to 0
3. Anticipated operational occurrences: 1.50E-01 curies added to release
4. Blowdown rate: 4.86E+14 (gms/year)
5. Total release (excluding tritium) is 1.3E+00 curies
6. Total release (excluding tritium) is 2.5E-09 μCi/gram

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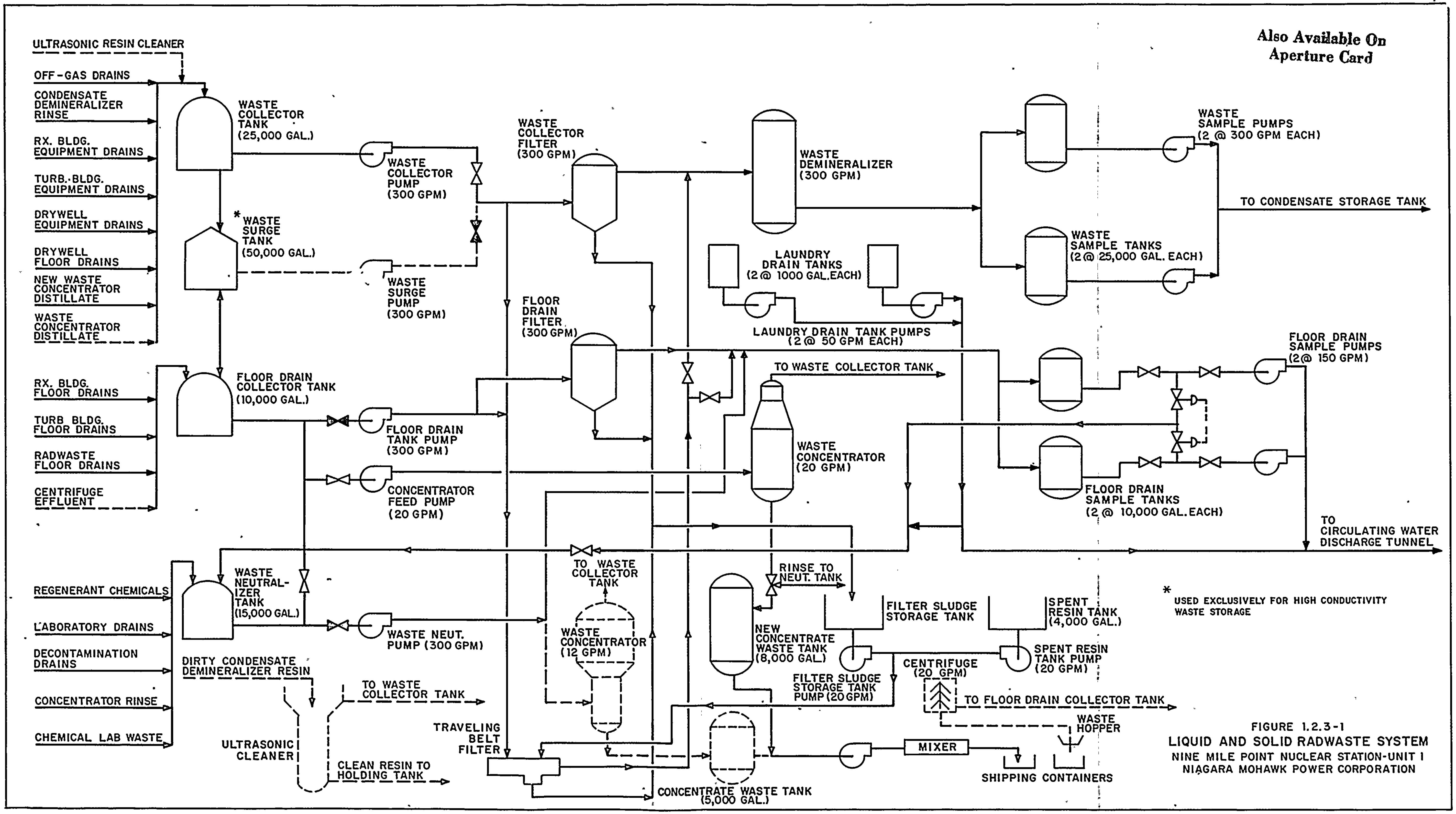

FIGURE 1.2.3-1
LIQUID AND SOLID RADWASTE SYSTEM
NINE MILE POINT NUCLEAR STATION-UNIT 1
NIAGARA MOHAWK POWER CORPORATION

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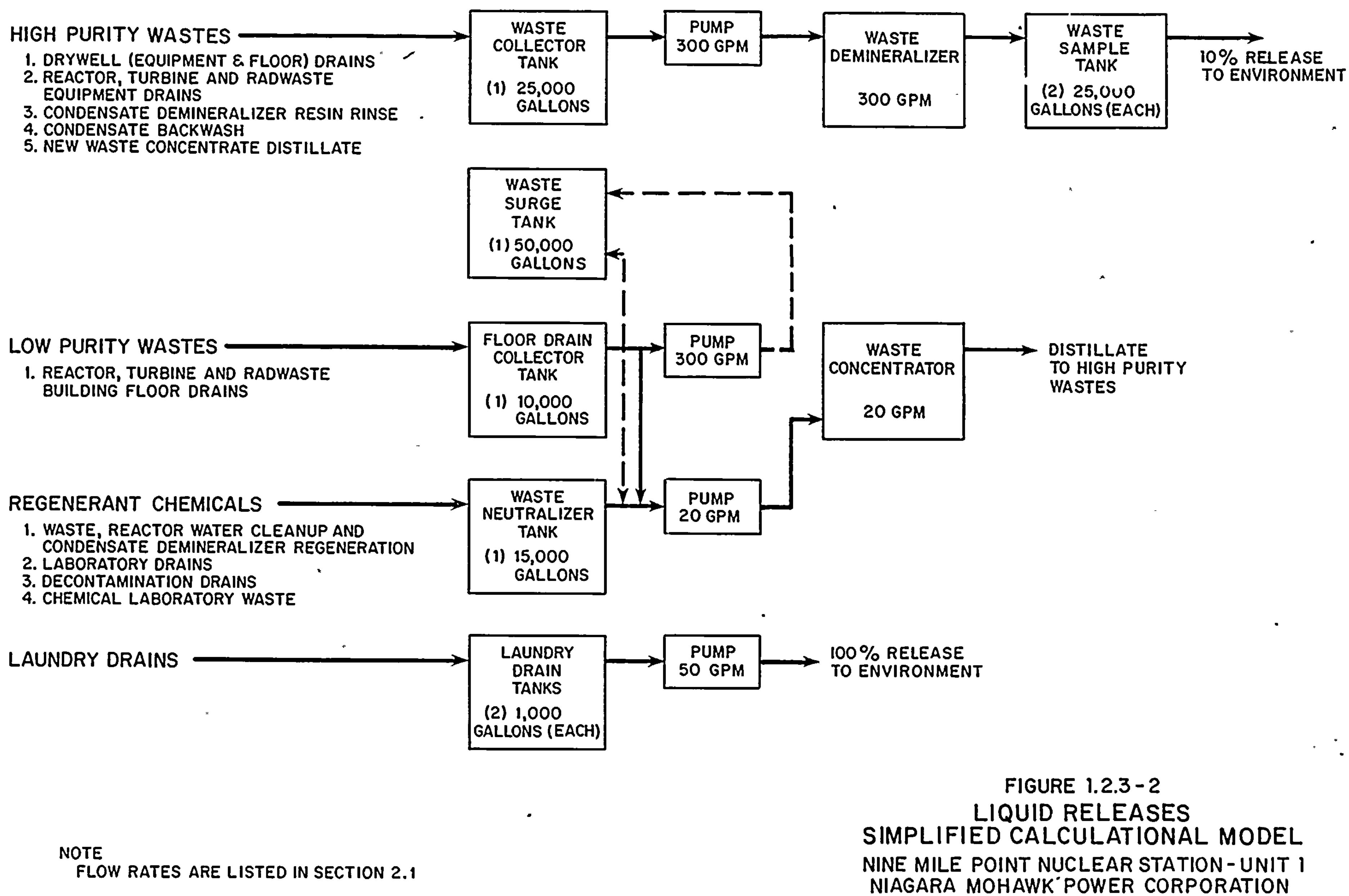


FIGURE 1.2.3-2
LIQUID RELEASES
SIMPLIFIED CALCULATIONAL MODEL
NINE MILE POINT NUCLEAR STATION-UNIT 1
NIAGARA MOHAWK POWER CORPORATION

1.3 Meteorology/Hydrology

This section is in two parts. Section 1.3.1 addresses meteorology and 1.3.2 addresses hydrology.

1.3.1 Meteorology

This section describes the meteorological data used in the dose assessments. The information referenced here and provided in the Nine Mile Point Nuclear Station Unit 2, Docket No. 50-410, Compliance with 10CFR50 Appendix I, June 4, 1976, is also applicable to Nine Mile Point Unit 1.

1.3.1.1 On-Site Meteorological Program Data

The on-site meteorological data for the years 1974 and 1975 have been summarized in Response B-1 of the Nine Mile Point Nuclear Station Unit 2, Docket No. 50-410, Compliance with 10CFR50 Appendix I, June 4, 1976. That response includes the following information:

a. Monthly and annual wind speed and direction data, in joint frequency form, at all heights of measurement representative of wind characteristics for points of effluent release to, and transport within, the atmosphere

b. Monthly and annual joint frequencies of wind direction and speed by atmospheric stability class at heights and intervals relevant to atmospheric transport of effluents

c. Total precipitation by month, number of hours with precipitation, rainfall rate distributions and monthly precipitation wind roses

1.3.1.2 Regional Meteorological Conditions

The regional meteorology has been discussed in Response B-2 of the Nine Mile Point Nuclear Station Unit 2, Docket No. 50-410, Compliance with 10CFR50 Appendix I, June 4, 1976. That response includes the following information:

a. Wind speed and direction data at all height(s) at which wind characteristic data are applicable or have been measured

b. Atmospheric stability data as defined by vertical temperature gradient or other well documented parameters that have been substantiated by diffusion test data

c. Monthly mixing height data

d. Total precipitation by month, number of hours with precipitation, rainfall rate distributions, and monthly precipitation wind roses

e. Describe airflow trajectory regimes of importance in transporting effluents to a distance of 50 miles from the plant, including airflow reversals

1.3.2 Hydrology

This section and the dose calculations are based on hydrology models which are consistent with Regulatory Guide 1.113.

The near field dilution factor at the edge of the initial mixing zone is based on the prompt lake dilution factor of 5, based on a submerged, high velocity, effluent discharge point in shallow water in accordance with Table A-1 of Regulatory Guide 1.109.

The dilution factors at larger distances are calculated in accordance with Regulatory Guide 1.113 and are summarized in Table 1.3.2-1.

1.3.2.1 Quantitative Water Use Diagrams

This section discusses the quantitative water use for the plant showing flow rates to and from the various plant water systems (heat dissipation system, sanitary system, radwaste and chemical waste systems, process water system, etc.) in support of liquid radionuclide release rate and concentration estimates.

Cooling water for the main condenser, auxiliary systems, reactor shutdown heat removal, and for water system makeup is withdrawn from Lake Ontario via the submerged intake tunnel. This water is circulated by the main condenser circulating water pumps and/or the service water pumps. The flow and heat dissipation rates are indicated on the Water Usage Flow Diagram, Figure 1.3.2-1.

During normal station operations, the closed loop cooling system heat exchangers are in use. However, when the station is shut down, this water use is reduced. At this time the Shutdown Cooling System utilizes the balance of the flow from the service water pumps.

Maximum flows indicated for auxiliary heat exchangers and reactor shutdown are based on design heat loads for heat exchangers and a lake temperature of 77 F. Three pumps and heat exchangers are run at this time rather than two which are used during normal operation.

1.3.2.2 Consumptive Plant Water Use

This section discusses the consumptive use of water by the plant, including the considerations of power operation and temporary shutdown.

In addition to the information included in Section 1.3.2.1, the water flow rates from waste regeneration, residual heat removal, makeup water, domestic water, laundry, and floor drain water usages are variable and are dependent upon such things as the phase of demineralizer regeneration, time of year, and station operating status. Consumption of water furnished by the City of Oswego water system has averaged 3300 gpd.

All systems which use water discharge to the lake, and an exact determination of water consumption cannot be made. However, it is estimated that water consumption due mainly to evaporation would not exceed 0.02 cfs or 10 gpm. This does not include evaporation from the lake surface due to thermal dissipation of the circulating water discharge.

1.3.2.3 Location and Nature of Water Use Within 50 Miles

This section identifies the location, nature, and amounts of present and projected (over plant life) surface water use (e.g., water supply, irrigation, reservoirs, fisheries, recreation) within 50 miles of the plant where detectable amounts of radioactivity from plant liquid effluents may be expected to affect such use. The bases for estimating present and projected water use are provided and the users located on maps of legible scale. A tabulation of the following specific information for water users is provided:

a. Map identification key

b. Radial and water route distance from the plant to the intake and discharge

c. Withdrawal and return rates in cfs or gpm for present and projected monthly use

d. Type of water use (e.g., municipal, industrial, irrigation)

e. Source and projection dates of water use estimates.

Studies to determine the exact data were not performed. However, a search of existing licensing documents has been performed and the results are presented below.

Water Supply and Industrial Use

Information regarding the location and average pumpage of water from Lake Ontario for human consumption within 50 miles of the Nine Mile Point Nuclear Station Unit 1 (NMP1) site was obtained for U.S. shores from: the New York State Public Water Supply in Albany, New York; from the local offices in Monroe, Wayne, Cayuga, Oswego, and Jefferson counties; from the water departments and water plants of various villages, towns, and cities; and from the Department of Environmental Conservation, Bureau of Water Regulations and Water Resources Planning.

Table 1.3.2-2 summarizes the locations and the average amounts of water pumped from the U.S. shores of Lake Ontario within a 50 mile radius of NMP1. Figure 1.3.2-2 shows the locations of these intakes. Only three pumpage intakes are located within 30 miles of the NMP1 discharge point (Locations 4, 5, and 6). The dilution provided by Lake Ontario for locations greater than 30 miles renders any dose to the population to be insignificant. The three locations within 30 miles are Sodus Point Village, East of Port Bay, and the City of Oswego. Of these three locations, the City of Oswego intake accounts for approximately 99 percent of the pumpage. For the above reasons,

the City of Oswego water intake is the only water usage for human consumption considered in this analysis.

Population projections may be used as an indication of future water usage. Population projections can be found from the following references:

1. Nine Mile Point Nuclear Station Unit 2 Preliminary Safety Analysis Report (NMP2-PSAR), Tables 2.1-1 and 2.1-2

2. Nine Mile Point Nuclear Station Unit 2 Environmental Report Construction Permit Stage (NMP2-ER), pages 2.2-4 and 2.2-5

3. NMP2-ER, Figure 2.2-6

4. NMP2-ER, page 5.2-8

5. NMP2-PSAR, Figures 2.1-5 through 2.1-14

Irrigation

Irrigation data are located on page 5.2-6 of the NMP2-ER. The most recent surveys indicate that the orchards discussed in the NMP2-ER no longer use lake water for irrigation.

Recreation and Fishing

Information on recreation and fishing within about 10 miles of the site is provided as follows:

1. NMP2-ER, pages 2.2-2 and 2.2-3

2. NMP2-ER, pages 5.2-3 and 5.2-5

3. NMP2-ER, page S2.6-2

4. NMP2-PSAR, pages 2.1-3 through 2.1-5

5. NMP2-PSAR, page R2.22-1

Additional information on fishing on Lake Ontario appears on page 8.4-5 of NMP2-ER.

General

Area maps useful in locating recreation areas, projected future land use, and present industry in Oswego are located in the following references:

1. NMP2-PSAR, Figure 2.1-2

2. NMP2-PSAR, Figure 2.1-18

3. NMP2-ER, Figures 2.2-2 and 2.2-3

4. NMP2-ER, page 5.4-11

1.3.2.4 Description of Discharge Structure

The following section provides a detailed description of the liquid discharge structure. It also discusses institutional restrictions (state or local) on releases.

Liquid Discharge Structure

As shown on Figure 1.3.2-3, water is returned to Lake Ontario at a point about one-tenth of a mile offshore (585 ft from the screenhouse) through a bell-mouthed outlet surmounted by a hexagonal-shaped discharge structure of concrete. The top of this structure is about 4 ft above lake bottom and 8 1/2 ft below the lowest anticipated lake level. There are six exit ports about 3 ft high by 7 1/3 ft wide. The vertical shaft connecting the discharge tunnel with the discharge channel under the screenhouse has a sand trap at its foot to catch and store any lake-bottom sand which may wash over the sills of the outlet structure.

Liquid waste is discharged directly to the vertical discharge shaft. A submerged diffuser in the vertical shaft ensures good dilution before discharge to the lake. Samples are drawn at a lower point in the shaft.

State and Local Restrictions

The New York State Environmental Conservation Law, Article 17, "Water Pollution Control," sets forth the state policy regarding this subject. Specific regulations pertinent to pollutant discharges and water quality standards are published as parts 700 through 704, Title 6 of the New York Code of Rules and Regulations.

1.3.2.5 Description of Ambient Flow in Lake Ontario

This section describes the ambient flow field of the water body affected by plant liquid radionuclide effluents out to a radius of 50 miles. It also describes expected seasonal and other temporal variations of important parameters (e.g., flow, currents).

New studies to determine exact ambient flow data were not performed. However, a search of existing licensing documents has been performed and the results are presented below.

Flows and currents in Lake Ontario have been described in the following locations:

1. Nine Mile Point Nuclear Station Unit 1 Environmental Report Operating License Stage (NMP1-ER), pages 2.5-1 through 2.5-4

2. NMP2-ER, page 5.1-4

3. NMP1-ER, pages 5.4-6 and 5.4-7

4. NMP1-ER, page H-6

5. James A. FitzPatrick Nuclear Power Plant Environmental Report Operating License Stage (JAF-ER), Appendix I.

6. Preliminary Hazards Summary Report, Nine Mile Point Nuclear Station Unit 1 (NMP1-PHSR), Appendix B

7. Nine Mile Point Nuclear Station Unit 2 Preliminary Safety Analysis Report (NMP2-PSAR), page 2.7-6

8. NMP2-PSAR, Figures R2.34-4 and R2.34-11

9. 1970 Lake Temperature and Current Studies, Stone & Webster Engineering Corporation, June 1971

10. Nine Mile Point Nuclear Station Unit 1, Final Safety Analysis Report (NMP1-FSAR), Appendix B

The only water body affected by plant liquid radionuclide effluents is Lake Ontario. The limited extent of detectable effects has been generally indicated on page 5.4-11 of the NMP2-ER. Data reported on page B-4 of the NMP1-PHSR and dilution factors for Canada given on page 45 of the JAF-ER support the conclusion of limited affected areas.

Bathymetry and shoreline geometry have been well described in the following references:

1. NMP2-ER, Figure 3.2-1

2. NMP2-PSAR, Figure 2.1-3

3. NMP2-PSAR, Figure 2.7-1

4. NMP2-PSAR, Figure 2.7-35

5. NMP2-PSAR, Figure R2. 13-3

6. NMP1-PHSR, Appendix B

7. 1970 Lake Temperature and Current Studies, Stone & Webster Engineering Corporation, June 1971

8. NMP1-FSAR, Appendix B

Some of the above sources are complete reports of limnological studies. Other references are listed in the NMP2-ER on pages F1, 2, 5, and 6; on page H-8; and on page S2.5-3.

1.3.2.6 Liquid Radionuclide Releases

The estimated monthly average of liquid effluent containing radionuclides, as calculated in accordance with Draft Regulatory Guide 1.CC, is 260,000 gal. The effluent is diluted with 1.07×10^{10} gal/month of liquid from the once-through cooling flow. The resulting concentrations in μCi/gm, released to Lake Ontario, are listed in Table 1.2.3-1.

1.3.2.7 Radionuclide Concentrations and Travel Times in Lake Ontario

This section provides estimates of radionuclide concentrations and travel times at use locations identified in Section 1.3.2.3, annually, and for the time periods used to identify water use, flow fields, and release rates. The transport model(s) used, input data and parameters, sources of data and parameters, techniques and results are discussed.

Table 1.3.2-3 provides estimated radionuclide concentrations. These concentrations represent annual average values. Dilution factors and travel times in the lake for water use at locations identified in Section 1.3.2.3 (mixing zone, Lakeview Summer Camp, Oswego City Public Water Supply, and Selkirk State Park) are presented in Table 1.3.2-1.

No travel time decay is considered in arriving at the Mixing Zone Concentrations. An approximate lake dilution factor of 5 is used based on a submerged, high velocity discharge in shallow water (See Table A-1 of Ref. 1). For other usage locations, lake dilution factors are calculated using the quasi-steady-state model as described in Section 3, "Great Lakes," of Regulatory Guide 1.113 (Ref. 2). Specifically, equations (17) and (18) of Regulatory Guide 1.113 are used for dilution factors:

$$D = W/(\chi Q)$$

$$\chi/W = \frac{1}{2\pi\sigma_y\sigma_z\mu} f(\sigma_z, Z, Z_e, d)\, f(\sigma_y, Y, Y_e)$$

where:

Q = Volumetric discharge rate (m^3/sec)
χ = Concentration at usage location (Ci/m^3)
W = Point source discharge rate (Ci/sec)
σ_y, σ_z = Standard deviations for coordinate directions Y and Z, respectively (m)
μ = Mean velocity in the X direction (m/sec)
Z_e, Y_e = Z and Y coordinates at the point source discharge (m)
Z, Y = Z and Y coordinate of the usage point (m)
d = Depth of the lake at the discharge point (m)

$$f(\sigma_z, Z, Z_e, d) = \sum_{m=-\infty}^{\infty} \left\{ \exp\left[-\frac{(2md + Z_e - Z)^2}{2\sigma_z^2}\right] + \exp\left[-\frac{(2md - Z_e - Z)^2}{2\sigma_z^2}\right] \right\}$$

$$f(\sigma_y, Y, Y_e) = \exp\left[-\frac{(Y_e - Y)^2}{2\sigma_y^2}\right] + \exp\left[-\frac{(Y + Y_e)^2}{2\sigma_y^2}\right]$$

The standard deviations σ_y, σ_z are given as follows:

$$\sigma_y = \sqrt{\frac{2K_y X}{\mu}}$$

$$\sigma_z = \sqrt{\frac{2K_z X}{\mu}}$$

Where K_y and K_z are diffusion coefficients (m^2/sec). Studies in the Great Lakes and other large lakes (Ref. 2) suggest that K_y is roughly in the range .05–0.1 m^2/sec and that K_z is in the range .0001–.003 m^2/sec.

A stable coastal current of .12 m/sec is assumed (Ref. 3). Normal current flow near the site is predominately west to east (Ref. 3). For conservatism, the flow is assumed to be westward in computing concentrations at the Lakeview Summer Camp and Oswego City Water Supply. The straight line distances from the discharge point to the Lakeview Summer Camp, Oswego Public Water Supply intake and Selkirk State Park are 0.8 miles, 8 miles, and 10 miles, respectively. For conservatism, centerline concentrations are used in calculating lake dilution factors (i.e., no credit is taken for the difference of depth between discharge point and water use locations). For further conservatism, the diffusion coefficient values of the large lakes (Ref. 2) that would result in the largest centerline concentrations are used (K_y = .05 m^2/sec, K_z = .0001 m^2/sec).

Section 1.3.2.7 References

1. Draft Regulatory Guide 1.109, "Calculation of Annual Average Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Implementing Appendix I," U.S. Nuclear Regulatory Commission, March 1976.

2. Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Releases for the Purpose of Implementing Appendix I," U.S. Nuclear Regulatory Commission, May, 1976.

3. Nine Mile Point Nuclear Station Unit 1 Environmental Report Operating License Stage, pages 5.4-6 and 5.4-7.

1.3.2.8 Sorption of Radionuclides by Sediments

The buildup of radionuclides in sediment has been considered at Lakeview Summer Camp, located 0.8 miles west of the site, and Selkirk State Park, approximately 10 miles east. Dilution in Lake Ontario and the associated travel times are given in Table 1.3.2-1.

The model used to calculate sediment concentrations is described in Regulatory Guide 1.109, Appendix A, Section 2-C. Briefly, the equation used is:

$$C_i = \frac{1.1 \times 10^5 \times W}{D \times F} \times Q_i e^{-\lambda_i t_h} \frac{(1.0-e^{-\lambda_i t_b})}{\lambda_i}$$

where:

C_i = the concentration of isotope i in sediment,
1.1×10^5 = a constant, pCi/m^2
W = the shore width factor, .3 for large lakes
D = the dilution factor at the given location
F = the discharge flow rate, ft^3/sec
Q_i = the release rate of nuclide i, Ci/yr
λ_i = is the decay constant of nuclide i, hr^{-1}
t_h = is the holdup time, from release to uptake by the sediment, hr
t_b = is the buildup time, hr. (1.314×10^5 hr is assumed)

The resultant concentrations of radionuclides in sediment are shown in Tables 1.3.2-4 and 1.3.2-5.

1.3.2.9 Potential Radionuclide Pathway Via Groundwater

This section discusses the potential for the release of liquid radionuclide effluents to the groundwater regime as a significant pathway to man.

As stated on page 5.2-13 of the Nine Mile Point Nuclear Station Unit 1 Environmental Report Operating License Stage (NMP1-ER), groundwater is not expected to be a pathway to man for radionuclides at this site. On-site groundwater contours, permeability, private use within two miles, etc., are detailed in the Nine Mile Point Nuclear Station - Unit 2 Preliminary Safety Analysis Report, Appendix ID. Source data on permeability and borings are located on pages IB-8 through IB-10, Plate IB-1 and Plate IB-2. Data on some additional private wells just beyond two miles distance are contained in Figure 2.5-4 and Table 2.5-3 of the NMP2-ER.

TABLE 1.3.2-1
DILUTION FACTORS AND TRAVEL TIMES

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Usage Location	Lake Dilution Factor	Travel Decay Time (Hr)
Selkirk State Park	8.4	37.0
Lakeview Summer Camp	5.0	2.9
Vicinity Mixing Zone	5.0	0.0
Oswego Water Intake	7.7	29.0

TABLE 1.3.2-2

WATER PUMPAGE FROM LAKE ONTARIO

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

	Location of Water Intake	Average Water Pumpage (Million Gallons/Day)
1.	At a point between Dennison Creek and Bear Creek at a site north of the intersection of Lake and Knickerbocker Roads	0.80
2.	At Pultneyville	1.0
3.	At a point north of the village of Sodus near the intersection of Shore Road and an extension of Maple Avenue	1.0
4.	In Sodus Point Village on Lake Road	0.133
5.	At East of Port Bay	0.095
6.	In the western part of the City of Oswego between Sixth and Sheldon Avenues and north of West Schuyler Street	20.0
7.	At east of the Village of Sackets Harbor	0.30
8.	In Sawmill Bay at a location on Independence Point approximately 0.5 miles south of Chaumont Village's southerly limit	0.04
9.	Cape Vincent	0.246
10.	Township of Pittsburg (Milton)	0.015
11.	Township of Pittsburg (Glen Lawrence)	0.015
12.	City of Kingston (2 intakes)	9.72
13.	Township of Kingston (Pt. Pleasant)	0.705
14.	Township of Kingston (Queen's Acres)	0.037
15.	Township of Ernestown (Amherstview)	0.270
16.	Village of Bath	0.150

TABLE 1.3.2-2 (CONT'D)

Location of Water Intake	Average Water Pumpage (Million Gallons/Day)
17. Town of Picton	0.679

Note: This table is reproduced from the James A. FitzPatrick Environmental Report Operating License Stage, Supplement 3, page 8.

TABLE 1.3.2-3

CONCENTRATIONS AT WATER USE LOCATIONS ($\mu Ci/gm$)

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Isotope	Selkirk State Park	Lakeview Summer Camp	Vicinity Mixing Zone	Oswego Water Intake
Na-24	1.2×10^{-12}	9.3×10^{-12}	1.1×10^{-11}	1.8×10^{-12}
P-32	1.9×10^{-13}	3.4×10^{-13}	3.4×10^{-13}	2.1×10^{-13}
Cr-51	5.6×10^{-12}	9.8×10^{-12}	9.8×10^{-12}	6.2×10^{-12}
Mn-54	3.4×10^{-13}	5.8×10^{-13}	5.8×10^{-13}	3.8×10^{-13}
Mn-56	1.2×10^{-15}	1.9×10^{-11}	4.2×10^{-11}	1.1×10^{-14}
Fe-55	1.4×10^{-12}	2.4×10^{-12}	2.4×10^{-12}	1.6×10^{-12}
Fe-59	3.5×10^{-14}	6.0×10^{-14}	6.0×10^{-14}	3.8×10^{-14}
Co-58	1.2×10^{-12}	2.0×10^{-12}	2.0×10^{-12}	1.3×10^{-12}
Co-60	2.7×10^{-12}	4.6×10^{-12}	4.6×10^{-12}	3.0×10^{-12}
Ni-63	1.4×10^{-15}	2.4×10^{-15}	2.4×10^{-15}	1.6×10^{-15}
Ni-65	6.7×10^{-18}	1.2×10^{-13}	2.6×10^{-13}	6.4×10^{-17}
Cu-64	2.9×10^{-12}	3.1×10^{-11}	3.6×10^{-11}	4.9×10^{-12}
Zn-65	6.5×10^{-13}	1.1×10^{-12}	1.1×10^{-12}	7.1×10^{-13}
Zn-69m	2.2×10^{-13}	2.1×10^{-12}	2.4×10^{-12}	3.6×10^{-13}
Sr-89	1.3×10^{-13}	2.2×10^{-13}	2.2×10^{-13}	1.4×10^{-13}
Sr-90	8.9×10^{-15}	1.5×10^{-14}	1.5×10^{-14}	9.7×10^{-15}
Sr-91	1.9×10^{-13}	3.6×10^{-12}	4.4×10^{-12}	3.6×10^{-13}
Sr-92	3.6×10^{-16}	4.0×10^{-12}	8.4×10^{-12}	3.1×10^{-15}
Y-91	7.1×10^{-14}	9.9×10^{-14}	9.4×10^{-14}	7.7×10^{-14}
Y-92	1.4×10^{-14}	7.5×10^{-12}	8.8×10^{-12}	6.8×10^{-14}
Y-93	2.1×10^{-13}	3.6×10^{-12}	4.4×10^{-12}	4.0×10^{-13}
Zr-95	8.9×10^{-15}	1.5×10^{-14}	1.5×10^{-14}	9.8×10^{-15}
Zr-97	7.5×10^{-16}	5.1×10^{-15}	5.8×10^{-15}	1.1×10^{-15}
Nb-95	4.7×10^{-13}	8.2×10^{-13}	8.2×10^{-13}	5.2×10^{-13}
Nb-98	Note 1	1.4×10^{-13}	1.4×10^{-12}	Note 1
Mo-99	1.1×10^{-12}	2.5×10^{-12}	2.6×10^{-12}	1.3×10^{-12}
Tc-99m	1.2×10^{-12}	1.5×10^{-11}	2.0×10^{-11}	1.6×10^{-12}
Tc-101	Note 1	6.6×10^{-16}	3.2×10^{-12}	Note 1
Tc-104	Note 1	6.4×10^{-15}	5.2×10^{-12}	Note 1
Ru-103	5.7×10^{-14}	9.8×10^{-14}	9.8×10^{-14}	6.2×10^{-14}
Ru-105	3.6×10^{-15}	1.3×10^{-12}	2.0×10^{-12}	1.4×10^{-14}
Ru-106	5.8×10^{-13}	9.8×10^{-13}	9.8×10^{-13}	6.4×10^{-13}
Ag-110m	1.1×10^{-13}	1.9×10^{-13}	1.9×10^{-13}	1.2×10^{-13}
Te-129m	4.4×10^{-14}	7.6×10^{-14}	7.6×10^{-14}	4.8×10^{-14}
Te-131m	3.1×10^{-14}	1.2×10^{-13}	1.2×10^{-13}	4.1×10^{-14}
Te-132	5.8×10^{-15}	1.3×10^{-14}	1.4×10^{-14}	6.8×10^{-15}
Ba-139	3.1×10^{-20}	1.4×10^{-12}	5.8×10^{-12}	1.9×10^{-18}
Ba-140	3.6×10^{-13}	6.6×10^{-13}	6.6×10^{-13}	4.0×10^{-13}
Ba-141	Note 1	9.4×10^{-16}	6.8×10^{-13}	Note 1
Ba-142	Note 1	1.2×10^{-18}	9.6×10^{-14}	Note 1
La-142	1.3×10^{-19}	9.8×10^{-13}	3.6×10^{-12}	5.0×10^{-18}
Ce-141	3.4×10^{-14}	5.8×10^{-14}	5.8×10^{-14}	3.7×10^{-14}

TABLE 1.3.2-3 (Cont'd)

Isotope	Selkirk State Park	Lakeview Summer Camp	Vicinity Mixing Zone	Oswego Water Intake
Ce-143	9.8×10^{-15}	3.4×10^{-14}	3.6×10^{-14}	1.3×10^{-14}
Ce-144	1.2×10^{-12}	2.0×10^{-12}	2.0×10^{-12}	1.3×10^{-12}
Pr-143	3.9×10^{-14}	6.8×10^{-14}	6.8×10^{-14}	4.3×10^{-14}
Nd-147	2.6×10^{-15}	4.8×10^{-15}	4.8×10^{-15}	2.9×10^{-15}
W-187	7.7×10^{-14}	3.5×10^{-13}	3.8×10^{-13}	1.1×10^{-13}
Np-239	3.5×10^{-12}	8.9×10^{-12}	9.2×10^{-12}	4.2×10^{-12}
Br-83	4.6×10^{-17}	1.5×10^{-12}	3.4×10^{-12}	5.1×10^{-16}
Br-84	Note 1	2.5×10^{-14}	1.1×10^{-12}	Note 1
Br-85	Note 1	Note 1	3.8×10^{-17}	Note 1
I-131	2.7×10^{-11}	5.2×10^{-11}	5.2×10^{-11}	3.1×10^{-11}
I-132	6.2×10^{-15}	1.3×10^{-11}	3.2×10^{-11}	1.0×10^{-14}
I-133	9.0×10^{-12}	4.7×10^{-11}	5.2×10^{-11}	1.3×10^{-11}
I-134	Note 1	3.2×10^{-12}	3.2×10^{-11}	Note 1
I-135	4.4×10^{-13}	2.5×10^{-11}	3.4×10^{-11}	1.1×10^{-12}
Rb-89	Note 1	3.9×10^{-15}	1.1×10^{-11}	Note 1
Cs-134	4.2×10^{-12}	7.0×10^{-12}	7.0×10^{-12}	4.5×10^{-12}
Cs-136	6.8×10^{-13}	1.2×10^{-12}	1.2×10^{-12}	7.6×10^{-13}
Cs-137	8.3×10^{-12}	1.4×10^{-11}	1.4×10^{-11}	9.1×10^{-12}
Cs-138	Note 1	2.4×10^{-12}	1.0×10^{-10}	Note 1
H-3	5.6×10^{-9}	9.4×10^{-9}	9.4×10^{-9}	6.1×10^{-9}

Notes:
1. The value is smaller than 1.0×10^{-20}
2. Concentrations are based upon the dilution factors and travel times stated in Table 1.3.2-1.

TABLE 1.3.2-4
CONCENTRATION OF SEDIMENT RADIONUCLIDES AT LAKEVIEW SUMMER CAMP SHORELINE

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

ISOTOPE	SEDIMENT CONCENTRATION (pCi/M²)
Na-24	1.7×10^{-1}
P-32	1.5×10^{-1}
Cr-51	8.4×10^{0}
Mn-54	5.2×10^{0}
Mn-56	6.0×10^{-2}
Fe-55	6.7×10^{1}
Fe-59	8.2×10^{-2}
Co-58	4.4×10^{0}
Co-60	2.2×10^{2}
Ni-63	2.6×10^{-1}
Ni-65	3.6×10^{-4}
Cu-64	4.8×10^{-1}
Zn-65	7.4×10^{0}
Zn-69m	3.4×10^{-2}
Br-83	4.3×10^{-3}
Br-84	1.6×10^{-5}
Br-85	Note 1
Rb-89	1.2×10^{-6}
Sr-89	3.2×10^{-1}
Sr-90	1.4×10^{0}
Sr-91	4.3×10^{-2}
Sr-92	1.3×10^{-2}
Y-91	1.6×10^{-1}
Y-92	2.1×10^{-2}
Y-93	4.7×10^{-2}
Zr-95	2.9×10^{-2}
Zr-97	1.1×10^{-4}
Nb-95	8.5×10^{-1}
Mo-99	2.1×10^{-1}
Tc-99m	1.1×10^{-1}
Tc-101	Note 1
Ru-103	1.1×10^{-1}
Ru-105	6.9×10^{-3}
Ru-106	1.1×10^{1}
Ag-110m	1.4×10^{0}
Te-129m	7.7×10^{-2}
Te-131m	4.3×10^{-3}
Te-132	1.3×10^{-3}
I-131	1.3×10^{1}
I-132	3.8×10^{-2}
I-133	1.2×10^{0}
I-134	3.6×10^{-3}
I-135	2.0×10^{-1}
Cs-134	1.5×10^{2}
Cs-136	4.7×10^{-1}

TABLE 1.3.2-4 (Cont'd)

ISOTOPE	SEDIMENT CONCENTRATION (pCi/M²)
Cs-137	1.4×10^{3}
Cs-138	1.5×10^{-4}
Ba-139	2.3×10^{-3}
Ba-140	2.5×10^{-1}
Ba-141	Note 1
Ba-142	Note 1
La-142	1.8×10^{-3}
Ce-141	5.5×10^{-2}
Ce-143	1.4×10^{-3}
Ce-144	1.7×10^{1}
Pr-143	2.8×10^{-2}
Nd-147	1.6×10^{-3}
W-187	1.0×10^{-2}
Np-239	6.1×10^{-1}

Note: 1. The value is smaller than 1.0×10^{-6}

TABLE 1.3.2-5
CONCENTRATION OF SEDIMENT RADIONUCLIDES AT SELKIRK STATE PARK SHORELINE

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

ISOTOPE	SEDIMENT CONCENTRATION (pCi/m^2)
Na-24	2.2×10^{-2}
P-32	8.1×10^{-2}
Cr-51	4.8×10^{0}
Mn-54	3.1×10^{0}
Mn-56	3.7×10^{-6}
Fe-55	4.0×10^{1}
Fe-59	4.8×10^{-2}
Co-58	2.6×10^{0}
Co-60	1.3×10^{2}
Ni-63	1.6×10^{-1}
Ni-65	Note 1
Cu-64	4.5×10^{-2}
Zn-65	4.4×10^{0}
Zn-69m	3.7×10^{-3}
Br-83	Note 1
Br-84	Note 1
Br-85	Note 1
Rb-89	Note 1
Sr-89	1.9×10^{-1}
Sr-90	8.5×10^{-1}
Sr-91	2.1×10^{-3}
Sr-92	1.3×10^{-6}
Y-91	9.6×10^{-2}
Y-92	1.6×10^{-5}
Y-93	2.7×10^{-3}
Zr-95	1.7×10^{-2}
Zr-97	1.5×10^{-5}
Nb-95	4.9×10^{-1}
Mo-99	8.8×10^{-2}
Tc-99M	1.3×10^{-3}
Tc-101	Note 1
Ru-103	6.7×10^{-2}
Ru-105	2.0×10^{-5}
Ru-106	6.4×10^{0}
Ag-110m	8.2×10^{-1}
Te-129m	4.4×10^{-2}
Te-131m	1.2×10^{-3}
Te-132	5.6×10^{-4}
I-131	6.6×10^{0}
I-132	Note 1
I-133	2.4×10^{-1}
I-134	Note 1
I-135	3.3×10^{-3}

TABLE 1.3.2-5 (Cont'd)

ISOTOPE	SEDIMENT CONCENTRATION (pCi/m^2)
Cs-134	9.1×10^{1}
Cs-136	2.6×10^{-1}
Cs-137	8.1×10^{2}
Cs-138	Note 1
Ba-139	Note 1
Ba-140	1.4×10^{-1}
Ba-141	Note 1
Ba-142	Note 1
La-142	Note 1
Ce-141	3.2×10^{-2}
Ce-143	4.0×10^{-4}
Ce-144	1.0×10^{1}
Pr-143	1.5×10^{-2}
Nd-147	8.6×10^{-4}
W-187	2.3×10^{-3}
Np-239	2.4×10^{-1}

Note: 1. The value is smaller than 1.0×10^{-6}

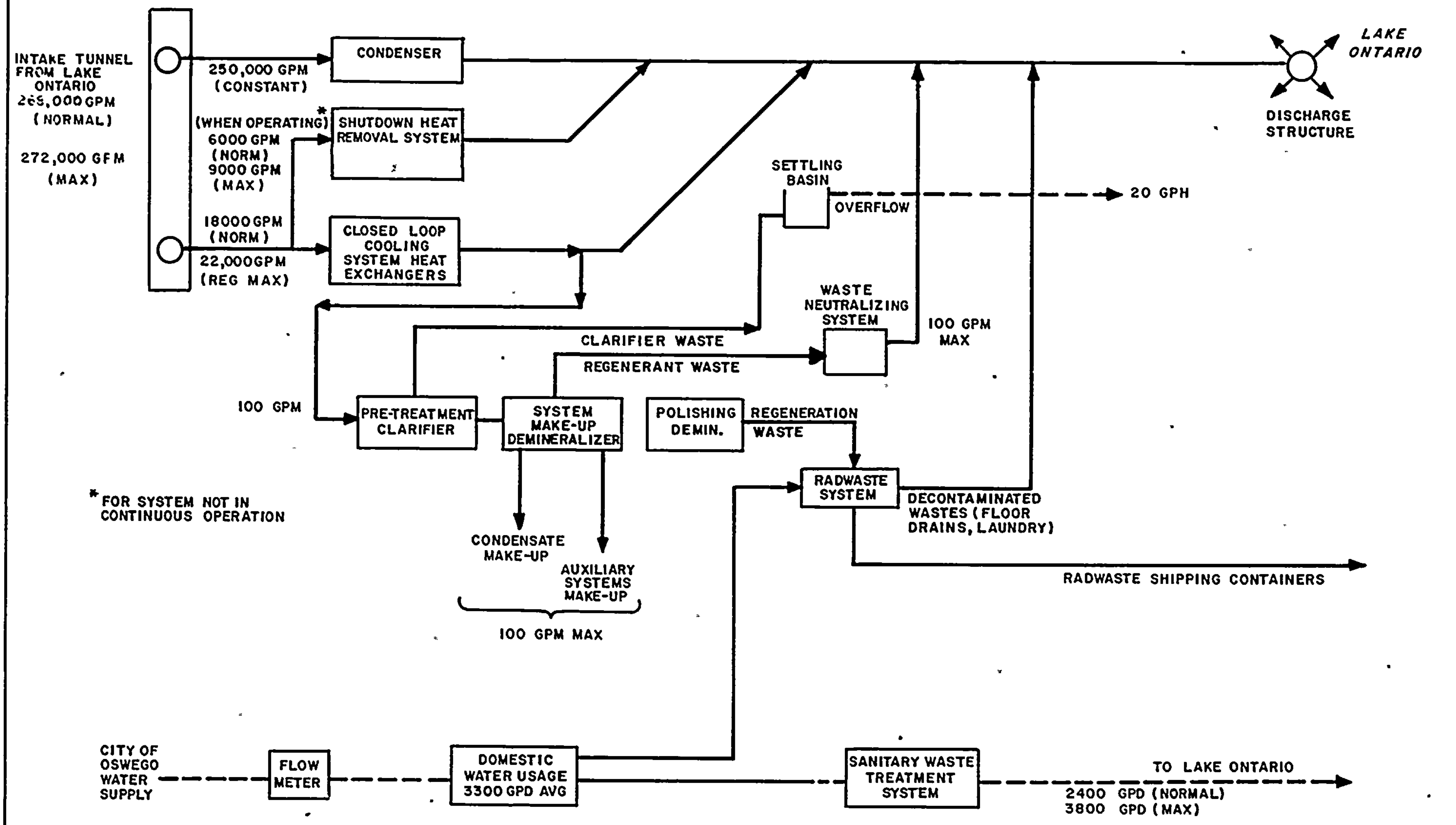
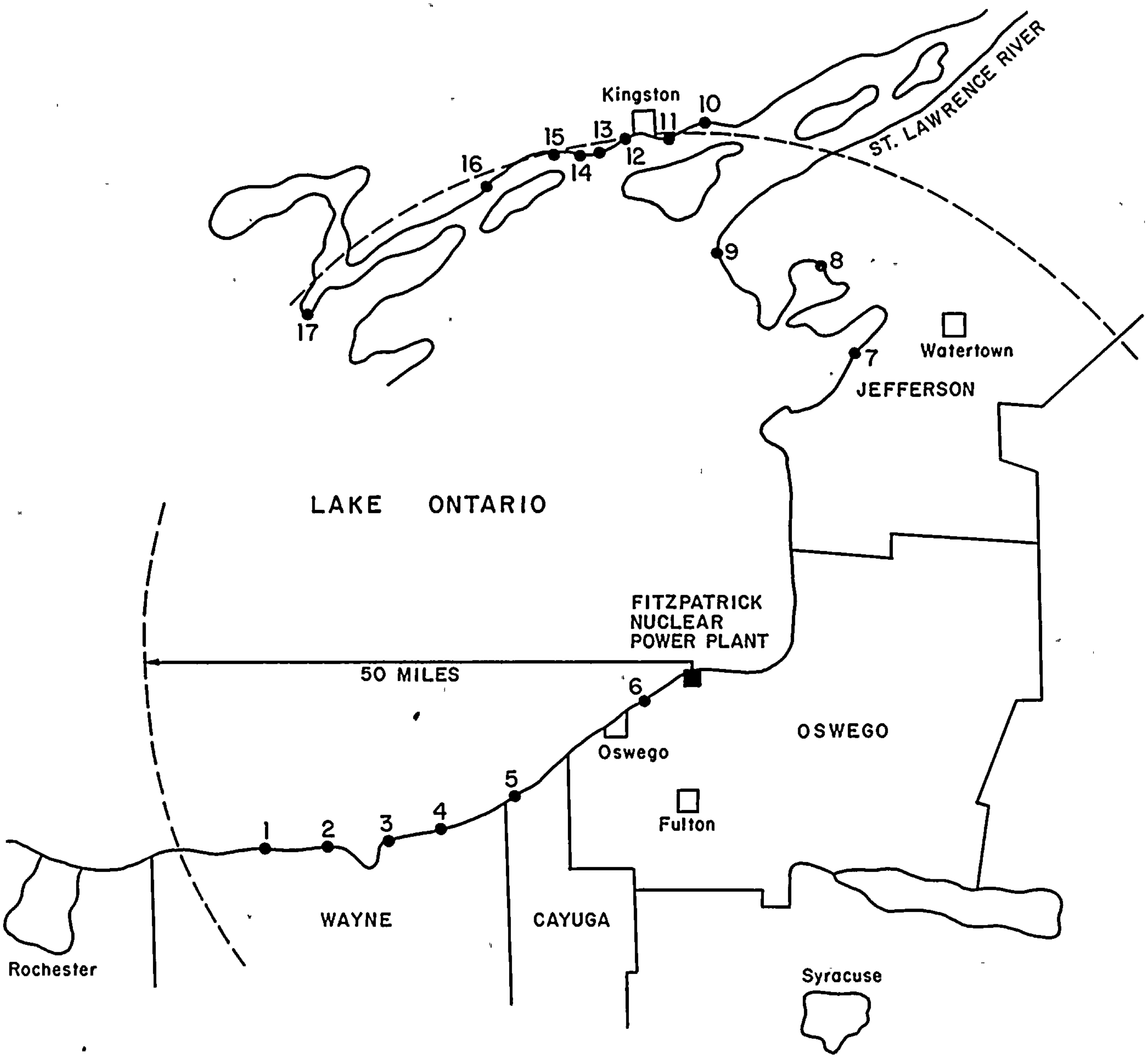


FIGURE 1.3.2-1
WATER USAGE FLOW DIAGRAM
NINE MILE POINT NUCLEAR STATION - UNIT I
NIAGARA MOHAWK POWER CORPORATION



NOTE:
THIS MAP IS REPRODUCED FROM THE JAMES A. FITZPATRICK ENVIRONMENTAL REPORT OPERATING LICENSE STAGE, SUPPLEMENT 3, PAGE 9.

FIGURE 1.3.2-2
WATER PUMPAGE FROM LAKE ONTARIO
NINE MILE POINT NUCLEAR STATION-UNIT 1
NIAGARA MOHAWK POWER CORPORATION

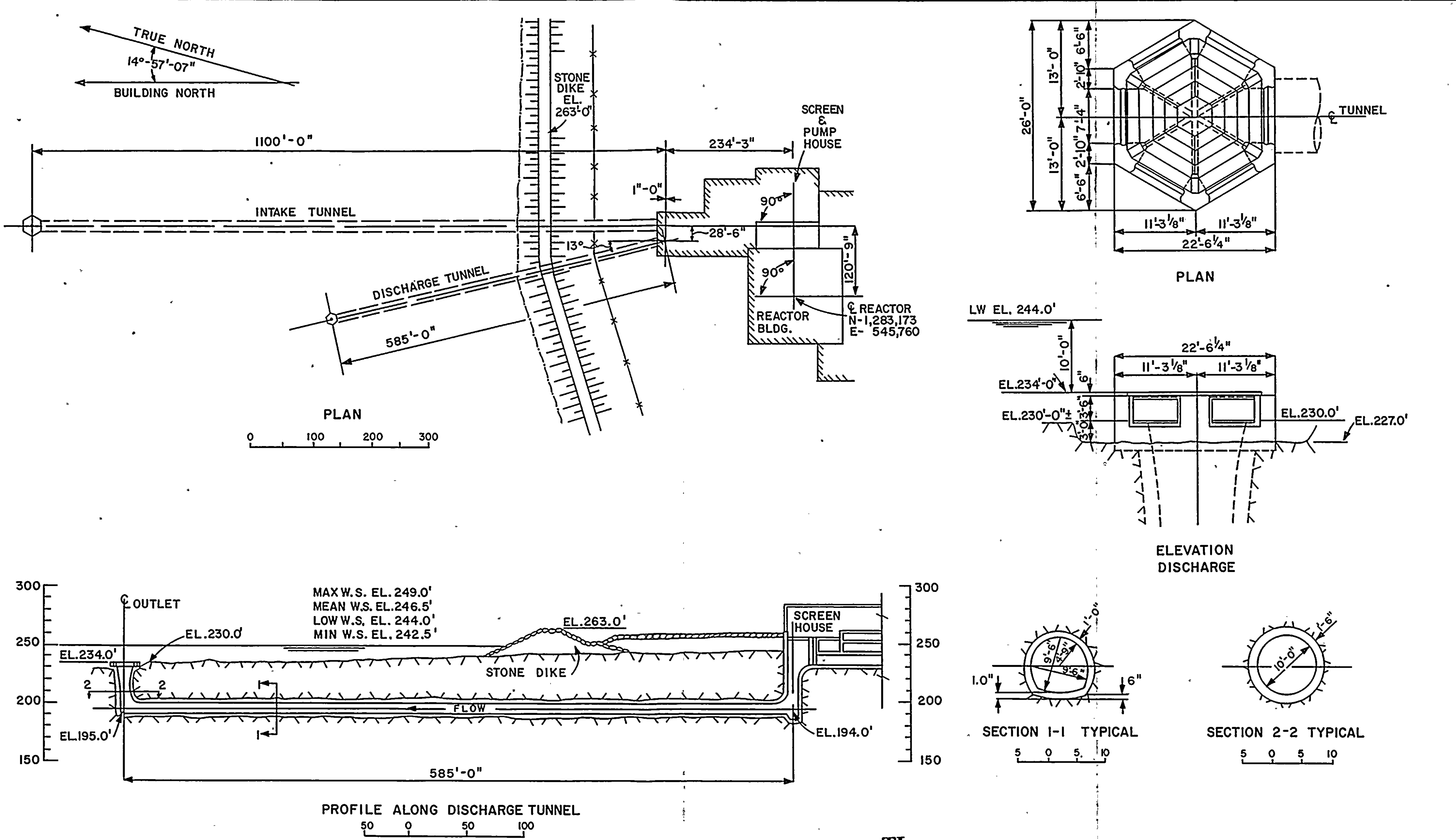


FIGURE 1.3.2-3
DISCHARGE TUNNEL PLAN & PROFILE
NILE MILE POINT NUCLEAR STATION - UNIT I
NIAGARA MOHAWK POWER CORPORATION

1.4 Dose Calculations

The models and assumptions used for calculating doses to individuals are described in Section 1.4.1. Section 1.4.2 presents the models and assumptions used for calculating doses to the population within 50 miles of the site.

1.4.1 DESCRIPTION OF MODELS AND ASSUMPTIONS USED IN INDIVIDUAL DOSE CALCULATIONS

1.4.1.1 LIQUID EFFLUENTS

Ingestion of Potable Water

The City of Oswego water supply, eight miles west of Nine Mile Point Nuclear Station Unit 1 (NMP1), is the closest Lake Ontario intake to the site. The lake dilution factor at this point is 7.7, as calculated using Regulatory Guide 1.113 (Ref. 4). A decay time of 29.0 hours is assumed, to account for transit from release to intake. An additional 12.0 hours' holdup for transport through the water purification plant is used (Page 1.109-20, Regulatory Guide 1.109, Ref. 2). The total time from release to consumption is 41.0 hours.

The dose, R_{aj}, mrem/yr, to organ j of a maximum individual of age group a is:

$$R_{aj} = 1100.0 \frac{U_a}{FDF} \sum_i D_{aij} \; Q_i \; e^{-\lambda_i t_p}$$

where:

U_a is the usage factor for age group a, liters/yr, for a maximum individual. An adult usage of 730 liters/yr is assumed. For a teen, child, and infant 510 liters/yr are consumed (Table A-2, Regulatory Guide 1.109.

F is the flow rate of the release stream, 544 ft³/sec

DF is the lake dilution factor at the point of intake, 7.7.

Q_i is the release rate of isotope i, Ci/yr (See Table 1.2.3-1)

D_{aij} is the dose factor for age group a, isotope i and organ j, mrem/pCi ingested, (Table A-3, Regulatory Guide 1.109)

λ_i is the decay constant of nuclide i, hr^{-1}

t_p is the total time from release to consumption, 41.0 hr

1100.0 is the factor used to convert $(Ci/yr)/(ft^3/sec)$ to (pCi/liter).

<u>Ingestion of Fish and Fresh-Water Invertebrates</u>

For the maximum individual case, fish and fresh-water invertebrates are assumed to be caught at the edge of the initial mixing zone. The approximate mixing zone lake dilution factor is 5.0 (Table A-1, Regulatory Guide 1.109). A holdup time of 24.0 hours is assumed (Page 1.109-30, Regulatory Guide 1.109).

The dose, R_{aj}, mrem/yr, to a maximum individual of age group a is:

$$R_{aj} = 1100.0 \frac{U_a}{FDF} \sum_i B_i Q_i D_{aij} \, e^{-\lambda_i t_p}$$

where:

U_a is the usage factor for age group a, of aquatic food type O, kg/yr. For fish, the factors are assumed to be 21.0, 16.0, and 6.9 kg/yr for an adult, teen, and child, respectively. The corresponding factors for seafood are 5.0, 3.8, and 1.7, respectively (Table A-2, Regulatory Guide 1.109)

F is the flow rate of the release stream, 544 ft^3/sec

DF is the lake dilution factor in Lake Ontario, 5.0

B_i is the bioaccumulation factor for aquatic food type O, liters/kg (Table A-8, Regulatory Guide 1.109)

Q_i is the release rate of nuclide i, Ci/yr (See Table 1.2.3-1)

D_{aij} is the ingestion dose factor, mrem/pCi ingested, (Table A-3, Regulatory Guide 1.109)

λ_i is the decay constant of nuclide i, hr^{-1}

t_p is the holdup time, 24.0 hr (Page 1.109-30, Regulatory Guide 1.109)

1100.0 is the factor used to convert (Ci/yr)/(ft^3/sec) to pCi/kg.

Swimming, Boating, and Fishing

The point of exposure for calculating swimming, boating, and fishing doses is assumed to be near the point of discharge, with an approximate lake dilution of 5.0. All age groups are assumed to swim 100 hours per year; fishing and boating usage is assumed to be 500 hours per year (Table 5.5, Ref. 7).

Additional details of the model are discussed in Section 1.4.2.1.

Shoreline Recreation

The Lakeview Summer Camp is the closest point to the site at which this pathway exists. A decay time of 2.9 hours is assumed, and a lake dilution factor of 5.0 is used based on the assumption that the initial mixing zone dilution is applicable at this location.

The dose, R_{aj}, mrem/yr, to the total body or skin of a maximum individual of age group a is:

$$R_{aj} = 3.18x10^3 \frac{U_a W}{FDF} \sum_i Q_i e^{-\lambda_i t_p} \left[\frac{1-e^{-\lambda_i t}}{\lambda_i} \right] D_{aij}$$

where:

U_a is the usage factor for a maximum individual of age group a, hr/yr. Values of 12, 67, and 14 hr/yr are used for an adult, teenager, and child, respectively (Table A-2, Regulatory Guide 1.109)

W is the shore width factor, 0.3 (Table A-9, Regulatory Guide 1.109)

F is the flow rate of the release stream, 544 ft^3/sec

DF is the lake dilution factor, 5.0

Q_i is the release rate of nuclide i, Ci/yr (See Table 1.2.3-1)

λ_i is the decay constant of nuclide i, hr^{-1}

t_p is the holdup time from release to deposition on the shore, 2.9 hours

t is the buildup time, 1.31×10^5 hr (Page 1.109-9, Regulatory Guide 1.109)

D_{aij} is as previously defined

3.18×10^3 is the factor used for conversion from (Ci/yr)/(ft³/sec) to pCi/liter, and to account for the proportionality constant used in the sediment radioactivity model.

1.4.1.2 GASEOUS EFFLUENTS

Exposure to Noble Gases

The individual annual gamma air dose, $D^{\gamma}(r,\theta)$, mrad/yr, due to main stack release of noble gases at distance r meters from the main stack in the sector at angle θ is calculated by the following equation as given in Meteorology and Atomic Energy, (Ref. 1) and Appendix B of Regulatory Guide 1.109:

$$D^{\gamma}(r,\theta) = \frac{260}{r(\Delta\theta)} \sum_{n} \frac{1}{U_n} \sum_{j} f_{nj} \sum_{k} \mu_a(E_k) I_j (H, u, \sigma_z, E_k) \sum_{i} Q_i A_{ki}$$

where:

r is the horizontal distance from the main stack to the receptor, 1,900 m (6,300 ft)

$\Delta\theta$ is the sector width over which atmospheric conditions are averaged, radians

U_n is the wind speed assigned to wind speed class n, m/sec

f_{nj} is the fraction of year for meteorological condition in wind speed class n and stability class j

$\mu_a(E_k)$ is the energy absorption coefficient in air for photon energy E_k MeV, m^{-1}

H is the effective height of main stack, 110 m (350 ft)

σ_z is the vertical standard deviation, m

$I_j(H, u, \sigma_z, E_k)$ is the integral accounting for the distribution of

radioactivity (Page 352, Ref. 1)

Q_i is the release rate of nuclide i, Ci/yr (See Table 1.2.2-1)

A_{k_i} is the fraction of disintegration of nuclide i yielding photons in the kth photon energy group.

The offsite location of maximum annual gamma air dose is found to be at r=1900 meters (6,300 ft), east of the plant (θ=90°). The wind velocities are classified into six groups (u_1 = 1.5 mph, u_2 = 5.5 mph, u_3 = 10 mph, u_4 = 10.5 mph, u_5 = 21 mph, and u_6 = 24 mph). Atmospheric stability classes equivalent to Pasquill classes A,B,D, and F are considered together with their frequency of occurrence (f_{ij}) for winds from the west direction (Page 2.2-3, NMP2-PSAR).

Gamma emitters released from the stack are classified into seven energy groups (E_1= 0.4 MeV, E_2= 0.7 MeV, E_3= 1.3 MeV, E_4= 1.7 MeV, E_5= 2.2 MeV, E_6=2.5 MeV, and E_7= 3.5 MeV). The corresponding attenuation coefficients in air, $\mu_a(E_k)$, are obtained from Figure 7.8, Ref. 1.

The values of the integral I (H, u, σ_z, E_k) for each equivalent Pasquill stability class and gamma energy group are obtained from Figure 7.21 and Figure 7.22 of Ref. 1. Other variables for the integrals I_j are as follows: The effective stack height is assumed to be 110 meters (350 ft). The vertical standard deviations, σ_z, for each equivalent Pasquill stability class are obtained from Figure 1 of Regulatory Guide 1.111 (Ref. 3).

No credit for decay during travel from the point of release to the receptor is considered for this calculation.

Inhalation Doses

The maximum inhalation dose occurs 6,300 ft east of NMP1. This inhalation dose, R_{aj} ,mrem/yr, to a maximum individual of age group a is:

$$R_{aj} = 3.2 \times 10^4\, U_a \sum_i D_{aij}\, Q_i^*$$

where:

$Q_i^* = Q_i$ (X/Q) Stack (Ci-sec)/(m^3-yr)

Q_i is the release rate of nuclide i, Ci/yr (See

Table 1.2.2-1)

X/Q is the atmospheric dispersion factor, sec/m^3. A value of 5.3×10^{-8} sec/m^3 is assumed for the stack releases

D_{aij} is the inhalation dose factor for isotope i, organ j, age group a, mrem/pCi inhaled (Table C-1, Regulatory Guide 1.109)

U_a is the amount of air inhaled yearly, m^3/yr, taken to be 7,300, 5,100, 2,700, and 1,900 for an adult, teen, child, and infant, respectively.

3.2×10^4 is the factor to convert (Ci/yr) to (pCi/sec).

Exposure from Contaminated Ground

The maximum exposure point is located 6,300 ft east of NMP1. The dose, R_j, mrem/yr, to organ j is calculated as follows:

$$R_j = 1.0 \times 10^{12} S_F \sum_i Q_i^* \left(\frac{1-e^{-\lambda_i t}}{\lambda_i} \right) D_{ij}$$

where:

$Q_i^* = (Q_i \delta)$ Stack $Ci/(yr\text{-}m^2)$

Q_i is the release rate of nuclide i, Ci/yr (See Table 1.2.2-1)

δ is the relative deposition rate at the point of exposure. A value of 5.3×10^{-10} m^{-2} is used for the stack releases

S_F is the shielding and occupancy factor, 0.7 (Page 1.109-12, Regulatory Guide 1.109)

λ_i is the decay constant of nuclide i, hr^{-1}

t is the buildup time, 1.31×10^5 hr (Page 1.109-9, Regulatory Guide 1.109)

D_{ij} is the dose factor for organ j (total body or skin), nuclide i adjusted to account for secular equilibrium $(mrem/hr)/(pCi/m^2)$ (Table A-3, Regulatory Guide 1.109)

1.0×10^{12} is a factor to convert Ci to pCi.

Ingestion of Milk and Meat

A six month grazing season is assumed for the NMP1 analysis. The deposition rates for the grazing season are given in Tables 2.3-7 and 2.3-8 of Response 2.3.

The location of the nearest milk cow and meat animal has been determined to be 8,900 feet ESE of NMP1. The relative deposition rate at this point is 1.6×10^{-10} m^{-2} for the stack releases. The corresponding χ/Q value is 1.6×10^{-8} sec/m^3.

The location of the nearest goat has been determined to be 19,000 ft SSE of NMP1. The relative deposition rate at this point is 1.9×10^{-11} m^{-2} for the stack releases. The corresponding χ/Q value is 1.9×10^{-9} sec/m^3.

The concentration, C_{iv}, pCi/kg, in the feed of isotope i is:

$$C_{iv} = Q_i^* \; 1.1 \times 10^8 \; f_i \left[\frac{r(1-e^{-\lambda_E t_E})}{\lambda_E Y} + \frac{B_{iv}(1-e^{-\lambda_i t_b})}{\lambda_i P} \right] e^{-\lambda_i t_h}$$

where:

$Q_i^* = (Q_i \, \delta)$ Stack $Ci/(yr\text{-}m^2)$

Q_i is the release rate of isotope i, Ci/yr (See Table 1.2.2-1)

δ is the relative deposition rate at the location of the milk cow, goat, or meat animal, m^{-2}

f_i is the fraction of the releases available for deposition for isotope i, as follows:
- 0.5 for iodine
- 1.0 for other nuclides (Page 1.109-54, Regulatory Guide 1.109)

r is the retention factor
- 0.2 for particulates
- 1.0 for other nuclides (Page 1.109-9, Regulatory Guide 1.109)

λ_i is the decay constant for isotope i, hr^{-1}

λ_E is the effective decay constant for isotope i, adjusted to account for weathering effects, as follows:

$$\lambda_E = \lambda_i + 0.0021 \quad hr^{-1}$$
(Page 1.109-10, Regulatory Guide 1.109)

t_E is the exposure time, 720.0 hr (Page 1.109-58, Regulatory Guide 1.109)

t_b is the buildup time, 1.31×10^5 hr (Page 1.109-9, Regulatory Guide 1.109)

Y is the crop yield for the feed, 0.75 kg/m² for pasture grass and 2.0 kg/m² for stored feed (Page 1.109-58, Regulatory Guide 1.109)

P is the effective surface density for soil, 240 kg/m² (Page 1.109-9, Regulatory Guide 1.109)

B_{iv} is the concentration factor from soil to crop isotope i (Table C-2, Regulatory Guide 1.109)

t_h is the holdup time for stored feed (from harvest to consumption by the milk cow, goat, or meat animal, 2.2×10^3hr (Page 1.109-55, Regulatory Guide 1.109)

1.10×10^8 is to convert (Ci/yr) to (pCi/hr).

The concentration, C_{iv}, pCi/liter, for tritium is:

$$C_{iv} = 3.17 \times 10^7 \, Q_i \, gf/H \cdot \chi/Q \qquad \text{pCi/kg}$$

where:

H is the absolute humidity in the region, 5.9 gm/m³

f is the ratio of tritium concentration in atmospheric water to tritium concentration in the plant water, 0.5 (Page 1.109-54, Regulatory Guide 1.109)

g is the fraction of the total plant mass that is water, 0.75 (Page 1.109-54, Regulatory Guide 1.109)

3.17×10^7 is to convert (Ci-sec/gm) to (pCi-yr/kg).

The concentration, C_{iv}, pCi/kg, for C-14 is:

$$C_{iv} = 3.17 \times 10^7 \, Q_i(L/k) \, \chi/Q \qquad \text{pCi/kg}$$

where:

χ/Q is the atmospheric dispersion factor at the appropriate location, sec/m³

L   is the fraction of the total plant mass that is natural carbon, 0.11 (Page 1.109-54, Regulatory Guide 1.109)

k   is the concentration of natural carbon in the atmosphere, 0.16 gm/m³ (Page 1.109-54, Regulatory Guide 1.109)

Other terms for tritium and C-14 calculations are as previously defined.

The concentration, C_{im}, pCi/liter or pCi/kg, in milk or meat is determined by:

$$C_{im} = F_{im} \left[(C_{iv} f_r)_{fresh} + (C_{iv} f_r)_{stored} \right] Q_F e^{-\lambda_i t_m}$$

where:

fr   is the fraction of the animal's feed composed of fresh or stored grain, 0.5

F_{im} is the fraction (uptake factor) of the animal's daily feed which appears in a liter of milk, days/liter or a kilogram of meat, days/kg (Tables C-5 and C-6, Regulatory Guide 1.109)

Q_F is the animal's daily feed, kg/day. A value of 50 kg/day is assumed for a milk cow or meat animal and a value of 6 kg/day is assumed for a goat (Page 1.109-58, Regulatory Guide 1.109)

t_m is the transport time, hr. For the milk pathway a value of 48.0 hours is used. For the meat, the appropriate time is 480.0 (Table D-2, Regulatory Guide 1.109).

The ingestion dose, R_{amj}, mrem/yr, from milk or meat to a maximum individual is:

$$R_{amj} = \sum_i C_{im} D_{aij} U_a$$

where:

D_{amj} is the ingestion dose factor for isotope i, age group a, and organ j, mrem/pCi ingested (Table A-3, Regulatory Guide 1.109)

U_a is the usage factor for age group a, liters/yr or

kg/yr. Values for the milk pathway of 310, 400, 330, and 330 liters/yr are used for an adult, teen, child, and infant, respectively. The corresponding values for the meat pathway are 110, 65, 41 and 0 kg/yr, respectively. (Table A-2, Regulatory Guide 1.109.)

Other terms are as previously defined.

Ingestion of Vegetation

The stored vegetable model is employed for an apple orchard, located 7,000 feet east of NMP1. For fresh, leafy vegetables, the calculation is made at 7,300 feet east. The atmospheric dispersion factors, χ/Q, sec/m³, and relative deposition rates, δ, m^{-2}, are presented below.

		Stack
Garden	χ/Q	5.9×10^{-8}
	δ	5.9×10^{-10}
Orchard	χ/Q	5.9×10^{-8}
	δ	5.9×10^{-10}

The concentration, C_{iv}, pCi/kg, of isotope i in the vegetation is:

$$C_{iv} = 1.1 \times 10^{8}\, Q_i^{*}\, f_i \left[\frac{r(1-e^{-\lambda_E t_E})}{\lambda_E Y_v} + \frac{B_{iv}(1-e^{-\lambda_i t_b})}{\lambda_i P} \right] e^{-\lambda_i t_h}$$

where:

Q_i^{*} = $(Q_i \delta)$ Stack Ci/(yr-m²)

Q_i is the release rate of isotope i, Ci/yr (See Table 1.2.2-1)

δ is the relative deposition rate at the location of the vegetation, m^{-2}

f_i is the fraction of the release available for deposition for isotope i, as follows:
- 0.5 for iodine
- 1.0 for other nuclides (Page 1.109-54, Regulatory Guide 1.109)

r is the retention factor:
- 0.2 for particulates
- 1.0 for other nuclides (Page 1.109-9 Regulatory Guide 1.109).

λ_i is the decay constant for isotope i, hr^{-1}

λ_E is the effective decay constant for isotope i, adjusted to account for weathering effects, as follows:

$$\lambda_E = \lambda_i + 0.0021 \quad hr^{-1}$$

(Page 1.109-10, Regulatory Guide 1.109)

t_E is the exposure time, 1,440 hr (Page 1.109-55, Regulatory Guide 1.109)

t_b is the buildup time, 1.31×10^5 hr (Page 1.109-9, Regulatory Guide 1.109)

Y_v is the crop yield for the vegetation, 2.0 kg/m^2 (Page 1.109-55, Regulatory Guide 1.109)

P is the effective surface density for soil, 240 kg/m^2 (Page 1.109-9, Regulatory Guide 1.109)

B_{iv} is the concentration factor from soil to crop for isotope i (Table C-2, Regulatory Guide 1.109)

t_h is the holdup time from harvest to consumption by the maximum individual, 1,440 hr for stored vegetables, and 24.0 hr for fresh vegetables (Page 1.109-55, Regulatory Guide 1.109)

1.10×10^8 is to convert (Ci/yr) to pCi/hr).

Concentrations of tritium and C-14 are calculated as described in Section 1.4.1.2.

The ingestion dose R_{avj}, mrem/yr, to a maximum individual is:

$$R_{avj} = \sum_i C_{iv} \; D_{aij} \; U_a$$

where:

D_{aij} is the ingestion dose factor for isotope i, age group a, and organ j, mrem/pCi ingested (Table A-3, Regulatory Guide 1.109)

U_a is the usage factor for age group a, kg/year. Values of 520, 630, and 520 kg/yr are assumed for an adult, teen, and child, respectively for the orchard. For the garden, the corresponding values are 64, 42, and 26 kg/yr, respectively (Table A-2, Regulatory Guide 1.109).

All other terms are as previously defined.

1.4.2 DESCRIPTION OF MODELS AND ASSUMPTIONS USED IN POPULATION DOSE CALCULATIONS

1.4.2.1 LIQUID EFFLUENTS

Ingestion of Potable Water

As discussed in Section 1.3.2.3, the only potentially significant public potable water supply intake is the City of Oswego water supply, eight miles west of the site. Users of the supply are residents of the City of Oswego and Onondaga County. In 1970, there were approximately 24,000 and 166,000 consumers, respectively (Pages 2.1-2 and 5.2-8 of Ref. 7).

Based on the population growth estimate discussed in Section 2.1 of the NMP2-PSAR, the number of consumers of the potable water from this intake is increased from 190,000 to 239,000. This accounts for a 26 percent increase to the midpoint of operation of NMP1.

A lake dilution factor of 7.7 is calculated by using Regulatory Guide 1.113. Decay of radionuclides occurs based on a lake transit time of 29.0 hours from the point of discharge to the point of intake; transport time through the water purification plant and water distribution system is 24.0 hours (Table D-2, Regulatory Guide 1.109).

The model used for calculating population doses from ingestion of potable water is based on Regulatory Guide 1.109. The concentration, C_i, pCi/liter, of isotope i at the point of intake is:

$$C_i = \frac{1100.0\ Q_i}{DF} e^{-\lambda_i t_p}$$

where:

Q_i is the release rate of the nuclide, Ci/yr (See Table 1.2.3-1)

t_p is the time from the point of discharge to the point of intake (lake transit time), 29.0 hr

λ_i is the decay constant of the nuclide, hr^{-1}

D is the lake dilution factor, 7.7

F is the flow rate of the release stream, 544 ft^3/sec

1100.0 is the factor to convert (Ci/yr)/(ft^3/sec) to pCi/liter.

The dose, R_{aj}, mrem/year, to an average individual of age group a, to organ j is:

$$R_{aj} = \sum_i C_i \; D_{aij} \; U_a \; e^{-\lambda_i t}$$

where:

C_i is the concentration at the point of water intake, pCi/liter

D_{aij} is the dose factor for ingestion to organ j, mrem/pCi ingested (Table A-3, Regulatory Guide 1.109)

t is the distribution transport time, 24.0 hr

U_a is the usage factor for age group a of potable water, for an average individual. For an adult, 370 liters/yr are consumed; for a teenager and child 260 liters/yr are consumed (Table D-2, Regulatory Guide 1.109)

The dose, D_j^p, man-rem/yr, to the 50-mile population (total body or thyroid) is:

$$D_j^p = 0.001 \; P \sum_a R_{aj} \; f_a$$

where:

P is the population served

R_{aj} is the dose to an average individual of age group a, to organ j, mrem/yr

f_a is the fraction of the population served belonging to age group a

0.001 is the factor to convert mrem to rem.

Ingestion of Fish

A total commercial fish catch for Lake Ontario of 3.2×10^6 pounds is reported for 1970 (Page 2.2-3, Ref. 7). For the purposes of this analysis, the catch was increased by a factor of four for conservatism (to 1.3×10^7 lb) to reflect sport fishing and growth in commercial fishing over the life of NMP1.

Most commercial fishing occurs in the extreme northeast portion of Lake Ontario (Page 2.2-3, Ref. 7). It is conservatively assumed that the lake dilution factor is 1.0×10^4.

It is conservatively assumed that the entire fish catch is for human consumption.

Distribution transport time is assumed to be 10 days, in accordance with Table D-2 of Regulatory Guide 1.109. A total annual United States fish consumption by humans of 3.2×10^9 pounds is used (Table 1106, Ref. 5), based on a consumption rate of 11 lb/person/yr and a U.S. population of 200 million. This assumption is conservative, since the model considers the Lake Ontario catch as part of the total U.S. catch. A larger U.S. fish consumption by humans would thus result in a smaller dose. The Lake Ontario catch, however, is increased by a factor of four to account for future growth in the fishing industry and consumption of the sport catch.

The model used in calculating the dose from ingestion of fish is based on Appendices A and D of Regulatory Guide 1.109. The concentration, C_{iF}, pCi/kg, of nuclide i in the fish is:

$$C_{iF} = \frac{1100.0\ Q_i}{DF}\ B_{is}\ e^{-\lambda_i t_p}$$

where:

B_{is} is the bioaccumulation factor in fish for water type s, fresh water in this case (Table A-8, Regulatory Guide 1.109).

All other terms are as previously defined.

The dose, D_j^p, man-rem/yr, to the population (total body or thyroid) is:

$$D_j^p = 0.001\, P_{50}\, \frac{m}{M} \sum_i \sum_a (f_a\, C_{iF}\, U_a\, D_{aij})\, e^{-\lambda_i t}$$

where:

P_{50} is the 50-mile population

m is the mass of fish caught annually from Lake Ontario, 6.0×10^6 kg/yr

M is the total annual U.S. fish consumption by humans, 1.5×10^9 kg/yr

f_a is the fraction of the population in age group a

C_{iF} is the concentration of radionuclide i in fish, pCi/kg

U_a is the usage factor for age group a, kg/yr. Fish ingestion for adult, teen, and child are 6.9, 5.2, and 2.2 kg/yr, respectively (Table D-1, Regulatory Guide 1-109)

D_{aij} is the ingestion dose factor (total body or thyroid) for age group a, isotope i, and organ j, mrem/pCi (Table A-3, Regulatory Guide 1.109)

t is the distribution transport time, 24.0 hr (Table D-2, Regulatory Guide 1.109)

0.001 is the factor to convert mrem to rem.

Fishing, Boating, and Swimming

The COHORT-II Monte Carlo Radiation Transport Code, (Ref. 6) has been used to determine the dose rates to which fishermen, boaters, and swimmers may be exposed. The source activity is presented in Table 1.4-1 for the initial mixing zone, Lakeview Summer Camp, Selkirk State Park, and for an average lake dilution five miles from the discharge structure for recreational boating and fishing and 25 miles for commercial fishing.

Swimming

The COHORT-II Monte Carlo program (Ref. 6) is used to calculate the dose rate for swimming. A cylindrical source 5 ft in radius is enclosed in an annular mass of water of 10 ft in outside radius. The economics of computer time resulted in limiting the source region to the 5 ft radius cylinder. The attenuation of this much water can readily be shown to be a sufficient representation of source contributions to a submerged receptor on the axis of the cylinder. The 10 ft outer cylinder is added to include backscattering into the source region, in the Monte Carlo analysis. A receptor point 2 ft below the surface is used.

An estimated 1,000 persons are assumed to swim at Selkirk State Park each week during a 10 week season (Page 5.2-5, Ref. 1). Adults are assumed to spend 2 hr per day swimming and children and teenagers are assumed to spend 4 hr per day swimming.

At Lakeview Summer Camp, 11,200 person-days are assumed for adults and 22,400 person-days for teenagers and children.

In addition, it is assumed that 10 teenagers swim 8 hr per weekend during a 10 week season, in the vicinity of the mixing zone.

The large dilution afforded by the lake at more distant recreational areas within the 50 mile radius is sufficient to make additional contributions to population man-rem estimates of negligible proportions.

Fishing and Boating

The dose rate for fishing and boating is approximated as being half the value obtained in the analysis for the swimming dose rate (as previously discussed). This approximation has been substantiated in the NMP2 Submittal for Compliance with 10CFR50 Appendix I, Volume II, pages C9A1-17 and 18.

In computing the population dose from fishing, an estimate of the number of hours of exposure is made as follows. An estimated total of 3.2×10^6 fisherman-days in 1960 is reported on page 8.4-5 of the NMP2-ER (Ref. 8). This number is assumed to double to a value of 6.4×10^6 for the purposes of this analysis.

Each fisherman is assumed to spend 2.5 hr per day on the lake. This results in a population usage of 1.6×10^7 person-hours per year. An average lake dilution factor of 1.0×10^4 is used in this analysis.

In computing the population dose from boating, a twelve week season is assumed. An estimated 1,000 persons are assumed to spend an average of 2 hr per weekday boating during this season. On weekends, 10,000 persons are assumed to use Lake Ontario for boating within a 50 mile radius for an average time of 4 hr per weekend. These assumptions result in a total of 6.0×10^5 person-hours per year for boating. A lake dilution factor of 6.1 is conservatively estimated, corresponding to an average distance of 5 miles from the discharge.

Shoreline Recreation

Near the NMP1 site, there are two predominant beach areas. The Lakeview Summer Camp, located 4,200 feet southwest of the station, is occupied for approximately 10 weeks per year. Maximum usage is 500 persons/weekday and 1,500 persons/weekend (Page 2.2-6, Ref. 7). This yields an average of approximately 800 persons per day during the 10 week period each year. It is assumed that, of these, 160 are adults, 320 are teenagers, and 320 are children. An adult usage of 2 hr per day is assumed; for teenagers and children, a usage of 4 hr per day is assumed. This is conservative, since the combined swimming and shoreline usage is 8 hr per day.

An initial mixing zone dilution factor of 5.0 is conservatively assumed for this beach location. A decay time of 2.9 hr is assumed.

Selkirk State Park is located 10 miles east-northeast of the station. According to page 2.1-4 of the NMP2-PSAR, an estimated 10,000 people use the park each weekend; based on a 10-week season, the total usage is assumed to be 100,000 person-days. Age group distributions of 62 percent adult, 14 percent teenager, and 24 percent child are used. Usages of 8.3, 47.0 and 9.5 hr per year are assumed for adults, teenagers, and children, respectively.

Regulatory Guide 1.113 serves as a basis for calculation of a lake dilution factor of 8.4; a decay time of 37.0 hr is used.

The model used for estimating population doses from this pathway is in accordance with Regulatory Guide 1.109. A shore width factor of 0.3 is used (Table A-9, Regulatory Guide 1.109). For the buildup time, a power plant lifetime midpoint of 15 years is assumed (Page 1.109-9, Regulatory Guide 1.109).

The footnote on Page 1.109-30 of Regulatory Guide 1.109 identifies a necessity to account for secular equilibrium of parent and daughter. In lieu of the NRC model, dose factors of each parent isotope are increased by that of its daughter isotope, where appropriate. This model has the advantage of accurately modeling a situation where the parent release is small and the daughter release is large.

The concentration, C_{is}, pCi/m², in the shoreline sediment of isotope i is:

$$C_{is} = \frac{3.18 \times 10^3}{FD} \frac{(1-e^{-\lambda_i t})}{\lambda_i} Q_i \; We^{-\lambda_i t_p}$$

where:

Q_i is the release rate of isotope i, Ci/yr (See Table 1.2.3-1)

λ_i is the decay constant of isotope i, hr^{-1}

t is the buildup time, 1.31×10^5 hr (Page 1.109-9, Regulatory Guide 1.109)

t_p is the holdup time, hr

W is the shore width factor, 0.3 (Table A-9, Regulatory Guide 1.109)

D is the lake dilution factor

F is the flow rate of the release stream, 544 ft^3/sec

3.18×10^3 is a factor for conversion from $(Ci/yr)/(ft^3/sec)$ to pCi/liter and to account for the proportionality constant used in the sediment radioactivity model.

The dose, R_{aj}, mrem/yr, to an organ j (total body or thyroid) of an average individual of age group a, due to the release of isotope i, is:

$$R_{aj} = \sum_i C_{is} U_a D_{aij}$$

where:

C_{is} is the concentration in the sediment, pCi/m^2

U_a is the usage factor for age group a, as previously defined, hr/yr

D_{aij} is the external dose factor for isotope i, organ j, $(mrem/hr)/(pCi/m^2)$ (Table A-7, Regulatory Guide 1.109).

The dose, D_j^p, man-rem/yr, described above to the population using the recreational facility is:

$$D_j^p = 0.001 P \sum_a f_a R_{aj}$$

where:

P is the population using the recreational facility

f_a is the fraction of the population in age group a

R_{aj} is the dose to an average individual, mrem/yr

0.001 is a factor for converting mrem to rem.

1.4.2.2 GASEOUS EFFLUENTS

Exposure to Noble Gases

Noble gas exposure (total body) population doses, D_T^p, man-rem/yr, are calculated based on a semi-infinite cloud model. This model provides a good approximation over a 50-mile region. The appropriate equation is:

$$D_T^p = 1.11 \times 0.001 \times 3.2 \times 10^4 \; S_F \sum_i DFB_i \sum_{r,\theta} P_{r,\theta} \; Q^*_{i_{r,\theta}}$$

where:

$Q^*_{i_{r,\theta}} = (Q_i \; (\chi/Q)_{r,\theta})$ stack (Ci-sec)/(m³-yr)

Q_i is the release rate of isotope i, Ci/yr (See Table 1.2.2.1)

χ/Q is the atmospheric dispersion factor, sec/m³, for the sector centered at distance r, angle θ

DFB_i is the total body dose factor for isotope i, (mrem/yr)/(pCi/m³) (Table B-1, Regulatory Guide 1.109)

$P_{r,\theta}$ is the population of sector (r,θ)

S_F is a shielding and occupancy factor, 0.5 (Page 1.109-68, Regulatory Guide 1.109)

0.001 is the factor to convert from mrem to rem

3.2×10^4 is the factor to convert (Ci/yr) to (pCi/sec)

1.11 is the ratio of tissue to air energy absorption coefficient (Page 1.109-42, Regulatory Guide 1.109).

Inhalation Doses

Inhalation doses, D^P, man-rem/yr are:

$$D^P = 3.2 \times 10^4 \sum_a \sum_i \sum_{r,\theta} U_a \, D_{aij} \quad P_{r,\theta} \quad Q^*_{i_{r,\theta}}$$

where:

$Q^*_{i_{r,\theta}} = (Q_i \; (\chi/Q)_{r,\theta}) \quad (Ci\text{-}sec)/(m^3\text{-}yr)$

Q_i is the release rate of isotope i, Ci/yr (See Table 1.2.2-1)

$(\chi/Q)_{r,\theta}$ is the atmospheric dispersion factor, sec/m³, associated with the sector centered at r, angle θ

U is the usage factor for age group a, m³/yr air. These factors are, for adult, teen, and child, 7,300, 5,100, 2,700, respectively

D_{aij} is the inhalation dose factor for age group a, isotope i, organ j, mrem/pCi inhaled (Table C-1, Regulatory Guide 1.109)

$P_{r,\theta}$ is the population occupying the sector centered at (r,θ)

3.2×10^4 is the factor required to convert (Ci/yr) to (pCi/sec)

Deposition on Ground

Dose factors are adjusted to account for secular equilibrium.

The total body exposure dose, D^P, man-rem/yr, due to deposition on ground is:

$$D^P = 0.001 \, S_F \; 1.0 \times 10^{12} \sum_{r,\theta} \delta^*_{r,\theta} \quad P_{r,\theta} \sum_i Q_i \frac{(1-e^{-\lambda_i t})}{\lambda_i} D_{ij}$$

where:

$\delta^*_{r,\theta}$ = ($\delta_{r,\theta}$) stack

$\delta_{r,\theta}$ is the relative deposition rate, m^{-2}, for the sector centered at r, angle θ

S_F is the shielding and occupancy factor, 0.5 (Page 1.109-69, Regulatory Guide 1.109)

λ_i is the decay constant of nuclide i, hr^{-1}

t is the buildup time, 1.31×10^5 hr (Page 1.109-9, Regulatory Guide 1.109)

Q_i is the release rate, Ci/yr (See Table 1.2.2-1)

D_{ij} is the total body dose factor, (mrem/hr)/(pCi/m^2) (Table A-3, Regulatory Guide 1.109). These factors have been adjusted to account for secular equilibrium between parent and daughter, where appropriate.

$P_{r,\theta}$ is the population in sector (r,θ)

0.001 is the conversion factor from mrem to rem

1.0×10^{12} is the conversion factor from Ci to pCi.

Ingestion of Milk

Distribution of milk production in the 160 subregions has been obtained using county data (Refs. 9 and 10). The area of each subregion is ratioed to the area of the county, and an appropriate percentage of the county production is calculated.

The average cow is assumed to consume 50 kg/day of feed; during the six-month grazing season, the cow's diet is assumed to be comprised of pasture grass only. For the remaining six months, no direct intake of pasture grass is assumed. Crop yields of 0.75 and 2.0 kg/m^2 are assumed for fresh and stored feed, respectively. A surface density for soil was taken to be 240 kg/m^2. No holdup time is assumed for pasture grass; it is assumed, however, that on the average, 90 days pass between harvest and consumption of stored grain. A growing season of 30 days is applied for all feed. Four days are allowed for distributing the milk.

The above data represent values of Appendix C and Table D-2 from Regulatory Guide 1.109. For conservatism, it is assumed that all milk is consumed fresh (i.e., no canning or other processing); 100 percent fresh daily feed is also a conservative assumption.

The concentration, C_{iF}, pCi/kg, in feed (fresh or stored) for any isotope except tritium or C-14 is determined by:

$$C_{iF} = 1.1 \times 10^8 \, \delta^*_{r,\theta} \, Q_i f_i \left[\frac{r(1-e^{-\lambda_{Ei} t_E})}{Y_{Ei} Y_v} + \frac{B_{iv}(1-e^{-\lambda_i t_b})}{\lambda_i P} \right] e^{-\lambda_i t_h}$$

where:

$\delta^*_{r,\theta}$ = $(\delta_{r,\theta})$ stack m^{-2}

$\delta_{r,\theta}$ is the relative deposition rate of sector (r, θ)

Q_i is the release of isotope i, Ci/yr (See Table 1.2.2-1).

f_i is the fraction of the isotopic release available for deposition, as follows:
- 0.5 for iodines
- 1.0 for other nuclides (Page 1.109-54, Regulatory Guide 1.109)

r is the retention factor:
- 0.2 for particulates
- 1.0 for other nuclides (Page 1.109-9, Regulatory Guide 1.109)

λ_i is the effective decay constant, hr^{-1}

λ_{Ei} is the effective decay constant for isotope i, adjusted to account for weathering effects, as follows:

$\lambda_{Ei} = \lambda_i + .0021$ hr^{-1} (Page 1.109-10, Regulatory Guide 1.109)

λ_i is the decay constant for nuclide i, hr^{-1}

t_E is the crop (pasture) exposure time, 720 hr (Page 1.109-58, Regulatory Guide 1.109)

Y_v is the crop yield, 2.0 kg/m² for stored feed and 0.75 kg/m² (Page 1.109-58, Regulatory Guide 1.109)

B_{iv} is the concentration factor from soil to crops for isotope i (Table C-2, Regulatory Guide 1.109)

t_b is the buildup time, 1.31×10^5 hr

(Page 1.109-9, Regulatory Guide 1.109)

P is the effective surface density for soil, 240 kg/m² (Page 1.109-9, Regulatory Guide 1.109)

t_h is the holdup time from harvest to consumption, 0.0 hr for pasture and 2,160 hr for stored feed (Page 1.109-58, Regulatory Guide 1.109)

1.1×10^8 is a factor to convert (Ci/yr) to (pCi/hr).

For tritium the concentration $C_{iF_{r,\theta}}$, pCi/kg, is:

$$C_{iF_{r,\theta}} = \frac{1.7 \times 10^7}{H} Q^*_{i_{r,\theta}}$$

where:

$Q^*_{i_{r,\theta}} = (Q_i \ (\chi/Q)_{r,\theta})$ stack (Ci-sec)/(m³-yr)

H is the absolute humidity in the atmosphere, 5.9 gm/m³

Q_i is the release of isotope i, Ci/yr (See Table 1.2.2-1)

$(\chi/Q)_{r,\theta}$ is the atmospheric dispersion factor associated with the sector centered at (r,θ), sec/m³

All other parameters are as defined above.

For C-14 the concentration, $C_{iF_{r,\theta}}$ pCi/kg is:

$$C_{iF_{r,\theta}} = 2.2 \times 10^7 \ Q^*_{i_{r,\theta}}$$

All parameters are as defined above for tritium.

For a six-month grazing season the concentration $C'_{iF_{r,\theta}}$, pCi/kg, is:

$$C'_{iF_{r,\theta}} = \frac{C_{iF_{r,\theta}} + C_{is_{r,\theta}}}{2}$$

where:

$C_{iF_{r,\theta}}$ is the concentration of nuclide i in fresh feed, pCi/kg in sector (r,θ).

$C_{is_{r,\theta}}$ is the concentration of nuclide i in stored feed, pCi/kg in sector (r,θ).

The concentration, $C_{im_{r,\theta}}$, pCi/liter, in milk is:

$$C_{im_{r,\theta}} = F_m C'_{iF_{r,\theta}} Q_F e^{-\lambda_i t}$$

where:

F_m is the uptake factor from feed to milk, days/liter (Tables and Regulatory Guide 1.109).

Q_F is the animal's daily feed, kg/day (Page 1.109-58, Regulatory Guide 1.109)

t is the distribution transport time, 96.0 hours (Table D2, Regulatory Guide 1.109).

The 50-mile average concentration, $\overline{C}_{im}$, pCi/liter, in milk is approximated by:

$$\overline{C}_{im} = \sum_{r,\theta} \frac{m_{r,\theta}}{M_{50}} C_{im_{r,\theta}}$$

where:

$m_{r,\theta}$ is the quantity of milk produced in the sector defined by (r, θ), liters/yr

M_{50} is the quantity produced within 50 miles, liters/yr.

The concept of effective population was applied for this pathway, as recommended in Appendix D of Regulatory Guide 1.109. The effective population, P*, is used when the 50-mile population does not consume the total production. The equation used is:

$$P^* = \frac{M_{50}}{\sum_a f_a U_a}$$

where:

M_{50} is the quantity produced within 50 miles, liter/yr

f_a is the fraction of persons in age group a

U_a is the usage factor for age group a. Values of 110, 200, and 170 liters/yr were applied for adult, teenager, and child, respectively. (Table D-1, Regulatory Guide 1.109)

P^* for milk is calculated to be 4.5×10^6.

The dose, D_j^p , man-rem/yr to the population from the milk pathway is:

$$D_j^p = 0.001\, P_{50} \sum_i \sum_a \overline{C}_{im}\, U_a\, f_a\, D_{aij}$$

where:

P_{50} is the 50 mile population

D_{aij} is the ingestion dose factor for age group a, isotope i, organ j, (mrem/hr)/(pCi/kg) (Table A-3, Regulatory Guide 1.109)

All other parameters are as previously defined.

<u>Ingestion of Vegetation</u>

Vegetable production is obtained using county data (Refs. 9 and 10). Five categories of vegetables are considered, and parameters which vary with the vegetable type are presented in Table 1.4-2. A retention factor of 1.0 and a soil surface density of 240 kg/m^2 are applied in all calculations. A growing season of 60 days is assumed (Page 1.109-55, Regulatory Guide 1.109), and the midpoint of plant operation is 15 years (Page 1.109-9, Regulatory Guide 1.109).

The model for calculating the concentration of an isotope on vegetation is the same as that for concentration in feed, described in the previous section.

The dose, D_v^p ,man-rem/yr, is computed by the following equation:

$$D_v^p = 0.001\ P_{50} \sum_i \sum_a \overline{C}_{iv} U_a f_a D_{aij}$$

where:

C_{iv} is the average concentration in vegetation over the 50-mile region, pCi/kg

All other parameters are as previously defined.

Ingestion of Meat

The model for calculating the dose to the population due to ingestion of meat is identical to that presented in the section dealing with ingestion of milk. County distribution data are used (Refs. 9 and 10). Beef cattle, pigs, sheep, lambs, and hogs are considered; feeding habits of beef cattle are assumed for all livestock. Twenty days are allowed for distribution of the meat. Usages of 95, 59, and 37 kg/yr are assumed for adults, teenagers, and children, respectively. Stable element transfer data for meat are taken from Table C-5 of Regulatory Guide 1.109. All other parameters are identical to those used in the milk ingestion calculation.

Section 1.4 References

1. Meteorology and Atomic Energy, D.H. Slade Editor, U.S. Atomic Energy Commission Office of Information Services, July 1968.

2. Draft Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance With 10CFR Part 50, Appendix I," USNRC, March, 1976.

3. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," USNRC, March 22, 1976.

4. Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, "U.S. Nuclear Regulatory Commission, May, 1976.

5. A Statistical Abstract of the United States, U.S. Department of Agriculture, 1968.

6. Cohort II Monte Carlo Radiation Transport Code, Oak Ridge National Laboratory Radiation Shielding Information Center, Document No. CCC198.

7. Nine Mile Point Nuclear Station Unit 1 Environmental Report, Operating License Stage, Niagara Mohawk Power Corporation, U.S. Atomic Energy Commission, Docket 50-220.

8. Nine Mile Point Nuclear Station Unit 2 Environmental Report, Construction Permit Stage, Niagara Mohawk Power Corporation, U.S. Atomic Energy Commission, Docket 50-410.

9. "1969 U.S. Census of Agriculture," New York Crop Reporting Service, Albany, New York, July, 1972.

10. "New York Agriculture Statistics, 1974," New York Crop Reporting Service, Albany, New York, July, 1975.

TABLE 1.4-1
SOURCE ACTIVITY FOR SWIMMING AND BOATING MODEL

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Average Energy (Mev)	Source Activity by Location (Mev/cc-sec)				
	Mixing Zone	Lakeview Summer Camp	SelKirk State Park	at 5 miles	at 25 miles
0.4	1.2×10^{-6}	1.2×10^{-6}	7.3×10^{-7}	1.0×10^{-6}	5.5×10^{-7}
0.8	8.7×10^{-6}	8.7×10^{-6}	5.2×10^{-6}	7.1×10^{-6}	3.9×10^{-6}
1.3	4.5×10^{-6}	4.5×10^{-6}	2.7×10^{-6}	3.7×10^{-6}	2.0×10^{-6}
1.7	6.8×10^{-6}	6.8×10^{-6}	4.1×10^{-6}	5.6×10^{-6}	3.1×10^{-6}
2.2	1.9×10^{-6}	1.9×10^{-6}	1.1×10^{-6}	1.5×10^{-6}	8.4×10^{-7}
2.5	2.3×10^{-6}	2.3×10^{-6}	1.4×10^{-6}	1.9×10^{-6}	1.1×10^{-6}
3.5	1.8×10^{-6}	1.8×10^{-6}	1.1×10^{-6}	1.5×10^{-6}	8.2×10^{-7}

TABLE 1.4-2
PARAMETERS USED IN CALCULATING POPULATION DOSES FROM INGESTION OF VEGETATION

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Vegetation Category	Effective Population*	Adult Usage (kg/yr)	Teen Usage (kg/yr)	Child Usage (kg/yr)	Crop Yield (kg/m²)	Mass Produced (kg/yr)	Holdup Time (hr)
Fruits	1.9×10^7	6.6	8.3	6.9	1.26	1.3×10^8	1.4×10^3
Fresh Vegetables	1.9×10^6	44.5	56.2	46.8	2.60	8.9×10^7	3.4×10^2
Processed Vegetables	1.1×10^6	29.5	37.3	31.1	1.01	3.5×10^7	1.4×10^3
Potatoes	1.1×10^6	52.7	66.6	55.5	2.92	6.2×10^7	1.4×10^3
Grains	2.7×10^6	66.6	84.1	70.1	.41	1.9×10^8	1.4×10^3

* Note estimated actual population within 50 miles is 1.3×10^6.

1.5 Effluent Release Data

The information regarding effluent release data is available in the Nine Mile Point Unit 1 Semi-annual and Annual Operating Reports previously submitted to the Commission.

2.1 Data Needed for Radioactive Source Term Calculations

The information requested in Chapter 4 of NUREG-0016 is provided in this section.

The symbol (+) designates those parameters which are NUREG-0016 assumptions. All other parameters are from actual Nine Mile Point Unit 1 operating data.

For the major streams, where the Nine Mile Point Unit 1 operating data is less than the NUREG-0016 value, the NUREG-0016 value was used.

2.1.1 General

a. The maximum core thermal power evaluated for safety considerations - 1,850 MWt

b. 1. The total mass of uranium and plutonium in an equilibrium core (metal weight) -

Uranium - *B.O.C. = 211,800 lb
*E.O.C. = 210,100 lb

Plutonium - B.O.C. = 900 lb
E.O.C. = 1,300 lb

*B.O.C. = Beginning of Cycle
*E.O.C. = End of Cycle

2. The percent enrichment of uranium in reload fuel -

No Plutonium recycle - 2.74 wt %
Plutonium recycle - 1.73 wt %

3. The percent of fissile plutonium in reload fuel -

No Plutonium recycle - 0 wt %
Plutonium recycle - 1.43 wt %

c. Parameters used in calculations of source terms in the primary coolant - per NUREG-0016. Table 1.2.1-4 lists the resultant coolant activities

(+) d. The quantity of tritium released in liquid and gaseous effluents - 23 Ci/yr Gaseous, 23 Ci/yr - Liquid

2.1.2 Nuclear Steam Supply System

a. Total steam flow rate - 7.29 x 10^6 lb/hr

b. Mass of reactor coolant and steam in the reactor vessel at full power

- Water - reactor vessel and recirculation lines - 3.96 x 10^5 lb

- Steam - 15,000 lb

2.1.3 Reactor Coolant Cleanup System

a. Average flow rate - 1.8×10^5 lb/hr

b. Demineralizer type - Deep bed

c. Regeneration frequency - 3/yr (1 bed on line 4 months)

d. Regenerant volume and activity - (+) 11,900 gal/event with a demineralizer activity input into radwaste system, based on all activity collected by the demineralizer from flow (a) at reactor coolant activity for time (c).

2.1.4 Condensate Demineralizers

a. Average flow rate - 7.29×10^6 lb/hr

b. Demineralizer type - Deep bed

c. Number and size of demineralizers - Number - 6,
Size -165 ft^3; 55 ft^3 = anion
110 ft^3 = cation

d. Regeneration frequency - 1 bed/3.5 days

e. Indicate whether ultrasonic resin cleaning is used and waste liquid volume associated with its use - No

f. Regenerant volume and activity - (+) 11,900 gal/event with a condensate demineralizer activity prior to regeneration equal to the buildup of main steam activity at a flow rate of $7.29 \times 10^6/6$ lb/hr for 21 days (+) (3.5 days times 6). Note: six condensate demineralizer beds operate in parallel.

2.1.5 Liquid Water Processing Systems

a. Sources, flow rates (gpd) and expected activities (fraction of primary coolant activity, PCA) for all inputs to each system.

Source	Flow Rate (Gpd)	Fraction and Type Of Primary Coolant	
(+) Drywell Equipment Drains	3,400	1.0	Liquid
(+) Drywell Floor Drains	700	1.0	Liquid

Source	Flow Rate (Gpd)	Fraction and Type Of Primary Coolant	
Reactor Building Equipment Drains	8,500	.01(+)	Liquid
Turbine Building Equipment Drains	37,000	.01(+)	Liquid
(+) Condensate Demin. Resin Rinse	5,000	.002	Liquid
(+) Condensate Backwash	8,100	2×10^{-6}	Liquid
(+) Radwaste Building Equipment Drains	1,060	.01(+)	Liquid
Reactor Building Floor Drains	7,500	.01(+)	Liquid
Radwaste Building Floor Drains	3,000	.01(+)	Liquid
Turbine Building Floor Drains	8,000	.01(+)	Liquid
Water Demineralizer Regeneration	720	See Section 2.1.5f	
Reactor Water Cleanup Demineralizer Regeneration	100	See Section 2.1.3d	
(+) Condensate Demineralizer Regeneration	3,400	See Section 2.1.4f	
(+) Lab. Drains	500	.02	Liquid

Source	Flow Rate (Gpd)	Fraction and Type Of Primary Coolant
(+) Decontamination Drains	450	See Table 2.1.5-1
(+) Chemical Lab. Waste	100	.02 Liquid
(+) Laundry Drains	450	See Table 2.1.5-1

b. Holdup times associated with collection, processing, and discharge of all liquid streams:

Tank	Collection (Hr)	Processing (Hr)
Waste Collector Tank	2.7	.56
Floor Drain Collector	5.3	3.3
Waste Neutralizer	27	5.0
Laundry Drain	For Calc. 0.0	For Calc. 0.0

Note: Collection time is based on filling tank to 40 percent capacity. In the event the waste concentrator is inoperable for two consecutive days per week (according to NUREG-0016), there is sufficient tank capacity (i.e., two days collection time by the waste neutralizer tank and waste surge tank when allowed to fill to 80 percent of capacity) so that there is no discharge of the chemical regenerant stream directly to the environment. Similarly, there is sufficient tank capacity (i.e., two days collection time by the Floor Drain Collector Tank, Floor Drain Sample Tanks, and the Waste Surge Tank when allowed to fill to 80 percent of capacity) so that alternate processing of the low purity wastes by the waste demineralizer is not required.

c. Capacities of all tanks (gal) and processing equipment (GPD) considered in calculating holdup times:

Tank/Processing Equipment	Volume (Gal)	Processing Capacity (Gpm)
Waste Collector Tank	25,000	-
Waste Surge Tank	50,000	-
Water Demineralizer	-	300
Floor Drain Collector Tank	10,000	-
Floor Drain Sample Tank	10,000	-
Waste Neutralizer Tank	15,000	-
Waste Concentrator	-	20
Laundry Drain Tank	1,000	-

(+)d. Decontamination factors for each process step:

Equipment	DF
Waste Evaporator - Polishing Demineralizer	1000 - All
Waste Demineralizer	2 - Cs, Rb 100 - Others

(+)e. Fraction of each processing stream expected to be discharged over the life of the plant:

Source	Fraction Discharged
Laundry Drains	1.0
All Others	0.1

f. For waste demineralizer regeneration:

a. Demineralizer type - deep bed

b. Regeneration frequency - 22/yr (1 bed on line for 19 days)

c. (+) 11,900 gal/regeneration which is sent to the waste neutralizer tank for subsequent process and discharge.

d. The activity on the waste demineralizer prior to regeneration is based on the radwaste flow scheme shown in Figure 1.2.3-2 and the parameters are listed in Sections 2.1.3 to 2.1.5.

g. Liquid source term by radionuclide in Ci/yr for normal operation including anticipated operational occurrences. The liquid source terms are listed in Table 1.2.3-1.

h. The liquid waste is normally discharged into the circulating water discharge flow which amounts to 1.07×10^{10} gal/month.

2.1.6 Main Condenser and Turbine Gland Seal Air Removal Systems

a. The holdup time for off-gases from the main condenser air ejector prior to processing by the off-gas treatment system - 0.0 hr for calculational purposes.

b. Description and expected performance of the gaseous waste treatment systems for the off-gases from the condenser air ejector and mechanical vacuum pump:

(+) 1. Expected air inleakage per condenser shell - 10 cfm

2. Number of condenser shells - 1

(+) 3. Iodine source term from the condenser I-131 - 5 curies/yr

c. 1. The mass of charcoal in the charcoal delay system used to treat the off-gases from the main condenser air ejector - 39.05 tons

2. The operating temperature of the delay system - 70 F

3. The dew point temperature of the delay system - -4 F

4. Dynamic adsorption coefficients Xe - 440 cc/gm, Kr - 25 cc/gm

d. Description of cryogenic distillation systems - not applicable

e. The steam flow to the turbine gland seal and the source of the steam. Primary steam - 7.29 x 10^3 lb/hr

f. The design holdup time for gas vented from the gland seal condenser, the iodine partition factor for the condenser, and the fraction of radioiodine released through the system vent. Description of the treatment system used to reduce radioiodine and particulate releases from the gland seal system.

1. Holdup time - 0.029 hr

(+)2. Iodine removal by condensing steam - 0.99

Description - See Section 1.2.2

2.1.7 Ventilation and Exhaust Systems

For each plant building housing system that contains radioactive materials, the main condenser evacuation system and the turbine gland sealing system exhausts, the provisions incorporated to reduce radioactive releases through the ventilation or exhaust systems are as follows:

1. Reactor Building:

   There is no filtration of normal exhaust ventilation.

2. Turbine Building:

   There is no filtration of exhaust ventilation.

3. Radwaste Building:

   HEPA filters on exhaust ventilation.

(+) a. Decontamination factors assumed and the bases (including charcoal adsorbers, HEPA filters, mechanical devices)

1. HEPA filters are 99 percent effective in removing particulates from air flow.

b. Release rates in curies/yr are presented in Table 1.2.2-1.

c. Release point description

The main stack which is the only release point at the Nine Mile Point 1 Plant is described in Section 1.2.2.

1. Location - 100 ft east of the northeast corner of the reactor building.

2. Height - 350 ft

3. ID of stack - 8 ft-6 in.

4. Effluent temperature - normally between 85 F and 100 F

5. Exit velocity - 63 ft/sec

d. Additional containment building information is discussed in Section 1.2.2.

Table 2.1.5-1

NUREG-0016 (Table 2-32)

Calculated Annual Release of Radioactive Materials in Untreated Detergent Waste from a BWR

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Nuclide	Ci/yr
Mn-54	0.001
Co-58	0.004
Co-60	0.009
Zr-95	0.0014
Nb-95	0.002
Ru-103	0.00014
Ru-106	0.0024
Ag-110m	0.00044
I-131	0.0006
Cs-134	0.013
Cs-137	0.024
Ce-144	0.005
Total	~ 0.06

Note: Detergent wastes include laundry drains, personnel and equipment decontamination drains, and cask cleaning drains.

2.2 Tabular Environmental Data

This section provides tabulations of the distances from the centerline of Nine Mile Point Unit 1 to the following locations for each of the 22-1/2 deg radial sectors centered on the 16 cardinal compass directions:

a. nearest milk cow (to a distance of 5 miles)

b. nearest meat animal (to a distance of 5 miles)

c. nearest milk goat (to a distance of 5 miles)

d. nearest residence (to a distance of 5 miles)

e. nearest vegetable garden greater than 500 ft^2 (to a distance of 5 miles)

f. nearest site boundary

In addition, the locations of all milk cows, milk goats, meat animals, residences, and vegetable gardens out to a distance of 3 miles for each radial sector are identified.

Field surveys were conducted on November 21, 1975, December 8, 1975, April 21, 1976, and April 22, 1976, to obtain the data reported herein. Maps of the Scriba and New Haven townships, provided by the Oswego County Planning Board, were used to plot the locations of residences, vegetable gardens, and meat and dairy livestock. U.S. Geological Survey Maps (7.5 minute series) for the Oswego East, New Haven, Texas, and West of Texas quadrangles were used in addition to the maps of Scriba and New Haven.

Interviews were conducted with persons known or believed to have meat or dairy livestock. Vegetable gardens and residences were located visually and their locations were plotted on the maps. Local, county, and federal agencies were contacted with reference to determining the number and locations of livestock in the study area.

Table 2.2-1 presents the locations of the nearest milk cows within a radius of 5 miles. Table 2.2-2 tabulates the locations of the nearest meat animals. As shown in Table 2.2-3, only one milk goat was located within a radius of 5 miles. The nearest residences within 5 miles are presented in Table 2.2-4. The nearest vegetable gardens greater than 500 ft^2 are presented in Table 2.2-5.

Tables 2.2-6 through 2.2-9 summarize the location of all milk cows, meat animals, residences, and vegetable gardens

greater than 500 ft^2 within a radius of 3 miles. As noted earlier, only one milk goat was located in the surveys. It was at a radius of 3.6 miles.

Figure 2.2-1 shows the locations of these tabularized residences, farm animals, and vegetable gardens within 3 miles of the site.

TABLE 2.2-1

NEAREST MILK COW WITHIN 5 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	Distance (ft)
N	-
NNE	-
NE	-
ENE	-
E	-
ESE	8,900
SE	15,000
SSE	12,300
S	11,000
SSW	16,000
SW	11,100
WSW	-
W	-
WNW	-
NW	-
NNW	-

NOTE: A dash (-) indicates none within 5 miles

TABLE 2.2-2

NEAREST MEAT ANIMAL WITHIN 5 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	Distance (ft)
N	-
NNE	-
NE	-
ENE	-
E	22,400
ESE	8,900
SE	10,400
SSE	12,000
S	9,400
SSW	12,500
SW	7,700
WSW	-
W	-
WNW	-
NW	-
NNW	-

NOTE: A dash (-) indicates none within 5 miles

TABLE 2.2-3

NEAREST MILK GOAT WITHIN 5 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	Distance (ft)
N	-
NNE	-
NE	-
ENE	-
E	-
ESE	-
SE	-
SSE	19,000
S	-
SSW	-
SW	-
WSW	-
W	-
WNW	-
NW	-
NNW	-

NOTE: A dash (-) indicates none within 5 miles

TABLE 2.2-4

NEAREST RESIDENCE WITHIN 5 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	Distance (ft)
N	-
NNE	-
NE	-
ENE	-
E	6,900
ESE	6,400
SE	8,700
SSE	8,100
S	8,600
SSW	6,900
SW	5,100
WSW	4,500
W	-
WNW	-
NW	-
NNW	-

NOTE: A dash (-) indicates none within 5 miles

TABLE 2.2-5

NEAREST VEGETABLE GARDEN (GREATER THAN 500 FT^2) WITHIN 5 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	Distance (ft)
N	-
NNE	-
NE	-
ENE	-
E	7,300
ESE	8,800
SE	9,600
SSE	8,000
S	9,400
SSW	12,100
SW	5,100
WSW	-
W	-
WNW	-
NW	-
NNW	-

NOTE: A dash (-) indicates none within 5 miles

TABLE 2.2-6

DISTRIBUTION OF ALL MILK COWS WITHIN 3 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	0-1 Mile	1-2 Mile	2-3 Mile
N	-	-	-
NNE	-	-	-
NE	-	-	-
ENE	-	-	-
E	-	-	-
ESE	-	35	-
SE	-	-	3
SSE	-	-	11
S	-	-	1
SSW	-	-	-
SW	-	-	2
WSW	-	-	-
W	-	-	-
WNW	-	-	-
NW	-	-	-
NNW	-	-	-

NOTE: A dash (-) indicates none within 3 miles

TABLE 2.2-7

DISTRIBUTION OF ALL MEAT ANIMALS WITHIN 3 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	0-1 Mile	1-2 Mile	2-3 Mile
N	-	-	-
NNE	-	-	-
NE	-	-	-
ENE	-	-	-
E	-	-	-
ESE	-	6	58
SE	-	32	94
SSE	-	-	70
S	-	2	27
SSW	-	-	33
SW	-	20	4
WSW	-	-	-
W	-	-	-
WNW	-	-	-
NW	-	-	-
NNW	-	-	-

NOTE: A dash (-) indicates none within 3 miles

TABLE 2.2-8

DISTRIBUTION OF ALL RESIDENCES WITHIN 3 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	0-1 Mile	1-2 Mile	2-3 Mile
N	-	-	-
NNE	-	-	-
NE	-	-	-
ENE	-	-	-
E	-	10	3
ESE	-	4	23
SE	-	41	42
SSE	-	9	46
S	-	8	23
SSW	-	6	27
SW	5	38	33
WSW	2	2	-
W	-	-	-
WNW	-	-	-
NW	-	-	-
NNW	-	-	-

NOTE: A dash (-) indicates none within 3 miles

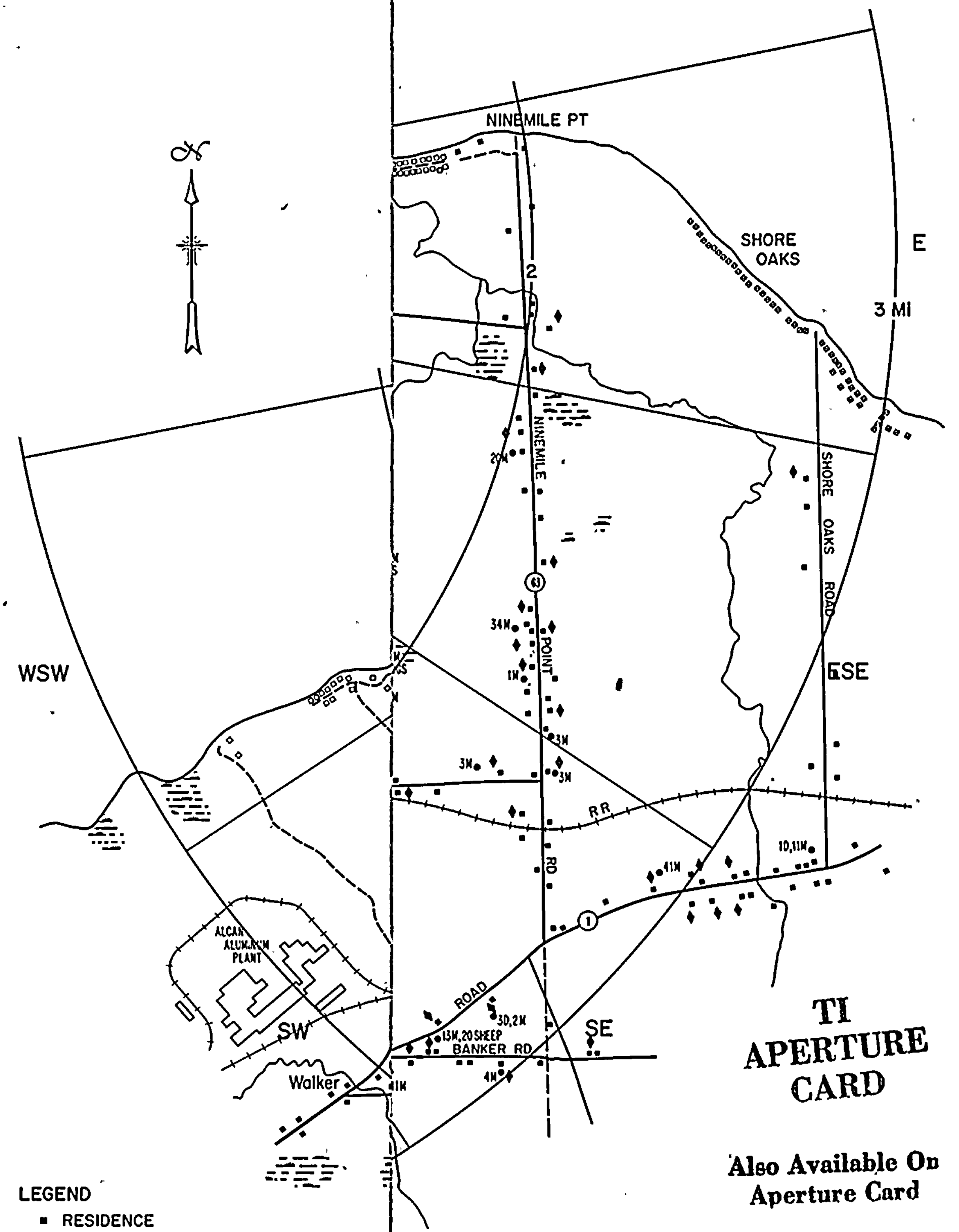
TABLE 2.2-9

DISTRIBUTION OF ALL VEGETABLE GARDENS (GREATER THAN 500 FT^2) WITHIN 3 MILES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

Sector	0-1 Mile	1-2 Mile	2-3 Mile
N	-	-	-
NNE	-	-	-
NE	-	-	-
ENE	-	-	-
E	-	1	2
ESE	-	2	8
SE	-	6	17
SSE	-	3	14
S	-	1	9
SSW	-	-	14
SW	1	3	8
WSW	-	-	-
W	-	-	-
WNW	-	-	-
NW	-	-	-
NNW	-	-	-

NOTE: A dash (-) indicates none within 3 miles



LEGEND
- ■ RESIDENCE
- ▫ RESIDENCE (SEASONAL)
- ▫ TRAILER
- ♦ VEGETABLE GARDEN
- • FARM ANIMALS
  - D-DAIRY CATTLE
  - M-MEAT CATTLE

FIGURE. 2.2-1
RESIDENCES, FARM ANIMALS AND VEGETABLE GARDENS WITHIN 3 MILES OF SITE
NINE MILE POINT-UNIT 1
NIAGARA MOHAWK POWER CORPORATION

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2.3 X/Q and D/Q Data

This section provides the following information concerning concentration evaluations as calculated using Smith-Singer Methodology:

a. Estimates of relative concentrations (X/Q) and or deposition (D/Q) at points of potential maximum concentrations outside the site boundary, at points estimated maximum individual exposure, and at points within a radial grid of sixteen 22.5 degree sectors (centered on true north, etc.) and extending to a distance of 50 miles from the plant. A set of data points should be located within each sector at increments of .25 mile to a distance of 1 mile, at increments of .5 mile from a distance of 1 to 5 miles, at increments of 2.5 miles from a distance of 5 to 10 miles, and at increments of 5 miles thereafter to a distance of 50 miles.

b. Estimates of X/Q for noble gas effluents and, if applicable, X/Q depleted by deposition and D/Q for iodine effluents at each of these grid points, as well as averages of these X/Q and/or D/Q values between all adjacent grid points along the radials.

c. A detailed description of the model(s) and the model assumption(s) used to determine the air concentrations and/or deposition, and information concerning the validity and accuracy of the model(s) and assumptions, and the identity of the meteorological data used.

2.3.1 X/Q Values

Combined annual X/Q values from the stack release are given in Tables 2.3-1 and 2.3-2. The corresponding data for the grazing season are shown in Tables 2.3-3 and 2.3-4.

2.3.2 D/Q Values

The annual deposition (D/Q) values are given in Tables 2.3-5 and 2.3-6. Tables 2.3-7 and 2.3-8 represent the grazing season.

2.3.3 X/Q and D/Q Computations

The Nine Mile Point Site has been studied in detail in two separate periods, 1963-1964, when Nine Mile Point Nuclear Station Unit 1 was being designed and constructed, and again during 1974-1975 for the development of Nine Mile Point Nuclear Station Unit 2 data.

The analysis of diffusion and deposition is based on the meteorological data collected during 1974-1975. The following formulas and assumptions were used in deriving the X/Q and D/Q estimates.

a. Stack Plume Rise

Radioactivity is released from a 350 ft stack, isolated from other structures. The large volume (101 m^3/sec) and speed of emission (19 m/sec) preclude any likelihood of significant downwash associated with other structures or the stack itself. Plume rise has therefore been calculated by the momentum formula in ASME Guide[1].

$$h_e = h_s + D \left(\frac{W_e}{\mu}\right)^{1.4}$$

where:

h_e = Effective height of the plume, meters

h_s = Actual stack height, meters

D = Diameter of the stack, meters

W_e = Vertical efflux velocity at release temperature, meters/second

u = Mean wind speed at actual stack height, meters/second

b. Diffusion Modeling

The Gaussian diffusion equation applicable to 22.5 deg sectors was used for the computations. The stability was determined from the temperature difference between the 200 and 27 ft levels and grouped as shown in Table 2.3-9.

The equations expressing the change in σ_z with distance are shown in the following table:

	Very Unstable	Unstable	Neutral	Stable
	Sources Higher Than 50 Meters			
σ_z	$.40x^{.91}$	$.33x^{.86}$	$.22x^{.78}$	$.06x^{.71}$

where:

σ_z = Vertical standard deviation of the Gaussian plume, meters

x = Distance downwind, meters

The X/Q and D/Q estimates have not been adjusted for possible changes in wind trajectories and diffusion conditions with distance. The Nine Mile Point site is open and uncomplicated, with a vigorous, reliable wind flow. The data from the Nine Mile Point Unit 2 tower should be quite representative of a large area. Furthermore, the data available from other locations are insufficient to define variations in trajectories and diffusion in a meaningful way.

Changes in terrain elevation are considered too small to have a significant effect on the estimates, and the calculations are developed on the basis of flat terrain.

c. <u>Wind Speed Profile</u>

The winds taken from the 200 ft level on the Nine Mile Point Nuclear Station Unit 2 tower were adjusted to stack height according to the formula:

$$U_h = U_1 \left(\frac{Z}{Z_1}\right)^q$$

where:

u_h = Wind speed at upper elevation, meters/second

u_1 = Wind speed at lower elevation, meters/second

z = Upper height, meters

z_1 = Lower height, meters

q = Exponent, ranges from 0.16 in unstable conditions to 0.50 in stable conditions

d. <u>Deposition</u>

One of the most complex problems in radiological evaluations is the representation of the deposition of halogens. Although some field data are available, considerable evidence exists (Pelletier[2], Barry[3], Hill[4]) to suggest that an average deposition velocity (Vg) of 0.01 m/sec is often found with active chemical compounds such as iodine. Therefore, reasonable estimates of D/Q should result from the single assumption of a

uniform deposition velocity of 0.01 m/sec. The D/Q estimates are based on this value.

Correction of the X/Q for removal by deposition has been made. For the tall stack source, it is evident that both deposition and depletion are very small. The formulas for depletion follow those given in Chamberlain[5].

<u>Section 2.3 References</u>

1. Smith, M.E. (ed): Recommended Guide for the Dispersion of Airborne Effluents, <u>ASME</u>, 1968.

2. Pelletier, C.A., Zimbrick, J.D., 1968, Kinetics of Environmental Radioiodine Transport Through the Milk-Food Chain, in Proceedings of, Environmental Surveillance in the Vicinity of Nuclear Facilities, W.W. Reinig, Editor, Thomas, Springfield, Ill., 1970.

3. Barry, P.J. and Chamberlain, A.C., Deposition of Iodine onto Plant Leaves from Air, <u>Health Phys.</u> 9:1149 (1963).

4. Hill, Clyde, A., 1971, Vegetation: A Sink for Atmospheric Pollutants, <u>Journ. of the Air Pollution Control Association</u>, V. 21, No. 6, June 1971.

5. Chamberlain, A.C., 1953, Aspects of Travel and Deposition of Aerosol and Vapor Clouds, A.E.R.E., HP/R, H.M.S.O.

TABLE 2.3-1

NINE MILE POINT 1

STACK

X/Q AT GROUND LEVEL APPLICABLE TO
LONG TERM (ROUTINE) GASEOUS RELEASES
(Seconds/m³)

SECTOR ANNUAL X/Q AT GROUND LEVEL

DISTANCE (MILES)	BEARING 22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0
.25	9.6976E-09	7.3463E-09	3.4796E-08	6.0694E-08	5.7012E-08	6.8108E-08	6.0101E-08	6.1983E-08
.50	1.3910E-08	1.2830E-08	4.9250E-08	8.0757E-08	7.0662E-08	6.7425E-08	4.8922E-08	5.5045E-08
.75	1.8386E-08	1.7835E-08	4.8093E-08	6.6358E-08	5.4818E-08	4.8364E-08	3.3392E-08	3.9082E-08
1.00	2.0684E-08	2.0038E-08	4.5868E-08	5.5687E-08	4.3624E-08	3.6642E-08	2.4674E-08	2.9667E-08
1.50	1.9908E-08	1.9124E-08	4.0209E-08	4.4820E-08	3.3603E-08	2.7202E-08	1.8019E-08	2.2231E-08
2.00	1.4788E-08	1.3959E-08	2.7564E-08	2.8506E-08	2.0430E-08	1.5908E-08	1.0392E-08	1.3368E-08
2.50	1.1593E-08	1.0853E-08	2.1064E-08	2.1284E-08	1.5035E-08	1.1544E-08	7.5132E-09	9.8814E-09
3.00	9.2131E-09	8.5757E-09	1.6481E-08	1.6422E-08	1.1503E-08	8.7573E-09	5.6870E-09	7.6053E-09
3.50	7.4631E-09	6.9214E-09	1.3212E-08	1.3043E-08	9.0870E-09	6.8827E-09	4.4622E-09	6.0411E-09
4.00	6.1810E-09	5.7013E-09	1.0822E-08	1.0611E-08	7.3649E-09	5.5631E-09	3.6012E-09	4.9190E-09
4.50	5.1823E-09	4.7897E-09	9.0389E-09	8.8150E-09	6.0990E-09	4.6021E-09	2.9747E-09	4.0891E-09
5.00	4.4408E-09	4.1011E-09	7.6840E-09	7.4595E-09	5.1443E-09	3.8822E-09	2.5061E-09	3.4600E-09
7.50	2.6232E-09	2.4143E-09	4.2155E-09	4.0028E-09	2.6783E-09	2.0359E-09	1.3125E-09	1.8209E-09
10.00	2.0301E-09	1.8620E-09	2.9434E-09	2.7272E-09	1.7368E-09	1.3253E-09	8.6167E-10	1.1868E-09
15.00	1.5291E-09	1.4047E-09	1.9270E-09	1.7216E-09	1.0086E-09	7.6008E-10	5.0707E-10	6.8857E-10
20.00	1.2094E-09	1.1199E-09	1.4310E-09	1.2549E-09	7.0570E-10	5.2041E-10	3.5461E-10	4.8051E-10
25.00	9.7816E-10	9.0670E-10	1.1134E-09	9.6715E-10	5.3466E-10	3.8653E-10	2.6744E-10	3.6421E-10
30.00	7.9057E-10	7.4523E-10	8.9229E-10	7.7100E-10	4.2370E-10	3.0132E-10	2.1088E-10	2.8925E-10
35.00	6.5510E-10	6.2203E-10	7.3171E-10	6.3042E-10	3.4641E-10	2.4299E-10	1.7162E-10	2.3701E-10
40.00	5.5166E-10	5.2687E-10	6.1161E-10	5.2621E-10	2.9018E-10	2.0111E-10	1.4318E-10	1.9881E-10
45.00	4.7141E-10	4.5226E-10	5.1952E-10	4.4686E-10	2.4791E-10	1.6994E-10	1.2187E-10	1.6989E-10
50.00	4.0810E-10	3.9286E-10	4.4742E-10	3.8502E-10	2.1527E-10	1.4608E-10	1.0547E-10	1.4739E-10

Based on 1974-1975

TABLE 2.3-2

NINE MILE POINT 1

STACK

X/Q AT GROUND LEVEL APPLICABLE TO
LONG TERM (ROUTINE) GASEOUS RELEASES
(Seconds/m³)

SECTOR ANNUAL X/Q AT GROUND LEVEL

DISTANCE (MILES)				BEARING				
	202.5	225.0	247.5	270.0	292.5	315.0	337.5	360.0
.25	3.3650E-08	2.6981E-08	5.8958E-09	5.1630E-09	1.4296E-08	2.4926E-08	2.7996E-08	2.9618E-08
.50	3.4790E-08	3.3961E-08	1.1759E-08	9.1740E-09	2.2360E-08	3.9006E-08	3.4686E-08	3.9408E-08
.75	2.7701E-08	2.8645E-08	1.1919E-08	1.0577E-08	2.6042E-08	4.7934E-08	3.5600E-08	4.3969E-08
1.00	2.2872E-08	2.4369E-08	1.1410E-08	1.1304E-08	2.7366E-08	5.0833E-08	3.5141E-08	4.5213E-08
1.50	1.8236E-08	1.9807E-08	1.0139E-08	1.0866E-08	2.5443E-08	4.7040E-08	3.1530E-08	4.1304E-08
2.00	1.1585E-08	1.2737E-08	7.2218E-09	8.3284E-09	1.8325E-08	3.3565E-08	2.2149E-08	2.9191E-08
2.50	8.6857E-09	9.5483E-09	5.6503E-09	6.6626E-09	1.4204E-08	2.5950E-08	1.7088E-08	2.2490E-08
3.00	6.7314E-09	7.3870E-09	4.5025E-09	5.3760E-09	1.1200E-08	2.0443E-08	1.3456E-08	1.7675E-08
3.50	5.3673E-09	5.8795E-09	3.6593E-09	4.4039E-09	9.0195E-09	1.6461E-08	1.0838E-08	1.4210E-08
4.00	4.3810E-09	4.7928E-09	3.0281E-09	3.6654E-09	7.4100E-09	1.3525E-08	8.9132E-09	1.1670E-08
4.50	3.6488E-09	3.9894E-09	2.5482E-09	3.1013E-09	6.2047E-09	1.1326E-08	7.4779E-09	9.7807E-09
5.00	3.0929E-09	3.3823E-09	2.1786E-09	2.6684E-09	5.2907E-09	9.6538E-09	6.3943E-09	8.3602E-09
7.50	1.6459E-09	1.8268E-09	1.2234E-09	1.6009E-09	3.0087E-09	5.3890E-09	3.7134E-09	4.9006E-09
10.00	1.0860E-09	1.2426E-09	8.8932E-10	1.2757E-09	2.2193E-09	3.8003E-09	2.7780E-09	3.7372E-09
15.00	6.3793E-10	7.7129E-10	6.4156E-10	1.0211E-09	1.5652E-09	2.4483E-09	1.9580E-09	2.7109E-09
20.00	4.4456E-10	5.5251E-10	5.1215E-10	8.4224E-10	1.1988E-09	1.7697E-09	1.4863E-09	2.0855E-09
25.00	3.3471E-10	4.2024E-10	4.1869E-10	6.9646E-10	9.4551E-10	1.3474E-09	1.1643E-09	1.6427E-09
30.00	2.6387E-10	3.3197E-10	3.4757E-10	5.8091E-10	7.6303E-10	1.0628E-09	9.3535E-10	1.3221E-09
35.00	2.1493E-10	2.6999E-10	2.9276E-10	4.9026E-10	6.2843E-10	8.6148E-10	7.6797E-10	1.0855E-09
40.00	1.7959E-10	2.2492E-10	2.5006E-10	4.1890E-10	5.2701E-10	7.1395E-10	6.4256E-10	9.0714E-10
45.00	1.5320E-10	1.9119E-10	2.1637E-10	3.6216E-10	4.4898E-10	6.0256E-10	5.4641E-10	7.6994E-10
50.00	1.3292E-10	1.6529E-10	1.8939E-10	3.1649E-10	3.8776E-10	5.1638E-10	4.7116E-10	6.6233E-10

Based on 1974-1975

TABLE 2.3-3

STACK X/Q AT GROUND LEVEL APPLICABLE TO
LONG TERM (ROUTINE) GASEOUS RELEASES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

GRAZING SEASON (APRIL 1 - SEPTEMBER 30)

SECTOR X/Q AT GROUND LEVEL
(Seconds/m³)

DISTANCE (MILES)	BEARING 22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0
.25	9.1689E-09	7.6903E-09	5.8711E-08	6.8033E-08	2.9963E-08	1.2241E-08	2.3411E-08	5.1432E-08
.50	1.6069E-08	1.4877E-08	8.0257E-08	8.7166E-08	3.6690E-08	1.6656E-08	2.1972E-08	4.0410E-08
.75	2.2277E-08	2.6503E-08	8.9933E-08	7.4667E-08	2.9080E-08	1.3207E-08	1.5279E-08	2.5375E-08
1.00	2.5258E-08	3.2644E-08	9.2673E-08	6.3550E-08	2.3663E-08	1.1052E-08	1.1307E-08	1.7451E-08
1.50	2.4309E-08	3.2593E-08	8.4722E-08	5.0761E-08	1.8418E-08	9.1035E-09	8.1989E-09	1.2146E-08
2.00	1.7866E-08	2.4556E-08	6.0111E-08	3.1369E-08	1.1166E-08	6.0945E-09	4.6338E-09	7.1538E-09
2.50	1.3902E-08	1.9231E-08	4.6510E-08	2.3056E-08	8.1675E-09	4.6589E-09	3.3104E-09	5.4753E-09
3.00	1.0980E-08	1.5244E-08	3.6702E-08	1.7584E-08	6.2134E-09	3.6510E-09	2.4818E-09	4.3860E-09
3.50	8.8488E-09	1.2314E-08	2.9603E-08	1.3842E-08	4.8837E-09	2.9311E-09	1.9318E-09	3.6100E-09
4.00	7.2714E-09	1.0135E-08	2.4360E-08	1.1184E-08	3.9407E-09	2.4053E-09	1.5494E-09	3.0272E-09
4.50	6.0863E-09	8.4930E-09	2.0422E-08	9.2398E-09	3.2512E-09	2.0160E-09	1.2762E-09	2.5769E-09
5.00	5.1838E-09	7.2400E-09	1.7420E-08	7.7852E-09	2.7346E-09	1.7254E-09	1.0780E-09	2.2224E-09
7.50	2.8880E-09	4.0360E-09	9.7356E-09	4.1384E-09	1.4285E-09	1.0462E-09	6.6026E-10	1.2312E-09
10.00	2.0609E-09	2.8682E-09	6.9088E-09	2.8273E-09	9.4483E-10	8.4611E-10	5.9318E-10	8.0948E-10
15.00	1.3812E-09	1.9141E-09	4.5495E-09	1.8261E-09	5.5934E-10	6.6548E-10	5.6628E-10	4.5114E-10
20.00	1.0269E-09	1.4407E-09	3.3398E-09	1.3662E-09	3.8646E-10	5.3035E-10	5.0285E-10	2.9574E-10
25.00	7.9445E-10	1.1394E-09	2.5627E-09	1.0743E-09	2.8609E-10	4.2449E-10	4.2849E-10	2.1104E-10
30.00	6.3208E-10	9.2870E-10	2.0278E-09	8.6843E-10	2.2122E-10	3.4431E-10	3.6161E-10	1.5904E-10
35.00	5.1460E-10	7.7349E-10	1.6446E-09	7.1662E-10	1.7658E-10	2.8375E-10	3.0615E-10	1.2459E-10
40.00	4.2717E-10	6.5513E-10	1.3614E-09	6.0143E-10	1.4448E-10	2.3750E-10	2.6125E-10	1.0050E-10
45.00	3.6046E-10	5.6251E-10	1.1463E-09	5.1206E-10	1.2059E-10	2.0161E-10	2.2501E-10	8.2958E-11
50.00	3.0846E-10	4.8860E-10	9.7933E-10	4.4140E-10	1.0231E-10	1.7331E-10	1.9559E-10	6.9758E-11

Based on 1974-1975

TABLE 2.3-4

STACK X/Q AT GROUND LEVEL APPLICABLE TO
LONG TERM (ROUTINE) GASEOUS RELEASES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

GRAZING SEASON (APRIL 1 - SEPTEMBER 30)

SECTOR X/Q AT GROUND LEVEL
(Seconds/m³)

DISTANCE (MILES)	BEARING 202.5	225.0	247.5	270.0	292.5	315.0	337.5	360.0
.25	4.7392E-08	7.8964E-08	3.4278E-09	8.4766E-10	7.4911E-09	1.8600E-08	3.3918E-08	2.9656E-08
.50	4.1947E-08	7.2184E-08	6.6739E-09	6.5865E-09	9.7337E-09	2.6287E-08	2.7612E-08	3.7989E-08
.75	3.0024E-08	5.0578E-08	6.6702E-09	1.1562E-08	9.0273E-09	2.3790E-08	2.1087E-08	3.5851E-08
1.00	2.3767E-08	3.7847E-08	6.4156E-09	1.3462E-08	8.4121E-09	2.0939E-08	1.7387E-08	3.2776E-08
1.50	1.8818E-08	2.8008E-08	5.6870E-09	1.2893E-08	7.2535E-09	1.7105E-08	1.3909E-08	2.7533E-08
2.00	1.2452E-08	1.6430E-08	3.9444E-09	9.2980E-09	4.8647E-09	1.0796E-08	8.8078E-09	1.7853E-08
2.50	9.6959E-09	1.1943E-08	3.0212E-09	7.1684E-09	3.6795E-09	7.9920E-09	6.5622E-09	1.3334E-08
3.00	7.7659E-09	9.0601E-09	2.3645E-09	5.6258E-09	2.8570E-09	6.1232E-09	5.0536E-09	1.0272E-08
3.50	6.3576E-09	7.1102E-09	1.8940E-09	4.5136E-09	2.2763E-09	4.8369E-09	4.0083E-09	8.1452E-09
4.00	5.2963E-09	5.7315E-09	1.5487E-09	3.6969E-09	1.8540E-09	3.9211E-09	3.2625E-09	6.6256E-09
4.50	4.4786E-09	4.7263E-09	1.2900E-09	3.0881E-09	1.5392E-09	3.2550E-09	2.7217E-09	5.5213E-09
5.00	3.8368E-09	3.9760E-09	1.0925E-09	2.6291E-09	1.2990E-09	2.7638E-09	2.3266E-09	4.7114E-09
7.50	2.0406E-09	2.1253E-09	5.8322E-10	1.5223E-09	6.6078E-10	1.6441E-09	1.4658E-09	2.9146E-09
10.00	1.2707E-09	1.4947E-09	4.0154E-10	1.1867E-09	4.0321E-10	1.3376E-09	1.2525E-09	2.4513E-09
15.00	6.3691E-10	1.0081E-09	2.7765E-10	9.1782E-10	1.9863E-10	1.0752E-09	1.0629E-09	2.0386E-09
20.00	3.8620E-10	7.5799E-10	2.3639E-10	7.3375E-10	1.1963E-10	8.6788E-10	9.1495E-10	1.6908E-09
25.00	2.6135E-10	5.9161E-10	2.1470E-10	5.9026E-10	8.0934E-11	6.9998E-10	7.9404E-10	1.4000E-09
30.00	1.9084E-10	4.7583E-10	1.9804E-10	4.8188E-10	5.9974E-11	5.7163E-10	6.9332E-10	1.1687E-09
35.00	1.4830E-10	3.9462E-10	1.8368E-10	4.0114E-10	4.8655E-11	4.7539E-10	6.0830E-10	9.8658E-10
40.00	1.2168E-10	3.3732E-10	1.7129E-10	3.4092E-10	4.3045E-11	4.0317E-10	5.3626E-10	8.4241E-10
45.00	1.0455E-10	2.9628E-10	1.6064E-10	2.9541E-10	4.0759E-11	3.4830E-10	4.7513E-10	7.2707E-10
50.00	9.3149E-11	2.6612E-10	1.5139E-10	2.6035E-10	4.0265E-11	3.0584E-10	4.2314E-10	6.3372E-10

Based on 1974-1975

TABLE 2.3-5

NINE MILE POINT 1

STACK

D/Q AT GROUND LEVEL APPLICABLE TO
LONG TERM (ROUTINE) GASEOUS RELEASES
(Seconds/m³)

SECTOR ANNUAL D/Q AT GROUND LEVEL

DISTANCE (MILES)	BEARING 22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0
.25	9.6929E-11	7.3448E-11	3.4791E-10	6.0683E-10	5.7000E-10	6.8078E-10	6.0065E-10	6.1944E-10
.50	1.3881E-10	1.2810E-10	4.9167E-10	8.0612E-10	7.0536E-10	6.7277E-10	4.8794E-10	5.4896E-10
.75	1.8339E-10	1.7798E-10	4.7962E-10	6.6127E-10	5.4621E-10	4.8165E-10	3.3235E-10	3.8890E-10
1.00	2.0595E-10	1.9980E-10	4.5702E-10	5.5417E-10	4.3400E-10	3.6433E-10	2.4514E-10	2.9466E-10
1.50	1.9802E-10	1.9031E-10	3.9994E-10	4.4516E-10	3.3362E-10	2.6993E-10	1.7861E-10	2.2031E-10
2.00	1.4612E-10	1.3809E-10	2.7266E-10	2.8156E-10	2.0178E-10	1.5709E-10	1.0243E-10	1.3175E-10
2.50	1.1395E-10	1.0683E-10	2.0741E-10	2.0928E-10	1.4788E-10	1.1356E-10	7.3732E-11	9.6951E-11
3.00	9.0068E-11	8.4007E-11	1.6154E-10	1.6074E-10	1.1267E-10	8.5816E-11	5.5569E-11	7.4269E-11
3.50	7.2568E-11	6.7480E-11	1.2892E-10	1.2710E-10	8.8650E-11	6.7199E-11	4.3419E-11	5.8711E-11
4.00	5.9597E-11	5.5335E-11	1.0514E-10	1.0297E-10	7.1569E-11	5.4125E-11	3.4900E-11	4.7576E-11
4.50	4.9885E-11	4.6292E-11	8.7455E-11	8.5195E-11	5.9046E-11	4.4625E-11	2.8719E-11	3.9362E-11
5.00	4.2554E-11	3.9485E-11	7.4061E-11	7.1823E-11	4.9627E-11	3.7526E-11	2.4107E-11	3.3153E-11
7.50	2.4801E-11	2.2970E-11	4.0053E-11	3.7992E-11	2.5456E-11	1.9410E-11	1.2435E-11	1.7103E-11
10.00	1.9140E-11	1.7653E-11	2.7761E-11	2.5681E-11	1.6334E-11	1.2493E-11	8.0736E-12	1.0991E-11
15.00	1.4256E-11	1.3141E-11	1.7916E-11	1.5982E-11	9.3274E-12	7.0157E-12	4.6592E-12	6.2489E-12
20.00	1.0950E-11	1.0160E-11	1.2947E-11	1.1355E-11	6.3737E-12	4.6817E-12	3.1744E-12	4.2586E-12
25.00	8.4336E-12	7.8873E-12	9.7011E-12	8.4413E-12	4.6714E-12	3.3681E-12	2.3142E-12	3.1284E-12
30.00	6.5824E-12	6.1786E-12	7.4425E-12	6.4523E-12	3.5560E-12	2.5317E-12	1.7544E-12	2.3918E-12
35.00	5.1828E-12	4.9011E-12	5.8274E-12	5.0450E-12	2.7818E-12	1.9639E-12	1.3688E-12	1.8778E-12
40.00	4.1606E-12	3.9419E-12	4.6485E-12	4.0247E-12	2.2267E-12	1.5625E-12	1.0938E-12	1.5050E-12
45.00	3.3940E-12	3.2146E-12	3.7712E-12	3.2690E-12	1.8186E-12	1.2700E-12	8.9233E-13	1.2276E-12
50.00	2.8103E-12	2.6562E-12	3.1063E-12	2.6981E-12	1.5120E-12	1.0513E-12	7.4115E-13	1.0168E-12

Based on 1974-1975

TABLE 2.3-6

NINE MILE POINT 1

STACK

D/Q AT GROUND LEVEL APPLICABLE TO
LONG TERM (ROUTINE) GASEOUS RELEASES
(Seconds/m^3)

SECTOR ANNUAL D/Q AT GROUND LEVEL

DISTANCE				BEARING				
(MILES)	202.5	225.0	247.5	270.0	292.5	315.0	337.5	360.0
.25	3.3632E-10	2.6969E-10	5.8941E-11	5.1612E-11	1.4291E-10	2.4916E-10	2.7984E-10	2.9606E-10
.50	3.4707E-10	3.3883E-10	1.1731E-10	9.1532E-11	2.2316E-10	3.8929E-10	3.4613E-10	3.9330E-10
.75	2.7581E-10	2.8518E-10	1.1864E-10	1.0538E-10	2.5964E-10	4.7801E-10	3.5488E-10	4.3846E-10
1.00	2.2734E-10	2.4219E-10	1.1340E-10	1.1250E-10	2.7256E-10	5.0646E-10	3.4999E-10	4.5049E-10
1.50	1.8084E-10	1.9640E-10	1.0053E-10	1.0790E-10	2.5288E-10	4.6778E-10	3.1345E-10	4.1077E-10
2.00	1.1420E-10	1.2551E-10	7.1117E-11	8.2102E-11	1.8095E-10	3.3185E-10	2.1892E-10	2.8862E-10
2.50	8.5210E-11	9.3628E-11	5.5321E-11	6.5262E-11	1.3950E-10	2.5535E-10	1.6808E-10	2.2130E-10
3.00	6.5711E-11	7.2073E-11	4.3814E-11	5.2304E-11	1.0940E-10	2.0021E-10	1.3169E-10	1.7309E-10
3.50	5.2137E-11	5.7086E-11	3.5389E-11	4.2553E-11	8.7640E-11	1.6046E-10	1.0555E-10	1.3851E-10
4.00	4.2351E-11	4.6319E-11	2.9103E-11	3.5178E-11	7.1638E-11	1.3125E-10	8.6395E-11	1.1325E-10
4.50	3.5108E-11	3.8386E-11	2.4343E-11	2.9569E-11	5.9703E-11	1.0944E-10	7.2159E-11	9.4525E-11
5.00	2.9627E-11	3.2412E-11	2.0691E-11	2.5287E-11	5.0689E-11	9.2918E-11	6.1450E-11	8.0495E-11
7.50	1.5479E-11	1.7231E-11	1.1368E-11	1.4886E-11	2.8427E-11	5.1151E-11	3.5221E-11	4.6664E-11
10.00	1.0088E-11	1.1609E-11	8.1947E-12	1.1833E-11	2.0881E-11	3.5836E-11	2.6232E-11	3.5480E-11
15.00	5.8192E-12	7.0870E-12	5.8447E-12	9.3793E-12	1.4555E-11	2.2790E-11	1.8265E-11	2.5428E-11
20.00	3.9648E-12	4.9466E-12	4.5264E-12	7.4859E-12	1.0842E-11	1.6114E-11	1.3519E-11	1.9044E-11
25.00	2.8982E-12	3.6349E-12	3.5331E-12	5.9081E-12	8.2312E-12	1.1926E-11	1.0244E-11	1.4480E-11
30.00	2.2065E-12	2.7613E-12	2.7749E-12	4.6703E-12	6.3619E-12	9.1149E-12	7.9303E-12	1.1207E-11
35.00	1.7302E-12	2.1562E-12	2.2011E-12	3.7219E-12	5.0089E-12	7.1504E-12	6.2648E-12	8.8372E-12
40.00	1.3901E-12	1.7255E-12	1.7678E-12	2.9985E-12	4.0155E-12	5.7337E-12	5.0424E-12	7.0944E-12
45.00	1.1405E-12	1.4114E-12	1.4388E-12	2.4442E-12	3.2736E-12	4.6844E-12	4.1272E-12	5.7896E-12
50.00	9.5270E-13	1.1766E-12	1.1866E-12	2.0157E-12	2.7098E-12	3.8894E-12	3.4291E-12	4.7952E-12

Based on 1974-1975

TABLE 2.3-7

STACK D/Q AT GROUND LEVEL APPLICABLE TO LONG TERM (ROUTINE) GASEOUS RELEASES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

GRAZING SEASON (APRIL 1 - SEPTEMBER 30)

SECTOR D/Q AT GROUND LEVEL
($1/m^2$)

DISTANCE	BEARING							
(MILES)	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0
.25	9.1676E-11	7.6890E-11	5.8700E-10	6.8024E-10	2.9958E-10	1.2239E-10	2.3400E-10	5.1407E-10
.50	1.6047E-10	1.4860E-10	8.0144E-10	8.7039E-10	3.6634E-10	1.6623E-10	2.1926E-10	4.0325E-10
.75	2.2233E-10	2.6470E-10	8.9756E-10	7.4471E-10	2.9000E-10	1.3157E-10	1.5220E-10	2.5278E-10
1.00	2.5186E-10	3.2576E-10	9.2424E-10	6.3310E-10	2.3575E-10	1.0997E-10	1.1247E-10	1.7359E-10
1.50	2.4189E-10	3.2458E-10	8.4351E-10	5.0477E-10	1.8322E-10	9.0424E-11	8.1410E-11	1.2062E-10
2.00	1.7664E-10	2.4298E-10	5.9525E-10	3.1049E-10	1.1064E-10	6.0180E-11	4.5816E-11	7.0781E-11
2.50	1.3673E-10	1.8930E-10	4.5852E-10	2.2744E-10	8.0686E-11	4.5752E-11	3.2629E-11	5.3981E-11
3.00	1.0743E-10	1.4927E-10	3.6018E-10	1.7290E-10	6.1205E-11	3.5645E-11	2.4389E-11	4.3038E-11
3.50	8.8149E-11	1.1998E-10	2.8921E-10	1.3571E-10	4.7975E-11	2.8449E-11	1.8931E-11	3.5218E-11
4.00	7.0454E-11	9.8279E-11	2.3694E-10	1.0934E-10	3.8612E-11	2.3214E-11	1.5144E-11	2.9335E-11
4.50	5.8709E-11	8.1994E-11	1.9780E-10	9.0109E-11	3.1781E-11	1.9353E-11	1.2444E-11	2.4792E-11
5.00	4.9798E-11	6.9612E-11	1.6805E-10	7.5749E-11	2.6672E-11	1.6484E-11	1.0491E-11	2.1222E-11
7.50	2.7354E-11	3.8260E-11	9.2556E-11	3.9944E-11	1.3818E-11	9.8716E-12	6.4065E-12	1.1338E-11
10.00	1.9411E-11	2.7028E-11	6.5223E-11	2.7187E-11	9.0939E-12	7.9808E-12	5.7673E-12	7.2394E-12
15.00	1.2843E-11	1.7813E-11	4.2363E-11	1.7389E-11	5.3149E-12	6.2098E-12	5.4093E-12	3.8639E-12
20.00	9.2921E-12	1.3081E-11	3.0313E-11	1.2707E-11	3.5897E-12	4.7997E-12	4.5971E-12	2.4415E-12
25.00	6.9281E-12	1.0004E-11	2.2486E-11	9.6358E-12	2.5809E-12	3.6888E-12	3.6959E-12	1.6819E-12
30.00	5.2895E-12	7.8376E-12	1.7137E-11	7.4510E-12	1.9329E-12	2.8619E-12	2.9229E-12	1.2248E-12
35.00	4.1274E-12	6.2457E-12	1.3374E-11	5.8566E-12	1.4935E-12	2.2541E-12	2.3134E-12	9.2837E-13
40.00	3.2850E-12	5.0446E-12	1.0658E-11	4.6751E-12	1.1836E-12	1.8045E-12	1.8455E-12	7.2565E-13
45.00	2.6610E-12	4.1220E-12	8.6503E-12	3.7869E-12	9.5775E-13	1.4670E-12	1.4879E-12	5.8123E-13
50.00	2.1894E-12	3.4043E-12	7.1339E-12	3.1098E-12	7.8882E-13	1.2097E-12	1.2132E-12	4.7496E-13

Based on 1974-1975

TABLE 2.3-8

STACK D/Q AT GROUND LEVEL APPLICABLE TO LONG TERM (ROUTINE) GASEOUS RELEASES

NINE MILE POINT NUCLEAR STATION - UNIT 1
NIAGARA MOHAWK POWER CORPORATION

GRAZING SEASON (APRIL 1 - SEPTEMBER 30)

SECTOR D/Q AT GROUND LEVEL
$(1/m^2)$

DISTANCE (MILES)	BEARING 202.5	225.0	247.5	270.0	292.5	315.0	337.5	360.0
.25	4.7368E-10	7.8934E-10	3.4274E-11	8.4763E-12	7.4899E-11	1.8597E-10	3.3899E-10	2.9648E-10
.50	4.1859E-10	7.2058E-10	6.6594E-11	6.5760E-11	9.7182E-11	2.6239E-10	2.7550E-10	3.7924E-10
.75	2.9918E-10	5.0396E-10	6.6427E-11	1.1528E-10	9.0045E-11	2.3718E-10	2.1009E-10	3.5752E-10
1.00	2.3658E-10	3.7649E-10	6.3807E-11	1.3404E-10	8.3837E-11	2.0857E-10	1.7303E-10	3.2657E-10
1.50	1.8703E-10	2.7803E-10	5.6439E-11	1.2806E-10	7.2163E-11	1.7013E-10	1.3820E-10	2.7389E-10
2.00	1.2312E-10	1.6223E-10	3.8879E-11	9.1740E-11	4.8130E-11	1.0698E-10	8.7088E-11	1.7683E-10
2.50	9.5421E-11	1.1741E-10	2.9613E-11	7.0367E-11	3.6243E-11	7.8971E-11	6.4617E-11	1.3163E-10
3.00	7.6013E-11	8.8674E-11	2.3047E-11	5.4952E-11	2.8019E-11	6.0343E-11	4.9554E-11	1.0108E-10
3.50	6.1860E-11	6.9291E-11	1.8361E-11	4.3882E-11	2.2231E-11	4.7546E-11	3.9146E-11	7.9911E-11
4.00	5.1208E-11	5.5626E-11	1.4937E-11	3.5785E-11	1.8036E-11	3.8454E-11	3.1740E-11	6.4822E-11
4.50	4.3019E-11	4.5692E-11	1.2381E-11	2.9772E-11	1.4918E-11	3.1854E-11	2.6388E-11	5.3884E-11
5.00	3.6612E-11	3.8299E-11	1.0438E-11	2.5255E-11	1.2546E-11	2.6997E-11	2.2490E-11	4.5884E-11
7.50	1.8857E-11	2.0216E-11	5.4775E-12	1.4478E-11	6.2871E-12	1.5995E-11	1.4091E-11	2.8273E-11
10.00	1.1414E-11	1.4149E-11	3.7433E-12	1.1276E-11	3.7908E-12	1.3006E-11	1.2057E-11	2.3784E-11
15.00	5.4632E-12	9.4122E-12	2.5636E-12	8.6042E-12	1.8330E-12	1.0282E-11	1.0109E-11	1.9495E-11
20.00	3.1951E-12	6.8554E-12	2.1388E-12	6.6345E-12	1.0882E-12	8.0067E-12	8.4658E-12	1.5658E-11
25.00	2.0997E-12	5.1253E-12	1.8796E-12	5.0884E-12	7.2783E-13	6.1737E-12	7.0905E-12	1.2443E-11
30.00	1.4983E-12	3.9337E-12	1.6541E-12	3.9446E-12	5.3543E-13	4.8061E-12	5.9269E-12	9.9191E-12
35.00	1.1464E-12	3.1185E-12	1.4466E-12	3.1200E-12	4.3396E-13	3.8132E-12	4.9360E-12	7.9696E-12
40.00	9.3378E-13	2.5620E-12	1.2634E-12	2.5280E-12	3.8565E-13	3.0945E-12	4.0999E-12	6.4635E-12
45.00	8.0142E-13	2.1774E-12	1.1075E-12	2.0983E-12	3.6683E-13	2.5680E-12	3.4040E-12	5.2934E-12
50.00	7.1461E-13	1.9024E-12	9.7681E-13	1.7793E-12	3.6171E-13	2.1740E-12	2.8315E-12	4.3777E-12

Based on 1974-1975

TABLE 2.3-9

Turbulence Class Systems and Temperature Differences

Nine Mile Point Nuclear Station - Unit 1
Niagara Mohawk Power Corporation

Brookhaven National Lab	Smith-Singer Temperature Difference System (°C/100m)
B_2	≤ -1.9
B_1	$-1.9 < \Delta T \leq -0.7$
C	$-0.7 < \Delta T \leq 0.0$
D	$\Delta T > 0.0$

2.4 Description of Meteorological Data, Models, and Parameters

The information regarding meteorological data requested by the NRC has been discussed in the response to Request B4 of the Nine Mile Point Nuclear Station Unit 2, Docket No. 50-410, Compliance with 10CFR50 Appendix I, June 4, 1976.

2.5 On-Site Meteorological Data (R.G. 1.23)

The information regarding on-site meteorological data requested by the NRC has been discussed in the response to Request B-1 of the Nine Mile Point Nuclear Station - Unit 2, Docket No. 50-410, Compliance with 10CFR50 Appendix I, June 4, 1976.

2.6 Description of Meteorological Measurements Program

The radiological conditions at the site and in its environment have been monitored in an extensive program initiated by the Niagara Mohawk Power Corporation in 1967, two years prior to start-up of the Nine Mile Point Station Unit 1. The results of this phase of the program were reported to the AEC in a document entitled "Environmental Preoperational Survey, Nine Mile Point," dated December 1969. Presently the program yields operational phase data for the Nine Mile Point Station Unit 1.

Additional meteorological information has been discussed in Part B, Meteorology, of the Nine Mile Point Nuclear Station Unit 2, Docket No. 50-410, Compliance with 10CFR50 Appendix I, June 4, 1976.

2.7 Description of Airflow Trajectory Regimes

The information regarding airflow trajectory regimes requested by the NRC has been discussed in the response to Request B2 of the Nine Mile Point Nuclear Station Unit 2, Docket No. 50-410, Compliance with 10CFR50 Appendix I, June 4, 1976.

2.8 Topographical Map

The information regarding the Topographical Map requested by the NRC has been discussed in the response to Request B3 of the Nine Mile Point Nuclear Station Unit 2, Docket No. 50-410, Compliance with 10CFR50 Appendix I, June 4, 1976. Figures B3b-1, B3b-2, B3b-3, and B3b-4 show the maximum topographical elevations out to 50 miles from the plant.

2.9 Dates and Times of Intermittent Radioactivity Releases

As stated in Section 1.2.2, the only release point for Nine Mile Point Unit 1 is the main stack and, therefore, no intermittent releases are being reported.