April 14, 1978

Docket No. 50-410

MEMORANDUM FOR: D. Skovholt, Assistant Director for Quality Assurance and Operations

FROM: D. B. Vassallo, Assistant Director for LWRs, DPM

SUBJECT: REVIEW OF FINANCIAL INFORMATION FOR NINE MILE POINT NUCLEAR STATION - UNIT 2

Niagara Mohawk Power Corporation has filed an amendment to the construction permit application to add additional owners for the plant. One of the matters that must be reviewed and accepted prior to amending the application is the financial viability of the co-owners.

We request that you review the financial information submitted in support of the amendment and provide the appropriate requests for additional information. A safety evaluation should be provided as the product of that review.

Our target date for your input to a safety evaluation is July 14, 1978.

Original signed by
D. B. Vassallo

D. B. Vassallo, Assistant Director
for Light Water Reactors
Division of Project Management

ccs:
W. Kane
B. Bordenick
A. Meltz

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# RESPONSES TO NRC REQUESTS DATED APRIL 22, 1977, FOR ADDITIONAL INFORMATION REGARDING THE PROPOSED COOLING SYSTEM DESIGN CHANGE

DOCKET NO. 50-410

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION

SEPTEMBER 30, 1977

Request 1

Provide the following performance characteristics (for design and off-design), as applicable for this system:

1. Air and water mass flow rates at tower emission point
2. Efflux speed
3. Temperature of water entering and leaving the tower
4. Temperature of air leaving the tower
5. Amount of heat released.

Response

The design point for the Unit 2 cooling tower is 74 F wet bulb temperature and 50 percent relative humidity.

The tower will have the following performance characteristics:

1. At the design point, the mass flow rate of dry air will be 166,779,400 lb/hr at the tower emission point. For the design heat load, wet bulb temperature, and relative humidity, the total mass flow rate of water at the tower emission point will be 8,926,000 lb/hr of which 6,484,000 lb/hr will be evaporation and drift and 2,442,000 lb/hr will be the initial moisture contained in the air. The exit air volumes and evaporation rates for the off-design performance characteristics are shown in Figures R1-1 and R1-2.

2. The efflux speed will be 11.4 fps at the design point. The approximate off-design velocities can be derived from the air volumes given in Figure R1-1 divided by the exit area, 59,900 $ft^2$.

3. At the design point, the temperature of the water entering the tower will be 117 F, and the water temperature leaving the tower will be 90 F. The minimum water temperature leaving the tower basin will be controlled at 55 F, at which time the water temperature entering the tower will be 82 F.

4. At the design point, the temperature of the air leaving the cooling tower will be 106.7 F. Figure R1-3 gives the exit air temperatures for the off-design conditions.

5. At full load and tower design point, the amount of heat released to the atmosphere will be $130.69 \times 10^6$ BTU/min. At full load and a minimum controlled cooling tower basin temperature of 55 F, the heat released will be reduced by approximately 1.7 percent. The cooling tower basin temperature will be controlled at a minimum of approximately 55 F regardless of meteorological conditions.

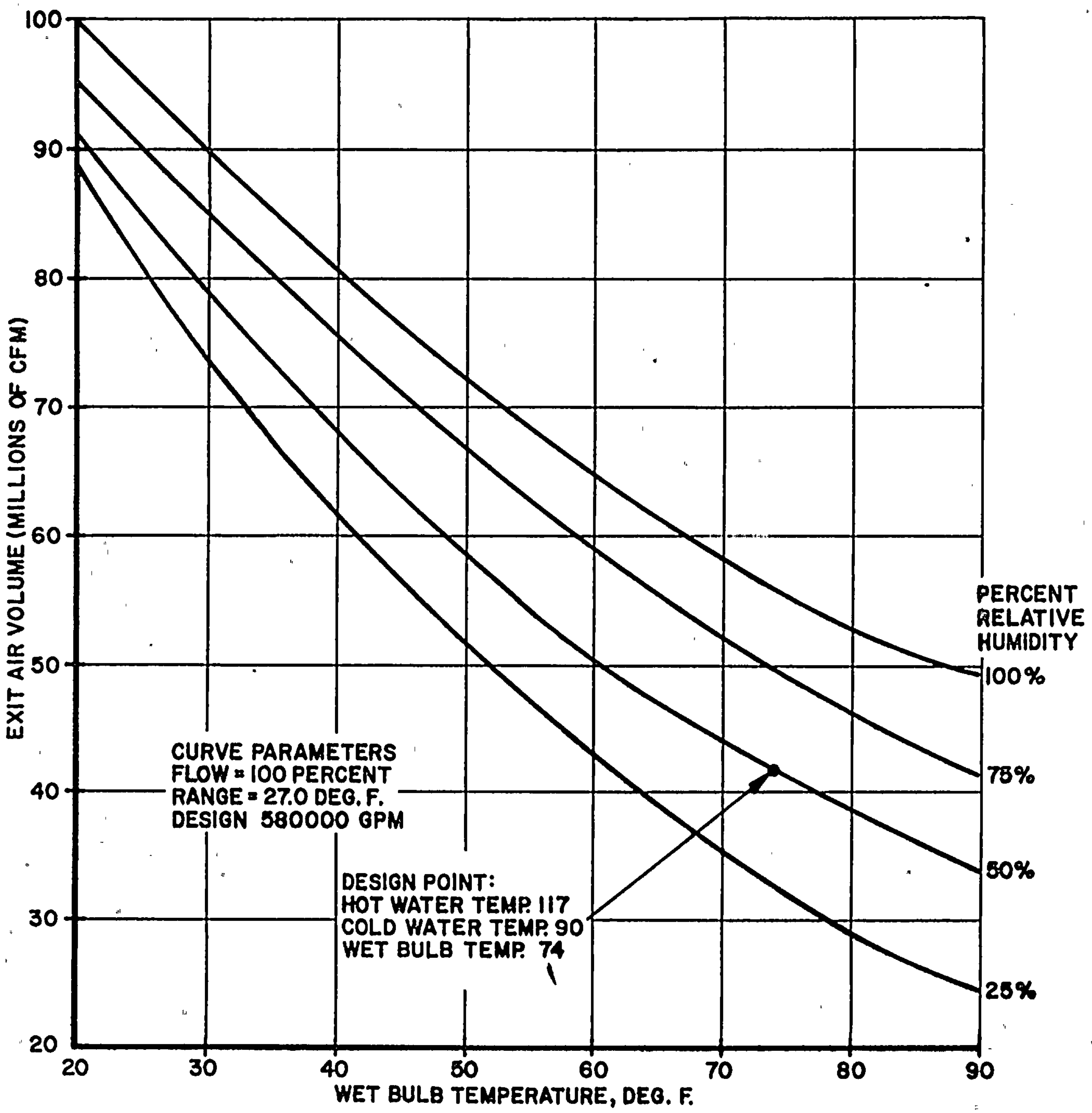



FIGURE RI-1

COOLING TOWER PERFORMANCE CURVES
EXIT AIR VOLUME VS WET BULB TEMPERATURE
NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

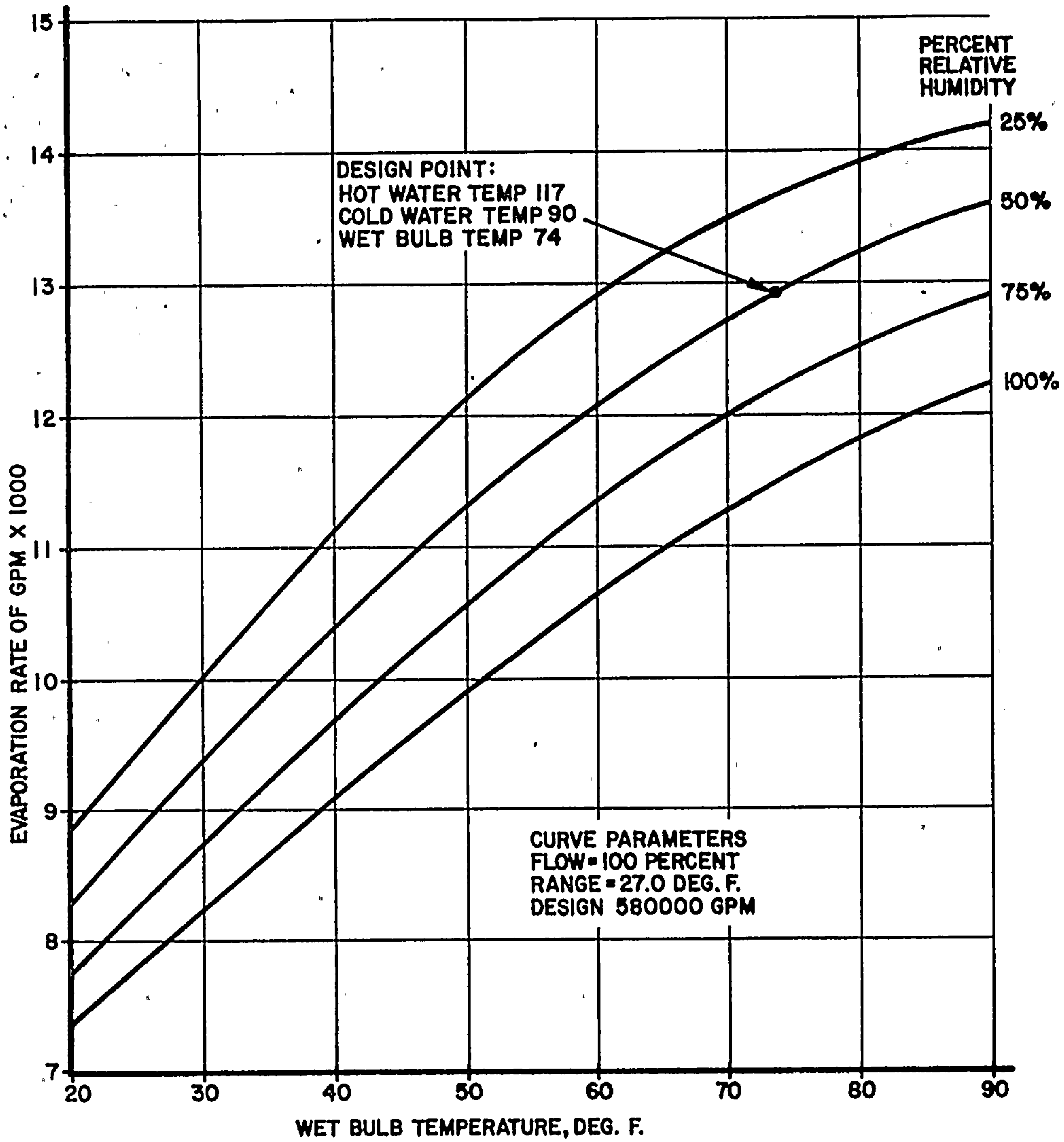



FIGURE RI-2

**COOLING TOWER PERFORMANCE CURVES**
**EVAPORATION RATE VS. WET BULB TEMPERATION**
**NINE MILE POINT NUCLEAR STATION-UNIT 2**
**NIAGARA MOHAWK POWER CORPORATION**

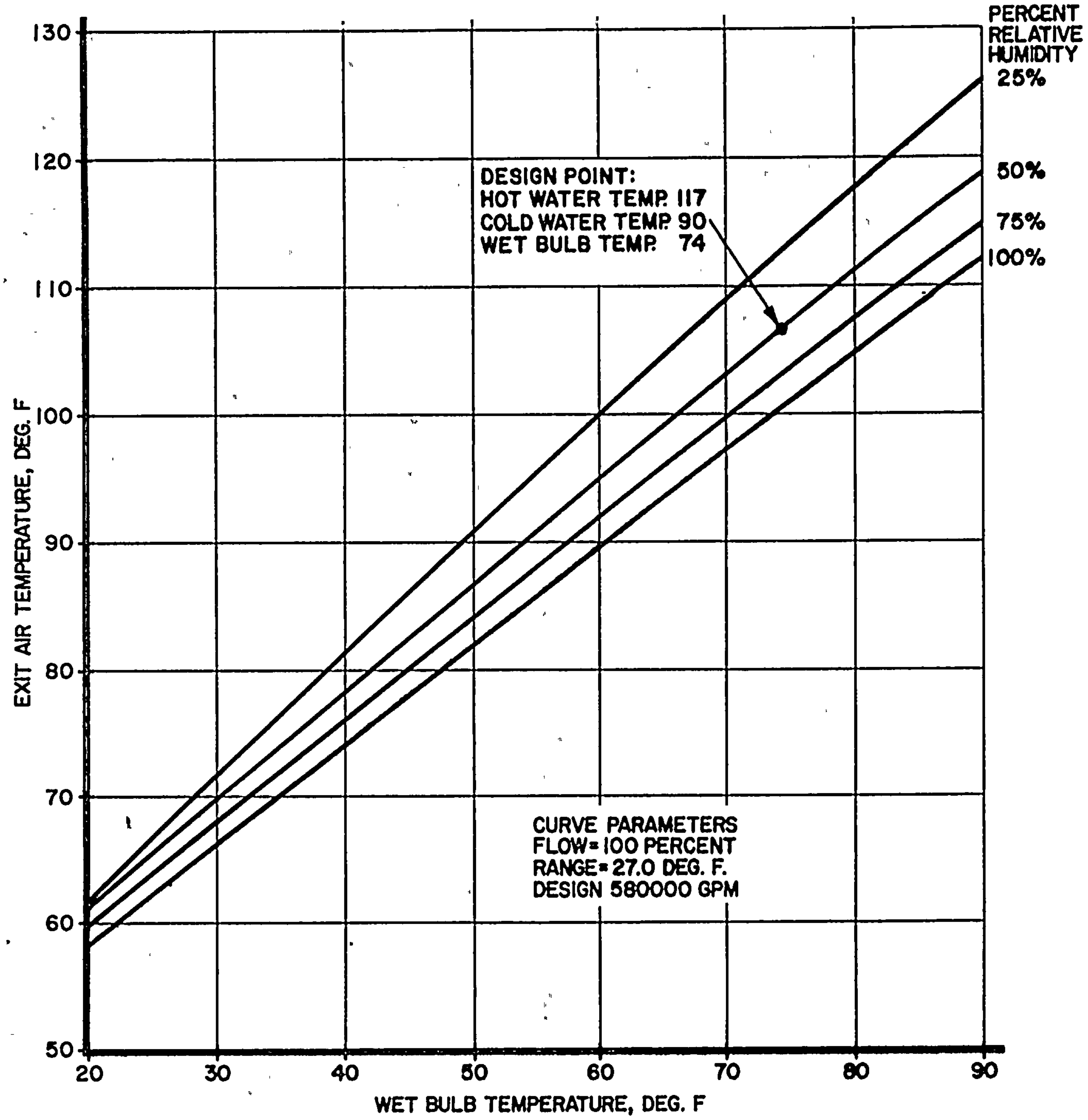



FIGURE RI-3

**COOLING TOWER PERFORMANCE CURVES**
**EXIT AIR TEMPERATURE VS. WET BULB TEMPERATURE**
**NINE MILE POINT NUCLEAR STATION—UNIT 2**
**NIAGARA MOHAWK POWER CORPORATION**

Request 2

Provide the following drift characteristics for this system:

1. Expected size distribution of drift droplets.

2. Concentration of dissolved and suspended solids in the tower basin.

Response

1. The drift droplet size spectrum used in the model is a composite of two distributions: one for a natural draft tower[1] and the other for a mechanical draft tower[2]. The spectrum is divided into six equal size classes with each class representing a fixed percentage of the total drift mass. The range of diameters spanned by the distribution is variable, depending on the rate of air flow through the tower. Thus, the distribution is applicable for both natural and mechanical draft cooling towers. The expected droplet size spectrum at the design point for this system is given in Table R2-1.

2. The cooling tower is expected to be run at a yearly average of 1.78 cycles of concentration which will cause a total dissolved solids (TDS) concentration of 388 mg/l in the tower basin. The predicted drift amounts presented in Response 4 are based on seasonal average cycles of concentration and total dissolved solids concentrations as follows:

   Winter, 1.75 cycles and 381 mg/l TDS
   Spring, 1.79 cycles and 390 mg/l TDS
   Summer, 1.87 cycles and 407 mg/l TDS
   Fall, 1.70 cycles and 370 mg/l TDS

   The expected concentration of suspended solids in the tower basin based on the mean makeup water suspended solids concentration and the above cycles of concentration are: winter, 14.7 mg/l; spring, 15.0 mg/l; summer, 15.7 mg/l; and fall, 14.3 mg/l.

References

1. Jersey Central Power and Light Company, Salt Water Cooling Tower Report, Forked River Nuclear Generating Station Unit 1, Environmental Report, Docket No. 50-363, Appendix B, Attachment 5, January, 1972.

2. Environmental Protection Agency, Office of Research and Monitoring, Corvallis, Oregon, "Development and Demonstration of Low-Level Drift Instrumentation," October, 1971.

TABLE R2-1

DROPLET SIZE SPECTRUM

| Droplet Interval (um) | Median Diameter (um) | Mass % |
|---|---|---|
| 2-25 | 12.5 | 5 |
| 25-50 | 37.5 | 30 |
| 50-75 | 62.5 | 39 |
| 75-100 | 87.5 | 17 |
| 100-125 | 112.5 | 7 |
| 125-150 | 137.5 | 2 |

## Request 3

Substantiate that the Tsai and Johnson drift model, your reference 6, is applicable for use at this Site and with the proposed cooling system. Include in your discussion whether the values of your input data (tower characteristics and meteorological variables) are within the range of the data used to formulate this model.

## Response

The Tsai and Johnson drift model[1] is not restricted to use for a specific type of cooling tower or range of meteorological conditions but is applicable to any natural draft or mechanical draft cooling tower. The model, reference 6, which was discussed in the "Report on the Circulating Water System Employing a Natural Draft Cooling Tower," is included in this response.

The dimensions and performance characteristics of each individual tower are used as input to the model. Performance data, such as exit air velocity and temperature, are provided to the model as a function of the ambient meteorological conditions. The drift droplet size spectrum used in the model is also a function of ambient conditions as well as the tower characteristics. Therefore, the model is applicable to any type of cooling tower, including the Unit 2 cooling tower for this Site.

The physical processes involved in drift droplet transport and deposition, such as plume rise and evaporation, are treated in such a way that they are well represented for any expected range of values of meteorological parameters. Thus, the values of the input data to the model are not confined to a narrow range because of the model formulations. The model can be applied to any type of cooling tower under any range of meteorological conditions.

## Reference

1. Tsai, Y. J. and Johnson, D. M., "Cooling Tower Drift Model," presented at the Fifth Annual Pittsburgh Conference on Modeling and Simulation, April, 1974.

COOLING TOWER DRIFT MODEL

Y. J. Tsai and D. H. Johnson
Environmental Engineering Division
Stone & Webster Engineering Corporation
Boston, Massachusetts

ABSTRACT

A computer model has been developed to predict the distribution of drift from brackish or salt water cooling towers for power plant condensate cooling. Drift from mechanical or natural draft towers can be evaluated, taking into account tower characteristics, drift rate, droplet size distribution, total dissolved solids in cooling water, rise of droplets in the plume, evaporation and trajectory of falling droplets, and ambient weather data.

INTRODUCTION

Limited water availability and avoidance of thermal pollution are leading to an increased reliance on cooling towers for power plant condensate cooling. Evaluation of the environmental impact of cooling tower discharges into the atmosphere requires prediction of the quantity and extent of discharged material distribution.

MODEL DEVELOPMENT

The drift droplets are entrained by the air draft through the tower fill, and the size distribution is determined by the air velocity inside the tower and drift eliminator efficiency. The model uses droplet size distributions for mechanical or natural draft towers based upon field measurements[(1)(2)]. The drift is carried out of the tower and rises within the buoyant plume to a height determined by the plume characteristics and the droplet fall velocity. Droplets fall from the tower plume with a terminal velocity. Stoke's Law is used for water droplets under 80 microns in diameter falling through air. Larger droplets fall with a velocity determined empirically to be a function of diameter[(3)]. The evaporation of the falling droplets is calculated as a function of droplet radius, air temperature, and relative humidity[(3)]. Evaporation continues until ground level is reached or the droplet vapor pressure is in equilibrium state with ambient air. The equilibrium diameter for saline droplets is calculated as a function of salt concentration and ambient relative humidity.

MODEL OPERATION

The imput data to the drift model consists of the cooling tower characteristics and field weather measurements. The model calculates the drift transport for each set of meteorological data at three hour intervals. The drift mass is divided into droplet size classes. For each size class, the initial rise in the plume is computed. Droplet fall, evaporation,

and downwind transport are calculated at ten-second intervals until ground level is reached. The process is iterated each three hours for 10 years of weather data and the drift accumulated by direction and distance from the tower.

RESULTS AND APPLICATIONS

The drift model has four groups of output: annual deposition of dissolved solids, annual deposition of water, maximum near-ground air concentration, and annual near-ground air concentration. These data are then used to evaluate cooling tower impact upon the environment. They are used to determine effects upon plant foliage and growth and ground water quality. The S&W cooling tower drift model results compare well with other existing models[4] such as the Bosanquet method, Gaussian dispersion method, Hosler, et al. method, and the diffusion model developed by Westinghouse. The S&W model has the added flexibility of using historical meteorological data and produces a comprehensive set of predictions for evaluation of cooling tower drift environmental impact.

REFERENCES

(1) EPA, Office of Research and Monitoring, Corvallis, Oregon, "Development and Demonstration of Low-Level Drift Instrumentation," October, 1971.

(2) Jersey Central Power and Light Company, "Cooling Tower Report," Forked River Nuclear Station Unit 1, Environmental Report, Appendix B, Attachment 5, January, 1972.

(3) List, Robert J., "Smithsonian Meteorological Tables," Smithsonian Institution, No. 4014, Washington, D. C., 1966.

(4) AEC, Division of Reactor Development and Technology, "The State of the Art of Saltwater Cooling Towers for Steam Electric Generating Plants," February, 1973.

Request 4

In addition to Figures 5 and 6, Water and Salt Drift for an Annual Period, provide figures showing water and salt drift amounts for each month or season of the year.

Response

The Tsai and Johnson drift model that was used to produce Figures 5 and 6 has since been revised to incorporate a more realistic plume rise approach and to differentiate between those drift droplets which settle to the ground and those that remain suspended in the atmosphere due to turbulent mixing. This latest version of the drift model was run with revised cooling tower characteristics and three years of onsite meteorological data (January 1, 1974, to December 31, 1976).

The meteorological input data used in the model consisted of wind speed, wind direction, dry-bulb temperature, wet-bulb temperature, and relative humidity at the 200 foot level. The difference between the dry-bulb temperature at 200 feet and at 27 feet ($\Delta T$) was also used. Normally, the low-level relative humidity would be used to determine tower performance; but due to the large amount of time data was not collected for this parameter, the upper level relative humidity was chosen. A comparison of the relative humidities at these two levels showed an average difference of only 4.6 percent, which has little effect on the salt drift model output. The results of a sensitivity test of the drift model to relative humidity, using one month (December, 1974) of meteorological data, showed an 11 percent decrease in the maximum salt deposition rate and an 8.7 percent decrease in the maximum water deposition rate by using the 200 foot relative humidity in place of the 30 foot relative humidity.

There was also a substitution of the 100 foot wind direction when the 200 foot wind direction was missing to ensure that a high percentage of the data was used. This practice does not significantly affect the salt drift results because of the very small changes in wind direction with height between these levels.

Average annual salt deposition rates in lbs/acre/year are shown in Figure 4-1. The maximum salt deposition rate was predicted to be 0.27 lbs/acre/year, 6750 feet northwest of the tower. Figure 4-2 presents annual water deposition rates in lbs/acre/year with maximum value of 690.6 lbs/acre/year occurring 6750 feet northwest of the tower. This amount of water corresponds to 0.0030 inches of water per year.

Average monthly salt deposition rates in lbs/acre/month are shown in Figures 4-3 through 4-14. Monthly and seasonal water deposition rates are not shown because the maximum annual amount of 0.0030 inches is insignificant compared to annual precipitation at the Site.

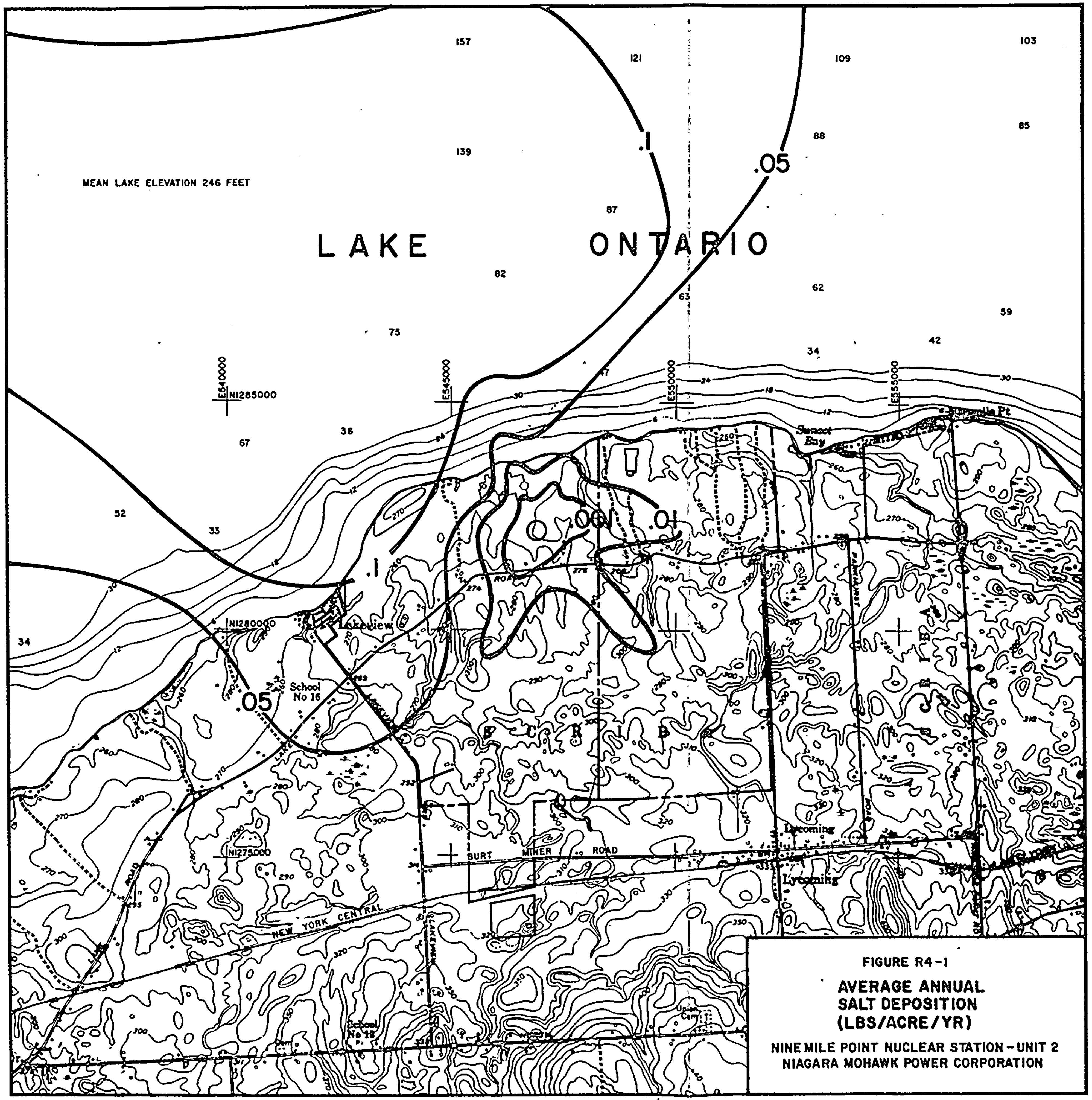



FIGURE R4-1

**AVERAGE ANNUAL SALT DEPOSITION (LBS/ACRE/YR)**

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION

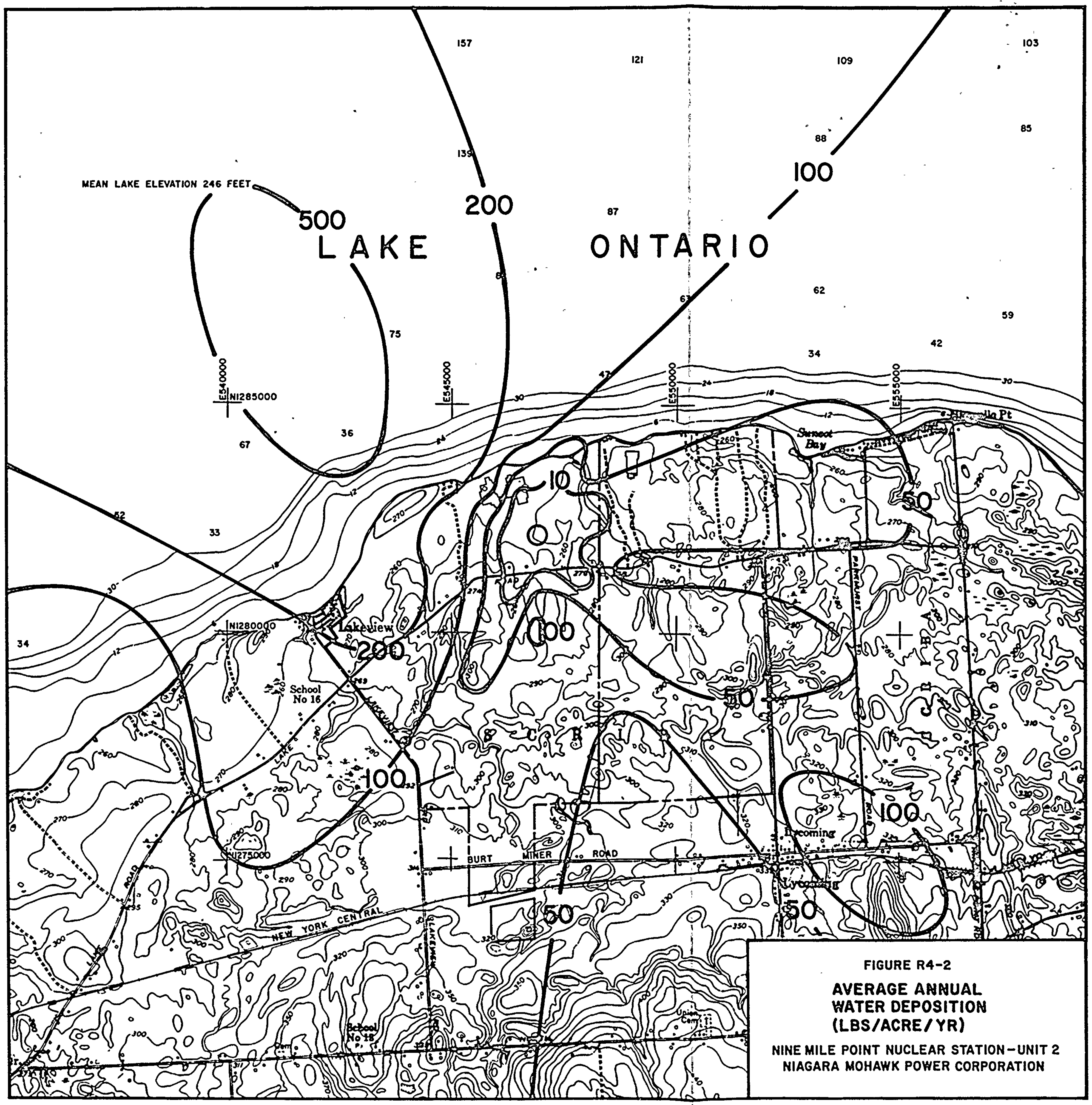



FIGURE R4-2

**AVERAGE ANNUAL WATER DEPOSITION (LBS/ACRE/YR)**

NINE MILE POINT NUCLEAR STATION–UNIT 2
NIAGARA MOHAWK POWER CORPORATION

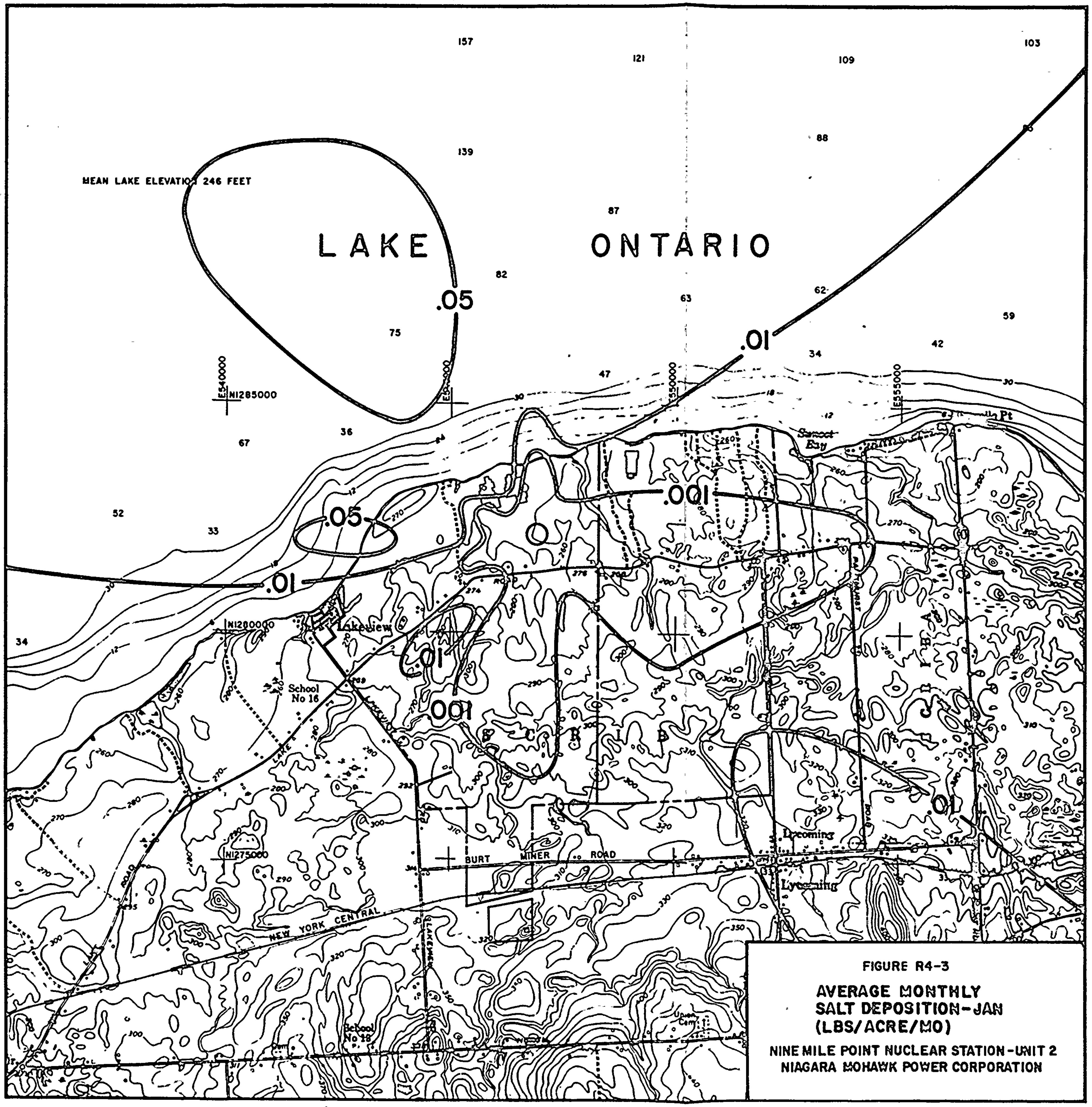



FIGURE R4-3

AVERAGE MONTHLY SALT DEPOSITION-JAN (LBS/ACRE/MO)

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION


FIGURE R4-4

**AVERAGE MONTHLY SALT DEPOSITION- FEB (LBS/ACRE/MO)**

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION


FIGURE R4-5
AVERAGE MONTHLY SALT DEPOSITION-MAR (LBS/ACRE/MO)
NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION


FIGURE R4-6

AVERAGE MONTHLY SALT DEPOSITION-APRIL (LBS/ACRE/MO)

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

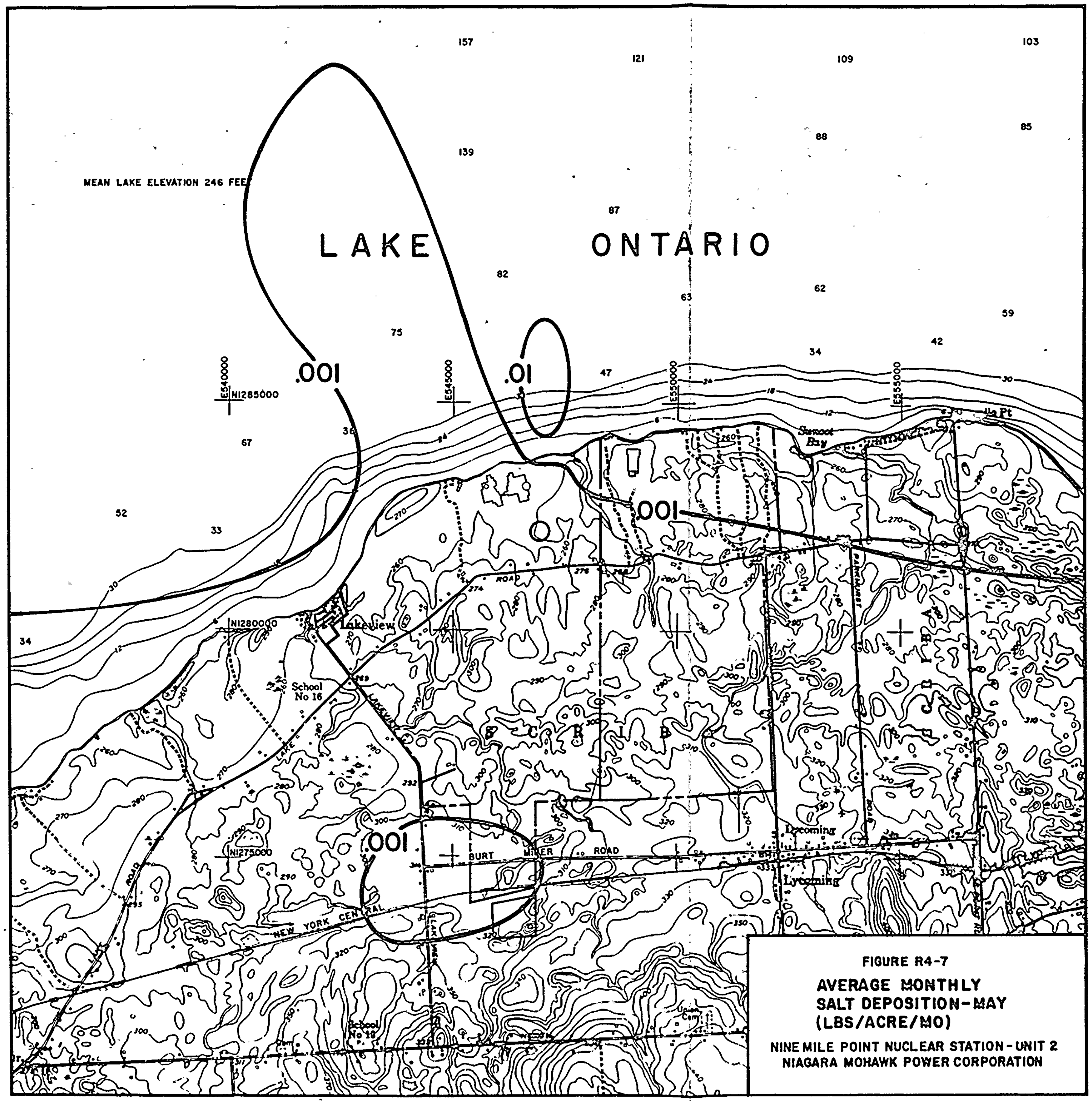



FIGURE R4-7

AVERAGE MONTHLY SALT DEPOSITION-MAY (LBS/ACRE/MO)

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

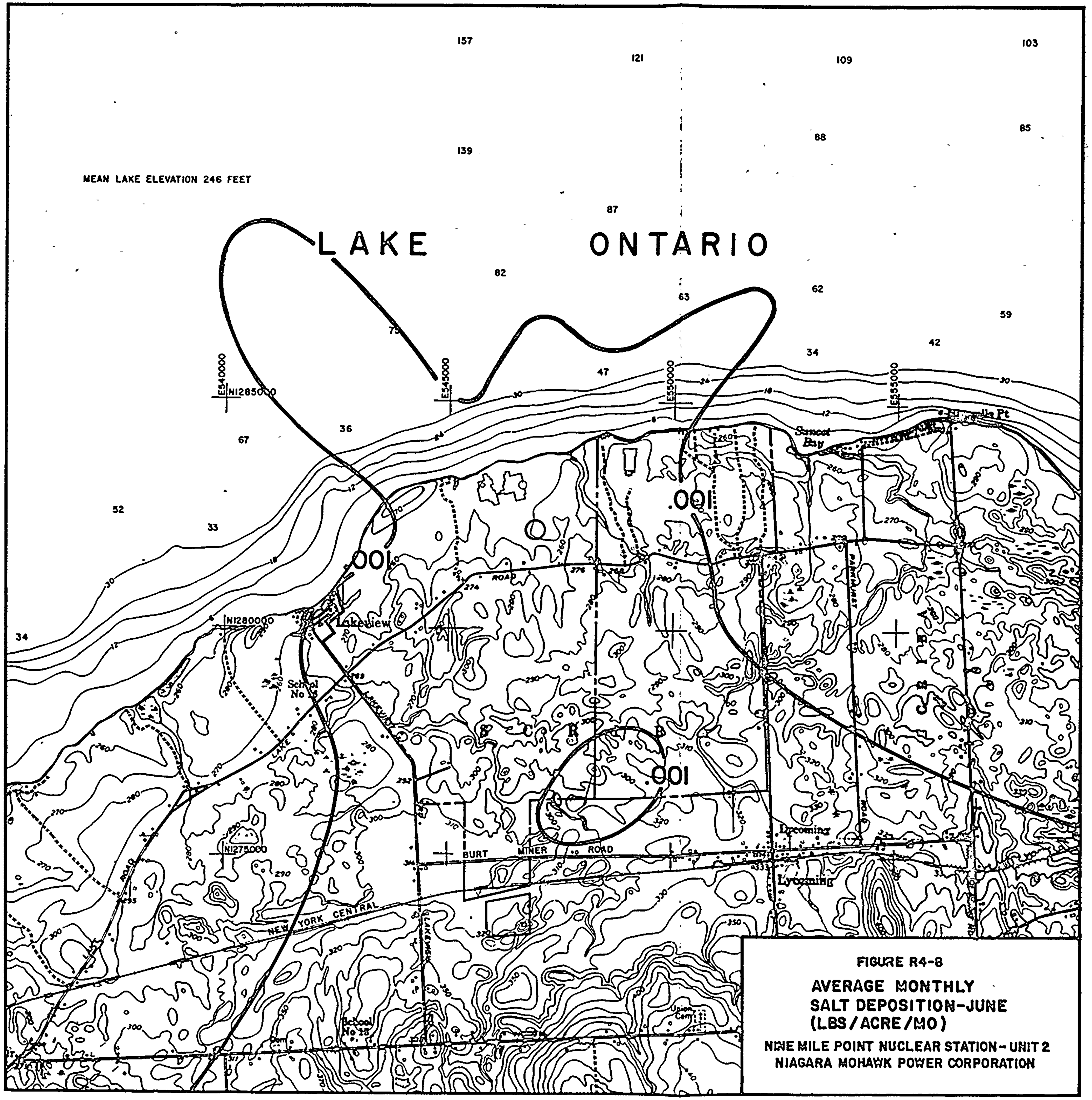



FIGURE R4-8

AVERAGE MONTHLY SALT DEPOSITION-JUNE (LBS/ACRE/MO)

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION


FIGURE R4-9

**AVERAGE MONTHLY SALT DEPOSITION-JULY (LBS/ACRE/MO)**

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION


FIGURE R4-10

AVERAGE MONTHLY SALT DEPOSITION-AUG (LBS/ACRE/MO)

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

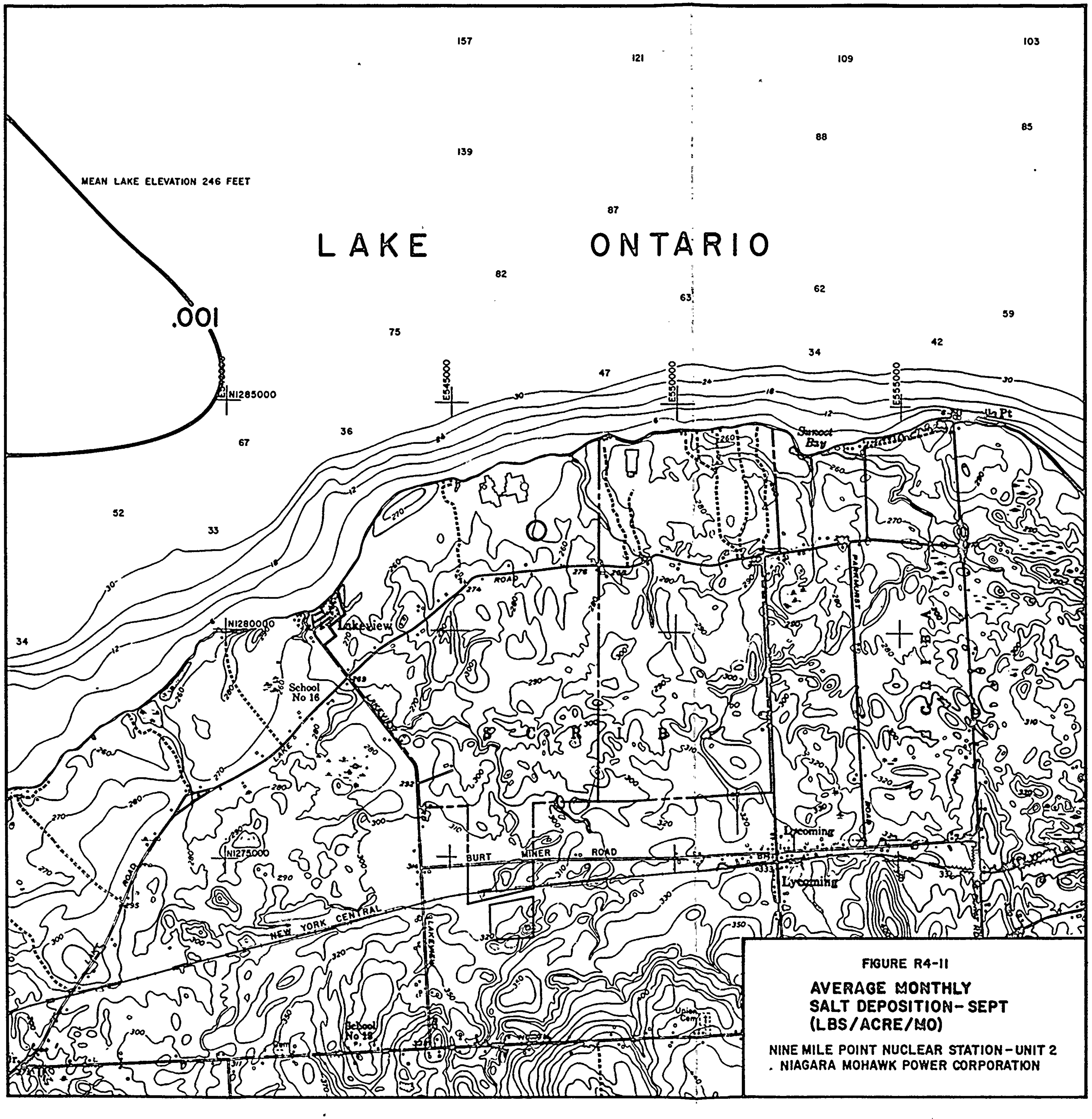



**FIGURE R4-11**

**AVERAGE MONTHLY SALT DEPOSITION-SEPT (LBS/ACRE/MO)**

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION


FIGURE R4-12

**AVERAGE MONTHLY SALT DEPOSITION-OCT (LBS/ACRE/MO)**

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION


FIGURE R4-13

**AVERAGE MONTHLY SALT DEPOSITION-NOV (LBS/ACRE/MO)**

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

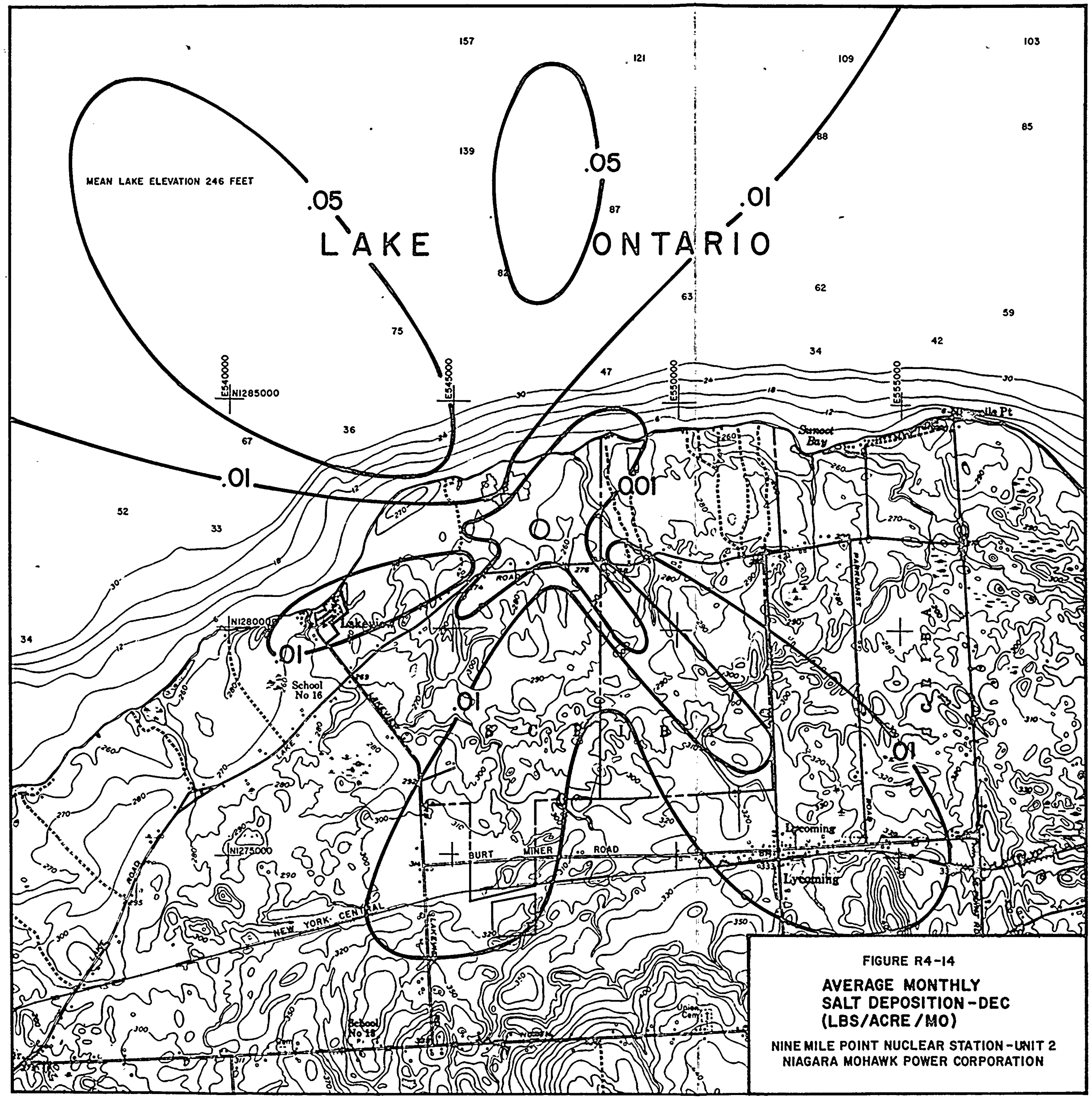



FIGURE R4-14

AVERAGE MONTHLY SALT DEPOSITION - DEC (LBS/ACRE/MO)

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION

## Request 5

Substantiate that the Kaylor, Petrillo, and Tsai plume model, your reference 7, is applicable for use at this Site and with this proposed cooling system. Include in your discussion whether the values of your input data (tower characteristics and meteorological variables) are within the range of data used to formulate the model.

## Response

The Kaylor, Petrillo, and Tsai plume model is applicable to any natural draft or mechanical draft tower including the Unit 2 cooling tower for this Site. The general applicability of the model results from using tower-specific information as input data to the model. Performance data, such as exit air velocity and temperature, are provided to the model as a function of the ambient meteorological conditions. Also, the basic equations used to formulate the model are applicable for any expected range of values of the meteorological parameters. Therefore, the values of the input data to the model are not restricted to a specific range of data used to formulate the model.

A validation of the Kaylor, Petrillo, and Tsai plume model was recently made by Argonne National Laboratory[1]. Field data at the Paradise and Chalk Point cooling towers were used for the model and data comparison of plume behavior. As a result of this validation, it was pointed out that plume length and plume height predicted by this model appear reasonable and acceptable in terms of model performance.

## Reference

1. Policastro, A. J., Carhart, R. A., and DeVantier, B., "Validation of Selected Mathematical Models for Plume Dispersion from Natural-Draft Cooling Towers," Argonne National Laboratory, presented at Waste Heat Management and Utilization Conference, Miami Beach, May 9-11, 1977.

Request 6

Substantiate that the use of your referenced Rochester data are applicable for drift and plume predictions at the Nine Mile Point Site. Include in your discussion a comparison of Rochester data (dry and wet-bulb temperatures, wind speed, and direction) with data collected onsite during a concurrent period.

Response

The Rochester data was originally used for preliminary drift and plume predictions because sufficient onsite data was not available. Three years of onsite data are now available, and the drift and plume predictions have been revised using the onsite data. These results are presented in response to Requests 4 and 7.

Request 7

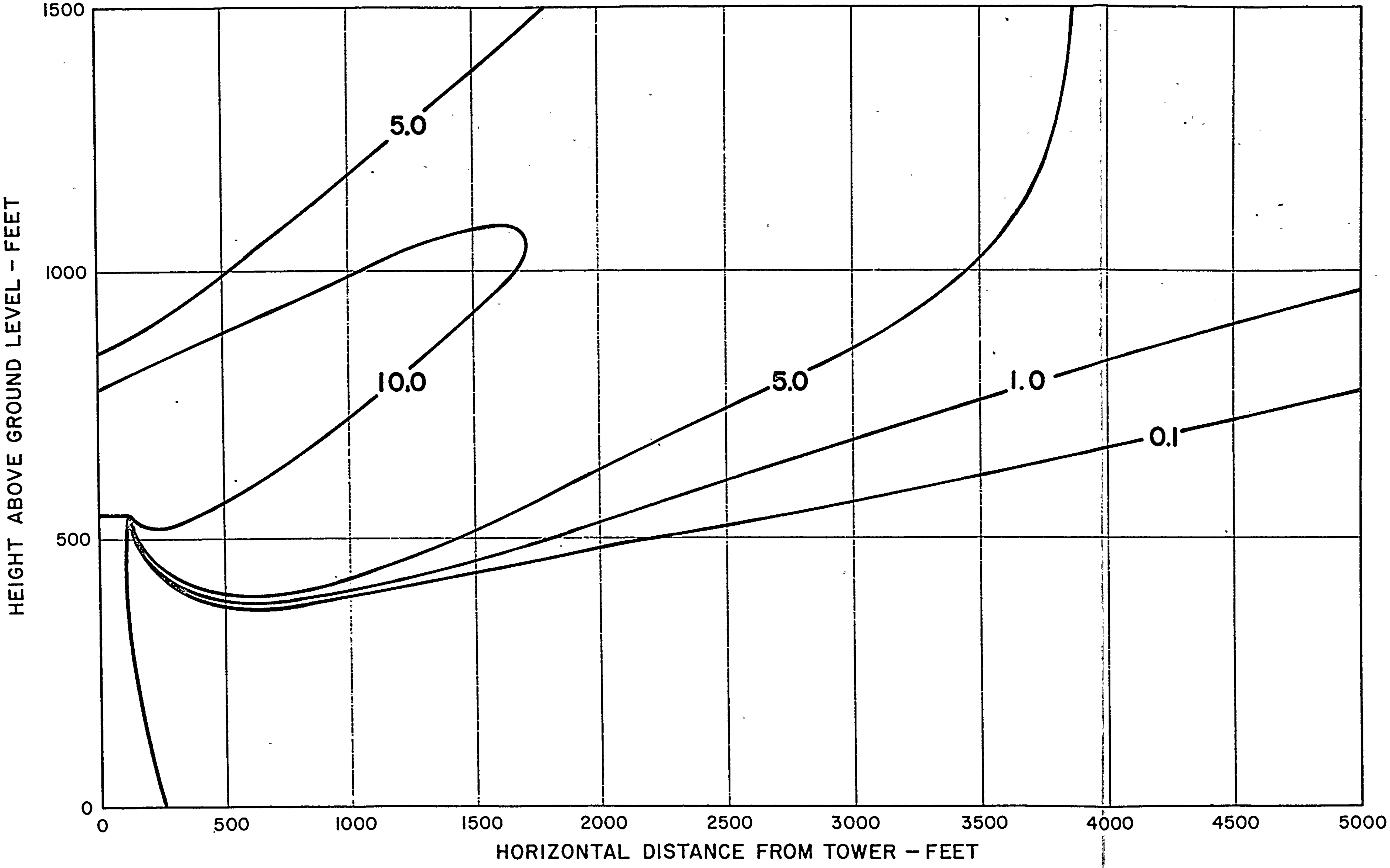
In addition to Figures 8 through 12, Predicted Annual Plume Lengths, provide figures showing monthly or seasonal elevated plume lengths.

Response

The visible plume model used to produce Figures 8 to 12 was run with revised cooling tower characteristics described in Request 1 and three years of onsite meteorological data from January 1, 1974, to December 31, 1976.

The meteorological input data used in the model consisted of wind speed, wind direction, dry-bulb temperature, wet-bulb temperature, and relative humidity at the 200 foot level. In order to ensure that greater than 90 percent of the 3 year data base would be used, the 100 foot wind direction was substituted for the 200 foot wind direction when it was missing. This procedure does not significantly alter the visible plume results since the change in wind direction with height is very small between these levels.

Figures 7-1 through 7-25 provide the percent of time that a visible plume is predicted to occur within 5000 feet of the natural draft cooling tower for each wind direction quadrant and for all wind directions combined for each season of the year and for the entire year. These contours do not represent individual plume outlines, but the combination of many individual plumes, in order to show the maximum vertical and horizontal extent of the visible plume for each given frequency of occurrence.




NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

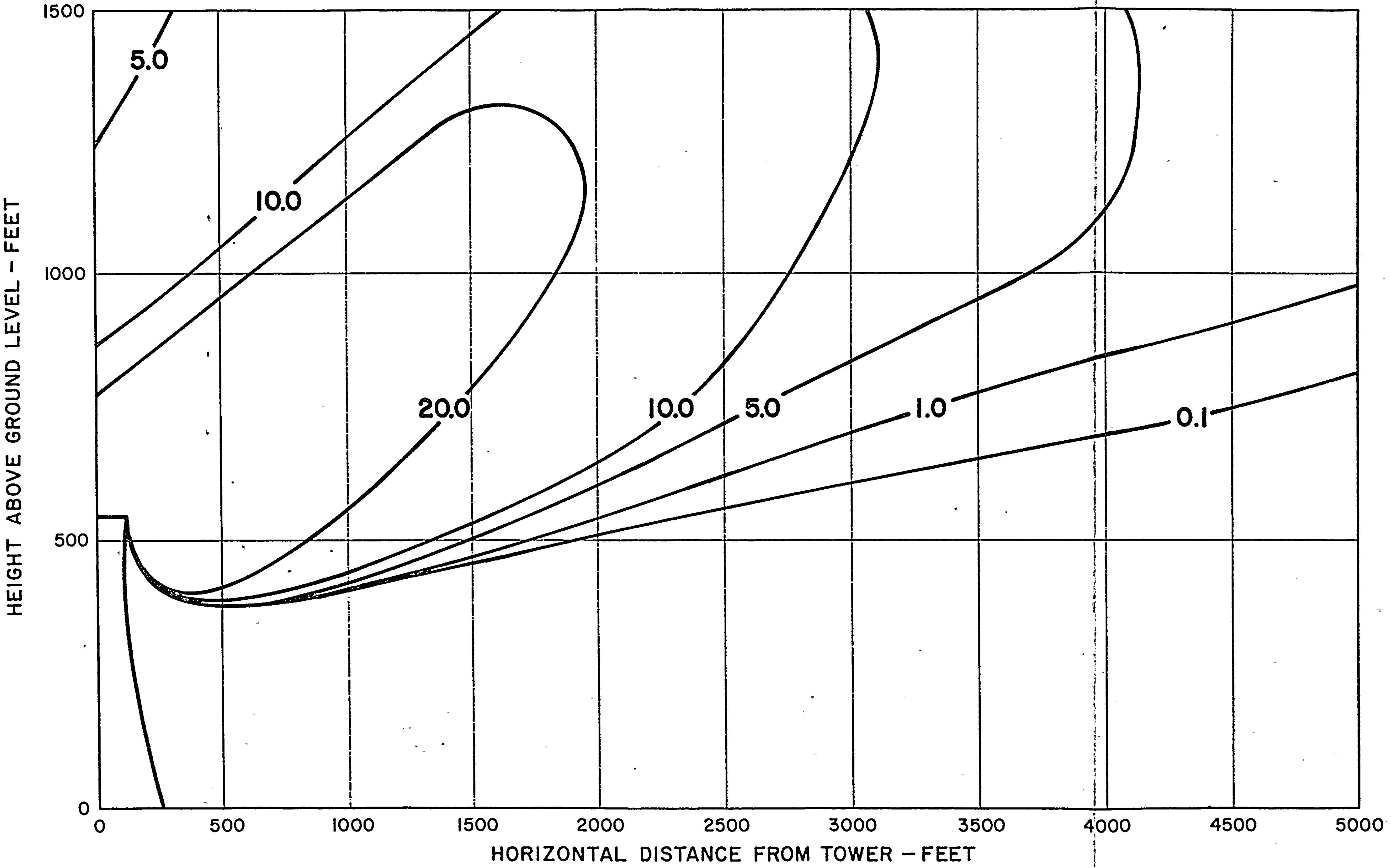
FIGURE R7-1

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR N, NNE, NE, ENE WIND DIRECTIONS-WINTER

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2

NIAGARA MOHAWK POWER CORPORATION




NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

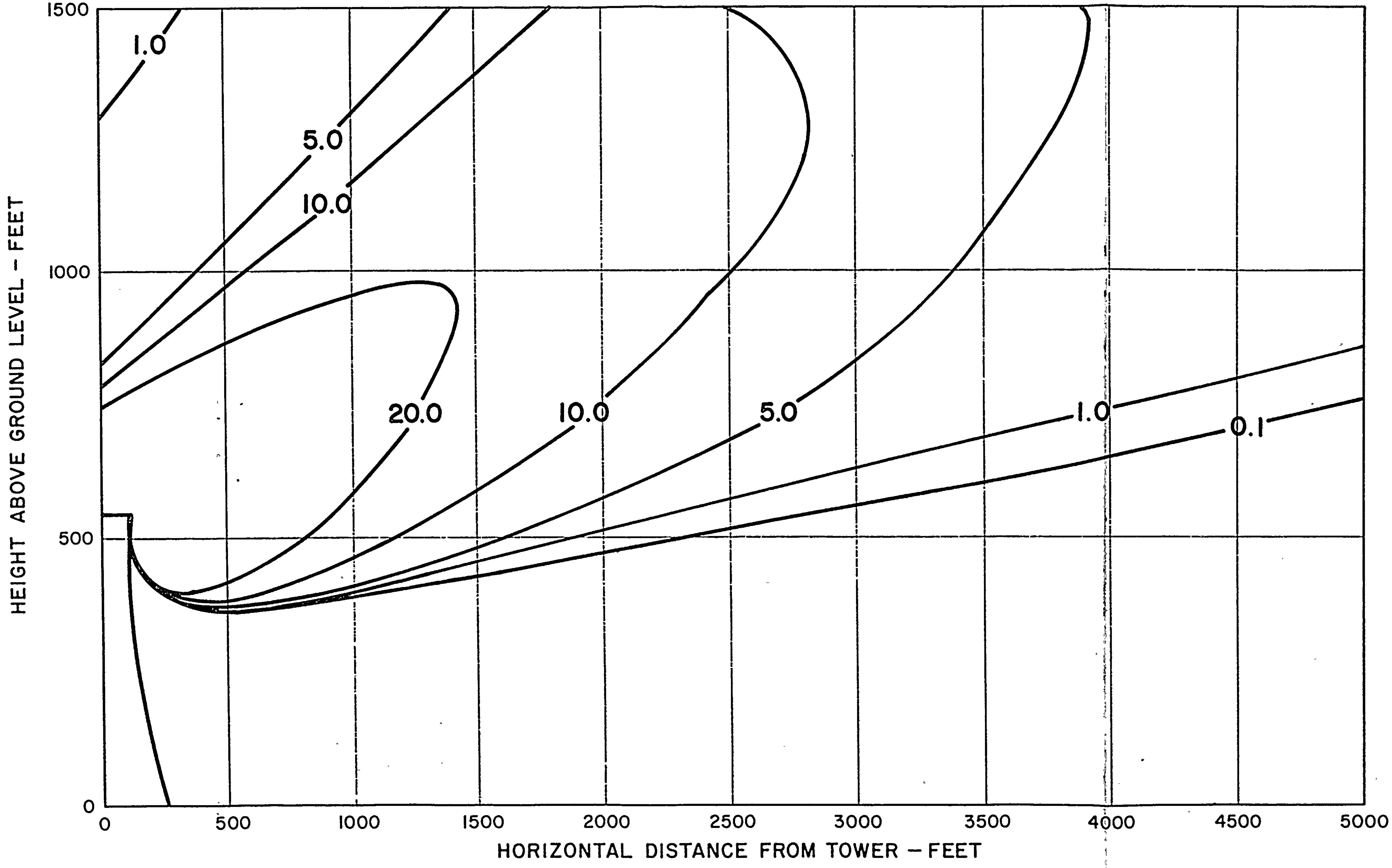
FIGURE R7-2

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR E, ESE, SE, SSE WIND DIRECTIONS-WINTER

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2

NIAGARA MOHAWK POWER CORPORATION




NOTE:

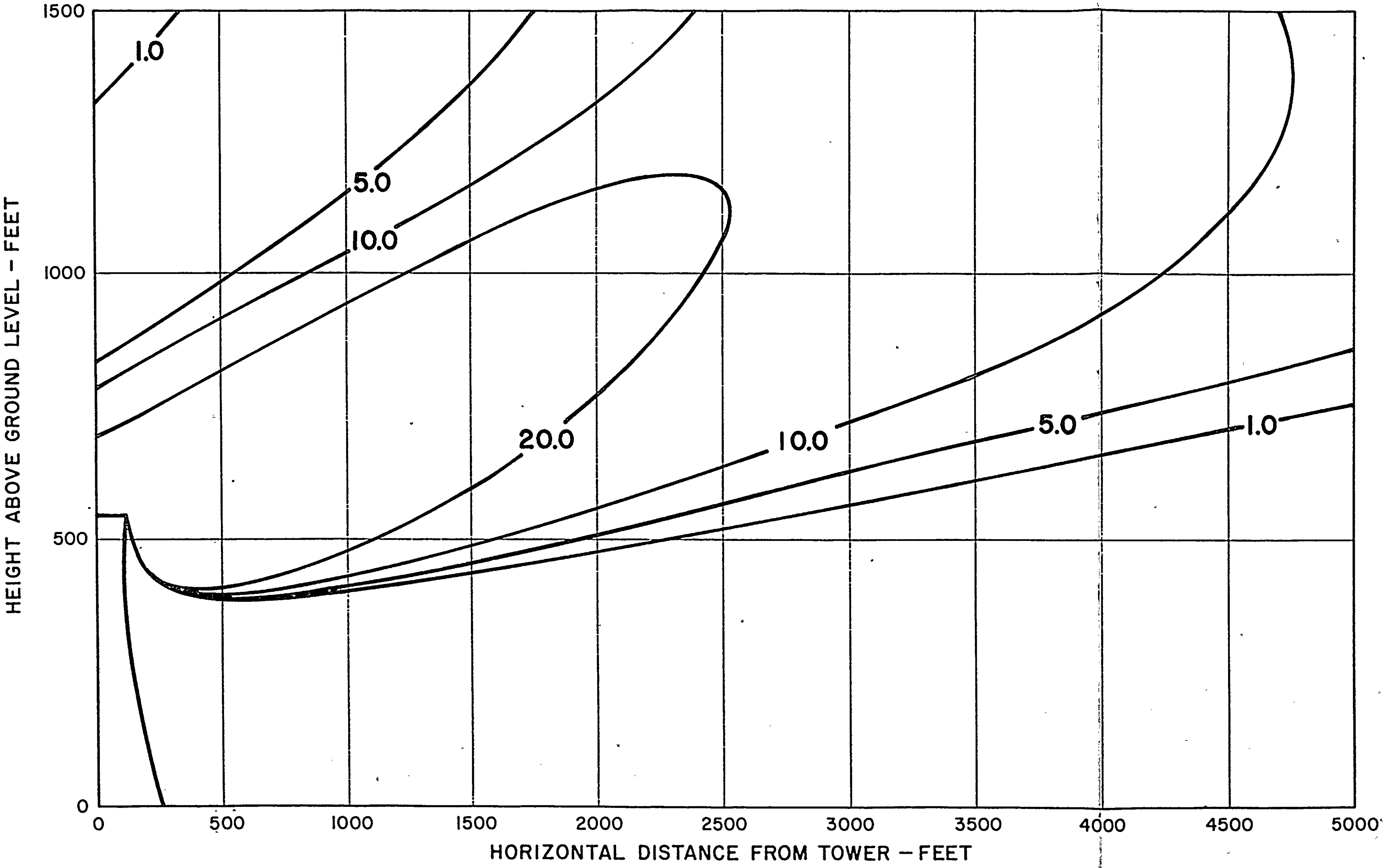
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-3

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR S, SSW, SW, WSW WIND DIRECTIONS - WINTER

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

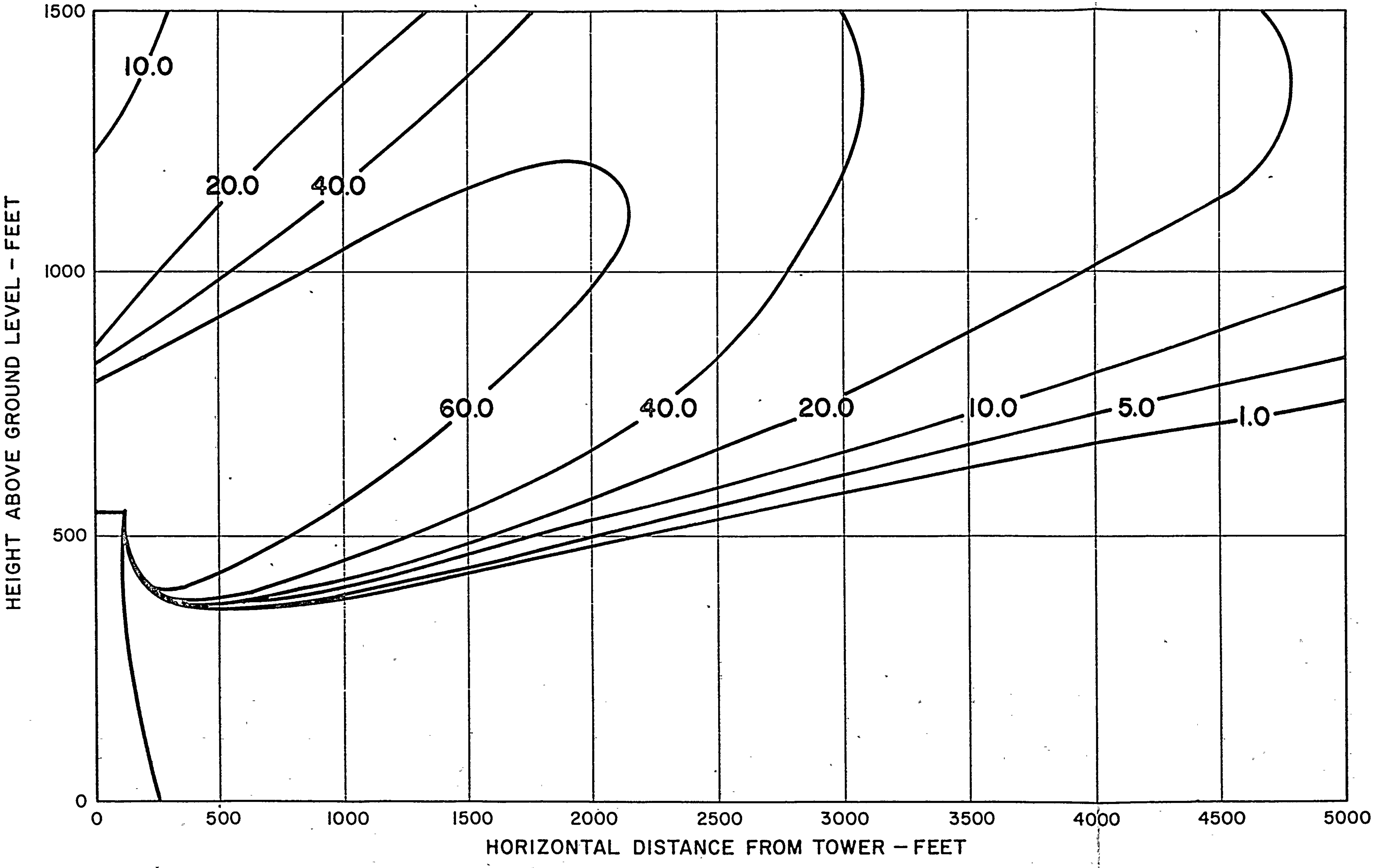
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-4

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR W, WNW, NW, NNW WIND DIRECTIONS-WINTER

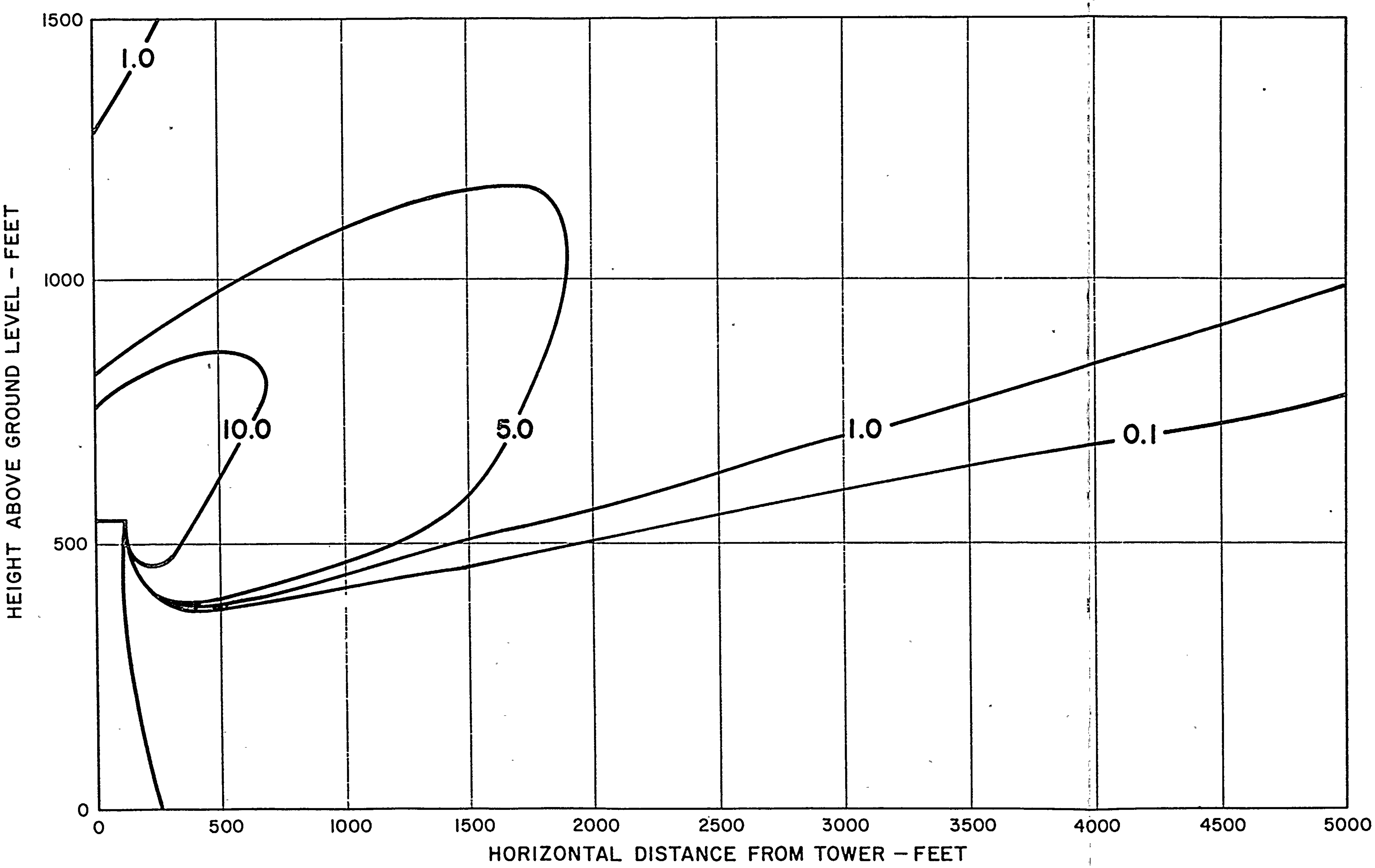
NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-5
PREDICTED FREQUENCY OF PLUME OCCURRENCE
FOR ALL WIND DIRECTIONS - WINTER
NATURAL DRAFT COOLING TOWER
NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

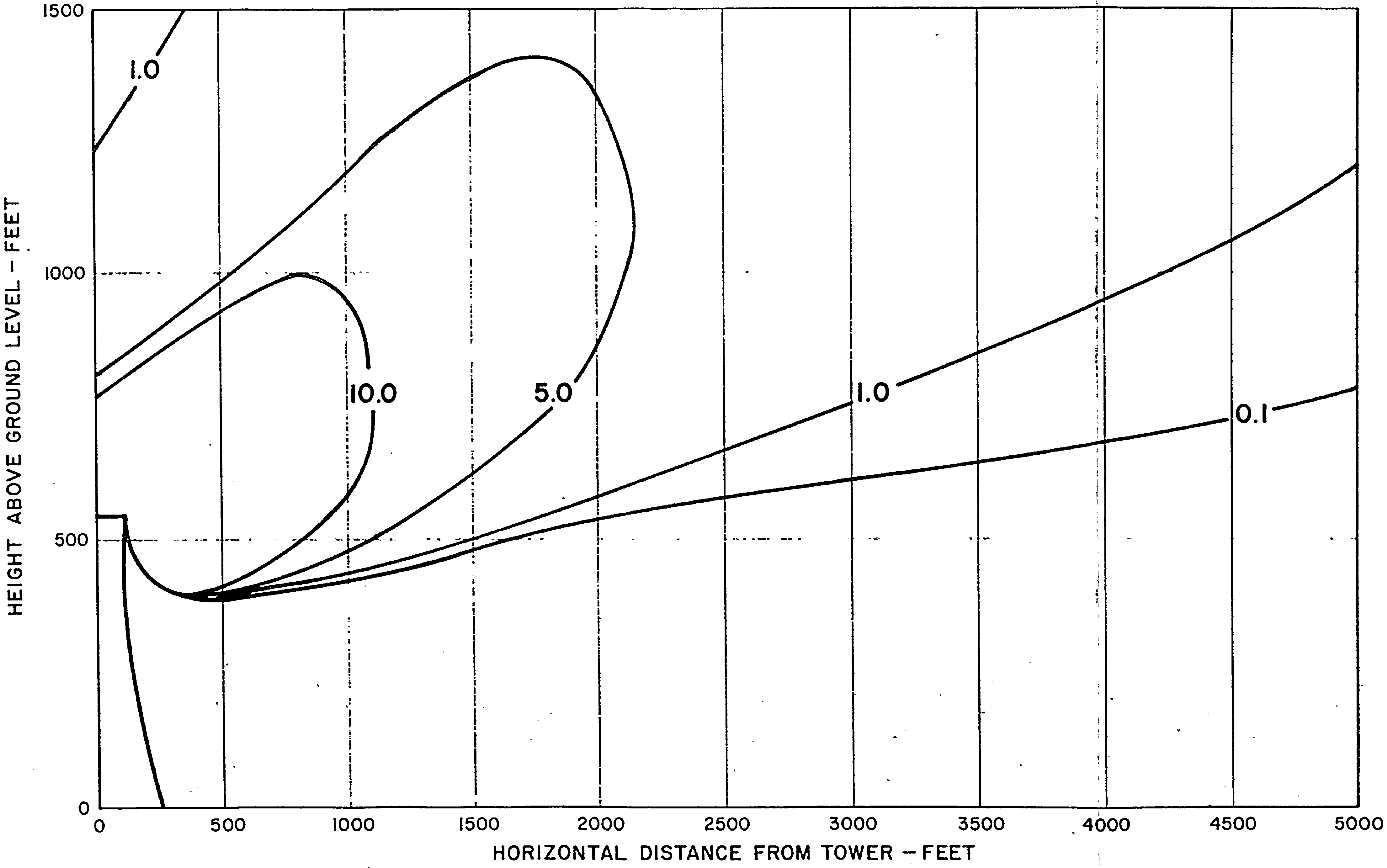
FIGURE R7-6

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR N, NNE, NE, ENE WIND DIRECTIONS - SPRING

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2

NIAGARA MOHAWK POWER CORPORATION



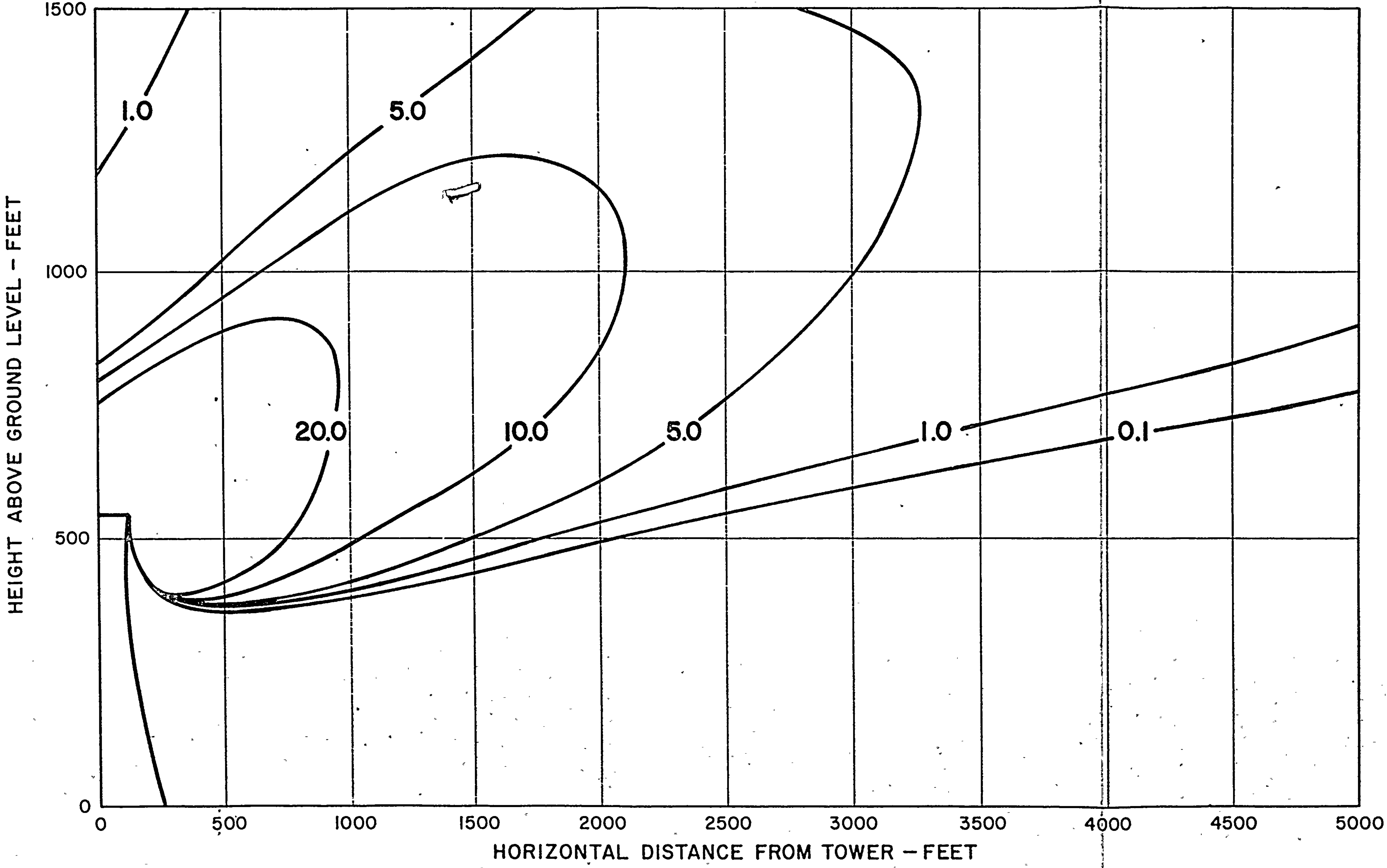

NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-7

PREDICTED FREQUENCY OF PLUME OCCURRENCE
FOR E, ESE, SE, SSE WIND DIRECTIONS-SPRING
NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION



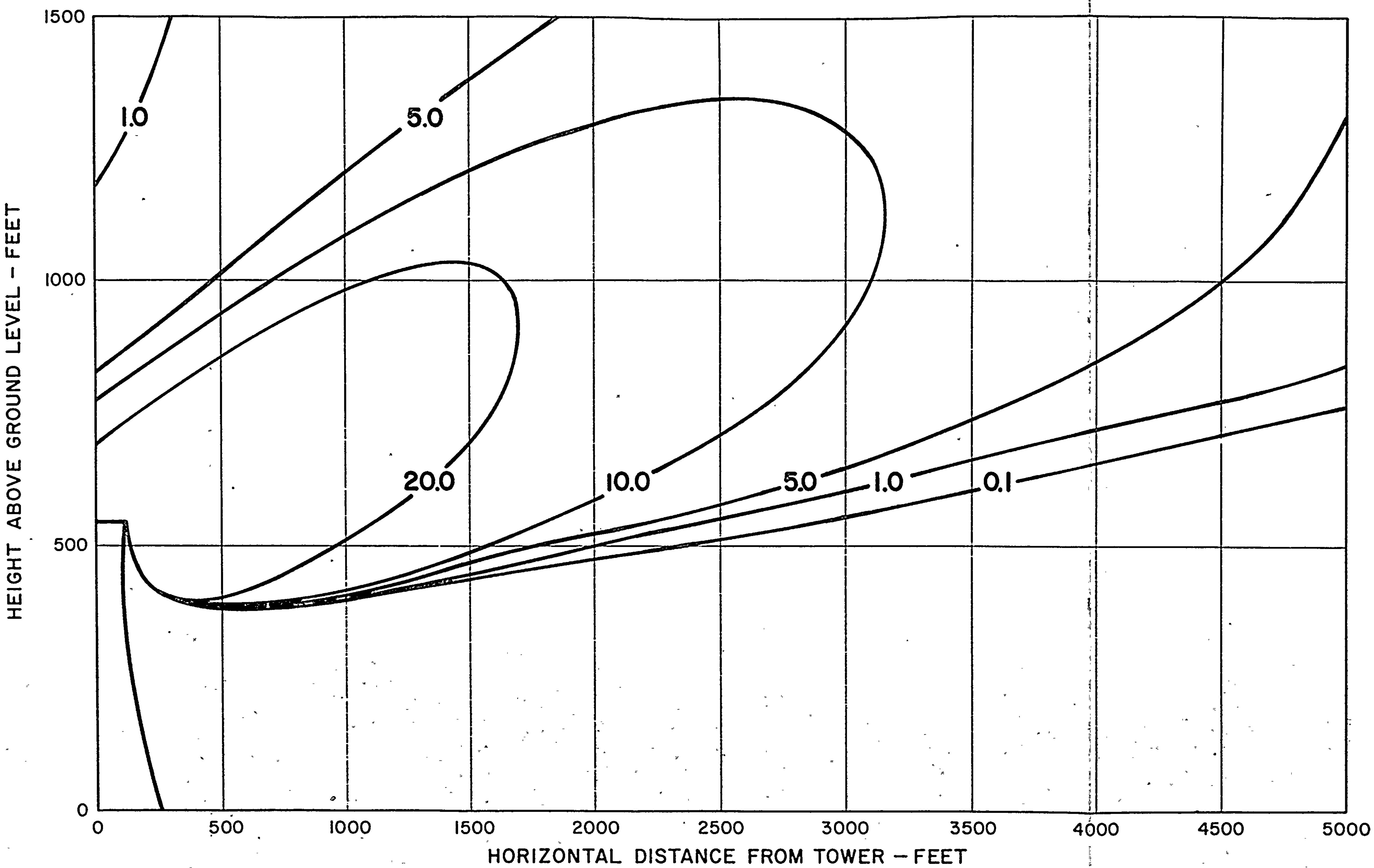

NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-8

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR S, SSW, SW, WSW WIND DIRECTIONS-SPRING NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

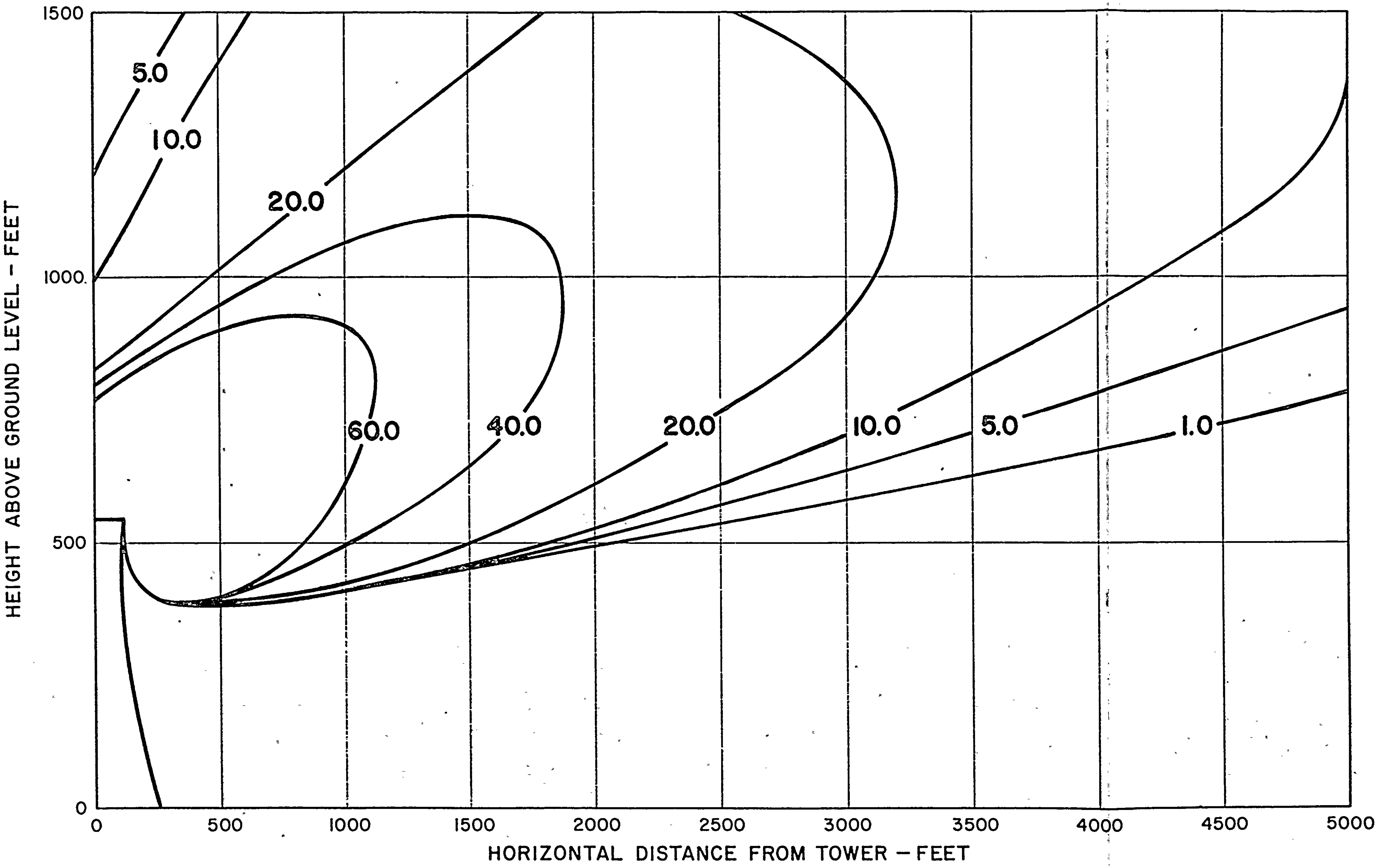
FIGURE R7-9

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR W, WNW, NW, NNW WIND DIRECTIONS-SPRING

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2

NIAGARA MOHAWK POWER CORPORATION




NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-10

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR ALL WIND DIRECTIONS-SPRING

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION – UNIT 2
NIAGARA MOHAWK POWER CORPORATION

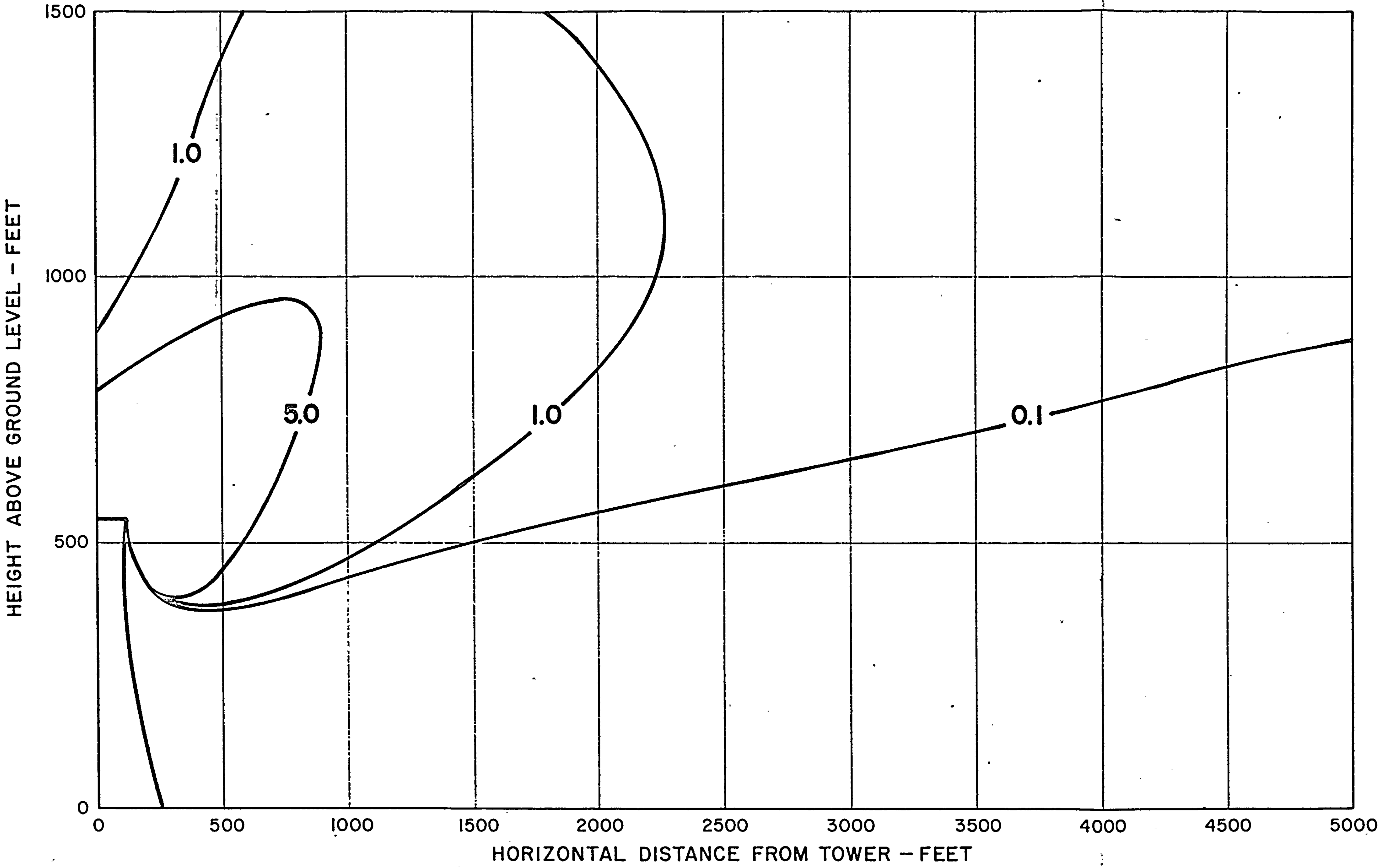
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]




NOTE:

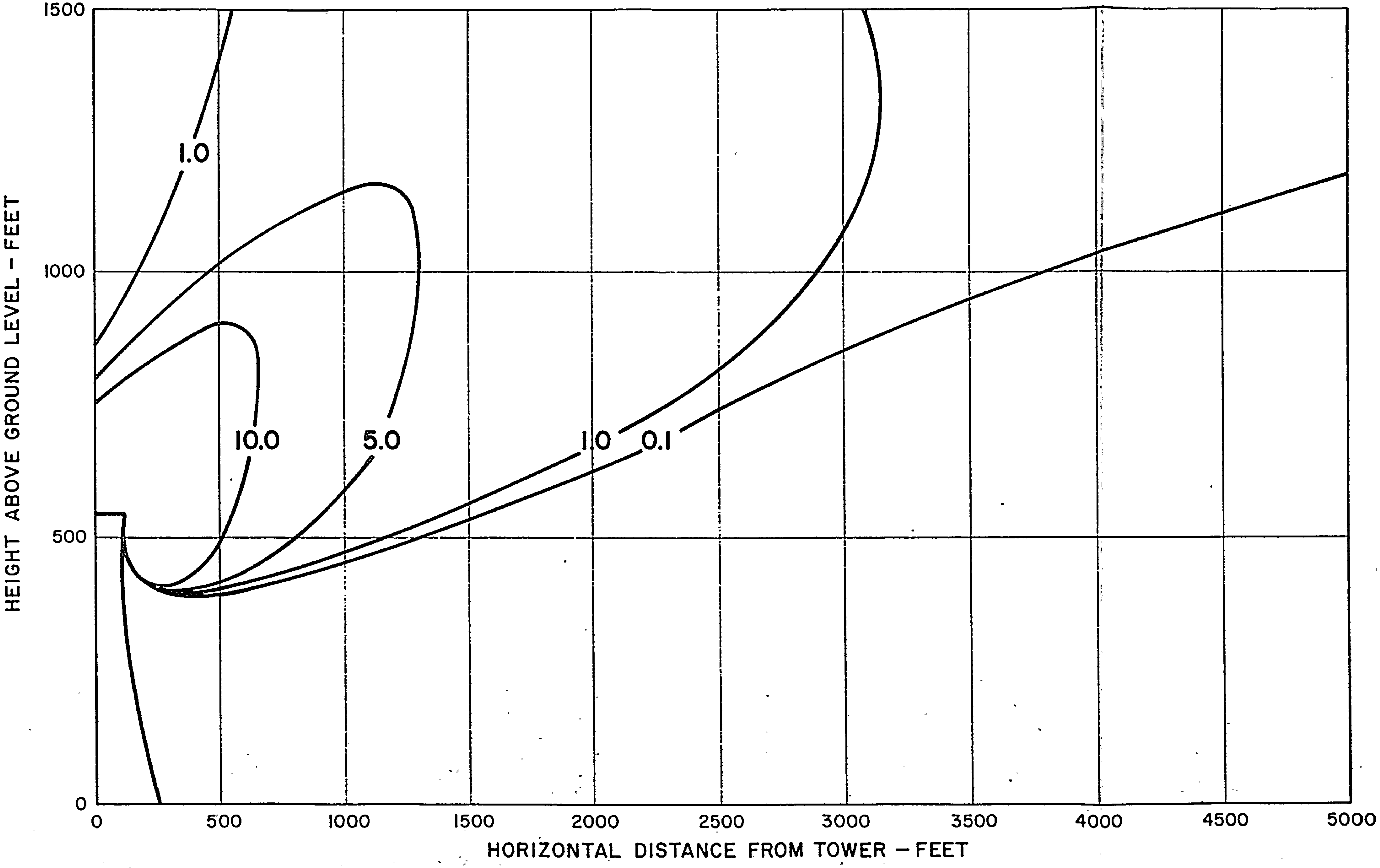
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-11

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR N, NNE, NE, ENE WIND DIRECTIONS-SUMMER

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

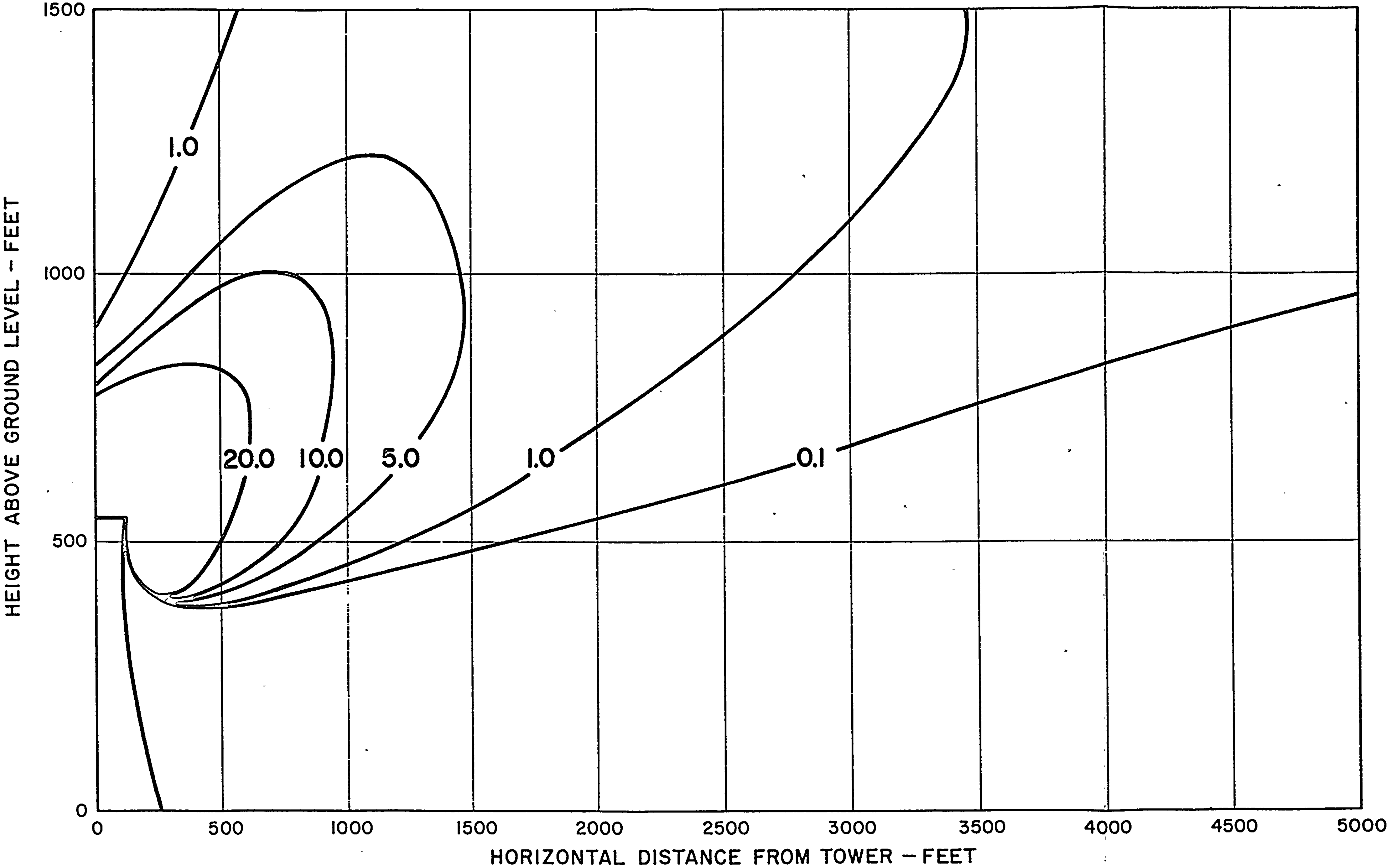
FIGURE R7-12

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR E, ESE, SE, SSE WIND DIRECTIONS - SUMMER

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2

NIAGARA MOHAWK POWER CORPORATION




NOTE:

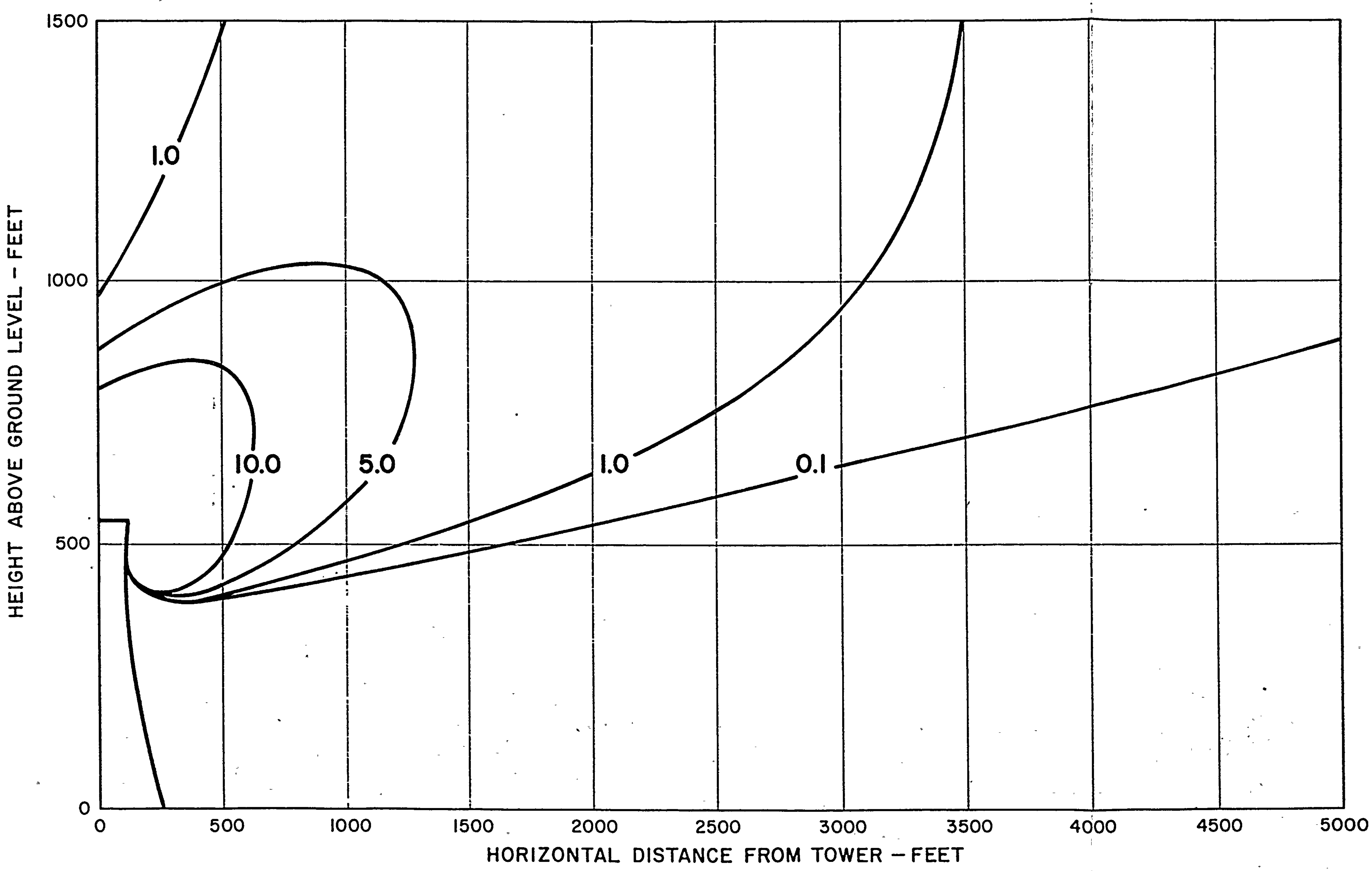
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-13

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR S, SSW, SW, WSW WIND DIRECTIONS-SUMMER

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

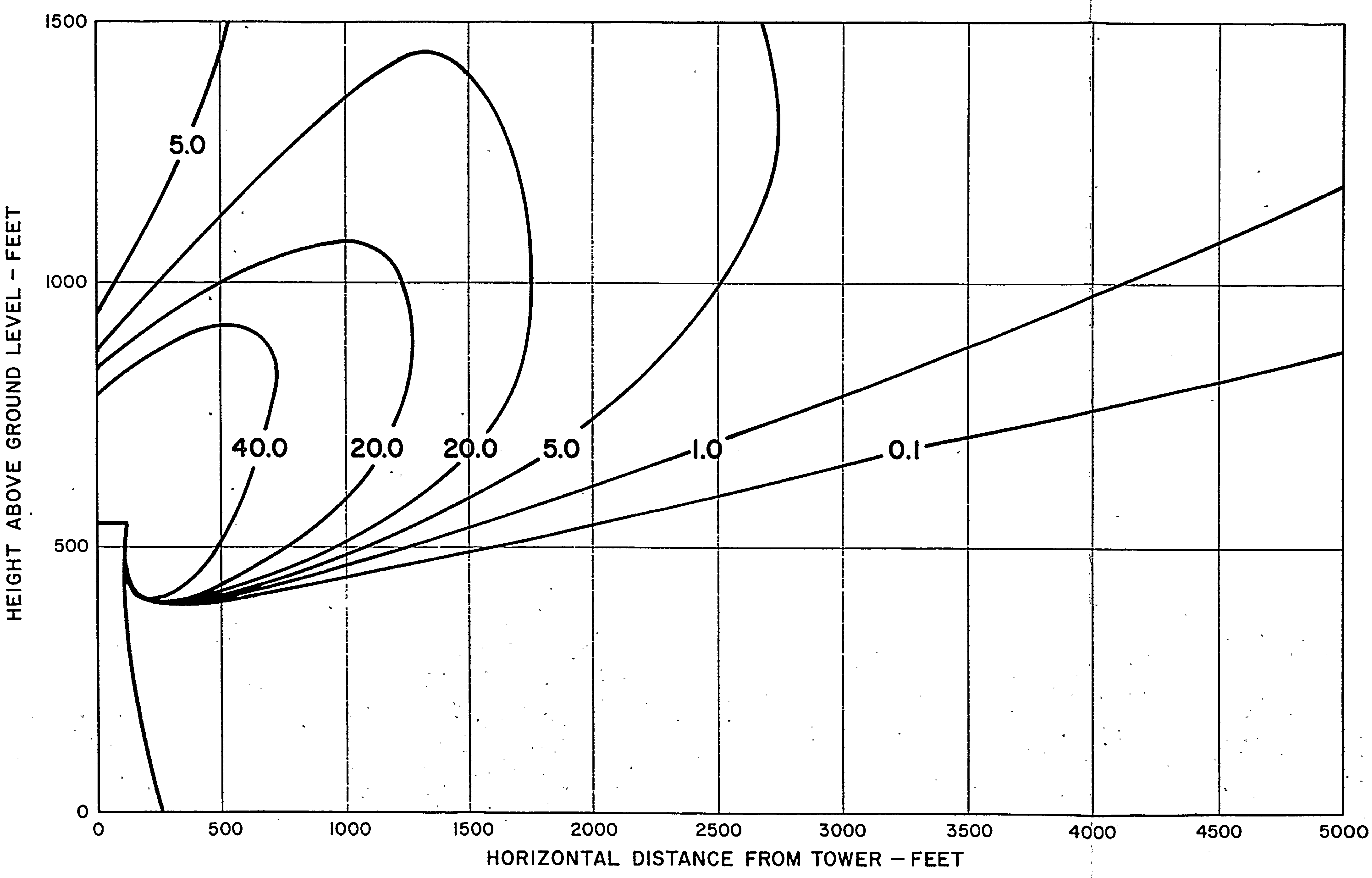
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-14

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR W, WNW, NW, NNW WIND DIRECTIONS-SUMMER

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION — UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

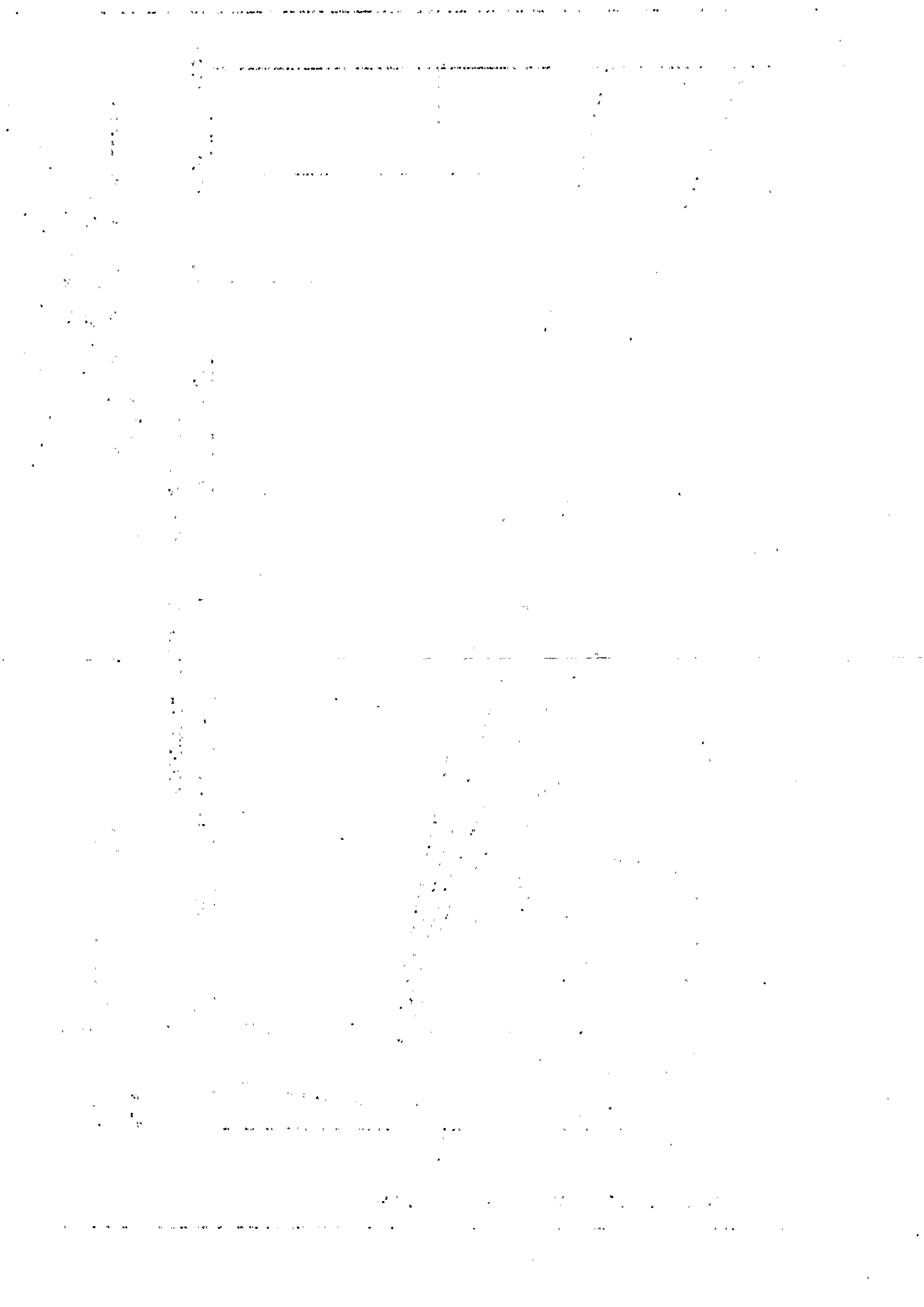
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

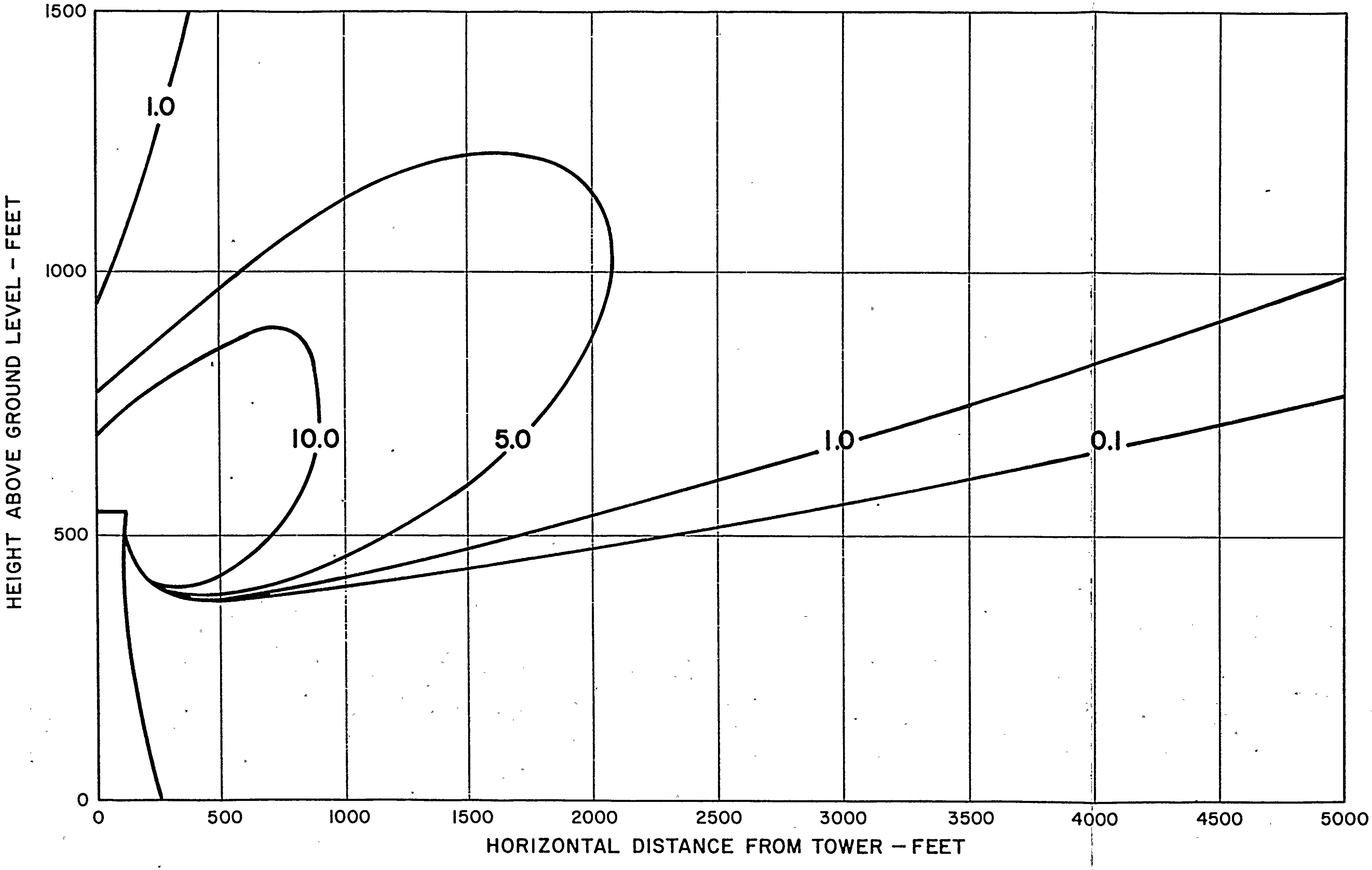
FIGURE R7-15

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR ALL WIND DIRECTIONS - SUMMER

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION






NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

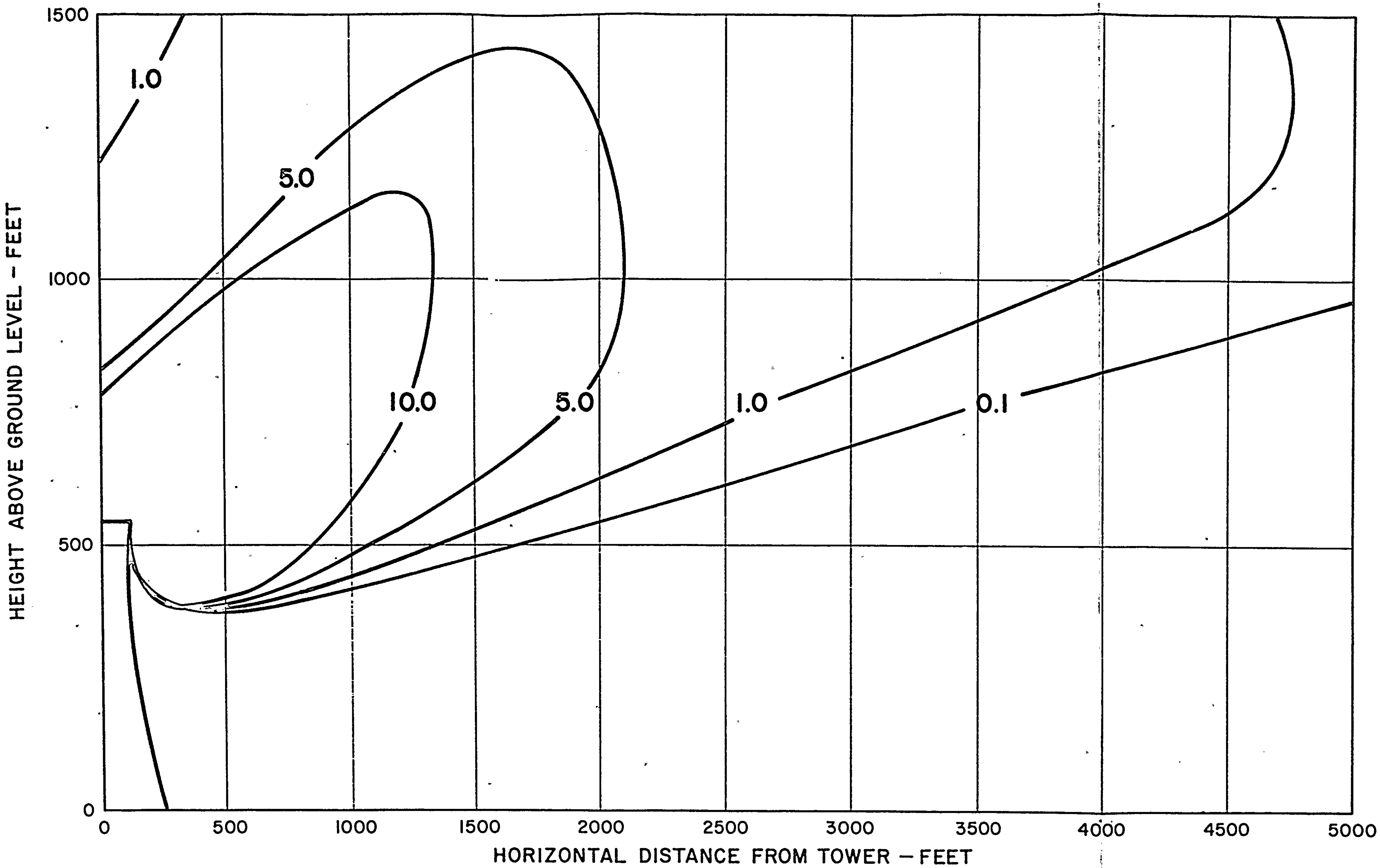
FIGURE R7-16

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR N, NNE, NE, ENE WIND DIRECTIONS-FALL

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION-UNIT 2

NIAGARA MOHAWK POWER CORPORATION




NOTE:

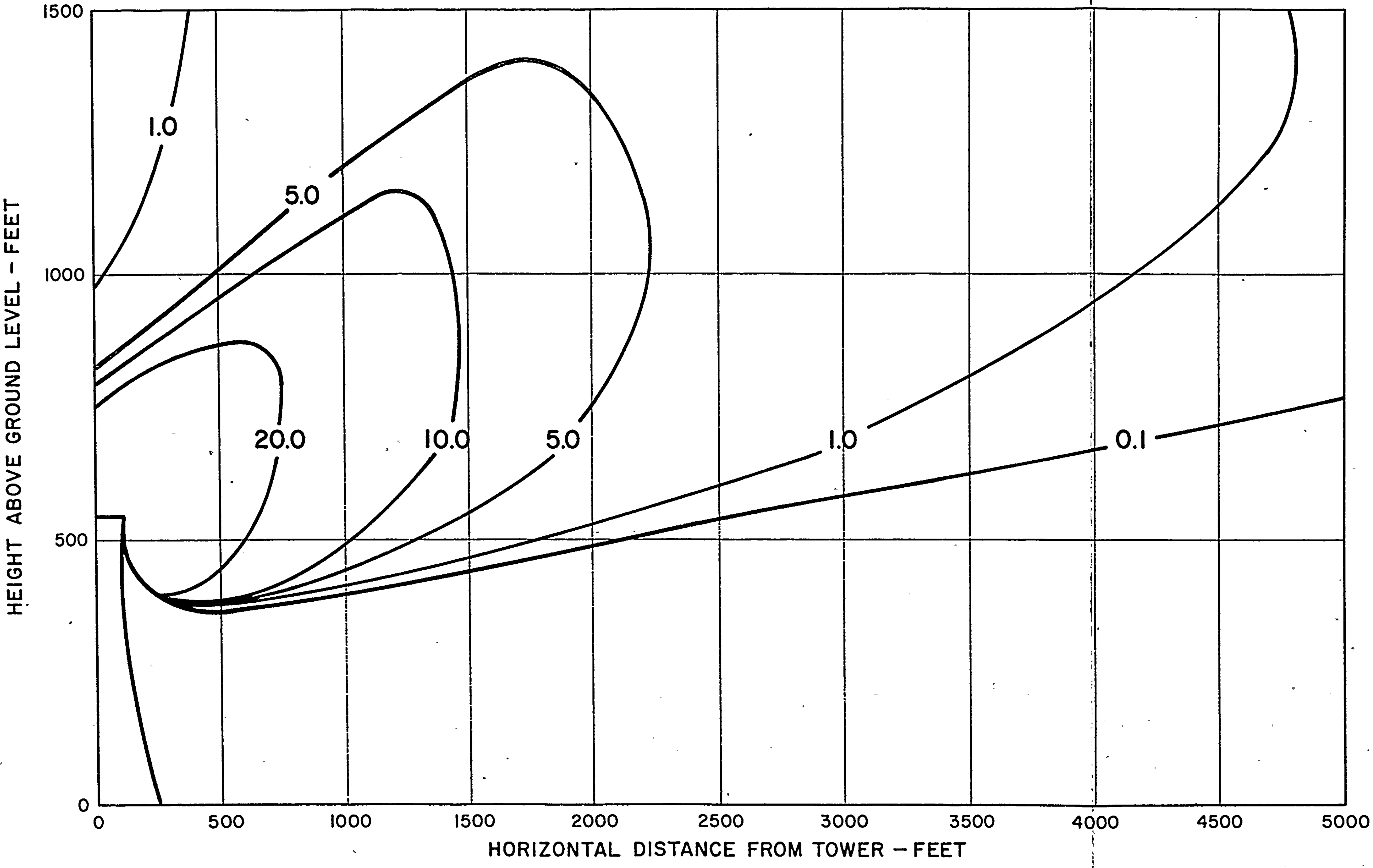
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-17

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR E,ESE,SE,SSE WIND DIRECTION-FALL

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

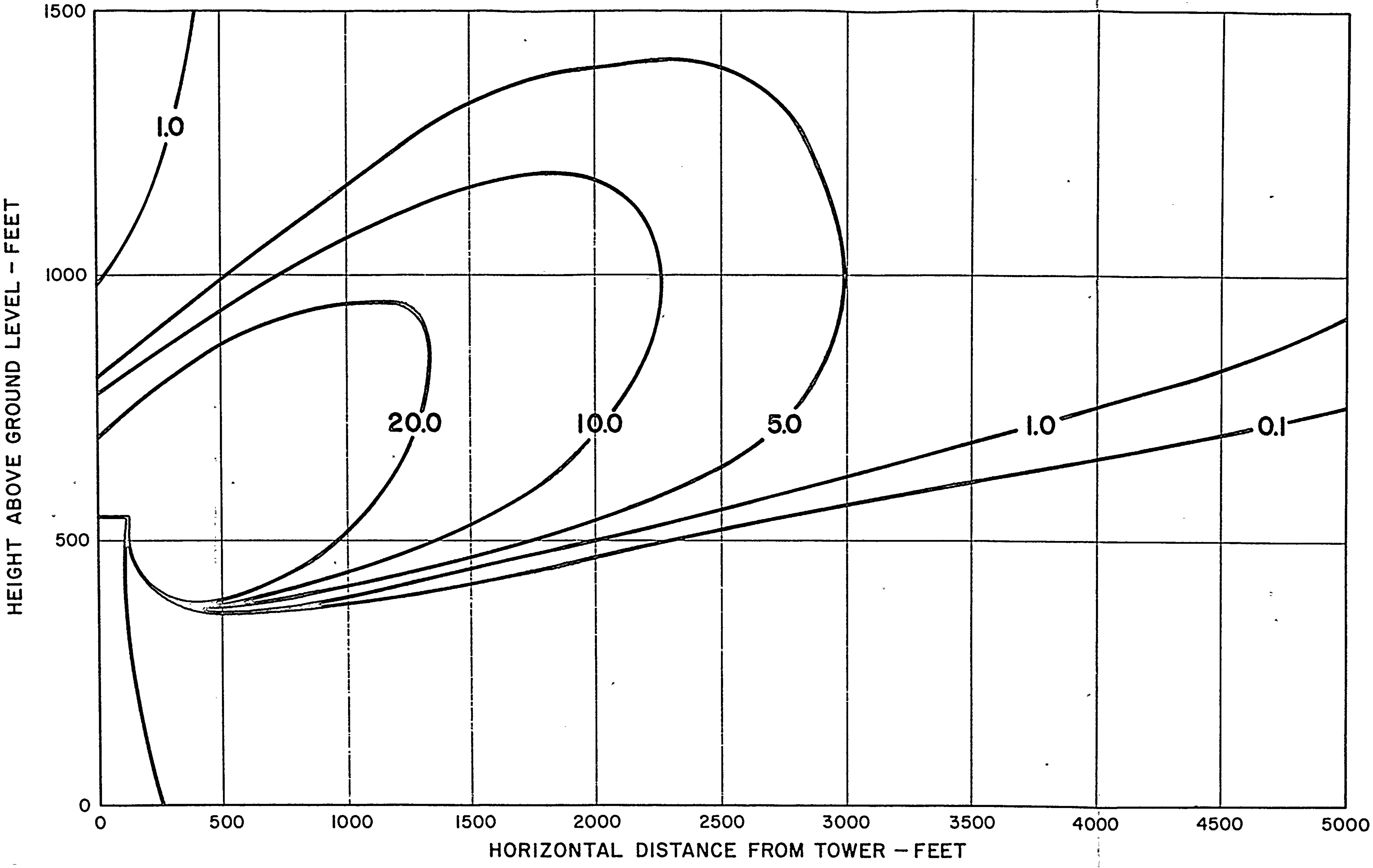
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-18

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR S, SSW, SW, WSW WIND DIRECTION - FALL

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

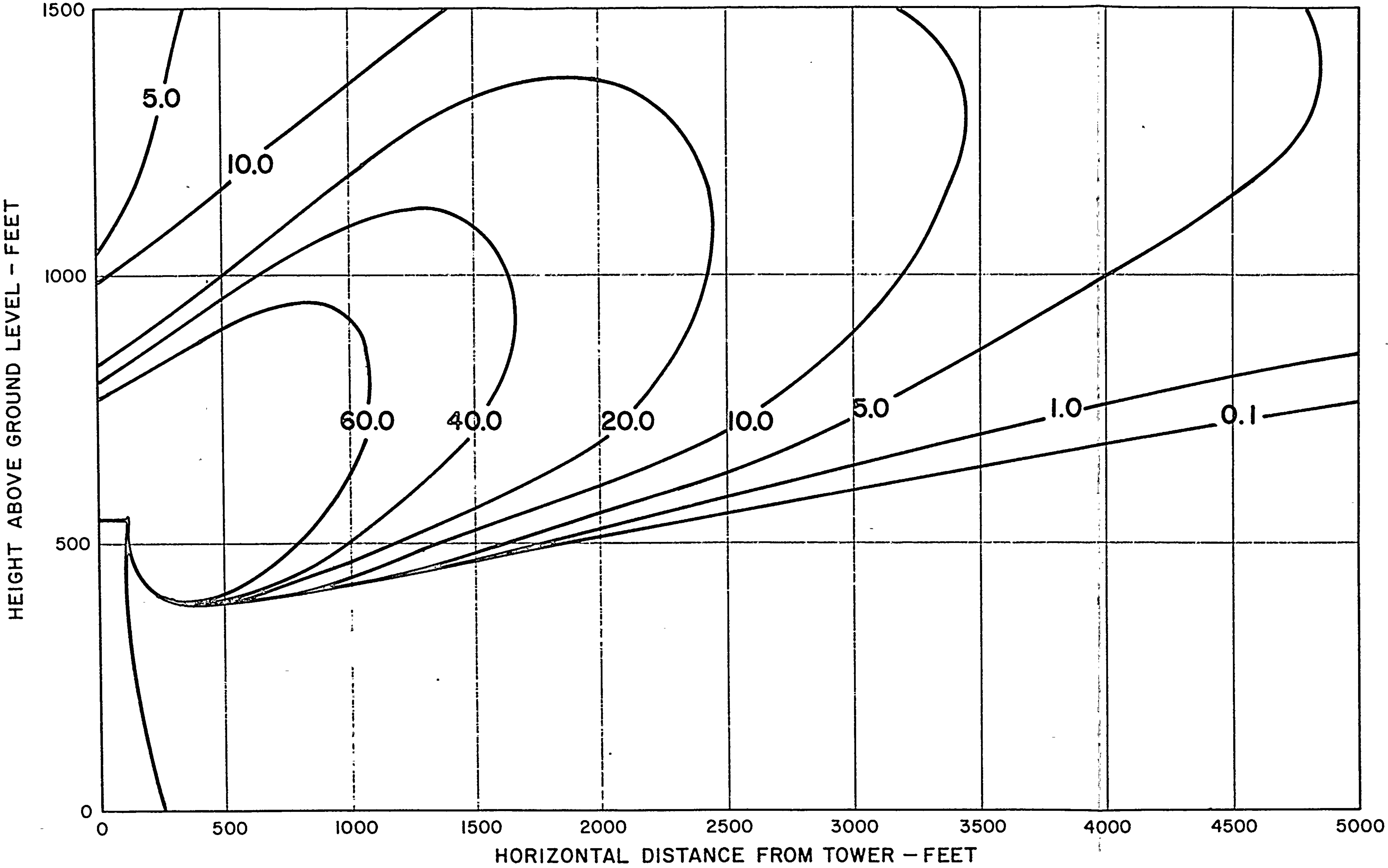
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-19

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR W, WNW, NW, NNW WIND DIRECTIONS-FALL

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

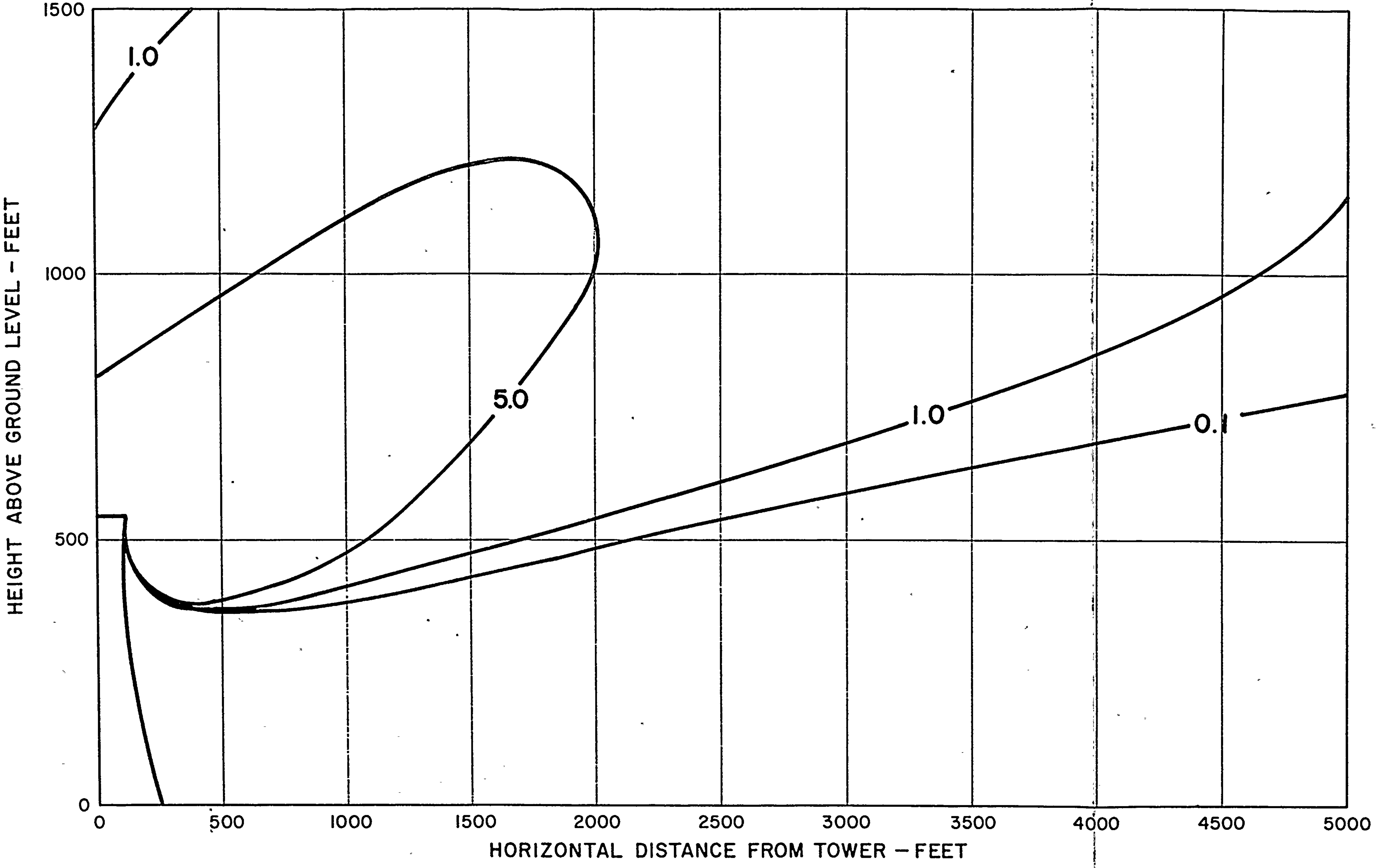
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-20

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR ALL WIND DIRECTIONS-FALL

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

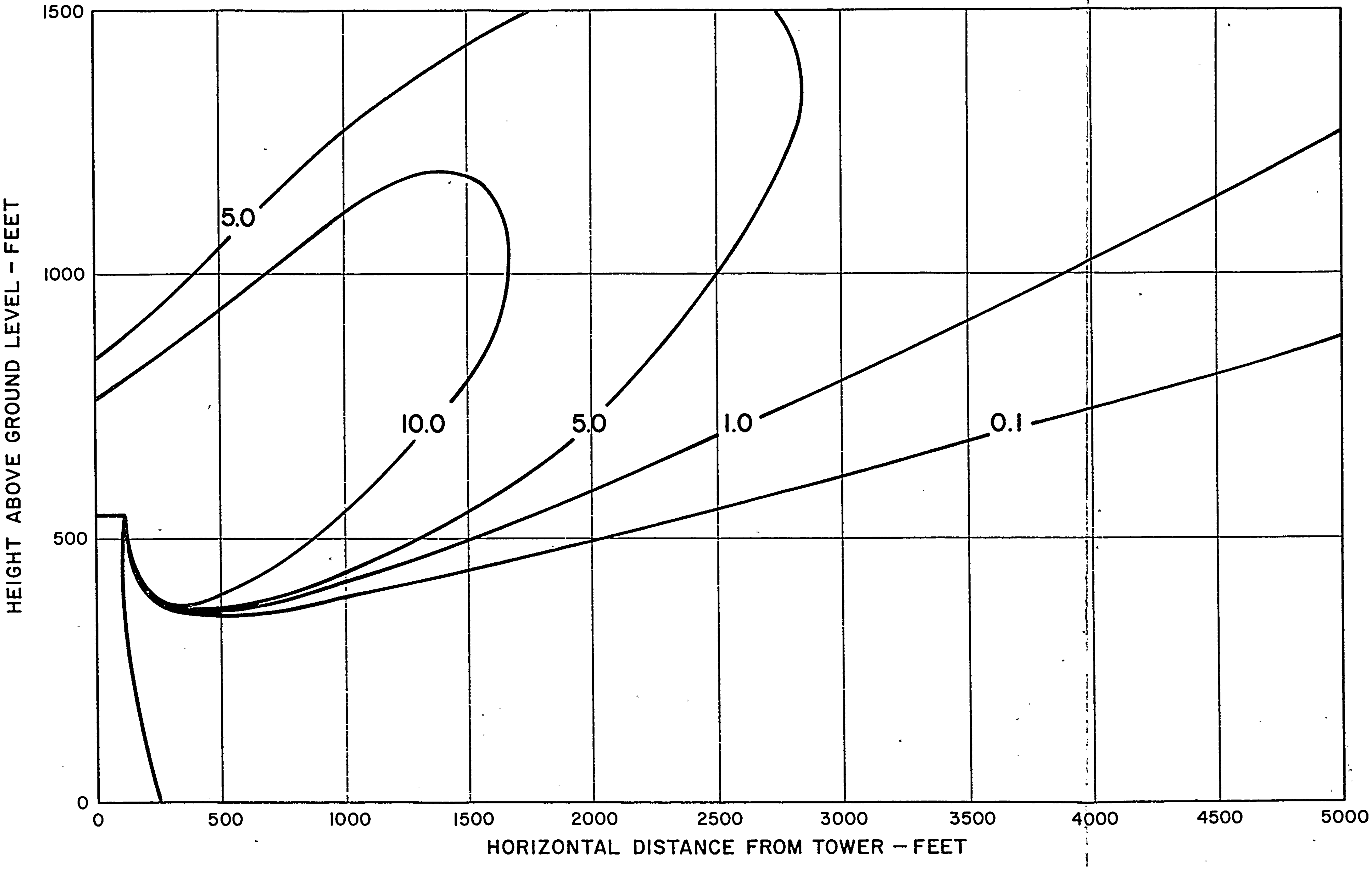
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-21

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR N, NNE, NE, ENE WIND DIRECTIONS - 3 YEARS

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

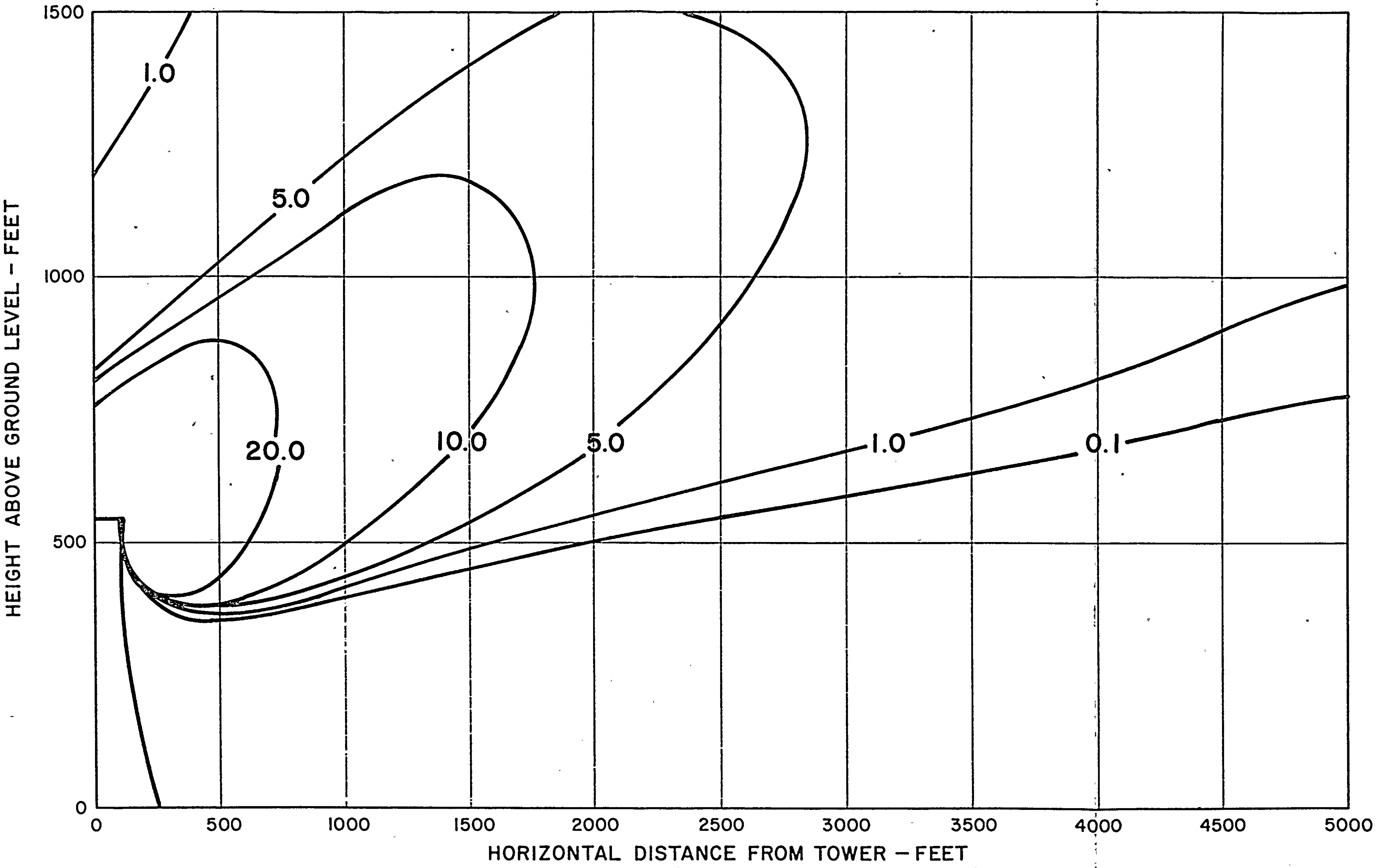
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-22

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR E, ESE, SE, SSE WIND DIRECTION - 3 YEARS

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION — UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

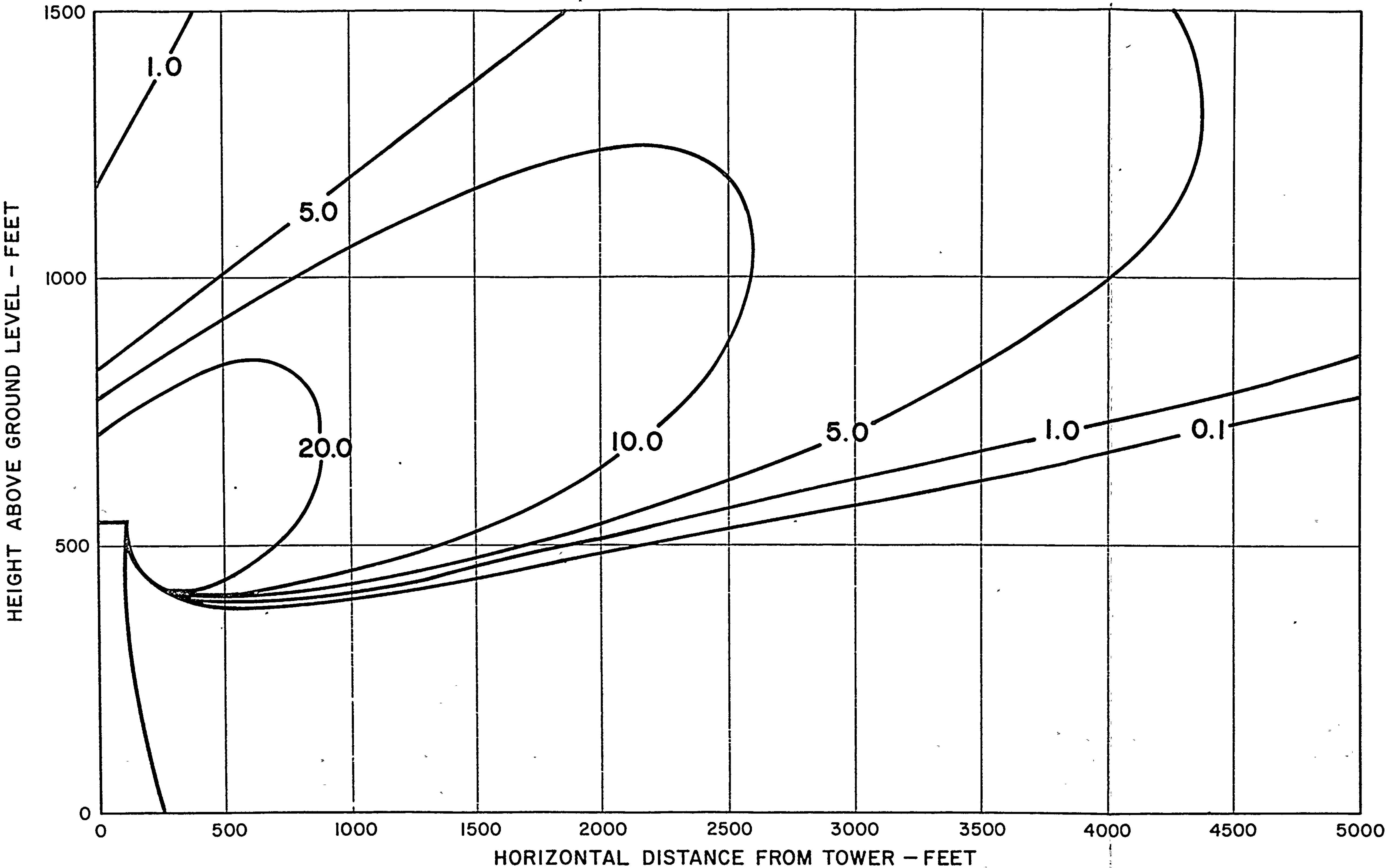
FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-23

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR S, SSW, SW, WSW WIND DIRECTIONS-3 YEARS

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION




NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

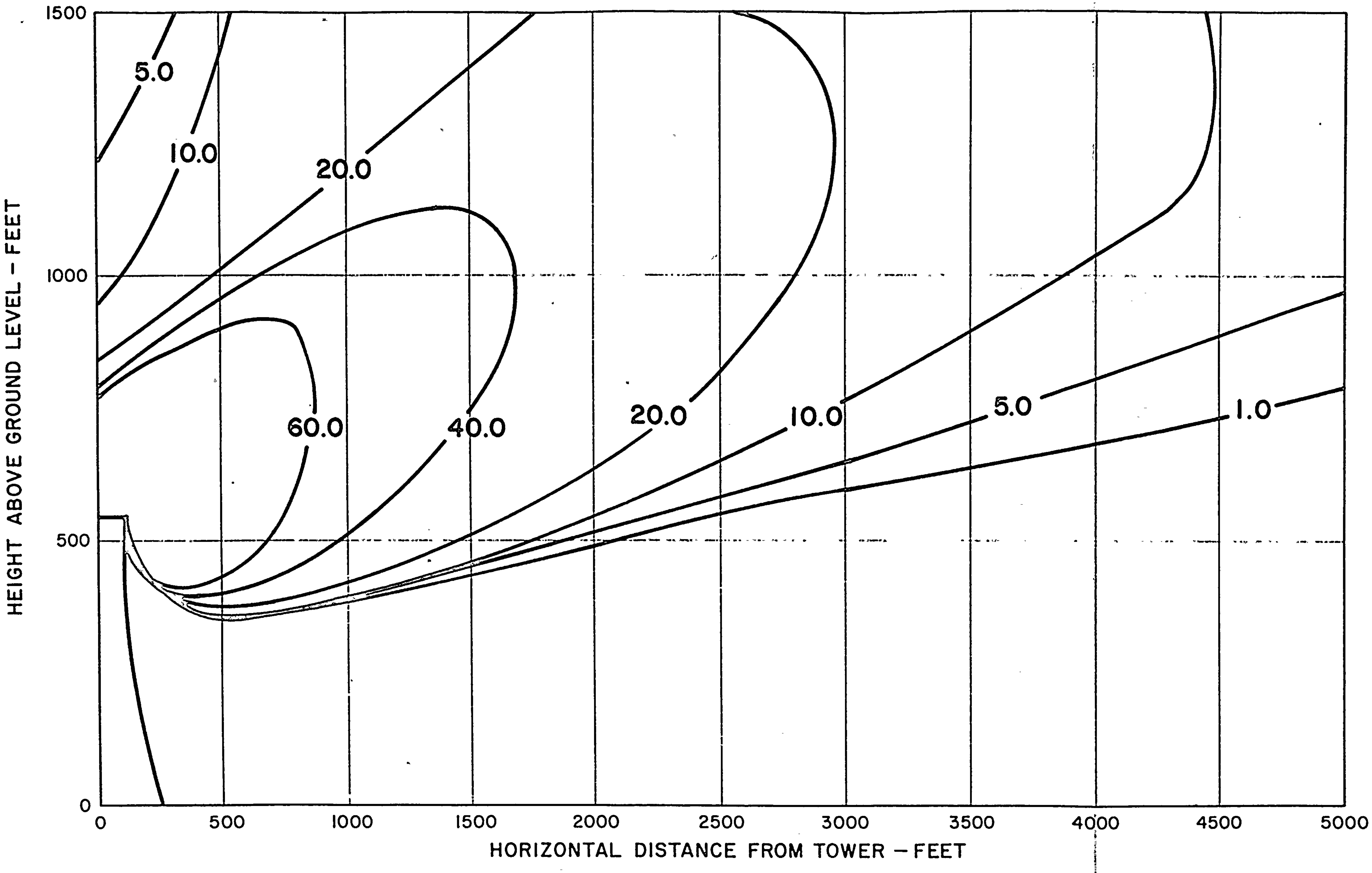
FIGURE R7-24

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR W, WNW, NW, NNW WIND DIRECTIONS - 3 YEARS

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION - UNIT 2

NIAGARA MOHAWK POWER CORPORATION




NOTE:

FIGURES DENOTE THE PERCENT OF TIME THAT VISIBLE PLUME EXTENDS TO CONTOUR.

FIGURE R7-25

PREDICTED FREQUENCY OF PLUME OCCURRENCE FOR ALL WIND DIRECTIONS - 3 YEARS

NATURAL DRAFT COOLING TOWER

NINE MILE POINT NUCLEAR STATION – UNIT 2
NIAGARA MOHAWK POWER CORPORATION

Request 8

Considering other local man-made thermal inputs to the atmosphere, discuss the potential for weather modification resulting from the addition of the Nine Mile Point system. Include additional precipitation, cloud formation and shadowing, and annual and monthly increase in humidity for nearby agricultural areas.

Response

The addition of the proposed natural draft cooling tower on the shore of Lake Ontario will create only modest changes in the shadowing of the underlying surface and possibly a small increase in precipitation, particularly during the winter months. Sufficient data are now available to rule out measurable changes in fog, humidity, temperature, and triggering of violent storms such as thunderstorms, squalls, or tornadoes.

Studies of actual plume behavior and environmental effects have been completed both in the U. S.[1,2,3] and in Europe[4]. These studies have shown the environmental effects to be negligible, except for shadowing and light precipitation.

The above studies indicated that the cooling tower plumes not only created some visible clouds, but may occasionally augment natural cloud formations. Near the Amos Plant in West Virginia[2,3], the maximum shadowing effect was found very close to the tower. In West Germany[4], four solar radiation monitors near a set of six forced draft and three natural draft towers showed a maximum increase in shadowing of 5 percent within 600 meters. Neither study suggested any significant change beyond 1000 meters.

The nearest gardens within five miles of the proposed cooling tower are listed in Table 8-1. The additional cloud formation and resultant shadowing potentially caused by the visible plumes will affect those sectors containing gardens only when the predicted plume lengths approach one mile or more. Refer to Response to Request 7. The shadowing of these gardens during the growing season solely due to the plume itself should not occur. Weather conditions conducive to long plumes on clear days occur in a winterlike environment. However, on naturally cloudy days, the cooling tower plumes may combine with natural clouds to shadow these nearby gardens. This effect should be negligible when compared with the effect of natural clouds.

Two research programs which were quite different in the way that precipitation was studied have been conducted. The AEP research[5] consisted of over 350 flights in the vicinity of the plumes during various seasons of the year. The West German data[4] were based on rain gauge measurements upwind and downwind of the plant. Over a two-year period, the latter study has shown that mean precipitation is 4 to 8 percent greater downwind of the six forced and three natural draft towers studied. It is

important to note that the natural variations in precipitation from any given storm are several times larger than the short-term variations which could possibly be attributed to the single cooling tower at Nine Mile Point.

Furthermore, only light, fluffy snowfall[6] has been observed in studies of natural draft cooling tower plumes from AEP towers associated with fossil plants of a size similar to the Unit 2 tower. These events have been of short duration and the area affected by the precipitation has been confined to the region under the visible plume trajectory. None of these occurrences took place during the agricultural season and, thus, the impact on nearby agriculture areas should be negligible.

In the West German program, after installation of six forced draft and three natural draft towers at a 1,500 MW plant[4], average relative humidity at ground level increased by only 0.03 percent in spring to a maximum of 1.3 percent in summer. These increases were due to those occasions when vigorous mixing caused the forced draft plumes to be brought near the ground.

At Nine Mile Point changes in relative humidity can be expected to be even less than the values reported above, since all of the emissions will be released at an elevation approximately 539 ft above grade. Additionally, Unit 2 uses a single tower rather than multiple towers of lower height. Long-term humidity changes should be well below the temperature-dew point specifications in Regulatory Guide 1.23[7].

Fog was not observed at the ground in either study.

Although the triggering of thunderstorms and squalls has not been observed in any studies of actual plumes, the question has been considered. Hanna[8] has compared the energy produced by natural phenomena such as thunderstorms and Great Lakes snowsqualls. He indicates that the energy produced by these phenomena is 10 to 10,000 times the energy released by a wet cooling tower at a 1,000 MW generating station. Such effects require concentrated heat releases in a small area substantially larger than those from the Nine Mile Point Unit 2 cooling tower.

Finally, it should be remembered that Lake Ontario itself is such a large source of local weather modifications along its shores that the effect of the cooling tower is certain to be miniscule in comparison.

The lake creates such enormous variations in fog, humidity, precipitation, and violent storm frequency that changes associated with the tower plume should be almost impossible to measure.

## References

1. Kramer, M. L. et al.: "Cooling Towers and the Environment," Air Pollution Control Association Journal, Volume 26, No. 8, August, 1976.

2. Kramer, M. L. et al.: "John E. Amos Cooling Tower Flight Program Data, December 1974-March 1975," Smith-Singer Meteorologists, Inc., Amityville, New York, 1975.

3. Kramer, M. L. et al.: "John E. Amos Cooling Tower Flight Program Data, December 1975-March 1976," Smith-Singer Meteorologists, Inc., Amityville, New York, 1976.

4. Seeman, J. et al.: "Effets Produits sur L'Agriculture par les Panaches Rejetes par les Tours de Refroidissement dans L'Environnement des Centrales Nucleaires," Department Etudes Generales-Programmes, Sites-Environnement, Paris, France, Octobre 20, 1976.

5. Brennan, P. T. et al.: "Behavior of Visible Plumes From Hyperbolic Cooling Tower," Proceedings of the American Power Conference, Vol. 38, 1976.

6. Kramer, M. L. et al.: "Snowfall Observations From Natural Draft Cooling Tower Plumes," Science, Vol. 193, September 24, 1976.

7. Regulatory Guide 1.23, U. S. Nuclear Regulatory Commission, Onsite Meteorological Programs, Regulatory Guide, Office of Standards Development, February 17, 1972.

8. Hanna, S. R., "Meteorological Effects of Cooling Tower Plumes," Presented at the Cooling Tower Institute Winter Meeting, Houston, Texas, January 25, 1971.

TABLE R8-1

NEAREST GARDEN OVER 500 $FT^2$ WITHIN FIVE MILES OF UNIT 2

| Sector | Distance (Ft.) |
|---|---|
| N | None |
| NNE | None |
| NE | None |
| ENE | None |
| E | 6,200 |
| ESE | 7,800 |
| SE | 8,700 |
| SSE | 8,400 |
| S | 7,900 |
| SSW | 9,700 |
| SW | 10,400 |
| WSW | 6,000 |
| W | None |
| WNW | None |
| NW | None |
| NNW | None |

Request 9

Discuss chemical interaction of the cooling system plume with existing nearby pollutant sources, such as the cooling plume combining with fossil, chemical, or industrial plant plumes.

Response 9

The chemical interaction of the natural draft cooling tower plume with any industrial plumes in the vicinity of Nine Mile Point should have a negligible impact on the environment. To date, both research and literature indicate that merging of cooling tower plumes with onsite fossil plant plumes produce no detrimental effects.

This is further supported by quantitative results from studies made by the Pennsylvania State University[1] and the Chalk Point Cooling Tower Project[2]. Qualitative studies by American Electric Power Service Corporation[3] also have indicated similar conclusions. Furthermore, the absence of any published reports of adverse effects in the Cooling Tower Environment[4] indicates that as of 1974 there were no known noticeable impacts from the merging of cooling tower plumes with associated fossil or industrial plumes.

The most recent summary by Argonne National Laboratory[5] concerning the atmospheric impacts of evaporative cooling systems concludes that the lack of reports of significant adverse impacts due to the merging of stack and cooling tower plumes suggests the effects of merging are of minor importance.

The nearest major sources of chemical plumes is some 2 miles away, and the nearest fossil-fuel power plant is 7 miles from Nine Mile Point. Thus, the impact of the cooling tower plumes with these nonadjacent industrial source plumes is considered negligible.

## References


1. Dittenhoefer, A. C. and Pena, R. G.: "A Study of Production and Growth of Sulfate Particles in Coal-Operated Power Plant Plumes," to be Presented at the International Symposium on Sulfur in the Atmosphere, Dubrovnik, Yugoslavia, September 7-14, 1977.

2. Woffinden, G. J. et al.: Cooling Tower Plume Survey, Volume 1, Technical Summary, MRI 76 FR-1462, November 30, 1976.

3. Kramer, M. L. et al.: "Cooling Towers and the Environment," Air Pollution Control Association Journal, Volume 26, No. 8, August, 1976.

4. Cooling Tower Environment-1974, ERDA Symposium Series, CONF-740302, 638 pp., USERDA Technical Information Center, Office of Public Affairs, Washington, DC, 1975.

5. Carson, J. E.: Atmospheric Impacts of Evaporative Cooling Systems, ANL/ES-53, Argonne National Laboratory, Argonne, Illinois, October, 1976.

Request 10

Discuss effects that the construction, operation, and location of the proposed cooling tower may have on the data collected on the onsite meteorological tower.

Response 10

The proposed construction and operation of the natural draft cooling tower should have a negligible effect on the data collected at the Nine Mile Point meteorological tower for several reasons. First, the cooling tower will be located too far from the meteorological tower to have a significant effect. In addition, the frequency of wind from the cooling tower towards the meteorological tower is quite low. Similarly, the temperature and moisture measurements taken on the tower should be unaffected. The visible or invisible cooling tower plumes should seldom pass directly above the meteorological facility. When they do, the plumes should be high above the meteorological tower.

The locations of both the Nine Mile Point meteorological tower and the proposed natural draft cooling tower are shown in Figure R10-1. The cooling tower, which will be 539 ft high and 433.5 ft in diameter at the base, will be 3800 ft east of the meteorological tower (bearing 92 degrees).

In accordance with NUREG-75/087[1], the meteorological tower has been situated to minimize the influence from the proposed natural draft cooling tower during construction and operation. The cooling tower will be located more than five tower heights from the onsite meteorological tower. Furthermore, the wind rarely blows from the cooling tower directly towards the meteorological tower, so that the frequency of possible influence of the cooling tower is small. The wind direction frequencies[2] at the 200 ft and 30 ft levels of the meteorological tower in the 22 1/2 east sector are only 2.6 and 3.1 percent, respectively. In fact, an even smaller frequency is more realistic, since about a 10 degree sector would have little likelihood of being affected at all. Because of the large distance between the two structures, the effect should be less than the wind measurement accuracies specified in Regulatory Guide 1.23[3] when the wind is in this narrow sector.

Similarly, the effect of the visible and/or invisible plume on the temperature and moisture measurements should be negligible. The visible plumes will infrequently shadow the tower, and rarely pass directly over the meteorological installation. On these few occasions, they should be several hundred to several thousand feet above the tower. Thus, the effect, if any, on the data collected at the meteorological installation will be negligible.

In addition, the effect of salt deposition and water drift on all measurements taken at the meteorological tower should be negligible.

## References

1. NUREG-75/087, U. S. Nuclear Regulatory Commission, Standard Review Plan, Office of Nuclear Reactor Regulation, "Onsite Meteorological Measurements Programs," Section 2.3.2, November 24, 1976.

2. Nine Mile Point Nuclear Station Unit 2, Docket 50-410, Compliance with CFR50 Appendix I, June, 1976.

3. Regulatory Guide 1.23, U. S. Nuclear Regulatory Commission, Onsite Meteorological Programs, Regulatory Guide, Office of Standards Development, February 17, 1972.

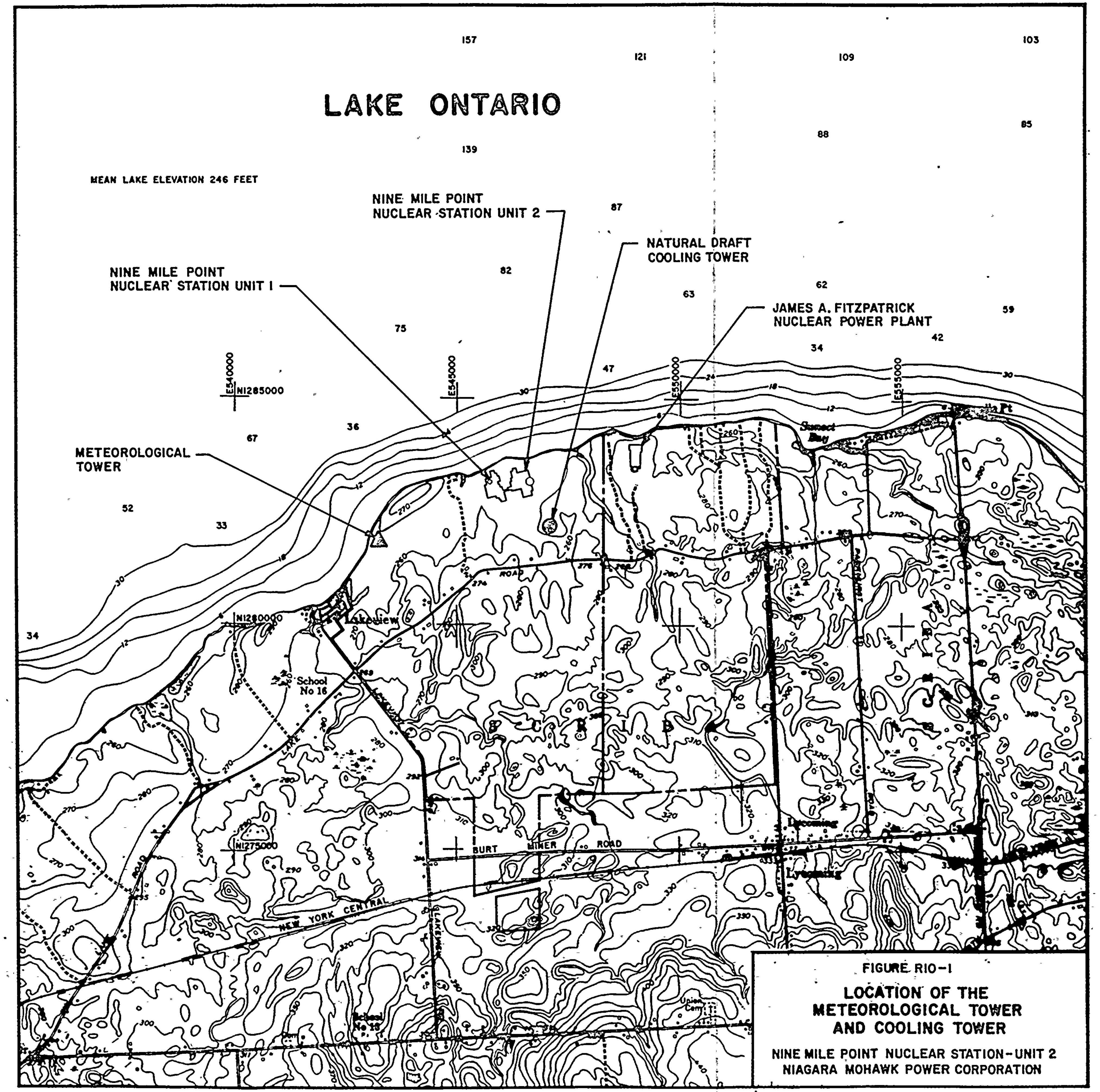



FIGURE RIO-I

**LOCATION OF THE METEOROLOGICAL TOWER AND COOLING TOWER**

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

Request 11

Clarify if the proposed design change will result in placing the intake and discharge structures at different locations from those previously reviewed. If applicable, any new location should be described with respect to:

a) the location of the previously proposed once-through system intake and discharge structures;

b) the locations of the sampling stations occupied to assess impacts;

c) the abundance of aquatic biota and species considered "important" with regard to potential impacts of construction and operation;

d) the potential effects of construction and operation of the intake and discharge structures in their new proposed location.

Response

a. The revised locations of the cooling tower intake and discharge structures for Unit 2 are shown on Figure R11-1 along with the previously submitted locations for the once-through cooling system. (A complete description of the intake discharge system and the range of operating conditions are given in the Response to Request 12.) As can be seen from Figure R11-1, the east intake is located approximately 200 ft to the southeast of the previously submitted Unit 2 intake location and will be located in approximately 19.5 ft of water as compared to 26.5 ft for the previous design (all depths relative to mean low water lake level, El. 244 ft USLS 1935 Datum). The currently proposed discharge structure is located approximately 100 ft southeast of the center of the previously proposed diffuser at a water depth of approximately 37.5 ft from the centerline of the diffuser nozzle to the surface at minimum controlled lake elevation (lake El. 243 ft USLS 1935 Datum). The proposed west intake structure is located approximately 480 ft shoreward of the new discharge along the same depth contour as the east intake.

b&c. The revised locations of the intake and discharge structures along with the location of the second intake structure are so close to the previous locations that the biology of the area would be similar. Thus, the previously submitted information on abundance of aquatic biota and "important" species is completely applicable to the new locations. Also, the same sampling stations would be used to evaluate potential impact.

d. Alterations in the potential effects of construction of the proposed facilities are discussed in the Response to Request 14. The actual operation of the proposed structures with the closed cycle cooling system will have reduced potential for impact compared with the previously submitted once-through design due to the reduction in both system flow rate and total heat discharged to the lake. In addition, the new discharge system will achieve higher dilutions than those predicted for the previous design. The proposed twin port diffuser is designed to achieve sufficient dilution prior to jet surfacing to assure that surface temperature rises will be less than 3 F.

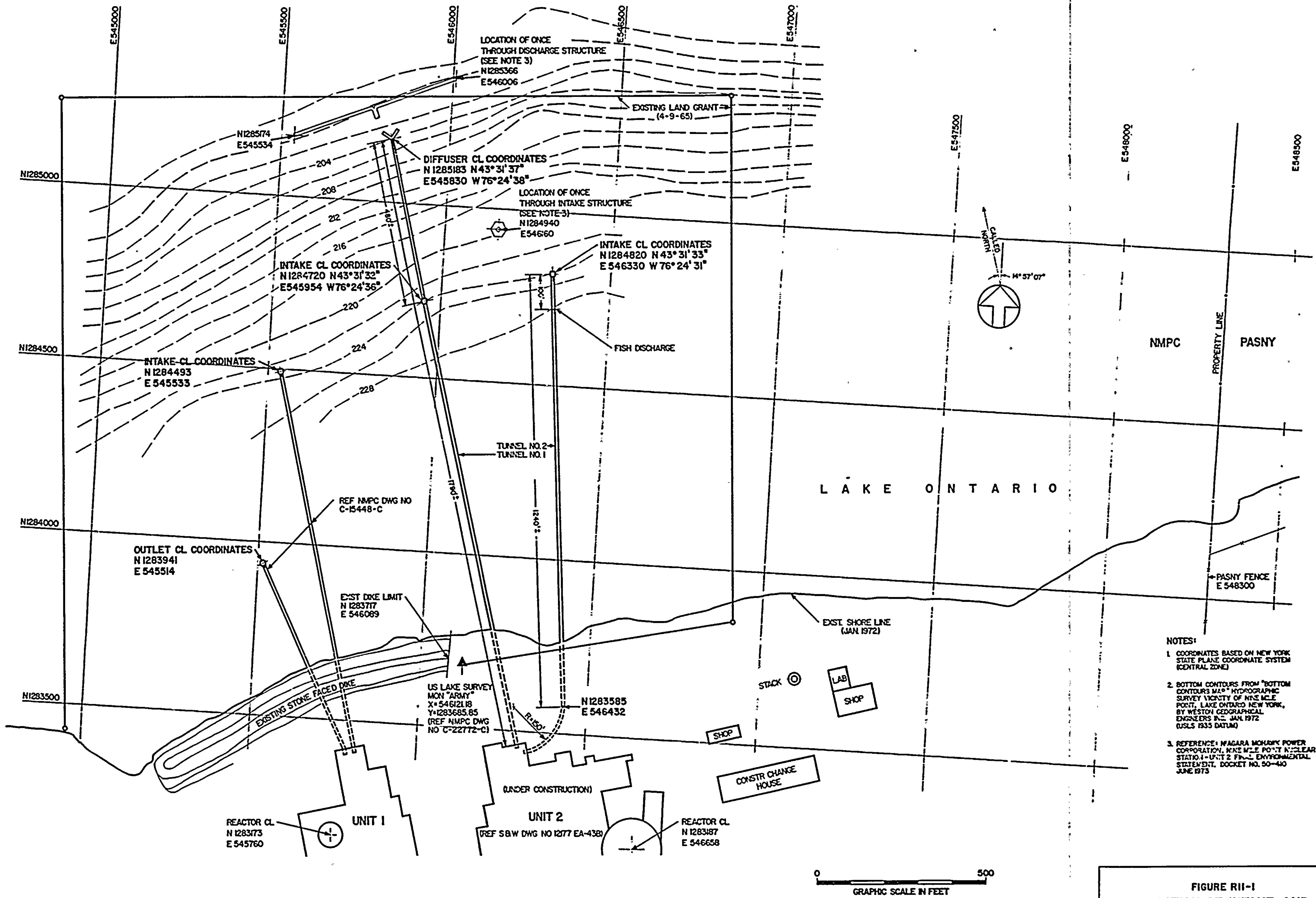



FIGURE RII-1
LOCATION OF INTAKE AND DISCHARGE STRUCTURES

NINE MILE POINT NUCLEAR STATION – UNIT 2
NIAGARA MOHAWK POWER CORPORATION

Request 12

Provide a description (along with illustrative figures) of any design features of the intake and discharge structures which differ from those previously proposed. To be included are the intake velocity, discharge velocity, and the proposed "fish-guidance-bypass-return-to-lake system."

Response

Cooling water for Unit 2 will be withdrawn from Lake Ontario into two hexagonal intake structures. The location of the two intake structures is discussed in the response to Request 11. The lake intake flow rates are given in Table R12-1.

Details of the two intake structures are shown in Figure R12-1. The structures will have a 4.5 ft sill at the bottom to prevent silt from entering the intakes. Each structure will have six intake openings 7.5 ft wide by 3 ft high, a 2 ft roof thickness, and a 10 ft clearance between the top of the structure and the lake surface at the mean low water level of 244 ft (USLS 1935 Datum). The width of each structure will be 22.5 ft between opposite openings. The six intake openings on each structure will be equipped with electrically heated bar racks to prevent the formation of frazil ice. The total area of the twelve openings is designed to provide a maximum intake velocity approaching the bar racks of 0.5 feet per second (fps) while drawing water through both structures.

Each intake structure will be independently connected to the screenwell and pump house located onshore by a 4.5 foot diameter concrete pipe within each tunnel. The concrete pipe has a design velocity of 2.5-4.5 fps while drawing water through both intake structures. The velocity is dependent on the lake temperature and whether or not the fish removal system is operating.

The two intake structures are designed and located to minimize the possibility of fish entering the structures as discussed in Section 5.1 of the Unit 2 Environmental Report - Construction Permit Stage. However, a fish removal system will be provided in the onshore screenwell.

The screenwell fish removal system is shown in Figure R12-2. There will be two screenbays, each 4 ft wide. Fish entering the screenwell will pass through trash racks made up of 3 in. by 1/2 in. bars with 3 in. clear spacing between the bars. After passing through the trash racks, the fish will be guided by angled, flush-mounted, traveling water screens into bypass slots. The two traveling water screens will be angled 25 degrees to the upstream direction of flow with their downstream ends converging, but separated by a 5 ft wide pier. The screens are similar to conventional vertical traveling water screens except that the screen panels and frames are designed to form flush surfaces along the screen face. At the downstream end of each screen and extending the

full depth of the water column, there will be a 6 inch wide bypass slot. The two slots will converge, and at their junction a funnel-shaped transition will converge in the vertical plane at a 30 degree angle to 18 inch diameter pipes. The two pipes will manifold into a single 24 inch diameter suction pipe leading to a peripheral jet pump. The jet pump will discharge into a 42 inch diameter fish return pipe within the east tunnel for approximately 1300 ft, where it will rise vertically and terminate horizontal to the lake bottom in an easterly direction. A fish sampling area will be provided downstream of the jet pump.

The cooling water discharge system will be designed to handle the discharge flow for Unit 2 only. The discharge flow rate will vary between 18,020 gpm and 35,900 gpm with an average flow of 25,170 gpm.

The discharge diffuser is shown in Figure R12-3. The diffuser will have two nozzles off a single riser. The nozzles will diverge at a 120 degree horizontal angle, and each nozzle will angle 5 degrees upward from the lake bottom. The nozzle ports will be 18 in. in diameter, and the centerline will be 45 in. off the lake bottom. The nozzle ports will have a 36.5 ft submergence at the minimum controlled lake level of 243 ft (USLS 1935 Datum). The nozzle exit velocity will range between a minimum of 11.3 feet per second and a maximum of 22.6 feet per second during normal plant operation. The average velocity will be 15.8 feet per second.

The location of the discharge diffuser is discussed in the response to Request 11. The discharge flow will be conveyed through the west tunnel from the screenwell discharge bay to the diffuser. A complete description of the intake and discharge system is given in the response to Request 15.

The size and location of the discharge nozzles are designed to meet the New York Criteria Governing Thermal Discharges (6NYCRR704) applicable to Lake Ontario. This regulation requires that a maximum surface temperature rise above the lake temperature that existed before the addition of heat of an artificial origin be 3 F.

## TABLE R12-1
## LAKE INTAKE FLOW

| Lake Temperature (°F) | Cooling Water Intake Flow for Normal Plant Operation (Gallons Per Minute) | Fish Return System Flow (Gallons Per Minute) | Lake Intake Flow (Gallons Per Minute) |
|---|---|---|---|
| 32°-38° | 31,400 - 36,000 | 13,400 | 44,800 - 49,400 |
| 38°-78° | 36,000 | 13,400 | 49,400 |
| Above 78° | 45,000 | 16,600 | 61,600 |

NOTE: During normal plant shutdown, the cooling water lake intake flow rate will be 48,750 gpm.

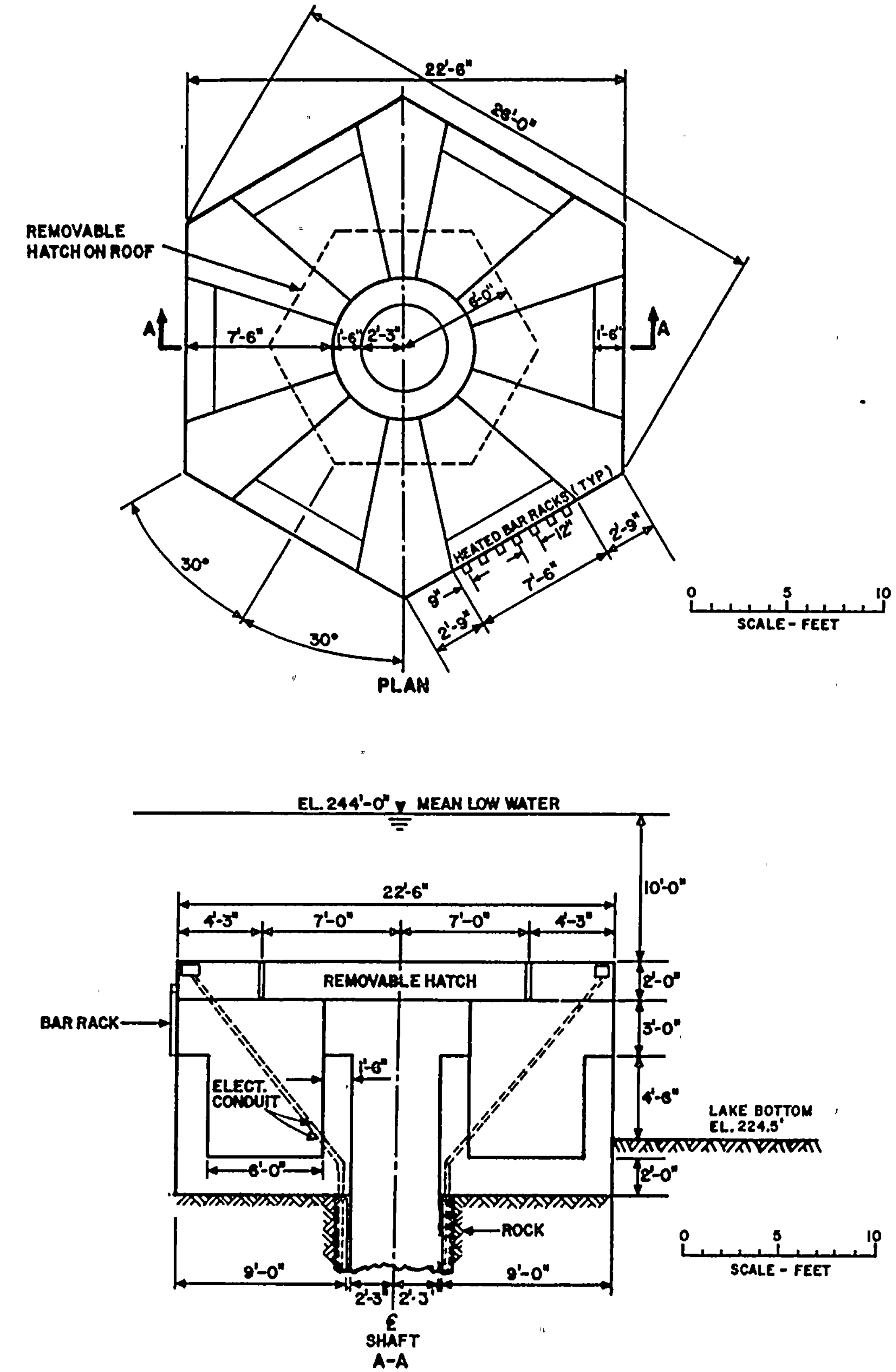



FIGURE R12-1

**INTAKE STRUCTURE**

**NINE MILE POINT NUCLEAR STATION-UNIT 2**

**NIAGARA MOHAWK POWER CORPORATION**

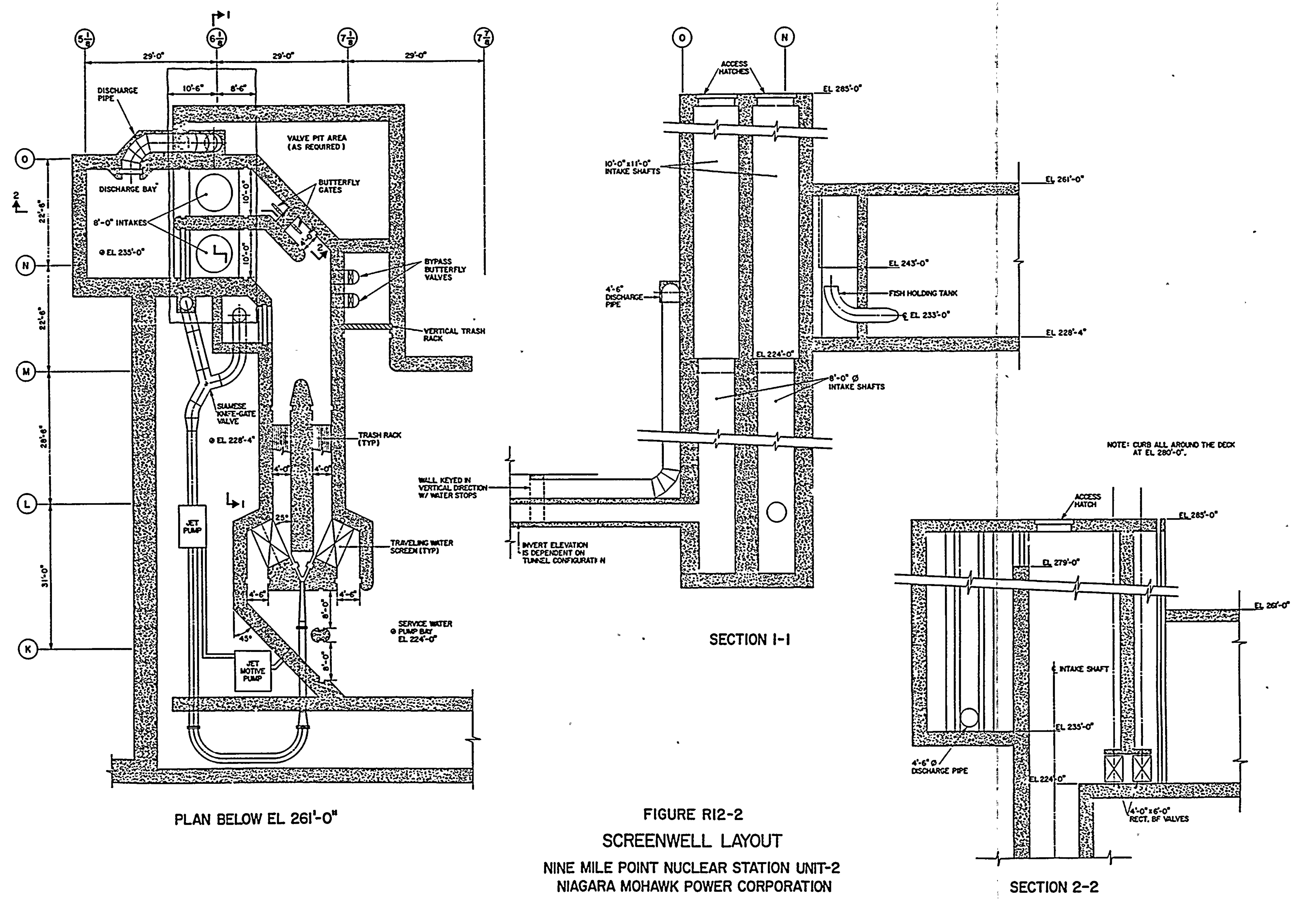



FIGURE R12-2

SCREENWELL LAYOUT

NINE MILE POINT NUCLEAR STATION UNIT-2
NIAGARA MOHAWK POWER CORPORATION

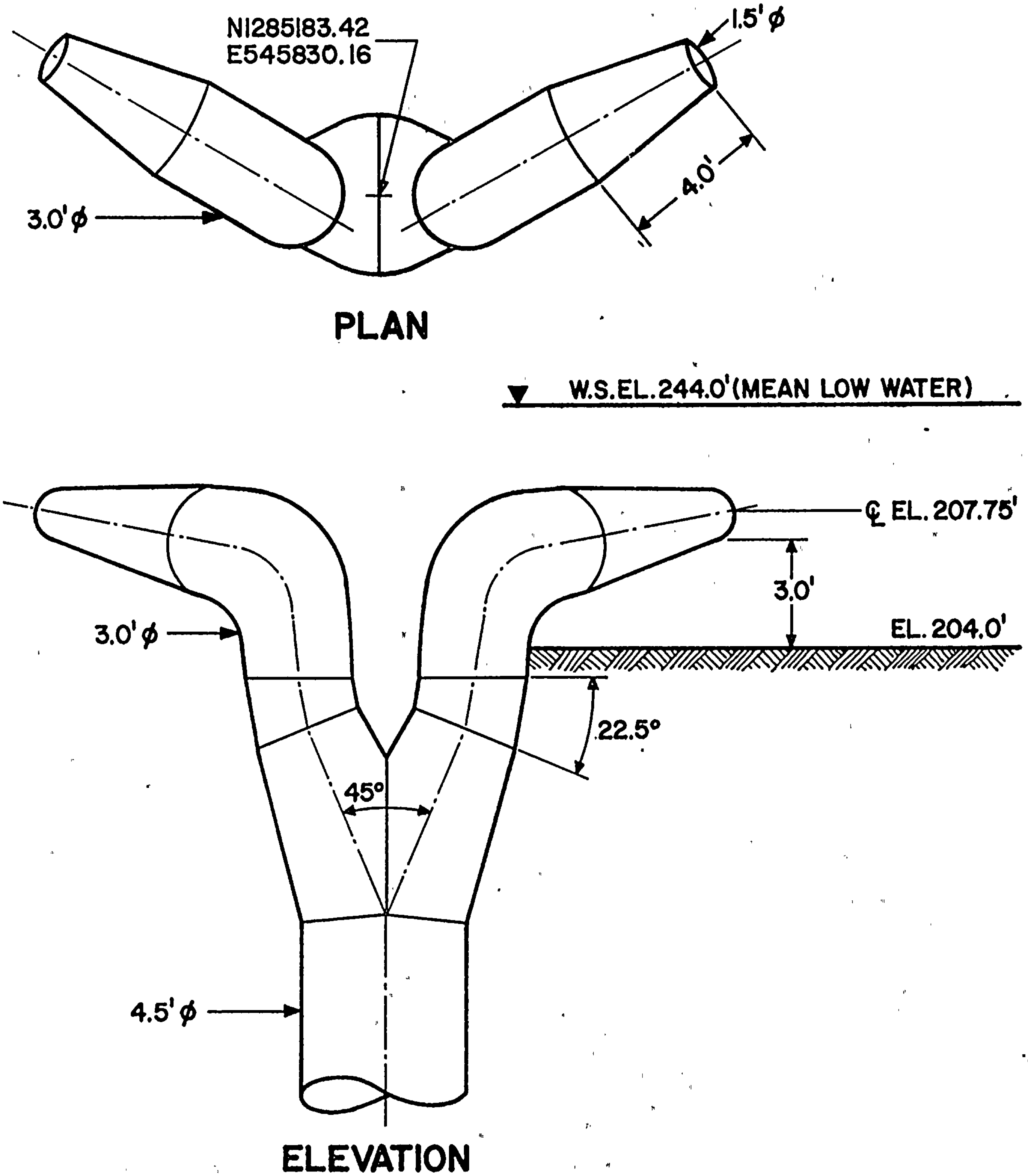



FIGURE R12-3

**DISCHARGE DIFFUSER**

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

Request 13

Provide a discussion and evaluation of the effectiveness and anticipated reduction in fish mortality as a result of the "fish-guidance-bypass-return-to-lake system."

Response

The fish diversion and transportation system to be installed at Unit 2 was developed during four years of laboratory studies for Niagara Mohawk Power Corporation. These studies involved separate evaluations of the hydraulic aspects and biological effectiveness of each component of the system followed by an investigation of the efficiency of the entire system in diverting and safely transporting alewives. The results of these studies have shown that the 25 degree angled screen is 100 percent effective in diverting alewives to a bypass over the wide range of environmental and hydraulic conditions tested. When the angled screen was evaluated in conjunction with a jet pump and transport pipe, the overall differential mortality associated with the system was 4 percent (test mortality = 11.8 percent; control mortality = 7.8 percent). On the basis of these results, it appears that the angled screen and fish transportation system will operate effectively at Unit 2 and will, therefore, substantially reduce the potential for impingement mortality.

Request 14

The original design for Unit 2 proposed to combine the discharges of Unit 1 and Unit 2. Provide an assessment of the potential impacts resulting from:

a. discharging at two separate locations rather than at one location;

b. the construction of two new structures (intake and discharge) rather than one (intake only).

Response

a. As described in the Response to Request 12, Unit 2 will employ a cooling tower, and cooling water will be discharged to the lake through a submerged diffuser. The discharge from Unit 1 will not be altered from its existing design and operation. Thus, the proposed system will result in the construction and operation of a new, single riser cooling water discharge for Unit 2 and the continued operation of the existing Unit 1 discharge.

The potential impacts of the combined once-through cooling discharge for Units 1 and 2 at a single location were previously evaluated by the AEC staff and found to be acceptable.[1,2] With both Unit 1 and Unit 2 in operation, the total combined discharge flow would be approximately 803,000 gpm. This would include 535,000 gpm for Unit 2 and 268,000 gpm for Unit 1.

Based on average operating conditions at Unit 2 utilizing the cooling tower and adding to this the existing Unit 1 discharge, the total flow to the lake would be approximately 293,000 gpm. These flows will be discharged separately as shown in Figure R11-1. Thus, the use of the cooling tower reduces the total flow to the lake.

With the use of the cooling tower at Unit 2, the quantity of heat to be discharged by Unit 2 will be less than 10 percent of the quantity of heat presently discharged from Unit 1. The addition of the heat released by the Unit 1 discharge to the heat to be released from Unit 2 to the lake will be less than 65 percent of the combined Unit 1 and Unit 2 once-through discharge previously found acceptable.

The currently operating Unit 1 discharge is as described in Section 3.4.2 and evaluated in Section 5.5.2 of the Unit 1 Final Environmental Statement.[1] The NRC evaluation is as follows: "the staff does not expect that the thermal discharge will have a significant deleterious effect on the plankton, benthos and fish life in the Nine Mile Point area." Five years of operational aquatic community studies in the vicinity of the Unit 1 discharge have shown that operation of the discharge has not resulted in any appreciable harm to the aquatic community.[3]

The Unit 2 cooling water discharge will have a lower temperature rise (19 F versus 32 F) than the existing Unit 1 discharge. The Unit 2 discharge is in conformance with EPA effluent guidelines and meets the New York State Water Quality Standards. Thus, the use of the cooling tower will have less impact on the aquatic community than the Unit 1 discharge, which has not resulted in any appreciable harm. Therefore, it is expected that the use of the cooling tower for Unit 2 in conjunction with the current discharge for Unit 1 will not adversely affect the aquatic community within the receiving body.

b. The original design for the combination of the discharges for Units 1 and 2 would have required the construction of a new common discharge for both units and one intake for Unit 2. The cooling water intake design will involve the construction of two intake facilities as opposed to the one intake for the previously submitted system. The construction of the cooling water discharge will involve the placement of one twin port riser at a point approximately 480 ft lakeward of the west intake structure. The lake bottom area for the cooling water structures will be much less than the area disrupted by the placement of the 10 twin diffusers under the previous design. Based on the reduction in both the amount of lake bottom drilling required and the lake bottom area temporarily disturbed during construction of the proposed structures, the potential impact due to construction of the current design is less than that for the design analyzed in the Final Environmental Statement for Nine Mile Unit 2.[2]

References

1. U.S. Atomic Energy Commission, "Final Environmental Statement," Nine Mile Point Nuclear Station - Unit 1, Docket No. 50-220, January, 1974.

2. U.S. Atomic Energy Commission, "Final Environmental Statement," Nine Mile Point Nuclear Station - Unit 2, Docket No. 50-410, June, 1973.

3. Nine Mile Point Unit 1, 316(a) Demonstration Subdivision NPDES Permit N.Y. 0001015.

Request 15

We have reviewed your July, 1976, report, "Circulating Water Cooling System Employing a Natural Draft Cooling Tower." As a result of this review, we have several questions regarding the capability of this system to satisfy the hydrologic criteria suggested in Reg. Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

As presented in your report, the ultimate heat sink complex does not meet the criteria of Reg. Guide 1.27 in that the system apparently cannot tolerate a single failure of the intake structure or intake tunnel. It is not clear how cooling will be accomplished if such failures occur. Alternate means of obtaining cooling water have not been documented in your report. In addition, the seismic capability of the service water system has not been documented.

Accordingly, document that the ultimate heat sink complex has sufficient redundancy to withstand the above single failures. Provide the seismic capability of the various structures, and document that the system meets the criteria suggested in Reg. Guide 1.27. Provide information regarding the conceptual design of the proposed system including sections, plans, and drawings of sufficient detail to show the locations, elevations, and features of the various structures of the system.

Response

Although the circulating water system for NMP2 employs a cooling tower and is considered a closed loop system, the service water system is a once-through system. Reg. Guide 1.27, Rev. 2 states in Section C.3, "For once-through cooling systems, there should be at least two aqueducts connecting the source(s) with the intake structures of the nuclear power units, and at least two aqueducts to discharge the cooling water well away from the nuclear power plant to ensure that there is no potential for plant flooding by the discharged cooling water, unless it can be demonstrated that there is extremely low probability that a single aqueduct can functionally fail as a result of natural or site-related phenomena." As described in more detail below, the Unit 2 intake and discharge facilities are designed to withstand the safe shutdown earthquake, and the design, fabrication, and installation meet the requirements of 10CFR50, Appendix B. In addition, the intake and discharge tunnels are through bedrock below Lake Ontario, and the tunnels and intake structures serve a totally passive function. For these reasons, there is an extremely low probability of failure for these structures, and the failure referred to in the above Request is not postulated. However, even if there were a single, passive failure of the intake structure or tunnel, the function of the ultimate heat sink would not be compromised.

The lake intake and discharge system is designed to meet the ultimate heat sink criteria of Regulatory Guide 1.27. As in the previous design, the ultimate heat sink will be Lake Ontario. The major justification of

compliance with Regulatory Guide 1.27 is found in the PSAR Response to Request 2.38. This response documents conformance of the connections between the lake and the plant.

The lake intake system will consist of two identical intake structures located approximately 1000 ft offshore, two intake pipes, and the screenwell intake bay. The location of the intake structures is shown in Fig. R11-1. Each structure will be independently connected to the onshore screenwell by a 4.5 ft diameter concrete intake pipe. The intake pipes will be located within two tunnels, as shown on Fig. R15-1 and 15-2. At the onshore screenwell, the intake pipes will connect to two vertical shafts, each pipe connecting to a separate shaft. The screenwell arrangement is shown on Fig. R12-2. Two motor operated rectangular butterfly gates, normally open, will be located between the north shaft and the intake bay. When the gates are closed, no flow will enter the intake bay from the north shaft. Downstream of these butterfly gates, flow from both vertical shafts will merge into a common bay and then divide into two 4 ft wide screenbays. Trash racks equipped with a rake and angled flush-mounted traveling water screens will be located in each screenbay. Two motor operated valves will be located upstream of the trash racks to bypass the two screenbays and provide a redundant flow path to the service water pumps. The bypass valves will be in parallel and connected to separate Class 1E electrical buses to ensure opening of one valve. A trash rack will be located between the valves and the service water pumps.

The minimum water surface elevation in the intake bay is 233.0 ft while drawing water through both structures with the postulated lake elevation of 236.5 ft, as discussed in Sections 2.3, 3.7 and 2.7.7 of the Preliminary Safety Analysis Report. Drawing the safe shutdown flow requirements through one structure will result in a water surface elevation of 234.7 ft in the intake bay. The service water pumps will be designed to operate at the minimum water elevation of 233.0 ft with the centerline of the horizontal suction pipes at elevation 226.17 ft.

The intake structures, intake pipes, screenwell substructure, bypass valves, trash racks, and butterfly gates will be designed to withstand the design basis earthquake. The traveling water screens will not be designed for seismic loadings. The seismic capability of the service water system beyond the service water pump suction is documented in Appendix C of the Preliminary Safety Analysis Report.

The lake discharge system will consist of a screenwell discharge bay, a discharge area within the west tunnel, a single riser, and a two-nozzle diffuser located approximately 1500 ft offshore. The profile of the discharge system is shown on Figure R15-1. The discharge bay will be connected to the west tunnel, Tunnel 1 on Figure R15-1, by a 4.5 ft diameter steel pipe. The flow will pass through the tunnel into a single riser and will be discharged from the two nozzles to the lake. The location of the diffuser nozzles is shown on Figure R11-1.

The maximum water surface elevation in the discharge bay will be 277.5 ft while discharging through the diffuser. To prevent discharge water from entering the intake bay, a weir with the crest elevation at 279.0 ft will be located between each vertical intake shaft and the discharge bay, as shown on Figure R12-2.

The diffuser nozzles, riser, and discharge tunnel will not be designed for seismic loadings. The screenwell discharge bay substructure and stop logs will be designed to withstand the design basis earthquake.

During normal plant operation, the intake flow required for the service water pumps will be conveyed through both intake structures to the onshore screenwell. The plant discharge will normally be conveyed from the discharge bay through the diffuser nozzles to the lake.

In order to meet the requirements of Regulatory Guide 1.27, each intake structure and intake pipe is designed for the safe shutdown flow requirements. Even if a single failure of an intake structure or intake pipe is postulated, the total flow will be transported through the remaining intake system. During this postulated single failure, the plant discharge will follow the normal flow path through the diffuser to the lake.

If a single failure in the discharge system is postulated, two level switches in the discharge bay, each connected to a separate butterfly gate, will close the gates, and the discharge water will overflow the weir into the north shaft. A stop log extending from the weir crest to the deck (elevation 285.0 ft) will prevent flow into the south vertical shaft. The discharge will flow to the lake through the west intake structure, while the intake requirement will flow through the east intake structure and the south shaft. The two rectangular butterfly gates will be in series and on separate Class 1E electrical buses to ensure closure of the flow path from the north shaft to the intake bay.

To prevent the formation of frazil ice on the intake structures, electrical heating elements will be provided in the bar racks on all the faces of both structures. The heating elements on the alternating faces of each structure will be powered from separate Class 1E electrical buses.

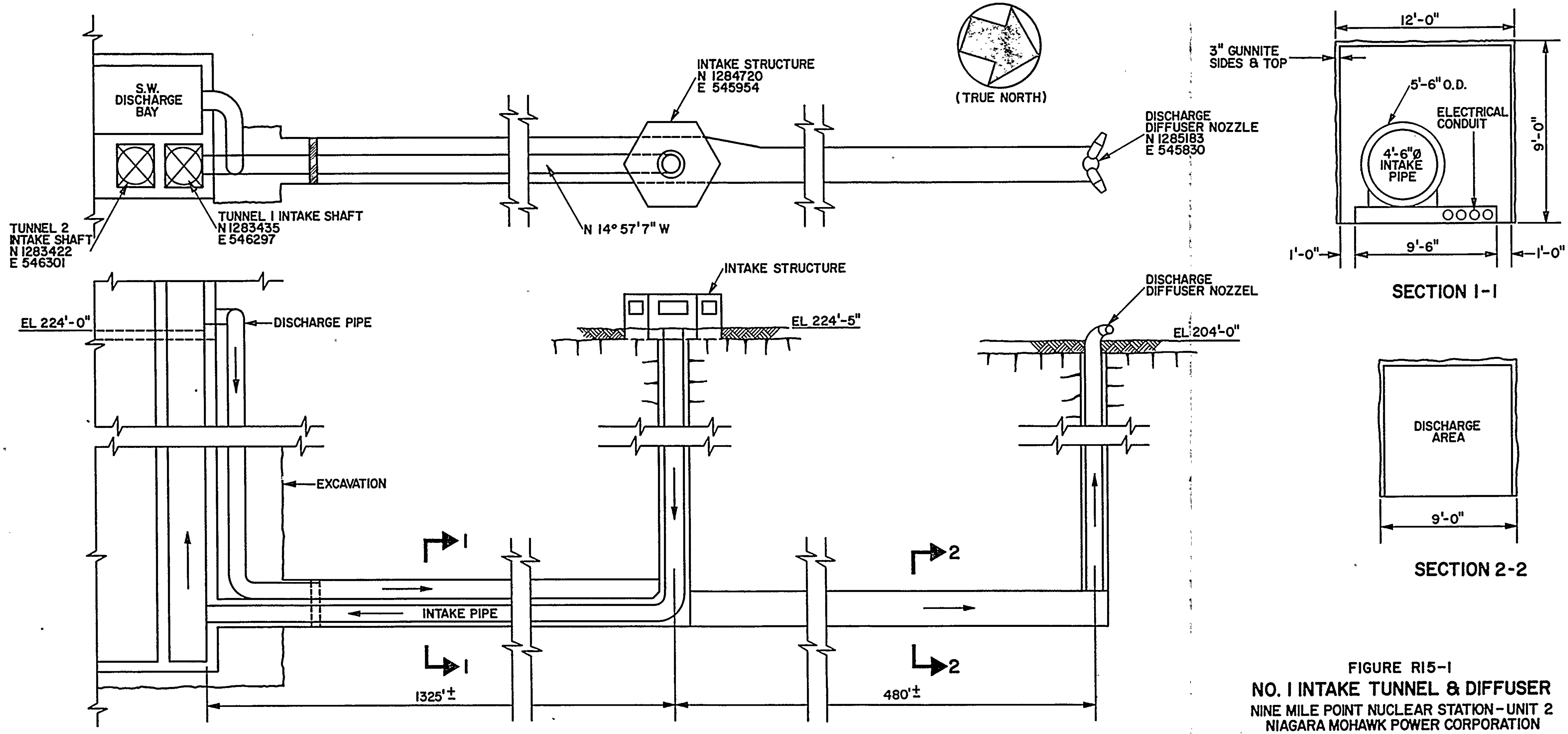



FIGURE R15-1
NO. 1 INTAKE TUNNEL & DIFFUSER
NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

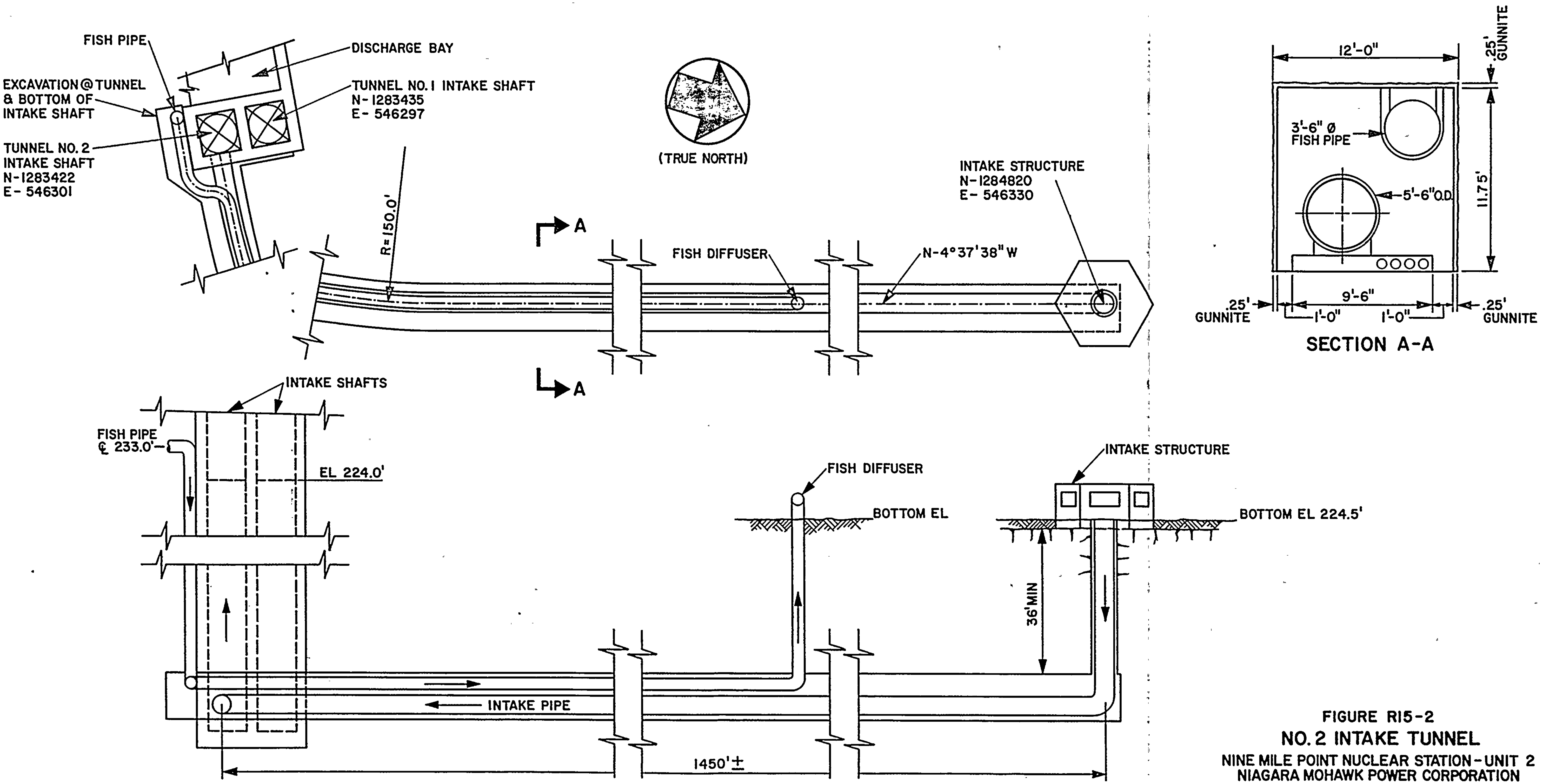



FIGURE R15-2
NO. 2 INTAKE TUNNEL
NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION