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DESCRIPTION:
Ltr submitted on behalf of Niagara Mohawk re our 10-7-72 ltr...furnishing informal response to question 5.12...and advising formal submittal in more detailed data & analysis will be submitted on/about 12-31-72.

ENCLOSURES:

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November 20, 1972

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Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Re: Niagara Mohawk Power Corporation
Nine Mile Point Unit 2
AEC Docket No. 50-410

Dear Mr. Muller:

Pursuant to your letter of October 2, 1972 and as counsel for the Applicant, we hereby submit our informal response to Request 5.12 of the attachment to that letter. By agreement with your Staff, 38 copies of this information are being supplied at this time.

The 200 copies (including three originals) of this information accompanied by more detailed data and analysis will be formally submitted on or before December 31, 1972.

Very truly yours,

LEBOEUF, LAMB, LEIBY & MACRAE
Attorneys for Niagara Mohawk
Power Corporation

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By Eugene B. Thomas, Jr.
Eugene B. Thomas, Jr.
Partner

Enclosures

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

RESULTS OF HYDRAULIC MODEL TESTING PROGRAM FOR THE SELECTION OF A COOLING WATER DISCHARGE DESIGN

NOVEMBER 1972

QUIRK, LAWLER & MATUSKY ENGINEERS

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

RESULTS OF HYDRAULIC MODEL TESTING PROGRAM FOR THE SELECTION OF A COOLING WATER DISCHARGE DESIGN

I. Description of the Model

Two nuclear power generating units are located on the Nine Mile Point promontory. They are the FitzPatrick plant owned by the Power Authority of the State of New York (PASNY) and Unit 1 of the Nine Mile Point station owned by Niagara Mohawk Power Corporation (NMPC). The latter unit has been in operation since 1969, and the former has not yet been started up.

NMPC proposes to erect a second unit at the Nine Mile Point station, adjacent to, and to the east of Unit 1, with the thermal discharges of both units to be combined into one turbulent jet diffuser. The model has been constructed to study the behavior of the plume from this combined discharge, including its interaction with that of the FitzPatrick plant.

Furthermore, it was desired to represent as much as possible of the far field in an undistorted model, under various conditions of current flow. However, at the same time, it was desired to employ as large a scale as possible. These differing requirements were accommodated by using a scale of 1:80, with a lake frontage of 14,000 ft and a distance offshore of 6,800 ft. In the model, this is 175 ft by 85 ft.

Figure 1 is a schematic layout of the model. The enclosed basin has been laid out to represent the lake bottom topography, together with a portion of the promontory shore. It is finished

in concrete, except for an area around the Nine Mile Point proposed combined discharge, which has been left as gravel. This was done originally to facilitate moving the buried discharge structure to different locations, as test results might indicate. However, to make this operation even easier, an additional movable device was constructed, supported on legs, with diffuser nozzles dipping down into the water, rather than projecting upwards through the floor of the model. Excellent agreement was obtained between the buried structure and the movable one.

Referring to Figure 1, it can be seen that the model basin is surrounded on three sides by a water channel. A continuous line of weirs (broken only by the sump pump) stands between the channel and the wire-mesh screen material that forms the walls of the model basin. The weirs can be tilted both ways, either to receive water from the channel and deliver it to the model, or vice versa. Thus, if the weirs on the left hand wall deliver water to the model, and those on the right hand wall discharge water to the channel, a left-to-right current is established. In terms of the prototype, this is a west-to-east (W-E) current. During such a set-up, the weirs along the back wall are raised to full upright position so that water is neither added there nor removed.

Water is supplied to the model by gravity from the head tank. It can be fed either to the left supply sump or the right one, depending on whether a W-E current or an E-W current is desired. The selected sump delivers water to its particular supply channel,

which conveys it along the wall of supply weirs. On the other side of the model, water overflows the discharge weirs into the discharge channel and then travels down to the far wall and along to the sump pump.

The sump pump, a vertical lift pump, returns the overflow to the storage tanks. Flow is metered by an orifice plate in the return line. The return piping is designed to ensure that water is discharged equally into both tanks and mixes thoroughly with each tank's contents. A horizontal pump withdraws water at an equal rate from both tanks, and delivers it to the head tank, which then supplies it to the model by gravity.

Operation of the three power plants is simulated by withdrawing water from the model via three separate scale-model intakes, at the correctly scaled flow rates. The two Nine Mile Point plant intake flows are combined, and the Nine Mile and FitzPatrick streams are heated in separate, automatically-controlled, steam heaters, before being returned to the model via their respective diffuser structures (Figure 1 shows the steam supply lines dotted).

If it should be necessary to heat the entire model before making a test run, for example to simulate summer operation during the winter, a large steam heater is provided, through which the entire water inventory can be circulated until the desired ambient temperature is achieved.

II. Model Test Program

The tests conducted in the Nine Mile Model were carried out to confirm the environmental suitability of the proposed

combined discharge structure serving both Units 1 and 2 of the Nine Mile Point Power Plant. Model testing utilized conservative operating conditions which would result in warmest surface temperatures. The design will, therefore, sufficiently dilute the effluent so that all applicable standards including the New York State Thermal Discharge Criteria will be complied with.

The conservativeness of the model operation resided in the following factors:

a) Maximum Summer Lake Ambient Temperature and Maximum Plant Capacity Operation

The operation of the model at summer ambient temperatures represents the condition under which the effluent is most buoyant. At cooler ambient lake temperatures greater dilution will result from a lesser buoyancy of the discharge. All three plants were simulated at full load, with their maximum effluent temperature for their design flow rates. If any unit were operating at a lesser generating rate, the effluent would be less buoyant and hence achieve greater dilution than those simulated in the model tests.

b) Low Water Datum

The model was operated to simulate the lake surface at the low water datum of 244 ft., international great lakes datum (1935), equivalent to 242.8 ft. IGLD (1955). Government records (1) show that the lake level is rarely this low. The monthly average for the period of record (1860 to date) cycles annually between a low of 1.15 ft above low water datum in December and a high of 2.8 ft above in June. The monthly average for the last ten years

cycles annually between a low of 0.9 ft above low water datum in December and a high of 2.6 ft above in June. In the past year, the low point was a monthly average of 0.9 ft above low water datum in December 1971. Hence, the available water depth in the prototype is usually more than one foot greater than the depth that was modeled. This greater actual submergence of the discharge nozzle will assist dilution.

c) Current Condition Sensitivity

Theory and previous model studies (2,3,4) indicate that submerged diffuser discharges respond differently to various currents and may be especially sensitive to crossflow. Currents of 0.5 fps west to east, 0.5 fps east to west, and still-water were simulated in the tests of the selected design. Over 90% of all summer currents near the site are less than or equal to 0.5 fps. (5)

d) Wind and Wave Action

No attempt was made to simulate the effects of wind and waves, although a current as high as 0.5 fps in the prototype would always be associated with fairly strong winds, and these in turn would raise waves. The additional turbulence in the prototype can only result in improved dilution of the thermal discharge.

III. Diffuser Design

The diffuser designs tested for the Nine Mile Point Units were all double-nozzled riser systems as shown in Figure 2, with the nozzles at a uniform elevation parallel to the bottom topo-

graphic contours five feet above the lake bottom and directed lakeward. Each nozzle is 2.5 feet in diameter at its exit. The initial design consisted of 12 risers placed in 35 feet of water, at low water datum, on 45 foot centers. Later tests included slightly decreasing the riser spacing (to 40 feet), increasing the exit velocity by removing one riser from each end of the diffuser, and moving the diffuser into deeper water.

The design as indicated in Table 1, consists of 10 risers, spaced 40 feet on centers. Each riser terminates in double nozzles, each 2.5 foot diameter, which are directed lakeward with an included angle between the pair of 20^{o}. The centerline submergence of all nozzles is 40 ft below the simulated lake surface, at low water datum.

In Figure 2, east and north coordinates are given for the two end risers, on the coordinate system of the U. S. Geological Survey quadrant sheets. The intermediate risers lie on the straight line joining these two points. The main tunnel joining the diffuser to the onshore screen-well is approximately 1700 feet in length, locating the diffuser about 1500 feet offshore.

IV. Results

Surface isotherm plots have been drawn of experimental results obtained with the selected diffuser described previously. These plots are as follows:

Figure 3 Zero lake current - Nine Mile Point Near Field

Figure 4 Zero lake current - Far Field

Figure 5 W-E Lake Current 0.5 fps - Nine Mile Point Near Field

Figure 6 - W-E Lake Current 0.5 fps - Far Field

Figure 7 E-W Lake Current 0.5 fps - Nine Mile Point Near Field

Figure 8 E-W Lake Current 0.5 fps - Far Field

From a study of these figures, it is apparent that the diffuser operation is more efficient in dilution under stillwater conditions than drift. This results from slight jet interference when the drift current deflects the individual jets. Figure 4 shows that, for the stillwater test, the area enclosed in the isotherm of $3^{o}F$ above ambient is of the order of half an acre. In Figure 6 the same isotherm for the west-to-east drift test appears to be in three parts, with a total area of approximately 2 acres. Finally, for the east-to-west drift test, the $3^{o}F$ ΔT isotherm enclosed an area of about 2.5 acres. In all cases, the area is within the New York State criterion of 6.5 acres. Furthermore, with the buoyant jets discharging from nozzles whose centerlines are 40 ft below low water datum, the plume complies with the state criterion that discharge must be into the lake's epilimnion.

Figures 4, 6 and 8 indicate that interaction with the thermal discharge of the FitzPatrick plant is of small magnitude. In the stillwater test, the interaction involved only the $0.5^{o}F$ ΔT isotherms (Figure 4). In the drift tests, interaction took place between the $1.0^{o}F$ ΔT isotherms (Figures 6 and 8). In no case was there any measurable increase in one plant's intake temperature ascribable to the other plant's discharge.

V. Conclusions

The design of the discharge diffuser ensures compliance with all applicable standards including the thermal discharge criteria for lakes, established by the Department of Environmental Conservation of the State of New York. Thus the environmental suitability of the proposed structure is confirmed.

The diffuser design described herein differs from the one given in a previous report (6), in that the structure is located further offshore in deeper water, and uses four less nozzles, resulting in 20% higher nozzle velocity. However, in every other respect, the designs are similar. Therefore, the analyses and conclusions presented in the Applicant's Environmental Report, which show that the effects of station operation on aquatic biology (Ref. 6, Section 5.1.3) will be insignificant, apply equally to the design presented herein.

References

(1) Monthly Bulletin of Lake Levels for October 1972. NOAA - National Ocena Survey, U.S. Dept. of Commerce.

(2) Quirk, Lawler & Matusky Engineers, "Effect of Circulating Water Systems on Lake Ontario and Oswego Harbor Water Temperature and Aquatic Biology," April 1971.

(3) Stone & Webster Engineering Corporation, "Engineering and Ecological Studies for Design of Intake and Discharge Facilities - James A. FitzPatrick Nuclear Power Plant, Power Authority of the State of New York," Appendix C, January 1970.

(4) Harleman, D.R.F., Jirka, G., and Stolzenback, K. D., "A Study of Submerged Multi-Port Diffusers for Condenser Water Discharge With Application to the Shoreham Nuclear Power Station," Ralph M. Parsons Laboratory Report NO. 139, July 1971.

(5) Stone & Webster Engineering Corporation, "Environmental Report - Operating License Stage, James A. FitzPatrick Nuclear Power Plant - Power Authority of the State of New York," Appendix I, May 1971.

(6) Niagara Mohawk Power Corporation, "Applicant's Environmental Report - Construction Permit Stage, Nine Mile Point Nuclear Power Station Unit 2," June 1972.

TABLE 1

Design Parameters of Combined Discharge Diffuser

1.	Total Discharge Flow	1785 cfs
2.	No. of Discharge Nozzles	20
3.	No. of Risers	10
4.	Flow per Nozzle	89 cfs
5.	Diameter of Nozzle	2.5 ft
6.	Nozzle Discharge Velocity	18.2 fps
7.	Centerline Spacing of Risers	40 ft
8.	Temperature Rise of Discharge	30.9°F
9.	Depth of Water at Discharge Location (Based on Low Water Datum)	45 ft
10.	Submergence of Nozzle Centerline	40 ft

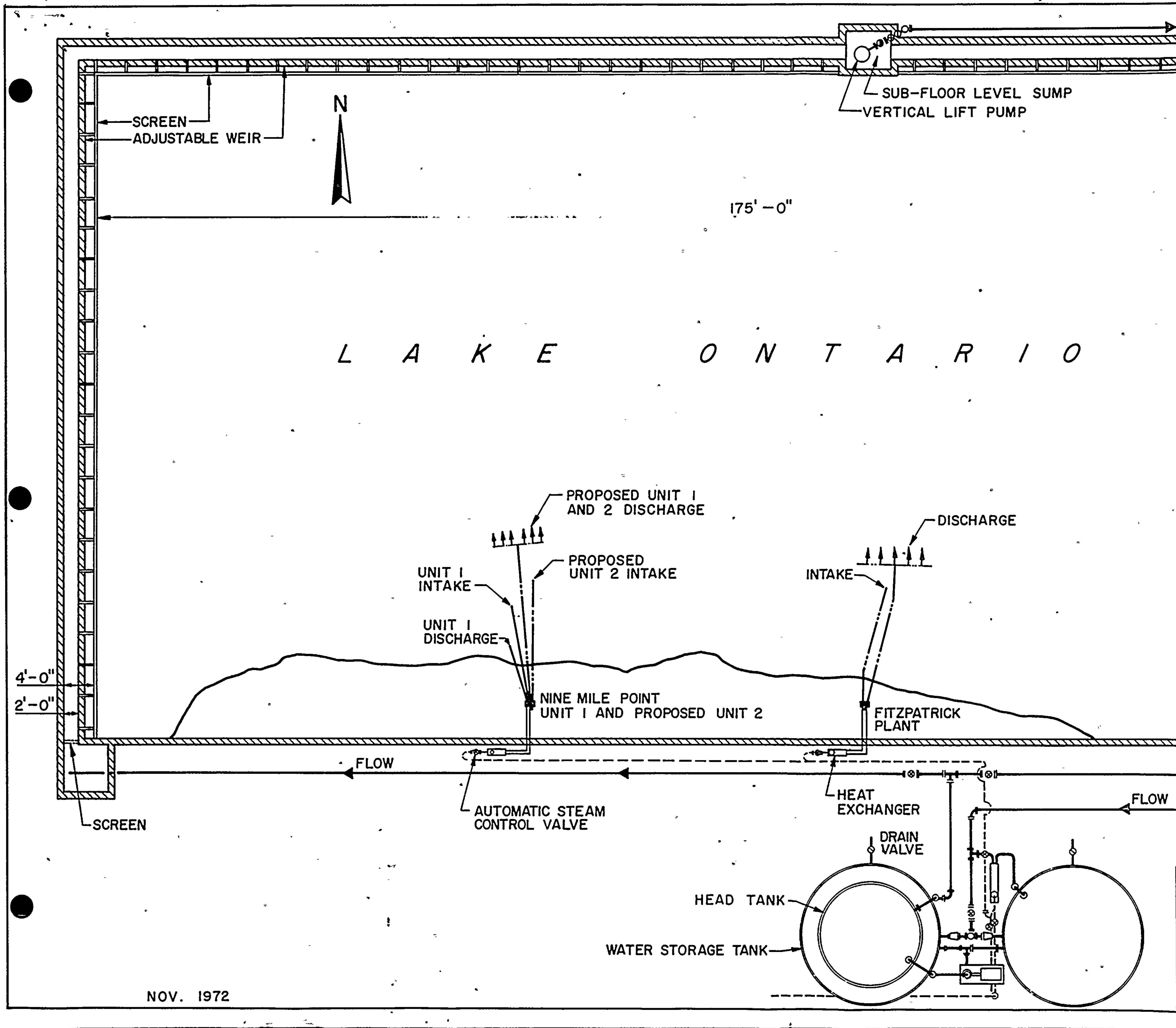
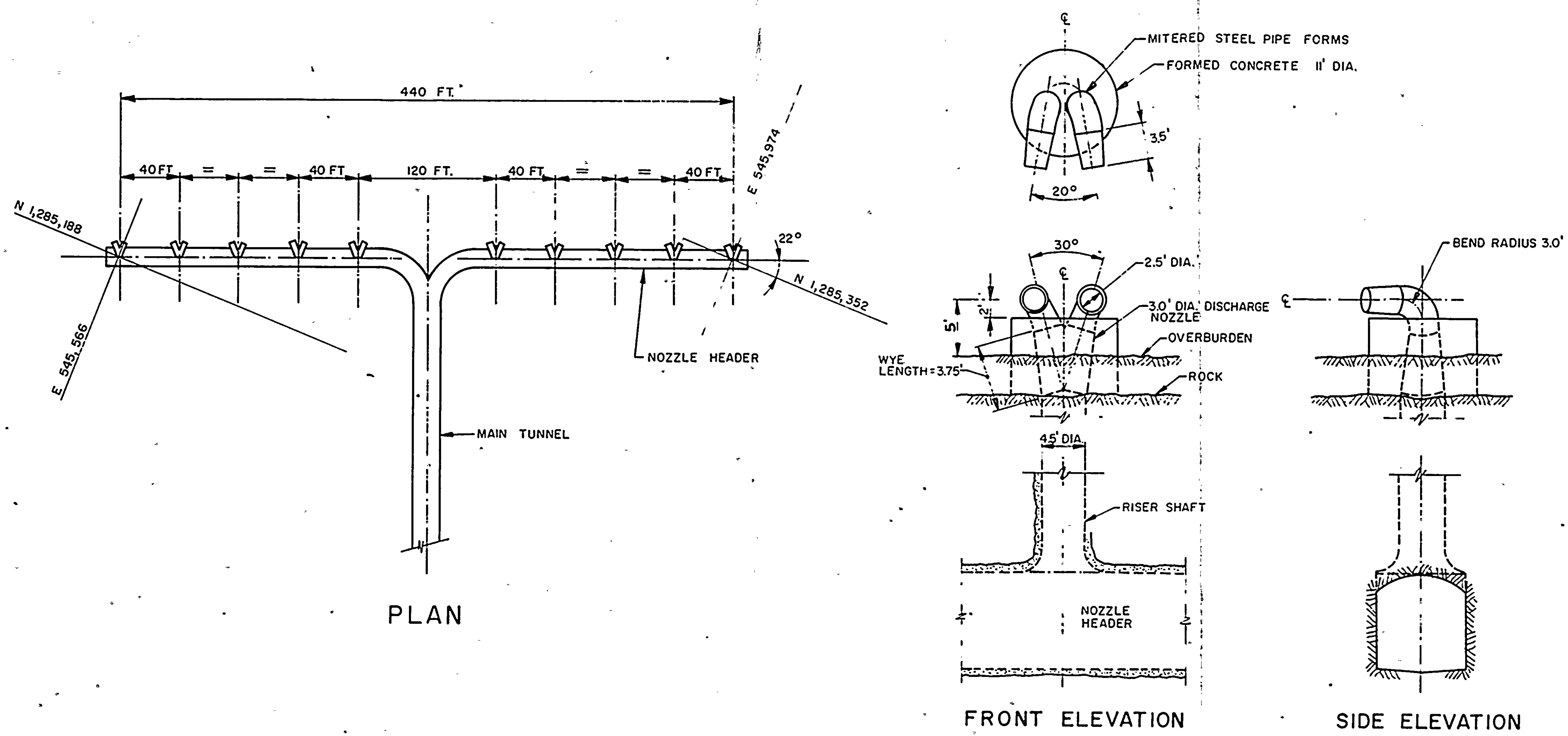


FIG. 1

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

SCHEMATIC LAYOUT OF HYDRAULIC MODEL



SCHEMATIC OF COMBINED THERMAL DISCHARGE STRUCTURE

NOT TO SCALE

NINE MILE POINT NUCLEAR STATION-UNIT 2

NIAGARA MOHAWK POWER CORPORATION

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FIG. 2

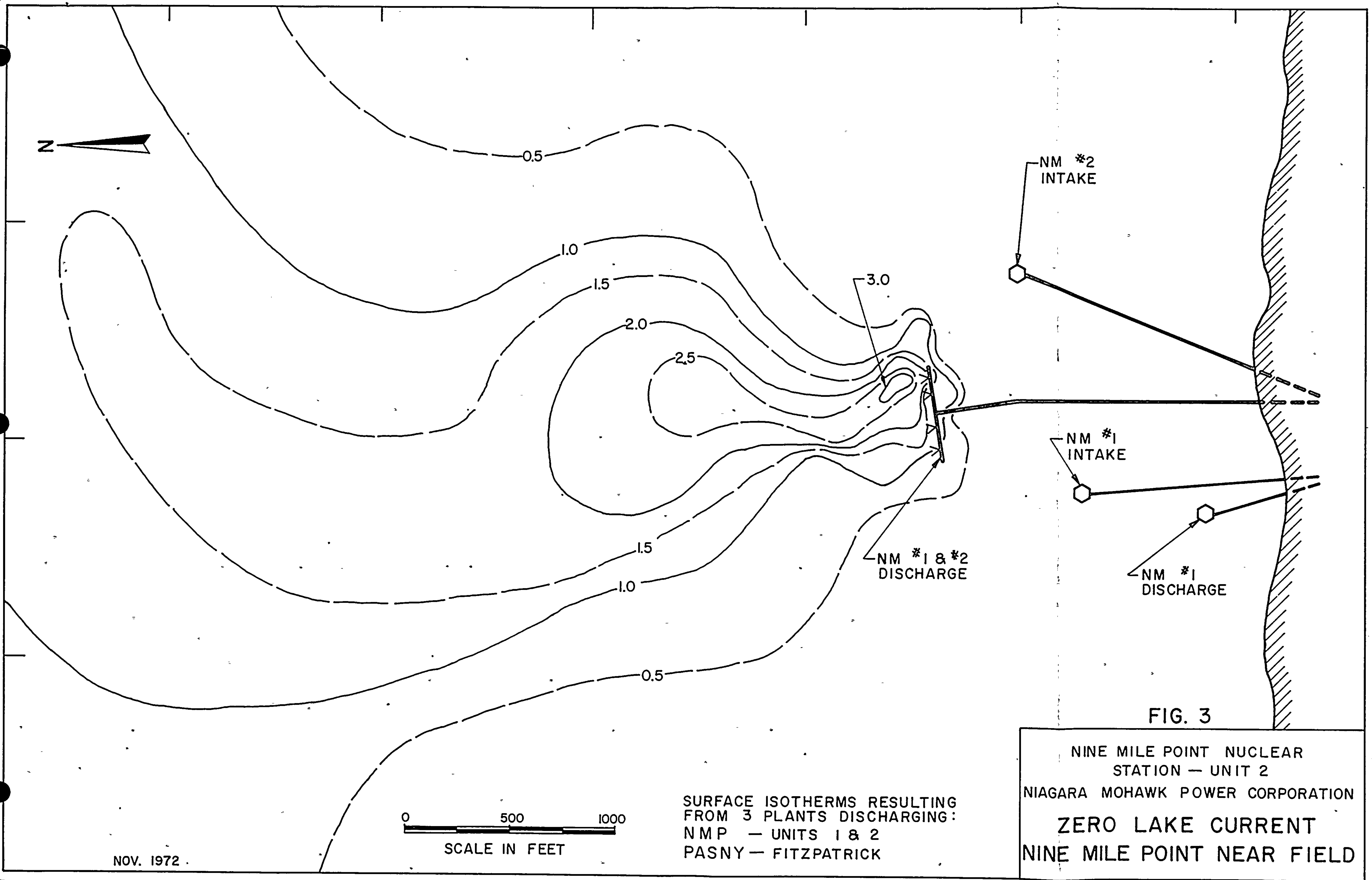


FIG. 3

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

ZERO LAKE CURRENT
NINE MILE POINT NEAR FIELD

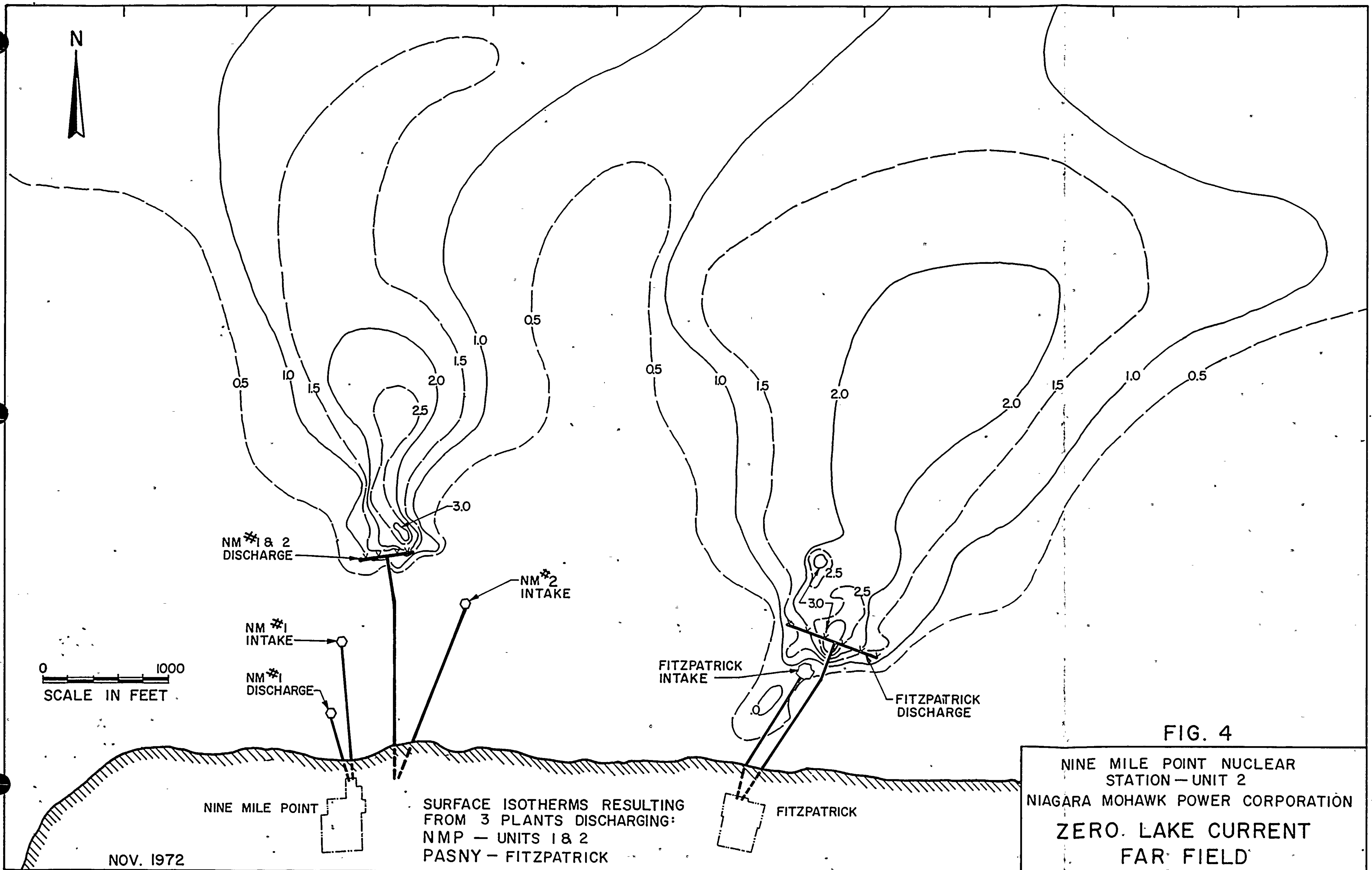
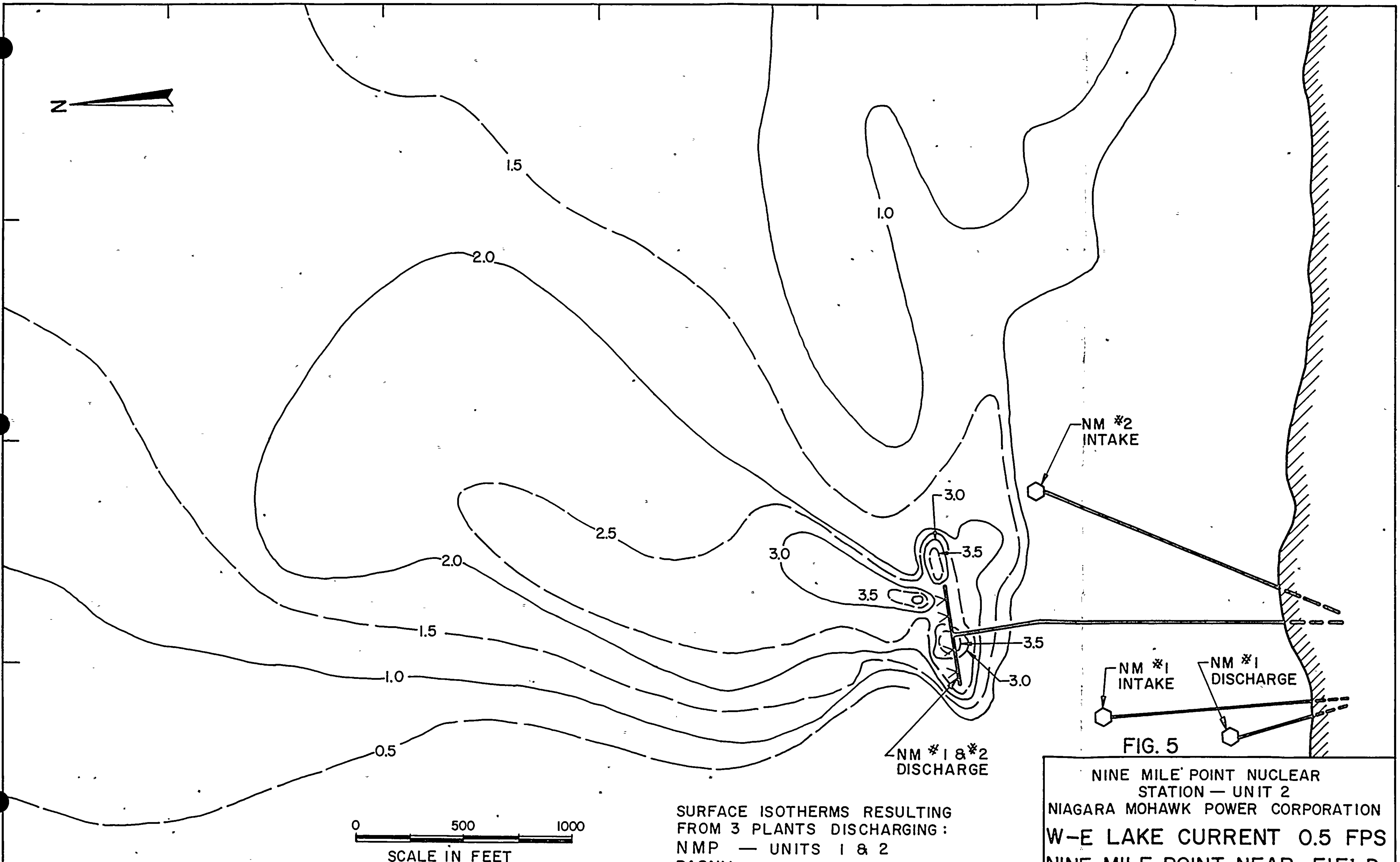


FIG. 4

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

ZERO LAKE CURRENT
FAR FIELD



SURFACE ISOTHERMS RESULTING FROM 3 PLANTS DISCHARGING:
NMP — UNITS 1 & 2
PASNY — FITZPATRICK

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FIG. 5

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

W-E LAKE CURRENT 0.5 FPS
NINE MILE POINT NEAR FIELD

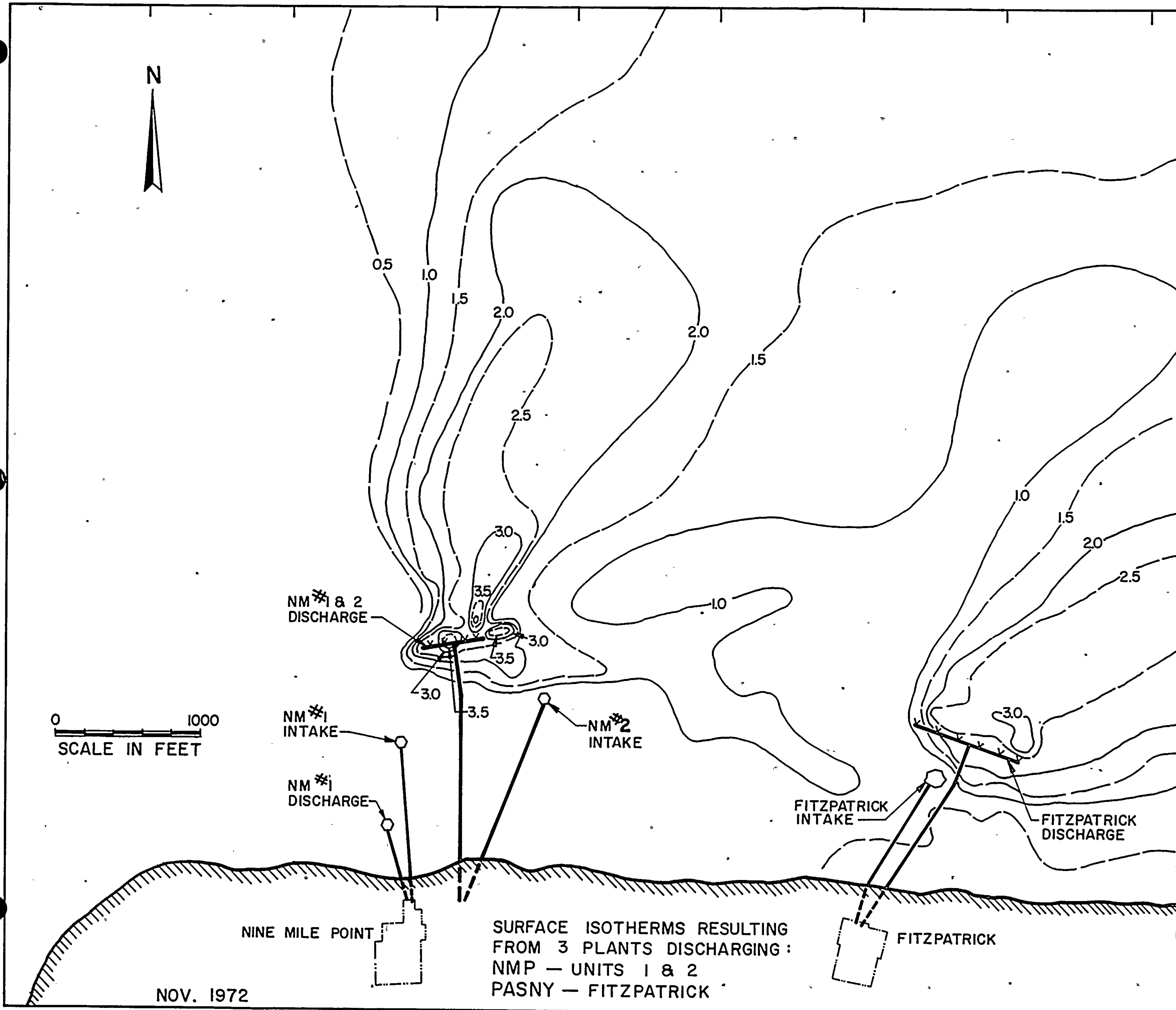
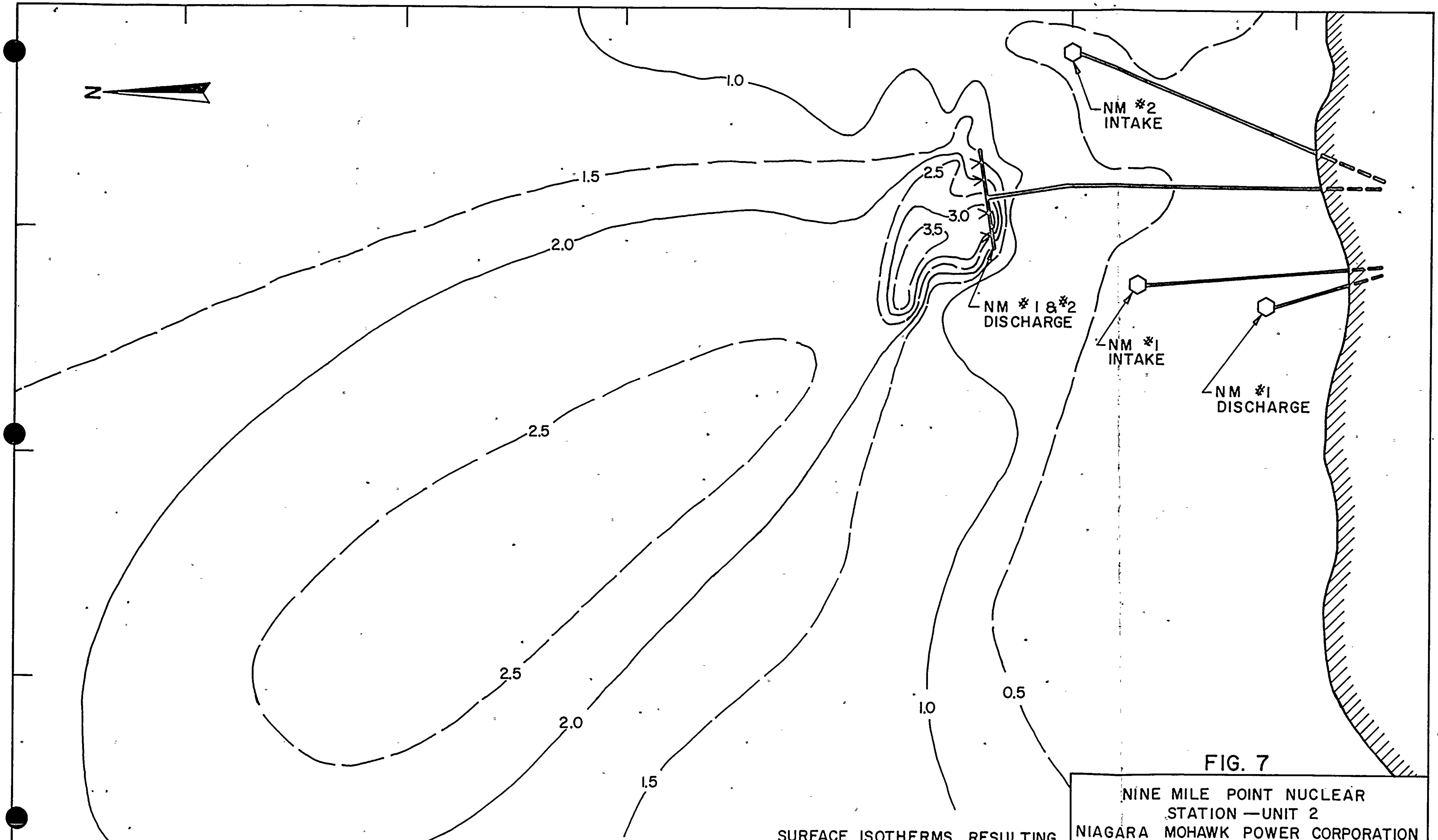


FIG. 6

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

W—E LAKE CURRENT 0.5 FPS
FAR FIELD



0 500 1000
SCALE IN FEET

SURFACE ISOTHERMS RESULTING FROM 3 PLANTS DISCHARGING:
NMP — UNITS 1 & 2
PASNY — FITZPATRICK

NOV. 1972

FIG. 7

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

E-W LAKE CURRENT 0.5 FPS
NINE MILE POINT NEAR FIELD

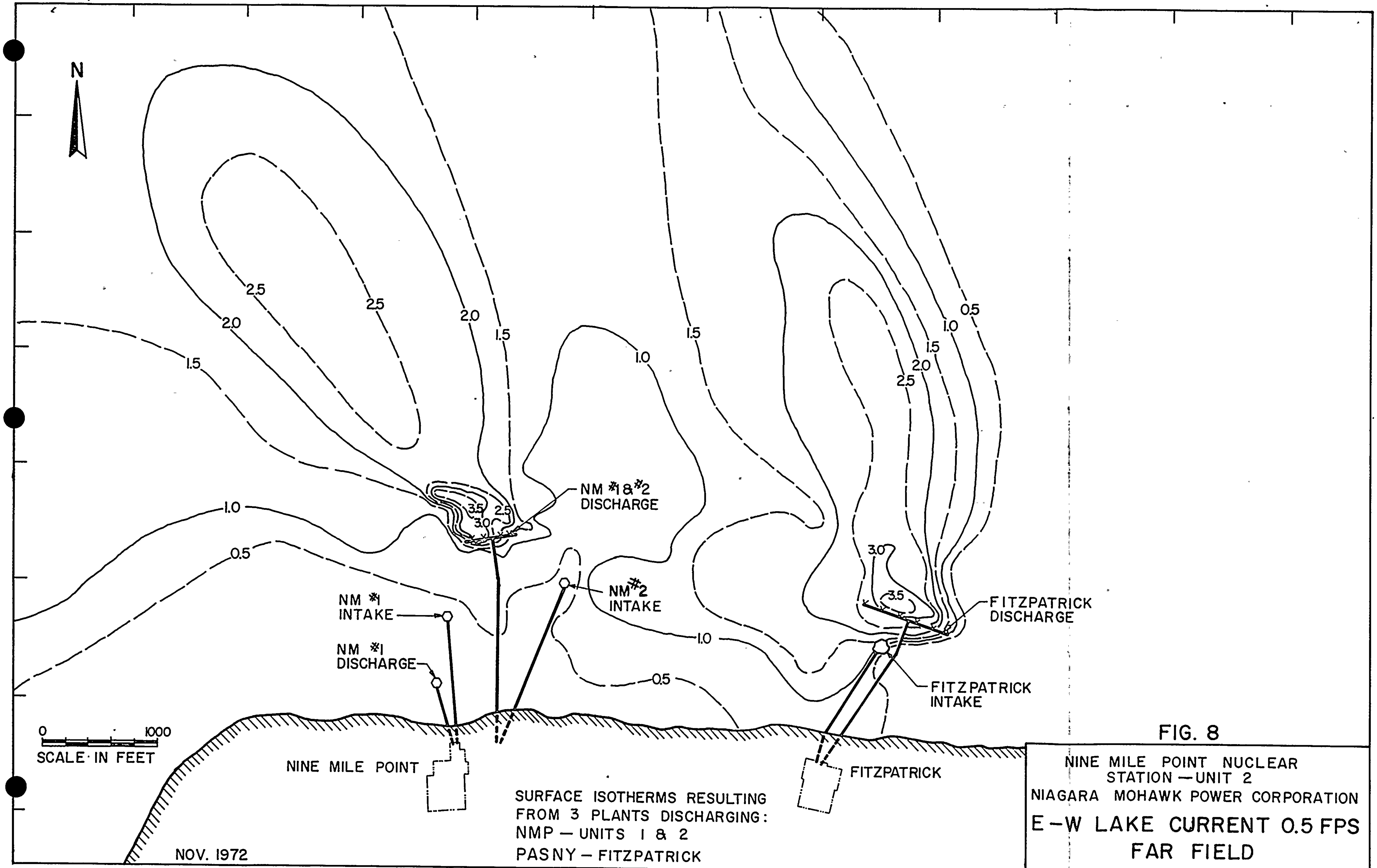


FIG. 8

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

E-W LAKE CURRENT 0.5 FPS
FAR FIELD