NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

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TO: Mr Lear	FROM: Niagara Mohawk Pwr Corp Syracuse, NY G K Rhode	DOCKET NUMBER 50-220 FILE NUMBER DATE OF DOCUMENT 10-18-76 DATE RECEIVED 10-20-76
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DESCRIPTION

Ltr re our 8-11-76 ltr...trans the following:

PLANT NAME: Nine Mile Pt #1

ENCLOSURE

Analysis of degraded grid voltage conditions.................

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ACKNOWLEDGED

FOR ACTION/INFORMATION ENVIRO 10-22-76 ehf

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NIAGARA MOHAWK POWER CORPORATION

NIAGARA MOHAWK

300 ERIE BOULEVARD WEST
SYRACUSE, N.Y. 13202

October 18, 1976

Director of Nuclear Reactor Regulation
Attn: Mr. George Lear, Chief
Operating Reactors Branch #3
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Nine Mile Point Unit 1
Docket No. 50-220
DPR-63

Dear Mr. Lear:

As requested by your August 11, 1976 letter, the enclosed information provides an analysis of Nine Mile Point Unit 1 during a degraded grid voltage condition.

Very truly yours,
NIAGARA MOHAWK POWER CORPORATION

GERALD K. RHODE
Vice President - Engineering

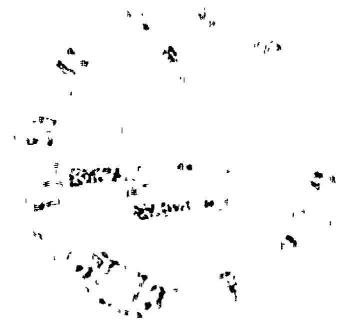
MGM/sz

Enclosure

RECEIVED
OCT 20 1976
U.S. NUCLEAR REGULATORY COMMISSION

The following information is in response to Enclosure 2 of an August 11, 1976 letter from Mr. George Lear to Mr. G. K. Rhode.

The results of a rigorous analysis performed for Nine Mile Point Unit 1 encompass the concerns of that letter with respect to plant operation and equipment failure during a degraded grid voltage condition.



Question No. 1

Evaluate the design of your facility's Class IE electrical distribution system to determine if the operability of safety related equipment, including associated control circuitry or instrumentation, can be adversely affected by short term or long term degradation in the grid system voltage within the range where the offsite power is counted on to supply important equipment. Your response should address all but not be limited to the following:

a. Describe the plant conditions under which the plant auxiliary systems (safety related and non-safety related) will be supplied by offsite power. Include an estimate of the fraction of normal plant operating time in which this is the case.

b. The voltage used to describe the grid distribution system is usually a "nominal" value. Define the normal operating range of your grid system voltage and the corresponding voltage values at the safety related buses.

c. The transformers utilized in power systems for providing the required voltage at the various system distribution levels are normally provided with taps to allow voltage adjustment. Provide the results of an analysis of your design to determine if the voltage profiles at the safety related buses are satisfactory for the full load and no load conditions on the system and the range of grid voltage.

d. Assuming the facility auxiliary loads are being carried by the station generator, provide the voltage profiles at the safety buses for grid voltage at the normal maximum value, the normal minimum value, and at the degraded conditions (high or low voltage, current, etc.) which would require generator trip.

e. Identify the sensor location and provide the trip setpoint for your facility's Loss of Offsite Power (undervoltage trip) instrumentation. Include the basis for your trip setpoint selection.

f. Assuming operation on offsite power and degradation of the grid system voltage, provide the voltage values at the safety related buses corresponding to the maximum value of grid voltage and the degraded grid voltage corresponding to the undervoltage trip setpoint.

Question No. 1 (Continued)

g. Utilizing the safety related bus voltage values identified in (f), evaluate the capability of all safety related loads, including related control circuitry and instrumentation, to perform their safety functions. Include a definition of the voltage range over which the safety related components, and non-safety components, can operate continuously in the performance of their design function.

H. Describe the bus voltage monitoring and abnormal voltage alarms available in the control room.

Response

a. The power supplies to safety related power boards are shown in Figure 1. Auxiliary systems which are safety related are supplied by two reserve station service transformers from offsite 115 KV transmission power at all times, except when supplied by the emergency diesel generators. During normal station operation, auxiliary systems which are non-safety related are supplied by the normal station service auxiliary transformer which is connected to the main generator output leads. During startup, shutdown and refueling or when the normal auxiliary transformer is not available, the two reserve station service transformers from offsite 115 KV transmission provide power to non-safety related auxiliary systems; this represents approximately 0.5 percent of the time. Since commercial operation in 1969, the normal station service transformer has been available when required for normal station operation.

b. Normal operating voltage of the 115 KV grid is 117 KV to 122 KV. The corresponding voltage values at the safety related buses are station auxiliary load dependant and are detailed in Response 1c below.

c. Results of voltage profile analysis are shown below:

GRID AT MINIMUM VOLTAGE

	No Load	Full Load
Grid Voltage (115 KV System)	115 KV	115 KV
Power Board 102 (103)	4085 Volts	3711 Volts
Power Board 16 (17)	585	509
Motor Control Center 161 (171)	585	508

1c. Continued

GRID AT MAXIMUM VOLTAGE

	No Load	Full Load
Grid Voltage (115 KV System)	122 KV	122 KV
Power Board 102 (103)	4306 Volts	3984 Volts
Power Board 16 (17)	621	551
Motor Control Center 161 (171)	621	550

Where:

Full Load -- Is the load as a result of a unit trip coincident with a Loss of Coolant Accident.

No Load -- Is when no safety related or non-safety related station auxiliary loads are connected to the reserve station service transformer.

The results of the analysis above show that the voltage profiles at the safety related buses are satisfactory for the full load and no load conditions on the system.

d. Safety related buses are connected to the 115 KV power source and are not connectible to the station generator.

e. Two undervoltage trip relays sense the 4160 volt bus voltage at each power board, 102 and 103. A low voltage sensed by the relays in a two out of two logic scheme initiate load shedding of a bus and isolation from offsite power. The undervoltage relays are set to trip at 93 volts which is equivalent to 3257 volts on a power board. The above setting was based on system practices for detection of a loss of voltage condition.

f. Assuming operation of offsite power and degradation of grid system voltage, the following values will occur at the safety related buses:

1f. Continued

GRID AT MAXIMUM VOLTAGE

	No Load	Full Load
Grid Voltage (115 KV System)	122 KV	122 KV
Power Board 102 (103)	4306	3984
Power Board 16 (17)	621	551
Motor Control Center 161 (171)	621	550

VOLTAGES CORRESPONDING TO THE
EXISTING UNDERVOLTAGE TRIP SETTING

	No Load	Full Load
Grid Voltage (115 KV System)	92.3 KV	103.8 KV
Power Board 102 (103)	3257	3257
Power Board 16 (17)	470	440
Motor Control Center 161 (171)	470	439

g. The bus voltage values identified in 1F above, corresponding to the undervoltage trip setting, are outside the normal voltage range for continuous operation of safety related equipment at Nine Mile Point Unit 1.

All motors on safety related buses are rated for operation at voltages between 90 percent and 110 percent of name plate rating. On power boards 102 and 103, all motors are rated at 4000 volts and the operating range is 3600 volts to 4400 volts. For power boards 16 and 17, and motor control centers 161 and 171, this range is 495 volts to 605 volts for motors rated at 550 volts. Motors rated at 575 volts are used in the emergency service water and diesel cooling water systems; however, they are only required to operate after onsite emergency power has been established. Under this condition, the 4000 volt bus voltage is regulated. Therefore, the 600 volt bus is maintained within the operating range for both the 550 and 575 volt motors. Also, 575 volt motors are used in the diesel generator and starting system, but operate intermittently. Therefore, the 495 volt to 605 volt normal operating range was established for the 600 volt system. All controls supplied with power from the above power boards will operate satisfactorily within the 495 to 605 voltage range.

1g. Continued

Safety related instrumentation including sensors and logic relays are supplied by 120 volt, single phase, uninterruptible power supplies which are independent of grid and in-plant a.c. distribution system voltage variations.

Refer to Response 4 for a description of modifications proposed to preclude low bus voltage conditions associated with existing trip set points.

h. The following instruments and alarms which monitor bus voltages and power supplies to safety related power boards are located in the Control Room. Also, refer to Figure 1.

Voltmeters

115 KV Line supply from Lighthouse Hill

115 KV Line supply from Oswego

115 KV Bus Voltage

4.16 KV Reserve supply to Power Boards 11, 101 and 102

4.16 KV Reserve supply to Power Boards 12, 101 and 103

Power Board Buses 11, 12, 102 and 103

Diesel Generator 102, 103

Voltage Recorders

115 KV Bus

Power Board 11 Bus

Power Board 101 Bus

Computer - Voltage Readout

Diesel Generator 102 (F456, F457, F458)[1]

Diesel Generator 103 (F466, F467, F468)[1]

115 KV Bus (F432, F433, F434)[1]

[1] Refer to Figure 1 for computer point identification.

1h. Continued

Computer and Annunciator Alarms

115 KV Reserve System Undervoltage (W030)[1]

Power Board 16 Bus B Undervoltage (E153)[1]

Power Board 17 Bus B Undervoltage (E175)[1]

Question No. 2

The functional safety requirement of the undervoltage trip is to detect the loss of offsite (preferred) power system voltage and initiate the necessary actions required to transfer safety related buses to the on-site power system. Describe the load shedding feature of your design (required prior to transfering to the onsite [diesel generator] systems) and the capability of the onsite systems to perform their function if the load shedding feature is maintained after the diesel generators are connected to their respective safety buses. Describe the bases (if any) for retention or reinstatement of the load shedding function after the diesel generators are connected to their respective buses.

Response

The following describes the load shedding and diesel start sequence for power board 102. An identical arrangement is provided for power board 103.

Power board 102 bus voltage is continuously monitored by two undervoltage relays with inverse time characteristics (lower voltage faster response). When the bus voltage drops, and the relays operate a load shedding signal will be initiated which starts diesel generator 102 and trips the following:

1. Power board 102 supply breaker R1012
2. Containment Spray Pumps 111, 112
3. Containment Spray Raw Water Pumps 111, 112
4. Core Spray Pump 121
5. Core Spray Topping Pumps 111, 121
6. Lock-out Relay 86-16 which starts Control Rod Drive Pump 11 and trips,
    a. Bus tie breaker R1042
    b. Reactor building closed loop cooling water pump 13
    c. Emergency service water pump 11
    d. Reactor shutdown cooling pumps 11, 13
    e. Spent fuel pool circulation pump 11

Lock-out Relay 86-16 is located in the control room and can be reset when power board voltage is restored to permit manual start of the equipment if required.

Response (Continued)

The diesel generator breaker R1022 will close to restore bus voltage after the following conditions are met:

1. Power board 102 supply breaker R1012 is open.
2. Diesel generator speed is above 750 RPM, and terminal voltage is above 3100 volts.
3. Fault protective relays do not sense a fault.

With the bus restored, the engineered safeguard equipment will start or re-start automatically upon initiation by the reactor protection system.

In the Nine Mile Point Unit 1 design, the load shedding feature is maintained after the diesel generators are connected to their respective safety buses. The capability of the on-site system to perform its function was demonstrated by pre-operation test prior to commercial operation. The tests were repeated prior to operation at 1850 Mw(t)[2] to demonstrate performance of the system simulating loss of off-site power and loss-of-coolant accident. Bus voltage was recorded during starting of the safeguard motors with diesel generator power. Analysis of the test results confirmed that undervoltage relays with their present settings would not initiate load shedding under motor starting conditions.

2. Nine Mile Point Nuclear Station Technical Supplement to Petition to Increase Power Level, Fifth Addendum, January 1971.

Question No. 3

Define the facility operating limits (real and reactive power, voltage, frequency and other) established by the grid stability analyses cited in the FSAR. Describe the operating procedures or other provisions presently in effect for assuring that your facility is being operated within these limits.

Response

Grid stability analysis was not included in the Nine Mile Point Unit 1 FSAR. Recent transient stability studies were performed simulating the performance of the interconnected transmission system for various contingency conditions in the vicinity of the Nine Mile Point plant. The transient stability studies were performed in conformance with criteria established by the Northeast Power Coordinating Council[3].

Analysis of the studies show:

(1) If a fault occurs on the 345 KV transmission system in New York State, the two 115 KV sources for the plant auxiliary equipment from Lighthouse Hill and Oswego are not interrupted.

(2) If a fault occurs on the 115 KV transmission system in the area of Lighthouse Hill or Oswego, the Nine Mile Point unit remains stable and its associated 345 KV transmission is not affected.

(3) Direct tripping of Nine Mile Point Unit 1, whether due to a fault on the 345 KV system or not, will neither open the two 115 KV auxiliary power lines nor disrupt the station service bus.

(4) The largest generating unit in the Northeast is Con Edison's Ravenswood #3 unit rated at 972 MW. For loss of this unit, the Nine Mile Point unit remains stable and its associated 345 KV transmission and the two 115 KV auxiliary power lines are not affected.

(5) The largest generating unit on the 115 KV system in the area is Oswego Unit 4 rated at 100 MW. For loss of this unit, remaining generating units in the area remain stable.

These results do not indicate any restrictions on the real and reactive power, voltage or frequency for Nine Mile Point Unit 1.

3. "Basic Criteria for Design and Operation of Interconnected Power Systems"

Question No. 4

Provide a description of any proposed actions or modifications to your facility based on the results of the analyses performed in response to items 1-3 above.

Response

The voltage profile analysis indicates that system voltages on power boards and motor control centers, corresponding to the undervoltage trip and transfer to diesel generator power, are too low to assure operation of all equipment and associated controls in the unlikely event of a degraded grid condition. The setpoint of the undervoltage relays will be raised to the equivalent of a bus voltage of 3600 volts. This is the minimum operating voltage level for the 4000 volts motors. The voltage levels on the safety related buses and the 115 KV system corresponding to the new setting are tabulated below.

VOLTAGES CORRESPONDING TO NEW UNDERVOLTAGE TRIP SETTINGS

	No Load	Full Load
Grid Voltage (115 KV System)	102 KV	112 KV
Power Board 102 (103)	3600	3600
Power Board 16 (17)	519	492
Motor Control Center 161 (171)	519	491

Since settings of the existing relays cannot be increased to 3600 volts, they will be replaced. Installation is scheduled for the Spring, 1977 refueling outage. Detail design information will be available by November 30, 1976. Equipment procurement, which has been initiated, will require a minimum lead time of 16 weeks.