NIAGARA MOHAWK

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B. Ralph Sylvia
Executive Vice President
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June 18, 1993
NMP1L 0765

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

Re: Nine Mile Point Unit 1
Docket No. 50-220
DPR-63
TAC No. M69209

Gentlemen:

SUBJECT: REGULATORY GUIDE 1.97 - BOILING WATER REACTOR NEUTRON FLUX MONITORING

Section 6.2 of Generic Letter 82-33 requested that licensees provide a report on their implementation of Regulatory Guide 1.97, Revision 2, and methods for complying with the Commission's regulations including supporting technical justification of any proposed deviations or alternatives. A large number of deviation requests were received from Boiling Water Reactor licensees concerning neutron flux monitoring instrumentation. These requests were initially denied.

In support of these requests, the Boiling Water Reactor Owner's Group submitted NEDO-31558, "Position on NRC Regulatory Guide 1.97, Revision 3, Requirements for Post-Accident Neutron Monitoring System." NEDO-31558 proposed alternative criteria for neutron flux monitoring instrumentation in lieu of the Category 1 criteria stated in RG 1.97.

The Staff completed its review of NEDO-31558, and by letter dated January 13, 1993, to the Boiling Water Reactor Owner's Group, issued a safety evaluation report. The safety evaluation report concluded that for current Boiling Water Reactor operating licensees the criteria of NEDO-31558 are acceptable.

By letter dated April 15, 1993, the Staff requested that Niagara Mohawk review the Nine Mile Point Unit 1 neutron flux monitoring instrumentation against the criteria of NEDO-31558 to determine whether these criteria are being met, and provide a letter to the Commission documenting the result of this review within 60 days. The Staff's letter requested that if the criteria are not being met, NMPC should either make a commitment to meet the criteria and state when this commitment will be fulfilled, or explicitly state any deviations from the criteria and provide supporting justification. The staff also requested that Niagara Mohawk review the Nine Mile Point Unit 1 Emergency Operating Procedures to assure that there is no plant-specific role for neutron flux monitoring that differs from that identified in NEDO-31558.

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The Staff indicated that if the role of neutron flux monitoring does not differ from that identified in NEDO-31558, Niagara Mohawk will not be required to upgrade its qualification to meet the Category I criteria. The enclosure to this letter provides the requested information.

Very truly yours,

B. Ralph Sylvia
Exec. Vice President-Nuclear

JMT/mls
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Enclosure

pc: Mr. T. T. Martin, NRC Regional Administrator
Mr. R. A. Capra, Director, Project Directorate I-1, NRR
Mr. D. S. Brinkman, Senior Project Manager, NRR
Mr. W. L. Schmidt, Senior Resident Inspector
Records Management

A COMPARISON OF THE NINE MILE POINT UNIT 1 NEUTRON FLUX MONITORING INSTRUMENTATION AGAINST THE DESIGN CRITERIA OF NEDO-31558

1. MONITORED RANGE-

   a. NEDO-31558 Criterion: Neutron flux display instrumentation should cover a range of at least 1% to 100% of rated reactor power.

   b. Nine Mile Point Unit 1 Design: Average Power Range Monitoring (APRM) System instrumentation monitors a range of approximately 0.5% to 125% of rated reactor power. Associated RG 1.97 display instruments (dual-pen chart recorders RI05A, B, C, and D located on main control room Console E) have a scale range of 0 to 125% of rated reactor power.

2. INSTRUMENT LOOP ACCURACY-

   a. NEDO-31558 Criterion: Instrument loop accuracy should be at least $\pm$2% of rated power throughout the monitored range identified in Item 1.a above (i.e., the indicated value of reactor power level shall be within $\pm$2% of actual reactor power throughout the monitored range).

   b. Nine Mile Point Unit 1 Design: The indicated value of reactor power shown on Average Power Range Monitoring (APRM) System display instrumentation is obtained by averaging the output signals of an assigned number of in-core Local Power Range Monitoring (LPRM) System detectors. LPRM and APRM instrument loops are periodically calibrated to assure that displayed values are an accurate reflection of actual reactor power level. LPRMs are calibrated using the Traversing In-Core Probe (TIP) System; a gain adjustment of each LPRM amplifier is made as necessary for the respective output signal to indicate actual (measured) local heat flux as determined by a movable TIP detector. Also, a plant heat balance is performed to determine actual reactor power level. The output signal from each of the APRM units is adjusted as necessary to indicate the true percentage of rated core thermal power consistent with the result of the heat balance calculation. The periodic performance of these calibrations assures that LPRM/APRM instrument loop inaccuracies during normal operating conditions are minimal - reduced to, essentially, the accuracy of display scale readability (typically, $\pm$0.5%). In addition, plans are currently in place - within the scope of the Design Basis Reconstitution Program - for computing the overall accuracy of the Average Power Range Monitoring (APRM) System instrument loops, from the LPRM detectors throughout the display device. These calculations are planned to include consideration of local environmental factors representative of normal operating conditions and, separately, post-accident conditions. The results of these calculations will be compared to the $\pm$2% accuracy criterion of NEDO-31558,

and if the criterion is not met Niagara Mohawk will either 1) make a commitment to meet the criterion and state when this commitment will be fulfilled or 2) provide appropriate supporting justification for deviating from the criterion. The accuracy calculation will be completed by March 31, 1994.

3. DISPLAY INSTRUMENT RESPONSE CHARACTERISTIC-

a. NEDO-31558 Criterion: Instrument loop response should be at least 5 sec/10% change in reactor power (i.e., a 10% change in actual reactor power level shall be indicated no later than 5 seconds after the occurrence of the change).

b. Nine Mile Point Unit 1 Design: The design of the power range neutron monitoring system at Nine Mile Point Unit 1 is essentially the same as that identified and described in NEDO-31558. Therefore, the monitor response time identified on page 41 of NEDO-31558 (1 second for a 100% change in flux) applies. Traces on the Average Power Range Monitoring (APRM) System chart recorders following a reactor scram, showing a prompt decrease in indicated report power level from 100% to 0%, also demonstrate conformance with the Response Characteristic criterion specified in NEDO-31558.

4. EQUIPMENT ENVIRONMENTAL QUALIFICATION-

a. NEDO-31558 Criterion: Instrument loop components should be qualified to operate in an ATWS environment, per the plant-specific criteria that apply for implementation of the ATWS Rule (10CFR50.62).

b. Nine Mile Point Unit 1 Design:

Based on requirements that have been established for plant-specific implementation of the ATWS Rule (10CFR50.62), the anticipated operational occurrence (as defined in 10CFR50 Appendix A) producing the most severe resultant plant conditions for Nine Mile Point Unit 1 when combined with a failure to scram has been determined to be a closure of the main steam line isolation valves (MSIVs) occurring at rated reactor power.

Note: "Loss of Coolant Accidents" as defined in 10CFR50 Appendix A are beyond the scope of anticipated operational occurrences and therefore postulated events of this type are exempted from consideration.

The Local Power Range Monitoring (LPRM) System detector assemblies (located within the reactor core) have been designed to operate continuously in a saturated liquid/steam environment of 600°F/1250 psig. Also, continued operability of the type of detectors used at Nine Mile Point Unit 1 (GE Model NA-200) has been verified through the performance of appropriate

qualification procedures for transient pressure conditions of up to 1400 psig. Analysis results confirm that these environmental design limits are not exceeded for the plant-specific design basis "MSIV closure with scram failure" event at Nine Mile Point Unit 1.

Power range neutron monitoring system electrical components that are located in the drywell include cables, connector assemblies, heat shrinkable tubing that is applied over connector assemblies to assure a completely moisture-proof seal, and primary containment electrical penetrations. Design temperature, relative humidity, and radiation ratings for the electrical function of these components are specified as appropriate considering 1) continuous exposure under normal operating conditions, and 2) peak profiles (e.g., temperature vs time) following occurrence of postulated design basis transients and accidents. The most limiting of these environmental design conditions are as follows:

Environmental Factor	Design Value	Remarks
Temperature Rating	268°F	Continuous over 40 years; some components may have a lower continuous temperature rating, but these components also have a higher temperature rating (greater than 300°F) for exposures limited to a duration of several hours.
Humidity Rating	90%	Continuous.
Radiation Rating	1 X 10^6 RADS	Total gamma exposure integrated over 40 years.

Analysis results confirm that the environmental conditions calculated to occur in the drywell during the first hour following the plant-specific design basis "MSIV closure with scram failure" event at Nine Mile Point Unit 1 do not exceed the environmental design limits specified for these power range neutron monitoring system components.

Environmental qualification of the power range neutron monitoring system electrical components that are located in the Reactor Building, in the Turbine Building and in the Control Complex is not required because these areas remain in a mild environment throughout the duration of the plant-specific

design basis "MSIV closure with scram failure" event at Nine Mile Point Unit 1.

5. FUNCTION TIME-

a. NEDO-31558 Criterion: Instrumentation shall function for a minimum of 1 hour in the operating environment defined in Item 4.a above.

b. Nine Mile Point Unit 1 Design: Power range neutron monitoring system electrical components have been designed to operate in the environment for the times identified in Item 4.b above. This data demonstrates conformance with the Function Time criteria specified in NEDO-31558.

6. EQUIPMENT SEISMIC QUALIFICATION-

a. NEDO-31558 Criterion: Seismic qualification of equipment is not required. Compliance with Regulatory Guide 1.100 is not required.

b. Nine Mile Point Unit 1 Design: Although seismic qualification of power range neutron monitoring system instrument loop components is not required per the criteria listing in NEDO-31558, design specifications for some neutron monitoring system components have incorporated seismic requirements imposed by other programs. Further discussion of such seismic design requirements is beyond the scope of information relevant to implementation of RG 1.97, and is therefore not included here.

7. INSTRUMENT LOOP REDUNDANCY AND SEPARATION-

a. NEDO-31558 Criterion: Monitoring instrumentation should be redundant; physical separation of redundant instrument loop cables and components is desirable, but is not required.

b. Nine Mile Point Unit 1 Design: The instrument loops and display devices for Average Power Range Monitoring (APRM) System Channels 11, 12, 13, and 14 are functionally independent from, and redundant to, the instrument loops and display devices for APRM System Channels 15, 16, 17, and 18.

Cabling associated with APRM System Channels 11, 12, 13, and 14 is routed such that physical separation is maintained between cabling associated with APRM System Channels 15, 16, 17, 18.

A comprehensive evaluation of the adequacy of APRM System instrument loop cable routing (including separation between redundant channels) was performed and documented by Niagara Mohawk as part of the restart activities for Unit 1 in 1989. The associated "Regulatory Guide 1.97 Cable Separation Evaluation Report" was reviewed by the NRC during Region I inspections

50-220/89-25 and 50-220/89-35, and the NRC concluded that the evaluating results and associated documentation were acceptable.

8. INSTRUMENT LOOP POWER SOURCES-

a. NEDO-31558 Criterion: Power to instrument loops should be supplied from an uninterruptible and reliable source; Class 1E power is not required.

b. Nine Mile Point Unit 1 Design: Power range neutron monitoring system instrumentation is powered by Safety Related, Class 1E, 120V AC Reactor Protection System (RPS) Busses 11 and 12. Redundant channels of monitoring and display instrumentation are powered by separate busses; specifically:

- Average Power Range Monitoring (APRM) System Channels 11, 12, 13, and 14 instrument loops (includes the APRM Channel 11/12 and the APRM Channel 13/14 dual-pen chart recorders), and the associated Local Power Range Monitoring (LPRM) System detector instrument loops, are powered by RPS Bus 11, and

- APRM System Channels 15, 16, 17, and 18 instrument loops (incudes the APRM Channel 15/16 and the APRM Channel 17/18 dual-pen chart recorders), and the associated LPRM System detector instrument loops, are powered by RPS Bus 12.

If a complete loss of all off-site power sources occurs, power to each RPS bus is supplied by the respective division emergency diesel generator. This transfer to emergency (diesel generator) power occurs automatically - initiated as a result of the emergency bus undervoltage condition. During the time between the loss of off-site power and closure of the respective emergency diesel generator output breaker (an interval of approximately 10 seconds) each RPS bus remains energized via the 125V DC battery and an associated divisional Uninterruptible Power Supply (UPS) DC inverter. Thus, a continuous supply of electrical power is available to power range neutron monitoring system instrumentation (including the associated chart recorders) during loss of off-site power events. Also, if a complete loss of one division of backup power sources (emergency diesel generator and UPS) occurs in combination with a complete loss of off-site power, four channels of power range neutron monitoring system instrumentation (including associated dual pen-chart recorders) remain available.

A detailed review of the power supplies and associated circuit breaker controls for both of the RPS busses, and of the loads supplied by each of the RPS busses, was performed and this review confirmed that actuation of control logics for automatic load shedding of emergency busses at Nine Mile Point Unit 1 design basis events does not result in any loss of power to any power range neutron monitoring system instrumentation.

9. INSTRUMENT CHANNEL AVAILABILITY-

a. NEDO-31558 Criterion: Instrumentation should be available prior to the start of an accident.

b. Nine Mile Point Unit 1 Design: During plant operation in the STARTUP and RUN modes, applicable Technical Specifications prescribe specific requirements for:

- The minimum number of operable Average Power Range Monitoring (ARPM) System instrument channels in each of the redundant reactor protection trip systems, and
- The maximum number of Local Power Range Monitoring (LPRM) detector inputs to an APRM channel that can be bypassed in order for the APRM channel to be considered operable.

Technical Specifications also require the periodic performance of APRM instrument channel functional tests and calibrations.

Instructions contained in the plant startup procedure require the performance of a functional check of the APRM System display instruments (the chart recorders on control room Console E) as part of the operator actions required in advance of transferring the reactor operating mode from STARTUP to RUN.

This combination of procedural instructions and Technical Specification operability requirements provides reasonable assurance that power range neutron monitoring system instrumentation is available prior to the start of an accident. (Also, refer to associated information on power supply availability that is presented under Item 8.b, above.)

10. QUALITY ASSURANCE PROGRAM APPLICABILITY-

a. NEDO-31558 Criterion: Quality Assurance Program requirements should be applied consistent with the guidelines specified in NRC Generic Letter 85-06.

b. Nine Mile Point Unit 1 Design: Local Power Range Monitoring (LPRM) System and Average Power Range Monitoring (APRM) System instrument loop electrical components that are necessary for display of reactor power (from sensor through display device) are each classified as Safety Related. In addition, all components that perform an electrical isolation function between Class 1E and Non-1E portions of the LPRM and APRM instrument loops are also classified as Safety Related. Niagara Mohawk "Quality Assurance Topical Report for Nine Mile Point Nuclear Station Operations" (NMPC-QATR-1) requirements are applied to equipment classified as Safety Related,

and through this application Niagara Mohawk achieves compliance with the guidance provided in NRC Generic Letter 85-06.

11. DISPLAY AND RECORDING-

a. NEDO-31558 Criterion: Instrument loop output signal [for each channel] should be continuously recorded.

b. Nine Mile Point Unit 1 Design: While the plant is in the power operating mode, the output of each Average Power Range Monitoring (ARPM) System channel is continuously recorded on a dedicated dual-function two-pen chart recorder (two APRM channels per recorder). These APRM chart recorders are located in the main control room on Console E.

12. DISPLAY DEVICE IDENTIFICATION-

a. NEDO-31558 Criterion: Display devices should be identified (i.e., uniquely marked) per CRDR Program criteria specified as applicable to post-accident monitoring instrumentation.

b. Nine Mile Point Unit 1 Design: The Average Power Range Monitoring (APRM) System chart recorders are uniquely marked to indicate their classification as key post-accident (Regulatory Guide 1.97) monitoring instruments. This marking is consistent with applicable specifications contained in the Nine Mile Point Unit 1 "Human Factors Manual for Future Control Room Design Changes."

13. INSTRUMENT LOOP INTERFACES-

a. NEDO-31558 Criterion: Non-1E portions of instrument loops should be electrically isolated from Class 1E portions as appropriate to assure that non-1E portions do not interfere with the accomplishments of reactor protection system [scram] function.

b. Nine Mile Point Unit 1 Design: A comprehensive evaluation of Local Power Range Monitoring (LPRM) System and Average Power Range Monitoring (APRM) System Class 1E instrument loop electrical isolation adequacy at interfaces with Non-1E circuits and components was completed by Niagara Mohawk as part of the restart activities for Unit 1 1989. This evaluation confirmed that the Class 1E portions of these instrument loops are adequately isolated from Non-1E circuits and components. The associated "Regulatory Guide 1.97 Isolation Evaluation Report" (Revision 0, dated September 19, 1990) was reviewed by the NRC during Region I inspection 50-220/89-25, and the NRC concluded that the evaluation results, and associated documentation, were acceptable.

14. SERVICE, TEST, AND CALIBRATION OF INSTRUMENT LOOP EQUIPMENT-

a. NEDO-31558 Criterion: Plant-specific procedures should be established for instrument loop servicing, testing, and calibration (including scheduling).

b. Nine Mile Point Unit 1 Design: Conformance with the power range neutron monitoring system service, test, and calibrations procedures criteria of NEDO-31558 is accomplished through plant-specific procedures which provide (as appropriate) detailed requirements, instructions, and acceptance criteria for each of the following:

- Functional test and calibration of LPRM meters
- Functional test and calibration of APRM recorders
- Gain Adjustment of APRM units
- Minimum required frequency for performance of LPRM and APRM functional tests and calibrations

15. HUMAN FACTORS-

a. NEDO-31558 Criterion: The design of display devices should incorporate good human factors engineering practices consistent with those established and specific by the CRDR Program as applicable to control room display instrumentation.

b. Nine Mile Point Unit 1 Design: The location and design features of the Average Power Range Monitoring (APRM) System chart recorders were evaluated and determined to be in conformance with standard human factors engineering guidelines for control room display instrumentation. Documentation of the performance and results of this human factors review is contained in the report "Nine Mile Point Unit 1 Human Factors Review of RG 1.97 Instruments" prepared and issued by the ARD Corporation and dated October 1990.

16. DIRECT MEASUREMENT OF VARIABLE-

a. NEDO-31558 Criterion: Instrumentation should be provided which directly monitors neutron flux.

b. Nine Mile Point Unit 1 Design: The Local Power Range Monitoring (LPRM) System detectors are located within the core, vertically and horizontally distributed such that neutron flux in all regions is monitored. The output of selected LPRM detectors is input to the Average Power Range Monitoring (APRM) System, and therefore APRM display instrumentation provides

indication of the direct measurement of neutron flux. (Also, refer to associated information presented under Item 2.b., above).

In summary, the Nine Mile Point Unit 1 Neutron Flux Monitoring system meets the criteria stated in NEDO-31558 as discussed above.

ROLE OF NEUTRON FLUX MONITORING DISPLAY INSTRUMENTATION AT NINE MILE POINT UNIT 1

The transient and accident event analyses descriptions contained in Section 4, "Event Analysis To Determine Required NMS Post-Accident Monitoring Function," of NEDO-31558 were reviewed for the purpose of assessing the role of neutron monitoring system (NMS) display instrumentation identified therein as compared to the role of NMS display instrumentation reflected in the Nine Mile Point Unit 1 Emergency Operating Procedures (EOPs). However, several of the relatively significant factors which make this type of a direct one-for-one comparison somewhat difficult are listed below.

1. The analyses of event sequences and the description of associated operator action is documented in NEDO-31558 do not consider the operation of the Emergency Cooling System. At Nine Mile Point Unit 1, the plant-specific response to isolation events (e.g., a closure of the main steam line isolation valves, or a turbine trip with bypass valve failure) differs substantially from that described in NEDO-31558. This difference is due primarily to the control of reactor vessel pressure that is effected through the operation (either manual or automatic) of the emergency condensers. In the extreme (an isolation event combined with a failure to scram), knowledge of reactor power level (supplied by NMS display instrumentation) can make a determinant difference in various decision steps related to response actions specified in the Emergency Operating Procedures; such actions include tripping reactor recirculation pumps, deliberately lowering reactor vessel water level, emergency depressurizing the reactor vessel, and/or injecting Liquid Poison (sodium pentaborate) into the reactor vessel. Therefore, unlike the conclusions stated in NEDO-31558, availability of NMS display instrumentation for some isolation events at Nine Mile Point Unit 1 does make a significant difference in resultant post-event plant conditions and associated required operator actions.

2. Certain statements regarding emergency response actions that are made in the event analysis section of NEDO-31558 deviate from applicable operator actions specified in the Nine Mile Point Unit 1 EOPs and/or are not fully consistent with the operations philosophy employed at Nine Mile Point Unit 1. Two examples of such statements from the discussion of the event "Large Break LOCA with Failure of One Division of Low Pressure ECCS," (NEDO-31558, page 22) are quoted below.

   - *"...the operator does not have to take manual actions until the reactor [vessel] is depressurized and reflooded with the low pressure ECCS."*

- *"IF RPIS [Rod Position Information System] and NMS [Neutron Monitoring System] both fail, it is likely that the operator will know the plant is shutdown by virtue of the excessive automatic low pressure injection into the core and the absence of any resulting power excursion."*

3. In the description of the operator actions for the event "Inadvertent SRV Opening with Partial Scram Failure," NEDO-31558 (page 30) states:

"The level restoration action is not based on neutron flux information."

Note: In the context of the above quotation, "level restoration" means increasing injection into the reactor vessel to restore reactor vessel water level to the normal operating range following injection of an amount of boron equal to the "Hot Shutdown Boron Weight."

While it is true that the actions to restore reactor vessel water level is directed (as stated above) based only on information regarding the amount of boron that has been injected into the reactor vessel, the corresponding series of steps in the Nine Mile Point Unit 1 EOPs (specifically, steps RL-20 through RL-22 in N1-EOP-3, "Failure to Scram") explicitly requires monitoring the status of reactor power (neutron flux indication) while the action to restore reactor vessel water level proceeds. The importance of monitoring reactor power is clearly indicted by the "override" (step RL-20) that applies during performance of the action to restore reactor vessel water level (step RL-22); the "override" states:

"IF reactor power commences and continues to increase,

THEN return to..."

Although some individual differences have been identified to exist between the event descriptions contained in NEDO-31558 and post-event conditions and associated response actions for Nine Mile Point Unit 1 (actions as directed per applicable instructions contained in the plant EOPs), the role of NMS display instrumentation at Nine Mile Point Unit 1 is essentially the same as that at all other operating Boiling Water Reactor plants. Also, like the EOPs at other Boiling Water Reactor plants, the EOPs at Nine Mile Point Unit 1 include explicit instructions addressing the extremely improbable condition "reactor power cannot be determined." These instructions are sufficient to assure public health and safety for the full scope of events subject to consideration under "anticipated transients without scram" (as defined in 10CFR50 Appendix A and 10CFR50.62).

In conclusion, on the basis of these similarities, the NMS design and qualification criteria of NEDO-31558 are judged by Niagara Mohawk to be appropriate and sufficient for Nine Mile Point Unit 1, and shall be applied in lieu of the Category I criteria specified in Regulatory Guide 1.97.