UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

MAIN STEAM ISOLATION VALVE LIMIT SWITCH TESTING

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-220

INTRODUCTION

The Nine Mile Point, Unit 1 (NMP-1) Technical Specifications (Table 4.6.2a(6)) require that an "Instrument Channel Test" be performed quarterly to verify operability of the main steam isolation valve (MSIV) position instrument channels used to initiate a reactor scram on MSIV closure. To cause a reactor scram, at least one MSIV (either inboard or outboard) in both main steam lines must close to the 10% closed position as sensed by limit switches mounted at the MSIVs. The limit switch contacts in the reactor protection system (RPS) logic circuits open to de-energize the associated channel trip relays (11K16 and 11K17) causing a scram.

During a review of licensee surveillance testing, the Resident Inspector noticed that the licensee was simulating MSIV closure by pulling fuses in series with the limit switch contacts. The contacts are closed when the MSIVs are greater than 90% open, maintaining the channel trip relays in an energized condition. Performance of the instrument channel test in this manner (i.e., pulling fuses) does not verify operability of the limit switches relied on to initiate a reactor scram under actual conditions. The NRC regional office (Region 1) believes that current testing of the MSIV position instrument

channels may be deficient in this regard. Furthermore, Region 1 believes that the technical specification definitions of "Instrument Channel" and "Instrument Channel Test" indicate that the testing should include provisions to verify operability of the sensors (i.e., the MSIV limit switches). A review of other operating BWRs in Region 1 indicates that operability of the limit switches is verified during testing by partially closing the MSIVs until a channel trip occurs. The licensee contends that it was never intended to verify operability of the limit switches as evidenced by the lack of a Technical Specification requirement for a "Sensor Check".

EVALUATION

The requirements concerning testability of nuclear power plant protection systems are set forth in 10 CFR 50, Appendix A, General Design Criterion (GDC) 21 "Protection System Reliability and Testability" and IEEE Standard 279 (Criteria for Protection Systems for Nuclear Power Generating Stations) Section 4.9 "Capability for Sensor Checks". GDC 21 states, in part, that the protection system shall be designed for high functional reliability and inservice testability commensurate with the safety functions to be performed. GDC 21 further states that the protection system shall be designed to permit periodic testing of its functioning when the reactor is in operation including a capability to test channels independently to

determine failures and losses of redundancy that may have occurred. Section 4.9 of IEEE Std. 279 states that means shall be provided for checking, with a high degree of confidence, the operational availability of each (protection) system input sensor during reactor operation. Therefore, verification of sensor (in this case, MSIV limit switch) operability during reactor operation is required.

The NMP-1 Technical Specifications provide the following definitions for "Instrument Channel" and "Instrument Channel Test":

> Instrument Channel
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> An instrument channel means an arrangement of a sensor and auxiliary equipment required to generate and transmit to a trip system a single trip signal related to the plant parameter monitored by that instrument channel.
>
> Instrument Channel Test
>
> Instrument channel test means injection of a simulated signal into the channel to verify its proper response including, where applicable, alarm and/or trip initiating action.

These definitions do not distinguish between analog channels (here the input to the protection system is typically a 4 to 20 mA variable signal from a process sensor/transmitter) and digital/bistable channels (here the protection system input is a fixed signal that is either present or absent depending

on the state of the sensor; e.g., limit switch contacts). Furthermore, the point of injection of the simulated signal into the instrument channel during testing is not specified. Typically, for analog channels, the test signal is injected as close to the sensor as practicable, thus testing the portion of the instrument channel downstream of the sensor. Operability of the sensor is then verified by cross comparison of its output (i.e., control room indication/readout) with other instrument channels monitoring the same parameter. This cross comparison of sensor readouts is known as a channel check or sensor check. A sensor whose output varies from the outputs of the remaining sensors is suspected of being failed. Thus, the instrument channel test (also referred to as a channel functional test) in conjunction with the channel check provide complete end-to-end testing of the instrument channel. The General Electric Standard Technical Specifications (GESTS; NUREG-0123) define a channel functional test for analog channels and a channel check as follows:

> Channel Functional Test
>
> Analog channels - the injection of a simulated signal into the channel as close to the sensor as practicable to verify operability including alarm and/or trip functions and channel failure trips.

Channel Check

A channel check shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.

The MSIV limit switches provide binary (also referred to as bistable or digital) outputs to the RPS (i.e., the limit switch contacts are in one of two possible states corresponding to the two possible MSIV positions; open or closed). The limit switches do not monitor a "live" parameter (i.e., the process is not being continuously received/monitored at the sensor input), or provide continuous indication in the control room. The exact positions of the MSIVs are unknown. A channel check is not applicable to sensors providing binary/bistable outputs. These sensors are often referred to as blind sensors. Therefore, the licensee's argument that it was not intended to require testing of the limit switches as indicated by the lack of a requirement to perform a sensor check is not valid.

The GESTS define a channel functional test for bistable channels as follows:

Channel Functional Test

Bistable channels - the injection of a simulated signal into the sensor to verify operability including alarm and/or trip functions.

For bistable channels, such as the MSIV limit switches, the simulated test signal must be injected into the sensor. This is done to verify operability of the sensor itself as well as the portion of the instrument channel downstream of the sensor. The ideal method of performing a channel functional test for the MSIV position channels is by partial closure of the MSIV past the 10% closed scram limit switch setpoint. This method of testing duplicates sensor operation under actual conditions.

Performance of the MSIV position instrument channel test by pulling fuses does not satisfy the requirements of GDC 21 or IEEE Std. 279 regarding verification of sensor operability during reactor operation. However, due to the vagueness of the NMP-1 Technical Specifications, it cannot be concluded that testing of the limit switch contacts is required and therefore, that testing was not being conducted by the licensee in accordance with the Technical Specifications. The Technical Specifications and associated test procedures should be revised to include provisions for periodic testing of the limit switch contacts.

The inboard MSIVs at NMP-1 are motor operated. The closure times for these valves are six seconds. The licensee contends

that testing the limit switches by partial closure of the MSIVs during operation could result in an unwanted reactor scram. The licensee believes that given the fast closure times of the MSIVs, it would be difficult for the control room operators to manually reverse the direction of valve travel following partial closure before the valve closed to the point where a reactor scram occurred on high steam line flow in the adjacent steam line. The MSIV motor operators do not have the capability for slow operation. The inboard MSIVs (as well as the outboard MSIVs) at other BWRs are air operated (air pressure is required to open the valves and vented to allow spring force to close the valves) and have the capability for slow closure (the air pressure is slowly vented) to allow for testing of the MSIV limit switches. In addition, other BWRs have four steam lines as opposed to two at NMP-1. Therefore, the steam flow rejected from a steam line due to partial MSIV closure during testing must be accommodated by the single remaining steam line. This makes the NMP-1 design more susceptible to high steam line flow reactor scrams during testing. The outboard MSIVs at NMP-1 are air operated, but do not have the slow test capability.

Staff guidance regarding testing of protection system circuits during reactor operation is provided in Regulatory Guide 1.22

(RG 1.22) "Periodic Testing of Electric Power and Protection Systems". Position D4 of RG 1.22 allows exceptions to the requirements for testing of protection system equipment during reactor operation if 1) there is no practicable system design that would permit operation of the actuated equipment without adversely affecting the safety or operability of the plant; 2) The probability that the protection system will fail to initiate the operation of the actuated equipment is, and can be maintained, acceptably low without testing the actuated equipment during reactor operation; and 3) the actuated equipment can be routinely tested when the reactor is shutdown. According to the licensee, in order to provide test capability for the MSIV limit switches at power without disrupting plant operation would require valve control circuit modifications providing the capability for slow closure. The staff believes that although such modifications would probably not cause an unnecessary burden to the licensee, that the benefit gained from the modifications would not contribute significantly to the safety of the plant. This assessment is based on the following: 1) The NMP-1 Chapter 15 transient analyses takes credit for a reactor scram initiated by the MSIV limit switches to help terminate a MSIV closure transient. However, if the limit switches should fail, two other independent and

diverse scram functions (reactor high pressure and high neutron flux) are available to terminate the transient. Periodic testing of the instrument channels monitoring the diverse parameters is performed during reactor operation as required by the NMP-1 Technical Specifications. 2) Although not presently required by the NMP-1 Technical Specifications, the licensee has committed to calibrate the MSIV limit switches, to ensure that a scram occurs at the 10% closed setpoint, during each refueling outage. The NMP-1 Technical Specifications will be revised to include provisions for calibration at refueling intervals.

The staff's position, however, is that verification of MSIV limit switch operability at a frequency of once per refueling outage is not sufficient to satisfy the requirements of GDC 21 and IEEE Standard 279. Operating experience has shown that reactors are typically shutdown at least several times between refueling outages. Therefore, the staff recommends that the licensee include in their technical specifications a requirement to verify operability of the MSIV limit switches prior to startup following each plant shutdown by actual valve closure past the 10% actuation setpoint, unless the test has been performed within the previous 92 days. Testing in this manner will prevent the operational problems encountered when performing the test at power. In addition, testing prior to startup by actual valve closure will eliminate the need for pulling fuses during testing which is discouraged by the

staff. It is recognized that pulling fuses in the fail safe RPS instrument channel circuits results in a channel trip. The staff is concerned, however, regarding the potential for the practice of pulling fuses to be carried over to energize-to-actuate safety related circuits during testing, which is clearly unacceptable. The licensee has indicated that with the exception of MSIV position, fuses are not pulled during RPS instrument channel testing.

CONCLUSION

The lack of a Technical Specification requirement to perform a sensor check does not relieve the licensee from periodically testing the operability of the MSIV limit switch contacts used to initiate a reactor scram. However, due to the operational problems encountered when testing the MSIV position instrument channels (including verification of limit switch operability) at power, the staff has determined that strict adherence to a fixed test frequency is not necessary. The staff recommends that the licensee incorporate a requirement in their technical specifications to test the MSIV position instrument channels prior to startup following plant shutdowns by actual closure of the MSIVs, unless the test has been performed within the previous 92 days. In addition, it is recommended that the Technical Specifications be revised to distinguish between analog and bistable channel functional tests consistent with the GESTS.

May 4, 1989

Docket No. 50-220

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MEMORANDUM FOR: John A. Skoczlas, Jr., Chief
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SUBJECT: MAY 8, 1984 MEMORANDUM FOR R. STAROSTECKI FROM D. EISENHUT, SUBJECT: NINE MILE POINT 1 - EVALUATION OF TECHNICAL SPECIFICATION REQUIREMENTS FOR MAIN STEAM ISOLATION VALVE LIMIT SWITCH TESTING - ACCESSION NUMBER 8405180131

The subject document (copy enclosed), an internal NRC memorandum, has been referenced by the Nine Mile Point 1 licensee in a licensing action, and it should be made available to the general public. The licensee already has a copy of it, and we have determined that it need not be withheld. Please provide appropriate distribution to the PDR/LPDR.

ORIGINAL SIGNED BY
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Enclosure:
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