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

ENCLOSURE 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

GPU NUCLEAR CORPORATION

MAIN STEAM LINE RUPTURE DETECTION SYSTEM

THREE MILE ISLAND NUCLEAR STATION UNIT 1

DOCKET NO.: 50-289

1 0 BACKGROUND

The Heat Sink Protection System (HSPS) includes the Main Steam Line Rupture Detection System (MSLRDS) as well as the Emergency Feedwater System (EFWS). The staff issued Amendment No. 124 to the TMI-1 operating license and its final safety evaluation pertaining to the EFWS on March 9, 1987, which closed NUREG-0737 item II.E.1.2 as an open issue for TMI-1. This evaluation addresses the qualification of the MSLRDS automatic initiation signals and circuits.

The MSLRDS is designed to provide safety-grade initiation of Main Feedwater (MFW) system isolation upon detection of low pressure in either of the Once Through Steam Generators (OTSGs). The MSLRDS is required to meet the relevant requirements of IEEE Std 279-1971. The licensee's April 29, 1985 response states that following completion of the long term modification to the Main Steam Line Rupture Detection Circuitry portion of the EFWS, the system will be capable of withstanding a single active failure while still performing its function of initiating MFW isolation. These design modifications will also ensure that a single active failure will not inadvertently isolate the Main Feedwater (MFW) system.

2.0 DISCUSSION AND EVALUATION

The initiating signals for the MSLRDS circuitry originate in the HSPS. The HSPS is designed to initiate MFW isolation on low pressure in either OTSG main steam line supply to the turbine generator. The HSPS logic circuitry for the MSLRDS is a two-out-of-four (2/4) taken twice logic scheme. There are four redundant instrumentation channels for each OTSG that provide the HSPS logic with signals indicating low pressure in the OTSG steam lines. Two pressure measurement channels are connected to each of the two steam lines from each OTSG. The pressure transmitters are located such that two channel pressure transmitters for each OTSG are located in the Reactor Building and the other two channel pressure transmitters for each OTSG are located in the Intermediate Building; this provides diversity of location. The actuation portion of the HSPS consists of two 2/4 logic trains for OTSG-A and two 2/4 logic trains for OTSG-B. The HSPS electronics will cause automatic isolation of the MFW to OTSG-A in the event of low pressure in the steam lines from OTSG-A and will

cause automatic isolation of the MFW to OTSG-B in the event of low pressure in the steam lines from OTSG-B unless the operator has bypassed one or both trains of the HSPS for the MSLRDS in accordance with normal shutdown procedures, in which case the MFW isolation by the HSPS will be bypassed.

The automatic initiation circuitry from the sensors to the HSPS circuitry for the MSLRDS and from the HSPS to the Feedwater Isolation Valves was reviewed to determine compliance with the single failure criterion of IEEE Std 279-1971. It is concluded the automatic initiation circuitry complies with the single failure criterion of IEEE Std 279-1971.

The licensee has documented that the MSLRDS initiating circuitry and controls are designed with channel independence and redundancy and that qualified isolation devices have been incorporated into the design that will provide the required isolation for shared common components of interfacing systems and non-IE equipment. Review of the EFWS design confirmed that the criteria of channel independence and of control and protection system interaction of IEEE Std 279-1971 have been met.

The licensee stated in a March 14, 1986 response that all devices in the MSLRDS automatic initiation circuitry can be tested at power. However, the pressure transmitters will only be tested at refueling intervals. All testing of the HSPS including the MSLRDS automatic initiation circuitry, sensors, and other associated equipment will be performed in accordance with technical specification requirements.

The criteria of paragraph 4.9 of IEEE Std 279-1971 require that means shall be provided for checking the operational availability of each system input sensor with a high degree of confidence during reactor operation. In a telephone conversation on April 8, 1987 to clarify how the licensee's design conforms to the criteria of Paragraph 4.9 and 4.10, the licensee stated that conformance to the criteria of Paragraph 4.9 is accomplished by cross-checking between channels that bear a known relationship to each other and have readouts available. The licensee verified that the capability for calibrating channels and the devices used to derive the final system output signal from the various channel signals is included in the design. The requirement to perform cross channel checks and calibration and the calibration frequency are included in the technical specifications. Procedures to perform these checks and calibrations are in place. We concluded that the criteria of Paragraph 4.9 and 4.10 of IEEE Std 279-1971 have been met.

The licensee has documented that the channel bypass capability requirements of paragraph 4.13 of IEEE Std 279-1971 have been incorporated into the design of the HSPS for automatic initiation of the emergency feedwater (EFW). This capability permits any single operable channel to be maintained or tested at power with a single active failure in another channel. The HSPS contains an operating bypass associated with the MSLRDS circuitry. This bypass is automatically removed when the steam line pressure increases above 750 psig and cannot be initiated whenever steam line pressure is greater than 750 psig. Paragraph 4.13 of IEEE Std 279-1971 states that if the protective action of some part of the system has been bypassed or deliberately rendered inoperative for any purpose, this fact should be continuously indicated in the control room. Section 3.3 of GPU's April 29, 1985 submittal states that when bypass occurs, an indicating light entitled "SLB ENABLED" will turn off indicating the MSLRDS has been bypassed.

The criteria of paragraph 4.17 of IEEE Std 279-1971 specify that the protection system shall include means for manual initiation of each protective action at the system level. In the April 8, 1987 telephone conversation, the licensee stated that the manual initiation for MFW isolation is performed by four pushbuttons which cause valve closure when activated. The pushbuttons actuate closure of the motor-operated valves and as a backup, the valve controller units can be actuated to assure isolation. This is acceptable.

As noted above, the TMI-1 design uses a bypass indicating light labeled "SLB ENABLED" which, when not lit, indicates that the MSLRDS has been bypassed. The licensee's Human Factors Group has reviewed this light and has found it acceptable; however, they stated that requiring this light to be lit to indicate bypass status would be an enhancement. By letter dated October 27, 1987, the licensee has committed to provide positive indication for both bypass and enabled for each steam generator. This will be accomplished by installing a backlit pushbutton for each bypass and enable. The licensee committed to make these changes by the end of the cycle 8 refueling (approximately January 1990) as part of more extensive HSPS changes. The staff finds these commitments an acceptable resolution.

Based on the review of the TMI-1 MSLRDS, the staff concludes that the automatic initiation circuitry complies with IEEE Std 279-1971. Specifically, the single failure criterion, calibration, channel independence and control and protection system interaction have been satisfied. The staff finds the design of the MSLRDS to be acceptable.

Dated:

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