TECHNICAL EVALUATION OF THE ELECTRICAL, INSTRUMENTATION, AND CONTROL ASPECTS OF THE OVERPRESSURE MITIGATING SYSTEM FOR TURKEY POINT, UNITS 3 AND 4

(Docket Nos. 50-250, -251)

EG&G Idaho, Inc.

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1.0 INTRODUCTION

By letter dated October 18, 1977 (Reference 1) Florida Power & Light Company (FPL) submitted to the NRC a plant specific analysis in support of the proposed reactor vessel overpressure mitigating system (OMS) for Turkey Point Nuclear Power Station, Units 3 and 4. This information supplements other documentation submitted by FPL during 1976 and 1977 (References 2 through 7). The electrical, instrumentation, and control system aspects of the proposed design have been reviewed for this Technical Evaluation Report.

The proposed OMS includes sensors, actuating mechanisms, alarms, and valves to prevent a reactor coolant system transient from exceeding the pressure/temperature limits included in the Turkey Point, Units 3 and 4 Technical Specifications as required by Appendix G to Chapter 10, Code of Federal Regulations, Part 50 (10 CFR 50).

2.0 EVALUATION

The proposed overall approach to eliminating overpressure events incorporates administrative, procedural, and hardware controls with reliance upon the plant operator for the principal line of defense. Preventive administrative/procedural measures include (a) procedural precautions, (b) deenergization of essential components not required during the cold shutdown mode of operation, and (3) maintaining a nonwater-solid reactor coolant system condition whenever possible.

The basic design criteria that were applied in determining the adequacy of the electrical, instrumentation, and control aspects of the low temperature overpressure protection system are:

(1) Operator Action – no credit can be taken for operator action until ten minutes after the operator is aware, through an action alarm, that a pressure transient is in progress.

(2) Single Failure Criterion – the pressure protection system shall be designed to protect the reactor vessel given a single failure in addition to the failure that initiated the pressure transient.

(3) Testability – the system design shall include provisions for testing on a schedule consistent with the frequency that the system is relied upon for pressure protection.

(4) Seismic and IEEE 279 Criteria – ideally, the system should meet seismic Category I and IEEE 279 criteria. The basic objective is that the system should not be vulnerable to a common failure that would both initiate a pressure transient and disable the OMS. Such events as loss of instrument air and loss of offsite power must be considered.

In addition to complying with these criteria, the licensee has agreed to provide a variety of alarms to alert the operator to (a) manually enable the pressure protection system during cooldown, (b) indicate the occurrence of a pressure transient, and (c) indicate closure of either power operated relief valve (PORV) isolation valve which ensures a complete pathway from the pressurizer to the pressurizer relief tank.

2.1 System Electrical and Control Description

The OMS design for Turkey Point, Units 3 and 4 uses pressurizer PORVs with a variable low pressure setpoint as the pressure relief mechanism (Reference 1). The variable low setpoint is energized and

deenergized by two switches, one for each PORV, on the main control board. The variable low pressure setpoint is derived from reactor coolant system (RCS) wide range temperature using redundant transmitters. The reactor coolant pressure signal is obtained from redundant wide range pressure transmitters. Below an RCS temperature of 300°F, the setpoint is a constant 415 psig. Above 300°F, the setpoint increases linearly from 415 psig at 300°F to 2335 psig at 462°F.

Various alarms are included in the OMS. On decreasing pressure, an alarm and annunciator will activate at 390 psig. This alarm alerts the operator to energize the OMS. The alarm will not clear unless (a) the low pressure setpoint is energized, (b) the PORV mode selector switch is in AUTO, and (c) the motor operated valves (MOVs) upstream of the PORVs are indicated open. This assures proper alignment of the OMS. On increasing pressure an alarm and annunciator will actuate at 400 psig. This alarm will inform the operator that RCS pressure is approaching the PORV low setpoint. Action can then be taken to remedy the cause of increasing pressure, or, if part of a normal heatup, to deenergize the OMS by placing the two NDTT control switches to the "Normal" position. Should pressure continue to increase to the PORV setpoint, an alarm and annunciator will inform the operator that the PORVs have received a signal to open from the OMS.

The PORVs are spring-loaded closed and require air to open. The air is presently supplied by instrument air. A redundant supply of air to the valves is included in the OMS. Redundant accumulators, one dedicated to each PORV, will be added to the present air source. Each accumulator will be sized to ensure a minimum of ten minutes operation of the OMS. Redundant check valves will be provided for each accumulator to prohibit backfeeding the instrument air system. Existing alarms in the control room will alert the operator to a loss of instrument air to the PORVs and associated accumulators.

2.1.1 Channel Separability. The OMS has two channels, one to control each PORV, that provide complete redundancy and are independent except for the use of common alarms and annunciators (as established by

the single failure analysis reported in Reference 6) which are isolated so that a failure in the circuitry will not incapacitate either channel. Either one of the two PORVs provides the relief capacity needed to protect the vessel against a low-temperature overpressurization event; the other PORV provides redundant capacity. The OMS setpoints and RCS pressure signals are derived from redundant temperature and pressure transmitters. Each channel has its own ENABLE/DISABLE switch installed on the main control board. The installation of the OMS is in accordance with the separation criteria used in the design of the Turkey Point Plant. Each of the two channels uses an independent power supply from the transmitters to the solenoid valves controlling the air to the PORVs. As discussed in the system description, the OMS has separate backup air supplies for each PORV. These design features are in compliance with the single failure design criterion.

2.1.2 Isolation Valve and Setpoint Alarms. As described in Paragraph 2.1, various alarms are included in the OMS. Clearing of these alarms ensures proper alignment of the OMS. The alarms provided meet the OMS design criterion.

2.1.3 Operator Action. The OMS is designed to perform its intended function for at least ten minutes without operator action. The most restrictive condition is the continued operation of a safety injection pump with an assumed loss of instrument air. The redundant sources of air to the PORVs are sized to ensure a minimum of ten minutes of operation after the loss of instrument air, and existing alarms alert the operator to this loss. The system meets the design criterion for operator action.

2.1.4 IEEE 279 Criteria. The OMS meets the intent of IEEE 279, is designed against single failure, and has two channels that are electrically separate and meet the physical separation requirements used in the design of the electrical system for the Turkey Point Plant. In addition, periodic testing of the OMS prior to the need for

its operation is included to enhance system reliability. The compliance of the design with the IEEE 279 design criteria is adequate.

2.1.5 Testability. Testability of the OMS is provided and the cooldown procedures include verification of OMS operability prior to solid-system, low-temperature operation. Testing will be accomplished by (a) closing the PORV isolation valves, (b) enabling the OMS, and (c) inputting a signal below 300°F (test done with RCS pressure above 415 psig). In this manner, OMS circuits as well as PORV operability will be verified. In addition, the associated instrumentation will be surveilled for calibration and proper operation using the same methods followed for safety-related instrumentation. These provisions and procedures for testability are adequate.

2.2 Pressure Transient Reporting and Recording Requirements

The staff position on a pressure transient which causes the overpressure protection system to function, thereby indicating the occurrence of a serious pressure transient, is that it is a 30-day reportable event. In addition, pressure and temperature instrumentation are required to provide a permanent record of the pressure transient. The response times of the temperature/pressure recorders shall be compatible with a pressure transient increasing at a rate of approximately 100 psi per second. This instrumentation shall be operable whenever the OMS is enabled.

2.3 Disabling of Components Not Required During Cold Shutdown

Except as required for brief intervals by operating procedures or Technical Specifications, the staff position requires that essential components not required during cold shutdown that could produce an overpressurization event be disabled or isolated from the RCS during cold shutdown, and that the controls to disable or isolate these components be incorporated in the Technical Specifications. In particular, the safety injection accumulators and the high pressure safety injection pumps are included in the components to be disabled or

isolated. Valves and breakers used to disable essential equipment during cold shutdown must be tagged or locked to prevent inadvertent changes of state.

2.4 Technical Specifications

To ensure operation of the OMS, the licensee is to submit for staff review Technical Specifications to be incorporated into the license for Turkey Point, Units 3 and 4. These specifications are to be consistent with the intent of the statements listed below. The licensee should ensure that the Technical Specifications proposed are compatible with other licensee requirements.

(1) Whenever the RCS temperature is less than the minimum pressurization temperature, the OMS shall be enabled with both PORVs operable, except one PORV may be inoperable for seven days. If these conditions are not met, the primary system must be depressurized and vented to the atmosphere or to the pressurizer relief tank within eight hours.

(2) Enablement of the OMS requires that the low pressure setpoint will be selected, the upstream isolation valves open, and the backup air supply charged.

(3) No more than one high head SI pump injection valve may be energized at RCS temperatures below 380^{o}F unless the vessel head is removed.

(4) A reactor coolant pump may be started (or jogged) only if there is a steam bubble in the pressurizer, or the SG/RCS temperature difference is less than 50^{o}F.

(5) The OMS must be tested on a periodic basis consistent with the need for its use.

(6) When the plant is in a cold shutdown condition the safety injection accumulators shall be isolated from the RCS by verifying that the accumulator isolation valves are in the closed position and power to the valve operators is removed.

3.0 CONCLUSIONS

The electrical, instrumentation, and control aspects of the Turkey Point, Units 3 and 4 OMS design are adequate on the basis that (a) the proposed control circuitry meets the intent of IEEE 279, (b) the system is redundant and meets the single failure criterion, (c) the design requires no operator action for ten minutes after the operator receives an overpressure action alarm, (d) the system is testable on a periodic basis, and (e) the proposed changes to the Technical Specifications reduce the probability of an overpressurization event to an acceptable level. However, it is recommended that final acceptance be contingent upon the licensee incorporating Technical Specifications that comply with the list in Section 2.4.

4.0 REFERENCES

1. FPL letter (Uhrig) to NRC (Lear) dated October 18, 1976.

2. FPL letter (Uhrig) to NRC (Lear) dated October 15, 1976.

3. FPL letter (Uhrig) to NRC (Lear) dated December 10, 1976.

4. FPL letter (Uhrig) to NRC (Lear) dated March 1, 1977.

5. FPL letter (Uhrig) to NRC (Lear) dated March 16, 1977.

6. FPL letter (Uhrig) to NRC (Lear) dated March 31, 1977.

7. FPL letter (Uhrig) to NRC (Lear) dated April 21, 1977.

8. Memorandum, R. Baer to K. Goller, December 29, 1977, Safety Evaluation of the Overpressure Mitigating System Designed for Turkey Point, Units 3 and 4.