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TECHNICAL EVALUATION OF THE ELECTRICAL, INSTRUMENTATION, AND CONTROL DESIGN ASPECTS OF THE OVERRIDE OF CONTAINMENT PURGE VALVE ISOLATION AND OTHER ENGINEERED SAFETY FEATURE SIGNALS FOR THE TURKEY POINT NUCLEAR POWER STATION, UNITS 3 and 4

by

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ABSTRACT

This report documents the technical evaluation of the electrical, instrumentation, and control design aspects of the override of containment purge valve isolation and other engineered safety feature signals for the Turkey Point Nuclear Power Station, Units 3 and 4. The review criteria are based on IEEE Std-279-1971 requirements for the safety signals to all purge and ventilation isolation valves.

FOREWORD

This report is supplied as part of the Selected Electrical, Instrumentation, and Control Systems Issues (SEICSI) Program being conducted for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Operating Reactors, by Lawrence Livermore National Laboratory, Field Test Systems Division of the Electronics Engineering Department.

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(Docket Nos. 50-250 and 50-251)

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1. INTRODUCTION

Several instances have been reported where automatic closure of the containment ventilation/purge valves would not have occurred because the safety actuation signals were either manually overridden or blocked during normal plant operations. These events resulted from procedural inadequacies, design deficiencies, and lack of proper management controls. These events also brought into question the mechanical operability of the containment isolation valves themselves. These events were determined by the U.S. Nuclear Regulatory Commission (NRC) to be an Abnormal Occurrence (#78-5) and were, accordingly, reported to the U.S. Congress.

As a follow-up on this Abnormal Occurrence, the NRC staff is reviewing the electrical override aspects and the mechanical operability aspects of containment purging for all operating power reactors. On November 28, 1978, the NRC issued a letter entitled "Containment Purging During Normal Plant Operation" [Ref. 1] to all boiling water reactor (BWR) and pressurized water reactor (PWR) licensees. In a letter [Ref. 2] dated January 5, 1979, the Florida Power and Light Company (FPLC), licensee for the Turkey Point Nuclear Power Station, Units 3 and 4, replied to the NRC generic letter. A meeting was held on May 30, 1979 by the NRC staff and EG&G, Inc. (San Ramon Operations) personnel. In the meeting of May 30, 1979, during a conference call, and in letters of June 8, 1979 [Ref. 3] and December 13, 1979 [Ref. 4], the licensee described the purge valve isolation system design of the Turkey Point Nuclear Power Station as discussed later in this report.

This document addresses only the electrical, instrumentation, and control (EI&C) design aspects of the containment ventilation isolation (CVI) and other engineered safety features (ESFs).

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2. EVALUATION OF TURKEY POINT NUCLEAR POWER STATION, UNITS 3 AND 4

2.1 REVIEW CRITERIA

The primary intent of this evaluation is to determine if the following NRC staff criteria are met for the safety signals to all purge and ventilation isolation valves:

(1) Criterion no. 1--In keeping with the requirements of GDC 55 and 56 [Ref. 5], the overriding* of one type of safety actuation signal (e.g., radiation) should not cause the blocking of any other type of safety actuation signal (e.g., pressure) for those valves that have no function besides containment isolation.

(2) Criterion no. 2--Sufficient physical features (e.g., keylock switches) are to be provided to facilitate adequate administrative controls.

(3) Criterion no. 3--The system-level annunciation of the overridden status should be provided for every safety system impacted when any override is active (see R.G. 1.47).

Incidental to this review, the following additional NRC staff design criteria were used in the evaluation:

(1) Criterion no. 4--Diverse signals should be provided to initiate isolation of the containment ventilation system. Specifically, containment high radiation, safety injection actuation, and containment high pressure (where containment high pressure is not a portion of safety injection actuation) should automatically initiate CVI.

(2) Criterion no. 5--The instrumentation and control systems provided to initiate ESF should be designed and qualified as safety-grade equipment.

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*The following definition is given for clarity of use in this evaluation:
Override: The signal is still present, and it is blocked in order to perform a function contrary to the signal.

(3) Criterion no. 6--The overriding or resetting* of the isolation actuation signal should not cause any valve or damper to change position.

Criterion 6 in this review applies primarily to related ESF systems because implementation of this criterion for containment isolation systems will be reviewed by the Lessons Learned Task Force, based on the recommendations in NUREG 0578, Section 2.1.4 [Ref. 6]. Automatic valve repositioning upon reset may be acceptable when containment isolation is not involved; consideration will be given on a case-by-case basis. Acceptability would be dependent upon system function, design intent, and suitable operating procedures.

2.2 DESIGN DESCRIPTION

Each of the Turkey Point units has two ESF trains which cause isolation of the containment ventilation system. The initiating signals for each train, which are listed below, are combined as parallel inputs to form an "OR" gate.

(1) Automatic Signals

(a) High radiation (particulate or gas)
(b) Safety injection actuation

(2) Manual Signals
(a) Containment isolation; phase A - pushbotton
(b) Containment isolation; phase B - pushbutton

Each train includes the automatic and manual input "OR" gates, a retentive memory element, which is a lock-out relay with a manual reset, and a containment ventilation isolation control circuit.

The retentive memory is a device which retains the condition of the output that corresponds to the last input. This retentive memory element is not capable of overriding containment ventilation isolation signals and will not latch an override on the CVI. If a manual reset is attempted when a trip signal is present, the device will return to a tripped condition.

When either a monitored plant condition or a manual input calls for isolation, the signal goes through the "OR" gate and trips the retentive memory element to the isolation state. The isolation valve control circuit operates to close the ventilation valve, and remains in that state until the retentive memory element is manually reset.

*The following definition is given for clarity of use in this evaluation:
Reset: The signal has come and gone, and the circuit is being cleared in order to return it to the normal condition.

Following manual reset, the retentive memory element remains in the reset condition until a subsequent trip signal (automatic or manual) occurs.

The trip condition of the CVI is annunciated on the control panel; valve-position lights (full open/full closed) are provided.

2.3 DESIGN EVALUATION

In their letter of December 13, 1979 [Ref. 4], the licensee for Turkey Point Nuclear Power Station, Units 3 and 4 has committed to limit containment purging during power operation (>2% power) to a total of 200 hours per year for the site, which includes purging of both units.

An override of the safety injection signal does not block or override the radiation or manual isolation signals. We conclude, therefore, that NRC criterion no. 1 is satisfied.

There is no override in the CVI circuit; therefore, special physical features are not required. We conclude that criterion no. 2 is not applicable.

There are annunciators on the safety injection actuation signal, the containment high pressure signal, and the high radiation and containment ventilation isolation signals. When asked if SI override was annunciated on the CVI panel, the licensee stated in the letter of October 27, 1980 [Ref. 7] that there is an annunciator for the override of safety injection targeted as "SI Blocked", and that "Containment Ventilation Isolation" override annunciation would be inappropriate. We conclude, that with the "SI Blocked" annunciator clearly visible from the containment ventilation control panel, NRC criterion No. 3 will be met.

Containment ventilation isolation is initiated by safety injection (including a high containment pressure signal) as well as by either of two high containment radiation signals. Hence, the CVI system design includes diverse actuation signals and satisfies NRC criterion no. 4.

Both the CVI system and the equipment providing signals for it are part of the plant safeguards actuation system. The licensee states in their letter of October 27, 1980 [Ref. 7] that the safeguards system is designed and qualified as safety-grade and that the CVI system also is safety-grade. We conclude, therefore, that NRC criterion no. 5 is satisfied.

Resetting the safety injection signal cannot cause the CVI system to reset, nor will it cause automatic reopening of the containment ventilation valves. Clearing the CVI isolation signal requires manual operation of the reset. Reopening the valves also requires manual operation of the individual ventilation valve switches. We conclude, therefore, that NRC criterion No. 6 is satisfied.

2.4 OTHER ENGINEERED SAFETY FEATURES (ESF) SYSTEM CIRCUITS

The other engineered safety features (ESF) audited were containment isolation Phase A. The other ESF system circuits are the same as the containment ventilation isolation (CVI) circuits with respect to overrides and valve reopening on reset. We conclude that the NRC criteria are met.

3. CONCLUSIONS

The EI&C design aspects of containment purge valve isolation and other ESF signals for the Turkey Point Nuclear Power Station, Units 3 and 4 were evaluated using those design criteria stated in Section 2.1 of this report.

We determine that the CVI system design and the design of other ESF circuits meet the NRC staff criteria stated in Section 2.1 of this report.

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REFERENCES

1. NRC/DOR letter (A. Schwencer) to NPPD, "Containment Purging During Normal Plant Operation," dated November 28, 1978.

2. NPPD letter (R. E. Uhrig) to NRC (A. Schwencer), "Docket 50-250, 251, Containment Purging During Normal Plant Operations, Turkey Point Nuclear Plant," dated January 5, 1979.

3. FPL letter (R. E. Uhrig) to NRC (A. Schwencer), "Containment Purging, Turkey Point Nuclear Station, Units 3 and 4," dated June 8, 1979.

4. FPL letter (R. E. Uhrig) to NRC (A. Schwencer), "Containment Purge," dated December 13, 1979.

5. U.S. Nuclear Regulatory Commission, Standard Review Plan, "Containment Isolation System" NUREG 76/087, Rev. 1, Section 6.2.4.

6. U.S. Nuclear Regulatory Commission, "TMI Short-term Implementation Action," NUREG-0578.

7. FPL letter (R. E. Uhrig) to NRC (T. Novak), "Turkey Point, Units 3 and 4, Docket Nos. 50-250 and 50-251, Containment Ventilation Isolation", dated October 27, 1980.

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