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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 DRESDEN STATION UNIT III NUCLEAR POWER PLANT

(DOCKET NO. 50-249)

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INTERIM REPORT

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Energy Measurements Group
San Ramon Operations

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by

J. H. Cooper

Approved for Publication

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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 Commonwealth Edison's Dresden Station Unit III Nuclear Power Plant. 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 Deparatment.

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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 to 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 generic letter entitled "Containment Purging During Normal Plant Operation" [Ref. 1] to all boiling water reactor (BWR) and pressurized water reactor (PWR) licensees. Commonwealth Edison, the licensee for this plant, replied by letters [Refs. 2-5] to concerns in the NRC generic letters.

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

2. EVALUATION OF THE DRESDEN III NUCLEAR GENERATING PLANT

2.1 REVIEW CRITERIA

The primary intent of this evaluation is to determine that the following requirements are met for the safety signals to all ESF equipment.

(1) Criterion no. 1--In keeping with the requirements of GDC 55 and 56, 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.

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

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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.

**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.

Criterion 6 in this review applies primarily to related ESF systems because implementation of this criterion for containment isolation systems has been 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. CONTAINMENT VENTILATION ISOLATION CIRCUITS DESIGN DESCRIPTION

Dresden Nuclear Generating Plant has two ESF trains which can cause isolation of the containment ventilation system. The initiating contacts of each train are combined as series inputs to form an "OR" gate. These contacts are described below:

(1) Automatic Contacts

(a) High drywell pressure
(b) Low reactor vessel water level

(2) Manual Contacts

(a) Manual valve control (open/close). There is no system level manual isolation control.

All of the drywell/torus purge and isolation valves are solenoid-controlled, air-operated valves which close on a-c power failure or loss of supply air. Normal actuation of these valves is by removal of a-c power from the solenoid. The sensed parameters are drywell high pressure or reactor water low level. The sensors and actuation logic are of the same type as the reactor protection system and are designed to meet IEEE Std-279.

Reset of an automatic activating condition (i.e., drywell high pressure and/or reactor low water level) does not automatically open the purge/isolation valves (as modified, [Ref. 7]). If the valves were open initially, reset of the actuation condition and operation of a switch is required to reopen the purge and vent valves in groups (inboard and outboard). A keylock-controlled bypass is available in the isolated condition to allow initiation of the standby gas treatment plant.

The purge system vents through the reactor building vent system and provides an indirect isolation on high radiation. High activity would cause a trip of the reactor building radiation monitors, initiating a control room alarm which could result in a manual isolation of the ventilation system, and start of the standby gas treatment. If the conditions were too low to initiate a Group II isolation, the control room alarm would alert the operator to take appropriate action.

2.3 CONTAINMENT VENTILATION ISOLATION SYSTEM DESIGN EVALUATION

In response to the issue of containment purging during normal plant operation, Commonwealth Edison has committed to limiting purging, and venting to those operations necessary to inert and de-inert the containment and maintain a pressure differential between the drywell and suppression chamber [Ref. 3].

The CVI valves have individual manual open/close switches, but no system-level reset or override control for normal operation. There is a control override on the outboard valve and on the two, two-inch inboard valves for postaccident venting to the Standby Gas Treatment System (SBGT). The SBGT system cannot be used during CVI, except with postaccident override, and is not in the scope of this issue. The control system has a keylock switch with the capability for administrative control of the key. It is stated in the attachment to the CEC letter of February 28, 1980 [Ref. 7] that the keylock functions have annunciators indicating that the bypass circuitry is in effect. Excluding this bypass as being beyond the scope of this issue, NRC staff criterion no. 1 is met.

Keylock switches are provided to control the bypass of ventilation control; therefore, NRC staff criterion no. 2 is satisfied.

An annunciator is used to indicate the bypassed condition of the ventilation control; therefore, NRC criterion no. 3 is satisfied.

The containment isolation automatic actuation signal is initiated by two safety signals as described in Section 2.2, but does not incorporate an automatic isolation from high radiation. We conclude that NRC staff criterion no. 4 is not satisfied.

Based on the information provided by the licensee in the attachment to the CEC letter of Februry 28, 1980 [Ref. 7], the instrumentation and control equipment at the Dresden III Nuclear Generating Plant is designed and qualified as safety-related (Class IE) equipment. We conclude that NRC staff criterion no. 5 is satisfied.

The licensee has stated [Ref. 7] that the valve control switches for the isolation valves have recently been modified to incorporate a permissive so that the valves will not re-open when the isolating signal is reset. This modification satisfies NRC critrion no. 6.

2.4 OTHER ENGINEERED SAFETY FEATURE SYSTEM CIRCUITS

As part of this review other ESF actuation systems were audited. The systems reviewed were the main steam isolation system and the recirculation pump trip (for control only). It was determined that these systems are functionally similar to the containment ventilation isolation system and meet the applicable criteria of Section 2.1. On the basis of this audit review, we conclude that there is reasonable assurance that other ESF systems comply with the NRC criteria.

3. CONCLUSIONS

The EI&C design aspects of the containment purge valve isolation and other ESF signals for the Dresden Station Unit III Nuclear Power Plant were evaluated using the design criteria in Section 2.1 of this report. The Dresden Station Unit II control is similar to the Unit III control reviewed previously.

It is concluded that the containment ventilation isolation system meets the criteria except for the absence of automatic isolation from a high radiation signal under diverse parameters as required by criterion no. 4.

Based upon our audit of other ESF systems, we conclude that there is reasonable assurance that these systems also comply with the applicable criteria of Section 2.1.

Incidental to the review, it was noted that the containment ventilation isolation circuit does not have a system-level manual isolation switch as specified by IEEE Std-279-1971 [Ref. 8]. We recommend that a manual system-level isolation switch be incorporated.

REFERENCES

1. Generic letter, "Containment Purging During Normal Plant Operation" from USNRC Division of Operating Reactors (A. Schwencer) to all licensees, dated November 28, 1978.

2. Commonwealth Edison letter, attachment 2 (D. Louis Peoples) to USNRC Office of Nuclear Reactor Regulation (H.R. Denton), dated October 4, 1979.

3. Commonwealth Edison letter (C. Reed) to USNRC Office of Nuclear Reactor Regulation (H.R. Denton), dated July 2, 1979.

4. Commonwealth Edison letter (C. Reed) to USNRC Office of Nuclear Reactor Regulation (H.R. Denton), dated July 30, 1979.

5. Commonwealth Edison letter (C. Reed) to USNRC Division of Operating Reactors (D.L. Ziemann), dated January 2, 1979.

6. U.S. Nuclear Regulatory Commission, "TMI-2 Task Force Short-Term Recommendations, Section 2.1.4, Appendix A, Position 4," NUREG 0578, dated July 1979.

7. Commonwealth Edison letter (R.F. Janecek) to USNRC Division of Operating Reactors (T. Ippolito), dated February 28, 1980.

8. Institute of Electrical and Electronic Engineers Standard 279-1971.

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