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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
JOSEPH M. FARLEY NUCLEAR POWER PLANT**

(DOCKET NO. 50-348)

NOVEMBER 1979

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Work Performed for Lawrence Livermore Laboratory under U.S. Department of Energy
Contract No. DE-AC08-76 NVO 1183.

Energy Measurements Group
San Ramon Operations

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by

D. B. Hackett

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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 Joseph M. Farley 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. This report is supplied as part of the Selected Electrical, Instrumentation, and Control Systems Issues Program being conducted for the U. S. Nuclear Regulatory Commission by Lawrence Livermore Laboratory.

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 Laboratory, Field Test Systems Division of the Electronics Engineering Department.

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THE JOSEPH M. FARLEY NUCLEAR POWER PLANT

(Docket No. 50-348)

D. B. Hackett
EG&G, Inc., Energy Measurements Group, San Ramon Operations

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"¹ to all boiling water reactor (BWR) and

pressurized water reactor (PWR) licensees. In a letter² dated January 9, 1979, a letter³ dated January 10, 1979, and a letter⁴ dated February 5, 1979, the Alabama Power Company (APC), the licensee for the Joseph M. Farley nuclear power plant, replied to the NRC generic letter. A meeting⁵ was held between the APC and the NRC in Washington, D. C. on July 31, 1979 and a conference call was made on October 29, 1979 to discuss this issue further. In a letter⁶ dated August 7, 1979, APC provided the information requested at the July 31, 1979 meeting.

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

2. EVALUATION OF JOSEPH M. FARLEY NUCLEAR POWER PLANT

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--The overriding* of one type of safety actuation signal (e.g., radiation) must not cause the blocking of any other type of safety actuation signal (e.g., pressure) to the isolation valves.
- (2) Criterion no. 2--Sufficient physical features (e.g., key lock switches) are provided to facilitate adequate administrative controls.
- (3) Criterion no. 3--The system-level annunciation of the overridden status is provided for every safety system impacted when any override is active.

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 should automatically initiate CVI. This is in conformance with Branch Technical Position 6.4 of Section 6.2.4 of the Standard Review Plan.
- (2) Criterion no. 5--The instrumentation and control systems provided to initiate CVI should be designed and qualified as safety-grade equipment.

*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 the automatic reopening of any isolation/purge valve.

2.2 CONTAINMENT VENTILATION ISOLATION CIRCUITS DESIGN DESCRIPTION

The Joseph M. Farley nuclear power plant containment ventilation/purge system is comprised of an 18-inch "mini-purge" system combined with 48-inch main-purge system. The "mini-purge" system was designed to maintain containment-atmosphere radioactivity levels consistent with occupancy requirements.

The Joseph M. Farley nuclear power plant has two ESF trains which can each cause isolation of the containment ventilation/purge system. The initiating contacts that effect CVI are listed below:

(1) Automatic Contacts

- (a) Containment high radiation (either of two separate monitors).
- (b) Safety injection actuation.

(2) Manual Contacts

- (a) Containment isolation pushbuttons.
- (b) Containment spray pushbuttons.

Each train includes as an input, the safety injection actuation signal to the solid-state protection system (SSPS). When a monitored plant condition (or manual input) calls for isolation, electric power is removed from the CVI solenoid-valve circuits causing the isolation valves to close. The manual containment spray pushbuttons, the containment isolation pushbuttons, and the safety-grade radiation monitors have normally open contacts directly in the CVI solenoid-valve circuits.

*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.

Both safety injection trains have a "reset" switch, as defined in this report. These switches are unprotected, T-handle, spring-loaded to neutral, momentary-contact switches. Upon clearing of both safety injection trains, the CVI signal will clear. However, this will not cause the valves to automatically reopen. To reopen the valves, the valve switch must be manually reinitiated to the "open" position. This will pick up a seal-in contact which will maintain electrical power to the CVI solenoid-valve circuit. The seal-in will not hold the valve open if a CVI signal is present or initiated.

The CVI actuation circuit does not contain a "reset" or override switch. The radiation monitors have "reset" switches, as defined in this report, but they do not contain an override or bypass feature. There is no apparent need to open any of the containment ventilation/purge valves following an accident condition, because the post-accident combustible gas recombiner system is located inside the containment.

2.3 CONTAINMENT VENTILATION ISOLATION SYSTEM DESIGN EVALUATION

In response to this issue, the containment large purge valves at Joseph M. Farley nuclear power plant are currently tagged shut on an interim basis. All venting and purging is being performed with the "mini-purge" system on an unlimited basis.

The CVI actuation system contains no resets or overrides. We conclude that NRC staff criterion nos. 1, 2, and 3 are satisfied.

The safety injection actuation signal is formed by an "OR" gate of several signals, including containment high pressure. Since CVI is initiated by safety injection or containment high radiation, we conclude that NRC staff criterion no. 4 is satisfied.

From the information provided by the licensee during the July 31, 1979 meeting⁵ with the NRC, the radiation-monitoring equipment at the

Joseph M. Farley nuclear power plant is designed and qualified as safety-grade equipment. We conclude that NRC staff criterion no. 5 is satisfied.

Resetting the actuation signal cannot cause the CVI valves to automatically reopen. To reopen these valves, their individual switches must be reinitiated to the "open" position. We conclude that NRC staff criterion no. 6 is satisfied.

2.4 OTHER ENGINEERED SAFETY FEATURE SYSTEM CIRCUITS

As part of this review, it was determined that the design of the containment isolation actuation system, the safety injection actuation system, and the containment spray actuation system circuits are functionally similar to the CVI system. None of these systems has an override feature. The safety injection actuation signal has a "reset" switch, as defined in this report. We conclude that the NRC staff criteria are satisfied.

3. CONCLUSIONS

The EI&C design aspects of containment purge valve isolation and other ESF signals for the Joseph M. Farley nuclear power plant were evaluated using those design criteria stated in Section 2.1 of this report.

We conclude that the CVI system and other ESF circuit designs are acceptable and meet the NRC staff criteria.

REFERENCES

1. NRC/DOR letter (A. Schwencer) to APC, "Containment Purging During Normal Plant Operation," dated November 28, 1978.
2. APC letter (F. L. Clayton, Jr.) to NRC (H. Denton, Attn: A. Schwencer), "J. M. Farley Nuclear Plant-Unit 1, Containment Purging During Normal Plant Operation," dated January 9, 1979.
3. APC letter (F. L. Clayton, Jr.) to NRC (H. Denton, Attn: A. Schwencer), "J. M. Farley Nuclear Plant-Unit 1, Containment Purging During Normal Plant Operation," dated January 10, 1979.
4. APC letter (F. L. Clayton, Jr.) to NRC (H. Denton, Attn: A. Schwencer), "J. M. Farley Nuclear Plant-Unit 1, Containment Purging During Normal Plant Operation," dated February 5, 1979.
5. APC meeting with NRC in Washington, D. C. held July 31, 1979, on "Containment Purging During Normal Plant Operation."
6. APC letter (F. L. Clayton, Jr.) to NRC (H. Denton, Attn: A. Schwencer), "J. M. Farley Nuclear Plant, Docket No. 50-348, Containment Purge Valves," dated August 7, 1979.
7. U. S. Nuclear Regulatory Commission, Standard Review Plan, "Containment Isolation System," NUREG 75/087, Rev. 1, Section 6.2.4.