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# DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS, MAINE YANKEE ATOMIC POWER STATION, DOCKET NO. 50-309, TAC NO. 10032

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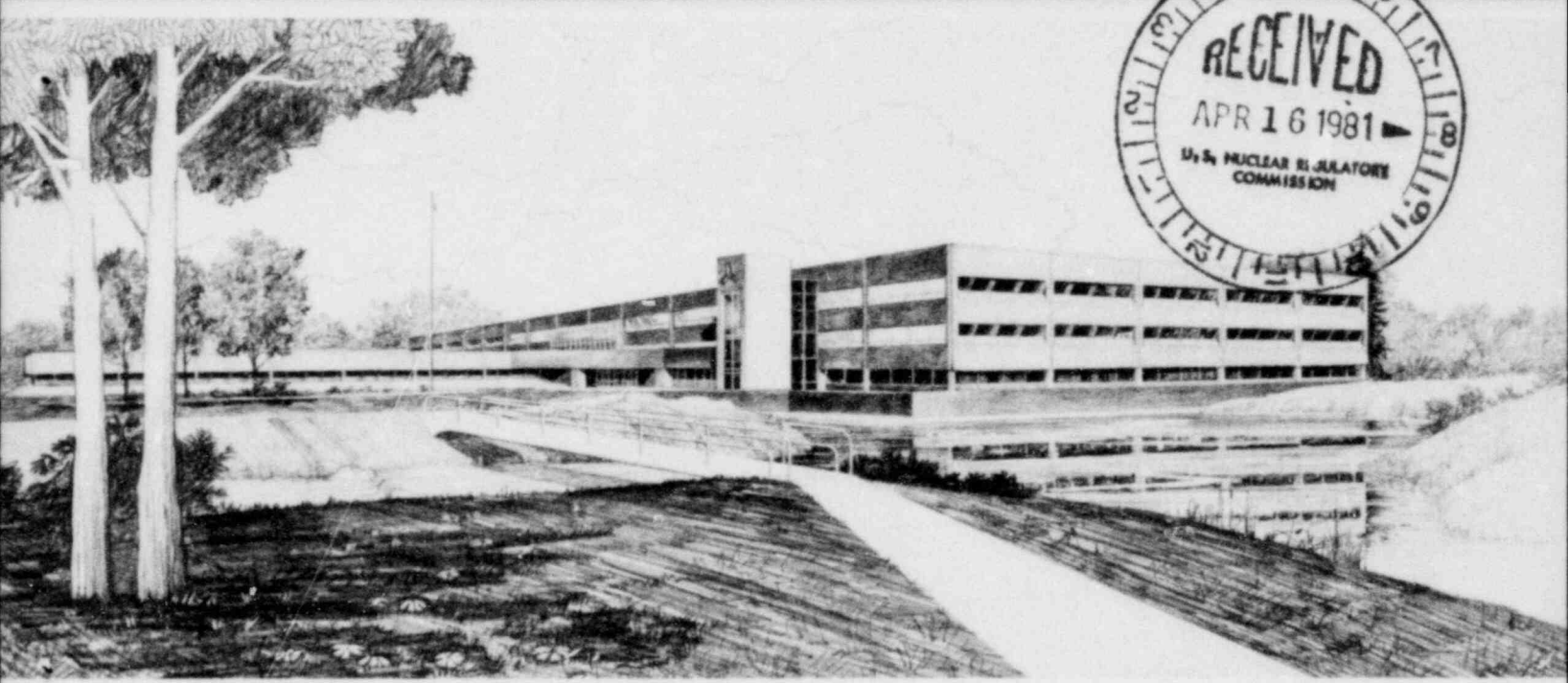
Idaho Operations Office • Idaho National Engineering Laboratory

**PRELIMINARY**





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# DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS

## MAINE YANKEE ATOMIC POWER STATION

Docket No. 50-309

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## ABSTRACT

In June 1977, the NRC sent all operating reactors a letter outlining three positions the staff had taken in regard to the onsite emergency power systems. Maine Yankee Atomic Power Company (MYAPCo) was to assess the susceptibility of the safety-related electrical equipment at the Maine Yankee Atomic Power Station to a sustained voltage degradation of the offsite source and the interaction of the offsite and onsite emergency power systems. This report contains an evaluation of the MYAPCo analyses, modifications, and technical specification changes that were submitted in response to these NRC positions. The evaluation has determined that MYAPCo does not comply with all of the NRC positions.


## FORWORD

This report is supplied as part of the "Selected Operating Reactor Issues Program (III)" being conducted for the U.S. Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Operating Reactors, by EG&G Idaho, Inc., Reliability and Statistics Branch.


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# DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS

# MAINE YANKEE ATOMIC POWER STATION

## 1.0 INTRODUCTION

On June 3, 1977, the NRC requested the Maine Yankee Atomic Power Company (MYAPCo) to assess the susceptibility of the safety-related electrical equipment at the Maine Yankee Atomic Power Station to a sustained voltage degradation of the offsite source and the interaction of the offsite and onsite emergency power systems.[1] The letter contained three positions with which the current design of the plant was to be compared. After comparing the current design to the staff positions, MYAPCo was required to either propose modifications to satisfy the positions and criteria or furnish an analysis to substantiate that the existing facility design has equivalent capabilities.

By letter dated July 18, 1977,[2] MYAPCo responded to the NRC letter. On May 5, 1980, a meeting was held between the NRC and MYAPCo.[3] The NRC positions were fully explained in this meeting. As a result, MYAPCo sent some information to the NRC on July 24, 1980.[4] On October 2, 1980, a formal request for information that was still unavailable was sent to MYAPCo by the NRC.[5] On January 20, 1981, MYAPCo submitted design modifications and answers to the request for additional information.[6] The modifications consist of the installation of coincident second-level undervoltage (UV) protection system for the class 1E equipment. To date, MYAPCo has not supplied or committed to supply the required technical specifications.

## 2.0 DESIGN BASE CRITERIA

The design base criteria that were applied in determining the acceptability of the system modifications to protect the safety-related equipment from a sustained degradation of the offsite grid are:

1. General Design Criterion 17 (GDC 17), "Electrical Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," of 10 CFR 50.[7]

2. IEEE Standard 279-1971, "Class 1E Power Systems for Nuclear Power Generating Stations."[8]

3. IEEE Standard 308-1974, "Class 1E Power Systems for Nuclear Power Generating Stations."[9]

4. Staff positions as detailed in a letter sent to the licensee, dated June 3, 1977.[1]

5. ANSI Standard C84.1-1977, "Voltage Ratings for Electrical Power Systems and Equipment (60 Hz)."[10]

## 3.0 EVALUATION

This section provides, in Subsection 3.1, a brief description of the existing undervoltage protection at Maine Yankee; in Subsection 3.2, a description of the licensee's proposed modifications for the second-level undervoltage protection; and in Subsection 3.3, a discussion of how the proposed modifications meet the design base criteria.

3.1 Existing Undervoltage Protection. On each of the two 4160V class 1E buses, there are two electromagnetic inverse time undervoltage relays to detect loss of power. They are arranged in a two-out-of-two logic scheme with a setpoint of 3255V.[11]

Should this relay logic detect a loss of voltage, the feed breakers to that bus will be tripped, the diesel generator associated with that bus will be started, and selected 4160V loads will be dropped. The diesel-generator breaker automatically closes as the generator voltage and frequency become acceptable.

3.2 Modifications. The licensee has proposed to change the Maine Yankee undervoltage protection scheme. In addition to the existing loss-of-voltage relay protection, each bus will be protected against sustained degraded voltage. This protection is by two undervoltage relays that detect

an abnormally low voltage on each of the 4160V class 1E buses. An instantaneous alarm occurs if either relay is tripped. A two-out-of-two logic in coincidence with an accident signal would, after a built-in time delay, automatically open the offsite source breaker, actuating the other existing function of the loss-of-voltage relays.

MYAPCo has not supplied technical specifications regarding the setpoints, the allowable upper and lower limits of the setpoint tolerance, the time delays, the allowable limits of the time delay, limiting conditions of operation, surveillance, or testing requirements.

3.3 Discussion. The first position of the NRC staff letter[1] required that a second level of undervoltage protection for the onsite power system be provided. The letter stipulates other criteria that the undervoltage protection must meet. Each criterion is restated below followed by a discussion regarding the licensee's compliance with that criterion.

1. "The selection of voltage and time setpoints shall be determined from an analysis of the voltage requirements of the safety-related loads at all onsite distribution system levels."

   MYAPCo has not provided voltage and time setpoints per the NRC requirement.[1] However, they have provided appropriate analysis separately (TAC 12774) that indicates that the setpoint on the 4160V buses must be maintained below 3832V, yet high enough to maintain 414V to all of the 480V loads. A time delay should be selected that would allow the worst transient voltage to recover after the start of large loads.

2. "The voltage protection shall include coincidence logic to preclude spurious trips of the offsite power sources."

   The proposed modification incorporates two-out-of-two logic that satisfys this guideline.

3. "The time delay selected shall be based on the following conditions:

   a. "The allowable time delay, including margin, shall not exceed the maximum time delay that is assumed in the FSAR accident analysis."

   b. "The time delay shall minimize the effect of short-duration disturbances from reducing the unavailability of the offsite power source(s)."

   c. "The allowable time duration of a degraded voltage condition at all distribution system levels shall not result in failure of safety systems or components."

   MYAPCo proposes to utilize automatic bus shedding should a sustained bus undervoltage occur when an accident occurs. MYAPCo has not identified the length of the time delay proposed for this system, which occurs regardless of whether an accident condition exists. Should both of the bus undervoltage relays trip, they start a timer. When the timing cycle is complete, if an accident condition occurs, the bus offsite source breaker is opened. Depending on when an accident signal occurs (before the degraded voltage is detected, during the timing cycle, or after the timing cycle), it is unknown if the maximum time delay assumed in the FSAR analysis is exceeded by the scenario of events.

4. "The voltage monitors shall automatically initiate the disconnection of offsite power sources whenever the voltage setpoint and time-delay limits have been exceeded."

   The literal intent of this guideline is not met; however, when an accident condition occure, it is met.

5. The voltage monitors shall be designed to satisfy the requirements of IEEE Standard 279-1971."

The licensee has not stated in his proposal that the modifications are designed to meet or exceed IEEE Standard 279 requirement.

6. "The technical specifications shall include limiting conditions for operation, surveillance requirements, trip setpoints with minimum and maximum limits, and allowable values for the second-level voltage protection monitors."

The licensee has not proposed any technical specifications for the second-level voltage protection monitors.

The second NRC staff position requires that the system design automatically prevent load-shedding of the emergency buses once the onsite sources are supplying power to all sequenced loads. The load-shedding must also be reinstated if the onsite breakers are tripped.

The current undervoltage relaying scheme for the class 1E buses already has load-shedding.[2] This will be maintained when the system is modified for second-level undervoltage protection as well. However, MYAPCo has refused to reinstate load-shedding if the onsite breakers are tripped.

The third NRC staff position requires that certain test requirements be added to the technical specifications. These tests were to demonstrate the full-functional operability and independence of the onsite power sources, and are to be performed at least once per 18 months during shutdown. The tests are to simulate loss of offsite power in conjunction with a safety-injection actuation signal, and to simulate interruption and subsequent reconnection of onsite power sources. These tests verify the proper operation of the load-shed system, the load-shed bypass when the emergency diesel generators are supplying power to their respective buses, and that there is no adverse interaction between the onsite and offsite power sources.

The current technical specifications comply with the requirement to test by simulated loss of offsite power in conjunction with a safety-injection signal. However, HYAPCo has refused to include testing in the technical specifications to simulate interruption and subsequent reconnection of the onsite power sources.

## 4.0 CONCLUSIONS

Based on the information provided by MYAPCo, it has been determined that the proposed modifications do not fully comply with NRC staff position 1.

The existing load-shed circuitry does not fully comply with staff position 2

MYAPCo has not proposed changes to the technical specifications to adequately test the system modifications and comply with staff position 3.

It is therefore concluded that the MYAPCo proposed modifications and technical specification changes are not acceptable.

## 5.0 REFERENCES


1. NRC letter to MYAPCo, dated June 3, 1977.

2. MYAPCo letter, E. W. Jackson, to Office of Nuclear Reactor Regulation, NRC, July 18, 1977, WMY-77-72.

3. Meeting May 5, 1980, MYAPCo and NRC, Bethesda, Md.

4. MYAPCo letter, D. E. Vandenburgh, to Office of Nuclear Reactor Regulation, NRC, "Mitigating the Effects of Grid Degradation on Safety Related Electrical Equipment," July 24, 1980, WYR-80-83.

5. NRC letter, R. A. Clark, to MYAPCo, R. H. Groce, October 2, 1980.

6. MYAPCo letter, R. H. Groce, to Office of Nuclear Reactor Regulation, NRC, "Mitigating the Effects of Grid Degradation on Safety-Related Electrical Equipment," January 20, 1981, FMY 81-5.

7. General Design Criterion 17, "Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

8. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."

9. IEEE Standard 308-1974, "Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."

10. ANSI C84.1-1977, "Voltage Ratings for Electric Power Systems and Equipment (60 Hz)."

11. MYAPCo letter, E. W. Jackson, to Office of Nuclear Reactor Regulation, NRC, July 18, 1977, WMY-77-72.