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DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS, LA CROSSE BOILING WATER REACTOR, DOCKET NO. 50-409, TAC NO. 10031

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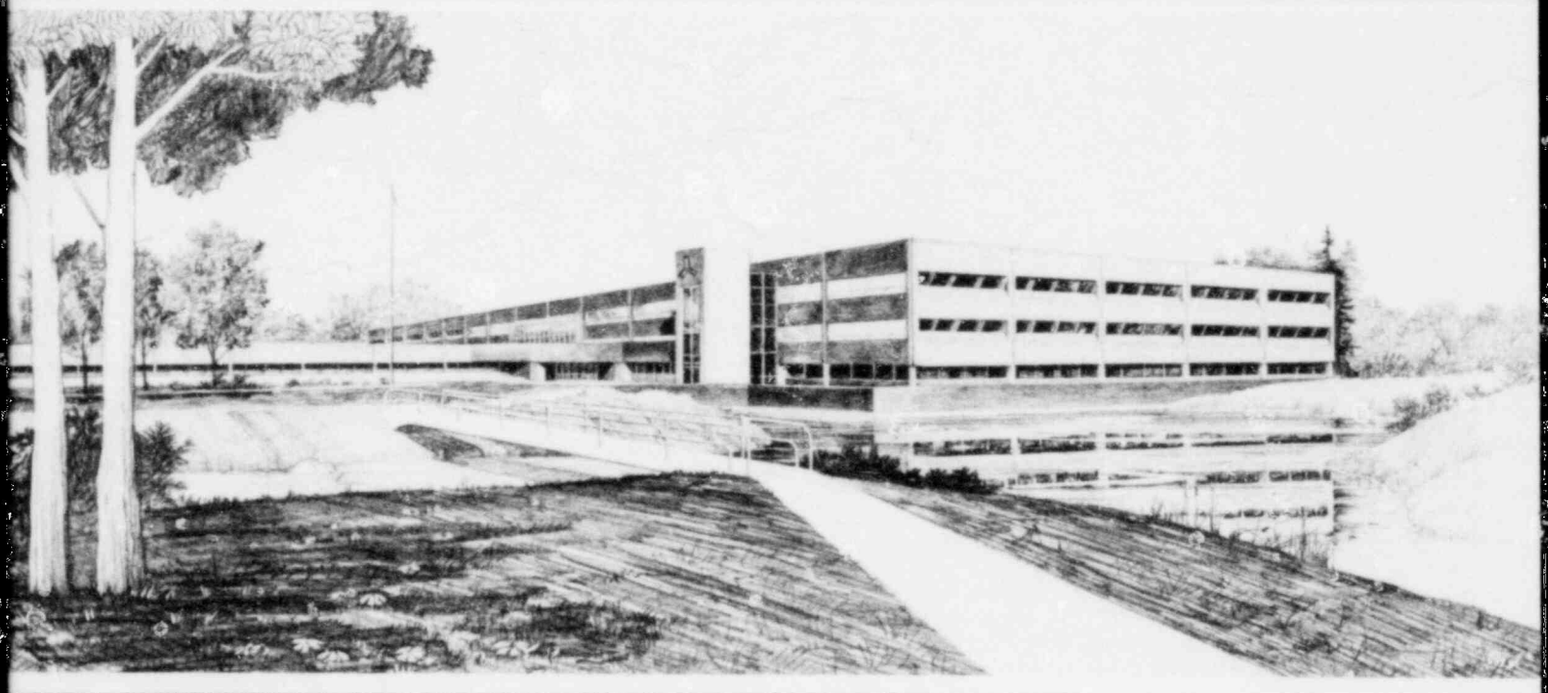
PRELIMINARY

U.S. Department of Energy
Idaho Operations Office • Idaho National Engineering Laboratory



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INTERIM REPORT

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DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS

LA CROSSE BOILING WATER REACTOR

Docket No. 50-409

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Reliability and Statistics Branch
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EG&G Idaho, Inc.

November 1981

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ABSTRACT

This EG&G Idaho, Inc. report reviews the susceptibility of the safety-related electrical equipment, at the La Crosse Boiling Water Reactor, to a sustained degradation of the offsite power sources.

FOREWORD

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

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DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS

LA CROSSE BOILING WATER REACTOR

1.0 INTRODUCTION

On June 3, 1977, the NRC requested the Dairyland Power Corporative (DPCo) to assess the susceptibility of the safety-related electrical equipment at the La Crosse Boiling Water Reactor (LACBWR) 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, DPCo 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 22, 1977,[2] DPCo responded to the NRC letter, deferring the submittal of a report on the subject. DPCo sent information to the NRC on March 17, 1980,[3] and March 28, 1980.[4] On September 9, 1980,[5] DPCo submitted proposed technical specifications for this review. A formal request for changing the technical specifications has not been made. Additional information and voltage analyses were obtained in the letters dated November 19, 1976,[6] March 13, 1980,[7] and May 12, 1980.[8]

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.[9]

2. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."[10]

3. IEEE Standard 308-1974, "Class 1E Power Systems for Nuclear Power Generating Stations."[11]

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)."[12]

3.0 EVALUATION

This section provides, in Subsection 3.1, a brief description of the existing undervoltage protection at La Crosse; 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. 480V essential buses 1A and 1B each have undervoltage relays that start the corresponding diesel generator and transfer the bus from the offsite power source to the diesel generator. The trip setpoint is equal to 328V with a time delay of less than 2.5 s on loss of power. One-out-of-two relay logic is used. Any loads required to mitigate the consequences of an accident are not shed from the bus and restart when the diesel-generator output is switched onto the bus.

480V essential buses 1A and 1B receive power from 480V buses 1A and 1B, respectively. Each of these buses also has undervoltage relays that are normally set at 220V. These relays isolate 480V buses 1A and 1B from 2400V buses 1A and 1B, respectively. This action is independent from the isolation of 480V essential buses 1A and 1B from 480V buses 1A and 1B. These relays only affect the essential buses indirectly and do not have any control over the starting and loading of the diesel generators.

3.2 Modifications. The setpoints of the existing undervoltage relays on the 480V essential buses will be raised to be equivalent to a nominal bus voltage of 372V (353V lower limit, 390V upper limit) with a time delay between 1.9 and 2.1 s on complete loss of power.

A second set of undervoltage relays would be installed on each 480V essential bus that has a setpoint equivalent to a nominal bus voltage of 400V (380V lower limit, 420V upper limit) with a time delay of 9 $\pm$ 0.9 s. These relays will use a two-out-of-three coincidence logic to start the diesel generator within the time delay assumed in the FSAR accident analysis. These voltage monitors are to be designed to meet the applicable requirements of IEEE Standard 279.

Both the loss-of-power and the second-level undervoltage relays will, on a trip, separate its bus from offsite power, start the diesel generator (D-G) and transfer the bus to the D-G when the D-G output is sufficient.

Proposed changes to the unit technical specifications (adding the surveillance requirements, allowable limits for the setpoints and time delays, and limiting conditions of operation for the second-level undervoltage relays) were also furnished by DPCo.

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."

   DPCo has provided voltage and time setpoints per the NRC requirement.[1] DPCo has provided appropriate analysis separately[8] that indicates that the setpoint tolerance on the second-level undervoltage relays is wide enough that it overlaps both above

the minimum expected voltage (from the offsite source) and below the voltage needed to maintain the load terminal voltage within equipment ratings.

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

   The proposed modification incorporates two-out-of-three logic that satisfies 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."

      DPCo has proposed a time delay of 9 $\pm$ 0.9 s.[3] This is within the 20-s time delay assumed in the FSAR accident analysis, including 10 s for the diesel generators to be started and available.

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

      This time delay is sufficiently long that the effect of short-duration disturbances will not reduce the availability of the offsite power sources.

   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."

DPCo has shown that equipment operation at reduced voltage levels for this time period will not result in the failure of safety systems or their components.

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 DPCo design meets this requirement.

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

   The licensee has stated in his proposal that the modifications will be designed to meet the applicable IEEE Standard 279 requirements.

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 proposed technical specifications for the second-level voltage protection monitors that meet these requirements.

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 La Crosse class 1E buses do not shed any essential loads. This meets the intent of this NRC position.

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, and to test to simulate interruption and subsequent reconnection of the onsite power sources.

4.0 CONCLUSIONS

Based on the information provided by DPCo, it has been determined that the proposed modifications comply with NRC position 1. However, I recommend that DPCo place a tighter tolerance on the second-level undervoltage relay setpoint to keep the setpoint below the expected bus voltage (when supplied from offsite power) yet above the voltage required to maintain the equipment terminal voltages above the minimum equipment rating.

NRC position 2 is complied with.

DPCo has proposed changes to the technical specifications to adequately test the system modifications. The proposed technical specifications comply with NRC position 3. However, the proposed changes to the technical specifications have not been formally submitted.

The DPCo proposed modifications and technical specification changes are acceptable. There is no reason to delay the formal submittal of the technical specification changes.

5.0 REFERENCES

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

2. DPCo letter, J. P. Madgett, to Director of Nuclear Reactor Regulation, NRC, "Emergency Power Systems for Operating Reactors," July 22, 1977, LAC-4793.

3. DPCo letter, F. Linder, to Director of Nuclear Reactor Regulation, NRC, "Onsite Emergency Power System," March 17, 1980, LAC-6824.

4. DPCo letter, F. Linder, to Director of Nuclear Reactor Regulation, NRC, "Onsite Emergency Power System," March 28, 1980, LAC-6841.

5. DPCo letter, R. M. Brimer, to C. Cleveland, EG&G Idaho, September 9, 1980, LAC-7130.

6. DPCo letter, J. P. Madgett, to Director of Nuclear Reactor Regulation, NRC, "Evaluation of Degraded Grid Voltage Condition," November 19, 1976, LAC-4350.

7. DPCo letter, F. Linder, to Division of Operating Reactors, NRC, "Adequacy of Station Electric Distribution System Voltage for La Crosse Boiling Water Reactor," March 13, 1980, LAC-6822.

8. DPCo letter, F. Linder, to Division of Operating Reactors, NRC, "Adequacy of Station Electric Distribution System Voltage for the La Crosse Boiling Water Reactor," May 12, 1980, LAC-6912.

9. 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."

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

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

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