

50-247

EGG-EA-5477

SEPTEMBER 1981

DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS,
INDIAN POINT NUCLEAR STATION UNIT 2, DOCKET NO. 50-247

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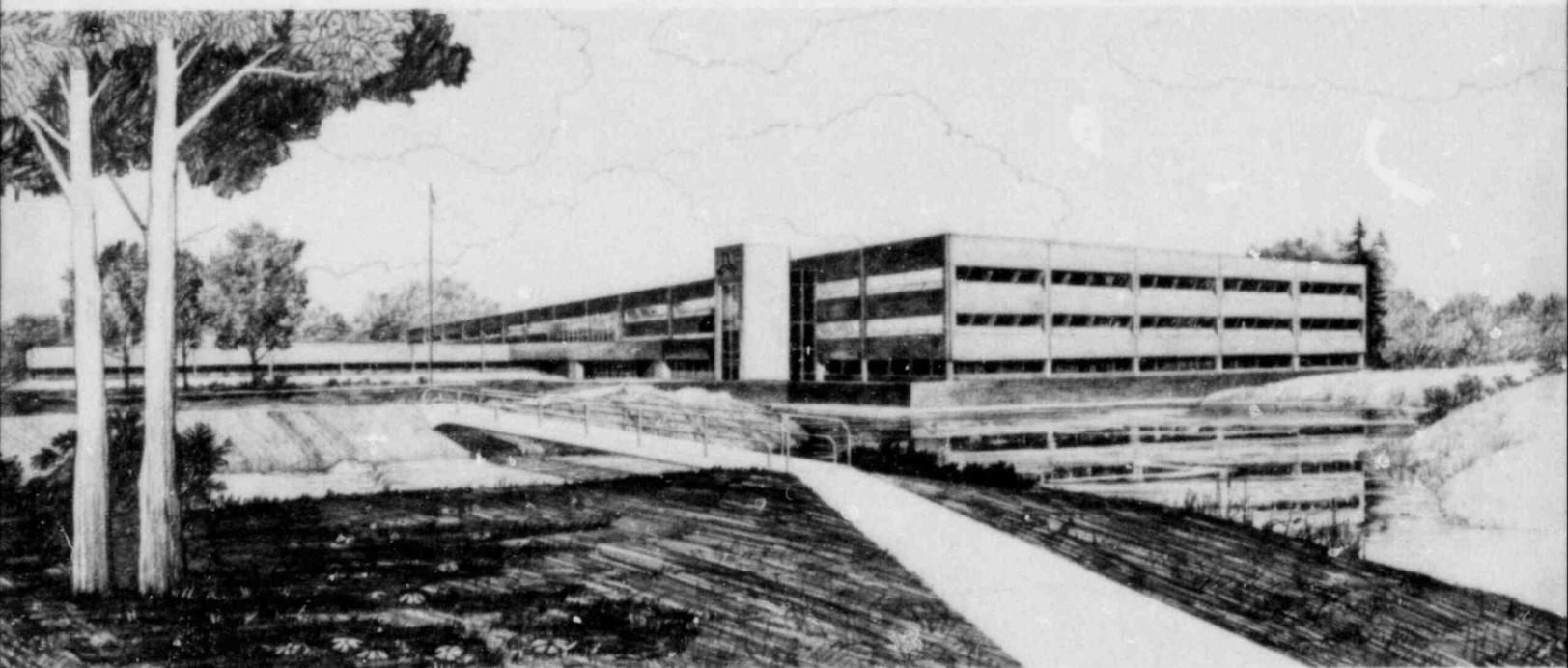
D. A. Weber

NRC Research and Technical Assistance Report



U.S. Department of Energy

Idaho Operations Office • Idaho National Engineering Laboratory



This is an informal report intended for use as a preliminary or working document

Prepared for the
U.S. Nuclear Regulatory Commission
Under DOE Contract No. DE-AC07-76ID01570
FIN No. A6429



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FORM EG&G-396
(Rev. 11-79)

INTERIM REPORT

Accession No. _____

Report No. EGG-EA-5477

Contract Program or Project Title:

Selected Operating Reactor Issues Program (III)

Subject of this Document:

Degraded Grid Protection for Class 1E Power Systems, Indian Point
Nuclear Station Unit 2, Docket No. 50-247

Type of Document:

Technical Evaluation Report

Author(s):

D. A. Weber

**NRC Research and Technical
Assistance Report**

Date of Document:

September 1981

Responsible NRC Individual and NRC Office or Division:

P. C. Shemanski, Division of Licensing

This document was prepared primarily for preliminary or internal use. It has not received full review and approval. Since there may be substantive changes, this document should not be considered final.

EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Nuclear Regulatory Commission
Washington, D.C.
Under DOE Contract No. **DE-AC07-76ID01570**
NRC FIN No. A6429

INTERIM REPORT

DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS

INDIAN POINT NUCLEAR STATION UNIT 2

Docket No. 50-247

D. A. Weber
Reliability and Statistics Branch
Engineering Analysis Division
EG&C Idaho, Inc.

September 1981

**NRC Research and Technical
Assistance Report**

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. Consolidated Edison Company (Con-Ed) was to assess the susceptibility of the safety-related electrical equipment at the Indian Point Nuclear Station Unit 2, to a sustained voltage degradation of the offsite source and interaction of the offsite and onsite emergency power systems. This report contains an evaluation of Con-Ed's analyses, modifications, and technical specification changes to comply with these NRC positions. The evaluation has determined that Con-Ed does not comply with one of the NRC positions.

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.

The U.S. Nuclear Regulatory Commission funded the work under the authorization, B&R 20 19 01 06, FIN No. A6429.

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TECHNICAL EVALUATION REPORT
DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS

INDIAN POINT NUCLEAR STATION UNIT 2

1.0 INTRODUCTION

On June 2, 1977, the NRC requested the Consolidated Edison Company (Con-Ed) to assess the susceptibility of the safety-related electrical equipment at the Indian Point Nuclear Station Unit No. 2 (IP-2) to a sustained voltage degradation of the offsite source and 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, Con-Ed 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.

Con-Ed responded to the NRC letter with two submittals dated August 29, 1977,^{2,3} These submittals and the submittals of September 20, 1976,⁴ September 24, 1976,⁵ December 17, 1976,⁶ March 31, 1977,⁷ June 17, 1977,⁸ September 15, 1977,⁹ October 16, 1979,¹⁰ April 28, 1980,¹¹ August 1, 1980,¹² December 31, 1980,¹³ April 14, 1981,¹⁴ April 27, 1981,¹⁵ and the Indian Point Unit No. 2 Final Safety Analysis Report (FSAR)¹⁶ complete the information reviewed for this report.

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 50¹⁶
2. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations"¹⁷
3. IEEE Standard 308-1974, "Class 1E Power Systems for nuclear Power Generating Stations"¹⁸
4. Staff positions as detailed in a letter sent to the licensee, dated June 2, 1977¹
5. ANSI Standard C84.1-1977, "Voltage Ratings for Electrical Power Systems and Equipment (60 Hz)."¹⁹

3.0 EVALUATION

This section provides, in Subsection 3.1, a brief description of the existing undervoltage protection at IP-2; 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. There are four 480V class 1E buses (2A, 3A, 5A, and 6A) for Indian Point 2. Each of the buses is equipped with CV-7 inverse-time relays set at 46% (220V) which automatically strip their associated loads (except safeguard MCC26A and 26B) after 2 seconds. These buses are also equipped with additional CV-7 relays which will initiate load shedding, start the emergency diesel generators, and energize the emergency buses through load sequencing operation.

3.2 Modifications. The licensee has proposed to install two second-level undervoltage relays on each 480 volt safety-related bus in a two-out-of-two logic. The set point for each relay is 403 volts (84%) with a time delay of 180 seconds. The existing time delay on the loss-of-voltage relays has been extended from 120 cycles (2 seconds) to 3 seconds.¹⁶ In addition the licensee has added undervoltage relays on each of the safety-related buses which will provide annunciation to the operator when the bus voltage drops to 93.3%.¹⁰ Proposed changes to the plant's technical specifications were also furnished by the licensee.

3.3 Discussion. The first position of the NRC staff letter¹ 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 system distribution levels."

The licensee has provided an analysis of the voltage requirements of the safety-related loads at all onsite system distribution levels and have concluded that the 460V motors are the most limiting safety-related equipment. The analysis was performed for the continuously running safety-related motors, all of which have service factors of 1.15 and running load less than the nameplate rating of the motor.

Con-Ed's proposed Technical Specifications require that the 480V Emergency Bus Undervoltage (Degraded Voltage) relays have a setpoint of $403V \pm 5V$. This setpoint and tolerance will provide adequate protection for the safety-related loads at all onsite system distribution levels.

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

The proposed modification incorporates a two-out-of-two logic scheme, thereby satisfying this criterion.¹⁵

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."

The proposed maximum time delay of 3 seconds + 1 second for the loss-of-voltage relays does not exceed this maximum time delay.

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

The licensee's proposed minimum time delay of 180 seconds is long enough to override any short, inconsequential grid disturbances and the starting of large motors.

- 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."

The proposed time delay of 180 seconds + 30 seconds will not result in failure of the safety-related equipment.

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

A review of the licensee's proposal substantiates that this criterion is met.

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 are designed to meet or exceed IEEE Standard 279.¹¹

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 protective monitors."

The licensee has provided surveillance requirements but the requirement to "test" every 18 months (noted as "R" for refueling in the proposed Technical Specification) is not acceptable. Testing (Channel Functional Test) frequency should agree with the NRC model Technical Specifications (at least once per 31 days).¹⁵

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 existing undervoltage relaying scheme for all safety-related buses already has these features incorporated. Only the time delay will be extended, from 2 seconds to 4 seconds when the system is modified for second-level undervoltage protection.

The third NRC staff position requires that certain test requirements be added to the technical specification. 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 shut-down. 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 position is satisfied as the Indian Point 2 Technical Specifications describe tests to demonstrate the full-functional operability and independence of the onsite systems.

4.0 CONCLUSIONS

Based on the information provided by Con-Ed, it has been determined that the proposed modifications, generally, do not comply with one of the NRC staff positions as described in the NRC letter of June 2, 1977. To comply with this letter the licensee should:

1. Change the unit technical specification surveillance requirements for second-level and loss-of-voltage Channel Functional Test to agree with the NRC requirements (at least once per 31 days).

5.0 REFERENCES

1. NRC letter (R. W. Reid) to Con-Ed, "Staff Positions Relative to the Emergency Power Systems for Operating Reactors," dated June 2, 1977.
2. Con-Ed letter (W. J. Cahill, Jr.) to NRC (R. W. Reid), dated August 29, 1971. (Responding to the NRC's generic letter of August 12, 1976 (Effects of Degraded Grid Voltage) and updating the Con-Ed letter of September 24, 1976.)

3. Con-Ed letter (W. J. Cahill, Jr.) to NRC (R. W. Reid), dated August 19, 1977. (Responding to the NRC letter of June 2, 1977 regarding emergency power systems.)
4. Con-Ed letter (W. J. Cahill, Jr.) to NRC (R. W. Reid), dated September 20, 1976.
5. Con-Ed letter (W. J. Cahill, Jr.) to NRC (R. W. Reid), dated September 24, 1976.
6. Con-Ed letter (W. J. Cahill, Jr.) to NRC (R. W. Reid), dated December 17, 1976.
7. Con-Ed letter (W. J. Cahill, Jr.) to NRC (R. W. Reid), dated March 31, 1977.
8. Con-Ed letter (W. J. Cahill, Jr.) to NRC (R. W. Reid), dated June 17, 1977.
9. Con-Ed letter (W. J. Cahill, Jr.) to NRC (R. W. Reid), dated September 15, 1977.
10. Con-Ed letter (W. J. Cahill, Jr.) to NRC (W. Gamill), dated October 16, 1979.
11. Con-Ed letter (W. J. Cahill, Jr.) to NRC (A. Schwencer), dated April 28, 1980.
12. Con-Ed letter (P. Zarakas) to NRC (S. A. Varga), dated August 1, 1980.
13. Con-Ed letter (J. D. O'Toole) to NRC (S. A. Varga), dated December 31, 1980.
14. Con-Ed letter (J. D. O'Toole) to NRC (S. A. Varga), dated April 14, 1981.
15. Con-Ed letter (J. D. O'Toole) to NRC (S. A. Varga), dated April 27, 1981.
16. Telecon, J. Toma, S. Mascell, NRC, D. Weber, EG&G Idaho, Inc., M. Scott and P. Szabados, Con Ed, August 27, 1981.
17. Final Safety Analysis Report (FSAR) for the Indian Point Nuclear Station Unit 2.
18. 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."
19. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."

20. IEEE Standard 308-1974, "Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."
21. ANSI C84.1-1977, "Voltage Ratings for Electric Power Systems and Equipment (60 Hz)."
22. IEEE Standard 141-1976, "IEEE Recommended Practice for Electric Power Distribution for Industrial Plants."
23. NEMA Standard, NEMA MG1-1972, "Motors and Generators."