EG&G Idaho, Inc.

FORM EG&G-398
(Rev. 11-79)

# INTERIM REPORT

Accession No. _____

Report No. EGG-EA-5186, Rev. 1

**Contract Program or Project Title:**

Electrical, Instrumentation, and Control System Support

**Subject of this Document:**

Technical Evaluation Report on the Degraded Grid Protection for Class 1E Power Systems for the Monticello Nuclear Generating Plant, Docket No. 50-263

**Type of Document:**

Technical Evaluation Report

**Author(s):**

C. J. Cleveland

**Date of Document:**

August 1980

**Responsible NRC Individual and NRC Office or Division:**

Paul C. Shemanski, NRC-NRR

This document was prepared primarily for preliminary or internal use. It has not received full review and approval. Since there may be subsequent 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. A6256

INTERIM REPORT

1585F

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

MONTICELLO NUCLEAR GENERATING PLANT
Docket No. 50-263

C. J. Cleveland

August 1980

(TAC 10034)
Revision 1

ABSTRACT

In June 1977, the NRC sent all licensees a letter outlining three positions the staff had taken in regards to the onsite emergency power system. Northern States Power Company (NSP) was to assess the susceptibility of the safety-related electrical equipment at the Monticello Generating Plant (NSP-1) to a sustained voltage degradation of the offsite source and interaction of the offsite and onsite emergency power systems. This report contains an evaulation of NSP's analyses, modifications, and Technical Specification changes to comply with these NRC positions.

CONTENTS

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

MONTICELLO NUCLEAR GENERATING PLANT

## 1.0 INTRODUCTION

On June 3, 1977, the NRC requested the Northern States Power Company (NSP) to assess the susceptibility of the safety-related electrical equipment at the Monticello Nuclear Generating Plant (NSP-1) 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, NSP was required to either propose modifications to satisfy the positions and criteria or furnish an analyis to substantiate that the existing facility design has equivalent capabilities.

By letter, dated April 21, 1978, NSP proposed certain design modifications to satisfy the criteria and staff positions. A request for additional information, to clarify some points in NSP's proposal, was sent to NSP by the NRC on June 18, 1979.[3] NSP responded by letters dated Spetember 14, 1979[4] and October 31, 1979[5]. The modifications consist of the installation of a second-level undervoltage protection system for the class 1E equipment, and blocking of the load-shedding feature when the diesel generator is supplying power to the emergency buses. The NRC required tha. the setpoint, surveillance requirements, test requirements, and allowable limits were to be included by NSP in the plant 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[6]

2. IEEE Standard 279-1971, "Class 1E Power Systems for Nuclear Power Generating Stations"[7]

3. IEEE Standard 308-1974, "Class 1E Power Systems for Nuclear Power Generating Stations"[8]

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)."[9]

## 3.0 EVALUATION

This section provides, in Subsection 3.1, a brief description of the existing undevoltage protection available to the NSP-1; 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. The present design uses two undervoltage relays on each of the two station 4160 V class 1E safety buses to detect a loss of offsite power. These relays have a setpoint of 2625 V (63%). When the offsite voltage drops to this value and persists for at least ten seconds, the offsite source breakers are tripped, load shedding is initiated, and the emergency diesel generator breaker is allowed to close automatically as soon as the unit has attained rated speed and voltage. Both emergency diesel-generator units are started immediately upon a loss of voltage.

The existing system, as designed, does disable the load-shedding circuits once the diesel-generator breaker is closed. If the diesel-generator breaker is tripped, load shedding is automatically reinstated, when an emergency power source becomes available.

3.2 Modifications. The licensee has proposed adding eight new undervoltage relays to the two 4160 V class 1E buses. There will be four relays per bus, arranged in a one-out-of-two taken twice coincidence logic. These relays will have a nominal setpoint of 3885 V (93.4% of bus voltage) with a time delay of ten seconds. When an undervoltage condition persists below the setpoint for at least ten seconds, the incoming line breakers to the emergency 4160 V buses are tripped. When these breakers trip, the loss-of-voltage relays start the diesel generators. The licensee has also added one new undervoltage relay to make the loss-of-voltage relay logic a three-out-of-three coincidence scheme. When the second-level undervoltage relays activate and the ten-second time delay is satisfied, the automatic fast transfer to the start-up transformer is inhibited. After an additional five-second delay, initiated by the actuation of the loss-of-voltage relays, load shedding is accomplished and the diesel generators energize the safety buses as rated speed and voltage are reached. Whenever an undervoltage relay is removed for testing or maintenance a trip signal for that relay will be initiated.

Load-shed blocking, once the diesel generator is supplying power to the emergency buses, is a part of the plants current design. This is accomplished by interlocks which sense the closed position of the onsite source supply breakers. If the onsite source breakers are tripped, load shedding is automatically reinstated.

Proposed changes to the plant's Technical Specifications, adding the surveillance requirements, allowable limits for the setpoint and time delay, and limiting conditions for operation for the second-level undervoltage monitors, were also furnished by the licensee. An analysis to substantiate the limiting conditions and minimum and maximum setpoint limits was also part of the proposal.

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 system distribution levels."

   The licensee's proposed setpoing of 3885 V at the 4160 V bus is 97% of the motor-related voltage of 4000 V. This setpoint reflected down to the 480 V buses will be greater than 90% of the motor-rated voltage. As the motors are the most limiting equipment in the system, this setpoint is acceptable. The licensee's analysis considered these factors.

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

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

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 time delay of ten seconds does not exceed this maximum time delay. This is substantiated by the licensee in his proposal.

The proposed time delay will not be the cause of any thermal damage to the safety-related equipment. The setpoint is within voltage ranges recommended by ANSI C84.1-1977 for sustained operation.

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 time delay of ten seconds is long enough to override any short incoming sequential grid disturbances. Further, we have reviewed the licensee's analysis and agree with the licensee's finding that any voltage dips caused from the starting of large motors will not trip the offsite source.

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."

A review of the licensee's voltage analysis[10] indicates that the time delay will not cause any failures of the safety-related equipment since the voltage setpoint is within the allowable tolerance of the equipment-rated voltage.

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 licencee'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.

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

   The licensee's draft proposal for Technical Specification changes does include all the required items. An analyses had been performed which assures that the range between the minimum and maximum trip point settings, as well as the allowable limits, will not be the cause of spurious trips of the offsite source nor will they allow the voltage to be so low as to allow damage to the safety equipment.

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 licensee stated in his proposal that the current design meets this position fully. A review of his submittal and logic diagrams confirms this contention.

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 licensee has stated that, with the exception of the 5 minute time duration of the diesel generator tests, this position is currently being met.[2] They have further committed to add this time duration to the diesel tests when they submit their Technical Specification changes. Load shedding on offsite power trip is tested. Load sequencing, once the diesel generator is supplying the safety buses, is tested. The time durations of the tests (five minutes with full safety loads) will verify that the time delay is sufficient to avoid spurious trips and that the load-shed bypass circuit is functioning properly.

## 4.0 CONCLUSIONS

Based on the information provided by NSP, it has been determined that the proposed modifications comply with NRC staff position 1. All of the staff's requirements and design base criteria have been met. The modifications will protect the class 1E equipment from a sustained degraded voltage condition of the offsite power source.

The existing load-shed circuitry does comply with staff position 2 and will prevent adverse interaction of the offsite and onsite emergency power systems.

The proposed draft changes to the Technical Specifications and change commitments do adequately test the system modifications and do comply with staff position 3. The surveillance requirements, limiting conditions for operation, minimum and maximum limits for the trip point, and allowable values meet the intent of staff position 1.

It is therefore concluded that NSP's proposed modifications are acceptable. Further, it is recommended that the changes to the Technical Specifications, if similar to the supplied draft and if they meet the licensee's commitment, be incorporated in the NSP-1 Technical Specifications when the modifications are complete.

## 5.0 REFERENCES


1. NRC (D. K. Davis) letter to NSP (L. O. Mayer), dated June 3, 1977.

2. NSP (L. O. Mayer) letter to NRC, dated April 21, 1978.

3. NRC (T. Ippolito) letter to NSP (L. O. Mayer), dated June 18, 1979.

4. NSP (L. O. Mayer) letter to NRC, dated September 14, 1979.

5. NSP (L. O. Mayer) letter to NRC, dated October 31, 1979.

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

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

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

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

10. NSP (L. O. Mayer) letter to NRC (D. L. Zeimann), dated September 17, 1976.

11. NSP (L. O. Mayer) letter to NRC (D. L. Zeimann), dated March 4, 1977.

12. NSP (L. O. Mayer) letter to NRC (D. K. Davis), dated July 25, 1977.

13. NSP (L. O. Mayer) letter to NRC (D. K. Davis), dated October 14, 1977.

14. Final Safety Analysis Report (FSAR) for the Monticello Nuclear Generating Plant (NSP-1).