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TECHNICAL EVALUATION OF THE PROPOSED DESIGN
MODIFICATIONS AND TECHNICAL SPECIFICATION
CHANGES ON GRID VOLTAGE DEGRADATION (PART A)
FOR THE RANCHO SECO NUCLEAR GENERATING PLANT

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MASTER

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Laboratory

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FOREWORD

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TECHNICAL EVALUATION REPORT
PROPOSED DESIGN MODIFICATIONS
AND TECHNICAL SPECIFICATION CHANGES
ON GRID VOLTAGE DEGRADATION
FOR THE
RANCHO SECO NUCLEAR GENERATING PLANT
(Docket No. 50-312)

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1. INTRODUCTION

By letter dated June 3, 1977 [Ref. 1], the U. S. Nuclear Regulatory Commission (NRC) requested the Sacramento Municipal Utility District to assess the susceptibility of the Rancho Seco Nuclear Generating Plant Class 1E electrical equipment to sustained degraded voltage conditions at offsite power sources and to the interaction between the offsite and onsite emergency power systems. In addition, the NRC requested that the licensee compare the current design of the emergency power systems at the plant facilities with the NRC staff positions as stated in the June 3, 1977 letter [Ref. 1], and that the licensee propose plant modifications, as necessary, to meet the NRC staff positions, or provide a detailed analysis which shows that the facility design has equivalent capabilities and protective features. Further, the NRC required certain Technical Specifications be incorporated into all facilities' operating licenses.

By letters dated August 1, 1980 [Ref. 2], June 20, 1978 [Ref. 3], July 19, 1977 [Ref. 4], and September 22, 1980 [Ref. 5], Sacramento Municipal Utility District proposed certain design modifications and additions to the licensee's Technical Specifications. The design modifications include the installation of a degraded voltage protection system for the Class 1E

equipment. The proposed additions to the Technical Specifications are in regard to the relay setpoints, calibrations, system tests, and surveillance requirements associated with the proposed voltage protection system.

The purpose of this report is to evaluate the licensee's proposed design modifications and Technical Specification changes and to determine that they meet the criteria established by the NRC for the protection of Class 1E equipment from a grid voltage degradation.

2. DESIGN BASIS CRITERIA

The design basis criteria that were applied in determining the acceptability of the system modification to protect the Class 1E equipment from degradation of grid voltages are as follows:

- (1) General Design Criterion 17 (GDC 17), "Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," in the Code of Federal Regulations, Title 10, Part 50 (10 CFR 50) [Ref. 6].
- (2) IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations" [Ref. 7].
- (3) IEEE Standard 308-1974, "Class 1E Power Systems for Nuclear Power Generating Stations" [Ref. 8].
- (4) NRC Staff positions as stated in a letter dated June 3, 1977 [Ref. 1].

3. EVALUATION

3.1 EXISTING UNDERVOLTAGE PROTECTION

The Rancho Seco Nuclear Generating Plant has two 4160-volt and two 480-volt Class 1E buses. The existing undervoltage protection design uses a single undervoltage relay on each 4160-volt Class 1E bus. If the voltage drops below 3534 volts (85% of 4160 volts), the undervoltage relay will energize a set of load-shedding relays. The load-shedding relays initiate the disconnection of the emergency 4160-volt buses from the off-site source, load shed the emergency 4160-volt buses, start the emergency diesel generators, and provide an enabling signal for the load-sequencing timing circuit. When the emergency diesel generator reaches the required voltage it is connected to the emergency buses and load-sequencing will begin automatically, if a safety injection (SI) signal exists.

The existing Rancho Seco design complies with NRC Staff Position 2 requiring the system to automatically prevent load shedding of the emergency buses once the onsite sources are supplying power to all sequenced loads on the emergency buses. The present design will also reinstate the load-shedding feature if the emergency diesel generator breakers are tripped.

3.2 MODIFICATIONS

The licensee has proposed a design change to establish an automatic degraded voltage protection circuitry. The modification consists of incorpo-

rating the existing undervoltage protection scheme with a degraded voltage protection scheme. The proposed scheme will consist of 3 undervoltage relays monitoring each 4160-volt emergency bus. The 3 undervoltage relays will be arranged in a 2-out-of-3 coincident logic with a setpoint of 3771 volts $\pm$ 38 volts (90.6% of 4160 volts) with a time delay of 12 seconds $\pm$ 1.2 seconds. There will be only one loss of voltage-degraded voltage protection system. The relays are of the inverse time-voltage type. Upon complete loss of voltage the undervoltage relays will trip in less than one second.

The licensee has provided proposed Technical Specification changes to document relay setpoints, surveillance requirements, limiting conditions for operation, and diesel generator test procedures for the proposed changes as presented in this evaluation.

3.3 DISCUSSION

This section presents a statement on the NRC staff position from their June 3, 1977 letter [Ref. 1] followed by an evaluation of the licensee's design.

3.3.1 NRC Staff Position 1: Second Level of Undervoltage or Overvoltage Protection with a Time Delay

This position is to be met by the licensee meeting certain criteria. Each criterion has been evaluated against the licensee's proposal and is addressed below.

- (i) "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 degraded voltage setpoint is 3771 volts + 38 volts (90.6% of 4160 volts). The proposed time-delay setpoint is 12 seconds + 1.2 seconds. The licensee's analysis shows that this setpoint and time delay are satisfactory for both 4000-volt and 460-volt Class 1E loads and for relays, contactors, and other components whose functional performance would be inadequate because of undervoltage.

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

The proposed modification for degraded voltage protection incorporates a 2-out-of-3 coincidence logic. Each 4160-volt Class 1E bus will have 3 phase-to-phase undervoltage relays. The logic will initiate a signal to trip the circuit breakers from the offsite source when 2 of the 3 independent input channels are actuated.

- (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 12 seconds + 1.2 seconds does not exceed the maximum time delay that is assumed in the FSAR accident report.

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

The licensee's proposed time delay of 12 seconds + 1.2 seconds is long enough to override any grid disturbances of short duration. This has been confirmed by testing.

- (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 indicates that the time delay will not cause any failure of any equipment connected to and associated with the Class 1E emergency power system.

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

The 2-out-of-3 coincident logic circuitry will automatically initiate the disconnection of offsite power sources whenever the voltage degrades below the voltage setpoint for a period of time exceeding the proposed time delay.

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

The licensee states that the degraded voltage monitors were designed to satisfy the requirements of IEEE Standard 279 and IEEE Standard 603.

- (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 has provided proposed Technical Specification changes to document voltage setpoints, surveillance requirements, limiting conditions for operation, and diesel generator test procedures for the degraded voltage protection system.

3.3.2 NRC Staff Position 2: Interaction of Onsite Power Sources with Load-Shed Feature

The second position requires the system to be designed to prevent automatic load shedding of the emergency buses once the onsite sources are supplying power to all sequenced loads. If an adequate basis can be provided for retaining the load-shed feature, the licensee must assign maximum and minimum values to the setpoint of the load-shed feature. These setpoints must be documented in the Technical Specifications. The load-shedding feature must also be reinstated if the onsite source supply breakers are tripped.

The present design for Rancho Seco meets NRC Staff Position 2. An auxiliary "b" contact from the diesel generator circuit breaker is used to prevent load-shedding when the emergency diesel generator is energizing

the Class 1E buses. If the diesel generator circuit breaker is tripped, the load-shedding logic circuitry will be automatically reinstated.

3.3.3 NRC Staff Position 3: Onsite Power Source Testing

The third position requires that certain test requirements be included in the Technical Specifications. These tests are to "...demonstrate the full functional operability and independence of the onsite power sources 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 will verify the proper operation of the load-shed system, the load-shed bypass circuitry, and that there is no adverse interaction between the onsite and offsite power sources.

The licensee states that Rancho Seco will meet Position 3 with a test of the system by simulating a loss of offsite power in conjunction with a SI signal. The test sequence will be bus de-energization, load shedding, voltage restoration, and load sequencing. The operating time on emergency onsite power will be at least 5 minutes. The licensee will also interrupt the emergency diesel generators while they are supplying the Class 1E buses to test the reinstatement of the load-shedding circuitry, the load-shedding operation and then upon re-energization of the emergency buses by the onsite power source, test the load-sequencing circuitry.

3.4 TECHNICAL SPECIFICATIONS

The changes proposed by Sacramento Municipal Utility District to the Rancho Seco Nuclear Generating Plant's Technical Specifications reflect the proposed design modifications. Specifically, the proposed changes:

- (1) Include the trip setpoints for the degraded voltage protection sensors and the associated time delays with tolerances (3771 volts + 38 volts [90.6% of 4160 volts] and 12 seconds + 1.2 seconds).
- (2) Provide the required coincidence logic (2-out-of-3).
- (3) Incorporate action statements regarding limiting conditions for operations when the number of operable channels for degraded voltage protection is reduced.
- (4) Provide the instrument surveillance requirements for channel check, channel calibration, and channel functional test.
- (5) Provide the surveillance requirements to demonstrate at least once per 18 months that the loss of offsite power in conjunction with a safety actuation signal will provide the sequence of Class 1E bus de-energization, load shedding, voltage restoration, and load sequencing.

4. CONCLUSION

Based on the information provided by Sacramento Municipal Utility District, it has been determined that the proposed modifications to Rancho Seco Nuclear Generating Plant comply with NRC Staff Position 1. All of the staff's requirements and design basis criteria have been met. The modifications will protect the Class 1E equipment from a sustained degraded voltage condition of the offsite power source.

The present design complies with Position 2 and will prevent load-shedding when the Class 1E buses are being energized by the onsite emergency source. The design also prevents adverse interaction of the offsite and onsite emergency power systems.

The proposed changes to the Technical Specifications and the method of testing the logic circuitry have been reviewed and found to comply with Position 3.

Accordingly, we recommend that the NRC approve the proposed design modifications and Technical Specifications.

REFERENCES

1. NRC letter (R. W. Reid) to Sacramento Municipal Utility District (J. J. Mattimoe), dated June 3, 1977.
2. Sacramento Municipal Utility District letter (J. J. Mattimoe) to NRC (R. W. Reid), dated August 1, 1980.
3. Sacramento Municipal Utility District letter (J. J. Mattimoe) to NRC (K. R. Goller), dated June 20, 1978.
4. Sacramento Municipal Utility District letter (J. J. Mattimoe) to NRC (R. W. Reid), dated July 19, 1977.
5. Sacramento Municipal Utility District letter (W. C. Walbridge) to NRC (R. W. Reid), dated September 22, 1980.
6. Code of Federal Regulations, Title 10, Part 50 (10 CFR 50), General Design Criterion 17 (GDC 17), "Electric Power Systems" of Appendix A "General Design Criteria for Nuclear Power Plants."
7. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."
8. IEEE Standard 308-1974, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."