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**TECHNICAL EVALUATION OF THE PROPOSED DESIGN
MODIFICATIONS AND TECHNICAL SPECIFICATION
CHANGES ON GRID VOLTAGE DEGRADATION FOR THE
H. B. ROBINSON NUCLEAR GENERATING PLANT,
UNIT 2**

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ABSTRACT

This report documents the technical evaluation of the proposed design modifications and technical specification changes on grid voltage degradation for the H. B. Robinson Nuclear Generating Plant Unit 2. The review criteria are based on IEEE Std. 279-1971, IEEE Std. 308-1974, and General Design Criterion 17 of the Code of Federal Regulations, Title 10, Part 50, Appendix A requirements for determining the acceptability of the proposed system to protect the Class 1E equipment from degradation of grid voltages.

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FOREWORD

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TABLE OF CONTENTS

		<u>Page</u>
1.	INTRODUCTION	1
2.	DESIGN BASIS CRITERIA	3
3.	EVALUATION	5
3.1	Existing Undervoltage Protection	5
3.2	Modifications	5
3.3	Discussion.	6
3.3.1	NRC Staff Position 1: Second Level of Under- voltage or Overvoltage Protection with a Time Delay	6
3.3.2	NRC Staff Position 2: Interaction of Onsite Power Sources with Load Shed Feature	8
3.3.3	NRC Staff Position 3: Onsite Power Source Testing	8
3.4	Technical Specifications	9
4.	CONCLUSION	11
	REFERENCES	13

TECHNICAL EVALUATION REPORT
PROPOSED DESIGN MODIFICATIONS
AND TECHNICAL SPECIFICATIONS CHANGES
ON GRID VOLTAGE DEGRADATION
FOR THE
H. B. ROBINSON NUCLEAR GENERATING PLANT
UNIT 2

(Docket No. 50-261)

Lawrence Livermore Laboratory, Nevada

1. INTRODUCTION

By letter dated June 3, 1977 [Ref. 1], the U.S. Nuclear Regulatory Commission (NRC) requested the Carolina Power & Light Co. (CP&L) to assess the susceptibility of the H. B. Robinson Nuclear Generating Plant, Unit 2 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 facility operating licenses.

By letters dated January 24, 1979 [Ref. 2] and October 3, 1979 [Ref. 3], CP&L 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 setpoints, calibrations, 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 define how they meet the criteria established by the NRC for the protection of Class 1E equipment from 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. 4].
- (2) IEEE Std. 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations" [Ref. 5].
- (3) IEEE Std. 308-1974, "Class 1E Power Systems for Nuclear Power Generating Stations" [Ref. 6].
- (4) NRC staff positions as stated in a letter dated June 3, 1977 [Ref. 1].

3. EVALUATION

3.1 EXISTING UNDERVOLTAGE PROTECTION

The present design (first-level protection) uses undervoltage relays in a two-out-of-three coincident logic to sense the loss of offsite power. There are no Class 1E loads on the 4160-volt buses. The relays are located on each of the two 480-volt Class 1E buses. An undervoltage condition (loss of voltage) to 394 volts (82 percent of 480 volts) will result in isolating the Class 1E buses from all offsite sources, initiating emergency diesel generator start and load shedding on the Class 1E buses, permitting closure of the emergency diesel generator supply breakers, and lastly, automatic time-sequencing of loads onto the buses.

The existing system does not bypass the load-shedding feature once the emergency diesels are energizing the Class 1E buses.

3.2 MODIFICATIONS

The licensee has proposed a design change which includes automatic degraded voltage protection (second-level protection). This modification consists of the addition of three time-delayed undervoltage relays on each of the two 480-volt Class 1E buses.

The licensee will make circuit design changes to prevent load shedding when the Class 1E buses are being energized by the diesel generators, and will reinstate this load-shedding feature if the diesel generator breaker trips.

The limiting conditions for operation and surveillance requirements for the proposed design changes as presented in this evaluation are documented in the licensee's proposed Technical Specifications.

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.

- (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 degraded undervoltage setpoint is 86 percent of 480 volts (413 volts $\pm$ 1 volt). The undervoltage time delay setting is 10 seconds $\pm$ 0.5 seconds. The licensee's analysis shows that this setpoint and time delay are satisfactory for 480-volt Class 1E loads as well as 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 incorporates a two-out-of-three coincidence logic scheme to trip the Class 1E bus incoming line breakers. Three degraded voltage relays will monitor the voltage on each 480-volt Class 1E bus through potential transformers and output a trip signal when the

voltage is below the relay setpoint for a specific time. Actuation of two of the three relays is needed to initiate the voltage restoring scheme which precludes spurious trips should one of the three relays malfunction.

- (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 10 seconds (± 0.5 seconds) does not exceed this maximum time delay of 25 seconds.

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

The licensee's proposed time delay of 10 seconds (± 0.5 seconds) is long enough to override any short grid disturbances.

- (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 two-out-of-three coincidence logic automatically disconnects offsite power from the Class 1E buses experiencing degraded voltage and initiates the voltage-restoring scheme.

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

The licensee states and our review finds that the relays and the relaying scheme will be in compliance with the requirements of IEEE Standard 279-1971.

- (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."

Limiting conditions for operation and surveillance requirements, as well as trip setpoints for allowable values for the second-level voltage protection monitors are included in the licensee's proposed Technical Specifications.

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

The second position requires that the system be designed to prevent load shedding of the emergency buses automatically 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 licensee's proposal states that a design has been completed to block the load shedding feature when the Class 1E buses are being energized by the diesel generators. The design consists of using the 'b' contact of the diesel generator breaker control circuit relay. This design ensures that the load-shedding logic circuitry will automatically be reinstated once the diesel generator load source breaker is tripped.

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 when the emergency diesel generators are supplying their respective buses, and that there is no adverse interaction between the onsite and offsite power sources.

The existing Technical Specifications meet the requirements of NRC Staff Position 3. There are no changes needed in the Technical Specifications for generator testing.

3.4 TECHNICAL SPECIFICATIONS

The changes proposed by Carolina Power and Light Co. to the Technical Specifications for H. B. Robinson Nuclear Generating Plant Unit 2, 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 (413 volts $\pm$ 1 volt and 10 seconds $\pm$ 0.5 seconds).
- (2) Provide the required coincidence logic (two-out-of-three).
- (3) Incorporate action statements regarding limiting conditions for operations when the number of operable channels for degraded voltage protection is reduced.
- (4) Provide the surveillance requirements for channel calibration during the refueling shutdown and monthly channel functional test.

The existing technical Specifications provide the surveillance requirements to demonstrate at least once per 18 months that the loss of off-site power in conjunction with a safety injection actuation signal will provide the sequence of Class 1E bus-energization, load shedding, voltage restoration, and load sequencing.

4. CONCLUSION

Based on the information provided by Carolina Power and Light Co., the proposed modifications comply with NRC Staff Position 1. All of the staff's requirements and design basis criteria have been met. The voltage setting and time delays will protect the Class 1E equipment from a sustained degraded voltage condition of the offsite power source.

The proposed modifications to the logic of the load shed circuitry comply with NRC Staff Position 2 and will prevent adverse interaction of the offsite and onsite emergency power systems.

The proposed additions to the Technical Specifications and the method of testing the logic circuitry have been reviewed and found to meet the intent of NRC Staff Position 3.

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

REFERENCES

1. NRC letter to Carolina Power & Light Co., dated June 3, 1977.
2. Carolina Power & Light Co., (E. E. Utley) to NRC (A. Schwencer), dated January 24, 1979.
3. Carolina Power & Light Co., (E. E. Utley) to NRC (A. Schwencer), dated October 3, 1979.
4. 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."
5. IEEE Std. 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."
6. IEEE Std. 308-1974, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."