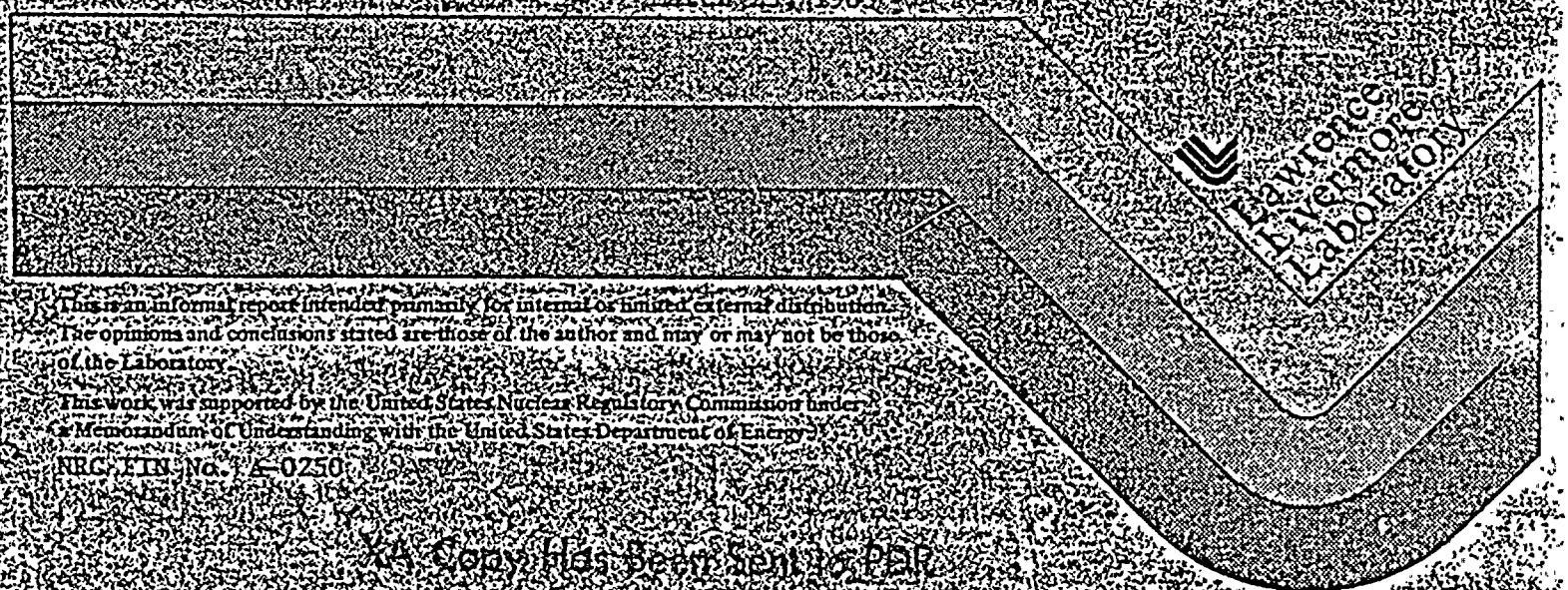
UCID-19450 Revision 1

TECHNICAL EVALUATION REPORT (REVISION 1) ON THE PROPOSED DESIGN MODIFICATIONS AND TECHNICAL SPECIFICATION CHANGES ON GRID VOLTAGE DEGRADATION FOR THE SEABROOK NUCLEAR POWER PLANT, UNIT 1

(Docket No. 50-335)

James C. Selan

March 23, 1983



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DISCLAIMER

ABSTRACT

This report is a revision of the technical evaluation documented in a separate report dated July 30, 1982 (UCID-19450) on the proposed design modifications and Technical Specification changes for the protection of the Class 1E equipment from grid voltage degradation for the St. Lucie Nuclear Power Plant, Unit 1. The review criteria are based on several IEEE standards and The Code of Federal Regulations. The evaluation compares the submittals made by the plant with the NRC staff positions and the review criteria. The evaluation finds that the proposed design modifications and Technical Specification changes will ensure that the Class 1E equipment will be protected from sustained voltage degradation during accident and non-accident conditions.

FOREWORD

This report is supplied as part of the Selected Operating Reactor Issues Program II being conducted for the U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Licensing, by Lawrence Livermore National Laboratory.

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1. INTRODUCTION

By letter dated June 3, 1977 [Ref. 1], the U. S. Nuclear Regulatory Commission (NRC) requested Florida Power and Light Company (FPL), the licensee, to assess the susceptibility of the St. Lucie Nuclear Power Plant, Unit 1, Class 1E electrical equipment to sustained degraded voltage conditions at the 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 the facility's operating license.

By letters dated July 25, 1977 [Ref. 2], November 9, 1979 [Ref. 3], July 3, 1980 [Ref. 4], March 18, 1982 [Ref. 5], May 24, 1982 [Ref. 6], December 10, 1982 [Ref. 7], December 10, 1982 [Ref. 8], and March 11, 1983 [Ref. 9], the licensee proposed certain design modifications, additions to the licensee's Technical Specifications, and limiting conditions for operation (LCO's). The design modifications include the installation of a degraded voltage protection system for the Class 1E equipment. The proposed additions to the Technical Specifications and LCO's are in regard to calibrations, surveillance requirements, test requirements, and "action" statements associated with the proposed voltage protection system.

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

This report is a revision of the technical evaluation documented in a separate report dated July 30, 1982 (UCID-19450) based on new information submitted in References 7, 8, and 9.

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," Code of Federal Regulations, Title 10, Part 50 (10 CFR 50) [Ref. 10].

(2) IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations" [Ref. 11].

(3) IEEE Standard 308-1974, "Class 1E Power Systems for Nuclear Power Generating Stations" [Ref. 12].

(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 at St. Lucie, Unit 1, utilizes one undervoltage relay on each of three 4160-volt Class 1E buses. The relay is an induction disc type (CV-2) which inversely relates time and voltage. That is, the lower the bus voltage, the faster the relay responds. The relay's voltage setpoint is 88.34% of 4160 volts (3675 volts) with a time dial setting of 1. This setting corresponds to relay actuation in 6 seconds at 79.5% of 4160 volts (3307 volts) or in 3 seconds at 70% of 4160 volts (2912 volts). The 88.34% voltage relay setpoint corresponds to 85% voltage (408 volts) at the 480-volt MCC buses where undervoltage is monitored by an annunciator/alarm system.

The function of the relay is to initiate source disconnection, load shedding, diesel generator starting, and load sequencing whenever the voltage and time delay setpoints are exceeded on its respective bus.

The relay is automatically bypassed approximately 0.2 seconds after the diesel generator breakers are closed. Should the diesel generator breakers trip open, the relay and load shedding logic is automatically reinstated.

3.2. MODIFICATIONS

The licensee is proposing a design change to the existing undervoltage protection system. This design change will replace the CV-2 relay (inverse time) with two definite-time delay relays in a 2-out-of-2 coincident logic [Ref. 13] to each 4160-volt Class 1E bus for loss-of-voltage detection. The setpoint for this scheme will be set at 2900 ± 29 volts (69.7% of 4160 volts) with a time delay of 1 ± 0.5 seconds. The function of these relays will remain the same (i.e., initiate source disconnection, load shedding, diesel generator starting, and load sequencing on the effected train).

The licensee is proposing a second design change which will add two sets of two definite-time delay relays on each 4160-volt Class 1E bus. The first set of relays, in a 2-out-of-2 coincident logic, will be set at 3675 ± 36 volts (88.34% of 4160 volts) with a time delay of 7 ± 1 minutes. The second set of relays, in a 2-out-of-2 coincident logic, will be set at 3592 ± 36 volts (86.35% of 4160 volts) with a time delay of 18 ± 2 seconds. These two separate sets of relays will define (to a greater degree of accuracy) two distinct points on the voltage/time curve required for equipment protection rather than utilizing inverse time relays [Ref. 13].

In addition to the above design changes, the licensee is also proposing to add a second relay on each 480-volt Class 1E load center bus to the already implemented design change [Ref. 6] to make up a 2-out-of-2 coincident logic scheme. These relays (ITE 27) will also be interlocked with a safeguard signal to insure adequate starting voltages during accident conditions. The relays will be set to actuate at 429 volts, +5 volts, -0.0 volts (89.38% of 480 volts) with a time delay of 7 ± 1 seconds. This setpoint is equivalent to 3927 volts (94.4% of 4160 volts) on the 4160-volt buses.

For sustained degraded voltages concurrent with or without a safeguard signal, all the above undervoltage schemes will initiate automatic disconnection from the offsite sources, load shedding, diesel generator starting and load sequencing. These systems will be bypassed 0.2 seconds after diesel generator breaker closing and automatically reinstated following breaker tripping.

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 analysis shows that the setpoints of 3675 ± 36 volts (88.34% of 4160 volts) with a time delay of 7 ± 1 minutes and 3592 ± 36 volts (86.35% of 4160 volts) with a time delay of 18 ± 2 seconds for non-accident conditions, and 429 volts, +5.0 volts, -0.0 volts (89.38% of 480 volts) with a time delay of 7 ± 1 seconds for accident conditions, will protect the Class 1E equipment including 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 2-out-of-2 coincident logic will preclude spurious tripping from the offsite power sources.

(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 7 ± 1 seconds for the 480-volt protection schemes, interlocked with a safeguard signal, does not exceed the time delay assumed in the FSAR accident analysis of 30 seconds.

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

The time delays selected for both accident and non-accident conditions are long enough to override any short duration transients.

(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 licensee's analysis has shown that the time delays will not cause the failure or effect the operation of any equipment connected to and associated with the Class 1E 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-2 coincident logic of the undervoltage protection schemes on the 4160-volt and 480-volt Class 1E buses will automatically initiate the disconnection from the degraded offsite sources for both accident and non-accident conditions.

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

The licensee states that the design modifications meet the requirements of IEEE 279-1971.

(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 submitted a Technical Specification change request for the proposed design modifications which included trip setpoints with tolerances, surveillance requirements and limiting conditions for operation.

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

The second position requires the system 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 licensee is bypassing the load-shed feature once the onsite sources are supplying the Class 1E buses. This bypassing occurs 0.2 seconds after the diesel generator breakers close and is auto-reinstated following breaker tripping. This bypassing/reinstatement feature is accomplished by utilizing close/trip signals from the diesel generator output breaker.

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.

Existing Technical Specifications include tests which demonstrate the full functional operability and independence of the onsite power sources by simulating a loss-of-offsite power in conjunction with a safety injection actuation signal. Conducting these tests will verify the functional operation of all the components used to initiate source disconnection, load-shedding, load-shed bypassing and auto-reinstatement, and to insure that there is no adverse interaction between the onsite and offsite sources.

3.4 TECHNICAL SPECIFICATION

The licensee has provided appropriate Technical Specification changes on the design modifications to the undervoltage protection system. Specifically, the proposed changes include:

(1) Voltage and time delay trip setpoints with tolerances of the undervoltage protection schemes (3675 $\pm$ 36 volts with a time delay of 7 $\pm$ 1 minutes and 3592 $\pm$ 36 volts with a time delay of 18 $\pm$ 2 seconds for non-accident conditions, and 429 volts, +5.0 volts, -0.0 volts with a time delay of 7 $\pm$ 1 seconds for accident conditions).

(2) The required coincident logic (minimum 2-out-of-2).

(3) Surveillance requirements for a channel check at least once per 12 hours, a channel test at least once per 31 days and a channel calibration at least once per 18 months (refueling).

(4) Limiting conditions for operation including action statements when the number of required channels is less than the minimum number required.

4. CONCLUSIONS

Based on the information submitted by Florida Power and Light Company, it has been determined that the proposed design modifications comply with NRC Staff Position 1. All of the staff's requirements and design basis criteria have been met. The voltage and time delay trip settings will protect the Class 1E equipment from sustained degraded voltages from the offsite sources during accident and non-accident conditions.

The licensee is bypassing the load-shed feature by using a close signal from the diesel generator breaker to prevent an adverse interaction when the onsite sources are supplying the Class 1E buses. The licensee is auto-reinstating the load-shed feature following diesel generator breaker tripping. Thus, NRC Staff Position 2 is met.

The existing Technical Specifications include tests which have been reviewed and found to meet the requirements of NRC Staff Position 3.

Accordingly, I recommend the NRC accept the proposed design modifications and Technical Specification changes for protecting the Class 1E equipment from sustained voltage degradation.

REFERENCES

1. NRC letter to Florida Power and Light Company (FPL), dated June 3, 1977.
2. FPL letter (R. E. Uhrig) to NRC (Don K. Davis), dated July 25, 1977.
3. FPL letter (R. E. Uhrig) to NRC (W. G. Gammill), dated November 9, 1979.
4. FPL letter (R. E. Uhrig) to NRC (R. A. Clark), dated July 3, 1980.
5. FPL letter (R. E. Uhrig) to NRC (R. A. Clark), dated March 18, 1982.
6. FPL letter (R. E. Uhrig) to NRC (R. A. Clark), dated May 24, 1982.
7. FPL letter (R. E. Uhrig) to NRC (R. A. Clark), dated December 10, 1982.
8. FPL letter (R. E. Uhrig) to NRC (D. G. Eisenhut), dated December 10, 1982.
9. FPL letter (R. E Uhrig) to NRC (R. A. Clark), dated March 11, 1983.
10. 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."
11. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."
12. IEEE Standard 308-1974, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations."
13. Telecon; D. Sells and H. Emami (NRC), P. Pace, R. Stephens, D. Smith and staff (FPL), J. Selan (LLNL), dated February 23, 1983.