UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

DOCKET NO. 50-333

DEGRADED GRID VOLTAGE

1.0 INTRODUCTION

By letter to the Power Authority of the State of New York (PASNY) dated June 3, 1977, we requested that the licensee assess the susceptibility of the safety-related electrical system at the James A. FitzPatrick Nuclear Power Plant to a sustained voltage degradation of the offsite sources. PASNY was also required to either propose design modifications or to demonstrate that the existing system design has equivalent capabilities after comparing the existing design to the Staff Positions contained in our letter.

By letter dated October 17, 1977, PASNY proposed certain design modifications and changes to the Technical Specifications to satisfy the criteria and Staff Positions. The modifications consist of the installation of a second-level undervoltage protection system for the safety-related equipment. We required that the setpoint, surveillance requirements, test requirements, and allowable limits be included in the Technical Specifications.

A separate Safety Evaluation regarding the adequacy of the station electric distribution system voltages was issued August 2, 1982.

2.0 EVALUATION

The licensee has proposed to install four undervoltage relays, two relays for each of the two 4160V emergency buses, and a timer to protect the A-C ESF loads from a degraded voltage condition. The undervoltage relays have a setpoint of 3720V (89.5% of bus voltage) with a time delay of ten seconds. Tnese undervoltage relays will be configured in a two-out-of-two coincidence logic per bus.

When an undervoltage condition persists below the setpoint for ten seconds, a diesel-generator start signal is generated. When either of the diesel generators on that bus reaches 75% of rated voltage, provided none of the diesel-generator breakers lockout relaying has been initiated, the offsite source to the effective bus will be tripped. When the emergency diesel generators reach 90% of rated voltage and other existing permissives are satisfied, the diesel-generator breakers will close.

The proposed design modifications and associated Technical Specification changes have been reviewed by our contractor, EG&G Idaho, Inc. The results of this evaluation are reported in the attached Technical Evaluation Report (TER). We have reviewed the TER and concur in its findings that the modifications will protect the safety-related equipment from a sustained degraded voltage of the offsite power source and that the design bases meet the Staff Positions. We also agree that the proposed changes to the Technical Specifications adequately address testing of the protection systems and comply with Staff Position 3.

3.0 CONCLUSION

We find that the design modifications and associated Technical Specification changes proposed by PASNY are acceptable.

Principal Contributor: S. Rhow

Attachment:
Technical Evaluation
Report

Dated: September 14, 1984

TECHNICAL EVALUATION REPORT

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
DEGRADED GRID PROTECTION FOR THE EMERGENCY A-C POWER SYSTEM

1.0 INTRODUCTION

On June 3, 1977, the NRC requested the Power Authority of the State of New York (PASNY) to assess the susceptibility of the safety-related electrical system at the James A. Fitzpatrick Nuclear Plant to a sustained voltage degradation of the offsite sources[1]. The letter contained three positions that the current design of the plant was to be compared. After comparing the current design to the Staff Positions, PASNY 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.

By letter dated October 17, 1977, PASNY proposed certain design modifications and changes to the Technical Specifications to satisfy the criteria and Staff Positions. The modifications consist of the installation of a second-level undervoltage protection system for the safety-related equipment. The NRC required that the setpoint, surveillance requirements, test requirements, and allowable limits were to be included by the PASNY in the plant Technical Specifications.

2.0 DESIGN BASE CRITERIA

The design basis 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[3].

(2) IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations"[4].

(3) IEEE Standard 308-1974, "Class IE Power Systems for Nuclear Power Generating Stations"[5].

(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)"[6].

3.0 EVALUATION

This section provides, in Subsection 3.1, a brief description of the existing undervoltage protection available at the James A. Fitzpatrick Nuclear Power Plant; 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 undervoltage (UV) relays to sense the loss of offsite power. These relays monitor the 4160 V emergency buses. When the voltage on these buses drops below 2,975 V (71%), for at least 2.5 seconds, the UV relays drop out. This drop-out action isolates the buses from offsite sources, initiates emergency diesel generator start, initiates load shedding, permits closure of the emergency diesel generator breakers, and alarms the undervoltage conditions.

The existing system does not disable the load-shedding feature once the emergency diesel is feeding the emergency buses.

3.2 Modifications. The licensee has proposed adding another four undervoltage relays, two relays (two of two logic) for each of the 4160 V emergency buses, to protect the emergency A-C system from a

degraded condition. The logic circuitry of the load-shedding feature will also be modified to prevent load shedding once the emergency diesel breakers are closed onto the emergency buses. The undervoltage relays will have a setpoint of 3720 V (89.5% of bus voltage) with a time delay of ten seconds. When an undervoltage condition persists below the setpoint for at least ten seconds, the offsite sources will be tripped off when either of the emergency diesel generators reach 75% of rated voltage, provided none of the lockout relaying has been initiated. When the emergency diesel generators reach 90% of rated voltage and other existing permissives are satisfied, the diesel generator breakers will close.

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 June 3, 1977 letter[1] required that a second level of undervoltage protection for the onsite power system be provided. The letter also went on to identify certain criteria that the undervoltage protection must meet. Each criterion has been evaluated against the licensee's proposal and are 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 licencee's proposed setpoint of 3720 V at the 4160 V bus is 93% of the motor rated voltage of 4000 V. This setpoint reflected down to the 600 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 two out of two coincidence 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 inconsequential 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[7] indicates that the time delay will not cause any failures of the safety related equipment since the voltage setpoint is within the allowable tolerence 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 licensee's proposal, including diagrams, 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 as well as IEEE Standard 338, 344, and 379. Also stated in the proposal, the Quality Assurance Program, in effect, incorporating the requirements of 10 CFR 50, Appendix B, will be applied to the extent necessary.

(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 proposal for Technical Specification changes does include all of the required items. An analysis is also provided 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. Instrument drift, transformer accuracy, and calibration accuracy were factors in this analysis.

The second 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's proposal states that modifications will be made to comply with this position. Logic diagrams enclosed in the licensee's proposal supports this statement.

The third 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 their

respective buses, and that there is no adverse interaction between the onsite and offsite power sources.

The testing procedures proposed by the licensee do comply with the full intent of this position. Load shedding on offsite power trip is tested. Load sequencing once the diesel generator is supplying the safety buses is tested. The diesel is also tripped and restarted per position 3. The time durations of the tests will verify that the time delay is sufficient to avoid spurious trips and that the load shed bypass circuit is functioning properly.

4.0 CONCLUSION

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

The modifications to the logic of the load shed circuitry do comply with position 2 and will prevent adverse interaction of the offsite and onsite emergency power systems.

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

It is therefore concluded that PASNY's proposed modifications and Technical Specification changes are acceptable.

5.0 REFERENCES

1. Reid to Berry, letter dated June 3, 1977.

2. Berry to Reid, letter dated October 17, 1977.

3. 10 CFR 50, Code of Federal Regulation, "General Design Criterion 17."

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

5. IEEE Standard 308-1974, Standard Criteria for Class IE Power Systems for Nuclear Power Generating Stations.

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

7. Berry to Reid, letter dated October 18, 1976.

8. Final Safety Analysis Report (FSAR) for the James A. Fitzpatrick Nuclear Power Plant.