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

SAFETY EVALUATION OF DEGRADED GRID VOLTAGE PROCEDURE

NORTHEAST NUCLEAR ENERGY COMPANY

MILLSTONE NUCLEAR POWER STATION UNIT 2

DOCKET NO. 50-336

INTRODUCTION

During normal plant operation, the safety class 1E power distribution busses are supplied electrical power by the plant's main turbine generator through the normal station service transformer. Power can also be supplied to the safety class 1E distribution busses from the off-site transmission grid via the reserve station service transformer. When off-site power is not available, redundant emergency diesel generators are available to supply power to the safety class 1E power distribution busses.

A degraded grid voltage condition occurred at Millstone Nuclear Power Station on July 5, 1976 which caused component failures in the class 1E electric system of Unit 2. The staff requested in the correspondence listed in the references that the licensee address this concern. The staff requested the licensee analyze the class 1E systems to determine the grid voltage at which damage could occur. As a result, the licensee made plans to install voltage sensing devices on the class 1E busses with coincident logic and with the low voltage set points above values where equipment damage could occur. The voltage sensing devices would cause the off-site grid power supply to be disconnected from the class 1E system at voltages where the damage could occur. The class 1E busses upon being disconnected would then be supplied power from their respective EDG.

New England licensees were concerned that significant degradation of the grid would result if the above automatic disconnection occurred. This was a result of the number of nuclear plants in the New England area. It was their view that automatic disconnection from the grid should only be required if a low grid voltage occurred at the same time as a Loss of Coolant Accident (LOCA). They agreed that should their plant have a LOCA at the same time there was a degraded grid voltage condition, they would automatically disconnect from the off-site grid. The EDG would then supply power to the class 1E systems. However, if there was a degraded grid voltage condition without a LOCA the operator would take the necessary manual action to protect the class 1E system.

This proposal has been reviewed and accepted by the NRC and is documented in a letter dated April 27, 1984, Reference 16. This letter identified that the licensee should develop an operating procedure to provide the necessary operator guidance to protect the class 1E system under degraded grid voltage conditions without a LOCA condition. By letter dated December 4, 1984, the licensee submitted for staff review plant procedures to cover operator actions. This procedure was subsequently revised to incorporate the

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staff's concerns. That procedure is contained in a licensee letter dated October 16, 1985. This safety evaluation is for these procedures.

DISCUSSION

The licensee submitted the plant procedure by letter dated December 4, 1984, which included NNECO's Operating Procedure OP 2347B, Revision 4, Change 1 and 2, Item 8.2(a) and 8.2(b), Normal Station Service Transformer 15G-2S. The procedure was designed to assure protection of class 1E systems under degraded grid voltage conditions without a concurrent LOCA. The procedure was reviewed during a site visit discussed in Inspection Report Number 50-336/85-19.

The following were identified during the visit:

The initiating low voltage computer alarm setpoint was 90% of the motor designed voltage of 4000 volts (3600). This is the minimum allowed steady state voltage which will not degrade the motor insulation. Since this voltage is measured at the 4.16 KV bus and not at the motor terminals a 20 volt lead drop has been added to the alarm setpoint which is 3620 volts. This voltage is measured on the common supply from the main generator to the 4.16 KV non class 1E busses 24A and 24B. The 4.16 KV class 1E (safeguard) busses 24C and 24D are normally supplied power from busses 24 A and 24B. There are four (4) voltage sensors on each bus 24C (Train A) and 24D (Train B). These ESFAS alarms have a setpoint of 88% of the normal bus voltage of 4,160 volts or 3,660 volts. An eight second time delay blocks the alarm to allow for a temporary low voltage condition due to motors starting.

During a low voltage condition, an alarm is sounded and indicated on the computer alarm printer. Additional ESFAS alarms would be received and indicated by the control room annunciator. The operator would then determine if the low voltage condition is caused by in-plant conditions or the off-site grid system.

If the low voltage is determined to be an off-site problem, the operator would contact the system dispatch center in Southington, Connecticut, (CONVEX) to raise the system voltage and the unit generator 24 KV voltage by increasing the reactive power (VAR) output. Should the degraded grid voltage condition continue for two (2) hours, the operator would energize one of the class 1E busses from its standby emergency diesel generator and remove the power to the bus from its normal source. The bus selected, 24C or 24D, will be that which is supplying power to the swing bus, 24E. This selection will protect two of three similar process pumps from the degraded grid voltage condition.

Should the degraded grid voltage condition continue for three (3) hours, the operator would manually trip the reactor/turbine and go to a hot standby mode.

When plant conditions require the 4.16 KV class 1E busses 24D or 24E to be energized from the reserve system, such as during startup or shutdown, a degraded grid voltage condition would cause automatic separation from that source and re-energization from the Standby Emergency Diesel Generators.

The licensee had determined that motors operating at 85% of their rated voltage for four (4) hours would probably be damaged. Since the unit would be shutdown in three (3) hours, the 4.16 KV class 1E bus which was not on its standby source would not have damaged motors and could be restarted and supplied power from its Standby Emergency Diesel Generator. After the degraded grid voltage event at Millstone Unit 2 on July 5, 1976, the licensee had changed the taps on the load center transformers to improve voltage on the 480 volt system where limiting conditions had occurred.

Other safety standby pumps such as auxiliary feedwater, high and low head safety injection, would not normally be running and their motors would not be affected by the degraded grid voltage condition.

EVALUATION

During this review, the staff determined that procedural changes were necessary to clarify and aid operator decision making.

Changes/improvements needed were:

-- Address the Engineered Safety Features Actuation System (ESFAS) low voltage alarms from the voltage sensor on the 4.16 KV class 1E (safeguard) busses 24C and 24D in addition to the initiating computer alarm from non-class 1E 4.16 KV busses 24A and 24B. Provide steps to assure that operators are aware that additional alarms may follow the computer alarm to provide additional verification of a degraded grid voltage condition.

-- Provide action steps and guidance for operators if the degraded condition exist after informing the Duty Officer.

The licensee in Revision 5, change 1 to OP 2347B made the following additional changes/improvements to the procedure to resolve the staff's concerns.

1. The eight (8) alarms associated with the safeguards busses are identified and discussed in the procedure.

2. After receiving the low voltage alarm the operator verifies that the problem is not within the plant. The CONVEX dispatch is requested to raise the grid voltage.

3. Should the degraded voltage condition continue for two (2) hours the operator would take the following action:

-- Start the standby Emergency Diesel Generator (EDG) for the bus, 24C or 24D, which is supplying power to the swing bus 24E.

-- Synchronize the EDG to the bus and separate the normal supply from the bus.

4. Should the degraded voltage condition continue for three (3) hours the unit would be shutdown and the reactor be placed in the hot standby mode.

The staff finds the procedure acceptable to provide the necessary operator guidance to protect the class 1E electric system under degraded grid voltage conditions without a LOCA condition.

CONCLUSION

The staff has concluded, based on the considerations discussed above, that:

1. The revised Licensee Operating Procedure OP 2347B, Revision 5, Change 1, provides technically acceptable procedures covering operator actions required during degraded grid voltage conditions without concurrent LOCA conditions.

2. There is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner.

Date: October 28, 1985

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References

1. Reportable Occurrence Report 76-42/IP, July 5, 1976, Millstone Unit 2 Degraded Grid Voltage and related event on July 21, 1976.
2. Licensee Event Report 76-42/IT, August 3, 1976, same subject as 1.
3. F. W. Hartley letter to J. P. O'Reilly dated July 21, 1976.
4. F. W. Hartley letter to J. P. O'Reilly dated July 27, 1976.
5. D. C. Switzer letter to G. Lear dated July 29, 1976.
6. G. Lear letter to D. C. Switzer dated July 30, 1976.
7. D. C. Switzer letter to G. Lear dated August 4, 1976.
8. G. Lear letter to D. C. Switzer dated August 11, 1976.
9. D. C. Switzer letter to G. Lear dated September 14, 1976.
10. G. Lear letter to D. C. Switzer dated June 2, 1977.
11. D. C. Switzer letter to G. Lear dated July 21, 1977.
12. W. G. Counsil letter to D. M. Crutchfield dated October 14, 1982.
13. W. G. Counsil letter to D. M. Crutchfield dated January 17, 1984.
14. W. G. Counsil letter to D. M. Crutchfield dated May 11, 1984.
15. W. G. Counsil letter to D. M. Crutchfield dated April 26, 1984.
16. J. R. Miller letter to W. G. Counsil dated April 27, 1984.
17. W. G. Counsil letter to J. R. Miller dated December 4, 1984.
18. J. F. Opeka letter to E. J. Butcher dated October 16, 1985.