June 4, 1981

Docket No. 50-245
LS05-81- 06-011

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U.S. NUCLEAR REGULATORY COMMISSION

Mr. W.G. Counsil, Vice President
Nuclear Engineering and Operations
Northeast Nuclear Energy Company
P. O. Box 270
Hartford, Connecticut 06101

Dear Mr. Counsil:

RE: SEP TOPIC VII-1.A, ISOLATION OF REACTOR PROTECTION SYSTEM FROM NON-SAFETY SYSTEMS, MILLSTONE NUCLEAR POWER STATION

Enclosed is a copy of our contractor's draft evaluation of SEP Topic VII-1.A for the Millstone Nuclear Power Station. This assessment compares your facility, as described in Docket No. 50-245, with the criteria currently used by the regulatory staff for licensing new facilities. Please inform us within 30 days if your as-built facility differs from the licensing basis assumed in our assessment or this topic will be assumed complete.

This evaluation will be a basic input to the staff's safety evaluation report on this topic for your facility unless you identify changes needed to reflect the as-built conditions at your facility. This assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this subject are modified before the integrated assessment is completed.

In future correspondence regarding this topic, please refer to the topic number in your cover letter.

Sincerely,

Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

Enclosure:
SEP Topic VII-1.A

cc w/enclosure:
See next page

PSB DSI
Srinivasan
p 5/28/81

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555
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SEP TECHNICAL EVALUATION

TOPIC VII-1.A
ISOLATION OF REACTOR PROTECTION SYSTEM FROM NON-SAFETY SYSTEMS

MILLSTONE 1

Docket No. 50-245

April 1981

CONTENTS

SEP TECHNICAL EVALUATION

TOPIC VII-1.A
ISOLATION OF REACTOR PROTECTION SYSTEM
FROM NON-SAFETY SYSTEMS

MILLSTONE 1

1.0 INTRODUCTION

The objective of this review is to determine if non-safety systems which are electrically connected to the Reactor Protection System (RPS) are properly isolated from the RPS and if the isolation devices or techniques used meet current licensing criteria. The qualification of safety-related equipment is not within the scope of this review.

Non-safety systems generally receive control signals from RPS sensor current loops. The non-safety circuits are required to have isolation devices to ensure electrical independence of the RPS channels. Operating experience has shown that some of the earlier isolation devices or arrangements at operating plants may not meet current licensing criteria.

2.0 CRITERIA

General Design Criterion 24 (GDC 24), entitled, "Separation of Protection and Control Systems," requires that:

> The protection system shall be separated from control systems to the extent that failure of any single control system component or channel, or failure or removal from service of any single protection system component or channel which is common to the ol and protection systems, leaves intact a system that satisfies all reliability, redundancy, and independence requirements of the protection system. Interconnection of the protection and control systems shall be limited so as to assure that safety is not significantly impaired.[1]

IEEE-Standard 279-1971, entitled, "Criteria for Protection Systems for Nuclear Power Generating Stations," Section 4.7.2, states:

The transmission of signals from protection system equipment for control system use shall be through isolation devices which shall be classified as part of the protection system and shall meet all the requirements of this document. No credible failure at the output of an isolation device shall prevent the associated protection system channel from meeting the minimum performance requirements specified in the design bases.

Examples of credible failures include short circuits, open circuits, grounds, and the application of the maximum credible AC or DC potential. A failure in an isolation device is evaluated in the same manner as a failure of other equipment in the protection system.[2]

3.0 DISCUSSION AND EVALUATION

3.1 General. The Reactor Protection System (RPS) includes the sensors, amplifiers, logic, power sources and other equipment essential to the monitoring of selected nuclear power conditions. It must reliably effect a rapid reactor shutdown if any one or a combination of parameters deviate beyond preselected setpoints to mitigate the consequences of a postulated design basis event.

The RPS parameters as identified in the Millstone 1 Technical Specifications[5] are as follows:

1. Mode Switch
2. Manual Scram
3. High IRM Neutron Flux
4. High APRM Neutron Flux
5. High Reactor Pressure
6. High Drywell Pressure
7. Low Reactor Water Level
8. High Scram Discharge Volume Level
9. Low Turbine Condenser Vacuum
10. Main Steam Line Radiation

11. Main Steam Line Isolation Valve Closure

12. Turbine Control Valve Fast Closure

13. Turbine Stop Valve

3.1.1 RPS Logic. The RPS logic is composed of two independent and separate logic channels. Each of the logic channels has two independent subchannels. The output of the subchannels in each channel are combined in a one-out-of-two trip logic. A trip of both logic channels is required to initiate reactor scram. Sensors for each subchannel are dedicated to the RPS and separate from the reactor instrumentation systems.[4]

Each parameter, with the exception of the IRM, the LPRM and the APRM, is monitored by four or more bistable sensors. The bistable contacts actuate individual relays with the contacts of these relays incorporated into the scram logic circuits actuating the eight scram relays. Contacts from the scram relays control the solenoid scram valves for the eight scram rod groups.[5] RPS annunciation, indicator lights, and event inputs to the computer are by auxilary contacts from the RPS relays. Circuit bypasses and interlocks are generated by bistable sensors, relays and manual switches including the mode switch. Circuit testing is by manually actuated switch or relay contacts in the logic circuits which interrupt (trip) the logic when actuated.

The four position reactor mode switch actuates various scram function as well as selected bypasses and interlocks. The switch is mechanically divided by linkage arrangement into two separate switch banks serving each of the RPS channels. Isolation of the RPS functions from control and non-safety function is by switch and/or relay contacts.

The neutron flux monitor system consists of intermediate range monitors (IRM) and average power range monitors (APRM). The APRM derives its input from local power range monitors (LPRM) and reactor coolant flow to provide an output signal proportional to reactor bulk power.

The IRMs monitor reactor power during refueling and reactor start-up and initiates a trip signal upon reactor high flux or when the channel is inoperative. A down scale trip will block control rod withdrawal. Four IRM channels are incorporated into each RPS channel. The IRM analog signal provides relay actuation for RPS trips as well as analog signals to indicating instruments and process recorders.

The APRMs average the output of selected LPRM amplifiers. Six APRM channels, each averaging the input from 14 to 16 LPRMs provide the trip functions for the two RPS channels. Any one of the three APRM high neutron flux monitors tripped in each channel will initiate a reactor scram. Interface between the APRM and the RPS is by relay actuation from the APRM analog output signal.

Analog signals from both the LPRMs and the APRMs are also fed to control room indicating meters and recorders.

Digital inputs from relay action of the IRM and LPRM systems provide input to the process computer. Analog signals from the APRM are also input directly to the process computer.

3.1.2 RPS Power. Power to the RPS is supplied from two 120V AC sources. The primary source is from the RPS motor generator sets RPMG-1 and RPMG-2. The alternate source of power is from transformer IRP-1 fed from MCC 2-4. Isolation of the motor generator sets from other control or non-safety leads is by circuit breakers. Output of each motor generator is isolated from the RPS channels by magnetic circuit breaker with under-voltage trip and thermal overloads.[6]

Each RPS logic channel is isolated from other safety functions on their respective MG panels by two 100 AMP thermal circuit breakers connected in series. Individual subchannel sensor logic trains, scram logic and control rod solenoid valve circuits are isolated from each other by fuses.

The backup scram auxiliary relays, initiated by manual scram or from the automatic scram logic from each RPS channel, are fed from separate 125V DC buses.

3.2 Evaluation. Based on the review of the referenced documents, that portion of the RPS comprised of sensors, relay logic, bypasses and mode switch is adequately isolated from control and non-safety functions.

There are no devices which isolate the IRM, LPRM and APRM analog signals from the control room process recorders and indicating meters.

The APRM scram function is derived from relay actuation resulting from amplified analog signals sensed by these relays. The amplified analog signals are also input directly to the process computer without isolation devices.

The two motor-generator sets supplying power to the RPS channels do not qualify as class 1E power systems.[7] Undetected failures of the motor-generator control system (abnormal voltage or frequency) would be transmitted to the RPS relays and solenoids posing potential damage or failure of an RPS channel to perform upon demand. However, reference 8 indicates this condition will be corrected in accordance with NRC approved modifications during the 1982 spring refueling.

4.0 SUMMARY

Based on current licensing criteria and review guidelines, the plant reactor protection system complies with all current licensing criteria listed in Section 2.0 of this report except for the following:

1. IEEE Standard 279, Section 4.7.2, requires isolation devices between RPS and control systems. There are no isolation devices between the nuclear flux monitoring systems and the process recorders and indicating instruments.

2. Isolation devices are not provided to isolate the APRM system from the process computer.

3. The power supplies for the RPS channels do not qualify as 1E equipment. Isolation between each RPS channel and its respective power supply is inadequate.

5.0 REFERENCES

1. General Design Criterion 24, "Separation of Protection and Control Systems," of Appendix A, "General Design Criteria of Nuclear Power Plants," 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

3. Millstone Nuclear Power Station Unit No. 1 Technical Specifications. Appendix A to License No. DPR-21, December 1977.

4. Millstone Nuclear Power Station, Unit No. 1, Final Safety Analysis Report, Amendment 12, February 26, 1969.

5. Ebasco drawings 25202-31001, sheets 555, 556, 557, 558, 559, 560, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, and 600.

6. Ebasco drawings 25202-31001, sheets 605 and 605A.

7. IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Station, IEEE standard 308-1974.

8. Letter (Council) to NRC, Millstone Nuclear Power Station, Unit No. 1, Reactor Protection System Power Supply, dated November 24, 1980.

APPENDIX A

NRC SAFETY TOPICS RELATED TO THIS REPORT

1. III-I Classification of Structures, Components and Systems.

2. YL-10.A Testing of Reactor Trip Systems and Engineered Safety Features, Including Response Time Testing.

3. VII-2 ESF System Control Logic and Design

4. VII-3 Systems Required for Safe Shutdown