August 28, 1981

Docket No. 50-255
LS05-81-08-082

Mr. David P. Hoffman
Nuclear Licensing Administrator
Consumers Power Company
1945 W Parnall Road
Jackson, Michigan 49201

Dear Mr. Hoffman:

SUBJECT: SEP TOPIC VII-1.A, ISOLATION OF REACTOR PROTECTION SYSTEM FROM NON-SAFETY SYSTEMS, INCLUDING QUALIFICATION OF ISOLATION DEVICES, SAFETY EVALUATION FOR PALISADES

Enclosure 1 is a revised Technical Evaluation Report on this topic. The report has been modified to reflect the information provided in your letter of June 29, 1981.

Enclosure 2 is a copy of our revised safety evaluation report that is based on Enclosure 1. This evaluation supports the findings of the staff safety evaluation of Topic VII-1.A and recommends modifications to the Reactor Protection System.

The need to actually implement these changes will be determined during the integrated safety assessment. This topic assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this topic are modified before the integrated assessment is completed.

Sincerely,

Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
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Enclosures:
As stated

cc w/enclosures:
See next page

SEO1
5.1.1

Add: Ted Michaels

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Enclosure 1

0490J

SEP TECHNICAL EVALUATION

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

FINAL DRAFT

PALISADES PLANT

Docket No. 50-255

July 1981

7-16-81

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SEP TECHNICAL EVALUATION

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

PALISADES

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 control 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 SYSTEM DESCRIPTION

The reactor protection system (RPS) includes the sensor instrumentation, amplifiers, logic, and other equipment necessary to monitor selected nuclear steam supply system conditions and to reliably effect a rapid reactor shutdown if any one or a combination of conditions deviates from a preselected operating range. The system functions to protect the reactor core.

The four RPS trip paths consist of redundant sensors, bistables, and relays operating through coincidence logic to maintain power to, or remove it from, the control rod drive (CRD) clutches. Four independent and separate measurement channels normally monitor each safety parameter. Individual channel trips occur when the measurement reaches a preselected value. Two-out-of-four channel trip logic provides trip signals to one-out-of-six matrix logic units, each of which causes a direct trip of the contactors in the a-c supply to the CRD clutch power supplies.

The RPS is derived from the following inputs:[3]

(1) High rate-of-change of power

(2) High power level

(3) Low reactor coolant flow

(4) High pressurizer pressure

(5) Thermal margin/low-pressure

(6) Loss of load

(7) Low steam generator water levels

(8) Low steam generator pressure levels

(9) Manual trip

(10) High containment pressure.

4.0 EVALUATION

Four basic types of isolation devices are used between the safety circuits and the non-safety devices. Devices used for isolation are optical isolators, thermistors, resistors, and operational amplifiers, which are described in the following paragraphs.

4.1 Thermistor Isolation. Tennecomp Systems drawings[4] show that isolation for the RPS analog signals to the data logger is achieved by 1-K ohm thermistors. The following RPS analog signals have this type of isolation:

a. Steam generators A and B pressure (channel A only).

b. Primary coolant flow (channel A only).

c. Steam generators A and B water level (channel A only).

d. Primary coolant loops 1 and 2 outlet temperature (channel A only).

e. Primary coolant loops 1 and 2 inlet temperature (channel A only).

f. Neutron flux safety (channels A through D).

The above RPS analog signals input to the RPS logic system and to the Tennecomp data logging system. The data logging system is located in the field remote station (FRS) in the plant feedwater purity room.

RPS analog signals connect to input conditioning cards in the FRS intra-cabinet assembly. The input conditioning cards include two 1-K ohm positive temperature coefficient thermistors and zener diodes for isolation.

Reference 5 describes the protection provided by the input conditioning cards against high voltage surges and overloads. It also analyzes the result of two or more inputs tied together as a result of a multiplexer relay failure. The analysis does not evaluate the effect of open and shorted circuits or maximum credible AC and DC potential on the output of the isolation device. Moreover, IEEE Standard 279-1971 states that the isolation device shall be classified as a part of the protective system and shall meet all the requirements of the standard. There is no indication that the input conditioning cards have been designed and qualified to Class 1E requirements. Qualification of these units should be addressed during the integrated assesment.

4.2 Isolation by Resistors and Optical Isolators. Reference 5 and the Tennecomp drawing[6] shows the isolation of digital RPS signals in the data logger is by 36K ohm input resistors and optical isolators. The RPS digital output signals to the data logger are by relay contact. These signals are:

a. Reactor control rod drive, clutch power relays

b. Reactor trip

c. Pressurizer pressure high (channels A through D)

d. Reactor core neutron flux (channels A through D)

e. Reactor power rate change (channels A through D)

f. Thermal margin (channels A through D)

g. Steam generator A and B pressure (channels A through D)

h. Steam generator A and B water level (channels A through D)

i. Primary coolant flow, loop 1 (channels A through D)

j. Reactor load, turbine trip (channels A through D)

Relay contact isolation is an acceptable means of isolation between RPS functions and control and non-safety equipment.

4.3 Resistor Isolation to Computers. Sketch VII-1.A.1[5] identifies four RPS analog signals to the plant computer. These functions are:

a. Neutron flux start up rate (channel 3)

b. Primary flow (channel A)

c. Steam generator A pressure (channel B)

d. Steam generator B pressure (channel B)

Reference 5, page 5 indicates the 100 ohm resistors were not intended as isolation devices for RPS inputs to the Fischer & Porter plant computer and with the exception of the neutron flux start up rate signal, the inputs are not in compliance with Section 2 of this report.

4.4 Isolation by Operational Amplifier. Operational amplifiers, Model A709C, are used as isolation buffers in the neutron flux start up rate channels to the Fischer & Porter computer. They are also used in the neutron flux safety channels to the Tennecomp auto logger as well as to recorders, remote meters and auxiliary circuits.[7]

The Model A709C operational amplifier is a relatively low input impedance amplifier and was not designed to be used as an isolation buffer. Qualification as class 1E equipment under Reg. Guide 1.89[8] should be addressed at the integrated assessment.

5.0 SUMMARY

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

1. The isolation devices used to isolate the RPS analog signals from the Tennecomp data logger, with the exception of neutron flux safety channels, do not meet IEEE 279-1971 par 4.7.2 requirements.

2. There are no isolation devices between the RPS primary flow and steam generator pressure channels and the Fischer and Porter plant computer.

3. Use of Model A709C operational amplifier as an isolation buffer device as defined in IEEE 279-1971 is questionable and requires further evaluation as class 1E equipment.

6.0 REFERENCES

1. General Design Criterion 24, "Separation of Protection and Control Systems," of Appendix A, "General Design Criteria for 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. Appendix A to the operating license DPR20, Technical Specifications for the Palisades Plant, Consumer Power Company, Docket 50-255.

4. Tennecomp Systems Drawing 161-002815, Rev. C and 114-002815, Rev. 0.

5. Letter R. A. Vincent to D. M. Crutchfield, Docket 50-255 DPRO-20, Palisades Plant--SEP Topic VII-1A, Electrical, Instrumentation and Control Portions of the Isolation of the RPS from Non-Safety Systems, including Qualification of Isolation Devices. June 29, 1981.

6. Tennecomp Systems Drawing 161-002811, Rev. B

7. Combustion Engineering Drawings 2966-E-2821, J147-1121, 2966-E-2858, 2966-D-3196, 2966-D-3198, 2966-E-2846 and 2966-D-3106.

8. U.S. Atomic Energy Commission Regulatory Guide 1.89, Qualification of Class 1E Equipment for Nuclear Power Plants.

9. Report, "Systematic Evaluation Program, Review of NRC Safety Topic VII-1.A, Associated with the Electrical, Instrumentation and Control Portion of the RPS from Non-Safety Systems, including Qualification of Isolation Device for the Palisades Nuclear Power Plant." By San Ramon Operations, 1183-4167 dated October 1980.

APPENDIX A

NRC SAFETY TOPICS RELATED TO THIS REPORT

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

2. VI-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

SYSTEMATIC EVALUATION PROGRAM
TOPIC VII-1.A

PALISADES

TOPIC: VII-1.A, ISOLATION OF REACTOR PROTECTION SYSTEM FROM NON-SAFETY SYSTEMS, INCLUDING QUALIFICATION OF ISOLATION DEVICES

I. INTRODUCTION

Non-safety systems generally receive control signals from the reactor protection system (RPS) sensor current loops. The non-safety circuits are required to have isolation devices to insure the independence of the RPS channels. Requirements for the design and qualification of isolation devices are quite specific. Recent operating experience has shown that some of the earlier isolation devices or arrangements at operating plants may not be effective. The objective of our review was to verify that operating reactors have RPS designs which provide effective and qualified isolation of non-safety systems from safety systems to assure that safety systems will function as required.

II. REVIEW CRITERIA

The review criteria are presented in Section 2 of EG&G Report 0490J, "Isolation of Reactor Protection System fron Non-Safety Systems."

III. RELATED SAFETY TOPICS AND INTERFACES

The scope of review for this topic was limited to avoid duplication of effort since some aspects of the review were performed under related topics. The related topics and the subject matter are identified below. Each of the related topic reports contain the acceptance criteria and review guidance for its subject matter.

VI-7.C.1	Independence of Onsite Sources
VIII-1.A	Degraded Grid
IX-6	Fire Protection

There are no safety topics dependent on the present topic information because proper isolation has been assumed.

IV. REVIEW GUIDELINES

The review guidelines are presented in Section 3 of Report 0490J.

V. EVALUATION

Based on current licensing criteria and review guidelines, the plant reactor protection system complies to all current licensing criteria listed in Section 2.0 of EG&G Report 0490J except for the following:

1. The isolation devices used to isolate the RPS analog signals from the Tennecomp data logger, with the exception of neutron flux safety channels, do not meet IEEE 279-1971 par 4.7.2 requirements.

2. There are no isolation devices between the RPS primary flow and steam generator pressure channels and the Fischer and Porter plant computer.

3. Use of Model A709C operational amplifier as an isolation buffer device as defined in IEEE 279-1971 is questionable and requires further evaluation as Class 1E equipment.

VI. CONCLUSION

The staff's position is that suitably qualified isolators should be provided for these channels or that the acceptability of the present design be justified by the licensee.