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SYSTEMATIC EVALUATION PROGRAM, TOPIC VII-1.A ISOLATION OF REACTOR PROTECTION SYSTEM FROM NON-SAFETY SYSTEMS, HADDAM NECK PLANT

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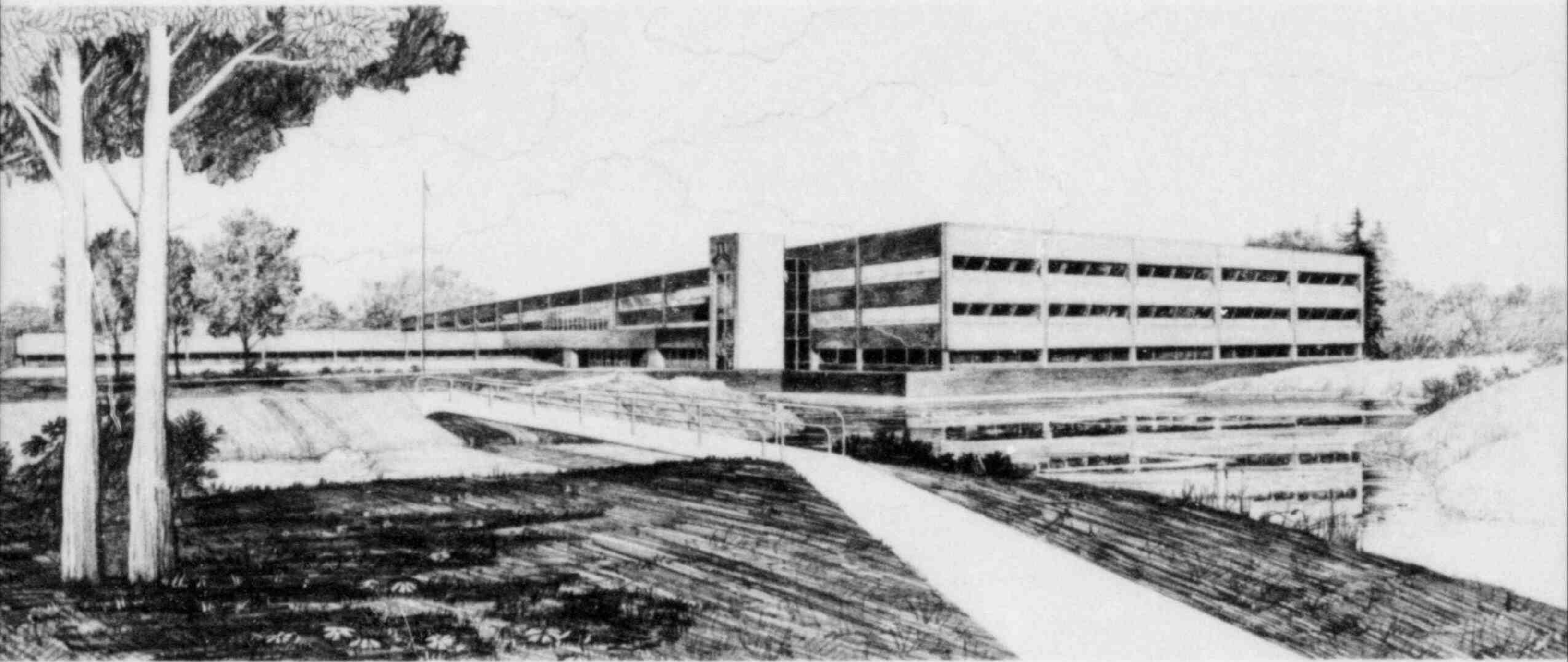

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SYSTEMATIC EVALUATION PROGRAM

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

HADDAM NECK PLANT

Docket No. 50-213

September 1982

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ABSTRACT

This SEP technical evaluation, for the Haddam Neck Plant, determines if the non-safety systems that are electrically connected to the Reactor Protection System are properly isolated from the Reactor Protection System and if the isolation devices and the techniques used meet current licensing criteria.

FOREWORD

This report is supplied as part of the "Electrical, Instrumentation, and Control Systems Support for the Systematic Evaluation Program (II)" being conducted for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Licensing, by EG&G Idaho, Inc., Reliability & Statistics Branch.

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SYSTEMATIC EVALUATION PROGRAM

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

HADDAM NECK PLANT

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, 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 and other equipment essential to the monitoring of selected nuclear power plant conditions. It must reliably effect a rapid shutdown of the reactor if any one, or a combination, of the parameters deviate beyond preselected values to mitigate the consequences of a postulated design basis event.

The RPS parameters and associated logic channels, as identified in the Haddam Neck Technical Specifications,[3,4] are as follows:

Parameter	Channels	Trip Logic
High Flux-Overpower	4	2 out of 4
Variable Low Pressure	3	2 out of 3*
High Pressurizer Pressure	3	2 out of 3
High Pressurizer Level	3	2 out of 3
Low Reactor Coolant Flow	4	1 out of 4**
Pressurizer Low Pressure (SI Trip)	3	2 out of 3
Steam-Feedwater Flow Mismatch	4	1 out of 4
Steam-Line Isolation Valves	4	1 out of 4*
Manual Trip	2	1 out of 2

* If any two of the four power range flux signals are below 10% full power, coincident with a turbine load below 10% full power, the reactor trip is blocked for these circuits (Permissive No. 7).

** The logic trip is 2 out of 4 when two of the power range channels and the turbine power levels are below 84% full power (Permissive No. 8).

3.1.1 High Flux-Overpower

The power range monitor system is comprised of four independent power range channels (N31, N32, N33 and N34).[5] Each channel includes one compensated and one uncompensated ion chamber detector. Two of the four compensated chambers are used in intermediate range as well as the power range channels. All four channels are the same, so only channel one will be described in detail.

Detector NE31-A is an uncompensated chamber and NE31-B is a compensated chamber. Two high voltage power supplies and one compensation voltage power supply provide the chamber voltages. Output signals from each chamber go to shunt assemblies ND-31-2A and ND-31-2B which permit selection of channel ranges of X10, X20 or X100 microamperes. The two shunt assemblies feed a summing assembly, providing an average power signal to a linear amplifier (A-1) which drives six input protection bistables. The bistables supply control signals for dropped rod-rod stop, overpower reactor trip (at 10%, 24% and 84%), and permissive circuits No. 7 and No. 8. Linear amplifier A-1 also supplies control signals for overpower-rod stop and rate of change of reactor power. Analog signals include shunt signals to special information channels and level amplifier signals to the main control board.

The output signals from the three overpower bistables, (high, medium and low power) are selected on the control console by selector switch NOS-1. Output of the selector switch feeds two relays in the coincidentor logic unit.

The coincidentor module is a relay logic system which receives inputs from all four power range channels and provides a two out of four logic output to the three logic trains in the reactor trip circuits. The coincidentor also accepts inputs from the two start up range channels during low power start up activity.

Each of the four power range channels have test and calibrate units with the necessary switches and signals for checking and calibrating each channel separately. Each power range channel has an ion current meter on the power range drawer and a power range meter on the main control boards. Power level signals for each channel are continuously recorded on strip chart recorders.

Evaluation. The four high flux overpower channels are electrically independent of each other. Relay logic provides isolation of the logic from control and non-safety systems. The remote power range meters are isolated by a 3,980 ohm resistor. The strip chart recorders are isolated from the power range analog signals by Electronic Modules Corp. (EMC) emitter follower isolation amplifiers.[6] The overpower-rod stop circuit is isolated from the A-1 amplifier by a optical meter relay. The rate of change of reactor power circuit is isolated from the A-1 amplifier by an operational amplifier (A-2). The A-2 amplifiers appear to meet the requirements of IEEE Standard 279-1971, but there is insufficient information available on qualification of the amplifiers to determine if they meet current standards.

3.1.2 Variable Low Pressure[7]

A variable low pressure reactor trip signal is generated whenever the pressurizer pressure is lower than a calculated low pressure setpoint.

Four independent differential temperature (ΔT) signals from signal units (TT 412, TT 422, TT 432, and TT 442), monitoring the differential temperature across each of the four steam generators, and four independent temperature averaged (Tavg) signals from signal units (TT 411, TT 421, TT 431, and TT 441), monitor the average reactor coolant loop temperature across each of the four steam generators, and provide input to three independent computer calculator units (PM 411, PM 412, and PM 413). On a continuous basis, each unit calculates a variable low pressure setpoint and transmits these setpoints through respective low limiter unit (SL 411, SL 412, Sl 413) to the three pressure comparator bistable units. Each setpoint is compared with its respective pressure signal from the three independent pressurizer pressure transmitters (PT 401-1, PT 401-2, and PC 401-3) by three independent pressure comparator bistable units (PA 401-1, PA 401-2 and PA 401-3). Each unit energizes a set of SCRAM relays (PA 401-1/63X, PA 401-2/63X and 63Y, and PA 401-3/63X and 63Y), where contacts from the SCRAM relays are arranged in a two out of three logic matrix in each of the three independent SCRAM channels (A, B, and the undervoltage (UV) bus trip.)

The three pressurizer pressure transmitters (PT 401-1, PT 401-2, and PT 401-3) also provide input signals to the three independent power operated relief valve controller units (PC 401-1A, PC 401-2, and PC 401-3). Each unit energizes its respective auxiliary relay (PC 401-1A/63X, PC 401-2/63X and PC 401-3/63X), where contacts from the auxiliary relays are arranged in a two out of three logic matrix in the circuitry of each of the two power operated relief valves. Each pressure signal also provides a voltage signal to the data logger from a 10 ohm resistor in the current loop.

The four temperature averaged (Tavg) signal units (TT 411, TT 421, TT 431 and TT 441) also provide input signals to the Reactor Control System for alarm and control function via four current repeater units (TM-4X1J, TM-4X1K, TM-4X1L, and TM-4X1M) and a summing amplifier unit (TM-4X1D). The current repeater units and the summing amplifier unit are Foxboro equipment, Models 66B and 66C, respectively. Both the current repeater units and the summing amplifier unit provide electrical isolation between the input and output signals, with the summing amplifier unit also providing electrical isolation between the input signal terminals.

The SCRAM logic relays have auxiliary contacts for inputs to the control room status lights and alarms.

Evaluation. The three pressure channels have analog input signals to the data logger without adequate isolation of the data logger from the RPS systems. Channel 1 provides an input to the process recorder without isolation. T_{avg} signals provide input for both protection and control functions, with isolation between the T_{avg} signals and the alarm and control functions. Thus the requirements of Section 4.7.1 and 4.7.2 of IEEE Std 279-1971 are met. Bistable contacts from the power operated relief valve controller units (PC 401-1A, PC 401-2 and PC 401-3) operate auxiliary relays which in turn operate the power operated relief valves. The auxiliary relays provide isolation between the RPS and the power operated relief valves.

3.1.3 High Pressurizer Pressure[8]

A high pressurizer pressure reactor trip signal is generated whenever any two of the three pressurizer pressure channels indicate a pressure above the setpoint (nominally 2300 psig). Pressure transmitters PT 401-1, PT 401-2 and PT 401-3 provide signals to the current loops that provide input signals to the pressure comparator bistable units (PA 401 1, PA 401 2 and PA 401 3). Each pressure comparator bistable also receives a signal from a computer calculator (PM 411, PM 412 and PM 413) through the low limiter units (SL 411, SL 412 and SL 413).

The pressure transmitters each feed a current loop which includes Sigma pressure indicating alarm modules. The outputs of these modules go to the high pressure SCRAM relays PIA401-1/63X, PIA401-2/63X and 63Y, and PIA401-3/63X and 63Y. A second output from these modules is to the safety injection SCRAM relays, XP1, XP2 and XP3. Each channel provides an indication of pressurizer pressure as well used as being the source of alarm and trip indications.

Contacts from the SCRAM relays provide 2 out of 3 logic inputs to SCRAM trains A, B and UV.

Evaluation. The same transmitters and current loops (channels) are used in this system as in the variable low pressure system, Section 3.1.2 above. Evaluation, therefore, is the same as the pressurizer pressure portion of Section 3.1.2.

3.1.4 High Pressurizer Level[9]

A high pressurizer level signal is generated whenever any two out of three pressurizer level monitor channels indicate a liquid level in excess of a nominal 86% of full level.

The three level transmitters (LT 401-1, LT 401-2 and LT 401-3) provide signals to their respective current loops. Channel 1 current loop includes the level transmitter LT 401-1, power supply L 401-1, a bistable unit LA 401-1A, process recorder controller LRC 401-1, two bistable units LIC 401-1A and LIC 401-1, and an indicating alarm unit LIA 401-1. The indicating alarm unit (LIA 401-1) provides a digital signal to SCRAM relay LIA 401-1/63X. Contacts from the 63X SCRAM relay provide an input to a two out of three logic matrix in each of the three independent SCRAM channels (A, B and undervoltage (UV) bus trip).

Channel 2 is comprised of level transmitter LT 401-2, power supply L 401-2 and an indicating alarm unit LIA 401-2. Contacts of LIA 401-2 provide input signals to SCRAM relays LIA 401-2/63X and 63Y. Contacts of the 63X and 63Y relays provide an input to a two-out-of-three logic matrix in each of the three SCRAM channels (A, B and undervoltage (UV) bus trip). The other inputs to this logic matrix are from Channels 1 and 3.

Channel 3 is the same as Channel 2 except the current loop includes a bistable unit (LIC 401-3). The contact output from the bistable unit energizes an auxiliary relay (LIC 401-3/63X), where contacts from the auxiliary relay control the pressurizer low level heater cut off and letdown valves closure. Also, the indicating alarm unit (LIA 401-3), which is in the current loop, provides a signal to SCRAM relays LIA 401-3/63X and 63Y. Contacts from the 63X and 63Y SCRAM relays provide an input to a two out of three logic matrix in each of the three SCRAM channels (A, B and undervoltage (UV) bus trip).

All three current loops have 10 ohm resistors in the loop to provide voltage signals to the data logger. Channel 1 current loop also includes a strip chart recorder LRC 401-1 in the circuit.

Evaluation. Relay contacts from the 63X and 63Y SCRAM relays provide adequate isolation in the SCRAM relay logic. There is no isolation between the process-strip chart recorder and the channel 1 RPS circuit. The data logger is not isolated from the three pressurizer level RPS logic channels.

3.1.5 Low Reactor Coolant Flow[10]

Low reactor coolant flow is monitored by three separate and diverse systems. The first measures the pressure drop across the steam generator. The second monitors auxiliary contacts on the reactor coolant pump circuit breakers. The third monitors undervoltage on the two 4160V buses supplying power to the coolant pump motors.

Coolant flow is measured directly by four delta pressure transmitters, FT 401, FT 402, FT 403 and FT 404. The transmitters measure flow in each of the four coolant loops. The four channels are identical, so only channel 1 will be described. Flow transmitter FT 401 feeds three independent bistable units (FIA 401A, FA 401B and FA 401C) where bistable units (FA 401B and FA 401C) energize their respecitve relays (63X/FA 401B and 63X/FA 401C). Contacts from the relays (63X/FA 401B, 63X/FA 401C), and an output contact from the bistable unit (FIA 401A) are arranged in a two out of three logic matrix to enable the SCRAM relays (63X/FIA 401 and 63Y/FIA 401) to operate. The other action to operate the SCRAM relays (63X/FIA 401 and 63Y/FIA 401) is by way of a mechanically operated switch from the 4160 volt switchgear circuit breaker for reactor coolant pump P17-1. The contacts from the SCRAM relays (63X/FIA 401 and 63Y/FIA 401) are arranged with the other three reactor coolant flow channel SCRAM relays (63X/FIA 402, 63Y/FIA 402 and 63X/FIA 403; 63Y/FIA 403, 63X/FIA 404, and 63Y/FIA 404) to provide a one out of four logic matrix in each of the three independent SCRAM channels (A, B and the undervoltage (UV) bus trip). The matrix is combined with the Permissive 8 contacts to provide a reactor trip when reactor power is above 84% full power. Also, contacts from the SCRAM relays (63X/FIA 401, 63Y/FIA 401) are arranged with the other three reactor coolant flow channel SCRAM relays (63X/FIA 402, 63Y/FIA 402 and 63X/FIA 403; 63Y/FIA 403, 63X/FIA 404 and 63Y/FIA 404) to provide a two out of four logic matrix in each of the three independent SCRAM channels (A, B and undervoltage (UV) bus trip). This matrix is combined with the Permissive 8 and 7 contacts to provide a reactor trip when reactor power is between 10% and 84% full power. There is no automatic reactor trip from reactor coolant flow channels for reactor power below 10% full power.

The second diverse system for monitoring reactor coolant flow senses each of the reactor coolant pump circuit breaker positions. Mechanically operated reactor coolant pump cell switches (P17-1/52S, P17-2/52S, P17-3/52S and P17-4/52S) provide direct input to the reactor trip coincidence circuits. The M19 and M20 relay contacts are in the flow monitoring circuit and, upon the opening of a Reactor Coolant Pump breaker, the supply voltage to its respective 63X and 63Y FIA SCRAM relay is interrupted causing the flow monitoring channel to log a loss of flow trip. In addition, several other contacts of the mechanically operated breaker cell switch interface with the Reactor Trip circuit directly in a 2/4 configuration below P-8 and a 1/4 configuration above P-8 in each of the three independent SCRAM channels (A, B and undervoltage bus trip).

The third diverse system for monitoring reactor coolant flow is by the use of undervoltage relays 271A, 271A1, 271B and 271B1 on the 4160V buses 1A and 1B. This system is comprised of two redundant channels. The undervoltage relays feed an auxiliary time delay relay (27X1A and 27X1B). Contacts of the time delay relays feed two inputs to each of the reactor trip coincidence circuits of trains A, B and UV. Each coincidence circuit initiates a 1 out of 2 reactor trip.

Evaluation. The logic channels for the three diverse systems monitoring reactor coolant low flow are electrically isolated from each other. Relay logic from the output of each channel to the reactor trip breakers provides adequate isolation. There are no control systems fed from these channels. The only non-safety equipment fed from these channels is the data logger.

3.1.6 Pressurizer Low Pressure (Safety Injection Trip)

Low Pressurizer Pressure initiates the Safety Injection system as well as providing a reactor trip.

The pressure transmitters (PT 401-1, PT 401-2 and PT 401-3) that provide input signals to the low variable pressure trip (Section 3.1.3) also provide inputs to Sigma indicating bistable alarms PIA 401-1, PIA 401-2 and PIA 401-3. These units generate an output signal for a high pressurizer pressure reactor trip signal (Section 3.1.4) and a pressurizer low pressure safety injection actuation with a reactor trip. Each Sigma unit feeds a safety injection relay (XP1, XP2 and XP3). Output contacts of the three relays are arranged in a 2 out of 3 logic feeding safety injection relays 4A and 4B. Contacts of relays 4A and 4B provide 1 out of 2 reactor trip coincident circuits for each of the three reactor trip trains (A, B and UV).

Evaluation. The trip logic from the three Sigma units to the reactor trip logic train is by relay contacts which provide adequate isolation between channels and from control and non-safety systems. Evaluation of the analog logic is the same as in Section 3.1.2 for the pressurizer pressure.

3.1.7 Steam-Feedwater Flow Mismatch[11]

Flow signals from the main steam flow are compared to the feedwater flow signals for each of the flow loops. If the steam flow exceeds the feedwater flow by a preset amount, an alarm is sounded. If, at the same time, the steam generator level is ≤10%, a reactor trip is initiated.

The system is comprised of four Dahl steam flow sensors (FE 1201-1, 2, 3 and 4), four feedwater flow sensors (FE 1301-1, 2, 3 and 4), and four steam generator level sensors (narrow range) (LT 1301-1, 2, 3 and 4). The three systems are arranged in four separate logic channels. The four channels are identical so only channel 1 will be described.

The Hagan steam flow transmitter FT 1201-1 provides an output signal proportional to steam flow as sensed by the Dahl sensor. Similarly, the feedwater flow transmitter FT 1301-1 provides an output voltage proportional to the feed water flow. These two signals are compared in a differential meter relay which will de-energize when steam flow exceeds feedwater flow by a preset amount. The output signal of the relay when de-energized feeds one half of an AND gate. The steam generator narrow range level transmitter LT 1301-1 drives a low level, voltage sensitive relay. When the steam generator level reaches a preset low level set-point, the voltage sensitive relay (LA 1301-1) de-energizes and the output contacts provide the second signal to the AND gate. The coincidence of the steam-flow mismatch and the low steam generator level provides an output signal to the reactor trip 1 out of 4 coincidence logic units for trains A, B and UV.

In addition to initiating a reactor trip, the steam, feedwater and level transmitters feed other functions.[12] The four steam flow transmitters each provide a voltage signal to the feedwater flow control systems, and to steam and feedwater flow two-pen process recorders. The four feedwater flow transmitters feed a voltage signal to the feedwater flow controller, and to the two-pen process recorders. The four steam generator level transmitters feed a voltage signal to the steam generator level controllers, to the auxiliary feedwater pumps and to process level recorders.

Evaluation. The four channels are redundant and electrically isolated from each other. Relays provide adequate isolation in the three logic trains A, B and UV. The input signals to the two-pen recorders from the steam flow and feedwater flow systems are not adequately isolated from the reactor protection system. The steam and feedwater flow channel provides signals to the feedwater flow controller without isolation from the RPS. The steam generator level channels are not adequately isolated from the steam generator level process recorder or from the steam generator level controller.

3.1.8 Steam Line Isolation Valves

Position switches on the four steam line valves will generate a reactor trip when any one of four valves close. Auxiliary position switches TVS 1211-1, 2, 3 and 4 feed two, 1 out of 4, coincidence circuits. The first coincidence circuit actuates trip relay 33X. Contacts of relay 33X provide a trip signal to reactor trip logic trains A and B. The second 1 out of 4 coincidence circuit actuates a trip relay in the UV logic train.

Evaluation. The four channels are separate and electrically isolated from each other. They are adequately isolated from control and non-safety systems.

3.1.9 Manual Trip[13]

Two redundant, momentary push button switches, PB1 and PB2, constitute the manual SCRAM actuation system. Two sets of normally open contacts and one set of normally closed contacts in each switch are located in the reactor trip logic trains A, B and UV. Pressing either switch reverses the contact arrangement, tripping the SCRAM breakers. Other contacts on the manual SCRAM switches provide input signals to the data logger and the reactor "trip cause" annunciator.

Evaluation. The manual SCRAM system is redundant and electrically isolated from control and non-safety systems.

3.2 Power Systems[14]

Power to the RPS logic channels is supplied from the four vital buses. RPS channels 1, 2, 3 and 4 receive power from vital buses 1, 2, 3 and 4, respectively. RPS systems are isolated from other functions on the same vital bus by circuit breakers. Power to the reactor trip logic trains is from the 125V DC RPS Bus supplied by two motor generators, RPS 1-A and RPS 1-B. The individual logic trains are isolated from each other by line fuses.

Evaluation. The power systems are redundant and adequate isolation is achieved by thermal breakers and line fuses.

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 of this report except for the following:

1. Isolation of the RPS monitoring channels from other measuring parameters does not meet current licensing criteria in the following subsystems:

    a. Pressurizer pressure channels from the data logger and process controller.

b. High pressurizer level channels from the data logger and process recorders.

c. Steam-feedwater flow mismatch channels (steam flow, feedwater flow and steam generator level) from the process recorders.

2. The steam-flow and feedwater flow signals, which provide input to the steam feedwater flow mismatch circuit for reactor trip, interface the feedwater flow controller without isolation. The steam generator level signals, which provide reactor trip signal in coincidence with the steam-feedwater flow mismatch circuit, interface the steam generator level controller without isolation.

5.0 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 Facility Operating License DPR-61, "Technical Specifications for the Connecticut Yankee Atomic Company CYAPCO, Haddam Neck Plant, Haddam, Connecticut," dated February 19, 1982.
4. CYAPCO letter, W. G. Counsil to NRC, D. M. Crutchfield, "Proposed Revision to Technical Specifications," dated October 28, 1981.
5. Westinghouse drawings 540F296, Rev. 2 and 540F654, Revision 3.
6. CYAPCO letter, W. G. Counsil to Director of Nuclear Reactor Regulation, attn. D. M. Crutchfield, NRC, "SEP Topic VII-1.A, Isolation of Reactor Protection System from Non-Safety Systems, Including Qualification of Isolation Devices," August 11, 1982, A02352.
7. Foxboro Drawing Y21208, Sheet 2, Revision 9, CYAPC Drawings EDSK 313551, Sheet 33, Revision 10 and Sheet 35, Revision 10.
8. CYAPCO Drawings EDSK 318710-D, Revision 13, 318711-D, Revision 9 and 318712-D, Revision 11.

9. CYAPCO Drawings EDSK 218704-D, Revision 12, 318705-D, Revision 6, and 318706-D, Revision 17.

10. CYAPCO Drawings EDSK 313551, Sheet 35, Revision 10, Sheet 37, Revision 10 and Sheet 38, Revision 11.

11. CYAPCO Drawings 16103-32150 Sheet 16A, Revision 2, Sheet 16B Revision 1, Sheet 16C, Revision 0, and Sheet 16D, Revision 0.

12. CYAPCO Drawing 16103-39014, Sheet 4, Revision 1.

13. CYAPCO Drawing EDSK 313551, Sheet 33, Revision 10.

14. CYAPCO Drawings EDSK 313551, Sheet 33, Revision 10, 16103-30055, Sheet 2, Revision 2 and 16103-30055, Sheet 1, Revision 2.

15. CYAPCO letter, W. G. Counsil, to NRC, D. M. Crutchfield, "SEP Topic VII-1.A, Isolation of Reactor Protection Systems from Non-Safety Systems, SEP Topic VII-2, ESF Systems Control Logic and Design," A01789, dated August 7, 1981.

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.