1183-4162
AUGUST 1980

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SYSTEMATIC EVALUATION PROGRAM
REVIEW OF NRC SAFETY TOPIC VII-2
ASSOCIATED WITH THE ELECTRICAL, INSTRUMENTATION, AND CONTROL PORTIONS OF THE ESF SYSTEM CONTROL LOGIC AND DESIGN FOR THE GINNA NUCLEAR POWER PLANT

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Derivative
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Work Performed for Lawrence Livermore National Laboratory under U.S. Department of Energy Contract No. DE-AC08-76 NVO 1183.

ABSTRACT

This report documents the technical evaluation and review of NRC Safety Topic VII-2, associated with the electrical, instrumentation, and control portions of the ESF system control logic and design for the Ginna Nuclear Power Plant, using current licensing criteria.

FOREWORD

This report is supplied as part of the Systematic Evaluation Program being conducted for the U.S. Nuclear Regulatory Commission by Lawrence Livermore National Laboratory. The work was performed by EG&G, Inc., Energy Measurements Group, San Ramon Operations for Lawrence Livermore National Laboratory under U.S. Department of Energy contract number DE-AC08-76NV01183.

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by

Donald H. Laudenbach

1. INTRODUCTION

The Engineered Safety Features Actuation Systems (ESFAS) of both PWRs and BWRs may have design features that raise questions about the electrical independence of redundant channels and isolation between ESF channels or trains.

Non-safety systems generally receive control signals from the ESF sensor current loops. The non-safety circuits are required to have isolation devices to insure electrical independence from the ESF channels. The safety objective is to verify that operating reactors have ESF designs which provide effective and qualified isolation between ESF channels and between ESFs and non-safety systems.

This report reviews the ESF EI&C design features of Ginna Nuclear Power Plant to insure that the non-safety systems electrically connected to the ESFs are properly isolated from the ESFs. This report also reviews the plant's ESFs to insure that there is proper isolation between redundant ESF channels or trains and that the isolation devices or techniques meet the current licensing criteria detailed in Section 2 of this report. The qualification of safety-related equipment is not within the scope of this report and is discussed in NRC Safety Topic III-12 and NUREG-0458 [Ref. 1].

2. CURRENT LICENSING CRITERIA

GDC 22 [Ref. 2], entitled, "Protection System Independence," states that:

> The protection system shall be designed to assure that the effects of natural phenomena and of normal operating, maintenance, testing, and postulated accident conditions on redundant channels do not result in loss of the protection function, or that they shall be demonstrated to be acceptable on some other defined basis. Design techniques, such as functional diversity or diversity in component design and principles of operation, shall be used to the extent practical to prevent loss of the protection function.

GDC 24 [Ref. 2], entitled, "Separation of Protection and Control Systems," states 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 system leave intact a system satisfying 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.

IEEE Std-279-1971 [Ref. 3], entitled, "Criteria for Protection Systems for Nuclear Power Generating Stations," states in Section 4.7.2 that:

> 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.

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

3. REVIEW GUIDELINES

The following NRC guidelines were used for this review:

Verify that the signals used for ESF functions are isolated from redundant ESF trains or channels. Review the schematic diagrams to assure that the wiring satisfies the functional logic diagrams in the FSAR or its equivalent (GDC 22).

Verify that qualified electrical isolation devices are utilized when redundant ESF trains or channels share safety signals. Identify and describe the type of isolation device employed (GDC 22).

Verify that the safety signals used for ESF functions are isolated from control or non-safety systems. Identify and describe the type of isolation device employed (GDC 24, IEEE Std-279-1971, Section 4.7.2).

Verify that the logic does not contain sneak paths that could cause false operation or prevent required action as the result of operation of plant controls.

Identify the related NRC Safety Topics in an appendix to the report.

4. SYSTEM DESCRIPTION

4.1 CONTAINMENT PRESSURE

The Ginna FSAR [Ref. 4] states in Section 7.5.2 that containment pressure is the variable required for post-accident monitoring. Six transmitters are installed outside the containment to prevent potential missile damage. The pressure is indicated and recorded (all six channels) on the main control board. The six channels monitoring the containment pressure reflect the effectiveness of engineered safety features. High pressure indicates high temperature and reduced pressure indicates reduced temperatures.

Loop A containment pressure is monitored by pressure transmitters PT-945, PT-946 and PT-947. Loop B containment pressure is monitored by pressure transmitters PT-948, PT-949 and PT-950.

4.1.1 Channel I (Loop A1)

Containment Pressure Channel I, Loop A1 (designated RED), originates at pressure transmitter PT-945 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol PM-945 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-14]. PT-945 provides an unisolated signal to Foxboro pressure controller, Model M/635-BR-OEHA, circuit symbol PC-945 A/B [Ref. 5, drawing BD-12]. The "A" section output of PC-945 A/B provides one of the inputs to the two-out-of-three (2/3) containment pressure safeguards actuation logic; the other two inputs are from PC-947A and PC-949A. The 2/3 containment pressure logic output provides enabling signals to feedwater isolation, containment isolation, reactor trip, containment ventilation isolation, and safeguards

sequence logic. The "B" section output of PC-945 A/B provides one of the inputs to the 2/3 containment pressure safeguards actuation logic; the other two inputs are from PC-947B and PC-949B. The 2/3 containment pressure logic output provides enabling signals to containment spray actuation logic [Ref. 6, drawing 882D612, sheet 6].

4.1.2 Channel II (Loop A2)

Containment Pressure Channel II, Loop A2 (designated WHITE) originates at pressure transmitter PT-946 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol PM-946 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-14]. PT-946 provides an unisolated signal to Foxboro pressure controller, Model M/635-BR-OEHA, circuit symbol PC-946 A/B [Ref. 5, drawing BD-12]. The "A" section output of PC-946 A/B provides one of the inputs to the two-out-of-three (2/3) containment pressure safeguards actuation logic; the other two inputs are from PC-948A and PC-950A. The 2/3 containment pressure logic output provides enabling signals to Loop A steam line isolation and Loop B steam line isolation. The "B" section output of PC-946 A/B provides one of the inputs to the 2/3 containment pressure safeguards actuation logic; the other two inputs are from PC-948B and PC-950B. The 2/3 containment pressure logic output provides enabling signals to containment spray actuation logic [Ref. 6, drawing 882D612, sheet 6].

4.1.3 Channel III (Loop A3)

Containment Pressure Channel III, Loop A3 (designated BLUE) originates at pressure transmitter PT-947 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol PM-947 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-14]. PT-947 provides an unisolated signal to Foxboro pressure controller, Model M/635-BR-OEHA, circuit symbol PC-947 A/B [Ref. 5, drawing BD-12]. The "A" section output of PC-947 A/B provides one of the inputs to the two-out-of-three (2/3) containment pressure safeguards actuation logic; the other two inputs are from PC-945A and PC-949A. The 2/3 containment pressure logic output provides enabling signals to feedwater isolation, containment isolation, reactor trip, containment ventilation isolation, and safeguards sequence logic. The "B" section output of PC-947 A/B provides one of the inputs to the 2/3 containment pressure safeguards actuation logic; the other two inputs are from PC-945B and PC-949B. The 2/3 containment pressure logic output provides enabling signals to containment spray actuation logic [Ref. 6, drawing 882D612, sheet 6].

4.1.4 Channel II (Loop B1)

Containment Pressure Channel II, Loop B1 (designated WHITE), originates at pressure transmitter PT-949 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol PM-949 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-14]. PT-949 provides an unisolated signal to Foxboro pressure controller, Model M/635-BR-OEHA, circuit symbol PC-949 A/B [Ref. 5, drawing BD-12]. The "A" section output of PC-949 A/B provides one of the inputs to the two-out-of-three (2/3) containment pressure safeguards actuation logic; the other two inputs are from PC-945A and PC-947A. The 2/3 containment pressure logic output provides enabling signals to feedwater isolation, containment isolation, reactor trip, containment ventilation isolation, and safeguards sequence logic. The "B" section output of PC-949 A/B provides one of the inputs to the 2/3 containment pressure safeguards actuation logic; the other two inputs are from PC-945B and PC-947B. The 2/3 containment pressure logic output provides enabling signals to containment spray actuation logic [Ref. 6, drawing 882D612, sheet 6].

4.1.5 Channel III (Loop B2)

Containment Pressure Channel III, Loop B2 (designated BLUE), originates at pressure transmitter PT-948 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol PM-948 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-14]. PT-948 provides an unisolated signal to Foxboro pressure controller, Model M/635-BR-OEHA, circuit symbol PC-948 A/B [Ref. 5, drawing BD-12]. The "A" section output of PC-948 A/B provides one of the inputs to the two-out-of-three (2/3) containment pressure safeguards actuation logic; the other two inputs are from PC-946A and PC-950A. The 2/3 containment pressure logic output provides enabling signals to Loop A steam line isolation and Loop B steam line isolation. The "B" section output of PC-948 A/B provides one of the inputs to the 2/3 containment pressure safeguards actuation logic; the other two inputs are from PC-946B and PC-950B. The 2/3 containment pressure logic output provides enabling signals to containment spray actuation logic [Ref. 6, drawing 882D612, sheet 6].

4.1.6 Channel IV (Loop B3)

Containment Pressure Channel IV, Loop B3 (designated YELLOW), originates at pressure transmitter PT-950 and provides isolated output to the control system via Foxboro isolation device, model M/66BR-OH, circuit symbol PM-950 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-14]. PT-950 provides an unisolated signal to Foxboro pressure controller, Model M/635-BR-OEHA, circuit symbol PC-950 A/B [Ref. 5, drawing BD-12]. The "A" section output of PC-950 A/B provides one of the inputs to the two-out-of-three (2/3) containment pressure safeguards actuation logic; the other two inputs are from PC-946A and PC-948A. The 2/3 containment pressure logic output provides enabling signals to Loop A steam line isolation and Loop B steam line isolation. The "B" section output of PC-950 A/B provides one of the inputs to the 2/3 containment pressure safeguards actuation logic; the other two inputs are from PC-946B and PC-948B. The 2/3 containment pressure logic output provides enabling signals to containment spray actuation logic [Ref. 6, drawing 882D612, sheet 6].

4.2 REACTOR COOLANT FLOW

Six reactor coolant flow channels are used for monitoring the RCS flow of the two-loop configuration. Isolated output signals from these channels are used for computer input and control board indication. Loop A coolant flow is monitored by flow transmitters FT-411, FT-412, and FT-413. Loop B coolant flow is monitored by flow transmitters FT-414, FT-415, and FT-416.

4.2.1 Channel I (Loop A1)

Reactor Coolant Flow Channel I, Loop A1 (designated RED), originates at flow transmitter FT-411 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol FM-411 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-15]. FT-411 provides an unisolated signal to Foxboro flow controller, Model M/635-AR-OAHA, circuit symbol FC-411 [Ref. 5, drawing BD-12]. The output of FC-411 provides one of the inputs to the two-out-of-three (2/3) Loop A RCS trip logic; the other two inputs are from FC-412 and FC-413. The 2/3 Loop A RCS trip logic output provides enabling signals to Loop B RCS trip logic and reactor trip logic [Ref. 6, drawing 882D612, sheet 14].

4.2.2 Channel II (Loop A2)

Reactor Coolant Flow Channel II, Loop A2 (designated WHITE), originates at flow transmitter FT-412 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol FM-412 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-15]. FT-412 provides an unisolated signal to Foxboro flow controller, Model M/635-AR-OAHA, circuit symbol FC-412 [Ref. 5, drawing BD-12]. The output of FC-411 provides one of the inputs to the two-out-of-three (2/3) Loop A RCS trip logic; the other two inputs are from FC-411 and FC-413. The 2/3 Loop A RCS trip logic output provides enabling signals to Loop B RCS trip logic and reactor trip logic [Ref. 6, drawing 882D612, sheet 14].

4.2.3 Channel III (Loop A3)

Reactor Coolant Flow Channel III, Loop A3 (designated BLUE), originates at flow transmitter FT-413 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol FM-413 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-15]. FT-413 provides an unisolated signal to Foxboro flow controller, Model M/635-AR-OAHA, circuit symbol FC-413 [Ref. 5, drawing BD-12]. The output of FC-413 provides one of the inputs to the two-out-of-three (2/3) Loop A RCS trip logic; the other two inputs are from FC-411 and FC-412. The 2/3 Loop A RCS trip logic output provides enabling signals to Loop B RCS trip logic and reactor trip logic [Ref. 6, drawing 882D612, sheet 14].

4.2.4 Channel II (Loop B1)

Reactor Coolant Flow Channel II, Loop B1 (designated WHITE), originates at flow transmitter FT-414 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol FM-414 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-15]. FT-414 provides an unisolated signal to Foxboro flow controller, Model M/635-AR-OAHA, circuit symbol FC-414 [Ref. 5, drawing BD-12]. The output of FC-414 provides one of the inputs to the two-out-of-three (2/3) Loop B RCS trip logic; the other two inputs are from FC-415 and FC-416. The 2/3 Loop B RCS trip logic output provides enabling signals to Loop A RCS trip logic and reactor trip logic [Ref. 6, drawing 882D612, sheet 14].

4.2.5 Channel III (Loop B2)

Reactor Coolant Flow Channel III, Loop B2 (designated BLUE), originates at flow transmitter FT-415 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol FM-415 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-15].

FT-415 provides an unisolated signal to Foxboro flow controller, Model M/635-AR-OAHA, circuit symbol FC-415 [Ref. 5, drawing BD-12]. The output of FC-415 provides one of the inputs to the two-out-of-three (2/3) Loop B RCS trip logic; the other two inputs are from FC-414 and FC-416. The 2/3 Loop B RCS trip logic output provides enabling signals to Loop A RCS trip logic and reactor trip logic [Ref. 6, drawing 882D612, sheet 14].

4.2.6 Channel IV (Loop B3)

Reactor Coolant Flow Channel IV, Loop B3 (designated YELLOW), originates at flow transmitter FT-416 and provides isolated output to the control system via Foxboro isolation device, Model M/66BR-OH, circuit symbol FM-416 [Ref. 5, drawing BD-12]. The control system provides signals to the computer and control board indicators [Ref. 5, drawing BD-15]. FT-416 provides an unisolated signal to Foxboro flow controller, Model M/635-AR-OAHA, circuit symbol FC-416 [Ref. 5, drawing BD-12]. The output of FC-416 provides one of the inputs to the two-out-of-three (2/3) Loop B RCS trip logic; the other two inputs are from FC-414 and FC-415. The 2/3 Loop B RCS trip logic output provides enabling signals to Loop A RCS trip logic and reactor trip logic [Ref. 6, drawing 882D612, sheet 14].

4.3 COOLANT TEMPERATURE T_{avg}

Four T_{avg} channels are used for overtemperature-overpower protection. Isolated output signals for all four channels are averaged for automatic control rod regulation of power and temperature. Unisolated output signals provide input enables to the safeguards actuation logic.

4.3.1 Loop A1

The Loop A1 T_{avg} signal is generated by a dual-current source device, circuit symbol TT-401, as a product of inputs from temperature elements TE-401A, TE-401B, TE-405A, and TE-405B. The T_{avg} signal is

isolated from the control system by Foxboro isolation device Model M/66GR-OW, circuit symbol TM-401C [Ref. 5, drawing BD-2]. The control system provides signals for control rod regulation and control board indication. In addition, the control system provides input to the computer through another stage of isolation, Foxboro isolation device Model M/66BR-OH, circuit symbol TM-401W [Ref. 5, drawing BD-17]. The control system also provides input to recorder TR-401 through Foxboro isolation device Model M/66BR-OH, circuit symbol TM-401G [Ref. 5, drawing BD-15]. The unisolated Low T_{avg} signal is generated by Foxboro temperature controller, Model M/635-BR-OEHA, circuit symbol TC-401A [Ref. 5, drawing BD-2]. The output of TC-401A provides one of the inputs to the two-out-of-four (2/4) Loop A RCS trip logic; the other three inputs are from TC-402A, TC-403A, and TC-404A. The 2/4 Loop A RCS trip logic output provides enabling signals to Loop A steam line isolation and Loop B steam line isolation [Ref. 6, drawing 882D612, sheets 6 and 14].

4.3.2 Loop A2

The Loop A2 T_{avg} signal is generated by a dual-current source device, circuit symbol TT-402, as a product of inputs from temperature elements TE-402A, TE-402B, TE-406A, and TE-406B. The T_{avg} signal is isolated from the control system by Foxboro isolation device Model M/66GR-OW, circuit symbol TM-402C [Ref. 5, drawing BD-3]. The control system provides signals for both control rod regulation and control board indication. In addition, the control system provides input to the computer through another stage of isolation, Foxboro isolation device Model M/66BR-OH, circuit symbol TM-402W [Ref. 5, drawing BD-17]. The control system also provides input to recorder TR-401 through Foxboro isolation device Model M/66BR-OH, circuit symbol TM-401G [Ref. 5, drawing BD-15]. The unisolated Low T_{avg} signal is generated by Foxboro temperature controller, Model M/635-BR-OEHA, circuit symbol TC-402A [Ref. 5, drawing BD-3]. The output of TC-402A provides one of the inputs to the two-out-of-four (2/4) Loop A RCS trip logic; the other three inputs are from TC-401A, TC-403A, and TC-404A. The 2/4 Loop A RCS trip logic output provides enabling signals to Loop A steam line isolation and Loop B steam line isolation [Ref. 6, drawing 882D612, sheets 6 and 14].

4.3.3 Loop B1

The Loop B1 T_{avg} signal is generated by a dual-current source device, circuit symbol TT-403, as a product of inputs from temperature elements TE-403A, TE-403B, TE-407A, and TE-407B. The T_{avg} signal is isolated from the control system by Foxboro isolation device Model M/66GR-OW, circuit symbol TM-403C [Ref. 5, drawing BD-4]. The control system provides signals for control rod regulation and control board indication. In addition, the control system provides input to the computer through another stage of isolation, Foxboro isolation device Model M/66BR-OH, circuit symbol TM-403W [Ref. 5, drawing BD-17]. The control system also provides input to recorder TR-401 through Foxboro isolation device Model M/66BR-OH, circuit symbol TM-401G [Ref. 5, drawing BD-15]. The unisolated Low T_{avg} signal is generated by Foxboro temperature controller, Model M/635-BR-OEHA, circuit symbol TC-403A [Ref. 5, drawing BD-4]. The output of TC-403A provides one of the inputs to the two-out-of-four (2/4) Loop B RCS trip logic; the other three inputs are from TC-401A, TC-402A, and TC-404A. The 2/4 Loop B RCS trip logic output provides enabling signals to Loop A steam line isolation and Loop B steam line isolation [Ref. 6, drawing 882D612, sheets 6 and 14].

4.3.4 Loop B2

The Loop B2 T_{avg} signal is generated by a dual-current source device, circuit symbol TT-404, as a product of inputs from temperature elements TE-404A, TE-404B, TE-408A, and TE-408B. The T_{avg} signal is isolated from the control system by Foxboro isolation device Model M/66GR-OW, circuit symbol TM-404C [Ref. 5, drawing BD-5]. The control system provides signals for control rod regulation and control board indication. In addition, the control system provides input to the computer through another stage of isolation, Foxboro isolation device Model M/66BR-OH, circuit symbol TM-404W [Ref. 5, drawing BD-17]. The control system also provides input to recorder TR-401 through Foxboro isolation device Model M/66BR-OH, circuit symbol TM-401G [Ref. 5, drawing BD-15].

The unisolated Low T_{avg} signal is generated by Foxboro temperature controller, Model M/635-BR-OEHA, circuit symbol TC-404A [Ref. 5, drawing BD-5]. The output of TC-404A provides one of the inputs to the two-out-of-four (2/4) Loop B RCS trip logic; the other three inputs are from TC-401A, TC-402A, and TC-403A. The 2/4 Loop B RCS trip logic output provides enabling signals to Loop A steam line isolation and Loop B steam line isolation [Ref. 6, drawing 882D612, sheets 6 and 14].

5. EVALUATION AND CONCLUSIONS

Based on a review of the Foxboro drawings [Ref. 5] and the Foxboro Technical Information Bulletins [Refs. 7, 8, and 9], we conclude that the ESF systems are adequately isolated from the control or non-safety systems, and that the isolation of the ESF systems from non-safety systems satisfies the requirements of GDC 24 and Section 4.7.2 of IEEE Std-279-1971 detailed in Section 2 of this report.

Based on a review of Westinghouse drawings [Ref. 6] and Rochester Gas and Electric Corp. drawings [Ref. 10], we conclude that the redundant ESF channels are NOT adequately isolated from one another and that the isolation of the redundant ESF channels does NOT satisfy the requirements of GDC 22 detailed in Section 2 of this report. The following examples are specific areas of non-compliance to GDC 22:

The Loop A 2/3 Reactor Coolant Flow LOW output signal is used, without isolation, in the Loop B Reactor Coolant Flow logic.

The Loop B 2/3 Reactor Coolant Flow LOW output signal is used, without isolation, in the Loop A Reactor Coolant Flow logic.

The Loop A RCP Breaker OPEN signal is used, without isolation, in the Loop B Breaker Open logic.

The Loop B RCP Breaker OPEN signal is used, without isolation, in the Loop A Breaker Open logic.

Isolation between Loop A steam line logic and Loop B steam line logic is defeated by the 2/4 LOW T_{avg} signal line that provides inputs to both loops in a series string arrangement.

Isolation between Loop A steam line logic and Loop B steam line logic is defeated by the 2/3 Pressurizer Pressure LOW signal line that provides inputs to both loops in a series string arrangement.

Isolation between Loop A steam line isolation logic and Loop B steam line isolation logic is defeated by the 2/3 Containment Pressure HIGH signal line that provides inputs to both loops in a series string arrangement.

6. SUMMARY

Based on a review of the documentation listed in the reference section of this report, we conclude that the isolation of the ESF systems from non-safety systems satisfies the current licensing criteria detailed in Section 2 of this report.

Based on a review of the documentation listed in the reference section of this report, we conclude that the isolation of redundant ESF channels does NOT satisfy the current licensing criteria detailed in Section 2 of this report.

REFERENCES

1. U.S. Nuclear Regulatory Commission, "Short-term Safety Assessment of the Environmental Qualifications of Safety-related Electrical Equipment of SEP Operating Reactors," NUREG-0458, May 1978.

2. Code of Federal Regulations, Title 10, Part 50 (10 CFR 50) Appendix A, (General Design Criteria), 1978.

3. Institute of Electrical and Electronics Engineers, IEEE Std-279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."

4. Rochester Gas and Electric Corp., Ginna Final Safety Analysis Report (FSAR) dated April 23, 1975.

5. Foxboro drawings; BD-2 through BD-19 for the Ginna Nuclear Power Station.

6. Westinghouse drawings 882D612 (sheets 1 through 15), for the Ginna Nuclear Power Station.

7. Foxboro Technical Information Bulletin #39-168b, dated March 30, 1965.

8. Foxboro Technical Information Bulletin #18-240, dated March 1965.

9. Foxboro Technical Information Bulletin #18-241, dated July 1965.

10. Rochester Gas and Electric Corp., drawings E33013-660 through E33013-665.

APPENDIX A
NRC SAFETY TOPICS RELATED TO THIS REPORT

1.	Safety Topic III-1	"Classification of Structures, Systems and Components."
2.	Safety Topic VI-10.A	"Testing of RTS and ESF including Response Time Testing.
3.	Safety Topic VI-10.B	"Shared ESFs, On-Site Emergency Power and Service Systems for Multiple Unit Facilities."
4.	Safety Topic VII-3	"Systems Required for Safe Shutdown."
5.	Safety Topic VII-4	"Effects of Failure in Non-Safety Related Systems on Selected ESFs."
6.	Safety Topic XVI	"Technical Specifications."

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