MAR 3 0 1981

Docket No. 50-219
LS05-81-03-071

Mr. I. R. Finfrock, Jr.
Vice President - Jersey Central
Power & Light Company
Post Office Box 388
Forked River, New Jersey 08731

Dear Mr. Finfrock:

SUBJECT: SEP TOPIC VII-2, ESF SYSTEM CONTROL LOGIC AND DESIGN (OYSTER CREEK)

A copy of our current evaluation of Systematic Evaluation Program Topic VII-2, ESF System Control Logic and Design is enclosed. This assessment compares your facility, as described in Docket No. 50-219, with the criteria currently used by the regulatory staff for licensing new facilities. Please inform us if your as-built facility differs from the licensing basis assumed in our assessment within 30 days of receipt of this letter.

This evaluation will be a basic input to the integrated safety assessment for your facility unless you identify changes needed to reflect the as-built conditions at your facility. 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
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

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SURNAME	RScholl:dk	RHermann	WRussell	WPaulson	DCrutchfield	GLainas
DATE	3/23/81	3/24/81	3/24/81	3/24/81	3/26/81	3/26/81

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

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SEP TECHNICAL EVALUATION

TOPIC VII-2

ESF SYSTEM CONTROL LOGIC AND DESIGN

OYSTER CREEK

Docket No. 50-219

March 1981

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CONTENTS

SEP TECHNICAL EVALUATION

TOPIC VII-2

ESF SYSTEM CONTROL LOGIC AND DESIGN

OYSTER CREEK

1.0 INTRODUCTION

The objective of this review is to determine if non-safety systems which are electrically connected to the Engineered Safety Features (ESF) are properly isolated from the ESF 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 ESF sensor current loops. The non-safety circuits are required to have isolation devices to ensure electrical independence of the ESF 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 22 (GDC 22), entitled, "Protective System Independence," requires 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 bases. 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.[1]

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.[2]

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.[3]

3.0 DISCUSSION AND EVALUATION

3.1 Discussion

3.1.1 General. The Oyster Creek FD&SAR[4] does not specifically differentiate between the Reactor Protection System and the Engineered Safety Features (ESF) System. The Standard Review Plan, Section 7.1-III, defines ESF systems as those functions which are required to function

automatically to mitigate the consequences of a postulated design basis event.

Based on the above definition, the following safety systems are classified for evaluation as ESF systems:

1. Low Pressure Core Spray System
2. Containment Spray System
3. Automatic Depressurization System
4. Emergency Condenser System
5. Containment Isolation.

3.1.2 Low Pressure Core Spray System.[5]

Discussion: The core spray system control logic consists of two independent logic channels with two subchannels arranged in a one-out-of-two-taken-twice configuration. Activation of the core spray is from four bistable delta pressure sensors, RE02A, C and B, D, measuring low-low reactor water level, or four pressure switches, RV46A, C and B, D, monitoring high drywell pressure. Redundant relay logic from these sensors in each channel initiates startup of both diesel generators and two core spray pumps. Failure of either or both spray pumps to start within a preset time period as monitored by pressure switches RV29A, C and B, D, will initiate start-up of the redundant core spray pump(s). Low core spray pump discharge pressure is monitored by separate pressure switches RV40A, C and B, D, which will initiate start-up of the core spray booster pumps.

Valve position indicators and annunciators for the core spray system are provided by torque and position switches located on each of the valves. Bypasses and test circuits are by relay contact inserted in or around the ESF control logic circuits.

Use of relay logic in redundant channels provides electrical isolation between channels of the core spray system and from other ESF, control, and non-safety systems.

Power for the core spray system logic is from the 125V dc buses. Channels A and B receive power from the 125V dc Panel D while Channels C and D receive power from the 125V dc Panel F. Isolation between Channels A and B and from other safety systems on Panel D is by thermal circuit breaker. Isolation between Channels C and D and from other safety functions on Panel F is by thermal-magnetic circuit breaker. Motor operated valves for each channels are powered from separate power buses and are isolated from other functions on the bus by magnetic-trip circuit breakers with motor-starter thermal-overloads. However, the thermal overloads for these circuits are jumpered.

Core spray pumps and booster pumps for each system are powered from separate power buses and are isolated from other power functions on the same buses by AK 50 breakers.

Evaluation: The low pressure core spray system logic function is redundant and provides adequate isolation between channels and from control and non-safety systems. Power to the logic circuits is from separate buses and isolated by thermal-magnetic breakers. Power for the redundant core spray pumps is from separate power buses and isolated from other systems by AK 50 breakers. Power to motor-operated (MO) valves is isolated between channels by separate buses; however, the isolation circuit breakers are magnetic trip only, which does not comply with the criteria of Nuclear Regulatory Guide 1.75, Rev. 1, Section C-1.

3.1.3 Containment Spray System.[6]

Discussion: Control logic for the containment spray system consists of two channels with two subchannels per channel configured in a one-out-of-two-taken-twice logic. Initiation of containment spray is from two sets of bistable sensors. One set of four sensors, IP15A, C and B, D, monitors

high drywell pressure while contacts from relays 110A, B, C, and D, actuated by core spray sensors RE02A, B, C, and D, monitoring low-low reactor water level. Containment spray actuation requires coincident high drywell pressure and reactor low-low water level signals.

The system consists of two loops with two containment spray pumps and one heat exchanger per loop plus essential valves. One containment spray pump in each loop and the associated loop valves are energized automatically on demand from the containment spray relay logic system. The secondary pumps can only be started manually. Time-delay relays in each loop logic circuit initiates startup of the emergency service water pump for condenser coolant water flow.

Decay of high drywell pressure to a preset value (1 psig) will shut down the containment spray system.

Control logic for actuation of the containment spray system is provided by combining the sensor-actuated relays into a relay matrix which actuates the dual-channel initiation signals. Isolation is maintained between channels and from other ESF, control, and non-safety systems by independent relay contacts.

Bypass and test circuits are by relay contacts inserted in and around the containment spray logic circuits. Valve positions, motor starter lights, and annunciators are indicated from individual position switches on the valves and from motor contactors.

Power for the system logic is from the 125V dc Panel F for System I and Panel D for System II. Line fuses in both positive and negative legs of the logic circuitry isolate the logic from other circuits on Panels D and F. Isolation of those circuits from other safety circuits on Panel D is by thermal circuit breaker and on Panel F by thermal-magnetic circuit breaker.

Power for Loop 1 motor-operated valves is supplied from Motor Control Center (MCC) 1A21B and Loop 2 from MCC 1B21B. Isolation from other safety functions on the same bus is by thermal-magnetic circuit breaker.

Loop 1 containment spray pumps are fed from substation power Bus 1A2 and Loop 2 from substation power Bus 1B2. Emergency service water pumps for Loops 1 and 2 are fed power from emergency switchgear Buses 1D and 1C, respectively. Service water pumps for each loop receive power from unit substation buses 1A3 and 1A4. Thus, adequate power isolation is maintained between loops. Isolation of pumps from other safety and non-safety loads on the same bus is by AK 50 circuit breakers.

Evaluation: The containment spray logic functions are by relay actuation, redundant and provide adequate isolation between channels and from control and non-safety systems. Power to the logic circuits are from separate 125V dc buses and isolated by thermal breakers in Panel D-1 and thermal-magnetic breakers in Panel F. Redundant containment spray pumps and emergency service water pumps are powered from separate buses and isolated from other systems by AK 50 breakers. Power to the MO valves is isolated between channels by separate buses. However, with the exception of containment spray inlet bypass valves and the pressure suppression chamber spray valves, which are protected by thermal-magnetic breakers, all other valves are protected by isolation breakers with magnetic trip only, which does not comply with the criteria of Nuclear Regulatory Guide 1.75, Rev. 1, Section C-1.

3.1.4 Automatic Depressurization System.[7]

Discussion: The Automatic Depressurization System (ADS) consists of five electromatic relief valves operating from high reactor pressure actuated by individual preset pressure switches, by operator manual actuation, or by ESF logic.

ESF initiation of the ADS requires coincident actuation of three reactor monitor systems, each utilizing four sensors in a one-out-of-two-taken-twice logic plus a nominal time delay. The ADS monitors are comprised of:

low-low-low reactor water level switches RE19A, B, C, and D; high drywell pressure using contacts from the core spray logic relays 115A, B, C, and D actuated from pressure switches RV46A, B, C, and D; and high core spray booster pump pressure using contacts from the core spray logic relays 114A, B, C, and D actuated from pressure switches RV40A, B, C, and D located on the spray booster pumps discharge lines.

Redundant relay and timer logic derived from these sensors opens the five electromatic relief valves in a time-sequenced order. Valves are solenoid-initiated, air-actuated. The two channels are independent and isolated from each other. Use of relay logic provides isolation between channels, from the core spray system, control system, and nonsafety systems.

Valve position is indicated for each valve from "uni-switches" on each solenoid actuator. Testing of the valve actuation (when the reactor is down) is by manual-control switch. Logic testing consists of applying pressure to the sensors. No bypass of the ADS system exists. Channel isolation from the redundant channel, from RPS channels, and from nonsafety circuits is by relay contact. Logic for each valve actuation circuit is separately fused to prevent loss of actuation of more than one valve should a single short circuit occur in the logic circuitry or valve actuator. Power to the relay-logic circuits and the solenoid-valve actuators is from the 125V dc Panels D and F. ADS Valves NR108A, C and E are nominally powered from two thermal breakers on Panel D while Valves NR108B and D are powered from two thermal-magnetic breakers on Panel F. Redundancy of power is also provided by loss-of-power transfer relays in each of the two main logic circuits.

Evaluation: The ADS logic functions are redundant and provide adequate isolation between channels and from other safety and control systems. Power to the logic channels and for solenoid actuated valves is from the 125V dc Panels D and F. Power isolation from other functions on these panels is by thermal breaker on Panel D and thermal-magnetic breaker on Panel F. This system complies with all current licensing criteria listed in Section 2 of this report.

3.1.5 Emergency (Isolation) Condenser System.

Discussion: The Emergency Condenser System consists of two condensers and appropriate valves and support systems to provide redundant coolant loops operating with natural recirculation upon demand.

Initiation of control logic for the Emergency Condenser System is from reactor high pressure or reactor low-low water level and a nominal 15 second delay. Four reactor high pressure switches, RE15A, B, C, and D and relay contacts actuated by the RPS low-low reactor water level switches RE02A, B, C, and D are arranged in a one-out-of-two-taken-twice logic. Sensing of high flow by redundant flow switches on each loop indicates loop piping failure and automatically signals closure of the redundant outlet and inlet block valves in the damaged loop.

The Emergency Condenser System was evaluated without benefit of detailed electrical control drawings. Based on the review of docketed information and on detailed review of other ESF logic, it is assumed that relay logic is also used in the emergency condenser logic circuits for valve control, bypasses, and manual override circuitry. Also, that the valve position indication and annunciation are from torque and limit switches on the valve. The single-failure analysis[5] supports the supposition that the channel redundancy and isolation from non-safety systems is adequate.

All valves are normally open except for one 125V dc valve in each condensate return line. The 125V dc valves are powered from MCC DC-1 and the ac valves are powered from MCC 1AB2. Loss of MCC DC-1 bus would prevent opening recirculation valves in both loops.

Evaluation: Based on reviews of the Emergency Condenser System docketed information, P&I Diagram, and evaluation of other ESF logic circuitry, but without the benefit of in-depth review of electrical, elementary, or schematic diagrams, it is suggested the logic circuitry isolation between channels and from control and non-safety systems is adequate. Power to the ac MO valves is fed from MCC 1AB2 and to the redundant dc valves

from dc Bus D-1. Loss of Bus DC-1 would prevent opening the loops to emergency condenser flow.[10] Power isolation at the power panels is by thermal-magnetic breakers.

3.1.6 Containment Isolation System.[10,11]

Discussion: The Containment Isolation System consists of redundant isolation valves placed in series on all pipes and ducts which penetrate the reactor primary containment. In each line, one valve is located inside the containment vessel and the second valve located outside. Systems included in the Containment Isolation System evaluation are:

1. Main steam line valves
2. Isolation condenser
3. Cleanup system
4. Shutdown system
5. Drywell vent purge and sumps.

Containment isolation may be initiated by manual control of each valve or upon demand by RPS requirements. Initiation of RPS control logic is from reactor low-low water level or high drywell pressure.[12] Closure of main steam and main steam-line drain valves may also be initiated by high radiation level, low steam-line pressure, or main steam-line break monitored by temperature sensors in the pipe tunnel. The four reactor low-low water level switches, RE02A, B, C, and D, and the four high drywell pressure switches, RE04A, B, C, and D, are each arranged in a one-out-of-two-taken-twice logic to provide redundant trip channels. Isolation between channels and from other RPS, ESF, control, and non-safety systems is by relay contacts.

Testing of individual valve actuation is by manual control while system testing is performed by pressurizing the RPS sensors. Bypasses and test circuitry are by relay contacts inserted in and around the control logic circuits. Valve position indication and annunciation are by torque and limit switches located on the valves.

Power for the system logic is from the RPS motor-generator sets (see SEP Topic VII-1.2). Individual relay logic circuits are separately fused to further isolate individual RPS and ESF logic circuits.

The main steam-line isolation valves are air-actuated from redundant ac and dc solenoids. 115V ac from VACP-1 actuates the ac solenoid valves while the dc solenoids are actuated from the 125V dc Panel F. Other isolation valves are located both inside and outside the primary containment. Valves located inside the containment are powered from the vital Bus MCC-1AB2. Valves located outside the primary containment are powered from the 125V dc Bus DC-1.

Evaluation: The Isolation Contanment System logic functions are redundant and provide adequate isolation between channels and from control and non-safety systems. Power to the logic circuitry is from the RPS buses. Power to the containment MO valves inside the containment is from MCC 1AB2 and for the outside MO valves from the 125V dc Bus DC-1. Each valve circuit is isolated from other power circuits on the same bus by thermal-magnetic breakers except for four ac valves, V-16-1, V-16-61, V-17-19, and V-17-54, which use magnetic trip only breakers which do not comply with the criteria of Nuclear Regulator Guide 1.75, Rev. 1, Section C-1.

4.0 SUMMARY

Based on current licensing criteria and review guidelines, the ESF systems logic circuits comply with all current licensing criteria listed in Section 2 of this report.

Based on current licensing criteria and review guidelines, isolation of power circuits to 23 ESF valves does not meet the criteria of IEEE

Standard 384, Section 3, as amended by Regulatory Guide 1.75, Rev. 1, Section C-1.

5.0 REFERENCES

1. General Design Criterion 22, "Protection System Independence," of Appendix A, "General Design Criteria of Nuclear Power Plants," 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

2. 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."

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

4. Oyster Creek Nuclear Power Plant Unit No. 1, "Facility Description and Safety Analysis Report," Final Amendment 3, Part 1, Vol. 1, January 25, 1967.

5. NUS Corp Drawing 5060F032, Rev. 1, and General Electric Drawing 718E644, Sheet 2, Rev. 11.

6. General Electric Drawing 237E901, Sheets 1 and 2, Rev. 7.

7. MRP Associates Drawing 1083-55-09, Sheet 1, Rev. A.

8. Letter (Finfrock) to NRC, June 24, 1975, "Oyster Creek Docket 50-219 (697), Compliance with Provisional Operating Licensee, Amendment 8, Licensing Condition."

9. Letter (Finfrock) to NRC, February 2, 1977, "Oyster Creek Docket 50-219 (1090), Supplement No. 8 (Rev. 3) to Application for a Full-Term Operating License."

10. Burns and Roe Drawing 3028-12.

11. Oyster Creek Nuclear Power Plant Primary Containment Report by the Ralph M. Parson Company, Amendment 15, September 7, 1967.

12. General Electric Drawing 237E566, Sheets 1, 2, 4, 5, 6, Rev. 15.

APPENDIX A

NRC SAFETY TOPICS RELATED TO THIS REPORT

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

2. VI-7.A3 "ECCS Actuation System"

3. VI-10.A "Testing of Reactor Trip Systems and Engineered Safety Features, Including Response Time Testing"

4. VII-1.A "Reactor Protection System Isolation"

5. VII-3 "Systems Required for Safe Shutdown"

6. VII-4 "Effects of Failures of Nonsafety-Related Systems on Selected ESFs"