GENERAL ELECTRIC

NUCLEAR POWER

SYSTEMS DIVISION

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MFN - 017-83
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January 31, 1983

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

Attention: Mr. D.G. Eisenhut, Director
Division of Licensing

SUBJECT: IN THE MATTER OF 238 NUCLEAR ISLAND
GENERAL ELECTRIC STANDARD SAFETY ANALYSIS REPORT
(GESSAR II) DOCKET NO. STN 50-447

Attached please find the remaining final draft responses to the Instrumentation and Control Systems Branch (ICSB) questions in the Commission's October 5, 1982 request for additional information. These responses reflect the NRC/GE information exchange meetings held in Bethesda October 14 & 15, 1982; San Jose December 7-9, 1982; and again in Bethesda January 11-13, 1983.

This transmittal contains the last three responses for the 421-series as promised in our previous submittal dated January 28, 1983. They are 421.16, 22 and 32.

Sincerely,

Glenn G. Sherwood, Manager
Nuclear Safety & Licensing Operation

Attachments

cc: M.J. Virgilio, NRC
D.C. Scaletti, NRC
L.S. Gifford, GE-Bethesda (Without Attachments)
F.J. Miraglia (Without Attachments)
C.O. Thomas (Without Attachments)
R.M. Ketchel (Without Attachments)

E003

FINAL DRAFT

421.16 QUESTION

Identify any "first-of-a-kind" instruments used in, or providing inputs to, safety-related systems. Include any microprocessors, multiplexers or computer systems which are used in, or interface with, safety-related systems.

421.16 RESPONSE

The GESSAR II design incorporates the Solid State Safety System which fundamentally replaces relays with solid-state devices. All hardware components for GESSAR II are identical with those used in the Clinton plant, and also with those planned for TVA, Skagit, Black Fox and Allen's Creek. Therefore GESSAR II, of itself, does not have any first-of-a-kind equipment.

However, these solid-state plant designs employ three basic types of devices which are new compared with Grand Gulf, Perry, Riverbend and previous BWR's. These are listed and discussed as follows:

1. The logic itself is solid-state as mentioned above. Functionally, this logic performs the same (i.e, has the same Boolean expressions) as other BWR 6 relay plants for all safety-related systems except the RPS. Solid-state RPS utilizes "2-out-of-4" channels to scram as compared with "1-out-of-2 twice" for relay plants.

2. The self-test feature is unique with the solid-state logic. This feature is described in conjunction with protection system in-service testability in subsection 7.1.2.1.6 of GESSAR II.

3. Analog trip modules (ATM's) replace the more conventional Analog Comparitor Units (ACU's) for solid-state plants. Functionally, both types of trip units serve the same purpose, but ATM's are designed to interface with the self-test feature.

The following information is added at the request of the NRC after reviewing 421.16 at the GE/NRC meeting December 7-9, 1982:

The PRA fault trees assume a 2.4 hour repair time for instrument failures based on the self-test feature applied to solid state instruments. This is somewhat less than values used in previous PRA's (ie WASH 1400), but in no cases does it significantly affect the results.

The PRA is a realistic assessment which accounts for all available systems regardless of design classification. Availability of these systems within the context of various failure modes is accounted for in the analysis.

421.16 RESPONSE (continued)

The following additional information is provided at the NRC's request following the ICSB review meeting in Bethesda, January 11-13, 1983.

Safety Grade Application of Microprocessors

The Rod Pattern Controller (RPC), which is a subsystem of the Rod Control and Information System (RC&IS), is the only design based safety grade application of microprocessors and multipexers. RPC is two divisional, and contains safety related components with the logic hardwired. It is not site programmable. The programs can only be modified by engineering approved changes to and replacement of electronic circuit cards.

The Rod Position Information Systems (RPIS), which is also a subset of RC&IS, while not required, is designed in a similar fashion to the RPC. It is also a 2 divisional system with safety-related components. the RPC and RPIS are separated from non-safety related portions of the RC&IS via isolators.

Manual Scram of RPS

The manual scram for GESSAR II shares the common logic with the auto scram at the trip logic level. There is a way to scram independent of the NSPS logic by manually tripping at the local panel the breakers protecting both A & B solenoids for a given group of rods.

The scram methods for GESSAR II are basically consistent with those employed on the Clinton design.

The self test system has the following characteristics, capabilities, & design configurations with respect to specific questions from the January 11 & 12, 1983 meeting in Bethesda, MD. A general description is presented in GESSAR II, Section 7.1.2.1.6.

Simulations Test of Two Divisions

The self test system, during the normal testing cycle, will send a test pattern to another division so that the inter-divisional communication path can be verified. This test is under a master/slave arrangement, with the division under test being the Master. During this test, the functional logic in one channel of two different divisions may be tested simultaneously. This test, however, will be under the same timing control (less than 1 msec.) as the other tests and so cannot cause or prevent a trip.

Pulse duration

The maximum time a functional input can see a test pulse is controlled by three different and independent means. First, the software generates timing pulses, as shown on the timing sheets provided as handouts during the self-test presentation. The gating pulses are

Pulse duration - (continued)

about 1 msec maximum duration. There is a separate timing circuit in each self test division which is hard wired and is checked against a different crystal clock than the normal self test timing elements. The self test timing is checked against this hard wired timer and a difference would be reported as a self test internal test failure. The final pulse limiting circuitry exists on the functional logic cards, is treated as part of the functional logic, and consists of a capacitor/resistor circuit which only permits a test signal to appear on a functional input for approximately 1 msec.

The unlikely failure of this highly reliable component could be detected during plant shutdown by special testing. However, the self test remains single failure proof with regard to pulse limiting even given the failure of these components.

Response Time Testing

The self test system will report any deviation in the output of a logic string from its expected state. Logic strings are tested end-to-end (NSPS input device to output device) with the same maximum timing constraints (less than 1 msec). Therefore, the maximum propagation delay (response time) through any logic channel in the NSPS will always be less than 1 msec or the self test system will report a logic fault. This constitutes a response time test of the logic components every hour. Responses of external elements such as transmitters and motors would be testable as normally required.

Fault Alarm

The self test system will provide an alarm on a logic fault or an internal self test fault by means of a window annunciator on the main control panel. These alarms are independent of diagnostic failure information available through the process computer interface.

Trip Setpoints

The recommended frequency of the trip setpoint check of the ATMs is one month. This recommendation will be conveyed to the applicant through technical specification inputs.

Reliability & Qualification

The self test system is comprized of highly reliable, commercially proven components. Solid state logic elements and other components are purchased MIL grade to insure maximum reliability. All boards are fully tested before being installed in the self test system. During NSPS panel qualification tests, the self test system is exercised before and after the seismic tests to ensure operability.

Latching Circuits

The NSPS latching circuits, composed of a resistor /capacitor network, are designed with an approximate minimum time delay of 20 ms. Since the maximum self test pulse duration is 1 ms, there is no dangerof the test latching a circuit. The exact time delay of the latching circuits is determined during the individual card tests prior to installation in the NSPS panels. Special testing during plant shutdown could reverify the timing of these latching circuits.

Software Verification

The self-test system to be provided on GESSAR plants will have its software designed in accordance with G.E.'s Software Engineering Manual. This manual was submitted in draft form for NRC staff review and will be formally submitted after receipt of NRC comments.

Manual and Automatic Mode Circuit Sharing

The NSPS is designed as all previous G.E. BWR designs, to maintain independance between automatic and manual functions as much as practical.

Manual and Automatic Mode Circuit Sharing (Continued)

Sharing of manual and automatic functions through load drivers is done in some cases such as the RPS scram function. The justification for this is that no common mode failure can be postulated that would hot short these load drivers on more than one channel, since the design complies fully with RG 1.75 separation criteria. In addition, load driver circuits are designed to handle any known type of electrical disturbance on their output. Over-voltage protection is provided to handle approximately an order of magnitude more that the expected voltage, and current capabilities are many times that which is required.

FINAL DRAFT

QUESTION

421.22
(7.2.1)

In Section 7.2.1.1.F.2 of our FSAR, you indicate that the reactor system mode switch is used for protective functions, restrictive interlocks and refueling equipment movement. Discuss how this mode switch is incorporated into the overall design so that the single failure criterion and separation requirements are satisfied. Use detailed drawings and schematics as appropriate.

RESPONSE

The Reactor Protection System (RPS) mode switch provides bypasses and interlocks associated with various plant operation modes: run, start-up and hot standby, refuel and shutdown.

The mode switch has four contact blocks, each physically separated within compartmental barriers. Switch action for each contact block is provided by a non-metal shaft.

The contacts within each block (Bank A,B,C,D) perform interlocking functions within their associated division (1, 2, 3, 4) respectively. The contact block designated to Div. 1 is located closest to the rotation stop (or front of switch) and the other blocks follow in order (i.e., 2, 3, 4 away from switch front).

The operation of the switch is under strict procedural control; therefore, the operator, when switching modes, is checking the plant's condition through indications provided (status lites, annunciators, display computer and performance monitoring computer). Discrepancies between these indication devices and the mode switch position will notify the operator that the mode has not changed successfully.

The display computer monitors each position of the mode switch. Specific annunciators provide indication such as "mode sw in shutdown" within each division and "mode sw not in run" within each division. Several annunciators and status lights are interlocked such that before a tripped condition from NMS, [redacted] and RPS channels are indicated, the mode switch has to be in 'run' position.

Because of the interlocking divisional logics of the Reactor Protection System, failure of contact blocks will not prevent normal protective action of the safety system (scram). ~~nor will it cause a scram.~~ The mode switch, as incorporated into this system meets design requirements of separation and redundancy. ~~The Reactor Protection System is a dual trip system with two channels per trip system. Trip of a signal channel trips one trip system. Both trip systems must be tripped to initiate scram. Each contact block is dedicated to only one channel within each trip system.~~

RON Siemer Comment

Solid state logic is effectively a quadruple trip system. Solid state is 2 out of 4 at the instrument channel level and essentially 2 out of 4 at the divisional level. At least two input channels for any process and at least two divisions must be tripped to initiate a scram. Each contact block is dedicated to only one division. Mode switch initiated scram function bypasses are implemented at the division level. At least three divisions must be bypassed to bypass a safety function.

421.22A QUESTION

Perform a FMEA for a postulated break in the reactor mode switch. The break is to be postulated for a one position at a time switch movement upwards or downwards. Only functional inputs need be considered. Positions between normal positions need not be considered.

RESPONSE

The attached Mode Switch Functional Matrix is formatted to illustrate which functions are normally performed in each of the four operating modes (switch positions). Each switch Bank corresponds to one logic channel. It should be noted that most functions require four Bank channels but some require only two.

The attached FMEA tables illustrate the postulated break locations and show which functions are imposed or bypassed for each break location when the Mode Switch is moved upward or downward to a different mode position.

The only break locations of concern are between Banks A and B (Banks B,C,D potentially malfunction) and between B and C (Banks A and B function normally but C and D potentially malfunction). A break between C and D causes potential malfunctions in only one Bank channel and one channel alone cannot degrade safety or initiate any action.

As shown on the FMEA "effects" description, there are no effects which degrade plant safety. There are cases where an undesireable trip would occur or rod motion is prohibited. These events would only affect availability and not plant safety.

MODE SWITCH FUNCTION MATRIX

BANK A	BANK B	BANK C	BANK D
1. DIS COMP MODE IND 2. ANN MODE IND 3. INTLK W/ SDV BYPS SW 4. BYPS SDV HI LVL TR 5. INTLK W/ MSIV BYPS SW 6. PER MON COMP 'REAC AUTO TRIP' IND 7. DIS COMP 'RPS TR' IND 8. TTP 'REAC AUTO SCRAM' 9. DE-ENG GP1 PSV SOL 'A' 10. RPS RESET PERM LITE ON 11. GP1 SOL 'A' LITE OFF 12. SDV ISOL VLV SOL 'A' DE-EN 13. ANN 'REAC AUTO SCRAM' IND 14. BYPS MSIV CLOS TR * 17. BYPS RHWL(8) TR 19. INTLK FOR ROD BLOCK 24. BYPS LO MSL PRESS TR	N/A SAME AS BANK 'A' 9. DE-ENG GP 2 PSV SOL 'A' SAME AS BANK 'A' 11. GP 2 SOL 'A' LITE OFF 12. SDV ISOL VLV SOL 'B' DE-ENG SAME AS BANK 'A'	N/A SAME AS BANK 'A' 9. DE-ENG GP 1 PSV SOL 'B' SAME AS BANK A 11. GP 1 SOL 'B' LITE OFF N/A SAME AS BANK A	N/A SAME AS BANK 'A' 9. DE-ENG GP 2 PSV S SAME AS BANK 11. GP 2 SOL 'B' LITE N/A SAME AS BANK
1. DIS COMP MODE IND 3. INTLK W/ SDV BYPS SW 4. BYPS SDV HI LVL TR 5. INTLK W/ MSIV BYPS SW 14. BYPS MSIV CLOS TR * 15. INTLK W/ REFL PLAT. 17. BYPS RHWL(8) TR 19. INTLK FOR ROD BLOCK 24. BYPS LO MSL PRSS TR	N/A SAME AS BANK 'A'	N/A SAME AS BANK A N/A SAME AS BANK A	N/A SAME AS BANK N/A SAME AS BAN
1. DIS COMP MODE IND 5. INTLK W/ MSIV BYPS SW 14. BYPS MSIV CLOS TR * 16. INTLK W/ RACC 17. BYPS RHWL(8) TR 19. INTLK FOR ROD BLOCK 24. BYPS LO MSL PRS TR	N/A SAME AS BANK 'A'	1, 5 } N/A 14 SAME AS "A" 16. N/A 17. SAME AS "A" 11, 24 } N/A	1, 5 } N/A 14 SAME AS "A" 16 N/A 17 SAME AS "A" 19, 24 } N/A
1. DIS COMP MODE IND 16. INTLK W/ RACC 18. BYPS 'NMS TR' ANN 20. INTLK FOR SBTDWN 21. INTLK FOR 'IRM TR OR 'RPS CHA TR' ANN 22. INTLK FOR 'SRM, IRM TR' PER MON COMP IND 23. INTLK FOR 'RETRACT PERMIT' LITE ON	N/A SAME AS BANK A	N/A SAME AS BANK A	N/A SAME AS BA

N/A = NOT APPLICABLE

SU & HS: START UP & HOT STAND BY
DIS COMP: DISPLAY COMPUTER
BYPS: BYPASS
INTLK: INTERLOCK
SDV: SCRAM DISCHARGE VOLUME

PSV: PILOT SCRAM VALVE
RHWL: REAC HI WATER LEVEL
RACC: ROD ACTION CONTROL CAB.
REFL: REFUEL

TTP: TRANSIENT TEST PANEL
PER MON COMP: PERFORMANCE MON. COMPUTER

* "MODE SW NOT IN RUN" - A

DRAWING NO.

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:–			
APPLIED PRACTICES	SURFACES	TOLERANCES ON MACHINED FRACTIONS ±	DECIMALS ±
	✓		

BREAK TYPE 1

SHUTDOWN → REFUEL

FUNCTIONS

RETAINED #8, 9, 12 Remain Operative for Banks B, C, D

UNCONNECTED #15 Inoperative for Banks B, C, D

EFFE

None — (8) Retaining
(9) all rods
(12) would al

None — (13) The RP
however
No sa

REFUEL → SU & HS

FUNCTIONS

RETAINED #3, 4 and 15 Remain Operative for Banks B, C, D

MISMATCH #16 – CONSTRAINTS ON ROD MOTION DIFFERENT DIV 1+2 RCTIS.

EFF

None — (3) } SDV
(4) } cha
(15) Refuel

(16) A ROD BL
motion ext
takes pr
NO ACTIO

SU & HS → RUN

FUNCTIONS

RETAINED #5, 19 and 21 Remain Operative for Banks B ONLY.
#14 and 19 Remain Operative for B, C, D

MISMATCH – #16 CONSTRAINTS ON ROD MOTION DIFFERENT DIV 1+2.

UNCONNECTED # 20, 21, 22, 23 Inoperative for Banks B, C, D.

EFFE

None – (5)(19)(24) The a
(14)(17) Howe
Mode

(16) SAME

None .. (20) } When
(21)
(22) }

(23) SRMs

ABBRV

SU&HS : START UP & HOT STANDBY
DISCOMP : DISPLAY COMPUTER
BYPS : BYPASS
INTLK : INTERLOCK
TR : TRIP
PSV : PILOT SCRAM VALVE
RHWL : REAC HI WATER LEVEL
RACC : ROD ACTION CONTROL CAB
REFL : REFUEL
SDV : SCRAM DISCHARGE VOLUME

REV NO.	TITLE	CONT ON SHEET	SH NO.
DIMENSIONS ANGLES + −	CONT ON SHEET SH NO.	FIRST MADE FOR	

1 of 6

CTS

test panel capability won't degrade safety or availability
remain inserted – fuel reload stopped
draining of SDV – no safety effect

Platform is not inhibited from moving
rods are inserted & will remain so (see above)
y effect

CTS

High level trip is bypassed in one of the two required
. If high level detected by A, a proper trip occurs.
platform is stored except for refueling.

will be initiated by RACS if limits for rod
straint are exceeded. More conservative of 2 division Aor B
clause. If not within limits of 2 modules
lock.

S

ociated trips would not be operative.
an annunciator would alarm to indicate
witch not In Run Mode".

3 Refuel → SU+HS

power exceeds 15%, undesired trip occurs

d IRMs should have been Retracted prior to Run

BREAK TYPE → 1 2 3

A	B	C	D

FUNCTION

1 DIS COMP MODE IND
2 ANN MODE IN
3 INTLK W/SDV BYPS SW
4 BYPS SDV HI LVL TR
5 INTLK W/MSIV BYPS SW
6 PER MON. COMP 'REAC AUTO TRIP IND
7 DIS COMP RPS TR IND
8 TTP REAC AUTO SCRAM
9 DE-ENG GPI PSV SOL A
10 RPS RESET PERM LITE ON
11 GPI SOL 'A' LITE OFF
12 SDV ISOL VLV SOL 'A' DE-EN
13 ANN REAC 1/2 SCRAM IND
14 BYPS MSN CLOS TR
15 INTLK W/REFL PLAT MODE SW NOT IN RUN ANNUN
16 INTLK W/RACC
17 BYPS RHWL (8) TR
18 BYPS NMS TR ANN
19 INTLK FOR ROD BLOCK
20 INTLK FOR SETDOWN
21 INTLK FOR IRM TR OR RPS CH 'A' TR ANN

REVISIONS	PRINTS TO
22 INTLK FOR SRM, IRM TR PER MON COMP IND	
23 INTLK FOR RETRACT PERMIT LITE ON	
24 BYPS LO MSL PR TR	

TTP: TRANSIENT TEST PANEL
PER MON COMP: PERFORMANCE MONITOR COMPUTER
LO MSL PRS TR: Low Main Steam Line Pressure Trips

MADE BY	APPROVALS	DIV OR DEPT	
ISSUED		LOCATION	CONT ON SHEET 2 SH NO. 1

DRAWING NO.

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:			
APPLIED PRACTICES	SURFACES	TOLERANCES ON MACHINE	
		FRACTIONS	DECIMALS
	✓	±	±

BREAK TYPE 1

SU & HS ← RUN

FUNCTIONS

RETAINED # 20, 21, 22, 23 Remain operative for Banks B, C, D.

MISMATCH # #16 RWD motion constraints for Div 1+2 different

UNCONNECTED # 5, 19 and 24 are Inoperative for Bank B. #14 and 17 are Inoperative for B, C and D.

EFFECTS

None — (20) Would ...
(21) (22) (23) } SRM, IRM ... all ...

(16) SAME AS

NONE — (5), (19) (24) The ... one ...

(14) (17) If the ... occur ...

REFUEL ← SU&HS

MISMATCH #16 RWD motion constraints for Div 1+2 are different.

EFFECTS

NONE — 16 Same

UNCONNECTED #3 and 4 are Inoperative for Banks B, C, D. #15 is Inoperative for Bank B only — not required for C and D

NONE — (3) (4) } SDV ... trip

(15) Bank ...

SHUTDOWN ← REFUEL

RETAINED #15 Remains Operative for Bank B only.

EFFECTS

NONE — Refuel ... to ... on

UNCONNECTED #8 and 9 are Inoperative for Banks B, C, D. #12 is Inoperative for Bank B. Not req'd for C and D

NONE — (8) auto ...
(9) If ... not required
(12) Normal

ABBRV

SU&HS : START UP & HOT STANDBY
DISCOMP : DISPLAY COMPUTER
BYPS : BYPASS
INTLK : INTERLOCK
PSV : PILOT-SCRAM VALVE
RHWL : REAC HI WATER LEVEL
RACC : ROD ACTION CONTROL CAB
REFL : REFUEL
SDV : SCRAM DISCHARGE VOLUME

GENERAL ELECTRIC

REV NO	TITLE	CONT ON SHEET	SH NO.
DIMENSIONS / ANGLES ±	CONT ON SHEET SH NO.	FIRST MADE FOR	2 of 6

reset trip from 118% to 15% power
trips not available
rods retracted a Rod Block occurs.
Break type 2 SDHS → RUN
function would operate properly from Bank A—
A or B are required.
MSIVs are closed or L(B) is reached a trip would

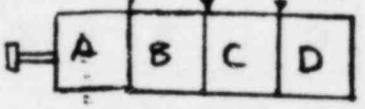
As Break type 1 Actual → SDV HI
or.

would have to be drained to avoid a continuous
signal
signals alone would control platform motion.

platform already in stored position. No effect
Bank.

motor scram indication lost on TTP— No effect
were not already in, a manual scram is
d.
draining if the SDV is inhibited.

BREAK TYPE → 1 2 3



FUNCTION

1 DIS COMP MODE IND
2 ANN MODE IN
3 INTLK W/SDV BYPS SW
4 BYPS SDV HI LVL TR
5 INTLK W/MSIV BYPS SW
6 PER MON. COMP REAC AUTO TRIP IND
7 DIS COMP RPS TR IND
8 TTP REAC AUTO SCRAM
9 DE-ENG GPI PSV SOL A
10 RPS RESET PERM LITE ON
11 GPI SOL 'A' LITE OFF
12 SDV ISOL VLV SOL 'A' DE-EN
13 ANN REAC 1/2 SCRAM IND
14 BYPS MSIV CLOS TR
15 MODE SWITCH NOT IN RUN ANNUN
16 INTLK W/REFL PLAT
16 INTLK W/RACC
17 BYPS RHWL (8) TR
18 BYPS NMS TR ANN
19 INTLK FOR ROD BLOCK
20 INTLK FOR SETDOWN
21 INTLK FOR IRM TR OR NMS CH 'A' TR ANN

REVISIONS	PRINTS TO
22 INTLK FOR IRM IRM TR PER MON COMP IND	
23 INTLK FOR RETRACT PERMIT LITE ON	
24 BYPS LO MSL PR TR	

TTP: TRANSIENT TEST PANEL
PER MON COMP: PERFORMANCE MONITOR COMPUTER

MADE BY	APPROVALS	DIV OR DEPT	CONT ON SHEET 5	SH NO. 4
ISSUED		LOCATION		

DRAWING NO.

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-			
APPLIED PRACTICES	SURFACES	TOLERANCES ON MACHINED	
		FRACTIONS	DECIMALS
	✓	±	±

BREAK TYPE 2

SHUTDOWN → REFUEL

EFF

FUNCTIONS

RETAINED # 8 9,12 Remain Operative for Banks C and D

None — (8) RETAIN ARE AV (9) A FA (12) WILL

UNCONNECTED # 15 Inoperative for Banks C and D

None — (15) THE F Band

REFUEL → SU&HS

EFFE

FUNCTIONS

RETAINED # 3,4 and 15 Remain Operative for Banks C and D

None — (3) } SI (4) } 4 (15) · R

UNCONNECTED None

SU&HS → PUN

EFF

FUNCTIONS

RETAINED # 14 and 17 Remain Operative for Bank C and D

NONE The ... D. Ho indica divisio 2

UNCONNECTED # 20, 21, 22 and 23 Inoperative for Banks C and D

None — 20 } 21 } 22 } U

23 S

ABBRV

SU&HS : START UP & HOT STANDBY
DISCOMP : DISPLAY COMPUTER
BYPS : BYPASS
INTLK : INTERLOCK
TR : Trip
PSV : PILOT SCRAM VALVE
RHWL : REAC HI WATER LEVEL
RACC : ROD ACTION CONTROL CAB
REFL : REFUEL
SDV : SCRAM DISCHARGE VOLUME

REV NO | TITLE | CONT ON SHEET | SH NO.

DIMENSIONS | ANGLES | CONT ON SHEET | SH NO. | FIRST MADE FOR

3 of 6

CTS

G TEST PANEL Capability WONT DEGRADE SAFETY
ab. 1.7
scram reduction results from Banks C and D
ALLOW DRAINING OF SDV NO SAFETY EFFECT

UEL PLATFORM IS prop'ly inhibited FROM MOVING
C and D are not required

S

HIGH LEVEL TRIP IS BYPASSED IN ch C and D. However
nd. B operate properly if high-SDV level trip is
quired.

ELING PLATFORM IS STORED EXCEPT FOR REFUELING

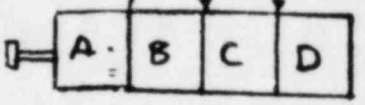
S

test-trips would be bypassed in Banks C and
ver, an annunciator would alarm to
"Mode Switch Not in Run Mode" ALSO 2-
3+4, still available for scram function
P:

RE POWER EXCEEDS 15% undesigned TRIP OCCURS

o and IRMs should have been Retracted prior to Run

BREAK TYPE → 1 2 3



FUNCTION

1 DIS COMP MODE IND
2 ANN MODE IN
3 INTLK W/SDV BYPS SW
4 BYPS SDV HI LVL TR
5 INTLK W/MSIV BYPS SW
6 PER MON. COMP REAC AUTO TRIP IND
7 DIS COMP RPS TR IND
8 TTP REAC AUTO SCRAM
9 DE-ENG GPI PSV SOL A
10 RPS RESET PERM LITE ON
11 GPI SOL 'A' LITE OFF
12 SDV ISOL VLV SOL 'A' DE-EN
13 ANN REAC 1/2 SCRAM IND
14 BYPS MSIV CLOS TR
Mode SW NOT IN RUN ANN IN
16 INTLK W/REFL PLAT
16 INTLK W/RACC
17 BYPS RHWL (8) TR
18 BYPS NMS TR ANN
19 INTLK FOR ROD BLOCK
20 INTLK FOR SETDOWN
21 INTLK FOR IRM TR OR RMS CH 'A' TR ANN

REVISIONS

22 INTLK FOR SRM, IRM TR PER MON COMP IND
23 INTLK FOR RETRACT PERMIT LITE ON
24 BYPS LO MSL PR TR

PRINTS TO

TTP: TRANSIENT TEST PANEL
PER MON COMP: PERFORMANCE MONITOR COMPUTER
LO MSL PRS TR: Low Main Steam Line Pressure Trip

MADE BY | ISSUED | APPROVALS | DIV OR DEPT | LOCATION | CONT ON SHEET 3 | SH NO. 2

DRAWING NO.

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWIN			
APPLIED PRACTICES	SURFACES	TOLERANCES ON MACH FRACTIONS	DECIMA
	✓	±	±

BREAK TYPE 2

SU&HS ← RUN

FUNCTIONS

RETAINED #20, 21, 22, 23 Remain Operative in Banks C&D

UNCONNECTED #14 and 19 Bypass are Inoperative for Banks C and D.

EFFE

None — Ban mod

× "None" — Ba close

REFUEL ← SU&HS

FUNCTIONS

RETAINED None

UNCONNECTED #3 and 4 are Inoperative for Banks C and D

#15 Operates properly for A&B — C&D not required

EFF

None — (3), (4)

(15)

SHUTDOWN ← REFUEL

FUNCTIONS

RETAINED None

UNCONNECTED #8 and 9 are Inoperative for Banks C and D

#12 Not required in C and D where A and B operate properly

None — (15) is m

None — (8) Loc (9) It is

(12) Ou

ABBRV

SU&HS : START UP & HOT STANDBY
DISCOMP : DISPLAY COMPUTER
BYPS : BYPASS
INTLK : INTERLOCK

PSV : PILOT SCRAM VALVE
RHWL : REAC HI WATER LEVEL
RACC : ROD ACTION CONTROL CAB
REFL : REFUEL
SDV : SCRAM DISCHARGE VOLUME

C and D are not required in SD&HS
A and B function properly.

desired trip may occur when the MSIVs
L(8) is reached.

CTS

SDV high level is reached, an undesirable
ip may occur.

y A and B are required and they operate properly.

FECTS

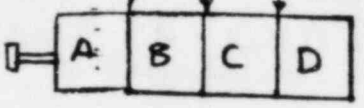
not operative for C&D in the RE[illegible] mode
required in Shutdown, therefore no effect.

y Test panel capability won't degrade safety
ds are not already inserted, a manual scram
uired.

Banks A and B are required and they operate properly

TTP: TRANSIENT TEST PANEL
PER MON COMP: PERFORMANCE MONITOR COMPUTER

BREAK TYPE → 1 2 3



FUNCTION

1 DIS COMP MODE IND
2 ANN MODE IN
3 INTLK W/SDV BYPS SW
4 BYPS SDV HI LVL TR
5 INTLK W/MSIV BYPS SW
6 PER MON. COMP REAC AUTO TRIP IND
7 DIS COMP RPS TR IND
8 TTP REAC AUTO SCRAM
9 DE-ENG GPI PSV SOL A
10 RPS RESET PERM LITE ON
11 GPI SOL 'A' LITE ON
12 SDV ISOL VLV SOL 'A' DE-EN
13 ANN REAC 1/2 SCRAM IND
14 BYPS MSIV CLOS TR
15 INTLK W/REFL PLAT
16 INTLK W/RACC
17 BYPS RHWL (8) TR
18 BYPS NMS TR ANN
19 INTLK FOR ROD BLOCK
20 INTLK FOR SETDOWN
21 INTLK FOR IRA TR OR RPS CH 'A' TR ANN
22 INTLK FOR SRM, IRM TR PER MON COMP IND
23 INTLK FOR RETRACT PERMIT LITE ON
24 BYPS LO MSLPR TR

REVISIONS | PRINTS TO

DRAWING NO. | CONT ON SHEET | SH NO

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:—			
APPLIED PRACTICES	SURFACES	TOLERANCES ON MACHINED FRACTIONS	DECIMALS
	✓	±	±

BREAK TYPE 3

SHUTDOWN → REFUEL

FUNCTIONS

RETAINED # 8, 9, 12 Remain Operative for Bank D

UNCONNECTED # 15 Inoperative for Bank D

EFFECTS

Voice — Three chan Channel D

REFUEL → SU&HS

FUNCTIONS

RETAINED # 3, 4 AND 15 REMAIN OPERATIVE FOR BANKS B, C, D

UNCONNECTED # 16 INOPERATIVE FOR BANKS B, C, D

SU&HS → RUN

FUNCTIONS

RETAINED # 5, 14, 17, 19, 24 REMAIN OPERATIVE FOR BANK B ONLY

UNCONNECTED # 20, 21, 22, 23 INOPERATIVE FOR BANKS B C D

ABBRV

SU&HS : START UP & HOT STANDBY
DISCOMP : DISPLAY COMPUTER
BYPS : BYPASS
INTLK : INTERLOCK
TR : TRIP

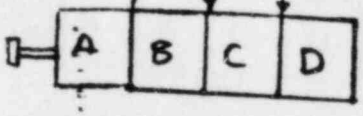
PSV : PILOT SCRAM VALVE
RHWL : REAC HI WATER LEVEL
RACC : ROD ACTION CONTROL CAB
REFL : REFUEL
SDV : SCRAM DISCHARGE VOLUME

GENERAL ELECTRIC

REV NO	TITLE	CONT ON SHEET	SH NO.
IMENSIONS / ANGLES ±			5 of 6
CONT ON SHEET SH NO.	FIRST MADE FOR		

to D.E.C operate properly for 2-actions & logic cannot by itself prevent or initiate any action.

BREAK TYPE → 1 2 3



FUNCTION

1 DIS COMP MODE IND
2 ANN MODE IN
3 INTLK W/SDV BYPS SW
4 BYPS SDV HI LVL TR
5 INTLK W/MSIV BYPS SW
6 PER MON. COMP 'REAC AUTO TRIP IND
7 DIS COMP RPS TR IND
8 TTP REAC AUTO SCRAM
9 DE-ENG GPI PSV SOL A
10 RPS RESET PERM LITE ON
11 GPI SOL 'A' LITE OFF
12 SDV ISOL VLV SOL 'A' DE-EN
13 ANN REAC 1/2 SCRAM IND
14 BYPS MSN CLOS TR
15 INTLK W/REFL PLAT MODE SW NOT IN RUN ANNUN
16 INTLK W/RACC
17 BYPS RHWL (8) TR
18 BYPS NMS TR ANN
19 INTLK FOR ROD BLOCK
20 INTLK FOR SETDOWN
21 INTLK FOR IRM TR OR RBM CH 'A' TR ANN
22 INTLK FOR SRM, IRM TR PER MON COMP IND
23 INTLK FOR RETRACT PERMIT LITE ON
24 BYPS LO MSL PR TR

REVISIONS	PRINTS TO

TTP: TRANSIENT TEST PANEL
PER MON COMP: PERFORMANCE MONITOR COMPUTER
LO MSL PRS TR: Low Main Steam Line Pressure Trip

MADE BY	APPROVALS	DIV OR DEPT	
ISSUED		LOCATION	CONT ON SHEET 4 SH NO. 3

DRAWING NO.

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING			
APPLIED PRACTICES	SURFACES	TOLERANCES ON MACHIN	
		FRACTIONS	DECIMAL
	✓	±	±

BREAK TYPE 3

SU & HS ← RUN

EFFE

FUNCTIONS

RETAINED * 20, 21, 22 23 INOPERATIVE FOR BANKS B, C, D

UNCONNECTED * 5, 14, 17, 19, 24 REMAIN OPERATIVE FOR BANK D ONLY

None - Three cha 2 out of 4 prevent or

REFUEL ← SU & HS

FUNCTIONS

RETAINED # 16 INOPERATIVE FOR BANKS B, C, D

UNCONNECTED # 3, 4 AND 15 REMAIN OPERATIVE FOR BANKS B, C, D

SHUTDOWN ← REFUEL

FUNCTIONS

RETAINED # 15 INOPERATIVE FOR BANK D

UNCONNECTED * 8, 9, 12 REMAIN OPERATIVE FOR BANK D

ABBRV

SU&HS : START UP & HOT STANDBY
DISCOMP : DISPLAY COMPUTER
BYPS : BYPASS
INTLK : INTERLOCK
PSV : PILOT SCRAM VALVE
RHWL : RPV HI WATER LEVEL
RACC : ROD ACTION CONTROL CAB
REFL : REFUEL
SDV : SCRAM DISCHARGE VOLUME

GENERAL ELECTRIC

CONT ON SHEET SH NO.

REV NO

TITLE

6 of 6

NSIONS

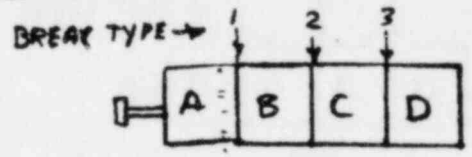
ANGLES

CONT ON SHEET SH NO.

FIRST MADE FOR

S

els - A, B, C operate properly for
ogic. Channel D cannot by itself
nitiate any action.



FUNCTION

1 DIS COMP MODE IND
2 ANN MODE IN
3 INTLK W/SDV BYPS SW
4 BYPS SDV HI LVL TR
5 INTLK W/MSIV BYPS SW
6 PER MON. COMP REAC AUTO TRIP IND
7 DIS COMP RPS TR IND
8 TTP REAC AUTO SCRAM
9 DE-ENG GPI PSV SOL A
10 RPS RESET PERM LITE ON
11 GPI SOL 'A' LITE OFF
12 SDV ISOL VLV SOL 'A' DE-EN
13 ANN REAC 1/2 SCRAM IND
14 BYPS MSN CLOS TR
15 MODE SWITCH NOT IN RUN
16 INTLK W/REFL PLAT
16 INTLK W/RACC
17 BYPS RHWL (8) TR
18 BYPS NMS TR ANN
19 INTLK FOR ROD BLOCK
20 INTLK FOR SETDOWN
21 INTLK FOR IRM TR OR MRS CH 'A' TR ANN

REVISIONS	PRINTS TO
22 INTLK FOR SRM, IRM TR PER MON COMP IND	
23 INTLK FOR RETRACT PERMIT LITE ON	
24 BYPS LO MSL PR TR	

TTP: TRANSIENT TEST PANEL
PER MON COMP: PERFORMANCE MONITOR COMPUTER

MADE BY	APPROVALS	DIV OR DEPT	CONT ON SHEET F SH NO 6
ISSUED		LOCATION	

FINAL DRAFT GESSAR II

QUESTION

421.32 Based on our review, it appears the the proposed logic for manual initiation for several DSF systems is interlocked with permissive logic from various sensors. In some cases, it appears that the permissive logic is dependent on the same sensors as those used for automatic initiation of the system. Our position on this matter is that the capability to manually initiate each safety system should be independent of the permissive logic, the sensors and the circuitry used for automatic initiation of that system. (Refer to Section 4.17 of IEEE Std. 279). Identify each safety system which is interlocked in a manner similar to that described above. Provide proposed modifications or justification for the present design.

In this regard, manual control of actuated devices at the motor control center (MCC) has been typically provided in previous designs. Our review of drawings I-960 A through M indicates that this feature has not been provided for your proposed design. Provide your rationale for not providing local control at the MCC's.

421.32 RESPONSE

(see attached 3 pages)

FINAL DRAFT

RESPONSE

QUESTION 421.32 ESF Manual Initiation

The ESF systems meet IEEE 279, paragraph 4.17, since each individual system and subsystem has provisions for manual initiation. Two of the ESF systems (MS-PLCS and the shutdown cooling mode of RHR) are manually initiated and have no automatic initiation . A third system, CRVICS, is initiated automatically as well as manually; however, there are no interlocks involved in manual operation.

The four ECCS subsystems (HPCS, LPCS, LPCI, and ADS) and the containment spray mode of RHR share common interlocks between the automatic and manual initiation modes. This arrangement is acceptable for several reasons.

1. The individual subsystems of ECCS are not required to meet the single failure criterion. The ECCS function will be met with any ONE of its subsystems inoperative.
2. The two loops of the containment spray mode are completely separate and no single failure could prevent operation of both loops.
3. All sensors, transmitters, and trip units used in permissive logic for system initiators are Class 1E and are completely qualified for their application. In addition, the testability features of the design permit frequent checks during normal operation to verify operability.

I. ECCS

LPCS and LPCI (Loop A)

The LPCS and LPCI (Loop A) subsystems are initiated automatically by a LOCA signal (low reactor water level and/or high drywell pressure) or by a single system-level remote manual switch.* In either mode, two interlocks, apply:

1. Power availability on pump motor bus**
2. Reactor pressure below set point (applies to injection valves only: 1 of 2 twice logic)***

The LPCS and LPCI (Loop A) subsystems can be initiated individually by use of individual remote manual switches for each valve and pump. In this mode, the injection valves cannot be opened unless either of two pressure permissives is present.

1. Reactor pressure below set point (same sensors as for system level initiation: 1 of 2 twice logic)**
2. Pressure at each injection valve below set point (2 out of 2 logic; No sensors are shared between LPCS and LPCI-A.)

421-32 RESPONSE (continued) FINAL DRAFT

I. ECCS (Cont.)

LPCS and LPCI (LOOP A)

* One initiation logic circuit is used for both LPCS and LPCI(A).

** Separate "power available" sensor for each subsystem.

*** One pressure permissive circuit applies to both subsystems

LPCI Loops B and C

Identical with LPCS and LPCI (Loop A) preceding. No sensors are shared between LPCI (B&C) and LPCS/LPCI(A).

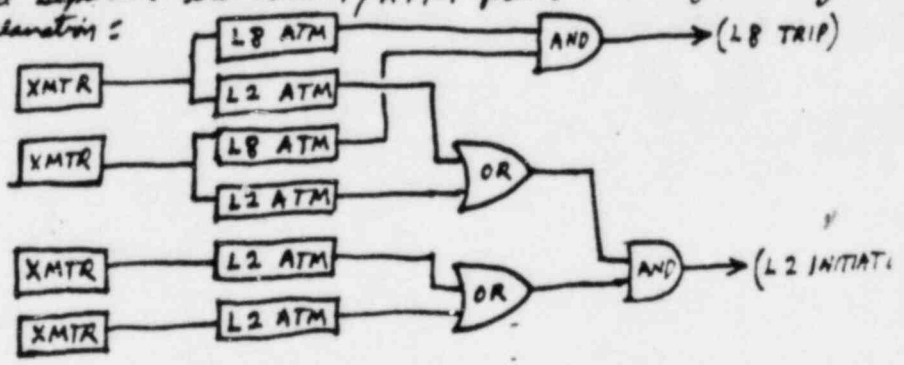
ADS

The ADS function is initiated automatically by a LOCA signal (low reactor water level and/or high drywell pressure) or by system-level remote manual switches. In either case, the ADS valves are prevented from opening unless the LPCS pump, or one of the three LPCI pumps, is running. In addition, each individual ADS valve can be opened manually without restrictions.

HPCS

The HPCS subsystem is initiated automatically by a LOCA signal (low reactor water level in a 1 out of 2 twice logic arrangement or high drywell pressure in 1 out of 2 twice logic) or manually by a system level armed pushbutton. In addition, the subsystem can be placed in operation by use of an individual remote manual switch for each valve and the pump. In all three initiation modes, the injection valve is interlocked closed by high water level (level 8) in a 2 out of 2 logic arrangement. If the valve is open, high water level (level 8) will cause it to close.

The level 8 signal is provided by two analog trip modules (ATM's) which are paired with two separate transmitters. These two transmitters in combination with two different ATM's also provide two of the four inputs used in the 1-out-of-2-twice, low-water-level system initiation circuit. The other two inputs come from two additional and separate transmitter/ATM pairs. The following sketch illustrates the above explanation:



The two level 8 ATM's provide the common interlock for injection valve opening in the automatic initiation mode and the two manual initiation modes.

FINAL DRAFT

II. Containment Spray Mode (RHR)

The containment spray mode (two loops) is placed in operation by opening injection valves E12-F028A and E12-F028B when LPCI loops A and B are in operation. Each of the two loops has its own separate initiation logic and power supply. The loops are identical except that loop B has a 90 second delay time in the automatic initiation logic.

Each containment spray loop is initiated automatically by high containment pressure (1 out of 2 logic) with permissives from high drywell pressure (1 out of 2) and a LOCA signal or LPCI system manual initiation. (The LOCA signal is from the same sensors used in LPCI(A) or LPCI(B) automatic initiation.) *

Each loop may also be initiated manually by an armed pushbutton switch. The injection valve is prevented from opening unless high drywell pressure is present (1 out of 2 logic). The sensors are the same ones used in the automatic mode high-drywell-pressure permissive.

Each containment spray injection valve can be opened individually (by separate remote manual switches) if valve E12-F027A or E12-F027B is closed.

---

* There is a 10 minute time delay in the LOCA/LPCI- initiation permissive signal; that is containment spray mode will not ~~automatically~~ ~~be~~ initiated until 10 minutes after LOCA or LPCI initiation.

* There is a 10-minute time delay in the LOCA/LPCI- initiation permissive signal; that is, containment spray mode will not automatically initiate until 10 minutes after LOCA or LPCI initiation.