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JOSEPH A. TIERNAN
VICE PRESIDENT
NUCLEAR ENERGY

June 11, 1987

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Compliance with 10 CFR 50.62, Reduction of Risk from ATWS Events

REFERENCE: (a) Letter from Mr. J. A. Tiernan (BG&E), to Mr. A. C. Thadani (NRC), dated June 27, 1986, same subject

Gentlemen:

The ATWS Rule, 10 CFR 50.62, requires that licensees provide sufficient information to verify compliance with the rule. In June 1986, we detailed how we intend to comply (Reference a). We provided you with more information in a meeting with members of your staff on April 1, 1987. While most of the outstanding issues were resolved at that meeting, we agreed to provide further information to resolve the few that remained. The attachments provided with this letter, along with our discussions on April 1, 1987, should provide you with sufficient information to verify our compliance with the rule.

Should you have any additional questions regarding this matter, we would be pleased to discuss them with you.

Very truly yours,

JATiernan

JAT/WPM/dlm

Attachment
cc: D. A. Brune, Esquire
J. E. Silberg, Esquire
R. A. Capra, NRC
S. A. McNeil, NRC
W. T. Russell, NRC
T. Foley/D. C. Trimble, NRC

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ATTACHMENT A

POWER SUPPLIES

The NRC Staff considers a station battery, not used to provide power to reactor trip system (RTS) components, to be a preferred source for providing power to diverse scram system (DSS) and diverse turbine trip (DTT) logic and actuation devices. However, a bus used to provide power to RTS loads may also be used to provide power to DSS or DTT circuitry provided:

- faults within the DSS or DTT circuitry cannot degrade the reliability/integrity of the existing RTS below an acceptable level, and

- a common cause (mode) failure mechanism affecting the RTS power distribution system (including degraded voltage conditions such as overvoltage and undervoltage) cannot compromise both the RTS and DSS functions.

(From: Letter from D. M. Crutchfield, to R. C. L. Olson, Status of the CE Owners Group Conceptual Design Review, June 6, 1986).

Our proposed design for the DSS, DTT, and diverse auxiliary feedwater actuation system (AFAS) will use the existing reactor protective system (RPS) power supply. The RPS power supply consists of four safety-related, 120 volt vital AC busses. A simplified block diagram was provided to you during the meeting on April 1, 1987. In the preliminary stages of design, we decided to use the existing RPS power supply to maximize the reliability of the ATWS power supply. We believe the design of the RPS power supply also minimizes the potential for common mode failure.

Faults within the DSS, DTT, and AFAS will not degrade the reliability or integrity of the RPS. The DTT and AFAS systems are original plant systems with a history of reliability and the new DSS system will use existing Engineered Safety Features Actuation System (ESFAS) equipment. The ATWS design does not change or affect the existing RPS power source configuration. Separately fused 120 VAC circuits from separate vital 120 VAC busses will be used to power each channel of each of these systems.

The vital power source design minimizes the possibility that a common mode failure would compromise both the RPS and DSS functions. To determine the potential impact of RPS/DSS power source common mode failure, the following cases were considered.

- Total Loss of Voltage

- Overvoltage Condition

- Undervoltage Condition

Total Loss of Voltage

A total loss of voltage will not compromise both the RPS and the DSS. A loss of voltage at any point in the power distribution system will not prevent both systems from functioning. A total loss of voltage at the 125 VDC or 120 VAC vital busses would result in an immediate reactor trip via Trip Circuit Breaker UV-trip Devices (DC) or RPS K relays (AC).

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POWER SUPPLIES

Overvoltage Condition

Table 1 lists the protective features (trips, alarms, indications) that are available to mitigate an overvoltage condition.
Overvoltage in the 125 VDC or 120 VAC systems would most likely originate in the chargers because they are the potential source of a higher than normal voltage. Charger input is 480 VAC. The regulating capabilities of downstream equipment (inverters and power supplies) mitigate this condition. The following sequence of events illustrates an overvoltage condition.

1. 125 VDC bus at normal voltage (about 132 VDC)

2. Charger Failure - Bus voltage begins increasing

3. 140 VDC - Inverter output begins increasing (from 120 VAC)

   a. 125 VAC - RPS power supply output begins increasing

   b. 132 VAC - DSS power supply output voltage begins increasing

4. 150 VDC - Battery Charger Overvoltage Alarm

5. If the overvoltage condition increases further, to the point that equipment failures result (blown fuses, damaged solid state devices, etc.), this will result in RPS channel trips and reactor trip.

Undervoltage Condition

Table 1 lists the protective features (trips, alarms, indications) that are available to mitigate an undervoltage condition.

Undervoltage is the more credible failure mode and can originate at any point in the power system. The following is an example of a sequence of events on an undervoltage condition in the 125 VDC system.

1. 125 VDC bus at normal voltage (about 132 VDC)

2. Battery lost or disconnected - Battery monitor alarms

3. Failure of chargers - Bus voltage begins dropping off

4. 123 VDC - 125 VDC Bus Undervoltage Alarm

5. 120 VDC - 125 VDC Battery Charger Undervoltage Alarm

ATTACHMENT A

POWER SUPPLIES

6. 105 VDC - Inverter output begins dropping off (from 120 VAC)

   a. 105 VAC RPS/ESFAS (DSS) power supplies outputs begin dropping off

   b. 100 VAC - RPS K relays trip reactor trip breakers

Undervoltage conditions originating in the 125 VDC or 120 VAC systems are of greatest concern from a common mode standpoint; however, the undervoltage alarm setpoints on the DC busses and charger outputs cause alarms well before the voltage level is low enough to prevent system operation.

The RPS and ATWS power sources are controlled by the Technical Specifications. Technical Specifications 3.8.1.1, 3.8.1.2, 3.8.2.1, 3.8.2.2, 3.8.2.3, and 3.8.2.4 cover the operational and surveillance requirements for these systems. The protective and alarm relays for these systems are covered by a preventive maintenance program which checks setpoints and calibrates the relays on a refueling basis.

ATTACHMENT A

TABLE 1

EQUIPMENT	NOMINAL VOLTAGE	ALLOWABLE VOLTAGE	UNDERVOLTAGE/OVERVOLTAGE PROTECTION & ALARM SETPOINTS	CONTROL RM ALARM	CONTROL RM INDICATION	MISCELLANEOUS
BATTERY CHARGER	480 VAC (IN) 132 VDC (OUT)	FOLLOWS 480(IN) 125-138VDC (OUT)	U/V-240 VOLTS (IN) U/V-120 VDC & O/V 150 VDC (OUT)	YES	YES	CHARGER OUTPUT 118-139 ON FLOAT 128-144 ON EQUALIZE
BATTERY	125 VDC	*105-125 VDC	SEE BATTERY MONITOR	--	YES	*105 BASED ON MINIMUM ALLOWED ON TEST DISCHARGE
BATTERY MONITOR	132 VDC (SAME AS CHARGER)	105-140 VDC	DETECTS ±3% CHANGE	YES	YES	DETECTS BATTERY FAILURE/DISCONNECT
DC BUS	132 VDC (SAME AS CHARGER)	SAME AS CHARGER OR BATTERY DEPENDING ON SOURCE.	U/V-123 VDC	YES	YES	--
DC DIST. PANEL	132 VDC	SAME AS CHARGER OR BATTERY DEPENDING ON SOURCE.	U/V-86 VDC	YES	YES	--
INVERTER	120 VAC	116-124 VAC	U/V-90 VAC	YES	YES	OUTPUT ±1% WITH INPUT 105-140 VDC
VITAL AC BUSSES	120 VAC	116-124 VAC	--	--	--	--
RPS POWER SUPPLIES	15 VDC 28 VDC	OUTPUT ±0.05% WITH INPUT 105-125 VAC (47-420 CPS)	MATRIX RELAYS TRIP ON LOSS OF VOLTAGE. MATRIX RELAYS TRIP UNIT.	-	--	--

ATTACHMENT A

TABLE 1

EQUIPMENT	NOMINAL VOLTAGE	ALLOWABLE VOLTAGE	UNDERVOLTAGE/OVERVOLTAGE PROTECTION & SETPOINTS	CONTROL RM ALARM	CONTROL RM INDICATION	MISCELLANEOUS
RPS K RELAYS	120 VAC	N/A	U/V-100 VAC	YES	YES	TRIPS REACTOR TRIP CKT. BREAKERS
ATWS (ESFAS) POWER SUPPLIES	5 VDC 15 VDC 28 VDC 48 VDC	OUTPUT ±0.05% WITH INPUT 105-132 VAC (45-440 CPS)	--	--	--	ACTUATION RELAYS REQUIRE POWER TO OPERATE
M/G SETS	480 VAC (IN) 240 VAC (OUT)	FOLLOWS 480 (IN) 240 VAC (OUT)	U/V-NONE, O/V-300 VAC	YES	NO	TRIPS M/G SET
DTT RELAYS	240 VAC	FOLLOWS M/G SET	U/V-216 VAC	YES	NO	TRIPS TURBINE
REACTOR TRIP CIRCUIT BRKR. TRIP DEVICES	125 VDC	N/A	U/V-37.5 to 75 VDC SHUNT-70 to 140 VDC	YES	YES	TRIPS REACTOR

ATTACHMENT B

ISOLATION DEVICES

Your request for additional information stated in part:

> Information must be provided to demonstrate the adequacy of all isolation devices used to protect the integrity of safety related circuits from non-safety related ATWS circuits. The required information is identified in Attachment 2. If the isolation devices are identical to isolation devices used in other applications (e.g., to isolate the safety parameter display system from safety related circuits), and the requested information has been previously submitted for staff review, and the isolation devices have been approved for their applications, the related correspondence should be referenced, and no additional information need be provided.

At the April 1, 1987 meeting, we provided the information requested under the title ATWS Isolation Devices (copy attached). We feel these isolation devices, which are currently approved for use in our Engineered Safety Features Actuation System (ESFAS), are adequate for ATWS isolation devices. In accordance with your request for additional information, we need not provide the information requested under Attachment 2 to your request. However, we have provided additional information, obtained from the vendor of the ESFAS actuation relays, concerning their isolation capabilities.

The ESFAS actuation relays, GE Model 3SAA1383A2, are miniature, canned, mil quality power relays. The relay has an eight pin configuration. Pins 2 and 7 are the primary (coil) connections (28 VDC for ESFAS, DDS, and DTT). Pins 1 to 3 (or 8 to 6) are normally open output contacts used by DTT (125 VDC). Pins 1 to 4 (or 8 to 5) are normally closed output contacts used by DSS (240 VAC).

The DTT is an existing system that has been in place from initial plant startup. The maximum credible faults for this circuit (turbine trip) are set by circuit fusing, 30 amps, and maximum credible DC bus voltage 150 VDC. The proposed DSS M/G contactor trip circuit has maximum credible faults of 300 VAC (overvoltage trip point of M/G set) and 10 amps by circuit fusing.

The ESFAS initiation relays (GS Model 3SAA1383A2) are tested by the manufacturer to insure 10,000 meg ohms minimum insulation resistance between primary (coil) and secondary (output) and between adjacent contacts. Also, the relays are subjected to a 1500 volt, 60 Hz AC Hi Pot Test from primary to secondary, across normally open contacts, and from all contacts to relay can. Finally, the output contacts are tested to insure a maximum contact resistance of 0.050 ohm (new) and 0.100 ohm after life testing.

These relays are part of the original design of the ESFAS system and meet the environmental and seismic qualification of this system.

The DSS M/G set contactor trip circuit wiring from ESFAS actuation relay output contacts to cabinet field cable terminal strips will be routed separate from existing ESFAS actuation wiring and routed in flexible conduit rather than existing wiring bundles.

These relays are powered from ESFAS cabinet 28 VDC power supplies which receive power from 1E vital 120 VAC busses.

ATTACHMENT B

ISOLATION DEVICES

Prior Approval of ATWS Isolation Devices

FSAR Section 7.3.1.1:

The design of the engineered safety features actuation systems and component parts was based on the applicable requirements of IEEE-279 Criteria for Protection Systems for Nuclear Power Generating Stations.

Electrical isolation has been provided between redundant channels, between sensor and actuation subsystems, and between the engineered safety features actuation system and ancillary equipment. Where electrical isolation is provided, an application of short circuit, open wire, ground, or potential does not inhibit a protective action as a result of the failure of the redundant system. (Emphasis added.)

The NRC questioned our design further (Q 7.3.1):

Provide identification of those features of the design that do not conform to the criteria of IEEE-279 . . . and an explanation of the reasons for these.

Our answer:

All protection systems that actuate reactor trip and engineered safety features components are designed to conform to the criteria of IEEE 279 . . .

IEEE-279:

4.7.2 Isolation Devices. 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.

NRC Safety Evaluation Report Section 3.2.4.2:

Those portions of the reactor protection system and the actuation systems for engineered safety features supplied by Combustion Engineering are functionally identical to the Maine Yankee plant protection systems. Combustion Engineering used IEEE-279 as a guide in the design of both of these systems. The applicant states that those features of the reactor protection systems and the engineered safety features actuation systems that are not of Combustion Engineering design meet or exceed the criteria of IEEE-279 . . .

We have reviewed the design of the plant protection system and have concluded that it conforms to the applicable criteria and is acceptable. (Emphasis added.)

ATTACHMENT C

ATWS SYSTEM RELIABILITY

ATWS System Reliability will be proven and maintained by coordinating the existing Surveillance Testing and Preventive Maintenance Program of RPS, AFAS, and ESFAS to include DSS and DTT.

The following surveillance philosophies currently apply to RPS, AFAS, ESFAS, and will be applied to DSS and DTT if applicable.

1. Daily (at least once per shift) channel checks of pressurizer pressure and S/G level.

2. Monthly channel functional testing.

3. Refueling interval calibration to include entire instrument loop (sensor, bistable, indications, etc.).

4. Refueling interval integrated system testing including final actuation device.

RPS, DSS, DTT, & AFAS Testing & Preventive Maintenance

Unit 1 (Unit 2)

System	Procedure	Function	Frequency
RPS	STP 0-6-1 (2), RPS Startup Test	Functionally Test Initiation Logic, Trip Circuit Breakers, etc.	Prior to S/U
RPS	STP M-200-1 (2), Reactor Trip Circuit Breaker Functional Test	Independent Functional Test of TCB Shunt and U/V Trips	Monthly
RPS, DSS	STP M-210A/B-1 (2), RPS Functional Test	Functional Test of Instrument Loops, Bistables, Logic, Alarms, etc.	Monthly
RPS, DSS	STP M-510-1 (2), RPS Calibration	Sensor, Instr. Loop, System Calibration	18 Month
RPS	STP M-511-1 (2), RPS Response Time Test	Sensor, Instr. Loop, System Time Response	18 Month
RPS, DSS	PM 1(2)-58-I-Q-1, Pressurizer Pressure Loop Resistor Cleaning	Clean Instrument Loop Resistor Terminals	Quarterly
RPS	PM 1(2)-58-I-Q-3, S/G Level Loop Resistor Cleaning	Clean Instrument Loop Resistor Terminals	Quarterly
RPS	PM 1(2)-58-I-R-15, T/U Power Supply Checks	Measures Power Supply Outputs for DC and AC Ripple for Degradation	18 Month
RPS	PM 1(2)-58-E-Q-1, Reactor Trip Breaker Quarterly PM	Trip Shaft Torque Measurement	Quarterly
RPS	PM 1(2)-58-E-A-1, Reactor Trip Breaker Annual PM	Complete PM of Breakers and Switchgear	Annually
DTT	PM 1(2)-58-E-R-2, Reactor Trip SWGR U/V Relay Calibration	Calibration of Bus U/V Relays	18 Month

System	Procedure	Function	Frequency
RPS	PM 1(2)-58-E-R-3, RPS Relay Calibration	Calibrates RPS K Relays	18 Month
AFAS	STP M-225-1(2), AFAS Functional Test	Functional Test of Instrument Loops, Bistables, Alarms, etc.	Monthly
AFAS	STP 0-5-1(2), Aux Feed System Test	Test Pumps & Valves	Monthly
AFAS	STP 0-9-1(2), AFAS Monthly Logic Test	Test AFAS Start Logic	Monthly
AFAS	STP M-525-1(2), AFAS Calibration	Sensor, Instr.Loop, System Calibration	18 Month
AFAS	STP M-526-1(2), AFAS Time Response	Sensor, Instr. Loop, System Time Response	18 Month
DTT	PE 1(2)-93-35-0-R	Turbine Trip Functional & Logic Test	18 Month
DSS	New (to be written) or will add to STP 0-6-1(2)	Diverse Scram Functional & Logic Test	Prior to S/U unless performed within the last six months.
DSS	ETP 87-1(X), DSS Testing, FCR 85-1052	Total Integrated System Functional & Operational Test	Initial System Startup
DSS, DTT	PM 1(2)-48-I-R-4, ESFAS Power Supply Checks	ESFAS (includes DSS, DTT) Bistable and Logic Power Supply Output Measurement for Degradation	18 Month
RPS, DSS AFAS	Control Room Log	Channel Checks of Pressurizer Pressure (at RPS & ESFAS), S/G Level (at RPS & AFAS)	Each Shift

ATTACHMENT D

REVISION TO THE SUMMARY PROVIDED
AT APRIL 1, 1987 MEETING

10 CFR 50.62 REDUCTION OF RISK FROM ATWS EVENT
SUMMARY OF DIVERSITY
BETWEEN
THE REACTOR PROTECTIVE SYSTEM
AND
THE DIVERSE SCRAM SYSTEM AND
THE DIVERSE TURBINE TRIP SYSTEM
FOR
CALVERT CLIFFS NUCLEAR POWER PLANT
UNITS 1 AND 2

SUMMARY

10 CFR 50.62 REDUCTION OF RISK FROM ATWS EVENTS REACTOR PROTECTIVE SYSTEM, DIVERSE SCRAM SYSTEM AND DIVERSE TURBINE TRIP COMPOSITE OF DIVERSITY COMPARISON

COMPONENT	DSS COMPONENT FUNCTION DIVERSITY	DTT COMPONENT FUNCTION DIVERSITY	NOTES
Sensors	No	Yes	1,2
Isolators	Yes	Yes	1,3.4
Bistables	Yes	Yes	5
Coincident Logic	Yes	Yes	5
Initiation Relay	Yes	Yes	6,7
Final Trip Device	Yes	Yes	8,9

OVERALL DIVERSITY CONCLUSION

Calvert Cliffs, Units 1 and 2 comply with the ATWS rule in terms of diversity between the reactor trip function and the diverse scram function and the turbine trip function. This is due to the design and functional diversity between the systems.

10 CFR 50.62 REDUCTION OF RISK FROM ATWS EVENTS REACTOR PROTECTIVE SYSTEM, DIVERSE SCRAM SYSTEM AND DIVERSE TURBINE TRIP DIVERSITY COMPARISON

NOTES for SUMMARY and TABLE 1:

1. The ATWS RULE requires diversity only from the sensor output. The DSS shares the same sensor loops as the RPS; however, the DSS bistable and logic circuits are isolated from the RPS circuits via Class IE isolators (see 'isolators') which are considered to be the first component in the DSS/RPS diversity comparison.

2. Diversity exists for the DTT CEDM Bus UV sensors and intermediate sensor relay due to differences in design principle, power source and function. Although G.E. relays are used in the RPS initiation circuit (see Table 2), they are a different model (NGV vs ICR & HFA for DTT), different design principles and operating voltages (120VAC vs 240VAC & 125VDC respectively). The power source for the U.V.ICR relay is the same AC source which is used for the RPS 'Final Trip device' ie. 240V,3 phase-MG 1 & 2 power to the CEDMCS -for the DTT this source also functions as the measured variable.

3. Diversity exists for the DTT Sensor Isolators due to differences in design principles, DC power source and function. Although Clare relays are an integral part of the RPS bistables, they are a different model (HGSM for RPS vs HFW for DTT), different design principles and operating voltage (15 VDC vs 40 VDC respectively). The RPS-HGSM relay deenergizes to trip, while the DTT-HFW relay energizes to trip (see Table 2).

4. Diversity exists for the DSS Sensor loop Isolator due to the fact that no comparable devices exist in the RPS system. The isolators are listed in this comparison to show that Class IE isolation is employed to seperate the DSS circuits from the RPS sensor loop; thereby, effectively preventing any malfunctions in the DSS circuits from influencing the RPS.

5. Diversity exists for the DSS & DTT Bistables & Coincident Logic due to differences in manufacture, design principles, DC power source and DC power supply manufacturer.

6. Diversity exists for the DSS & DTT Initiation Relays due to the differences in model,design principles,power source and function. Although all the relays are G.E. manufacture, the models numbers and design principles are different (ie. RPS-NGV type in draw out case vs DSS/DTT - hermetically sealed plug-in type); operating voltages (RPS - 120VAC vs DSS/DTT - 28VDC) and function (ie. RPS-deenergize to trip vs DSS/DTT - energize to trip) are different (see Table 2).

7. The Unit 1 DTT system is equipped with two 'intermediate' relays in the initiation circuit. These are located in the Turbine EHC cabinet and are called the '1st Hit Customer Trip Relay' and the 'Master Trip Relay'.

Notes continued on Page No. iii

10 CFR 50.62 REDUCTION OF RISK FROM ATWS EVENTS
REACTOR PROTECTIVE SYSTEM, DIVERSE SCRAM SYSTEM AND DIVERSE
TURBINE TRIP
DIVERSITY COMPARISON

NOTES for SUMMARY and TABLE 1:

7. (cont'd)
Diversity exists for the '1st Hit' relay due to differences in model, function and operating voltage. Although the manufacturer is the same as in the RPS Bistables (eg. Clare), the model and operating voltage (RPS- 15VDC dual coil bistable vs DTT- 125VDC single coil self-reset) and function (ie.RPS - deenergize to trip vs DTT - energize to trip) establish the required diversity (see Table 2).

Diversity exists for the 'Master Trip' relay due to differences in model no., design principle, operating voltages and DC power supplies. The G.E. type CR120 relay for DTT is a different model and design principle than the G.E. type NGV relay used in the RPS initiation circuit; operating voltage (120VAC -RPS vs 24VDC -DTT) and AC power source (120VAC vital - RPS vs 120VAC non-vital -DTT) differences further enhance the diversity (see Table 2).

8. Diversity exists for the DSS Final Trip Device due to differences in model, design principles and operating voltage. Although the manufacturer is G.E. for both the RPS & DSS, the RPS is a circuit breaker while the DSS device is a contactor; the circuit breaker operating voltage (ie. trip coil & close coil) is 125 VDC while the contactor operating voltage is 240 VAC for the aux. relay and a rectified 240 V for the contactor coil.

9. Diversity exists for the DTT Final Trip Device due to differences in type, model, design principle and operating voltage (Unit 1). Athough G.E. is the manufacturer for both the Unit 1 DTT device and the RPS device, diversity is established by the design principle difference (eg. RPS circuit breaker vs DTT solenoid valve) and operating voltage (125VDC - RPS vs 24VDC - DTT).

For Unit 2 the solenoid valve is manufactured by Westinghouse, which further establishes the diversity, even though the DC power source is the same for Unit 2 DTT and the RPS Final Trip devices.

10 CFR 50.62 REDUCTION OF RISK FROM ATWS EVENTS
RPS, DSS AND DTT DIVERSITY COMPARISON
TABLE 1

COMPONENT TYPE	DESIGN DESCRIPTION	REACTOR PROTECTION SYSTEM	DIVERSE SCRAM SYSTEM	DSS DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY	DIVERSE TURBINE TRIP	DTT DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY
** SENSORS								
HIGH PRESSURIZER PRESSURE	REF. FIGURE & ID/TAG NUMBER	FIG.4.INPUT 6 1/2-PT-102A.B.C.D	FIG.1-1 & 1-2 1/2-PT-102A.B.C.D	---	---	N/A	N/A	N/A
	MANUFACTURER	ITT BARTON	ITT BARTON	NO. 1	NO. 1	---		
	MODEL NO.	763	763	NO		---		
	DESIGN PRINCIPLE	4-20 MA THRU 250OHM RESISTOR, 1-5 V TO RPS	4-20 MA THRU 250OHM RESISTOR, TO E/E. 1-5V TO DSS & SIAS	NO		---		
	D.C.POWER SOURCE	45 VDC	45 VDC	NO		---		
	D.C.POWER SUPPLY MANUFACTURER	LAMBDA	LAMBDA	NO		---		
	D.C.POWER SUPPLY PART NO.	LCD-2-44	LCD-2-44	NO		---		
	A.C.POWER SOURCE	CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	NO		---		
CEDM POWER BUS UNDERVOLTAGE	REF. FIGURE & ID/TAG NUMBER	N/A	N/A	N/A	N/A	FIG.2&4.UV RELAY 27-1.-2.-3.-4	---	---
	MANUFACTURER	---	---			GENERAL ELECTRIC	NO. 2	YES. 2
	MODEL NO.	---	---			12ICR54B2A	YES, 2	
	DESIGN PRINCIPLE	---	---			PHASE SEQUENCE & 3 PHASE U.V. RELAY DEENERG.TO TRIP	YES. 2	
	D.C.POWER SOURCE	---	---			N/A	N/A	
	D.C.POWER SUPPLY MANUFACTURER	---	---			N/A	N/A	
	D.C.POWER SUPPLY PART NO.	---	---			N/A	N/A	
	A.C.POWER SOURCE	---	---			MG1&2 POWER TO CEDM 240V.3 PHASE.60 HZ	YES. 2	

10 CFR 50.62 REDUCTION OF RISK FROM ATWS EVENTS
RPS, DSS AND DTT DIVERSITY COMPARISON
TABLE 1

COMPONENT TYPE	DESIGN DESCRIPTION	REACTOR PROTECTION SYSTEM	DIVERSE SCRAM SYSTEM	DSS DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY	DIVERSE TURBINE TRIP	DTT DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY
INTERMEDIATE SENSOR RELAY	REF. FIGURE & ID/TAG NUMBER	N/A	N/A	N/A	N/A	FIG.4, UV RELAY UV1.UV2.UV3.UV4	---	---
	MANUFACTURER	---	---			GENERAL ELECTRIC	NO. 2	YES. 2
	MODEL NO.	---	---			12HFA151A2F Code06	YES. 2	
	DESIGN PRINCIPLE	---	---			ELECTROMECHANICAL INST. RELAY. DEENERG. TO TRIP	YES. 2	
	D.C.POWER SOURCE	---	---			CHANNELIZED 125VDC BUS ZA.ZB.ZC.ZH	YES. 2	
	D.C.POWER SUPPLY MANUFACTURER	---	---			N/A	N/A	
	D.C.POWER SUPPLY PART NO.	---	---			N/A	N/A	
	A.C.POWER SOURCE	---	---			N/A	N/A	

10 CFR 50.62 REDUCTION OF RISK FROM ATWS EVENTS
RPS, DSS AND DTT DIVERSITY COMPARISON
TABLE 1

COMPONENT TYPE	DESIGN DESCRIPTION	REACTOR PROTECTION SYSTEM	DIVERSE SCRAM SYSTEM	DSS DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY	DIVERSE TURBINE TRIP	DTT DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY
** ISOLATORS SENSOR LOOP ISOLATION	REF. FIGURE & ID/TAG NUMBER	N/A	FIG.1-1 & 1-2 1/2-E/E-102A.B.C.D	---	---	FIG.2-1 & 2-2 XK9	---	---
	MANUFACTURER	---	TRANSMATION	YES, 1.4	YES. 1.4	CLARE	NO, 3	YES. 3
	MODEL NO.	---	230-IT	YES		HFW1201K01	YES, 3	
	DESIGN PRINCIPLE	---	ELECTRONIC. E/E 1-5V TO 1-5V	YES		ELECTROMECHANICAL CONTACT ISOL.	YES, 3	
	D.C.POWER SOURCE	---	N/A	N/A		40 VDC/ 26 VDC via DROPPING RESISTORS	YES	
	D.C.POWER SUPPLY MANUFACTURER	---	N/A	N/A		VITRO	YES	
	D.C.POWER SUPPLY PART NO.	---	N/A	N/A		PART OF ANNUN.ASS'Y 1628-1084	YES	
	A.C.POWER SOURCE	---	CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	YES		CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	YES	
INTER-CHANNEL ISOLATORS	REF. FIGURE & ID/TAG NUMBER	N/A	FIG.1-1 & 1-2 XA16&21.XA23&26	---	---	FIG.2-1 & 2-2 XA1.XA6	---	---
	MANUFACTURER	---	VITRO	YES	YES	VITRO	YES	YES
	MODEL NO.	---	1628-1044	YES		1628-1044	YES	
	DESIGN PRINCIPLE	---	ELECTRO-OPTICAL ISOLATION.MULTI-CHANNEL	YES		ELECTRO-OPTICAL ISOLATION.MULTI-CHANNEL	YES	
	D.C.POWER SOURCE	---	15 VDC	YES		15 VDC	YES	
	D.C.POWER SUPPLY MANUFACTURER	---	LAMBDA	YES		LAMBDA	YES	
	D.C.POWER SUPPLY PART NO.	---	LMCC15-Y	YES		LMCC15-Y	YES	
	A.C.POWER SOURCE	---	CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	YES		CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	YES	

10 CFR 50.62 REDUCTION OF RISK FROM ATWS EVENTS
RPS, DSS AND DTT DIVERSITY COMPARISON
TABLE 1

COMPONENT TYPE	DESIGN DESCRIPTION	REACTOR PROTECTION SYSTEM	DIVERSE SCRAM SYSTEM	DSS DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY	DIVERSE TURBINE TRIP	DTT DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY
** BISTABLES HIGH PRZR PRESS & CEDM BUS UV	REF. FIGURE & ID/TAG NUMBER	FIG.4 TRIP UNIT RELAYS	FIG.1-1 & 1-2 XA28 & XA30	---	---	FIG.2-1 & 2-2 XA7	---	---
	MANUFACTURER	GULF ELECTRONICS (SORENTO)	VITRO LABS	YES, 5	YES, 5	VITRO LABS	YES, 5	YES, 5
	MODEL NO.	ELD240-0000F	1628-1063	YES		1628-1060	YES	
	DESIGN PRINCIPLE	SIG. COMP'D TO TRIP SETPT. TRIP DEENG'S CLARE HGSM51113R01 RELAYS(2/4 LOGIC)	SIG. COMP'D TO TRIP SETPT. TRIP INIT'S 20MA SIG.TO ISOL'S THEN TO 2/4 LOGIC	YES		48VDC DIGITAL HIGH INITIATES 20MA SIG. TO ISOL'S THEN TO 2/4 LOGIC MODULES	YES	
	D.C.POWER SOURCE	+/- 15 VDC	+5 VDC, +15 VDC,+28 VDC	YES		+15 VDC,+28 VDC	YES	
	D.C.POWER SUPPLY MANUFACTURER	POWER MATE	CEA, LAMBDA	YES		LAMBDA	YES	
	D.C.POWER SUPPLY PART NO.	DRA 15.750/15.750	CEA6D50X251F2T1U, LMCC15-Y,LCS-C-28	YES		LMCC15-Y,LCS-C-28	YES	
	A.C.POWER SOURCE	CHANNELIZED VITAL BUS ZA,ZB,ZC,ZH	CHANNELIZED VITAL BUS ZA,ZB,ZC,ZH	NO		CHANNELIZED VITAL BUS ZA,ZB,ZC,ZH	NO	

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TABLE 1

COMPONENT TYPE	DESIGN DESCRIPTION	REACTOR PROTECTION SYSTEM	DIVERSE SCRAM SYSTEM	DSS DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY	DIVERSE TURBINE TRIP	DTT DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY
** COINCIDENT LOGIC SEE DESIGN PRINCIPLES	REF. FIGURE & ID/TAG NUMBER	FIG.4 MATRIX LOGIC A-B THRU C-D	FIG.1-1 & 1-2 XA28	---	---	FIG.2-1 & 2-2 XA25	---	---
	MANUFACTURER	ELECTRO-MECHANICS INC. (DOUGLAS RANDALL)	VITRO LABS	YES, 5	YES. 5	VITRO LABS	YES, 5	YES. 5
	MODEL NO.	34460-0 (378907)	1628-1061	YES		1628-1033	YES	
	DESIGN PRINCIPLE	BISTABLE OUTPUTS & MATRIX RELAYS: ELECTROMECHANICAL	2/4 LOGIC MODULE: SOLID STATE	YES		2/4 LOGIC MODULE: SOLID STATE	YES	
	D.C.POWER SOURCE	+28 VDC DIODE COUPLED	+15 VDC,+28 VDC	YES		+15 VDC,+28 VDC	YES	
	D.C.POWER SUPPLY MANUFACTURER	POWER MATE	LAMBDA	YES		LAMBDA	YES	
	D.C.POWER SUPPLY PART NO.	RB28-1.5	LCS-A-15,LME-28	YES		LCS-A-15,LMD-28	YES	
	A.C.POWER SOURCE	CHANNELIZED VITAL BUS ZA,ZB,ZC,ZH	CHANNELIZED VITAL BUS ZA,ZB,ZC,ZH	NO		CHANNELIZED VITAL BUS ZA,ZB,ZC,ZH	NO	

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RPS. DSS AND DTT DIVERSITY COMPARISON
TABLE 1

COMPONENT TYPE	DESIGN DESCRIPTION	REACTOR PROTECTION SYSTEM	DIVERSE SCRAM SYSTEM	DSS DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY	DIVERSE TURBINE TRIP	DTT DESIGN DIVERSITY	COMPO FUNCT DIVER
** INITIATION RELAY								
INITIATION RELAYS	REF. FIGURE & ID/TAG NUMBER	FIG.4 K1.K2.K3.K4	FIG.1-1 & 1-2 XK119.XK120	---	---	FIG.2-1 & 2-2 XK103	---	---
	MANUFACTURER	GENERAL ELECTRIC	GENERAL ELECTRIC	NO. 6	YES. 6	GENERAL ELECTRIC	NO. 6	YES. 6
	MODEL NO.	12NGV13A1A	3SAA1383A2	YES		3SAA1383A2	YES	
	DESIGN PRINCIPLE	ELECTROMECHANICAL LEAFTYPE CONTACTS DRAWOUT CASE DEENERG. TO TRIP	ELECTROMECHANICAL HERMETICALLY SEALED PLUG-IN TYPE ENERGIZE TO TRIP	YES		ELECTROMECHANICAL HERMETICALLY SEALED PLUG-IN TYPE ENERGIZE TO TRIP	YES	
	D.C.POWER SOURCE	N/A	+28 VDC	YES		+28 VDC	YES	
	D.C.POWER SUPPLY MANUFACTURER	N/A	LAMBDA	YES		LAMBDA	YES	
	D.C.POWER SUPPLY PART NO.	N/A	LME-28	YES		LMD-28	YES	
	A.C.POWER SOURCE	120V VIA ISOLATION TRANSFORMER FROM CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	NO		CHANNELIZED VITAL BUS ZA.ZB.ZC.ZH	NO	
INTERMEDIATE INIT.RELAYS UNIT 1 ONLY	REF. FIGURE & ID/TAG NUMBER	N/A	N/A	N/A	N/A	FIG.2-1 KT823	---	---
	MANUFACTURER	---	---			CLARE	NO. 7	YES. 7
	MODEL NO.	---	---			HGSM51111V00	YES. 7	
	DESIGN PRINCIPLE	---	---			(1st HIT-CUSTOMER TRIP-ENERG.TO TRIP) MERCURY WETTED CONT	YES. 7	
	D.C.POWER SOURCE	---	---			125 VDC. BUS ZA	YES	
	D.C.POWER SUPPLY MANUFACTURER	---	---			N/A	N/A	
	D.C.POWER SUPPLY PART NO.	---	---			N/A	N/A	
	A.C.POWER SOURCE	---	---			N/A	N/A	

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TAPLE 1

COMPONENT TYPE	DESIGN DESCRIPTION	REACTOR PROTECTION SYSTEM	DIVERSE SCRAM SYSTEM	DSS DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY	DIVERSE TURBINE TRIP	DTT DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY
INTERMEDIATE INIT.RELAYS UNIT 1 ONLY	REF. FIGURE & ID/TAG NUMBER	N/A	N/A	N/A	N/A	NONE XKT1000	---	---
	MANUFACTURER	---	---			GENERAL ELECTRIC	NO. 7	YES, 7
	MODEL NO.	---	---			CR120HF47J10	YES	
	DESIGN PRINCIPLE	---	---			ELECTROMECHANICAL (MASTER TRIP RELAY) ENERGIZE TO TRIP	YES	
	D.C.POWER SOURCE	---	---			+24 VDC	YES	
	D.C.POWER SUPPLY MANUFACTURER	---	---			LAMBDA	YES	
	D.C.POWER SUPPLY PART NO.	---	---			LMF-24-0V-M-Y-33962	YES	
	A.C.POWER SOURCE	---	---			120 VAC, BUS A	YES	

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TABLE 1

COMPONENT TYPE	DESIGN DESCRIPTION	REACTOR PROTECTION SYSTEM	DIVERSE SCRAM SYSTEM	DSS DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY	DIVERSE TURBINE TRIP	DTT DESIGN DIVERSITY	COMPONENT FUNCTION DIVERSITY
** FINAL TRIP DEVICE								
SEE DESIGN PRINCIPLES	REF. FIGURE & ID/TAG NUMBER	FIG.4 & FIG.3 TCB-1 THRU TCB-8	FIG.4 M-1.M-2	---	---	UNIT1-FIG.NONE UNIT2-FIG.2-2 20-1/AST.20-2/AST	---	---
	MANUFACTURER	GENERAL ELECTRIC	GENERAL ELECTRIC	NO. 8	YES. 8	UNIT1-GENERAL ELEC. UNIT2-WESTINGHOUSE	NO, 9 YES	YES, 9
	MODEL NO.	AK-2A-25	IC2812B113	YES. 8		UNIT1: 154B813 UNIT2: 439A936G01	YES YES	
	DESIGN PRINCIPLE	REACTOR TRIP BKR: MECH.LATCH.TRIP ON U.V. & SHUNT TRIP COIL	CEDM M.G.SET OUTPUT CONTACTOR: ELECTRO-MECHANICAL,AUX.CONT RELAY TRIP	YES		MASTER TRIP SOLEN. VALVE. PART OF TURB ELECTRO-HYDRAULIC CONTROLS	YES	
	D.C.POWER SOURCE	CHANNELIZED 125VDC BUS ZA.ZB.ZC.ZH	N/A	N/A		UNIT1: +24 VDC UNIT2: 125 VDC, BUS ZA	YES NO, 9	
	D.C.POWER SUPPLY MANUFACTURER	N/A	N/A	N/A		UNIT1: LAMBDA UNIT2: N/A	YES N/A	
	D.C.POWER SUPPLY PART NO.	N/A	N/A	N/A		LMF-24-0V-M-Y-33962 UNIT2: N/A	YES N/A	
	A.C.POWER SOURCE	MG1&2 POWER TO CEDM 240V.3 PHASE.60 HZ	MG POWER TO CEDMCS 240V,1 PHASE.60 HZ	NO. 8		UNIT1: 120VAC,BUS A UNIT2: N/A	YES N/A	

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TABLE 2

SYSTEM	TAG NO.	MODEL NUMBER	FUNCTION	DATA
** MANUFACTURER: GENERAL ELECTRIC CO.				
RPS	K1,K2,K3 K4	12NGV13A1A	INITIATION RELAY	HI SPEED AC UNDERVOLTAGE RELAY, 120VAC OPERATED HINGED-ARMATURE TELEPHONE TYPE,DIODE BRIDGE FOR AC APPLIC.,2N.O.&2N.C. CONT'S,S1 CASE 9 1/8"X6 5/8"X7 1/2", WT.10LBS
DSS DTT	XK119, XK120, XK103	3SAA1383A2	INITIATION RELAY	MINIATURE, PLUG-IN OCTAL SOCKET E-FRAME MAGNET,28VDC,DPDT 10A CONT 1.67"X1.48"X2.1",WT.4.5OZ
DTT	27-1,-2, 27-3,-4	12ICR54B2A	UNDERVOLATAGE RELAY	3 PH.VOLTAGE OPER'D INDUCTION-DISK TIME DELAY(0.17sec)-RESPONDS TO PH SEQUENCE,OPEN PH.OR U.V.,240VAC OP FIELD SET @ 216V, 1 N.O.& 1 N.C. 10 5/16"X6 5/8"X6 3/4",WT.12LBS
DTT	UV1,UV2, UV3,UV4	12HFA151A2F CODE 06	U.V.RELAY CONTACT MULTI. RELAY	MULTICONTACT AUXILIARY RELAY,6N.O. CONTACTS,125VDC COIL, OPER. TIME= 5 CYCLES,SELF-RESET,REOSTAT ADJ. CAL.RANGE 70-100V,SEMI-FLUSH MTG. 6 1/2"X7"X5 3/16",WT.5LBS
DTT	XKT1000	CR120HF47J10	INTERM. INIT. RELAY 'MASTER TRIP'	GEN. PURPOSE RELAY, 11 PIN RECT. PLUG-IN, 24VDC COIL,DUST COVER, DPDT 10A CONTACTS 2.12"X2.06"X1.44"

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TABLE 2

SYSTEM	TAG NO.	MODEL NUMBER	FUNCTION	DATA
** MANUFACTURER: CLARE				
RPS	K1,K2,K3	HGSM51113R01	BISTABLE & 2/4 LOGIC RELAY	MINIATURE PLUG-IN,METAL CASE,MERC. WETTED CONTACT,HERMETICALLY SEALED DUAL COIL-BISTABLE,10VDC MIN.OPER. 1250 OHM WINDG,2A,100VA,500V CONT. MIN.OPER @ 7.2MA,RELE @ 1.8MA
DTT	XK9	HFW1201K01	CEDM BUS U.V. SIGNAL ISOLATION	MFGR. COMM.INSTRUMENT INC.,HALF-SIZE CRYSTAL CAN,WELDED,HERMETICAL LY SEALED ENCL,.187"PCB/PLUG-IN 26VDC COIL DPDT BIFURCATED HARDNED SILVER ALLOY CONT,.81"X.41"X.41"
DTT	KT823	HGSM51111V00	INTERMEDIATE INIT. RELAY '1ST HIT'	MINIATURE PLUG-IN,METAL CASE,MERC. WETTED CONTACT,HERMETICALLY SEALED SINGLE COIL,48 VDC,8600 OHM WINDNG 2 AMP,100VA,500V CONTACTS,MIN.OPER @ 2MA,RELE @ .5MA,.64"X.64"X2.08"