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SCHWENCER,A. Licensing Branch 2

SUBJECT: Submits info re surveillance criteria that will be used in maint program to test second level undervolatge protective relays, in response to 820208 telcon. Table re non-class IE loads & proposed FSAR changes encl.

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	MPA		1	0	NRR/DE/CEB	11	1	1
	NRR/DE/EQB	13	3	3	NRR/DE/GB	28	2	2
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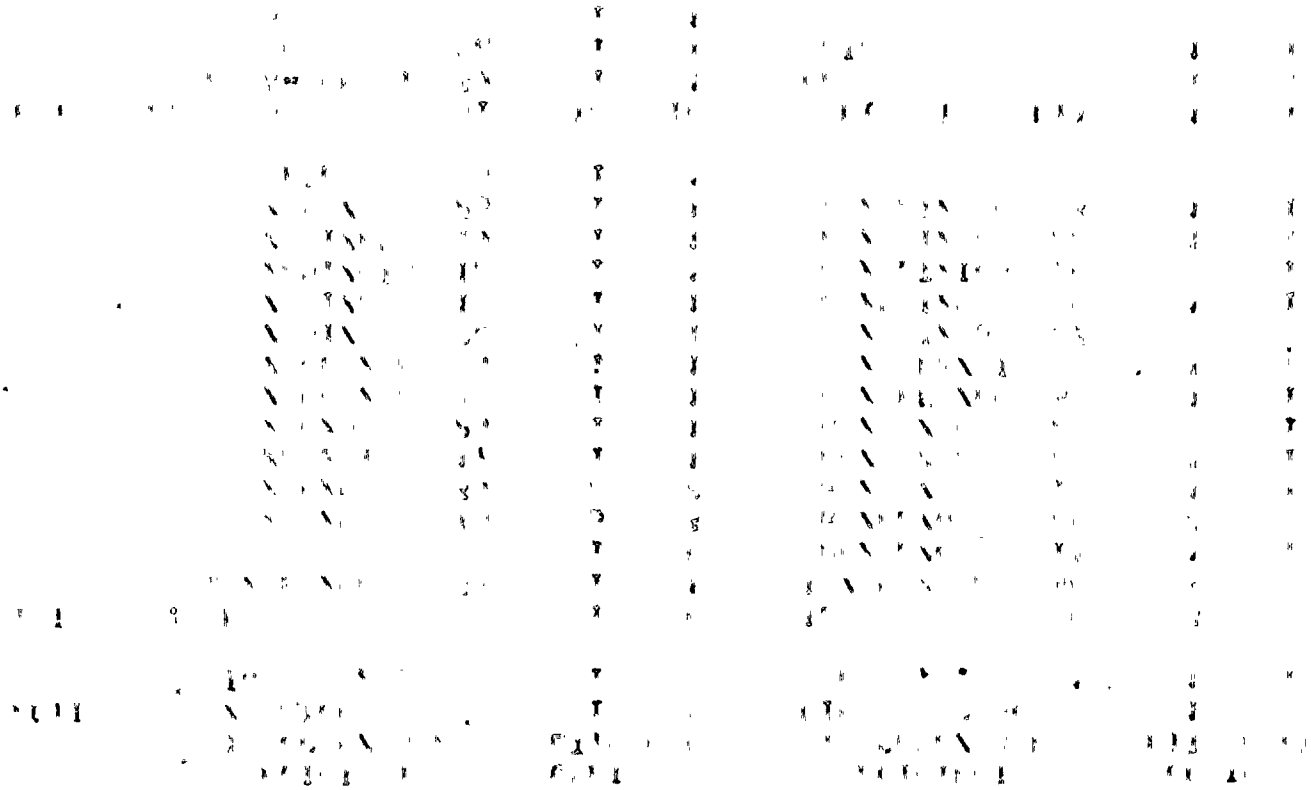

Washington Public Power Supply System
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February 11, 1982
G02-82-161

Docket No. 50-397

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
SER OPEN ITEMS, PSB ELECTRICAL

The following is in response to Mr. Sang Rhow's concerns expressed via conference telephone conversation, Monday, February 8, 1982.

The surveillance criteria that will be used in the maintenance program to test the second level under-voltage protective relays is as follows:

- ± 3% tolerance band on drop-out setpoint
- Annual periodicity
- 103% pick up after drop-out

Non-Class IE loads were included in the table (8.3-1) which identifies the loading of engineering safety systems buses. These loads have been further identified with note 7. The table shows that the addition of the Non-Class IE loads does not exceed the capability of the Diesel Generator.

Attached is a forthcoming FSAR change which responds to the concern that the motors may not have the capability to withstand a degraded bus voltage condition for the eight (8) seconds. This change also contains a one (1) line diagram showing the logic associated with the second level under-voltage protection.

B001
S 1/1

The second level under-voltage protection logic does not trip the supply breaker from the Diesel Generator under any circumstance. Thus, there is no need to bypass this protection when the Diesel Generator is supplying the bus.

Very truly yours,

G. D. Bouchey
Deputy Director, Safety and Security

TLM/jca
Attachment

cc: R Auluck - NRC
WS Chin - BPA
R Feil - NRC Site
S Rhow - NRC

TABLE 8.3-1

DIVISION 1 DIESEL-GENERATOR LOADING SEQUENCE
AUTOMATIC AND MANUAL LOADING OF ENGINEERED SAFETY SYSTEMS BUS

	Item Description	No. On Bus	Total HP/KW Connected To Bus	SHUTDOWN WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start (1)	Time to Stop	KW	LOCA WITH LOSS OF OFFSITE POWER: No. Req'd Part Of Set	Time to Start	Time to Stop	KW
1)	Motor Operated Valves (5)	Set	200kw	Set	0 Sec	(2)	-	Set	0 Sec	(2)	-
2)	Emergency Lighting & Power (7)	Set	124kw	Set	0 Sec	(4)	124	Set	0 Sec	(4)	124
3)	Diesel Auxiliaries & HVAC	Set	200kw	Set	0 Sec (3)	(3)	124	Set	0 Sec (3)	(3)	94
4)	LPCS Water Leg Pump	1	15/12kw	1	0 Sec (3)	(3)	12	1	0 Sec (3)	(3)	12
5)	Standby Liquid Control Pump	1	40/33kw	-	-	-	-	-	-	-	-
6)	RCIC Water Leg Pump	1	15/12kw	1	0 Sec (3)	(3)	12	1	0 Sec (3)	(3)	12
7)	Fuel Pool Recirc. Pump	1	50/40kw	1	10 Hrs (4)	(4)	(40)	-	-	-	-
8)	Plant Service Water Pump A (7)	1	1500/1197kw	1	10 Sec	(4)	1197	-	-	-	-
9)	LPCS Pump	1	1500/1197kw	-	-	-	-	1	0 Sec	(4)	1197
10)	RHR Pump A	1	800/642kw	1	10 Min (4)	(4)	(642)	1	5 Sec	(4)	642
11)	Standby Service Water Pump	1	1750/1377kw	1	20 Sec	(4)	1377	1	20 Sec	(4)	1377
12)	Cooling Tower Make-up Water Pump (7)	* 2	1600/1270kw	1	Note 6 (4)	(4)	(635)	-	-	-	-
13)	Control Rod Drive Pump (7)	** 1	250/205kw	1	(4)	(4)	(205)	-	-	-	-
14)	Reactor Closed Cooling Pump	1	200/160kw	1	0 Sec	(4)	160	-	-	-	-
15)	Load Center Transformer Losses TR-7-71 & 7-73	2	45kw	2	0 Sec	Cont.	33	2	0 Sec	Cont.	33
16)	250 V Battery Charger	1	165kw	1	0 Sec	(4)	135	1	0 Sec	(4)	135
17)	125 V Battery Charger	1	43kw	1	0 Sec	(4)	43	1	0 Sec	(4)	43
18)	Uninterruptible Power Supply (7)	1	30kw	1	0 Sec	(4)	30	1	0 Sec	(4)	30
19)	Standby Gas Treatment Fans	2	50/40kw	1	10 Min (4)	(4)	(20)	1	30 Sec	(4)	20
	& Heater Coils	2	45kw	-	-	-	-	2	20 Sec	(3)	45
20)	RPS Mg Set (7)	1	25/20kw	1	0 Sec	(4)	20	1	(4)	(4)	(20)
21)	Hydrogen Recombiner	1	10/44kw	-	-	-	-	1	60 Min (4)	(4)	(44)
22)	Drywell Cooling & Fans	Set	182kw	Set	0 Sec	(4)	182	-	-	-	-
23)	Control Air Compressor (7)	1	100/82kw	1	1 Hr (4)	(4)	(82)	-	-	-	-
24)	Containment Instrument Air Compressor	1	15/12kw	1	0 Sec (3)	(4)	12	-	-	-	-
26)	Reactor Bldg. Elec. Equip. HVAC	Set	368kw	Set	0 Sec (3)	(4)	15	Set	0 Sec (3)	(4)	15
27)	Control Bldg. Elec. Equip. HVAC	Set	283kw	Set	5 Sec (3)	(4)	71	Set	5 Sec (3)	(4)	71
28)	Rad. Bldg. Elec. Equip. HVAC (7)	Set	150kw	-	-	-	-	-	-	-	-
29)	Make-up Water Pumphouse Electric Equipment HVAC (7)	* Set	90kw	Set	Note 6 (4)	(4)	(90)	-	-	-	-
30)	Standby Service Water Pump-house Elec. Equip. HVAC	Set	38kw	Set	0 Sec	(4)	10	Set	0 Sec	(4)	10
					Total Automatically Applied		3557kw		Total Automatically Applied		3860kw

For Notes see bottom of Table 8.3-2
* Only 1 required. Not added to load since other load can be dropped when they are necessary a few days later.
** Can be supplied manually after operator checks load capacity on generator.
( ) kw Figures in parenthesis are for manually applied loads not added to total automatically applied loads.

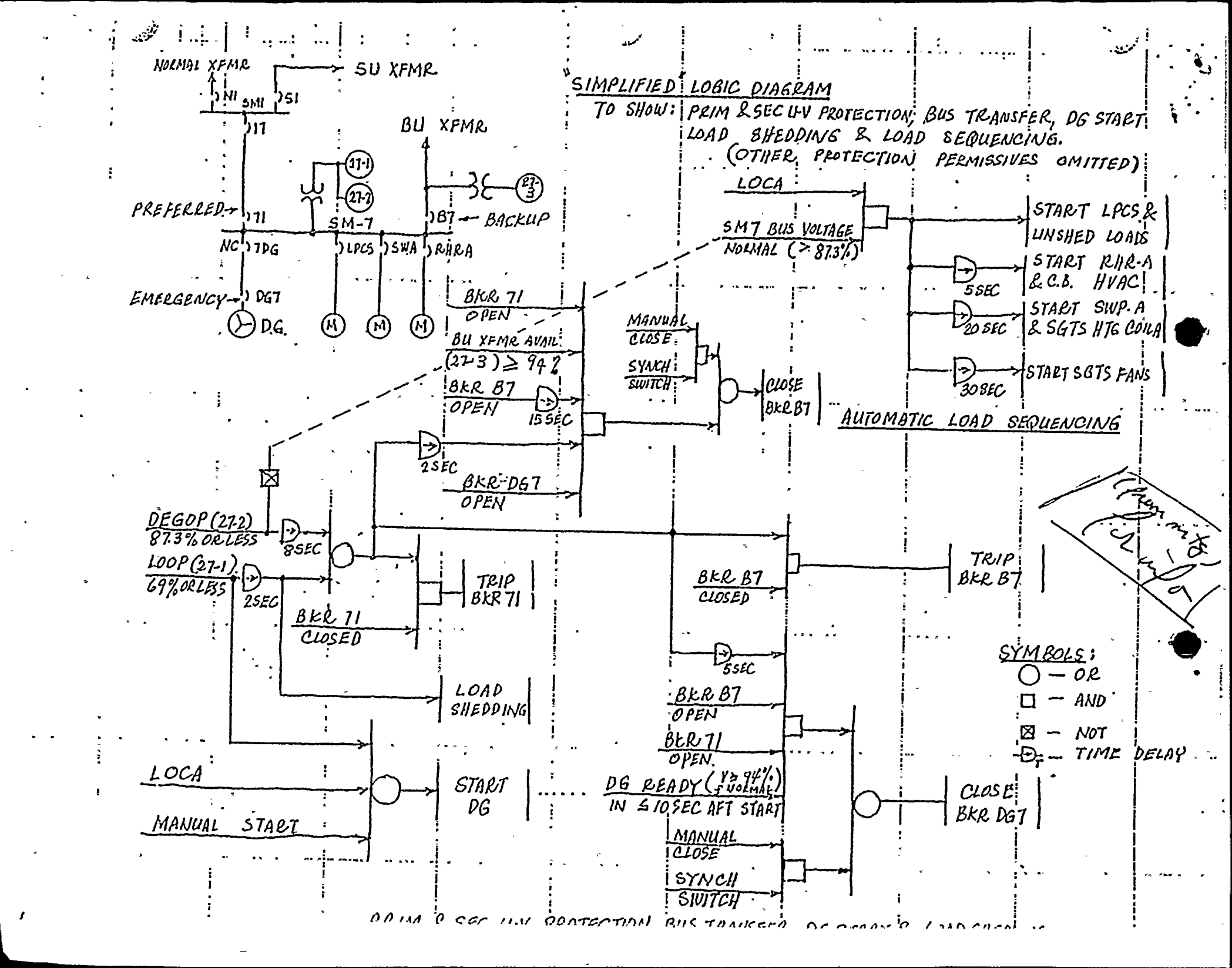
TABLE 8.3-2

DIVISION 2 DIESEL-GENERATOR LOADING SEQUENCE
AUTOMATIC AND MANUAL LOADING OF ENGINEERED SAFETY SYSTEMS BUS

				SHUTDOWN WITH LOSS OF OFFSITE POWER				LOCA WITH LOSS OF OFFSITE POWER			
	Item Description	No. On Bus	Total HP/KW Connected To Bus	No. Req'd Part Of Set	Time to Start (1)	Time to Stop	KW	No. Req'd Part Of Set	Time to Start (1)	Time to Stop	KW
1)	Motor Operated Valves (5)	Set	200kw	Set	0 Sec	(2)	-	Set	0 Sec	(2)	-
2)	Emergency Lighting & Power (7)	Set	122kw	Set	0 Sec	(4)	122	Set	0 Sec	(4)	122
3)	Diesel Auxiliaries & HVAC	Set	185kw	Set	0 Sec (3)	(3)	127	Set	0 Sec (3)	(3)	97
4)	RHR Water Leg Pump	1	15/12kw	1	0 Sec	(4)	12	1	0 Sec	(4)	12
5)	Standby Liquid Control Pump	1	40/33kw	-	-	-	-	-	-	-	-
6)	Standby Liquid Control Tank Heaters	2	50kw	1	0 Sec (3)	(3)	10	1	0 Sec (3)	(3)	10
7)	Fuel Pool Cooling & Cleanup Sys.	Set	50/40kw	Set	10 Hrs (4)	(4)	(40)	-	-	-	-
8)	Plant Service Water Pump B (7)	1	1500/1197kw	1	10 Sec	(4)	1197	-	-	-	-
9)	RHR Pumps B & C	2	1600/1284kw	1	10 Min (4)	(4)	(642)	2	5 Sec & 0 Sec	(4)	1284
10)	Standby Service Water Pump	1	1750/1377kw	1	20 Sec	(4)	1377	1	20 Sec	(4)	1377
11)	Cooling Tower Make-Up Water Pump (7)	* 2	1600/1270kw	1	Note 6 (4)	(4)	(635)	-	-	-	-
12)	Control Rod Drive Pump (7)	** 1	250/205kw	1	(4)	(4)	(205)	-	-	-	-
13)	Reactor Closed Cooling Pump	2	400/320kw	1	0 Sec	(4)	160	-	-	-	-
14)	Load Center Transformer Losses TR-8-81 & 8-83	2	45kw	2	0 Sec	Cont.	33	2	0 Sec	Cont.	33
15)	125 V Battery Charger	1	43kw	1	0 Sec	(4)	43	1	0 Sec	(4)	43
16)	Standby Gas Treatment Fans & Heater Coils	2	50/40kw	1	10 Min (4)	(4)	(20)	1	30 Sec	(4)	20
		2	45kw	-	-	-	-	2	20 Sec	(3)	45
17)	RPS Mg Set (7)	1	25/20kw	1	0 Sec	(4)	20	1	(4)	(4)	(20)
18)	Hydrogen Recombiner	1	10/44kw	-	-	-	-	1	60 Min (4)	(4)	(44)
19)	Drywell Cooling & Fans	Set	186kw	Set	0 Sec	(4)	186	-	-	-	-
20)	Control Air Compressor & Dryers (7)	1	100/126kw	1	1 Hr (4)	(4)	(126)	-	-	-	-
21)	Containment Instrument Air Compressor	1	15/12kw	1	0 Sec (3)	(4)	12	-	-	-	-
22)	Reactor Bldg. Elec. Equip. HVAC	Set	371kw	Set	0 Sec (3)	(4)	12	Set	0 Sec (3)	(4)	12
23)	Control Bldg. Elec. Equip. HVAC	Set	331kw	Set	0 Sec	(4)	61	Set	0 Sec	(4)	61
24)	Radwaste Bldg. Elec. Equip. HVAC (7)	Set	145kw	-	-	-	-	-	-	-	-
25)	Make-up Water Pumphouse Equip. HVAC (7)	**Set	90kw	Set	Note 6 (4)	(4)	(90)	-	-	-	-
26)	Standby Service Water Pumphouse	Set	40kw	Set	0 Sec	(4)	10	Set	0 Sec	(4)	10
				Total Automatically Applied			3382kw	Total Automatically Applied			3126kw

NOTE:
(1) Time to start after bus voltage and frequency have been established. Maximum time after signal to start generator for voltage to be established is 10 seconds.
(2) Motors stop automatically when valve action is completed.
(3) Start and/or stop automatically with associated pump or diesel, pressure, temperature switch or flow.
(4) Start and/or stop manually.
(5) Intermittent loads not included as long term loading.
(6) Available after one day.
For additional notes see bottom of Table 8.3-1.

(7) Items are non-Class 1E.


NORMAL XFMR
SU XFMR
NI
SMI
SI
11
BU XFMR
4
11-1
27-2
27-3
PREFERRED
71
SM-7
B7
BACKUP
NC
7DG
LPCS
SWA
RHRA
EMERGENCY
DGT
D.G.
M
M
M
SIMPLIFIED LOGIC DIAGRAM
TO SHOW: PRIM & SEC U-V PROTECTION, BUS TRANSFER, DG START
LOAD SHEDDING & LOAD SEQUENCING.
(OTHER PROTECTION PERMISSIVES OMITTED)
LOCA
SM7 BUS VOLTAGE
NORMAL (≥ 87.3%)
START LPCS & UNSHED LOADS
5SEC
START RHR-A & C.B. HVAC
20SEC
START SWP. A & SGTS HTG COILA
30SEC
START SGTS FANS
BKR 71
OPEN
BU XFMR AVAIL
(27-3) ≥ 94 %
MANUAL CLOSE
SYNCH SWITCH
CLOSE BKR B7
BKR B7
OPEN
15SEC
2SEC
BKR DG7
OPEN
AUTOMATIC LOAD SEQUENCING
DEGOP (27-2)
87.3% OR LESS
8SEC
LOOP (27-1)
69% OR LESS
2SEC
TRIP BKR 71
BKR 71
CLOSED
BKR B7
CLOSED
TRIP BKR B7
5SEC
LOAD SHEDDING
BKR B7
OPEN
BKR 71
OPEN.
LOCA
MANUAL START
START DG
DG READY (V ≥ 94% of NORMAL)
IN ≤ 10SEC AFT START
MANUAL CLOSE
SYNCH SWITCH
CLOSE BKR DG7
SYMBOLS:
— OR
— AND
— NOT
— TIME DELAY

starting the diesel generators)

In the event of sustained bus undervoltage (87.3% of ~~rated~~ nominal bus voltage lasting more than 8 seconds), the second level of undervoltage protection automatically ~~isolates~~ trips the feeder breaker connecting the normal/startup sources to their respective 4.16 kV Class 1E buses. This action results in loss of bus voltage, thereby initiating load shedding and energizing the three bus transfer timers mentioned in the primary undervoltage scheme above. In this case, however, the first two-second timer is bypassed. The second two-second timer permits closing of the backup source breaker and the five-second timer permits closing of the diesel generator breaker assuming a failure of the backup source breaker to close. Closure of the backup source and diesel generator breakers is permitted if the source voltage is at least 94% of normal.

(For Div 1 + 2 for the

Should the degraded voltage condition exist on the backup power source while the source is supplying the load, the second level undervoltage relays would then isolate that source, again initiating the sequence of events described for the secondary undervoltage sensing scheme above. However, closing of backup feeder breakers, as part of that sequence of events, is blocked.

When the Class 1E buses SM-7 and SM-8 are being fed from the turbine generator, the possibility of sustained undervoltage is not considered credible due to response characteristics of the voltage regulator and protection equipment for the unit.

The scheme described assures a power source within the acceptable voltage limits for the Class 1E loads at all times. Circuit design allows for testing of the individual relays, one at a time, without disrupting the protective function.

For division 3, the second level of undervoltage protection trips the normal/startup source breaker, thereby causing a loss of bus voltage. From this point on the primary undervoltage relay takes over and the ensuing sequence of events will be the same as in the case of the loss of off site power discussed above.

Note: ~~supply~~ bypass concurrence required.

8.3.1.2.4.3.2 Secondary Undervoltage Sensing

Static Class 1E undervoltage relays with definite time delay located in each of the redundant Division 1 and Division 2 4.16 kV Class 1E switchgear units are utilized for detection of sustained degraded voltage in the offsite power system. This protection scheme is designed to compliment the primary undervoltage scheme described above.

The trip setpoint of each relay is ~~set~~ at 3631 volts, corresponding to 87.3 percent of nominal bus voltage and 90.8 percent of nominal motor voltage. Trip setpoint selection is based upon insuring 90 percent of motor nominal voltage at the motor terminals, including allowance for feeder voltage drop. The relay automatically resets when the bus voltage recovers to 89.9% or more. Eight seconds of time delay is provided to permit override of motor starting dip. The duration of motor starting voltage dip is very short lived - in the order of 2 to 5 seconds. The second level of undervoltage relays will not, therefore, initiate actions for this condition.

The relays operate to isolate the degraded source and initiate the sequence of events to select the next available source. Circuit design precludes spurious voltage loss signal and allows for testing of the individual relay, one at a time, without disrupting the protective function. During a loss-of-coolant accident, diesel generator power is available to the emergency loads 13 seconds after the sustained degraded grid voltage condition is sensed at the emergency bus. The above time delay is DERIVED FROM This time delay is equal to the 8 sec delay prior to the offsite breaker trip plus a 5 sec delay prior to the DG breaker closure. acceptable since during a concurrent loss-of-coolant accident ~~(LOCA)~~, the emergency core cooling system (ECCS) coolant injection time requirements as specified in Table 6.3-1 are met.

See Figures 8.3-16C and 8.3-17C for the logic diagrams of Divisions 1 and 2 secondary undervoltage protection.

Note: Apply system concurrence required →

The same voltage trip and time delay setpoints are used for the Division 3 secondary undervoltage relays. For Division 3, however, the diesel generator power is available at the bus 11 sec after a coincident occurrence of a loss-of-coolant accident and a degraded grid condition. See Figure 8.3-18C for the Division 3 secondary undervoltage protection logic diagram. The HPCS injection time requirement of Table 6.3-1 is also met.

This time delay is equal to the 8 second delay prior to the offsite breaker trip plus a 3 second delay prior to the DG breaker closure.

during an accident with

* Assume that the emergency motor loads are running a subsequent degradation of off-site grid voltage occurs Assuming further that the degraded voltage is anywhere between 69% and 87.3% of the bus nominal voltage; the following analysis shows that the motor loads remain adequately protected and ready for a restart as soon as the power supply has been restored to normal. Under the above condition the emergency motors would be exposed (approximately) to a terminal voltage between 72% and 90% of nameplate value. For terminal voltages between 80% (or 75% for the HPCS pump motor) and 90%, the motor will continue to run overloaded up to 125% (133% for the HPCS pump motor) of full load current*. For voltages less than 80% (75% for the HPCS pump motor), the motor torque could be less than the load torque, thus resulting in deceleration and eventual stalling.

~~The motors can safely carry this overload for 8 seconds.~~

The motors are protected against locked rotor conditions by a relay which trips and locks out in 10 seconds. Since the secondary undervoltage relaying is set to trip the offsite source breaker 8 seconds after the undervoltage condition develops, the locked rotor protective relay will not trip. Load shedding after the 8th second trips the motors without locking them out. A subsequent motor restart when power supply is restored will expose the motor to locked rotor currents for another 5 seconds as a maximum.

* - The motors can safely carry this overload for 8 seconds. 8.3-52b

The total ~~locked rotor~~ stall time is therefore equal to 13 seconds. This is less than the designed motor safe stall time ~~which is~~ of 14 seconds at rated terminal voltage or greater than 17 seconds at voltages less than 90% of rated. Since the voltage at the motor is assumed to be less than 90% of nameplate value, it ~~is concluded~~ follows that there is sufficient margin between the motor stall time under the above worst case conditions, and the ~~the~~ designed motor safe stall time.

If on the other hand it is assumed that the motor starting signal comes after the occurrence of the degraded grid voltage condition, the emergency motors are prevented from starting until the voltage has been restored to normal. This is accomplished by instantaneous interlocks from the secondary undervoltage relays to the motor starting circuit or by time delay ~~relays per Provide~~ relays which ~~allows~~ delay motor starting following the accident signal, as in the case of the standby service water pumps.

The primary undervoltage sensing scheme for the 4.16 kV Class 1E distribution system utilizes instantaneous under-voltage relays to start the Divisionn 1, 2 and ~~—~~ 3 standby diesel-generators immediately upon loss of voltage at their associated 4.16 kV Class 1E switchgear buses. These relays also energize ~~two-second~~ timers which allow the system to attempt to establish supply from the startup source (if the plant is operating from the normal source at the time) or verify that voltage loss is maintained (if the plant is operating from the startup source initially).

In the event that voltage loss is maintained for two seconds, the Division 1 and/or 2 timers trip the Class 1E bus normal/startup source breakers, institute load shedding, and energize additional two-second and five-second timers. The second two-second timer are utilized to attempt closing of the backup source breakers; backup transformer undervoltage relays will inhibit breaker closure in the event of backup source undervoltage. The five-second timers are used to inhibit closure of the diesel generator breakers until the system has had time to attempt re-establishment of supply via the backup source. Since there is no provision for transfer to the Division 3 4.16 kV Class 1E bus ~~cannot be supplied by~~ the backup source, its diesel generator breaker closes via signals from the single Division 3 three-second timer, which is energized by the bus undervoltage relay.

Refer to 8.3.1.1.8.1.7 and 8.3.1.1.8.2.7 for additional discussion of the standby diesel generator starting and loading systems.

A second level of undervoltage protection is provided to protect against the effects of prolonged degraded voltage which could adversely affect the operation of Class 1E electric motors requiring at least 90% of the ~~rated~~ nameplate voltage for continuous operation. (See Table 8.3-13.) For this reason, Class 1E bus SM-7 and SM-8 voltages are monitored by an additional set of Class 1E undervoltage relays. Three static type undervoltage relays are provided for each bus and are connected ~~in such a manner~~ as to monitor all three line voltages (i.e., phases AB, BC, & CA). The arrangement utilizes a 2-out-of-3 logic to preclude the possibility of spurious voltage loss signal and facilitate testing.

SM-4, ← Note: Supply bys. concurrent required

Hold for new addition