The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

July 18, 1985
ST-HL-AE-1298
File No.: G4.2

Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Closeout of ICSB Meeting Item Regarding
Auxiliary Feedwater Turbine Control

Dear Mr. Knighton:

During the week of March 26 through 29, 1985, Houston Lighting & Power Company (HL&P) representatives met with members of the NRC Instrumentation and Control Systems Branch (ICSB) staff in the Houston office and at the jobsite to discuss issues and questions regarding the South Texas Project (STP) instrumentation and controls design features and program implementation. Meeting notes for this meeting were provided to the NRC via letter ST-HL-AE-1239 dated May 13, 1985 from M. R. Wisenburg to G. W. Knighton.

In Attachment 5 ("Action Items") to the meeting notes we committed to provide a response to ICSB item 32 regarding Auxiliary Feedwater (AFW) turbine control design. Our commitment was to provide new design information in Final Safety Analysis Report (FSAR) Amendment 49 in mid-July, 1985. The attached marked-up FSAR pages have been approved as shown for incorporation into the FSAR in response to the subject item. These pages are provided at this time to expedite your review. They will be formally incorporated into a future FSAR amendment.

If you should have any questions, please contact Mr. M. E. Powell at (713) 993-1328.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

CAA/as
Attachments: Marked-up FSAR pages

W2/NRC4/d

B001
1/1

cc:

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Washington, DC 20555

Attachment
ST-HL-AE-1298
File No.: G4.2

Marked-up FSAR Text
Auxiliary Feedwater Turbine Control

W2/NRC4/d

b. Atmospheric steam relief valves (Main Steam [MS] Safety Valves* and SG Power-operated relief valves)

c. Pressurizer backup heaters

d. Centrifugal charging pumps*

e. Boric acid transfer pumps*

f. Letdown stop valves*

2. Supporting Systems and Components

a. Essential cooling water (ECW) pumps *

b. Component cooling water (CCW) pumps*

c. Reactor Containment fan coolers (RCFCs)*

d. Standby diesel generators (SBDG) (and associated onsite electrical distribution system)*

e. Control room ventilation*

f. Emergency Ventilation System for those areas housing equipment required for safe shutdown* 41 Q32.39

3. Essential Monitoring Indicators

a. Steam Generators (SGs)

1) Water level for each SG*

2) Pressure for each SG*

b. Reactor Coolant System (RCS)

1) Pressurizer water level*

2) RCS wide-range pressure*

3) RCS wide-range temperature (^{T}hot and ^{T}cold)*

editors: the "hot" and "cold" should be subscripted. The "T" is not a superscript.

c. Auxiliary Feedwater System

1) Auxiliary feedwater (AFW) flow to each SG*

d. Chemical and Volume Control System (CVCS)

1) Charging flow

*Essential systems and components for safe shutdown

2) RCP seal injection flow 41

e. Condensate Storage and Transfer System Q32.3

1) Auxiliary feedwater storage tank (AFST) level*

The description and design criteria for the essential monitoring indicators are described in Section 7.5 and Appendix 7B. 41

the ESF Actuation System as discussed in Section 7.3.1.

7.4.1.1 Auxiliary Feedwater Control. The AFWS consists of three motor-driven pumps and one steam turbine-driven pump, associated piping, valves, instruments, and controls as shown in Figure 10.4.9-1. The three motor-driven pump trains and the turbine-driven pump train are started automatically by ~~signals from the actuation logic shown in Figure 7.2-10~~. All four pumps can be started manually from the control room or the ASP. Each pump feeds one SG through an individual auxiliary feedwater line. Flow control is provided by individual, motor-operated regulator valves that can be manually controlled from the control room or the ASP. AFW flow indication and SG level for each SG is provided in the control room and on the ASP. 4 4 2 Q 32.16 4

Each AFW pump may be remote-manually cross-connected in absence of a safety actuation signal to feed any combination of steam generators if instrument air is available. Manual valve operability is also provided.

Replace with Insert I

~~The AFW pump turbine is supplied with steam from one main steam line through a normally open motor-operated stop-check valve (the steam inlet valve) and the normally closed turbine trip and throttle valve. These valves are automatically opened by the AFW auto-start signals. Manual control of the steam inlet valve and the turbine trip and throttle valve is provided in the control room and on the ASP. Nonsafety-grade manual speed control is also provided in the control room and on the ASP for the AFW pump turbine.~~ 41

Status indication is provided in the control room and at the ASP for the motor-driven pumps, steam inlet valveS, turbine trip and throttle valve, regulator valves and isolation valves.

The AFWS is described in Section 10.4.9. 2

1. Initiating Circuits Q32.

The motor-driven pumps are immediately started on a two-out-of-four low-low water level signal from any SG and are started by the Engineered Safety Feature (ESF) load sequencers following a safety injection (SI) signal or a LOOP. The AFW valves are automatically actuated to their proper position by a two-out-of-four low-low water level signal from any SG or a SI signal. The flow to the SGs is not automatically provided after a LOOP until a SG low-low water level signal or a SI signal is received. The Qualified Display Processing System (QDPS) controls the flow into the SGs through the AFW regulator valves within prescribed limits (see Section 7.5). 41

As noted above, the AFW turbine steam inlet valve opening is delayed to assure proper turbine speed control.

*Essential systems and components for safe shutdown

Insert I

The AFW turbine driven pump is supplied with steam from S/G 1D through the steam inlet valve, the steam inlet bypass valve and the turbine trip throttle valve. The steam inlet valve and the steam inlet bypass valve are both normally closed. When open, they allow steam flow to the normally open turbine trip throttle valve. These valves all receive open signals on an AFW initiation. The steam inlet valve receives its open signal through a time delay (approximately ~~x~~ 15 sec.). This time delay allows steam flow thru the steam inlet bypass valve and bypass orifice to accelerate the turbine to a speed which allows the turbine governor to assume speed control prior to the steam inlet valve opening. Manual control of the steam inlet valve, steam inlet bypass valve and the turbine trip throttle valve is available in the Control Room and on the ASP.

2. Logic 2

See Figure 7.2-16. Q32.16

3. Bypass

Control from the control room and automatic control are bypassed at the transfer switch panels when control is transferred to the ASP. This 41 transfer of control is alarmed and indicated in the control room through the ESF Status Monitoring System (see Section 7.5.4).

4. Interlocks

There are no interlocks.

5. Redundancy

Four level sensors for each steam generator and three actuation channels are provided for system actuation logic redundancy. Any two of the four 41 auxiliary feedwater pumps provide sufficient feedwater for safe shutdown requirements.

6. Diversity

The SI signal and SG level signals are provided for actuation diversity. 41 AFWS diversity is provided by motor-driven pumps and one turbine driven pump. 2 Q32.16

7. Actuated Devices

Actuated devices are listed in Table 7.3-~~12~~15. 41

8. Supporting Systems

The Class 1E electric systems are required for AFW control. Ventilation 41 support is required (see Section 9.4). The AFST is required (see Section 10.4.7).

9. Portion of System Not Required for Safety

The ESF Status Monitoring System ~~and the manual speed control for the turbine driven pump are~~ is not required for safety. 41

10. Design Basis Information

Design bases for the AFWS are that the operation will be controlled automatically by the Engineered Safety Features Actuation System (ESFAS) or manually from the control room or the ASP and that no single failure will prevent the system from performing the required safety function. The 41 AFWS design basis is discussed in detail in Section 10.4.9.1.

7.4.1.2 Atmospheric Steam Relief. The MS safety valves and the SG 41 power-operated relief valves (PORVs) are located upstream of the main steam isolation valves outside of the Containment, and both provide a means of

7.4.2.1 Analysis for Auxiliary Feedwater Controls.

1. Conformance to NRC General Design Criteria (GDC)

   a. GDC 13

      Instrumentation necessary to monitor station variables associated with safe shutdown is provided in the main control room and at the ASP. Controls for the AFW are provided at each location. A description of the surveillance instrumentation is provided in Section 7.5.

   b. GDC 19

      All controls and indications required for safe shutdown of the reactor are provided in the main control room. In the event that the main control room must be evacuated, adequate controls and indications are located outside the main control room to (1) bring to and maintain the reactor in a safe shutdown condition and (2) provide potential capability to achieve cold shutdown. 41

      The ASP and the transfer switch panels, located outside the main control room, are described in Section 7.4.1.9. 41

   c. GDC 34

      The AFW provides an adequate supply of feedwater (FW) to the SGs to remove reactor decay heat following reactor trip. Two SGs with AFW supply are sufficient to remove reactor decay heat without exceeding design conditions of the RCS. 41

2. Conformance to NRC Regulatory Guides (RGs) 2

   a. RG 1.22 The AFW controls are designed to allow periodic testing to satisfy Technical Specification requirements. Q32.1 Q32.16

      ~~The PORV controls can be tested periodically. The MS safety valves will be tested at intervals to be identified in the Technical Specifications.~~

   b. RG 1.29

      The AFW controls are designed to withstand the effects of an earthquake without loss of function or physical damage. The AFW control system is classified seismic Category I in accordance with the guide.

3. Conformance to IEEE 279-1971

   The AFW controls are designed to conform to the applicable portions of IEEE 279-1971. The control and actuation circuits are designed such that any single failure will not prevent proper protective action (adequate AFW supply) when required. This is accomplished by redundant systems. Each AFW train, including valves, utilizes control power from independent Class 1E power systems.

TABLE 7.3-15

AUXILIARY FEEDWATER INITIATION ACTUATED EQUIPMENT LIST

Equipment Identification	Description	ESF Train	Function	Figure No.	P&ID Number
11	AFW pump	A	Start*	10.4.9-1	9F00024
12	AFW pump	B	Start*	10.4.9-1	9F00024
13	AFW pump	C	Start*	10.4.9-1	9F00024
FV-7518	AFW crossover valve	A	Close	10.4.9-1	9F00024
FV-7517	AFW crossover valve	A	Close	10.4.9-1	9F00024
FV-7516	AFW crossover valve	B	Close	10.4.9-1	9F00024
FV-7515	AFW crossover valve	C	Close	10.4.9-1	9F00024
FV-7523	AFW regulator valve	C	Open	10.4.9-1	9F00024
FV-7524	AFW regulator valve	B	Open	10.4.9-1	9F00024
FV-7525	AFW regulator valve	A	Open	10.4.9-1	9F00024
FV-7526	AFW regulator valve	A	Open	10.4.9-1	9F00024
MS0143	AFW turbine pump steam inlet valve	A	Open**	10.4.9-1	9F00024
XMS0514	AFW pump turbine trip and throttle valve	A	Open	10.4.9-1	9F00024
~~SY-7538A~~	~~AFW turbine speed control~~	~~A~~	~~Deenergize~~	~~10.4.9-1~~	~~9F00024~~
AF0019	AFW turbine pump isolation valve	A	Open	10.4.9-1	9F00024
AF0048	AFW pump isolation valve	A	Open	10.4.9-1	9F00024
AF0065	AFW pump isolation valve	B	Open	10.4.9-1	9F00024

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Q32.16

** After a time delay to assure proper turbine speed control (see Section 10.4.9)

* Through ESF load sequencer

TABLE 7.3-15 (Continued)

AUXILIARY FEEDWATER INITIATION ACTUATED EQUIPMENT LIST

Equipment Identification	Description	ESF Train	Function	Figure No.	P&ID Number
AF0085	AFW pump isolation valve	C	Open	10.4.9-1	9F00024
FV-0143	AFW pump turbine steam inlet bypass valve	A	Open	10.4.9-1	9F00024
FV-4150	Steam generator blowdown valve	A	Close	10.4.8-1	9F20001
FV-4151	Steam generator blowdown valve	C	Close	10.4.8-1	9F20001
FV-4152	Steam generator blowdown valve	B	Close	10.4.8-1	9F20001
FV-4153	Steam generator blowdown valve	A	Close	10.4.8-1	9F20001
FV-4186	Steam generator sample isolation valve	A	Close	10.4.8-1	9F20001
FV-4187	Steam generator sample isolation valve	C	Close	10.4.8-1	9F20001
FV-4188	Steam generator sample isolation valve	B	Close	10.4.8-1	9F20001
FV-4189	Steam generator sample isolation valve	A	Close	10.4.8-1	9F20001

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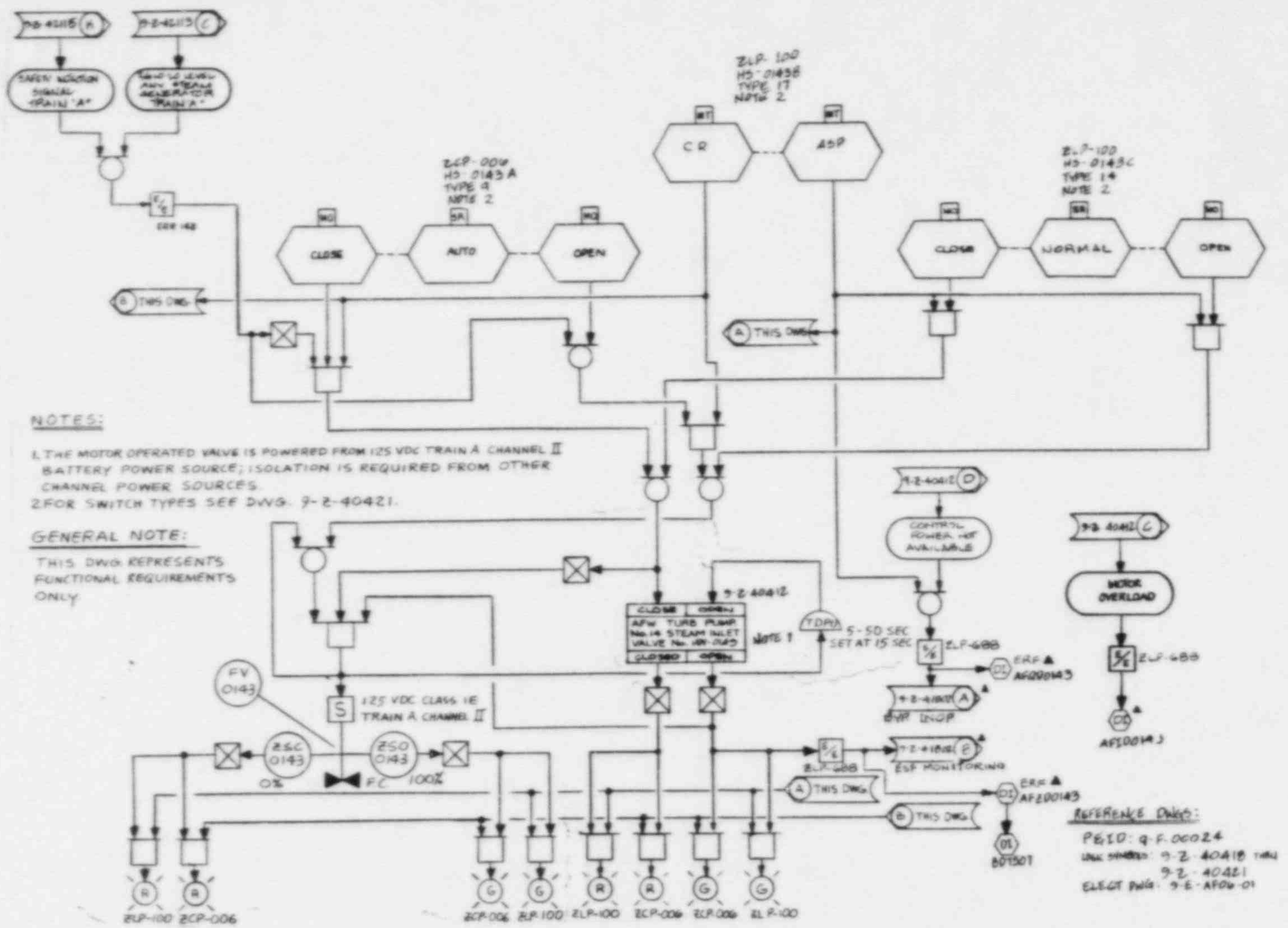
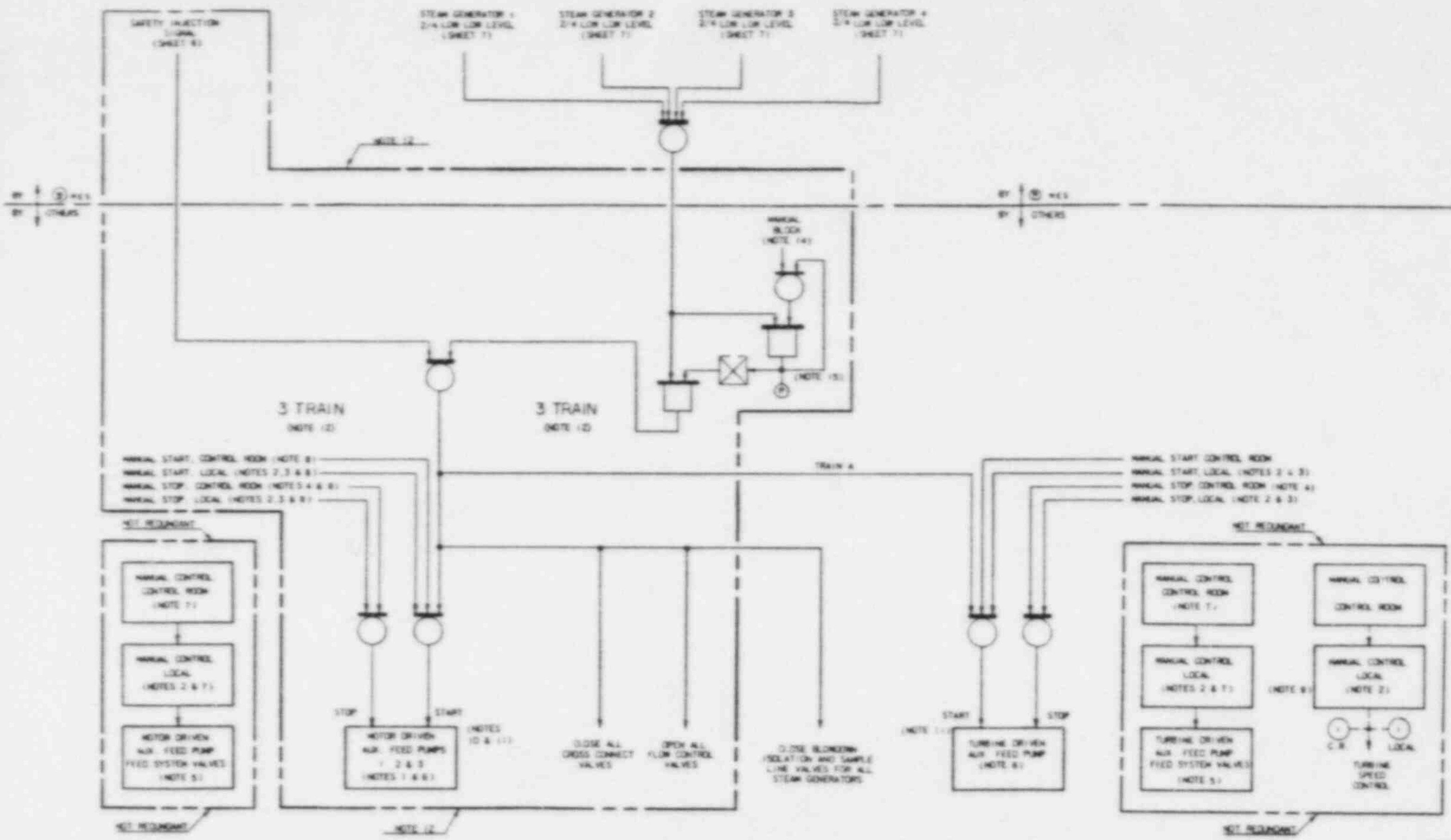


SOUTH TEXAS PROJECT
UNITS 1 & 2

AFW TURBINE STEAM
INLET VALVE
SYSTEM: AF

Dwg. 5S14-9-Z-40132 Rev. 3

Figure 7.3-21A



NOTES:

1. TRAIN A CONTROLS MOTOR AUXILIARY FEEDWATER PUMP 1.
TRAIN B CONTROLS MOTOR AUXILIARY FEEDWATER PUMP 2.
TRAIN C CONTROLS MOTOR AUXILIARY FEEDWATER PUMP 3.
2. LOCAL CONTROL OVERRIDES ALL OTHER SIGNALS.
3. LOCAL OVERRIDE ACTUATES ALARM IN CONTROL ROOM.
4. MANUAL STOP AND PULL OVERRIDES THE AUTOMATIC START. MANUAL STOP OVERRIDE ACTUATES AN ALARM IN THE CONTROL ROOM.
5. OPEN/SHUT INDICATION IN CONTROL ROOM.
6. PUMP OPERATING LIGHTS IN CONTROL ROOM.
7. INDIVIDUAL FOR EACH VALVE.
8. INDIVIDUAL FOR EACH PUMP.
9. THE TURBINE SPEED CONTROL IS TYPICAL. ACTUAL IMPLEMENTATION MAY NOT INCLUDE SPEED CONTROL.
10. THE PUMP START MAY BE DELAYED AND SEQUENCED IF THE EMERGENCY DIESEL POWER CAPABILITY IS LESS THAN THE TOTAL LOAD WITH ALL SYSTEMS STARTING. THE TIME DELAY, IF USED, MAY NOT EXCEED THE MAXIMUM STARTING TIME REQUIREMENTS FOR THIS SYSTEM.
11. THE PUMP START MUST BE SEALED IN (LATCHED), SO THAT LOSS OF THE ACTUATION SIGNAL WILL NOT CAUSE THE PUMP TO STOP.
12. THE ENCLOSED REDUNDANT LOGIC OUTPUT CIRCUITS ARE BUILT IN THE THREE OUTPUT TRAINS A, B, AND C. THAT IS EVERY LOGIC CIRCUIT SHOWN HAS A DUPLICATE AND A TRIPLICATE LOCATED IN SEPARATE CABINETS.
13. A LOSS OF OFFSITE POWER SHOULD NOT CAUSE ACTUATION OF THE AUXILIARY FEEDWATER SYSTEM, EXCEPT BY THE WAY OF THE LOW-LOW STEAM GENERATOR LEVEL SIGNAL.
14. THE REDUNDANT MANUAL BLOCK CONSISTS OF THREE MOMENTARY CONTROLS ON THE CONTROL BOARD, ONE FOR EACH TRAIN.
15. THREE STATUS LIGHTS ARE CONNECTED TO THIS CIRCUIT, INDIVIDUAL FOR EACH TRAIN.

SOUTH TEXAS PROJECT
UNITS 1 & 2

FUNCTIONAL DIAGRAM
AUXILIARY FEEDWATER
PUMPS STARTUP
(SHEET 16)

Figure 7.2-16

TABLE 7.4-1 (Continued)

CONTROLS AND MONITORING INDICATORS

LOCATED ON THE AUXILIARY SHUTDOWN PANEL

ITEM NO.[a]	DEVICE DESCRIPTION[b]	INSTR. TAG NO.[c]	POSITION[d]	SEPARATION GROUP[e]
100K004	SG 1D PORV PV-7441	D1MS-PK-7441A	N/A	D
~~100K005~~	~~AFW PUMP 14 TURB~~ SPEED CONTROL	~~N1AF-SK-7538A~~	~~N/A~~	~~N~~
100K006	RHR HX 1A BYPASS FLOW CONTROL	N1SI-HK-0851	N/A	N
100K007	RHR HX 1B BYPASS FLOW CONTROL	N1SI-HK-0852	N/A	N
100K008	RHR HX-1C BYPASS FLOW CONTROL	N1SI-HK-0853	N/A	N
100K009	RX HEAD VENT THROTTLE VLV HCV-602	B1RC-FK-602A	N/A	B
100K010	RX HEAD VENT THROTTLE VLV HCV-601	A1RC-FK-601A	N/A	A
100K011	RHR HX 1A OUTLET TEMP CONTROL HCV-0864	N1RH-HK-0864	N/A	N
100K012	RHR HX 1B OUTLET TEMP CONTROL HCV-0865	N1RH-HK-0865	N/A	N
100K013	RHR HX 1C OUTLET TEMP CONTROL HCV-0866	N1RH-HK-0866	N/A	N
100K014	CHARGING FLOW CONTROL	N1CV-FK-0205A	N/A	N
100M001	PLASMA DISPLAY QDPS	N/A	N/A	C
100M002	PLASMA KEYBOARD QDPS	N/A	N/A	C

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TABLE 7.4-1 (Continued)

CONTROLS AND MONITORING INDICATORS

LOCATED ON THE AUXILIARY SHUTDOWN PANEL

ITEM NO.[a]	DEVICE DESCRIPTION[b]	INSTR. TAG NO.[c]	POSITION[d]	SEPARATION GROUP[e]	
100S010	LETDN ORIFICE ISOL VLV MOV-0014	C1CV-HS-0014A	CLOSE OPEN	C	
100S011	BORIC ACID TRANSFER PMP 1A	C1CV-HS-0209C	STOP START	C	
100S012	BORIC ACID TRANSFER PMP 1B	A1CV-HS-0209E	STOP START	A	
100S013	AFW PMP #14 TURB TRIP & THROTTLE VALVE	D1AF-HS-0514B	CLOSE OPEN	D	
100S014	AFW PUMP #14 TURB STEAM INL VALVE MOV-0143 / FV-0143	D1AF-HS-0143C	CLOSE OPEN	D	41
100S015	AUX FW PMP 11 ISO VLV MOV-0048	A1AF-HS-0048C	CLOSE OPEN	A	
100S016	AUX FW PMP 12 ISOL VLV MOV-0065	B1AF-HS-0065C	CLOSE OPEN	B	
100S017	AUX FW PMP 13 ISO VLV MOV-0085	C1AF-HS-0085C	CLOSE OPEN	C	
100S018	STM GEN 1D AUX FW ISOL VLV MOV-0019	D1AF-HS-0019C	CLOSE OPEN	D	
100S019	AFW PUMP #14 STM INL ~~VLVE~~ VALVES ~~MOV-0143C~~ TRANSFER SWITCH MOV-0143/ FV-0143	D1AF-HS-0143B	CR ASP	D	

TABLE 7.4-1 (Continued)

CONTROLS AND MONITORING INDICATORS

LOCATED ON THE AUXILIARY SHUTDOWN PANEL

ITEM NO.[a]	DEVICE DESCRIPTION[b]	INSTR. TAG NO.[c]	POSITION[d]	SEPARATION GROUP[e]
100S020	AFW TURB TRIP & THROTTLE VALVE TRANSFER SWITCH	D1AF-HS-0514C	CR ASP	D
100S021	AFW TURB PUMP ISOL VALVE MOV-0019 TRANSFER SWITCH	D1AF-HS-0019B	CR ASP	D
100S022	PRESSURIZER PORV PCV-0656A	B1RC-HS-0656B	CLOSE OPEN	B
100S023	PRESSURIZER PORV PCV-0655A	A1RC-HS-0655B	CLOSE OPEN	A
100S024	RHR PUMP 1A INLET ISOL VLV MOV-0060A	A1RH-HS-0060G	CLOSE OPEN	A
100S025	RHR PUMP 1C INLET ISOL VLV MOV-0061C	A1RH-HS-0061I	CLOSE OPEN	A
100S026	RHR PUMP 1B INLET ISOL VLV MOV-0060B	B1RH-HS-0060H	CLOSE OPEN	B
100S027	RHR PUMP 1A INLET ISOL VLV MOV-0061A	B1RH-HS-0061A	CLOSE OPEN	B
100S028	RHR PUMP 1C INLET ISOL VLV MOV-0060C	C1RH-HS-0060I	CLOSE OPEN	C
100S029	RHR PMP 1B INLET ISOL VLV MOV-0061B	C1RH-HS-0061H	CLOSE OPEN	C
100S030	ACC TK 1A DISCH ISOL VLV MOV-0039A	A1SI-HS-0039J	CLOSE OPEN	A

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TABLE 7.4-1 (Continued)

CONTROLS AND MONITORING INDICATORS

LOCATED ON THE AUXILIARY SHUTDOWN PANEL

ITEM NO.[a]	DEVICE DESCRIPTION[b]	INSTR. TAG NO.[c]	POSITION[d]	SEPARATION GROUP[e]
100S039	SG 1D AFW FLOW CONTROL VLV FV-7526	D1AF-HS-7526	JOG CLOSE JOG OPEN	D
100S040	ACC TK 1C DISCH ISOL VLV MOV-0039C	C1SI-HS-0039P	POWER OFF POWER ON	C
100S041	SG 1D AFW FLOW CONTROL VLV FV-7526 TRANSFER SWITCH	D1AF-HS-7526B	CR ASP	D
100S042	MSIV ABOVE SEAT DRN ISOL VLV FV-7900A	A1MT-HS-7900	CLOSE OPEN	A
100S043	RCS ISOL VLV RVHVS FV-3658A	A1RC-HS-3658C	CLOSE OPEN	A
100S044	SG 1D PORV TRANSFER SWITCH	D1MS-HS-7441	CR ASP	D
100S045	PRZR PORV BLOCK VLV MOV-0001A	A1RC-HS-0001C	CLOSE OPEN	A
100S046	RCS ISOL VLV RVHVS FV-3657A	A1RC-HS-3657C	CLOSE OPEN	A
100S047	RCS ISOL VLV RVHVS FV-3657B	B1RC-HS-3657E	CLOSE OPEN	B
100S048	RCS ISOL VLV RVHVS FV-3658B	B1RC-HS-3658E	CLOSE OPEN	B
100S049	PRZR PORV BLOCK VLV MOV-0001B	B1RC-HS-0001E	CLOSE OPEN	B
100S050	AFW PUMP 14 TURB TRIP	D1AF-HS-7537B	TRIP	D

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TABLE 7.4-1 (Continued)

CONTROLS AND MONITORING INDICATORS

LOCATED ON THE AUXILIARY SHUTDOWN PANEL

ITEM NO.[a]	DEVICE DESCRIPTION[b]	INSTR. TAG NO.[c]	POSITION[d]	SEPARATION GROUP[e]
100S051	AFW PUMP 14 TURB TRIP	D1AF-HS-7537C	CR ASP	D
100S052	ACC TK 1A DISCH ISOL VLV -0038A	A1SI-HS-0039M	POWER OFF POWER ON	A
100S053	ACC TK 1B DISCH ISOL VLV MOV-0039B	B1SI-HS-0039N	POWER OFF POWER ON	B
100S054	MSIV ABOVE SEAT DRN ISOL VLV FV-7901A	A1MT-HS-7901	CLOSE OPEN	A
100S055	MSIV ABOVE SEAT DRN ISOL VLV FV-7902A	B1MT-HS-7902	CLOSE OPEN	B
100S056	MSIV ABOVE SEAT DRN ISOL VLV FV-7903A	B1MT-HS-7903	CLOSE OPEN	B

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/Category	Sensor Qualification		Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication	TSC Indication	Conformance to RG 1.97, Rev. #2
			Environmental	Seismic							
RHR Valve Status	Open/Closed	D2	Yes	Yes (Isolation Valves Only)	1 per valve	1 pair of lights per valve	Core Load	1E/N-1E	Yes	Yes	Conforms (Note f)
Reactor Trip Breaker Position	Open/Closed	D2	Yes	Yes	1 per breaker	1 pair of lights per breaker	Complete	1E	Yes	Yes	Conforms (Note f)
Turbine Governor Valve Position	Open/Closed	D2	Yes	No	1 per valve	1 pair of lights per valve	Complete	N-1E	Yes	Yes	Conforms (Notes f,z)
Turbine Stop Valve Position	Open/Closed	D2	Yes	No	1 per valve	1 pair of lights per valve	Complete	N-1E	Yes	Yes	Conforms (Notes f,z)
Motor-Driven Auxiliary Feedwater Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Core Load	1E	Yes	Yes	Conforms (Note f)
Auxiliary Feedwater Turbine Pump Status	~~0-5000 rpm~~ Open/Closed	D2	Yes	Yes	~~1 turbine speed indicator,~~ 1 per steam inlet valve	~~1 meter,~~ 1 pair of lights per valve	Core Load	1E	Yes	Yes	Conforms (Note f)
SI Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Complete	1E	Yes	Yes	Conforms (Note f)
SI Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Complete	1E	Yes	Yes	Conforms (Note f)
Essential Cooling Water Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Complete	1E	Yes	Yes	Conforms (Note f)
CCW Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Complete	1E	Yes	Yes	Conforms (Note f)

40

The turbine is a tandem-compound, six-flow, 40-in., last-stage-blade, 1,800-rpm machine installed outdoors on a turbine pedestal. Steam is supplied to the unit at a throttle design pressure of 1,060 psia and 0.25-percent moisture from four SG's.

The turbine guaranteed rating is 1,311,838 Kw at a backpressure of 3.5 in. Hg abs. and 0-percent makeup.

Turbine overspeed protection is discussed in Section 10.2.

The rating of the electric generator is 1,504,800 Kva, 60 Hz, 0.90 power factor, and short circuit ratio equal to 0.58 corresponding to the maximum expected turbine capability at 1.5 in. Hg condenser pressure.

The turbine shaft and the SG feed pump turbine shafts are sealed to prevent inleakage of air to the turbines or outleakage of steam.

The three-shell condenser is of the single-pass type.

Circulating water for the condenser is provided from a reservoir, where heat is primarily rejected into the atmosphere by surface evaporation and radiation.

Three condenser vacuum pumps are provided for hogging the condenser before startup and continuous air removal during operation.

A condensate polishing demineralizer system is provided for removing impurities and facilitating good feedwater purity control. 39

To enable the NSSS to follow turbine load reductions which may exceed transient load-changing capabilities, the Turbine Bypass System, designed for 40-percent of rated steam flow, is provided to give a maximum load rejection capability, in conjunction with a 10-percent reactor power decrease, of 50-percent rated steam flow without a trip. 39

An Auxiliary Feedwater (AFW) System primarily functions to supply FW available to the SGs whenever the normal FW supply is not available. It is also ~~used~~ during hot and cold shutdown to back up the main FW system. No radiation shielding is required for the components and piping of the Steam and Power Conversion System. 39

The system safety-related components included in the Steam and Power Conversion System are: 39

1. Main steam isolation valves (MSIVs) and MSIV bypass valves

2. SG power-operated relief valves

3. SG safety valves

4. MS lines extending from the SG to the downstream side of the torsional and moment restraint located in the IVC wall. 39

5. FW isolation valves

valves, flash tank level, and flash tank steam discharge valves from the control room. The SG blowdown and sample Containment isolation valves are closed automatically by the signals initiating the start of the AFW System. (See Section 10.4.9.5 for a discussion of AFW control.) The SG blowdown inlet flow control valves are controlled automatically by flow transmitters and controllers which maintain the blowdown flowrate from each SG to the flash tank. 39

Flash tank level is maintained by controlling the flash tank condensate drain to the condenser with a flow override to prevent excessive flow through the blowdown demineralizers when the blowdown flowrate is increased above normal. Flash tank pressure is maintained by controlling flash tank steam flow to the FW heater 13, with a provision of bypassing this steam to the condenser if the heater is out of service and also on turbine trip. Blowdown water temperature to the demineralizers is regulated by a control valve in the cooling water outlet line from the SG blowdown regenerative heat exchanger. A blowdown flash tank safety relief valve provides overpressure protection. 39

Blowdown flowrate from each SG, blowdown flash tank pressure and temperature, and steam and liquid flowrate from the flash tank are displayed in the control room. High and low water levels in the flash tank are alarmed on a control room annunciator. High blowdown flowrate and high and low flash tank pressures are displayed on the plant computer and on an annunciator. 39

High blowdown water temperature at the SG blowdown regenerative heat exchanger outlet is alarmed in the control room. This high temperature also terminates the blowdown water flow to the mixed-bed demineralizers. On high level in the flash tank, the control valve at the flash tank outlet line (which goes directly to the condenser, bypassing the HXs and the demineralizers) is modulated to maintain proper flash tank water level. Local pressure gauges are furnished throughout the system, and a level gage is installed on the blowdown flash tank. 39

10.4.8.5 Tests and Inspections. Periodic tests and recalibration will be performed on flow, pressure, and temperature indicators. The system isolation valves will be periodically tested to check operability in accordance with ASME B&PV Code, Section XI. In addition, periodic inspection and preventive maintenance will be conducted on components as required. Valving and system arrangement will be such as to make all components available for inspection. Active components are so designed that they can be tested during plant operation. 39

10.4.9 Auxiliary Feedwater System

10.4.9.1 Design Bases. The function of the AFW System is to supply FW to the secondary side of the SGs whenever the normal FW supply is not available. Causes and analyses for conditions which require the use of the AFW System, including loss of coolant from small breaks, are discussed in Chapter 15.

The AFW System is designed to perform the following safety functions: 39

1. Supply the SGs with water required for decay heat removal. 31

No change-this page

2. Start and deliver design flow automatically following any incident causing loss of FW. Under any condition, the AFWS is capable of starting and operating unattended for at least 10 minutes.

3. Function within a SG pressure range from approximately 100 psia up to a pressure equivalent to the lowest set SG safety-valve relief pressure plus accumulation (1,338 psia). The lower value corresponds to the point at which the Residual Heat Removal System (RHRS) can be operated for continuing cooldown. 46

4. Function under the following conditions: loss of main FW; various environmental occurrences; a main FW line break or a MS line break; with or without offsite power available considering at the same time any single failure.

5. Supply FW in the unlikely event the control room must be evacuated.

6. Be tested during normal plant operation.

7. Meet safety class (refer to the AFWS, piping diagram, Figure 10.4.9-1, for SC 2 and SC 3 divisions) and seismic Category I requirements as defined in Section 3.2. 39

The AFWS is designed to deliver 550 gal/min within one minute of automatic initiation to at least one SG after a feedwater line rupture or steam line break. The AFWS is designed to deliver 550 gal/min within one minute of automatic initiation to each of at least two SGs after a loss of FW accident. 31 39 31 39

The AFWS is designed to deliver 550 gal/min within one minute of automatic initiation to at least two SGs after loss of offsite power (LOOP). The motor driven AFW pumps are automatically started by the load sequencers, though when the pumps are started they are in a recirculation mode, and no flow will enter the SGs until a SG low-low water level or safety injection (SI) signal initiates flow. 45 39 45

The AFWS is designed to prevent the possibility of hydraulic instability (i.e., water hammer) by incorporation of the following:

1. A separate nozzle is provided for the introduction of AFW to the SG. (This AFW nozzle does not incorporate a feed ring or feed preheater design.)

2. The length of horizontal piping immediately upstream of the AFW nozzle is minimized. 39

3. The AFW inlet piping within the SG is designed to be self venting.

4. The outlet of the AFW nozzle is designed to be below the normal SG water level.

The combination of the above prevents the formation of steam voids in the inlet piping which is susceptible to condensation upon the introduction of AFW.

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The AFWS is also designed for the following normal plant operations. 39

10.4.9.1.1 Plant Cold Startup: The AFWS is designed to back up the main FW system during plant startup in the event the main FW system and/or the startup SGFP is unavailable.

10.4.9.1.2 Plant Hot Shutdown: The AFWS is designed to back up the main FW system during plant hot shutdown (or hot standby) in the event the main FW system and/or the startup SGFP is unavailable. The AFWS can be used as a 45
means of continuous FW supply even if this condition is maintained for extended periods. FW is continuously supplied from the AFST, which during normal operation receives required makeup from the demineralized water storage tank (DWST). The DWST in turn is supplied by water from wells through the demineralizers, as shown on Figures 9.2.3-1 and 9.2.6-1.

10.4.9.1.3 Plant Cold Shutdown: The AFWS is designed to back up the main FW system when achieving plant cold shutdown.

10.4.9.2 System Description. One AFWS is provided for each unit. The piping diagram is shown on Figure 10.4.9-1. The system includes an adequate 39
water storage, redundant pumping capacity to supply the SGs, associated piping, valves, and instrumentation.

The AFWS supplies water to the SGs, where it is converted into steam by the heat transferred from the primary coolant that removes decay heat from the reactor core and heat generated in the primary coolant loop by the reactor 39
coolant pumps.

The AFST provides water to the AFW pumps. It is a concrete, stainless steel lined, 500,000 gallon tank with capacity based on: 31

- maintaining the plant in hot standby for four hours, then
- cooling down the primary system to 350°F, the point at which the residual heat removal system may be initiated

The cooldown rate is 50°F/hr with one RCP operating or 25°F/hr with natural circulation. During normal cooldown the rate is limited to 100°F/hr due to 39
structural limits of the RCS components.

Four AFW pumps, each with independent motive power supplies, are provided to 46
comply with redundancy requirements of the safety standards, both for equipment and power supplies. Pump characteristics are given in Table 10.1-1. 39

Three horizontal, centrifugal, multistage, electric motor-driven pumps supply one SG each. Each pump motor is supplied power from a separate engineered safety bus, and the power supply is separated throughout.

No change - this page

The fourth pump is a horizontal, centrifugal, multistage, noncondensing steam turbine-driven unit which supplies FW to the fourth SG. A steam line connection is taken from the SC 2 section of one MS line upstream of the MS isolation valve (see Figure 10.3-1). The AFW steam line is provided with ~~a remote manual~~ steam inlet valves which function as containment isolation valveS. The turbine discharge steam exhausts directly to the atmosphere. | 39-

Each SG is supplied by a separate AFW train. Normally closed, fail-closed cross-connections are provided between the four trains to permit flow from any pump to any SG. | 39

Each of the four pumps is provided with a minimum-flow automatic recirculation system. The recirculation flow returns to the upper section of the AFST. | 31

Each pump recirculation line is designed to SC 3 requirements inside the isolation valve cubicle (IVC). The recirculation lines from the IVC to the AFST are designed to NNS class requirements. Water losses through credible failures of recirculation lines are included in the storage tank inventory requirements. | 39

The AFW line to each SG, one per pump, is provided with a remote manual containment isolation valve (see Section 6.2.4). Each line connects directly to the upper shell of the SG. | 39

The AFW pumps are located in a seismic Category I building and are physically separated from each other by their placement in individual compartments. | 39
These compartments are designed to preclude coincident damage to redundant equipment in the event of a postulated pipe rupture, equipment failure, or missile generation. | 39

Figures 1.2-21 and 1.2-25 show the AFWS component arrangements. The AFW steam supply pipe to the AFW turbine is routed directly to the turbine pump compartment, located immediately beneath the MS line piping. This piping is routed such that it does not penetrate any of the AFW motor-driven pump compartments. | 39

10.4.9.3 Safety Evaluation. The AFWS is designed to seismic Category I requirements and will withstand a single failure and still perform its design requirements. The loss of one motor-driven pump or the turbine-driven pump will not limit the design safety function of the system. In the event that the makeup water to the AFST is lost, the minimum quantity of water within the AFST is sufficient for a safe shutdown of the reactor. Therefore, failure of any one AFW component will not preclude safe shutdown of the reactor. To demonstrate the capability to meet the single-failure criterion, a component failure mode and effects analysis is presented in Table 10.4-3. In addition the AFWS has been analyzed to determine its reliability and the results of the analysis are provided in Appendix 10A (Later). The system is SC 3 from the AFST (Figure 9.2.6-2) up to the containment isolation valves. The steam line to the AFW pump turbine is SC 2 to the ~~isolation~~ steam inlet valves and SC 3 to the turbine. The isolation valves and piping from the containment isolation valves to the SG are SC 2 (see Figure 10.4.9-1). | 31 | 39 | 45 | 39

The AFWS's water supply is from the AFST which is designed to seismic Category I SC 3 requirements and the applicable codes discussed in Section 3.8.4. The AFST is designed to withstand environmental design conditions, including
flood, earthquake, hurricane, tornado loadings, and tornado missiles. The 31
AFST is designed to retain a sufficient quantity of water for AFWS use. The AFST is designed such that no single active failure will preclude the ability to provide water to the AFWS. The AFW suction and discharge lines are routed separately to prevent coincident damage.

For vacuum protection, the AFST is provided with a water loop seal fabricated
of safety class piping physically located within the AFST seismic Category I, 44
Safety Class 3 concrete structure. In addition, redundant non-safety vacuum breakers are provided.

The AFWS is provided with control at the auxiliary shutdown panel in addition 39
to those in the control room so operation is possible in the unlikely event the control room is inaccessible.

10.4.9.4 Tests and Inspections. The AFWS may be tested and inspected while the plant is in operation. Only one pump at a time may be tested. A
test line is provided on each pump discharge back to the AFST to allow for 31
performance testing of each pump.

Leakage can be detected by visual inspection and by loss of tank inventory. 31

The AFWS will be tested in accordance with Section 14.2. 39

10.4.9.5 Instrumentation Application. The control logic for the AFWS is 2
described in Section 7.4.1.1 and 7.3.1. 45

The AFWS is capable of starting automatically and supplying the SGs with water required for decay heat removal. Each motor-driven AFW pump is started automatically by two out of four low-low water level signals from any SG, or by an automatic load sequencer signal based upon a LOOP or an SI signal. The turbine-driven AFW pump is automatically started by the opening of the steam inlet bypass valve, which is opened by a two of four low-low water level signal from any SG or by an SI signal. Insert I All AFW pumps may be manually controlled from the control room and the auxiliary shutdown panel. Status lights are provided at both locations to monitor the performance of each AFW pump. The two of four
low-low water level signals in any SG or the SI signal close the SG blowdown 39
valves, sample line valves, and AFW crossover isolation valves, and open the AFW regulator valves. It also allows the stop check valves to function normally. Thus on a LOOP, the motor driven AFW pumps start and recirculate water to the AFST until an SI signal or a two of four low-low water level signal in any SG occurs. Each AFW regulator valve may be manually reset and remotely positioned by manual switches in the control room and at the auxiliary shutdown panel for jogging operation. An automatic recirculation system is provided for the turbine-driven AFW pump and the motor-driven AFW pumps.

Control room instrumentation is provided to monitor major AFWS parameters, such as the discharge pressure of each AFW pump (turbine driven pump discharge
pressure is available at a control room indicator, the motor driven pump 46
discharge pressures ~~is~~ are available through the Emergency Response Facilities Data Acquisition and Display System, [ERFDADS]) and through the Qualified Display Processing System, turbine-driven AFW pump inlet

(available through the plant computer)

steam pressure, and AFW flow to each SG. This instrumentation in combination with the SG level indication described in Section 7.5 provides the operator with reliable indication of the AFW System performance. If evacuation of the control room becomes necessary, AFW System monitoring and control is available to the operator at the auxiliary shutdown panel. For a detailed description of the auxiliary shutdown panel, refer to Section 7.4. 46 39 45

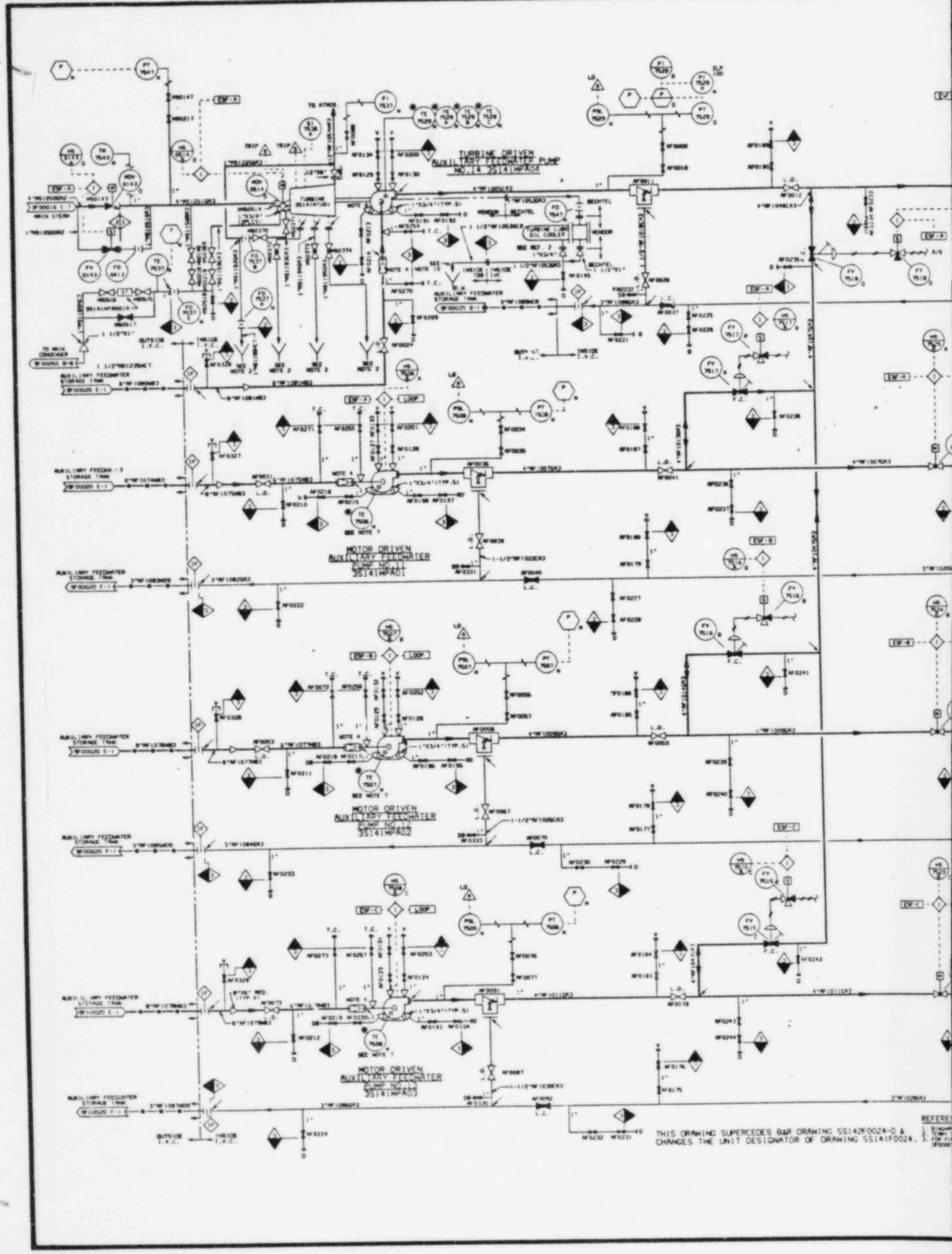
~~Redundant~~ AFST level indication is provided in the control room (through the use of QDPS and the level recorder in the control room) and at the auxiliary shutdown panel (via the QDPS). 46

Alarms indicating high and low AFST water levels are provided in the control room. 46

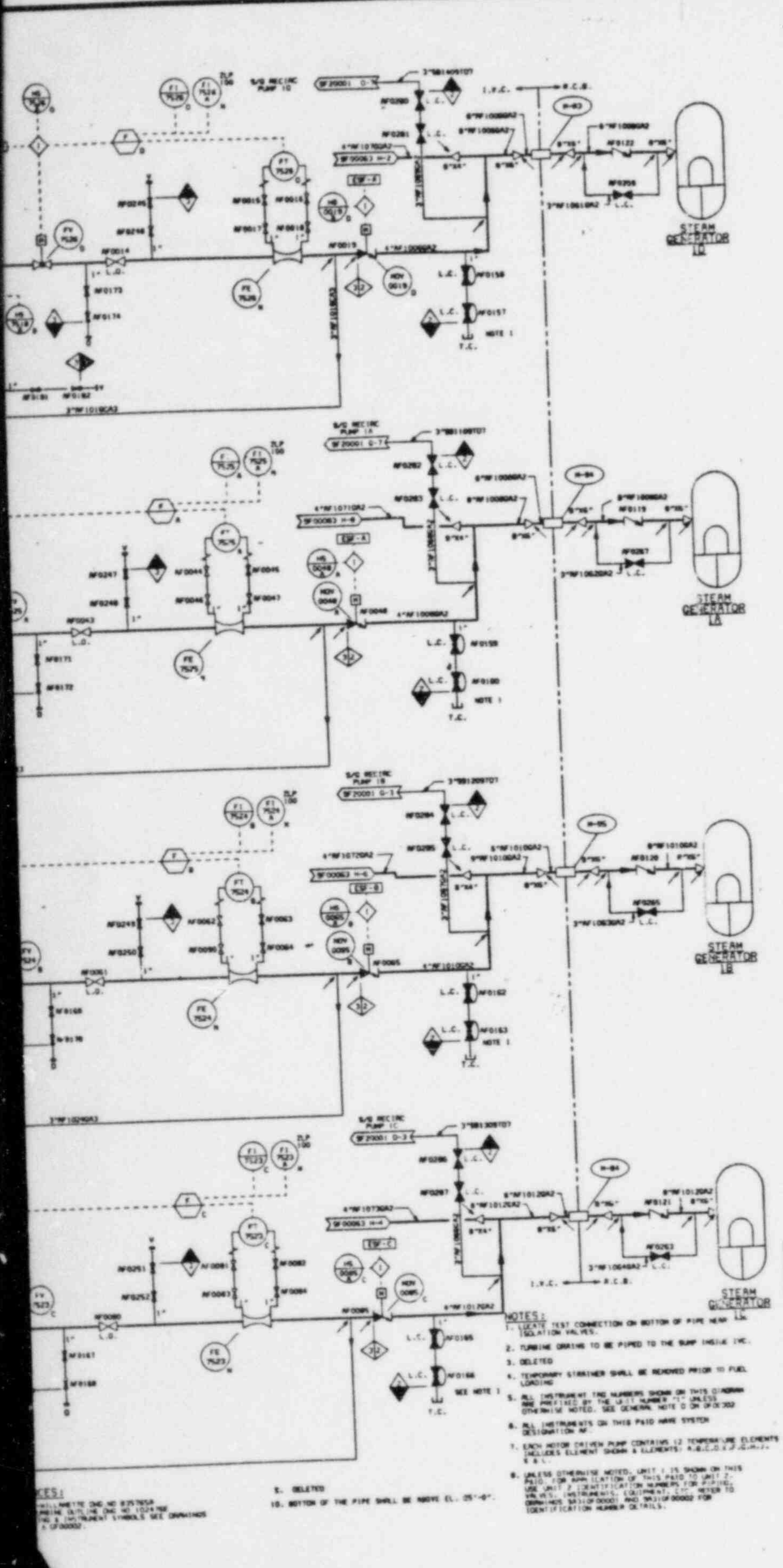
Automatic level control is utilized to maintain the minimum operating storage capacity in the AFST. Level instrumentation on the AFST regulates a level control valve to control the flow of demineralized water into the AFST.

Insert I

After the steam inlet bypass valve opens, steam flows to the AFW pump turbine through the bypass orifice at a limited flowrate to permit the turbine to accelerate to a speed at which the governor can assume control. After a time delay sufficient for the turbine governor to assume speed control, the steam inlet valve is opened and the turbine is allowed to accelerate to normal operating speed. The turbine trip & throttle valve, supplied with the pump turbine, is a normally open valve. It receives a confirmatory open signal (SG low-low water level in any SG or an SI signal) and may be manually controlled from the control room or the auxiliary shutdown panel.



TURBINE DRIVEN
AUXILIARY FEEDWATER PUMP
NO. 14 3S141MPA04
MOTOR DRIVEN
AUXILIARY FEEDWATER
PUMP NO. 11
3S141MPA01
MOTOR DRIVEN
AUXILIARY FEEDWATER
PUMP NO. 12
3S141MPA02
MOTOR DRIVEN
AUXILIARY FEEDWATER
PUMP NO. 13
3S141MPA03
AUXILIARY FEEDWATER STORAGE TANK
TURBINE LUBE OIL COOLER
MAIN STEAM
TO MAIN CONDENSER
THIS DRAWING SUPERCEDES B&R DRAWING SS142F0024-D &
CHANGES THE UNIT DESIGNATOR OF DRAWING SS141F0024.
REFERE



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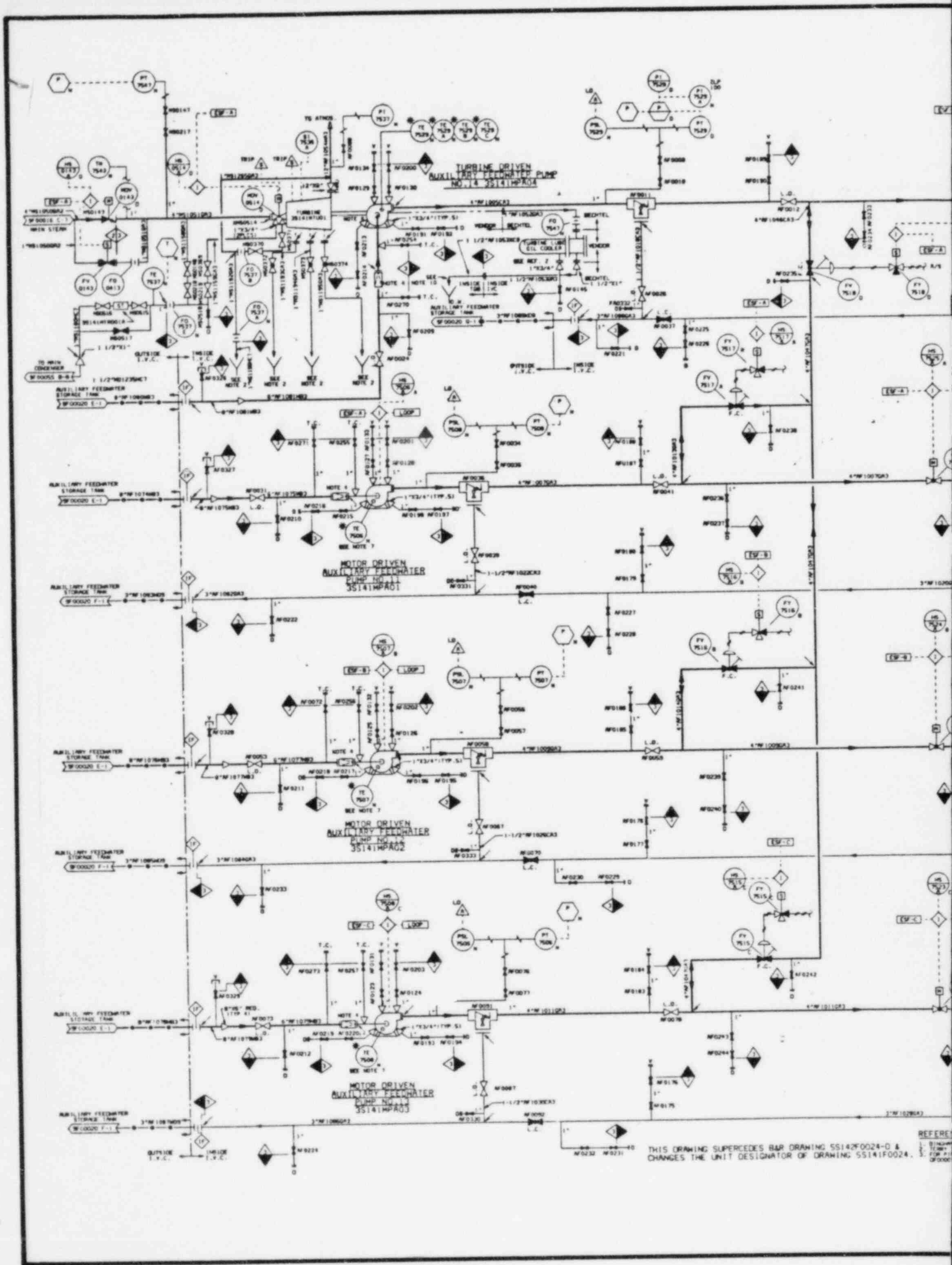
SOUTH TEXAS PROJECT
UNITS 1 & 2

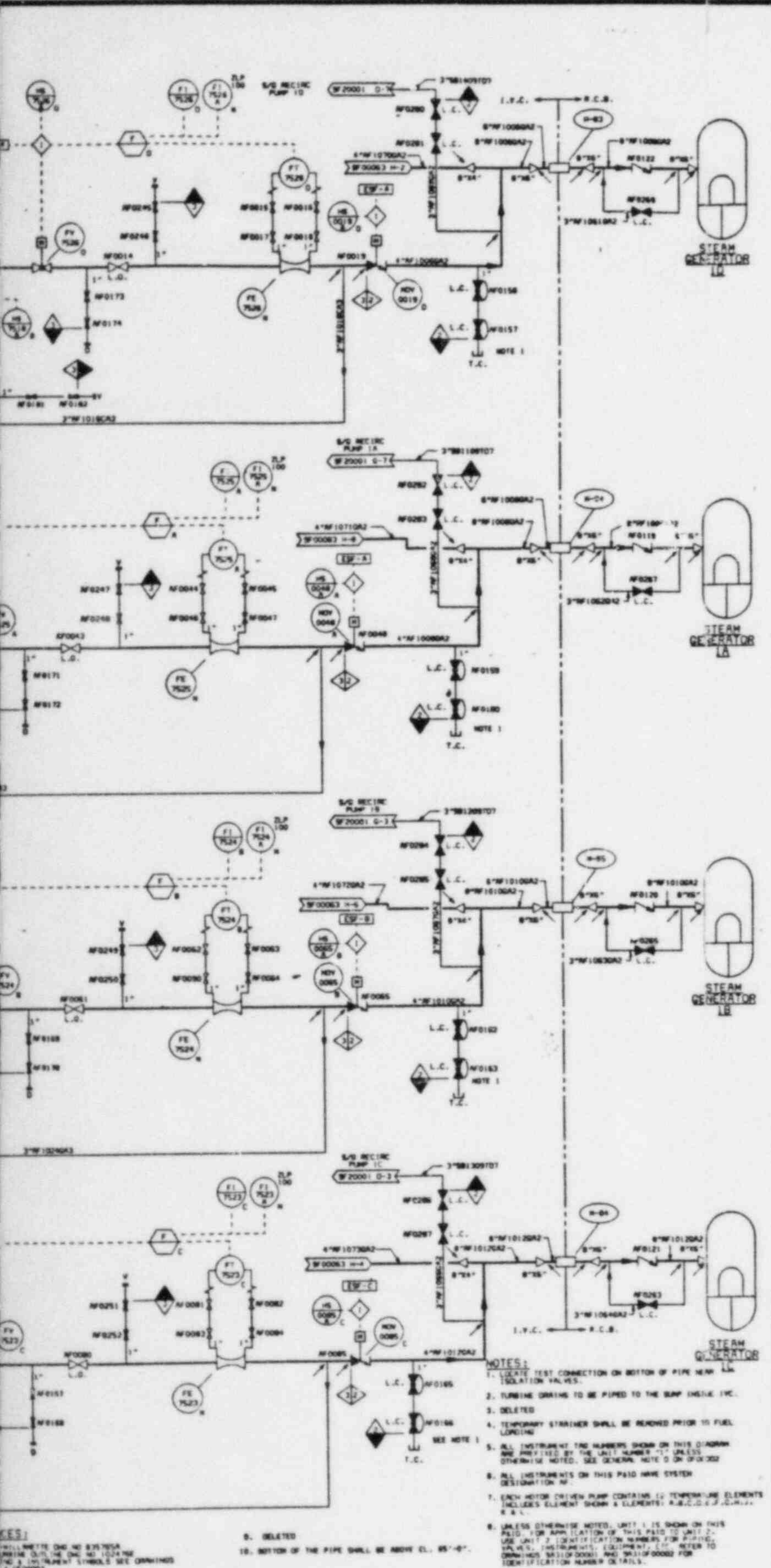
PIPING & INSTRUMENTATION DIAGRAM
AUXILIARY FEEDWATER

Dwg. No. 5S14-9-F-00024 Rev. 5

Figure 10.4.9-1

8507230433-01


TURBINE DRIVEN
AUXILIARY FEEDWATER PUMP
NO. 14 3S141HPA04
MAIN STEAM
TO MAIN CONDENSER
AUXILIARY FEEDWATER STORAGE TANK
OUTSIDE I.V.C.
INSIDE I.V.C.
MOTOR DRIVEN
AUXILIARY FEEDWATER
PUMP NO.11
3S141HPA01
MOTOR DRIVEN
AUXILIARY FEEDWATER
3S141HPA02
MOTOR DRIVEN
AUXILIARY FEEDWATER
3S141HPA03
THIS DRAWING SUPERCEDES B&R DRAWING SS142F0024-D &
CHANGES THE UNIT DESIGNATOR OF DRAWING SS141F0024.



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SOUTH TEXAS PROJECT UNITS 1 & 2

PIPING & INSTRUMENTATION DIAGRAM AUXILIARY FEEDWATER

Dwg. No. 5S14-9-F-00024 Rev. 5

Figure 10.4.9-1

8507230433-01

TABLE 1.3-2 (Continued)

SIGNIFICANT DESIGN CHANGES

Item	References FSAR	Description of Change
Main steam isolation valve cubicles	Sections 9.4.5, 3.8.4	Due to changes in building design, this subsystem has been revised from a common ventilation to train separated supply ventilated system. Building has been redesigned for more open areas to the atmosphere to relieve any pressure buildup in case of a break in the steam line (changed roof design from concrete to sheet metal).
Main ~~Auxiliary~~ feedwater	Sections ~~10.4.6~~/10.4.7/10.4.9	The addition of a startup SGFP allows plant startup (and shutdown) without the use of the AFWS. ~~Also the AFWS is dedicated for safety use only.~~ ~~Through~~ Through the use of the startup SGFP, the operation of the AFWS during non-emergency conditions is minimized 45
Condensate Polishing System	Section 10.4.6	Upgraded the Condensate Polishing System to include mixed bed demineralizers as well as the cation demineralizers and associated regeneration equipment.
Deaerator addition	Section 10.4.7	A full flow deaerator was added to the FW system in place of the second stage FW heaters for the primary purpose of entrained oxygen removal. The deaerator necessitated the addition of 3-50% FW booster pumps while deleting the need for the two high pressure heater drip pumps. Deaerator addition made minor heat balance changes.
Anti-water hammer modifications	Section 10.4.7	The feedwater system has been upgraded to assure that no FW will enter the SG preheat section when the potential for water hammer exists.
SG blowdown system	Section 10.4.8	Instead of routing the SGBD flash tank outlet liquid directly to the condenser, the liquid is cooled and processed (using demineralizers) before routing to the condenser.
Auxiliary feedwater	Section 10.4.9	Auxiliary feedwater lines go directly to the steam generator. This change is based on Westinghouse interface criteria. The contents of the ~~AFW~~ Auxiliary Feedwater Storage tank (previously called condensate storage tank) are dedicated for AFW service.

TABLE 3.2.A-1 (Cont'd)

BALANCE OF PLANT-QUALITY CLASSIFICATION OF
STRUCTURES, SYSTEMS, AND COMPONENTS

Sheet 5 of 23

Structure, System or Component	Safety Class[1]	Standard or Code[2]	Seismic[3] Category	Quality[4] Assurance	Remarks	
Auxiliary Feedwater (AFW) System					For more detail, refer to P&IDs, Sec. 10.4.9	33
Pumps	3	III/3	I	B		
AFW pump turbine	3	Built III/3	I	B	Not N-stamped	30
AFW piping and supports from AFWST to first isolation valve outside Containment	3	III/3	I	B		45
AFW steam line and supports from main steam line isolation valves (steam inlet and steam inlet bypass valves) to AFW pump turbine and exhaust line	3	III/3	I	B		30
Containment isolation valves, penetrations, AFW piping and supports from the isolation valves to SG	2	III/2	I	B		
AFW pump test/recirculation lines inside IVC also AFW cross connecting piping and valves	3	III/3	I	B		33
Main steam isolation valves & (steam inlet and steam inlet bypass valves), AFW steamline and supports upstream of the isolation valve	2	III/2	I	B		
AFW storage tank (AFWST) except liner	3	ACI 318-71, AISC-69	I	B	Concrete tank	
AFWST Liner	3	ASME III, AISC-69	I	B	Not N-stamped	45
Remainder of system	NNS	ANSI B31.1	NA	NA		33

bonnet-to-body bolting material by rules set forth in the ASME Boiler and Pressure Vessel Code, Section III, and by designing flanges in accordance with applicable code requirements. Even if bolt failure were to occur, the likelihood of all bolts experiencing a simultaneous complete severance failure is very remote. The widespread use of valves with bolted bonnets, and the low historical incidence of complete severance valve bonnet failures confirm that bolted valve bonnets need not be considered as credible missiles.

Valve stems were not considered as potential missiles if at least one feature, in addition to the stem threads, is included in their design to prevent ejection. Valves with backseats are prevented from becoming missiles by this feature. In addition, air- or motor-operated valve stems will be effectively restrained by the valve operators. 36

Nuts, bolts, nut and bolt combinations, and nut and stud combinations have only a small amount of stored energy and thus are of no concern as potential missiles.

Valves with threaded bonnet studs are not utilized in high energy piping and thus are of no concern as potential missiles.

3.5.1.1.2 Rotating Machinery: Potential missile sources associated with rotating machinery were identified as:

- Motor-driven pumps and compressors
- Turbine-driven pumps
- Heating, ventilating, and air conditioning (HVAC) fans
- Diesel generator turbocharger rotors
- Motor generator set flywheels

Missile selection was based on the following considerations:

1. Rotating components that are operated during normal plant conditions are capable of becoming missiles.

2. The energy of a rotating part associated with 120 percent overspeed is assumed sufficient for component failure unless analysis is performed to indicate otherwise. 36

3. Determination of whether the energy of the missile is sufficient to perforate the protective housing. For example, electrical motors are not considered potential missile sources due to their cast iron housing. The housing itself is capable of withstanding internal faults such as cooling fan break down or armature disintegration. Missiles generated by postulated failures of pumps and fans are in the process of being evaluated. Discussion of these missiles will be provided in a future amendment. The following are not potential missile sources:

   a. There are four turbine-driven pumps, of two types: the turbine-driven auxiliary feedwater pump and the three turbine-driven

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~~(only a single overspeed trip on the auxiliary feedwater pump drive turbines)~~ INSERT

steam generator (SG) main feed pumps. ~~These pumps and their drive turbines are protected from overspeed by redundant overspeed trips, and neither is considered to be a source of missiles.~~

b. HVAC and chiller fans were reviewed. Chillers have very low rpm fans which are not a credible source of missiles. Nearly all of the HVAC fans are separated from safety-related equipment and cable trays to the extent that postulated missiles do not pose a safety hazard. The supply subsystem fan is the only fan which might be a source of missiles and is located in the Mechanical-Electrical Auxiliaries Building (MEAB) at El. 60.0 ft. The blades of this fan are made of aluminum and are postulated to impact the housing at 26.7 ft/sec. The housing is 1/4-in.-thick steel and would contain such a missile.

c. The diesel generators (DGs) are designed to withstand overspeeds of 125 percent; redundant mechanical and electrical overspeed trips operate at 110 percent overspeed. The only portion of the diesels considered to be a credible source for postulated missiles is the turbocharger, which is not speed controlled and operates at high rpm. The turbocharger rotors weigh 270 pounds and are mounted on the diesels. In the event of failure, only one DG unit would be affected since each is separated from adjacent units by 2-ft-thick reinforced concrete walls which would contain any turbocharger missile.

d. Motor generator (MG) set flywheels were reviewed to determine missile generation potential. The fabrication specifications of the MG set flywheels control the material to meet American Society for Testing and Materials (ASTM) A533-70a, Grade B, Class I, with | 44
inspections in accordance with MIL-I-45208A and flame-cutting and machining operations governed to prevent flaws in the material. Nondestructive testing for nil-ductility (ASTM-E-208), Charpy V-notch (ASTM A593-69), ultrasonic (ASTM A578-71b and A577-70a), and | 44
magnetic particles (ASME Section III, NB2545) has been performed on each flywheel material lot. In addition to these requirements, stress calculations have been performed consistent with guidelines of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section III, Appendix A to show the combined primary stresses due to centrifugal forces and to show that the shaft interference fit does not exceed one-third of the yield strength at normal operating speeds (1,800 rpm) and does not exceed two-thirds of the yield strength at 25 percent overspeed. However, no overspeed is expected for the following reason: The flywheel weighs approximately 1,300 lbs and is 35.26 in. in diameter by 4.76 in. wide. The flywheel mounted on the generator shaft, which is directly coupled to the motor shaft, is driven by a 200-hp, 1,800-rpm synchronous motor. The torque developed by the motor is insufficient for overspeed. Therefore, there are no credible missiles from the MG sets.

3.5.1.1.3 Gravitational Missiles: Virtually the only significant gravitational missiles would be from overhead cranes. As discussed in Section | 36
9.1.4, overhead cranes either have interlocks or are single-failure-proof or

INSERT

THE MAIN FEED PUMPS AND THEIR DRIVE TURBINES ARE PROTECTED FROM OVERSPEED BY REDUNDANT OVERSPEED TRIPS. A SINGLE OVERSPEED TRIP IS PROVIDED ON THE AUXILIARY FEEDWATER PUMP DRIVE TURBINE. THESE PUMPS ARE NOT CONSIDERED TO BE A SOURCE OF MISSILES.

TABLE 3.9-1.2 (Continued)

ACTIVE VALVES (BOP SYSTEMS)

SYSTEM	VALVE NUMBER	SIZE	TYPE	ACTUATED BY	
Post Accident Sampling	FV2454	1"	Globe	solenoid	
	FV2453	1"	Globe	solenoid	
	FV2455	1"	Globe	solenoid	
	FV2456	1"	Globe	solenoid	
	FV2458	1"	Globe	solenoid	
	FV2457	1"	Globe	solenoid	
Hydrogen Monitoring	FV4100	1"	Globe	solenoid	
	FV4124	1"	Globe	solenoid	
	FV4125	1"	Globe	solenoid	
	FV4126	1"	Globe	solenoid	
	FV4101	1"	Globe	solenoid	
	FV4127	1"	Globe	solenoid	
	FV4128	1"	Globe	solenoid	41
	FV4103	1"	Globe	solenoid	
	FV4129	1"	Globe	solenoid	
	FV4130	1"	Globe	solenoid	
	FV4131	1"	Globe	solenoid	
	FV4104	1"	Globe	solenoid	
	FV4133	1"	Globe	solenoid	
	FV4134	1"	Globe	solenoid	
Essential Cooling Water	EW0121, EW0137, EW0151	30"	Butterfly	motor	
	FV6914, FV6924, FV6934	3"	Globe	air	
	FV6935, FV6936, FV6937	4"	Globe	air	
Radioactive Equipment Floor Drain	ED0064	3"	Gate	motor	5
	FV7800	3"	Gate	air	Q 10.5
Auxiliary Feedwater	FV7523, FV7524, FV7525, FV7526, ~~FV7519, FV7520, FV7521, FV7522~~	4"	Globe	motor	
	FV7515, FV7516, FV7517, FV7518	4"	Globe	air	
	AF0019, AF0048, AF0065, AF0085	4"	Stop Check	motor	
	MS0143	4"	Stop Check	motor	
	AF0011, AF0036, AF0058, AF0091	4"	Auto Check	process flow	
	FV0143	1"	Globe	solenoid	

EXPLANATIONS AND ABBREVIATIONS:

1. **ISOLATION VALVE NO:** ONLY CONTAINMENT ISOLATION VALVE NUMBERS ARE LISTED THOUGH OTHER VALVES NECESSARY FOR PERFORMING LEAK RATE TESTING ARE SHOWN.
2. **ISOLATION SIGNAL:** THE SIGNAL THAT CAUSES CLOSURE OF THE VALVE TO FACILITATE ISOLATION OF THE CONTAINMENT.
3. **RM:** REMOTE MANUAL.
4. **CHK:** CHECK VALVE
5. **L.O./L.C.:** LOCKED OPEN/LOCKED CLOSED.
6. **LENGTH OF PIPING OUTSIDE CONT:** THE LENGTH OF PIPING FROM OUTSIDE THE CONTAINMENT TO THE OUTSIDE CONTAINMENT ISOLATION VALVE.
7. **GDC:** 10 CFR 50, APPENDIX A, GENERAL DESIGN CRITERIA.
8. **IRC/ORC:** INSIDE REACTOR CONTAINMENT/OUTSIDE REACTOR CONTAINMENT.
9. **ACTUATION TRAIN:** THE ACTUATION POWER TRAIN (A, B, OR C) THAT ENABLES THE CLOSURE OF THE VALVE FOR CONTAINMENT ISOLATION. AN ENTRY OF D INDICATES DC POWER SUPPLIED FROM THE CHANNEL II BATTERY SYSTEM.
10. **FWI:** FEEDWATER ISOLATION SIGNAL.
11. **PHASE A:** PHASE A ISOLATION SIGNAL.
12. **CVI:** CONTAINMENT VENTILATION ISOLATION.
13. **PMD:** PACKLESS METAL DIAPHRAGM.
14. **ELEC/HYD:** ELECTRO-HYDRAULIC OPERATOR.
15. **SI:** SAFETY INJECTION SIGNAL.
16. **AFWI:** AUXILIARY FEEDWATER INITIATION SIGNAL.
17. **MSLI:** MAIN STEAM LINE ISOLATION SIGNAL.

SOUTH TEXAS PROJECT UNITS 1 & 2

CONTAINMENT PENETRATIONS

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Figure 6.2.4-1

VALVE NO.	VALVE SIZE (IN.)	INSIDE/ OUTSIDE CONT.	NORMAL FLOW DIRECTION	VALVE TYPE	VALVE OPERATOR	POWER SOURCE	PRIMARY MODE	SECONDARY MODE	CLOSURE TIME (SEC.)	VALVE POSITION NORMAL	SHUTDOWN	POST ACCIDENT	FAIL	ACTUATION TRAIN	ISOLATION SIGNAL
FSV-7444	30	OUTSIDE	OUT	GLOBE	SOLENOID (2)	AIR	AUTO	RM	5	OPEN	CLOSED	CLOSED	CLOSED	A OR B	MSLI
FV-7442	4	OUTSIDE	OUT	GATE	DIAPHRAGM	AIR	AUTO	RM	10	CLOSED	CLOSED	CLOSED	CLOSED	A OR B	MSLI
FV-7903A	2	OUTSIDE	OUT	GATE	SOLENOID	ELEC (B)	AUTO	RM	5	OPEN	OPEN	CLOSED	CLOSED	A OR B	MSLI
MS-0143	4	OUTSIDE	OUT	STOP/CHK	MOTOR	ELEC (D)	AUTO	RM	N/A	CLOSED	OPEN	OPEN	AS IS	D	NA
PV-7441	8	OUTSIDE	OUT	GLOBE	ELEC/HYDR	ELEC (D)	AUTO	RM	N/A	CLOSED	CLOSED	CLOSED	CLOSED	D	NOTE 1
PSV-7440	6	OUTSIDE	OUT	SAFETY	SELF ACT.	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
PSV-7440A,B	6	OUTSIDE	OUT	SAFETY	SELF ACT.	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
PSV-7440C,D	6	OUTSIDE	OUT	SAFETY	SELF ACT.	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
FV-0143	1	OUTSIDE	OUT	GLOBE	SOLENOID	ELEC. (D)	AUTO	RM	N/A	CLOSED	OPEN	OPEN	CLOSED	D	N/A

ENGINEERED SAFETY FEATURES SYS. SEE NOTE 2 YES ☐ NO ☒

FLUID CONTAINED: STEAM

LENGTH OF PIPING OUTSIDE CONT.: 46.3 FT.

APPLICABLE GDC NO.: 57

REFERENCE P&ID: 9F00024, 9F00016

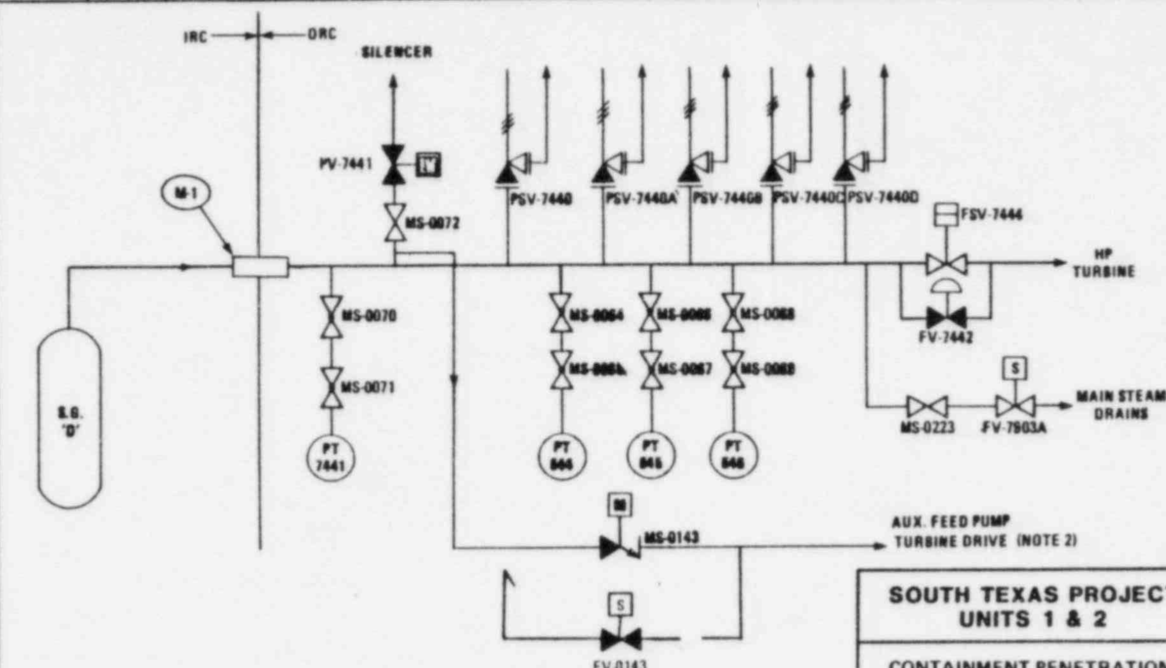
GENERAL COMMENTS:

NOTE 1: OPEN ON HIGH PRESSURE

NOTE 2: THE MAIN STEAM SUPPLY TO THE TURBINE DRIVEN AFW PUMP IS ESSENTIAL.

10 CFR 50 APPENDIX J REQUIREMENT

TYPE A ☐
B ☐
C ☐
NONE ☒



CONTAINMENT PENETRATION NO. M-1

DESCRIPTION: MAIN STEAM LINE
SYSTEM: MAIN STEAM SYSTEM

SOUTH TEXAS PROJECT
UNITS 1 & 2

CONTAINMENT PENETRATIONS
Sheet 2 of 95

Figure 6.2.4-1

ISOLATION VALVE NO.	VALVE SIZE (IN.)	INSIDE/ OUTSIDE CONT.	NORMAL FLOW DIRECTION	VALVE TYPE	VALVE OPERATOR	POWER SOURCE	PRIMARY MODE	SECONDARY MODE	CLOSURE TIME (SEC.)	VALVE POSITION NORMAL	SHUTDOWN	POST ACCIDENT	FAIL	ACTUATION TRAIN	ISOLATION SIGNAL
FSV-7414	30	OUTSIDE	OUT	GLOBE	SOLENOID	AIR	AUTO	RM	5	OPEN	CLOSED	CLOSED	CLOSED	A OR B	MSLI
FV-7412	4	OUTSIDE	OUT	GATE	DIAPHRAGM	AIR	AUTO	RM	10	CLOSED	CLOSED	CLOSED	CLOSED	A OR B	MSLI
FV-7900A	2	OUTSIDE	OUT	GATE	SOLENOID	ELEC.(A)	AUTO	RM	5	OPEN	OPEN	CLOSED	CLOSED	A OR B	MSLI
PV-7411	8	OUTSIDE	OUT	GLOBE	ELEC/HYD.	ELEC.(A)	AUTO	RM	10	CLOSED	CLOSED	CLOSED	CLOSED	A	N/A
PSV-7410, A	6	OUTSIDE	OUT	SAFETY	SELF ACT.	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
PSV-7410B,C	6	OUTSIDE	OUT	SAFETY	SELF ACT	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
PSV-7410D	6	OUTSIDE	OUT	SAFETY	SELF ACT	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A

ENGINEERED SAFETY FEATURES SYS. YES ☐ NO ☒

FLUID CONTAINED: STEAM

LENGTH OF PIPING OUTSIDE CONT.: 46.3 FT.

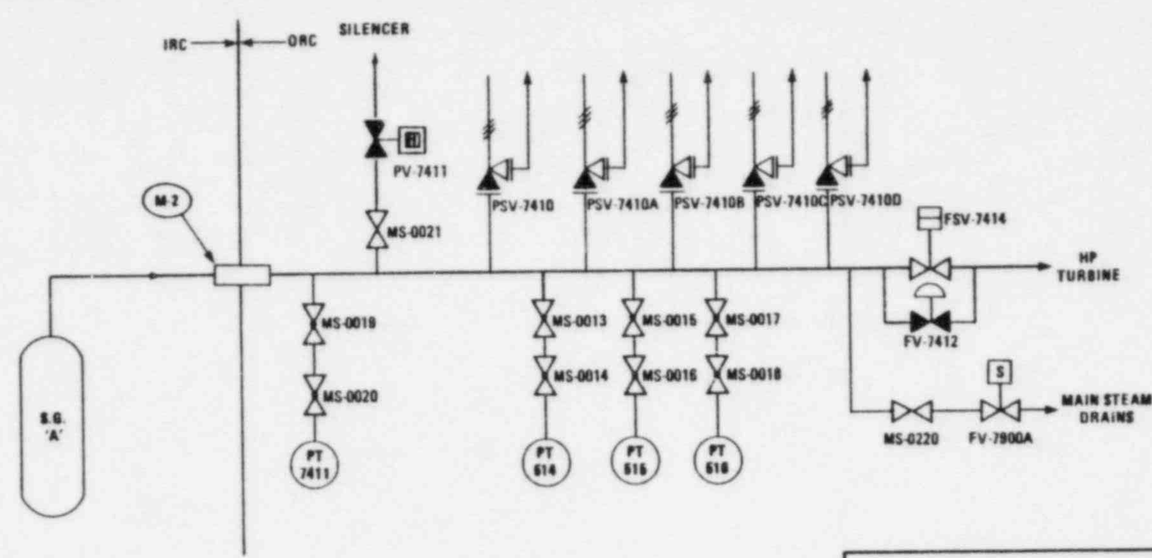
APPLICABLE GDC NO.: 57

REFERENCE P&ID: 9F00016

GENERAL COMMENTS:

10 CFR 50 APPENDIX J REQUIREMENT

TYPE A ☐
B ☐
C ☐
NONE ☒



CONTAINMENT PENETRATION NO. M-2

DESCRIPTION: MAIN STEAM LINE

SYSTEM: MAIN STEAM SYSTEM

SOUTH TEXAS PROJECT UNITS 1 & 2

CONTAINMENT PENETRATIONS

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Figure 6.2.4-1

ISOLATION VALVE NO.	VALVE SIZE (IN.)	INSIDE/ OUTSIDE CONT.	NORMAL FLOW DIRECTION	VALVE TYPE	VALVE OPERATOR	POWER SOURCE	PRIMARY MODE	SECONDARY MODE	CLOSURE TIME (SEC.)	VALVE POSITION NORMAL	SHUTDOWN	POST ACCIDENT	FAIL	ACTUATION TRAIN	ISOLATION SIGNAL
FSV-7424	30	OUTSIDE	OUT	GLOBE	SOLENOID	AIR	AUTO	RM	5	OPEN	CLOSED	CLOSED	CLOSED	A OR B	MSLI
FV-7422	4	OUTSIDE	OUT	GATE	DIAPHRAGM	AIR	AUTO	RM	10	CLOSED	CLOSED	CLOSED	CLOSED	A OR B	MSLI
FV-7901A	2	OUTSIDE	OUT	GATE	SOLENOID	ELEC.(A)	AUTO	RM	5	OPEN	OPEN	CLOSED	CLOSED	A OR B	MSLI
PV-7421	8	OUTSIDE	OUT	GLOBE	ELEC/HYDR	ELEC.(B)	N/A	MANUAL	10	CLOSED	CLOSED	CLOSED	CLOSED	B	N/A
PSV-7420,A	6	OUTSIDE	OUT	SAFETY	SELF ACT	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
PSV-7420B,C	6	OUTSIDE	OUT	SAFETY	SELF ACT	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
PSV-7420D	6	OUTSIDE	OUT	SAFETY	SELF ACT	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A

ENGINEERED SAFETY FEATURES SYS. YES ☐ NO ☒

FLUID CONTAINED: STEAM

LENGTH OF PIPING OUTSIDE CONT.: 48.3 FT.

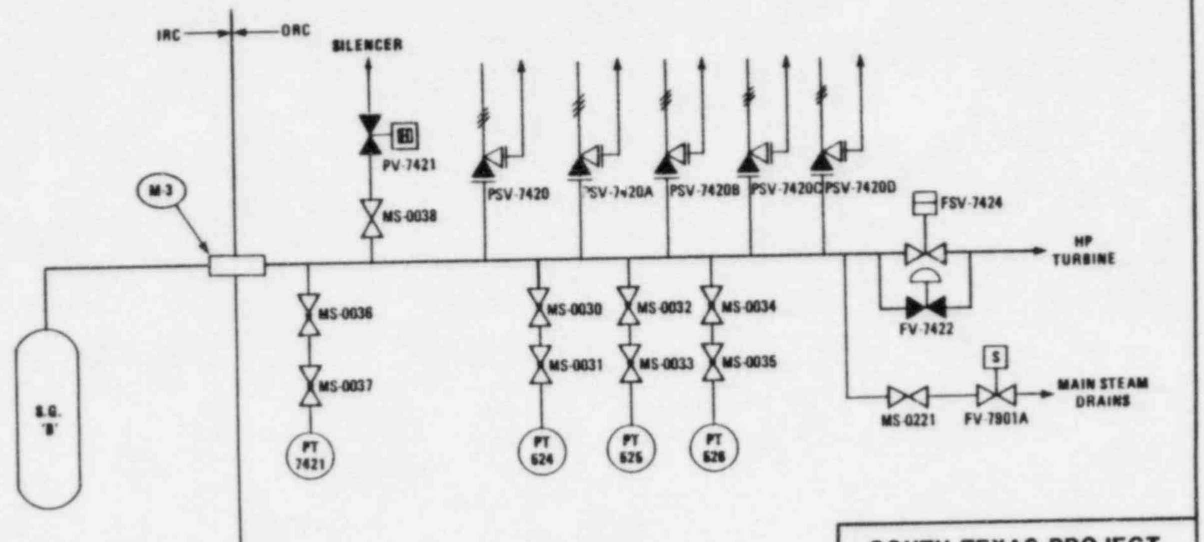
APPLICABLE GDC NO.: 57

REFERENCE P&ID: 9F00016

GENERAL COMMENTS:

10 CFR 50 APPENDIX J REQUIREMENT

TYPE A ☐ B ☐ C ☐ NONE ☒



CONTAINMENT PENETRATION NO. M-3

DESCRIPTION: MAIN STEAM LINE
SYSTEM: MAIN STEAM SYSTEM

SOUTH TEXAS PROJECT UNITS 1 & 2

CONTAINMENT PENETRATIONS

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Figure 6.2.4-1

ISOLATION VALVE NO.	VALVE SIZE (IN.)	INSIDE/ OUTSIDE CONT.	NORMAL FLOW DIRECTION	VALVE TYPE	VALVE OPERATOR	POWER SOURCE	PRIMARY MODE	SECONDARY MODE	CLOSURE TIME (SEC.)	VALVE POSITION				ACTUATION TRAIN	ISOLATION SIGNAL
										NORMAL	SHUTDOWN	POST ACCIDENT	FAIL		
FSV-7434	30	OUTSIDE	OUT	GLOBE	SOLENOID	AIR	AUTO	RM	5	OPEN	CLOSED	CLOSED	CLOSED	A OR B	MSLI
FV-7432	4	OUTSIDE	OUT	GATE	DIAPHRAGM	AIR	AUTO	RM	10	CLOSED	CLOSED	CLOSED	CLOSED	A OR B	MSLI
FV-7902A	2	OUTSIDE	OUT	GATE	SOLENOID	ELEC. (B)	AUTO	RM	5	OPEN	OPEN	CLOSED	CLOSED	A OR B	MSLI
PV-7431	8	OUTSIDE	OUT	GLOBE	ELEC/HYDR	ELEC. (C)	N/A	MANUAL	10	CLOSED	CLOSED	CLOSED	CLOSED	C	N/A
PSV-7430,A	6	OUTSIDE	OUT	SAFETY	SELF ACT.	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
PSV-7430B,C	6	OUTSIDE	OUT	SAFETY	SELF ACT	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A
PSV-7430D	6	OUTSIDE	OUT	SAFETY	SELF ACT	N/A	N/A	N/A	N/A	CLOSED	CLOSED	CLOSED	N/A	N/A	N/A

ENGINEERED SAFETY FEATURES SYS. YES ☐ NO ☒

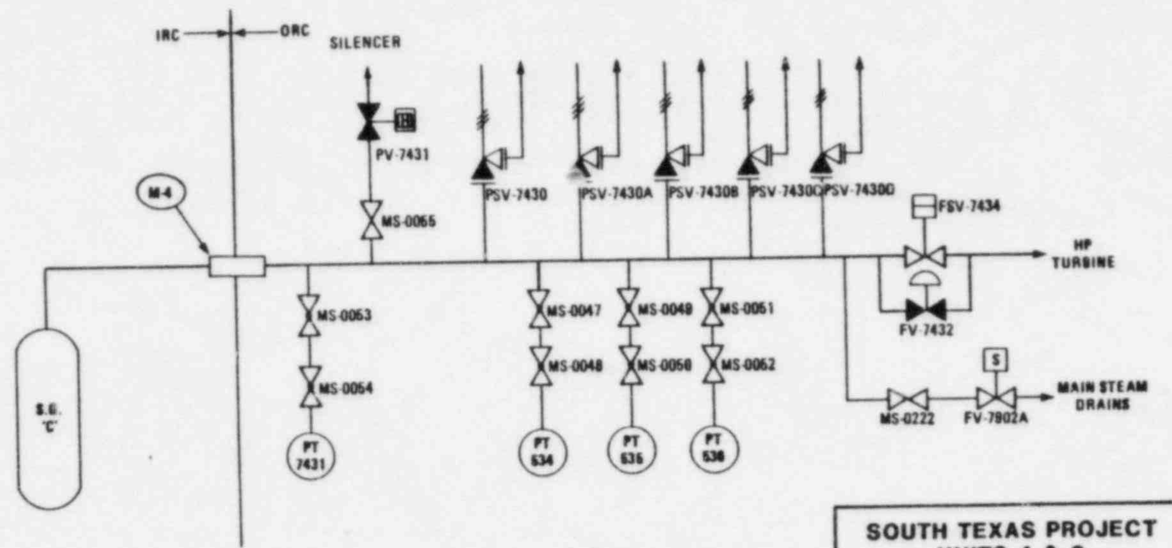
FLUID CONTAINED: STEAM

LENGTH OF PIPING OUTSIDE CONT.: 48.2 FT.

APPLICABLE GDC NO.: 57

REFERENCE P&ID: 9F00016

GENERAL COMMENTS:



10 CFR 50 APPENDIX J REQUIREMENT

TYPE A ☐
B ☐
C ☐
NONE ☒

CONTAINMENT PENETRATION NO. M-4

DESCRIPTION: MAIN STEAM LINE
SYSTEM: MAIN STEAM SYSTEM

SOUTH TEXAS PROJECT UNITS 1 & 2

CONTAINMENT PENETRATIONS
Sheet 5 of 95

Figure 6.2.4-1

TABLE 8.3-6

125 VDC ESF LOADS

Load	Bus E1A11 (Charger I) 1st Min.	1-120 Min.	Random	Bus E1B11 (Charger III) 1st Min.	1-120 Min.	Random	Bus E1C11 (Charger IV) 1st Min.	1-120 Min.	Random	Bus E1D11 (Charger II) 1st Min.	1-120 Min.	Random
Static Inverter	236A	236A		80A	80A		236A	236A		80A	80A	
125 vdc Distribution Panel	50A	12A	10A	50A	12A	10A	30A	5A	10A	20A	20A	10A
Reactor Trip Switchgear	29A	5A		29A	5A		---	---				
DG Field Flash	75A	7A		75A	7A		75A	7A				
DG Control Panel	5A	5A		5A	5A		5A	5A				
4.16 kV Switchgear Control	23A	3A	80A	23A	3A	80A	23A	3A	80A			
4.80 V Load Center Control	85A	1A	20A	86A	2A	20A	85A	1A	20A			
Load Sequencer	17A	17A		17A	17A		17A	17A				
DC Switchboard Control	1A	1A		1A	1A		1A	1A		1A	1A	
	9A	9A		9A	9A							
AFW Pump Turbine Control										14A	6A	12A
Aux Feed Water to ~~Stream Gen. 1D~~ SG 1D ~~Main Stream~~ Steam Inlet Vlv. MOV 0143												40A
Aux Feed to Steam Generator Isolation Vlv. MOV 0019												40A
Bus Total	530	296	110	375	141	110	472	275	110	115	107	102
Estimated Battery Capacity	1800 AH			1200 AH			1800 AH			1200 AH		

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