Omaha Public Power District
1623 Harney Omaha, Nebraska 68102
402/536-4000

December 19, 1983
LIC-83-305

Mr. James R. Miller, Chief
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Licensing
Operating Reactors Branch No. 3
Washington, D.C. 20555

Reference: Docket No. 50-285

Dear Mr. Miller:

Adequacy of Station Electrical Distribution
System Voltages at the Fort Calhoun Station
Unit No. 1

The Commission's letter to the Omaha Public Power District dated October 20, 1983, formalized the latest request for additional information on the subject issue. The following responses are labeled by the number of the request.

1. The attached two tables (Attachments 1 and 2) together with the following discussion provide the District's response to the first request for additional information.

   The two tables contain analyzed voltage values which have been revised using more realistic loading rather than the more conservative loading which has been used in earlier analyses. These loading figures are based on a load survey which was conducted this past year (see Attachment 3) and also on the manufacturer's specifications of pump loading requirements under various operating conditions (see Attachment 4). Specifically, the condensate and feedwater pumps which when operating in the recirculating mode, as they would be during accident conditions, require 70% and 63% of their motor horsepower, respectively. Also, there is an automatic 480V load shed initiated by the accident signal which was not taken into consideration by previous District analyses. Thus, the maximum post accident loading on either of the safeguards buses would be 9.82 MW on the 1A4 side, (the 1A3 side has only 1/3 of the condensate system, thus it will always be more lightly loaded than the 1A4 side which feeds the other 2/3, therefore, voltages were not analyzed for the 1A3 side). The 9.82 MW includes bus 1A2 and all loads which could be, but would not likely be, running, i.e., worst case.

   The minimum and maximum grid voltage values are determined by the System Operations Department Operating Guide 11-78 (Attachment 5). This

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requires that operators maintain the 161 kV level at the Fort Calhoun substation between 163 kV (101%) and 169 kV (105%) and the 345 kV at a minimum 351 kV with the unit out of service. As discussed in the District's original design (see Attachment #6 of the August 28, 1978, submittal) the generator actually regulates the voltage on the 22 kV bus when it is operating in a preset range regardless of what level the offsite grid is at. To illustrate this point, a recent check with the unit at full load showed the 345 kV at 103% and bus 1A1 at 99% of 4160 v. Because the unit does regulate the 22 kV bus, calculations were not done for the case where an automatic fast transfer had occurred switching buses 1A3 and 1A4 from the preferred 161 kV to the 345 kV with the unit remaining at 100% load. However, the hot shutdown operating mode would be the loading condition relevant to lower voltage on the 345 kV grid. This loading on the 1A4 side would be 7.14 MW, including one each: feedwater pump, condensate pump, and heater drain pump. Operation with buses 1A3 and 1A4 on the 345/22 kV system with the unit at power is done only on very rare occasions, however, the District will take steps, via operating procedure, to assure that the bus voltage does not exceed 4400 volts (110% of 4000 volt rated motors). This will be satisfactory; the plant does have direct control of the 22 kV bus voltage via the generator exciter control.

Also, in order to substantiate these maintained values, the actual 161 kV and 345 kV levels have been recorded beginning September 30, 1983, to the present at approximately 8-hour intervals. The lowest recorded voltages have been 164.3 kV and 347.0 kV (102.0% and 100.6%, respectively) and the highest voltages were 170.9 kV and 358.8 kV (106.2% and 104%, respectively), while the average values were approximately 168 kV and 352 kV. These minimum and maximum grid values are well within the safe operating range for the Class 1E motors at the Fort Calhoun Station which is guaranteed by motor manufacturers to be 90 to 110% of nameplate voltage. As shown in Attachment 1, the minimum analyzed grid voltage of 101.1% of 161 kV provides 96.6% of nameplate voltage (460V) at the motor terminals (worst case). This 101.1% of 161 kV is the analyzed minimum expected grid voltage (ref.: the District submittal of August 30, 1983), while the minimum allowable as per Operating Guide 11-78 is actually slightly higher at 163 kV or 101.2% (see Attachment 5).

Calculations were not done for the steady-state maximum case simply because it was obvious that the maximum expected 161 kV grid level would have to be in the range of 113 to 114% to cause a 110% motor terminal voltage, and the maximum voltage analyzed on the grid is only 105.1%, while the maximum recorded is only 106.2%. The maximum analyzed is lower than the maximum recorded for the same reason that the minimum analyzed is lower than the minimum recorded; because the voltage drop parameters used in the calculations are worst case and thus more conservative than the real world operating conditions. This consistency points out the validity of the model used for calculating the grid voltages, i.e., the analyzed values are consistently in the range of 1% lower at both extremes, both minimum and maximum.

The minimum transient voltage values, as per the subject telephone conferences of September 26, 29 and October 6, 1983, were to be calcu-

lated based on the inadvertent starting of a large non-Class 1E load during accident conditions to determine if it would actuate the accident undervoltage (O.P.L.S.) relays, thereby automatically transferring the Class 1E buses to diesel-generator supply. The analysis determined that the starting of either a reactor coolant pump or a feedwater pump (both highly improbable occurrences during an accident) would cause a transient both low enough (83% voltage) and long enough (15 sec. in the case of the reactor coolant pump) to actuate the O.P.L.S. relays. The O.P.L.S. relay trip setpoint on bus 1A4 is 89.97% voltage for 5 seconds. At the end of the 15 second motor start transient (RC-3D) the bus voltage would recover to 93.4% and the O.P.L.S. relays would reset at 90.9%, according to the manufacturer's specifications, allowing the transfer back to the 161 kV grid.

2. In the District's submittal of August 31, 1981, the results of some transient starting tests were compared to the corresponding analytically derived values. The District believes that this comparison showed the validity of the analytical model that has been used consistently since the original undervoltage study submitted on August 28, 1978. The important parameter to compare is the consistency of the difference between the calculated values and the tested values, and as discussed in the August 31, 1981, submittal this difference was consistent. The magnitude of this difference is a function of the selection of the input parameters and thus is not as important. For example, the conservative bus loading values used in the calculations of the August 28, 1978, submittal and all other earlier submittals, accounted for a comparative difference as large as 3.8%, however, the consistency of this difference varied by only 0.3%, down to 3.5%. Therefore, the actual voltage drop model is accurate and the District does not believe that any further testing is necessary.

3. The taps on transformers T1A-3 and T1A-4 are on 161 kV and this is what has been used in the analysis.

4. See Question #1, and Attachments #1 and #2.

In closing, the following list of District submittals to the Commission is provided so that the Commission may verify that they are all available for reference in the Commission's file on the adequacy of Fort Calhoun Station distribution system voltages. It has been brought to the District's attention in correspndence over the last 3 or 4 Commission requests for additional information, that due to personnel changes the Commission may not have reviewed past information which has been provided by the District. If any of these submittals are not in the Commission's files, the Commission is requested to notify the District so that copies may be sent.

1. September 17, 1976, to George E. Lear, ONRR

2. August 28, 1978, to Robert W. Reid, ONRR via H. H. Voigt of LeBoef, Lamb, Leiby and MacRae

3. May 13, 1981, to Robert A. Clark, ONRR

4. March 19, 1982, to Robert A. Clark, ONRR

5. May 21, 1982, to Robert A. Clark, ONRR

6. December 1, 1982, to Robert A. Clark, ONRR

7. April 22, 1983, to R. A. Clark, ONRR

8. August 30, 1983, to R. A. Clark, ONRR

Sincerely,

W. C. Jones
Division Manager
Production Operations

WCJ/DJM/rh-A

Attachments

cc: LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N.W.
Washington, D.C. 20036

Mr. E. G. Tourigny, NRC Project Manager

Mr. L. A. Yandell, Senior NRC Resident Inspector

Attachment 1
Worst Case Analyzed Voltages
With the Plant Distribution System Supplied by the 161 kV Grid

	Plant Conditions: Normal Operation With Unit at 100% Load		Plant Conditions: Post Accident Operation, All Class 1E Loads Operating	
	Steady-State Maximum	Steady-State Minimum	Transient Minimum Due to Large Motor Start	Steady-State Minimum After Large Motor Start Transient
Offsite Grid (% of 161 kV)	105.1	101.1	See Note	See Note
Bus 1A4 (% of 4160v)	See Note	96.2 (9.25 MW Load on Bus)	83 (Start RC-3D with 7.82 MW Load on Bus)	93.4 (90.9% is required for reset of undervoltage relays)
Terminals of Class 1E Load (% of 4160v)	See Note	96.0 (AC-10B)	See Note	93.3
Bus 1B4A (% of 480v)	See Note	93.1	See Note	90.4
Terminals of Class 1E Load (% of 460v name-plate voltage rating)	See Note	96.6 (AC-3B)	See Note	93.8

NOTE: See the discussion of the applicable question for explanation of why these calculations were not performed.

Attachment 2
Worst Case Analyzed Voltages
With the Plant Distribution System Supplied by the 345 kV Grid

	Plant Conditions: Normal Operation With Unit at 100% Load		Plant Conditions: Post Accident Operation, All Class 1E Loads Operating	
	Steady-State Maximum (Observed)	Steady-State Minimum (Observed)	Transient Minimum Due to Large Motor Start	Steady-State Minimum After Large Motor Start Transient
Offsite Grid (% of 345 kV)	104	100.6	See Note	See Note
Bus 1A4 (% of 4160v)	See Note	See Note	85.9 (Start RC-3D with 7.14 MW Load on Bus)	92.8
Terminals of Class 1E Load (% of 4160v)	See Note	See Note	See Note	92.7
Bus 1B4A (% of 480v)	See Note	See Note	See Note	91.4
Terminals of Class 1E Load (% of 460v name-plate voltage rating	See Note	See Note	See Note	94.8

NOTE: See the discussion of the applicable question for explanation of why these calculations were not performed.

Attachment 3

Load Survey

Assume

T1A1	Feeding	Bus 1A1
T1A2	Feeding	Bus 1A2
T1A3	Feeding	Bus 1A3
T1A4	Feeding	Bus 1A4

Alignment 1 is considered worst case loading on the 161 KV system. T1A2 is shown at its lightest loading.

Alignment 2 is the lightest loading on the 161 KV system.

Alignments 1 and 2 are given assuming all equipment is running necessary for 100% power operation of the generator.

Actual data taken with the unit at 100% load on February 4, 1982, at 0830.

Bus 1A1	7.5 MW	RC-3A, FW-2A, FW-14A, CW-1A
Bus 1A2	6.5 MW	RC-3B, FW-4B, FW-5B, CW-1B
Bus 1A3	3.3 MW	RC-3C, Misc. Loads
Bus 1A4	6.2 MW	RC-3D, FW-2C, FW-5C, CW-1C

Alignment 1

Bus	Major Loads
1A1	RC-3A - 2 MW FW-2A - 1.62 MW FW-4A - 2.84 MW FW-5A - .49 MW CW-1A - 1 MW
1A2	RC-3B - 2MW FW-2B - 0 FW-4B - 0 FW-5B - 0 CW-1B - 1 MW
1A3	RC-3C - 2 MW Misc. - 1.3 MW
1A4	RC-3D - 2 MW FW-2C - 1.62 MW FW-4C - 2.84 MW FW-5C - .49 MW CW-1C - 1 MW Misc. - 1.3 MW

Alignment 2

Bus	Major Loads
1A1	RC-3A - 2 MW FW-2A - 1.62 MW FW-4A - 2.84 MW FW-5A - .49 MW CW-1A - 1 MW
1A2	RC-3B - 2MW FW-2B - 1.62 MW FW-4B - 2.84 MW FW-5B - .49 MW CW-1B - 1 MW
1A3	RC-3C - 2 MW Misc. - 1.3 MW
1A4	RC-3D - 2 MW FW-2C - 0 FW-4C - 0 FW-5C - 0 CW-1C - 1 MW Misc. - 1.3 MW

Attachment 4

Design Parameters

Items numbers	CW-1A, CW-1B, CW-1C
Number	3
Type	Foster Wheeler 84" MFV-2 K6.6
Design capacity, each	120,000 gpm
Total dynamic head	33 feet
Operating temperature	85°F
Pump Efficiency	86.5% as shown in Figure 2.1.2
Materials of construction	
Casing	Cast Iron
Impeller	Ni-Al Bronze
Shaft	Carbon steel Hy-Ten B-3X Annealed Steel
Pump Speed	295 rpm
Drive	Electric Motor
	4160 V 3 phase 60 cycle
Design hp	1175 = 0.88 MW
Flow requirements	
Condensing water (design flow @ 60°F)	315,000 gpm
Bearing cooling, (2) condensate cooling	17,900
Screen wash	3,000
Surface diversion	24,100
	360,000

2.0 SYSTEM COMPONENTS (Continued)

2.3 Condensate Pumps (FW-2A, FW-2B, and FW-2C)

2.3.1 General Description

The condensate pumps are vertically mounted 10-stage motor driven turbine pumps. They consist of two sections, each of which contains five stages. The sections are coupled together to form one unit.

Condensate is supplied to the pump through a suction strainer. The condensate flows down the casing to the bottom where the pump first stage takes a suction and discharges to the next stage bolted on top of it. Each stage discharges to the next stage, increasing the pressure of the condensate as it progresses. The pump casing is equipped with a continuous vent connection that removes any noncondensable gases and vents them to the conde... The pump shaft is sealed by a rotating mechanical se... which is filled and flushed prior to startup and the cooled and lubricated by water from the discharge of ... pump through valve PCV-1214 when the pump is running. Each pump is capable of supplying 50 percent of the required condensate flow for 100 percent reactor power.

2.3.2 Design Parameters

Item Numbers	FW-2A, 2B, 2C
Number	3
Type	Vertical, Turbine
Shaft Seals	Mechanical
Power Supply	FW-2A Bus 1A1 FW-2B Bus 1A2 FW-2C Bus 1A4
Design Capacity, each	5600 gpm
Total Dynamic Head	1150 Ft.
Operating Temperature	92°F.
Operating Flow at 100 percent load	4600 gpm

2.0 SYSTEM COMPONENTS (Continued)

2.3.2 Design Parameters (Continued)

Materials of Construction

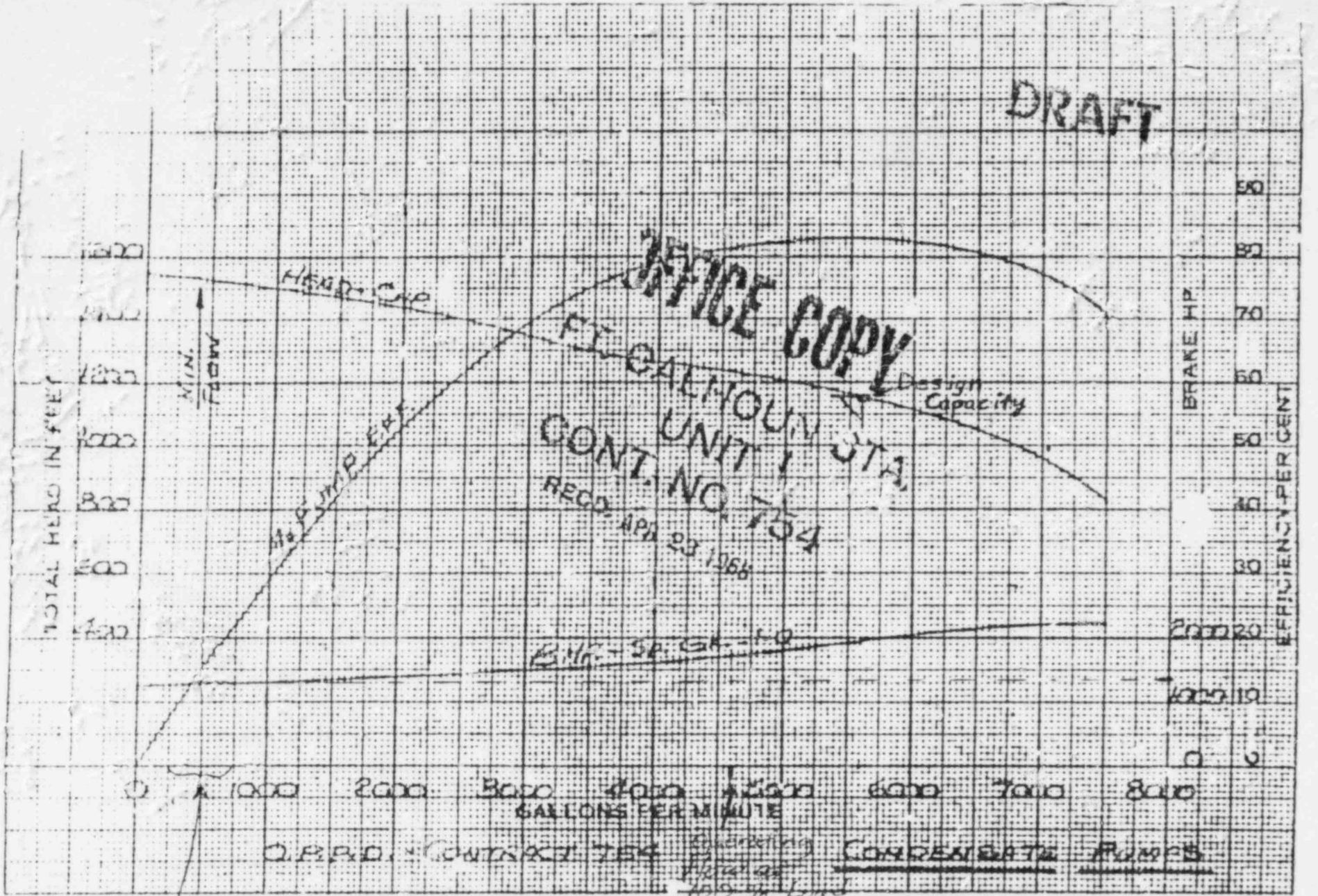
Outer Casing	Welded Steel
Impellers	S.S., 11.5-13 percent Chrome, 0.5 percent moly
Shaft	S.S., 11.5-13 percent Chrome, heat treated
Pump NPSH Required at Design Flow	0 ft. @ base
Pump Speed	1190 rpm
Drive	2000 hp Electric Motor 4160V, 3 Phase, 60 Cycle
Pump Horsepower at Design Conditions	2000 hp

2.3.3 Instrumentation and Control

The condensate pumps are controlled from two locations, one is the main control room on CB-10 and the other is locally at the pumps. Local control consists of push-button start and stop switches. They are mounted on the west wall near the pumps. Remote control is accomplished in the main control room on Panel CB-10. Three switches control the condensate pumps. Also located on CB-10 are green stop/red run lights and an ammeter for each condensate pump.

To start a condensate pump, the breaker must be racked in and the "69" permissive switch on the breaker cabinet must be in reset. The Auto/Off-Auto switch in the control room must be in Off-Auto. When these conditions are met the pump is electrically ready to be started.

After a condensate pump is running, the operational control of the pumps can be placed in an automatic standby mode. The Auto/Off-Auto switch is common to all three condensate pumps as well as all feed pumps, heater drain pumps and the motor driven auxiliary feed pump. When in Auto, this switch, along with the position of the individual condensate pump control switches on CB-10, set up an automatic control circuit for the standby condensate pump. The


DRAFT
WHITE COPY
FT. CALHOUN UNIT 3TH
CONT. NO. 754
RECD. APR 23 1968
TOTAL HEAD IN FEET
MIN. FLOW
HEAD-CAP.
Design Capacity
BRAKE HP.
EFFICIENCY PER CENT
GALLONS PER MINUTE
0
1000
2000
3000
4000
5000
6000
7000
8000
1600
1400
1200
1000
800
600
400
200
80
70
60
50
40
30
20
10
Approx. Range of Recirc Flow
CONDENSATE PUMPS
C4CNX-16H-10STG-VMT
RPM 1180
671-H-0626
G. S.
3-26-68
W. ARTHUR
PC-28899-A-1

2.0 SYSTEM COMPONENTS (Continued)

2.10 Steam Generator Feed Pumps - FW-4A, FW-4B, and FW-4C

2.10.1 General Description

The steam generator feed pumps are horizontally mounted two-stage motor driven centrifugal pumps. The pumps function to supply feedwater to the Steam Generators.

Each feed pump has a separate oil system that lubricates the one thrust and three journal bearings. The oil system consists of a sump, auxiliary motor driven gear pump, a gear pump connected to the feed pump shaft, cooler and interconnecting piping. During normal operation the gear pump connected to the feed pump shaft supplies oil to the system. The motor driven auxiliary gear pump is intended for use during startup and shutdown of the feed pump. In the event of trouble with the shaft driven gear pump the auxiliary gear pump can and will supply the feed pump with oil until it is stopped.

Each feed pump has two rotating mechanical seals, one on each shaft end as it penetrates the pump casing. The seals are initially filled with water from the condensate system. They are then kept full and lubricated by pump leakage to the seals and the pumping groves on the rotating face circulating seal water through the seal water cooler.

Each feed pump is provided with a suction relief valve to protect its suction piping from overpressurization in the event of back flow through the pump when it is stopped.

Each pump is designed to supply 50 percent of the required feed flow for 100 percent reactor power.

2.10.2 Design Parameters

Motors	3 Allis-Chalmers 4160 Volts - 3 phase - 60 hertz
Size	3500 H.P.
Speed	3570 RPM
Power Supply	FW-4A Bus 1A1
	FW-4B Bus 1A2
	FW-4C Bus 1A4

2.0 SYSTEM COMPONENTS (Continued)

2.10.2 Design Parameters (Continued)

Pumps	3 Byron Jackson
Type	Centrifugal, horizontal
Shaft Seals	Mechanical
Total Dynamic Head	1740 ft. (full flow)
Design Temperature	396°F.
Operating Pressure	1090 psig
Operating Temperature	396°F.
Recirc. Flow Rate per Pump	750 gpm ⇐ Corresponds to a 1800 H.P. load (from pump curve)
Pump Discharge Pressure at Recirculation	1560 psig
Design Flow (each pump)	8000 gpm
N.P.S.H. @ 100% Load	133 ft.
N.P.S.H. @ Design Flow	143 ft.
Flow Data @ 100% Load	
Feedwater Flow	15,200 gpm
Nominal Operating Press.	1055 psig
Final Feedwater Temperature	437.9°F.
Blowdown Rate	2 percent

2.10.3 Instrumentation and Control

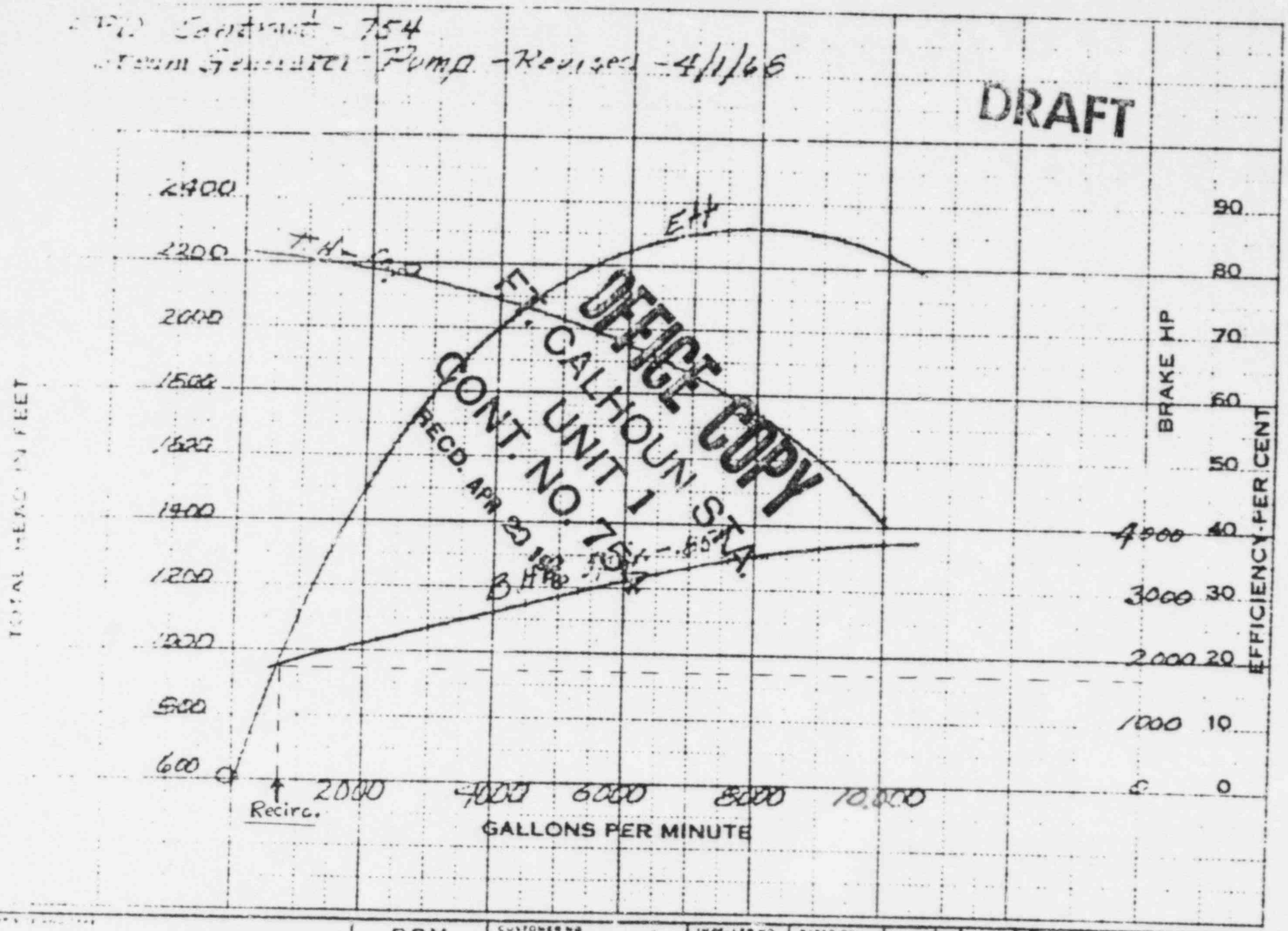
The steam generator feed pumps are controlled from two locations, one is the main control room and the other is locally at the pump. Local control is performed on a control box for each pump mounted on the north wall directly adjacent to the pump. Each control panel consists of three sets of pushbuttons with associated lights. The pushbuttons control starting and stopping the feed pump and motor driven auxiliary oil pump and opening and closing the feed pump discharge valve. Remote control is performed via switches located on the desk section of CB-10. Three switches control the feed pumps and three control the motor driven auxiliary oil pumps.

BYRON JACKSON

Unit 754 - 754

Vertical Centrifugal Pump - Revised - 4/1/66

DRAFT



	RPM	CUSTOMER NO.	ORDER NO.	DATE	BYRON JACKSON NUMBER
10 x 8 - 22 DVMX	3570	Cont 754	R-3510	4/07/66	PC 12-944-2
		G. S.	23193H	R.A.W.	

Attachment 5

SYSTEM OPERATIONS DEPARTMENT
OPERATING GUIDE 11-78

Subject: Operating Voltage at Substation 1251/3451 (Fort Calhoun)

Reference: D. D. Wittke (P. K. Mazumder) letter GSE-FC!-78-390 of October 20, 1978, to System Operations

Letter Text:

Subject: Operating Voltage at Substation 1251 and 3451

As requested by you, following are the limiting operating voltages at Substation 1251 and 3451:

Substation 1251

Minimum allowable voltage: 163 Kv
Maximum allowable voltage: 169 Kv

Substation 3451

Minimum allowable voltage with the unit out: 351 Kv

This is for your information and necessary action. If you need any further clarification, contact P. K. Mazumder (4590).

Action for System Operator: Maintain voltages within above limits.

R. E. Taylor

R. E. Taylor
Supervisor - System Operations

RET/jmm
10/30/78

Fort Calhoun Station Unit No. 1
Operating Procedure No. 10
Annunciator A-16
Panel CB-20

ISSUED
JAN 18 1979

Trans T1A-1 Oil Level Lo Oil Temp A-1	Trans T1A-1 Secondary Low Voltage A-2	Trans T1A-1 4160V Bus Ground A-3	4160 Volt Bus Trans to 22KV Blocked A-4	A-5	A-6
Trans T1A-1 Winding Temp Hi B-1	Volt to House Transfer Parallel B-2	4160 V Bus 1A1 Low Voltage B-3	B-4	4160V Bus 1A1-1A3 125 V DC Transfer Switch Off Normal B-5	4160V Bus 1A1-1A3 125 V DC Transfer Sw. Emerg. Supply Off Normal B-6
Trans T1A-1 Pressure Relay Oper C-1	Trans T1A-1 Gas Press. Relief C-2	Bkr. 1A11 Auto Trip C-3	Bkr. 1A13 Auto Trip C-4	480V Bus 1B3A/1B3A-4A/1B3B/1B3C/1B3C-4C 125 VDC Trans Sw Of Normal C-5	480V Bus 1B3A/1B3A-4A/1B3B/1B3C/1B3C-4C 125 VDC Trans Sw. Emerg Sup Off Norm C-6
Trans's T1A-1 & T1A-2 Deluge Viv Operated D-1	D-2	Bkr. 1A11 Lockout Relay operated 86/1A11 D-3	Bkr. 1A13 Lockout Relay Operated 86/1A13 D-4	D-5	D-6

Attachment 6

Fort Calhoun Station Unit No. 1
Operating Procedure No. 10
Annunciator A-16
Panel CB-20

ISSUED
JAN 18 1979

OP-10-...6-2

Window	Alarm	Trip Device	Set Point (Reset)	Corrective Action	Tech. Spec. Reference
A-1	Transformer T1A1 Oil Level Low	Contact operation of gauge contacts	Level low Mark on gauge Temp. 90°C. Oil leak or cooler/fan malfunction	Auto: Alarm Follow-up-Check for oil leak and excessive	2.7
A-2	Transformer T1A-1 Secondary Low Voltage	27-1X/1A1-13 and 27-2X/1A1-13 or 27-7H/T1A1	3115 volts 3115 volts 4003 volts	Auto: Alarm Follow-up-Check generator or 345 KV voltage for malfunction. If unable to clear alarm, transfer bus power to 161 KV system if voltage below 3115V.	2.7
A-3	Transformer T1A-1 4160V Bus Grounded	Contact operation on ground fault relay 64X/1A1-B	Transformer fault or 4160V equipment fault.	Auto: Alarm Follow-up-Locate grounded component with fault locator and de-energize if plant conditions allow Contact electrical maintenance.	2.7
A-4	4160 Volt Bus Trans To 22KV Blocked	Contact from synch-check relay 25-1/G1 or under-freq. relay 81/G1	22KV system out of synch with 161KV or gen. freq. 59Hz.	Notify: 906 Electrical Maint. Check: Relays/Flags Notify: System Protection for check prior to resetting any flags/relays. Do not perform any hot bus transfers when this alarm in...	2.7

B5.1-Ja-79

Fort Calhoun Station Unit No. 1
Operating Procedure No. 10
Annunciator A-17
Panel CB-20

ISSUED

Trans T1A-3 Oil Level Lo Oil Temp Hi A-1	Trans T1A-3 Secondary Low Voltage A-2	Trans T1A-3 4160 V Bus Ground A-3	4160 Volt Bus Trans to 161KV Blocked A-4	4160V Bus 1A1-1A3 Transfer Off Auto A-5	Fire Sprinkler Diesel RM-1 Actuated A-6	Aux. Bldg. Deluge Valve Open A-7	480V Bus 1B3A, 1B3B & 1B3C Ground A-8	480V Trans Secondary Bkrs. Trip/ Off Normal A-9
Trans T1A-3 Winding Temp. Hi B-1	4160 Bus 1A Trans Feeders Bkr Auto Trip B-2	4160V Bus 1A3 Low Voltage B-3	B-4	B-5	Diesel Bkr. 1AD1 Trip B-6	B-7	480V Bus 1B3A, 1B3B & 1B3C Low Voltage B-8	480V Bus Tie Bkrs. Trip/Off Normal B-9
Trans T1A-3 Pressure Relay Oper C-1	Trans T1A-3 Gas Press Relie C-2	Bkr. 1A31 Auto Trip C-3	Bkr. 1A33 Auto Trip C-4	OPLS Lock-out Relay Test Switch Open Ch. A C-5	Diesel D1 Over-load C-6	C-7	480V Bus 1B4A/1B3B-4B/1B4B/1B4C 125V DC Transfer Sw. Off Normal C-8	480V Bus 1B4A/1B3B-4B/1B4B/1B4C 125V DC Transfer Sw. Emerg. Supply Off Normal C-9
Trans's T1A-3 & T1A-4 Deluge Vlv. Operated D-1	Trans T1A-3 Lockout Relay Oper 86/T1A3 D-2	Bkr. 1A31 Lockout Relay Oper 86/1A31 D-3	Bkr. 1A33 Lockout Relay Oper 86/1A33 D-4	Bus 1A3 Lockout Relay Oper 86/1A3-TFB D-5	Diesel D. Lockout Relay Oper 86/D1 D-6	D-7	480V Bus 1B3A-4A 1B3B-4B 1B3C-4C Low Voltage D-8	Trans. T1B-3A/3B/ 3C Winding Temp Hi D-9

Window	Alarm	Trip Device	Set Point (Reset)	Corrective Action	Tech. Spec. Reference
A-1	Transformer T1A-3 Oil Level Low Oil Level Hi	Contact operation of gauge contacts	Level - Low mark on gauge Temp - 90°C	Auto: Alarm Follow-up-Check for oil leaks and excessive current.	2.7
A-2	Transformer T1A-3 Secondary Low Voltage	27-1X / 1A3-13 and 27-2X / 1A3-13 or 27-74 / T1A3	3115V 3115V 4003V	Auto: Alarm Follow-up-Check that alarm is valid. Transfer power supply from T1A3 if cause is due to low voltage. Contact Elect. Maint.	2.7
A-3	Transformer T1A-3 4160V Bus Ground	Contact operation on ground fault relay 64X/1A3-13	Transformer fault or 4160V equipment fault.	Auto: Alarm Follow-up-Locate grounded component with fault locator and de-energize if plant conditions allow. Contact electrical maintenance.	2.7
A-4	4160 Volt Bus Trans To 161KV Blocked	Contact from synch-check relay 25-2/G1 or under-freq. relay 81/G1	161KV out of synch with 22KV or gen. freq. <59 Hz.	Notify: 906 Electrical Maint. Check; Relays/Flags Notify System Protection for check prior to resetting any flags/relays. Do not perform any hot bus transfers when this alarm is in.	

RF 3-1 81

Fort Calhoun St[illegible]on Unit No. 1
Operating Procedure No. 10
Annunciator A-17
Panel CB-20

ISSUED

OP-10-A17-5

Window	Alarm	Trip Device	Set Point (Reset)	Corrective Action	Tech. Spec. Reference
B-1	Transformer T1A-3 Winding Temp Hi	Contact operation on winding temp. gauge	120°C	Auto: Alarm Follow-up-Reduce load on transformer by transferring auxiliaries. Determine cause of hi temp.	
B-2	4160 Bus 1A3 Transformer Feeder Breakers Auto Tripped	Contact operation of CB-20 control switch and breaker position.	CB-20 control switch in the after close position and the breaker open for the following breakers: T1B-3A, T1B-3B, T1B-3C, or T1B-3D.	Auto: Alarm : Trips 480V transformer secondary breaker and associated island bus tie. Follow-up-Close bus tie breakers to feed the island and 480V bus from Bus 1A4 after insuring the trip was not a fault on the bus. Carry out follow-up of A-9	2.7
B-3	4160V Bus 1A3 Low Voltage	27-1X / 1A3 27-2X / 1A4	90%	Auto: Alarm Follow-up-Verify if alarm if valid. Transfer power supply if power supply has malfunctioned. Contact Elect. Maint.	2.7

R7 3-12-81

Window	Alarm	Trip Device	Set Point (Reset)	Corrective Action	Tech. Spec. Reference
B-6	Diesel Breaker 1AD1 Tripped	Contact operation in breaker 1AD1	Breaker Emergency Control Switch in the "Trip" position, control switch on CB-20 in the "Trip" position, lock relay 86/D1 provided breaker protection override is not in effect, or if diesel D1 shutdown.	Auto: Alarm : If lockout relay 86/D1 operates, D2 will start. Load shed of Bus 1A3 if no other power supply on bus. Follow-up-Investigate reason for trip and transfer emergency loads to Bus 1A4 insuring D-2 if operating does not exceed overload rating.	2.7
B-8	480V Bus 1B3A, 1B3B and 1B3C Low Voltage	27-1X/1B3A and 27-2X/1B3A or 27-1X/1B3B and 27-2X/1B3B or 27-1X/1B3C and 27-2X/1B3C	90%	Auto: Alarm Verify if valid alarm; if so, check for transformer malfunction and inform Electrical Maintenance.	

Fort Calhoun Station Unit No. 1
Operating Procedure No. 10
Annunciator A-18
Panel CB-20

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SWGR Room HVAC AI-187 Trouble A-1	480V Bus 1B4A, 1B4B and 1B4C Ground A-2	A-3	Fire Sprinkler Diesel Rm-2 Actuated A-4	4160V Bus 1A2-1A4 Transfer Off Auto A-5	A-6	Trans T1A-4 4160V Bus Ground A-7	Trans T1A-4 Secondary Low Voltage A-8	Trans T1A-4 Oil Level Lo Oil Temp Hi A-9
480V Bus 1B3A-4A Bus Tie Bkr. Off Normal B-1	480V Bus 1B4A, 1B4B & 1B4C Low Voltage B-2	B-3	Diesel Bkr. 1AD2 Trip B-4	4160V Bus 1A2-1A4 125V DC Transfer Sw Off Normal B-5	4160V Bus 1A2-1A4 125 V DC Transfer Sw Emer Supply Off Normal B-6	4160V Bus Bus 1A4 Low Voltage B-7	4160V Bus 1A4 Trans Feeder Bkr Auto Trip B-8	Trans T1A-4 Winding Temp Hi B-9
480V Bus 1B3B-4B Bus Tie Breaker Off Normal C-1	C-2	C-3	Diesel D2 Overload C-4	OPLS Lock Out Relay Test Switch Open Channel B C-5	Bkr. 1A44 Auto Trip C-6	Bkr. 1A42 Auto Trip C-7	Trans T1A-4 Gas Press. Relief C-8	Trans T1A-4 Pressure Relay Oper C-9
480V Bus 1B3C-4C Bus Tie Breaker Off Normal D-1	Trans. T1B-4A/4B/4C Winding Temp Hi D-2	D-3	Diesel D2 Lockout relay Oper 86/D2 D-4	Bus 1A4 Lockout relay Oper 86/1A4-TFB D-5	Bkr. 1A44 Lockout relay Oper 86/1A44 D-6	Bkr. 1A42 Lockout relay Oper 86/1A42 D-7	Trans T1A-4 Lockout relay Oper 86/T1A4 D-8	D-9

Window	Alarm	Trip Device	Set Point (Reset)	Corrective Action	Tech. Spec. Reference
A-7	Transformer T1A-4 4160V Bus Ground	Contact operation on ground fault relay 64X/1A4-24	Transformer fault or 4160V equipment fault.	Auto: Alarm Follow-up-Locate grounded component with fault locator and de-energized if plant conditions allow. Contact electrical maintenance.	
A-8	Transformer T1A-4 Secondary Low Voltage	27-1X/1A4-24 and 27-2X/1A4-24 or 27-74/T1A4	3115V and 3115V or 3980V	Auto: Alarm Follow-up: Check that alarm is valid. Transfer power supply if cause is due to low voltage from the power supply.	2.7
A-9	Transformer T1A-4 Oil Level Lo Oil Temp. Hi	Contact operation of gauge contacts.	Level - Low mark on gauge Temp - 90°C. Cause - oil leaks.	Auto: Alarm Follow-up-Check for oil leak and excessive current	

Fort Calhoun Station Unit No. 1
Operating Procedure No. 10
Annunciator A-18
Panel CB-20

OP-10-A18-4

Window	Alarm	Trip Device	Set Point (Reset)	Corrective Action	Tech. Spec. Reference
B-1	480V Bus 1B3A-4A Bus Tie Breaker Off Normal	Contact operation of breaker BT-1B4A	Bus tie breaker BT-1B4A closed.	Auto: Alarm Follow-up-Return bus 1B3A-4A to normal line up as soon as possible to insure a separation of safeguard loads.	2.7
B-2	480V Bus 1B4A, 1B4B, & 1B4C Low Voltage	27-1X / 1B4A and 27-2X / 1B4A or 27-1X / 1B4B and 27-2X / 1B4B or 27-1X / 1B4C and 27-2X / 1B4C	90%	Auto: Alarm Follow-up: Verify if a valid alarm. If so, check transformers for malfunction and contact Electrical Maintenance.	2.7

Window	Alarm	Trip Device	Set Point (Reset)	Corrective Action	Tech. Spec. Reference
B-7	4160 V Bus 1A4 Low Voltage	27-1X 1A4 27-2X 1A4	90%	Auto: Alarm Follow-up: Verify if alarm valid. Transfer power supply if power supply has malfunctioned.	2.7
B-8	4160V Bus 1A4 Transformer Feeder Breakers Auto Trip	Contact operation of CB-20 control switch and breaker position.	CB-20 Control switch in the after close position and the breaker open for the following breakers: T1B-4A, T1B-4B, T1B-4C, and T1C-4A.	Auto: Alarm : Trips 480V transformer secondary breaker and associated island bus tie. Follow-up-Close bus tie breakers to feed the island and 480V bus from Bus 1A3, after insuring the trip was not a fault on the bus.	2.7

Fort Calhoun Station Unit No. 1
Operating Procedure No. 10
Annunciator A-19
Panel CB-20

ISSUED DEC 3 1981

A-1	A-2	A-3	Trans T1A-2 4160V Bus Ground A-4	Trans T1A-2 Secondary Low Voltage A-5	Trans T1A-2 Oil Level Lo Oil Temp Hi A-6
DC Bus #2 Ground B-1	B-2	B-3	4160V Bus 1A2 Low Voltage B-4	B-5	Trans T1A-2 Winding Temp Hi B-6
C-1	C-2	Bkr. 1A24 Auto Trip C-3	Bkr. 1A22 Auto Trip C-4	Trans T1A-2 Gas Press. Relief C-5	Trans T1A-2 Pressure Relay Oper C-6
D-1	Panel AI-41B Transfer Sw. Emerg Supply Off Normal D-2	Bkr. 1A24 Lockout Relay Oper 86/1A24 D-3	Bkr. 1A22 Lockout relay oper 86/1A22 D-4	Low Voltage AC Buses 1A and 2A DC Dist. Pnls. 1 & 2 D-5	Weather Tower Trouble D-6

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Window	Alarm	Trip Device	Set Point (Reset)	Corrective Action	Tech. Spec. Reference
A-4	Transformer T1A-2 4160V Bus Ground	Contact operation on ground fault relay 64X/1A2-24	Transformer fault or 4160V equipment fault.	Auto: Alarm Follow-up-Locate grounded component with fault locator and de-energize if plant conditions allow. Contact electrical maintenance.	
A-5	Transformer T1A-2 Secondary Low Voltage	27-1X/1A2-24 and 27-2X/1A2-24 or 27-74/T1A2	3115V and 3115V or 3980V	Auto: Alarm Follow-up-Verify alarm. Check gen. and 345 KV voltage. Transfer bus power supply if bus is being fed from affected power supply	2.7
A-6	Transformer T1A-2 Oil Level Lo Oil Temp Hi	Contact operation of gauge contacts	Level - Low mark on gauge Temp - 90°C.	Auto: Alarm Follow-up-Check for oil leak and excessive current Ensure cooling fans are in operation.	