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October 20, 1992
LIC-92-312

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-137
Washington, DC 20555

Reference: Docket No. 50-285

Gentlemen:

SUBJECT: System Information for Auxiliary Feedwater Pump FW-54

Omaha Public Power District (OPPD) is submitting information on the third Auxiliary Feedwater pump (FW-54) at Fort Calhoun Station, as requested by OPPD's NRC/NRR Project Manager. Attachment 1 is a "white paper" describing the modification that added FW-54, including design considerations, procedural guidance for intended use, and the current maintenance and testing schedule for FW-54 compared to the other two Auxiliary Feedwater pumps. A simplified flow diagram of FW-54 and auxiliary equipment is shown in Attachment 2. Attachment 3 is an exerpt from an OPPD System Description.

This submittal is for information only and is not considered part of the current licensing basis for Fort Calhoun Station. If you should have any questions, please contact me.

Sincerely,

W. G. Gates

W. G. Gates
Division Manager
Nuclear Operations

WGG/tcm

Attachment

c: LeBoeuf, Lamb, Leiby & MacRae
J. L. Milhoan, NRC Regional Administrator, Region IV
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Fort Calhoun Station (FCS)
Third Auxiliary Feedwater Pump, FW-54
Modification Request FC-88-017

Scope:

- Addition of an engine driven, non-safety grade, non-seismic 300 gpm auxiliary feedwater (AFW) pump, Tag #FW-54, in the Turbine Building basement.

- Changes to eight air operated valves and two motor operated valves in the feedwater (FW) and AFW systems.

- Addition of two thermal relief valves on the AFW piping between the inboard and outboard AFW containment isolation valves.

This equipment is shown on the following P&IDs:

Auxiliary Feedwater	11405-M-253 Sh 4
Fuel Oil	11405-M-262 Sh 1
Misc Drains and Chem. Feed	11405-M-265 Sh 1
Plant One-Line Elec. System	FIG 8.1-1

General Design Features:

OPPD added a third auxiliary feedwater pump, Tag #FW-54, which is independent of the existing FCS power sources and of the water supply for the existing safety related auxiliary feedwater pumps FW-6 (electric motor driven) and FW-10 (steam turbine driven). FW-6 and FW-10 are supplied by the safety grade Emergency Feedwater Storage Tank in Room 81 of the Auxiliary Building. FW-54 is a centrifugal eight-stage unit driven by a diesel engine. It is manually started either locally or from the control room. It can be used for normal startup or shutdown operations, or it can be used as a backup to the safety grade pumps during a plant event.

Specific features:

- A diesel engine (V-8 Caterpillar) running at 1817 rpm drives a 1 to 2.08 ratio speed increaser to a Byron Jackson 3 x 4 x 9B 8-stage model DVMX pump (this pump is identical to FW-6, the electric motor driven AFW pump).

- The pump, driver, and appurtenances are commercial grade. A four-hour endurance test of the engine and pump at full load was performed by the vendor and witnessed by OPPD prior to shipment to FCS.

- The water source is the condensate storage tank (DW-48) located outdoors along the Missouri River, diverse from the safety grade Emergency Feedwater Storage Tank source for FW-6 and FW-10.

- The pump and engine are located in a 3 hour fire rated room with attendant fire detection and sprinkler coverage.

- Cooling water for the engine jacket water and speed increaser heat exchangers is provided directly from the first stage of the pump.

General Design Features: (continued)

- The fuel oil day tank is in the FW-54 pump r om. The fuel supply is shared with the auxiliary boiler fuel tank (FO-10). The fuel transfer pump is located in the Service Building.

- Engine pump auxiliaries (ventilation fans, battery charger, jacket water heater, fuel transfer pump) are powered by a dedicated Motor Control Center (MCC-3C4C-3) outsic the pump room. If the normal feed is lost, the automatic transfer swit.h transfers load to an engine-driven 480 volt, 12.46 kW generator.

- Manual Start switches are installed remotely on CB-10/11 in the control room and locally at AI-114.

- A dedicated hydrazine metering pump and control loop is available to meter hydrazine into the discharge piping for start-up oxygen control.

Regulatory and Design Inputs:

- In 1988, Fort Calhoun Station was one of seven plants with two AFW pumps.

- As part of OPPD's response to Generic Issue 124, Auxiliary Feedwater System Reliability, the original two pump (FW-6 and FW-10) AFW system was modeled in accordance with the guidance of the Standard Review Plan (SRP). The calculated reliability (mean) was 1.8×10^{-4} failures per demand, a value exceeding the SRP Section 10.4.9 criteria of 10^{-4} to 10^{-5} failures per demand.

- A February 17, 1988 letter (LIC 89-955) from OPPD (W. C. Jones) to the NRC committed OPPD to installing a third auxiliary feedwater pump.

- NRC Letter of May 9, 1988, "Resolution of Generic Issue 124, Auxiliary Feedwater System Reliability for the Fort Calhoun Station" stated "the staff concludes that the licensee's commitment to install a third AFW pump and consideration of the following additional enhancements will ensure appropriate AFWS reliability."

  One of the additicnal enhancements noted is "the four air-operated valves (HCV-1107A and B, and HCV-1108A and B) that permit the AFW pumps flow to the steam generators are normally closed and should open upon receipt of an AFWS initiation signal. Since there is a potential that the closed valves may fail to open on demand, the licensee is requested to evaluate the merits of both the normally open and normally closed valve configuration and adopt the more reliable configuration. A high degree of reliability of these discharge valves would alleviate the staff concerns raised in Generic Issues GI-122.1.a, b, and c, with respect to isolation valve failure, and interruption and recovery of AFW flow."

  In response to this staff position, OPPD added accumulators and control changes to the scope of the modification. These changes are included in the description of other changes on Pages 3 and 4.

Regulatory and Design Inputs: (continued)

- Addition of a third auxiliary feedwater pump was incorporated into OPPD's Safety Enhancement Program as part of SEP Item 38.

- OPPD's Probabilistic Risk Assessment (PRA) group determined that the SRP calculated reliability noted previously was not based on the quality class of components. Therefore, availability of a non-safety grade third AFW pump would be a valid improvement of the calculated AFW reliability.

- Two other plants, Trojan and Davis-Besse, added non-safety grade third AFW pumps and obtained NRC acceptance.

- Early PRA input into the design recommended a water supply diverse from FW-19, the Emergency Feedwater Storage Tank (EFWST) that supplies AFW pumps FW-6 and FW-10, in order to provide a significant increase in reliability. As a result, Operations personnel requested that the new pump be capable of resupplying FW-19, which requires refilling 8 hours after an accident. The new source was preferable to the fire water system, which was a backup if condensate or demineralized water were not available. Plant staff requested that a full flow test line for FW-6 and FW-10 be integrated into the EFWST fill line.

- FW-54 was not connected to existing automatic AFW actuation logic, providing manual starting control for Operations personnel.

  During the initial design phase of the third AFW pump, the unresolved safety issue of Station Blackout was being explored for plant-specific vulnerabilities. At that time, because use of FW-54 was considered necessary during station blackout, the engine mounted 480 volt generator, motor control center, and automatic transfer switch described earlier were incorporated into the design. Availability of FW-54 was later determined not to be necessary for Station Blackout considerations (Reference: OPPD Engineering Analysis 89-054 "Station Blackout Coping Assessment").

- The design and installation of the pump and appurtenances (though non-safety grade) were controlled by various Design Engineering and Plant Standing Orders. The following portions of 10CFR50 Appendix B apply to the installation and maintenance of this equipment: Design Control, Instructions, Procedures and Drawings, Document Control, Control of Special Processes, Inspections, Test Control, Control of Test and Measuring Equipment, and Inspection, Test and Operating Status.

Other changes:

- Pneumatic circuitry changes were made to HCV-1105 and HCV-1106, main feedwater (startup) regulating valves which have a backup safety function. These valves are in the "alternate flow path" for auxiliary feedwater if the normal safety grade flow path is not available. Control changes now allow an operator to reopen HCV-1105 and HCV-1106 (after CIAS) and close them after loss of instrument air up to 3 times in 8 hours. Also, the valves can be partially opened after CIAS closure if instrument air is available.

Other changes (continued):

- Accumulators were added to the (fail-open) minimum flow recirculation valves on existing motor and steam driven AFW pumps, FW-6 and FW-10.

- On the existing AFW discharge piping to the steam generators, the inboard and outboard containment isolation valves fail open upon loss of air or electrical signal. On the inboard (containment side) isolation valves, HCV-1107A and HCV-1108A, accumulators were added to allow 3 open/close cycles in 8 hours. On the outboard valves, HCV-1107B and HCV-1108B, accumulators were also added. In addition, a pressure switch and pneumatic solenoid valve were added to each of the outboard valves to remove the Electrical/Pneumatic throttling components from the pneumatic circuit upon loss of instrument air, ensuring full use of the accumulator air for open/close operation of the control valves.

- Motor operated valves HCV-1385 and HCV-1386 are containment isolation valves on the main feedwater system. They receive a closure signal upon CIAS. If the "alternate flow path" for injecting AFW is needed, the bypass switches installed by the modification will allow reopening.

  All of the above features are operator selected. Control room annunciation denotes off-normal conditions for the valves.

- Thermal relief valves were added outside containment between the inboard and outboard AFW containment isolation valves to prevent over-pressurization of the exposed piping in containment due to a MSLB or LOCA.

Maintenance and Periodic Testing of FW-54

- FW-54 is not safety related equipment and is not incorporated into the plant Technical Specifications. Pump availability is assured through inclusion in the plant preventive maintenance program.

  The following is a summary of current/planned maintenance and periodic testing in a matrix format comparing all three AFW Pumps.

	FW-6 (electric)	FW-10 (steam)	FW-54 (diesel)
Operability (in recirculation)	OP-ST-AFW-0004(M)	OP-ST-AFW-0004(M)	N/A
Full Flow Test	SE-ST-AFW-3005(Q)	SE-ST-AFW-3006(Q)	OP-PM-AFW-0004(M)
Pump Bearing Oil Check	WP000409(M)	WP000412(M)	OP-PM-AFW-0004(M)
Vibration Analysis (Pump)	WP000411(Q)	WP000906(Q)	MM-PM-AFW-0002(Y)[1]
Vibration Analysis (Driver)	WP000411(Q)	WP00906(Q)	MM-PM-AFW-0002(Y)[1]
Coupling Insp./Lub.	WP000463(Y)	N/A	MM-PM-AFW-0003(Y2)

Maintenance and Periodic Testing of FW-54 (continued)

	FW-6 (electric)	FW-10 (steam)	FW-54 (diesel)
Clean/Inspect Motor	WP001623(RO)	N/A	N/A
Driver, Change Oil Sentinel Relief Valve	N/A	WP004127(R2)	N/A
Gland Relief Valve	N/A	WP004128(R2)	N/A
Speed Limit Governor	N/A	WP004796(Y2)	N/A
Back Press Trip	N/A	WP005634(Y2)	N/A
Pump Pressure Gage Calibration	WP004661(M18)	WP004862(M18)	PM Planned
Starting Battery Check	N/A	N/A	WP006641(M)
Room Fans, Batt. Chg Transfer Switch	N/A	N/A	EM-PM-AFW-0001(Y)
Diesel Engine	N/A		N/A
- Coolant: Sample/Change			MM-PM-AFW-0002(Y)[1]
- Coolant filter: Change			MM-PM-AFW-0002(Y)[1]
- Crankcase Oil/Filter: Replace			MM-PM-AFW-0002(Y)[1]
- Fuel Filters: Replace			MM-PM-AFW-0002(Y)[1]
- Air Filter; Replace			MM-PM-AFW-0005(Y)[1]
- Belt: Inspect			MM-PM-AFW-0005(Y)[1]
- Valve Lash: Adjust			MM-PM-AFW-0005(Y)[1]
- Coupling: Inspect			MM-PM-AFW-0003(2Y)[1]
- Gear Red Oil: Inspect/Change			MM-PM-AFW-0003(2Y)[1]
- Alignment Pump, Driver, Gear Reducer: Inspect			MM-PM-AFW-0003(2Y)[1]
- Fuel Transfer Pump Filter: Change			MM-PM-AFW-0004(Y)[1]

Frequency Key:
(M) = Monthly
(Q) = Quarterly
(Y) = Annual
(RO) = Every Refueling Outage
(M18) = 1 per 18 months
(Y2) = 1 per 24 months
(RO2) = Every Other Refueling Outage

NOTES: 1. This procedure is planned but not approved as of this date.
2. Maintenance intervals for some items may change as a result of operating and industry experience.
3. A Reliability Centered Maintenance (RCM) analysis on FW-54 has not yet been performed. Upon completion of this analysis, additional PM tasks may be developed.

Operational Procedures Applicable to FW-54

Operating Procedures

- OI-AFW-1, "Auxiliary Feedwater Actuation System Normal Operation," Section IX through XIII list functions of annunciators and switches related to FW-54 and auxiliaries.

- OI-AFW-4, "Auxiliary Feedwater Start-Up and Normal System Operation," Steps 6.13 through 6.22 give instructions for start, stop and control of FW-54 and auxiliaries.

Abnormal Operating Procedures

- AOP-28, "Auxiliary Feedwater System Malfunctions"

  Section I, "Loss of FW-6" directs the operator to start FW-10. The contingent action is to start FW-54.

- AOP-30, "Refilling Emergency Feedwater Storage Tank"

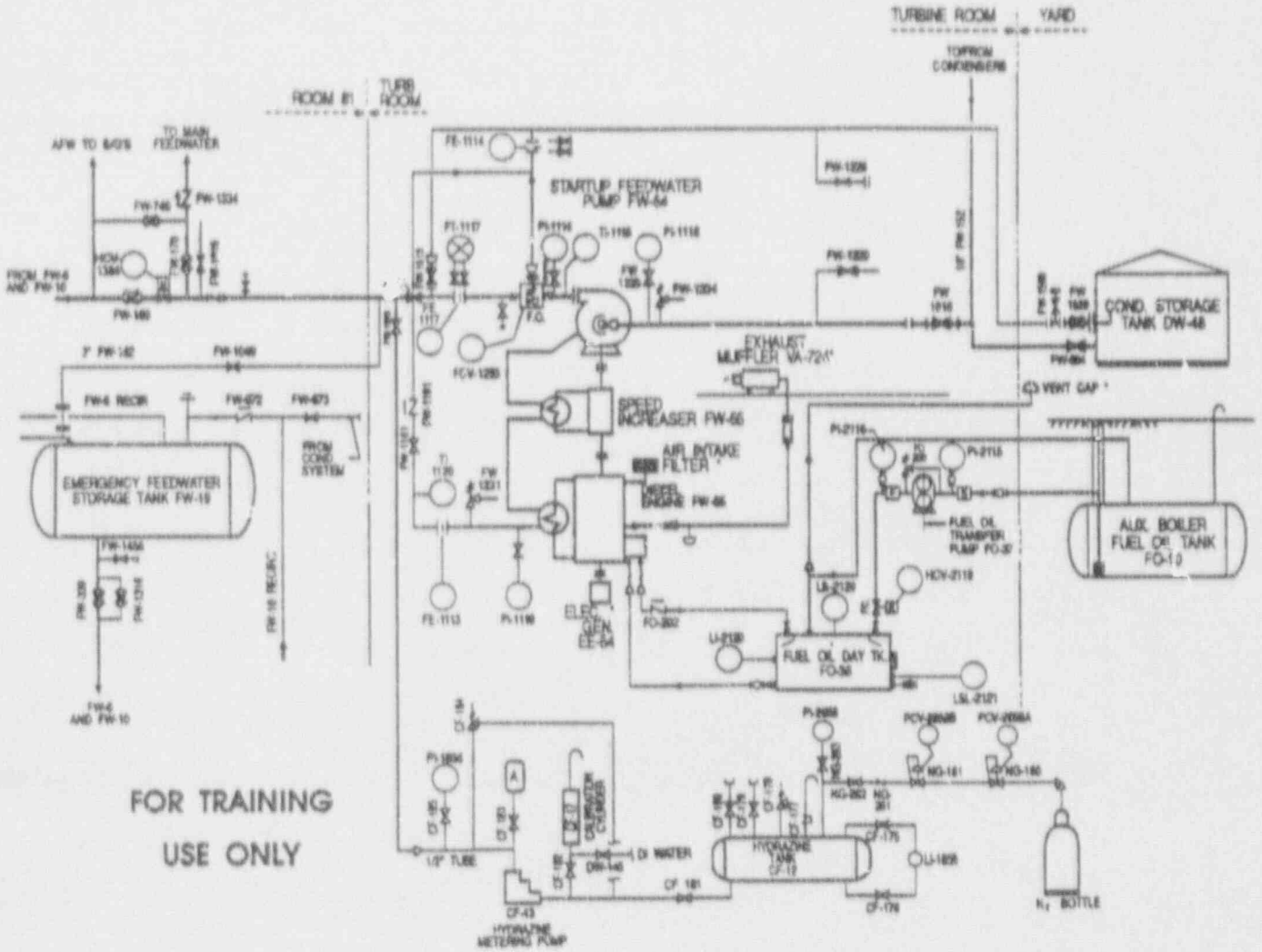
  The order of preference is DI Makeup, Condensate Makeup, FW-54 which provides makeup from the Condensate Storage Tank DW-48, then Fire Protection water.

Emergency Operating Procedures

- EOP-20, "Functional Recovery Procedure"

  Section 16.0 "RCS and Core Heat Removal," steps in subsections 9.0 and 10.0 state that if FW-6 and FW-10 are unavailable, FW-54 is to be started.

FW-54 FLOW DIAGRAM



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Attachment 3

Excerpt from OPPD System Description
Auxiliary Feedwater

2.8 Auxiliary Startup Feedwater Pump FW-54

2.8.1 General Description

A non-CQE diesel engine driven auxiliary (startup) feedwater pump FW-54) is located in the southeast corner of the Turbine Building basement floor under the truck dock. The pump can be used to provide feedwater to the steam generators during plant startup and cooldown operations. It will also provide a backup source of auxiliary feedwater to the steam generators.

Pump suction is drawn from the 10 inch condensate surge line from the condensate storage tank (DW-46). The pump discharges via a 3 inch line and ties into the auxiliary feedwater system between HCV-1384 and FW-170. A connection is also provided to the EFWST to provide condensate quality makeup water in the event the normal makeup water supply is not available.

An Automatic Recirculation Control Valve (ARC) is provided at the discharge of the pump to ensure low flow protection. The recirculation flow is directed to the Condensate Storage Tank. Full flow testing can be performed without disrupting other systems by a line downstream of the ARC valve. Flow is directed back to the Condensate Storage Tank during full flow testing in this mode.

The pump is driven by a diesel engine (FW-56) through a 1 to 2.08 speed increaser (FW-55) at constant speed. The engine is fueled by a day tank (FO-38) located in the pump room. A fuel oil transfer pump (FO-37) is located in the service building transfers fuel from the Auxiliary Boiler Fuel Oil Tank (FO-10) to maintain level in the day tank. The day tank is sized for an 8 hour operation. A 12.46 KW generator mounted on the diesel engine provides power to its associated electrical loads in the event of station blackout.

Cooling water for the engine is provided from a first stage takeoff connection on the pump. Automatic temperature control is provided by the engine jacket water cooling system. The cooling water line discharges to the pump recirculation line downstream of the ARC valve.

2.8.2 Design Parameters

FW-54 Auxiliary Feedwater Pump

Manufacturer	Byron Jackson
Pump Size	3x4x9b 8-stage DVMX
Stuffing Box	packed
Bearings	Ball and Ball
Temperature	85°F normal 120°F max, 33°F min
Flow (discharge)	300 gpm startup 260 gpm emergency 150 gpm recirculation
Flow (1st stage takeoff)	65 gpm to engine and speed increase hx's
Rated head	2300 ft startup 2600 ft emergency
Pump Speed	3780 rpm
BHP required	340
Efficiency	67.5%

FW-56 Diesel Engine

Manufacturer	Caterpillar
Model	3408
Operating Maximum Speed	1817 rpm + 2%
Fuel	2-D Diesel
Net Available BHP	400% BHP
Fuel Oil Transfer Pump	FO-37
Design Flow	5.8 gpm
Design Pressure	150 psi at 220 ssu
Max Available Suction Press	6.6 psia
Electrical Generator	EE-54
Output	480V 3 pm 60 Hz
Cont Rating	12.46 kVA at 50°C amb
Max Voltage Drop With Step Load Addition	25%

2.8.3 Instrumentation and Control

The third auxiliary feedwater pump is manually controlled from Control Room Panel CB-10 or locally from pump control Panel AI-114. The controlling station is determined by a "Local/Remote" selector switch on Panel AI-114. The switch is normally positioned to "Remote" which selects CB-10 as the controlling station.

The pump can be manually started by positioning the "STOP-RUN" switch on CB-10 to "RUN" when CB-10 is the controlling station, or by placing the "STOP-RUN" switch on AI-114 to "RUN" when AI-114 is the controlling station.

In addition, an "EMERGENCY STOP" pushbutton is provided locally, outside the pump room, to stop the diesel engine for the startup feedwater pump and the fuel oil transfer pump in the event of an emergency. The pushbutton also closes the fuel oil supply isolation Valve (HCV-2119).

The FW-54 pump will automatically shutdown if any of the following conditions exist:

- High-High engine cooling water temperature
- Low engine lube oil pressure
- High-High engine lube oil temperature
- Diesel overspeed
- Diesel overcrank

The engine's fuel oil pressure, lube oil pressure, lube oil temperature, speed, cooling water temperature, and elapsed hours are monitored and displayed on pump control Panel AI-114.

2.8.3 Pump suction flow is measured on FI-1112 displayed on CB-10. The pump discharge flow is monitored (FI-1117) and displayed on local control Panel A1-115. The pump discharge flow signal can also be used to control the injection rate from the hydrazine injection metering pump (CF-13) in an open loop fashion. In order to maintain acceptable accuracy over a measured feedwater flow range of 20-350 GPM, two flow transmitters arranged in a split range configuration are used. Flow signal is linear.

Currently pump flow indication on CB-10 is discharge flow. The change to suction flow is being evaluated in accordance with Standing Order G-21, "Modification Control".

Local instruments include temperature indicators TI-1115 located at the pump discharge and TI-1120 to display diesel engine cooling water temperature. Pressure indicators will include PI-1116 to display pump discharge pressure, PI-1118 to display pump inlet pressure and PI-1119 to display diesel engine cooling water pressure.

The day tank fuel oil level can be controlled manually or automatically. The type of operation will be determined by the position of the "HAND-OFF-AUTO" switch located adjacent to the day tank. Fuel oil is provided to the tank by the fuel oil transfer pump (FO-37). Positioning the switch in the "HAND" position will start the transfer pump and will continue filling the tank until the switch is positioned in the "OFF" position. The "Trouble" annunciator previously described will alarm if the fuel oil level in the day tank drops to 10 percent full.

The day tank fuel oil level is controlled automatically by level switch LS-2120, when the switch is in the "AUTO" position. The transfer pump will start when the level in the tank drops below 15 percent and stop when the level reaches 90 percent.

The fuel oil transfer pump will stop and the fuel oil isolation valve will close regardless of the position of the control switch if the pump emergency stop pushbutton is depressed.

Local instruments include fuel oil day tank level indicator LI-2120 and pressure gauges PI-2116 for the fuel oil transfer pump outlet pressure and PI-2115 for the fuel oil transfer pump inlet pressure.

2.8.3 The pump room incorporates two air inlet openings and two air outlet fans with fire dampers for room ventilation and engine combustion air. The pump room (including fire dampers and self closing doors) is designed as a three hour fire rated enclosure as required by NFPA 37 "Stationary Combustion Engines". Flow through ventilation is used to maintain room temperature at al level acceptable for pump/engine operation.

The fans (VA-720 and VA-721) can be controlled manually or automatically. The type of operation will be determined by the position of the "HAND-OFF-AUTO" selector switches located on MCC-3C4C-3 (one switch for each fan). When the switches are positioned in "HAND," the fans will run. and when positioned in "OFF" the fans will stop.

With the switches in the "AUTO" position ventilating fan VA-720 will start and stop with the auxiliary feedwater pump (FW-54). Ventilating fan VA-721 will start when the temperature in the room is greater than 105°F. This temperature control will be performed by temperature switch TS-795.

Green-stop/red-run indicating lights are provided at motor control center MCC-3C4C-3 to indicate ventilating fan operating status.

Fire detection in the pump room is provided by two infra-red flame detectors connected to alarm at the plant XL-3 fire detection panel located in Control Room Panel AI-56. Fire protection in the pump room is provided by the Turbine Building sprinkler system.

The pump room for fire protection purposes is considered extra hazard group 1 in accordance with NFPA 13.

The pump room has one gaitronics speaker for plant communication, a flashing emergency alarm light for the emergency alarm system, and two fire alarm bells.

2.8.3 The pump room enclosure consists of eight inch thick block walls and two self-closing doors. A curbed oil spill area sized to hold the entire contents of the day tank is installed under the day tank. A trolley beam is installed above the pump/increaser/engine center line to aid maintenance activities of the equipment. A 20A/120V receptacle will be provided for the pump room hoist.

MCC-3C4C-3 provides power for the fuel oil transfer pump (FO-37), the pump room ventilation fans (VA-720 and VA-721), the third auxiliary feedwater pump (FW-54) auxiliary loads. MCC-3C4C-3 is located outside the pump room and will be fed from either MCC-3C4C-1, which is the normal source or from the diesel engine shaft driven generator (EE-54). Transfer switch EE-55 automatically transfers the power source between MCC-3C4C-1 and generator EE-54 upon loss of voltage from MCC-3C4C-1.

Water chemistry control will be accommodated by providing taps suitable for connection to a mobil condensate demineralizer unit on the pump suction and recirculation lines. (Valves FW-1230 and FW-1229 on Dwg. 11405-M-253 Sh. 4) Total dissolved solids can be controlled by periodically cycling the contents of the condensate storage tank through the demineralizer unit.

2.8.3 Hydrazine Injection System

For oxygen control while FW-54 is supplying the steam generators during startup, hot standby and shutdown conditions, a hydrazine injection system was installed. Just west of the FW-54 pump room, in the Turbine Building Basement, is the skid location for the 55 gallon hydrazine storage tank, Item CF-12, and the hydrazine metering pump (Item CF-13). The pump is a positive displacement Pulsa-feeder Model 7120 with a variable speed motor drive and a manual pump stroke adjustment. The manual adjustment will be used to make corrections for suction temperature of the condensate. Flow rate to maintain between 1 1/2 and 2: 1 ratio of hydrazine to dissolved oxygen, will vary from approximately 3 ml/min at 20 gpm forward feedwater flow to approximately 45 ml/min at 300 gpm forward flow. A calibration cylinder is permanently installed on the suction line to the pump.