DUKE POWER COMPANY

DESCRIPTION OF PROPOSED MODIFICATIONS
for
GENERIC LETTER 89-19

OCONEE NUCLEAR STATION

STEAM GENERATOR DRYOUT PROTECTION

'SGDO'

STEAM GENERATOR OVERFILL PROTECTION

'SGOP'

ORIGINAL ISSUE: MARCH 19, 1990

1.0 Introduction

Generic Letter 89-19 recommends specific upgrades to resolve operational situations defined under Unresolved Safety Issue (USI) A-47, "Safety Implications of Control Systems in Light Water Reactor Nuclear Power Plants."

Analyses documented in NUREG 1217 and 1218 have led the NRC Staff to recommend that all Pressurized Water Reactors (PWR's) should provide automatic Steam Generator Overfill Protection (SGOP). In addition to this upgrade, the staff has also concluded that the Oconee Nuclear Station should also provide automatic Emergency Feedwater (EFW) initiation on low Once Through Steam Generator (OTSG) water level (or through other acceptable designs) to prevent OTSG Dryout (SGDO) on loss of control system power.

This submittal describes the proposed modifications to be implemented on the Oconee Nuclear Station to meet the intent of GL89-19.

2.0 Existing Emergency Feedwater System Design

The present Emergency Feedwater (EFW) system design initiates the Motor Driven pumps (MDEFWP's) and the Turbine Driven pump (TDEFWP) independently upon loss of both main feedwater pumps as sensed by:

1. Loss of Hydraulic Control Oil Pressure to the Steam Supply Stop Valves.

OR

2. Loss of Feedwater Pumps Discharge Pressure

Figures 1 and 2 show the starting logic for each of the pump types.

The EFW system is designed in accordance with NUREG 0737 as a two train system and meets the requirements of IEEE 279-1971. The present design provides for anticipatory recognition of low steam generator water level occurrences by monitoring the above identified variables. By responding to the above conditions in advance of low generator water level, the EFW system can provide feedwater while OTSG inventories are still near normal levels. This responsiveness of EFW precludes waiting for OTSG inventories to be reduced unnecessarily.

2.1 Proposed Modifications for SGDO Protection

Modifications to improve the recognition of and response to Steam Generator Dryout conditions will consist of the following changes to the Steam Generator Level Control System (SGLCS) and the Motor Driven Emergency Feedwater Pumps (MDEFWP's).

1. Add low level set points to the OTSG level transmitter instrument loops presently used for control of steam generator level during operation of the Emergency Feedwater system. This setpoint will provide a diverse means of actuating EFW as the steam generator approaches dryout conditions. Based on the uncertainty in the steam generator level instrument string, the set point will be selected to provide a high level of confidence that an EFW start signal is generated prior to steam generator dryout. In addition, sufficient margin to the main feedwater low level control set point will be included to prevent inadvertent EFW starts.

   The starting logic for the MDEFWP's will be such that upon 2 out of 2 low level in either OTSG both pumps will start and provide water to both steam generators.

2. Provide a time delay at the low level set point which will delay starting the MDEFWP's for approximately 30 seconds in order to allow the water level in the OTSG's to stabilize after a plant trip to prevent inadvertent starts of EFW.

3. Provide sufficient noise filtering circuits on the level signal inputs to prevent spurious process system noise from inadvertently starting EFW.

The proposed modifications are consistent with recommendations contained in the B&W Owner's Group (BWOG) Safety Performance Improvement Program (SPIP). Recommendations TR-022-EFW, TR-160-EFW, and TR-161-EFW address these design features.

2.1.1 Detailed Design Information for SGDO Protection

The SGLCS is a two Train safety-related system installed to meet the requirements of NUREG 0737. The SGLCS is located in the Cable Spreading Room below the Main Control Room in a mild environment. The power source for each train of SGLCS is from the safety related Vital Instrumentation and Control power panelboards.

The SGLCS receives four OTSG level signals. Each train receives one signal from each steam generator (OTSG A & B Level to Train A and the same to Train B). These level signals control OTSG level by modulating EFW valve FDW315 which feeds OTSG A and valve FDW316 which feeds OTSG B.

See Figure 3 for a simplified flow diagram of the EFW system.

These level signals will be used to start the MDEFWP's upon 2 out of 2 low OTSG level. Isolated outputs from the SGLCS will be arranged such that if low level is sensed in either OTSG both MDEFWP's will start and provide water to both steam generators as controlled by the same level transmitters. At the same time as the pumps are commanded to start, the level control system will be directed to control level to the appropriate set point depending upon whether any Reactor Coolant Pumps are running. Computer alarms will be provided to alert the operator to initiation of EFW due to low OTSG levels and to serve as a record for transient event evaluation.

A 30 second time delay (adjustable) is expected to be used upon indication of 2 out of 2 low level in either steam generator to distinguish between transitory level swings during post trip conditions and true low level situations. The initiation level set point and the time delay will be prudently selected such that inadvertent starts of EFW and the resulting additional operator burdens are minimized.

Rosemount 1154 transmitters are used to determine OTSG level for the SGLCS. Because of the dynamics of measuring level in the OTSG's, it will be necessary to install noise filtering methodologies to improve signal quality for initiating EFW on low OTSG level. The techniques employed may be of both a mechanical nature (snubbers in the impulse lines) and an electrical nature (noise filters).

Figure 4 shows a functional block diagram of the proposed SGLCS initiation of EFW on low OTSG level.

3.0 Existing Steam Generator Overfill Protection

Overfill protection is presently provided through the Integrated Control System (ICS) to terminate feedwater when the high level set point is reached. The existing SGOP is a 2 out of 2 logic on either steam generator. Four transmitters monitor OTSG water level and trip both the main turbine and the main feedwater pumps when high level is sensed. The steam generator overfill protection circuits are composed of reliable non-safety grade hardware which has proven itself over the operating history of the Oconee plant. The existing ICS functions are designed to limit the potential for overfill in two ways. The ICS controls main feedwater pump speed and main feedwater control valve position to assure supply of the required feedwater and the proper steam generator operating level. OTSG operate level is used as a key component in the feedwater control sub-system in the ICS.

To insure that the plant goes to a stable and known state, the ICS has been configured such that upon loss of Hand Power, loss of Auto Power, or loss of both Hand and Auto Power the OTSG high level monitoring circuits will fail (de-energize)and trip the main turbine and the main feedwater pumps. The reactor will also trip due to the Anticipatory Reactor Trip System (ARTS). Emergency Feedwater is initiated on loss of feedwater as described earlier. In addition, the operator interface with the ICS during power failure events has been improved. As part of the SPIP efforts, additional alarms have been provided in the control room to alert the operator to ICS power failures. Additional training has also been provided to the control room operators to help in the recognition and response to ICS power loss events.

3.1 Proposed Modifications for SGOP

Modifications to assure the termination of main feedwater flow to the OTSG's in the event of overfill conditions will consist of utilizing an additional existing non-safety grade trip device and the main feedwater pump turbine to assure trip of the turbine and termination of forward feedwater flow.

The existing steam generator high level monitoring circuits have been reviewed with respect to the design guidance information provided in the generic letter. The Oconee design falls within the Group II designs shown on page 7 of GL89-19. The three points of acceptability are:

1. Separation between overfill-protection circuits and feedwater control system such that both areas are not subject to power source problems, not located in the same cabinets, and not located or routed so that a fire is likely to affect both systems.

2. Design modifications are implemented per the guidance in paragraph (3) (a) on page 6 of GL89-19.

3. Plant procedures and technical specifications include requirements to periodically verify operability of the overfill protection system/circuits.

Duke finds that the existing design for steam generator overfill protection meets the intent of the generic letter in each of the three areas. This conclusion is based upon the following justifications.

Item 1.

The existing overfill protection circuits and the feedwater control system are located in different ICS Cabinets. The feedwater control circuits which regulate feedwater pump turbine speed and main feedwater control valve position are located in ICS Cabinets 4,5, and 7. The overfill protection circuits are located in ICS Cabinet 14 which is also on a separate row from the others. In addition to the separation provided by the location of the control and monitoring functions in different cabinets, the Smart Automatic Signal Selector (SASS) and the plant computer outputs are connected to the level transmitter signals in ICS Cabinet 8. The SASS will automatically transfer the feedwater control system to a valid transmitter while the computer will alert the operator to the failed signal such that appropriate action may be taken.

Figure 5 shows the typical physical arrangement of the ICS cabinets in the Oconee plant.

Duke finds the existing design for SGOP to meet the intent of Item 1. Power source failures are acceptable. The signal modules de-energize to actuate. The overfill protection circuits and the feedwater control system are located in separate cabinets. The existing cable routes for the overfill protection and feedwater control systems are routed in the normal plant cable tray system which is designed to minimize common fire related affects. Fire detection and protection measures are provided in areas where these cables pass.

ITEM 2.

The proposed modification to the main feedwater pump turbine trip circuits will be implemented such that potential for common mode failures will be minimized. As already discussed above, the overfill protection circuits and the feedwater control system are arranged such that common mode failures are reduced and those that are postulated result in expedient detection. Duke finds the existing plant design is sufficient to identify potential common mode failures and the expected responses of the feedwater pump, the overfill protection circuits, and feedwater control system are acceptable.

ITEM 3.

The proposed modifications are to the feedwater pump turbine overspeed trip circuit and are part of a weekly surveillance and test routine. Each week the overspeed trip circuit is exercised to verify functionality. This assures that the pump will trip when required.

The level monitoring circuits are part of the ICS which are also input to the SASS. These circuits are dispayed on the main control board and monitored by the plant computer. If there is a problem with one of the level circuits, the plant computer will alert the operator to the condition. Duke finds these measures to be satisfactory for verifying operability of the overfill protection system/circuits.

3.1.1 Detailed Design Information for SGOP

The main feedwater pump turbine trip circuits will be modified to utilize an additional trip device to assure that the turbine trips when required. Solenoid valve SV6 will be connected to the existing steam generator level monitors on separate contacts. These contacts are presently used to trip the main turbine. This modification will add an auxiliary relay to trip both pieces of equipment.

See Figure 6 for a simplified electrical circuit showing the proposed modifications to the level monitoring circuits.

See Figure 7 for a simplified electrical circuit showing the proposed modifications to the feedwater pump trip circuits.

See Figure 8 for a simplified hydraulic oil circuit which show the feedwater pump turbine trip device relationships.

The power sources for the existing feedwater pump turbine trip device (SV12) is from the non-safety grade 125VDC station power batteries. The additional trip device (SV6) will also be powered from this source. The power source for the auxiliary relay to be added for actuating SV6 will be from the 125VDC station instrumentation and control batteries.

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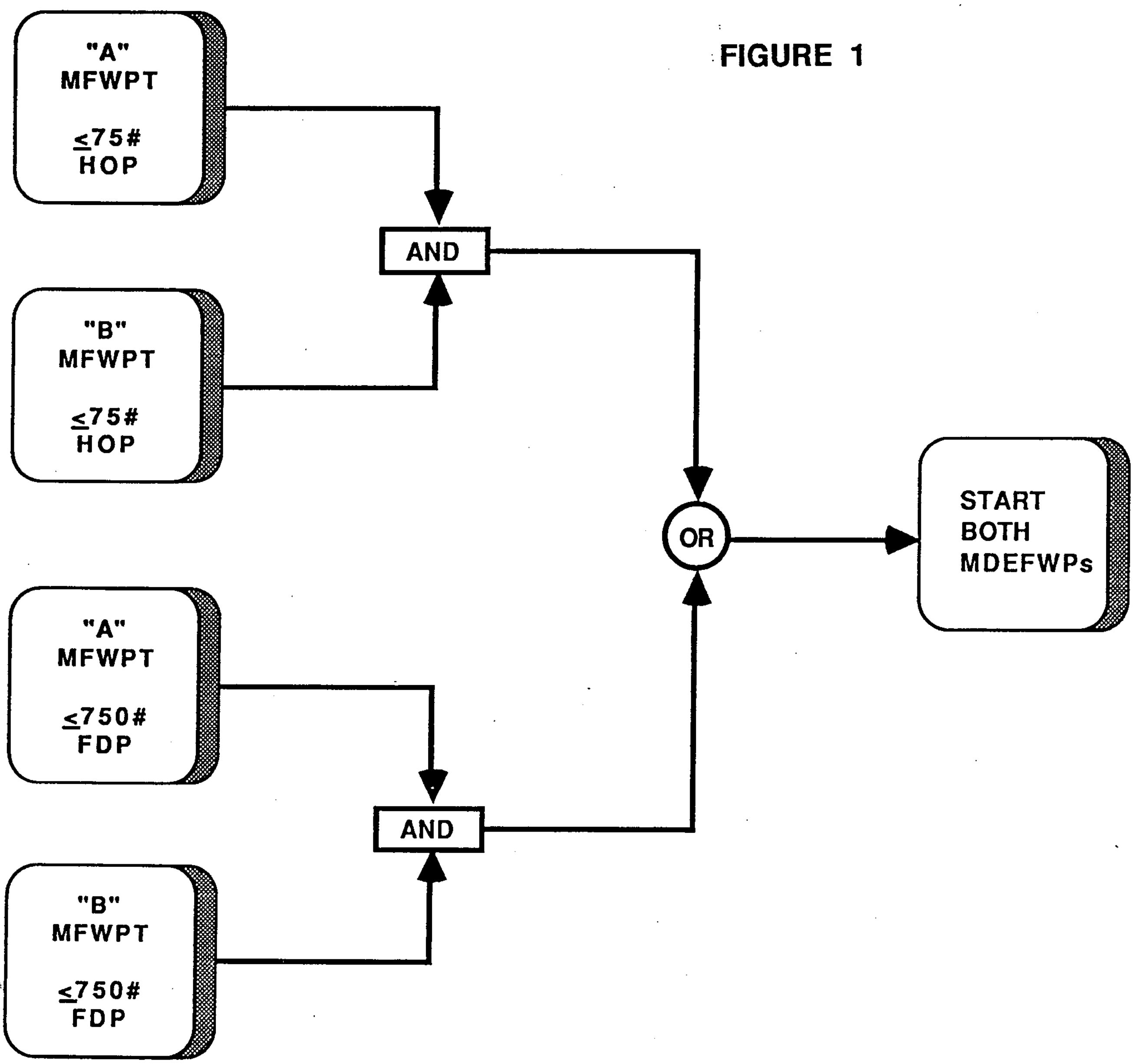
MOTOR DRIVEN
EMERGENCY FEEDWATER PUMP
AUTO START LOGIC

FIGURE 1



HOP = HYDRAULIC OIL PRESSURE

FDP = FEEDWATER DISCHARGE PRESSURE

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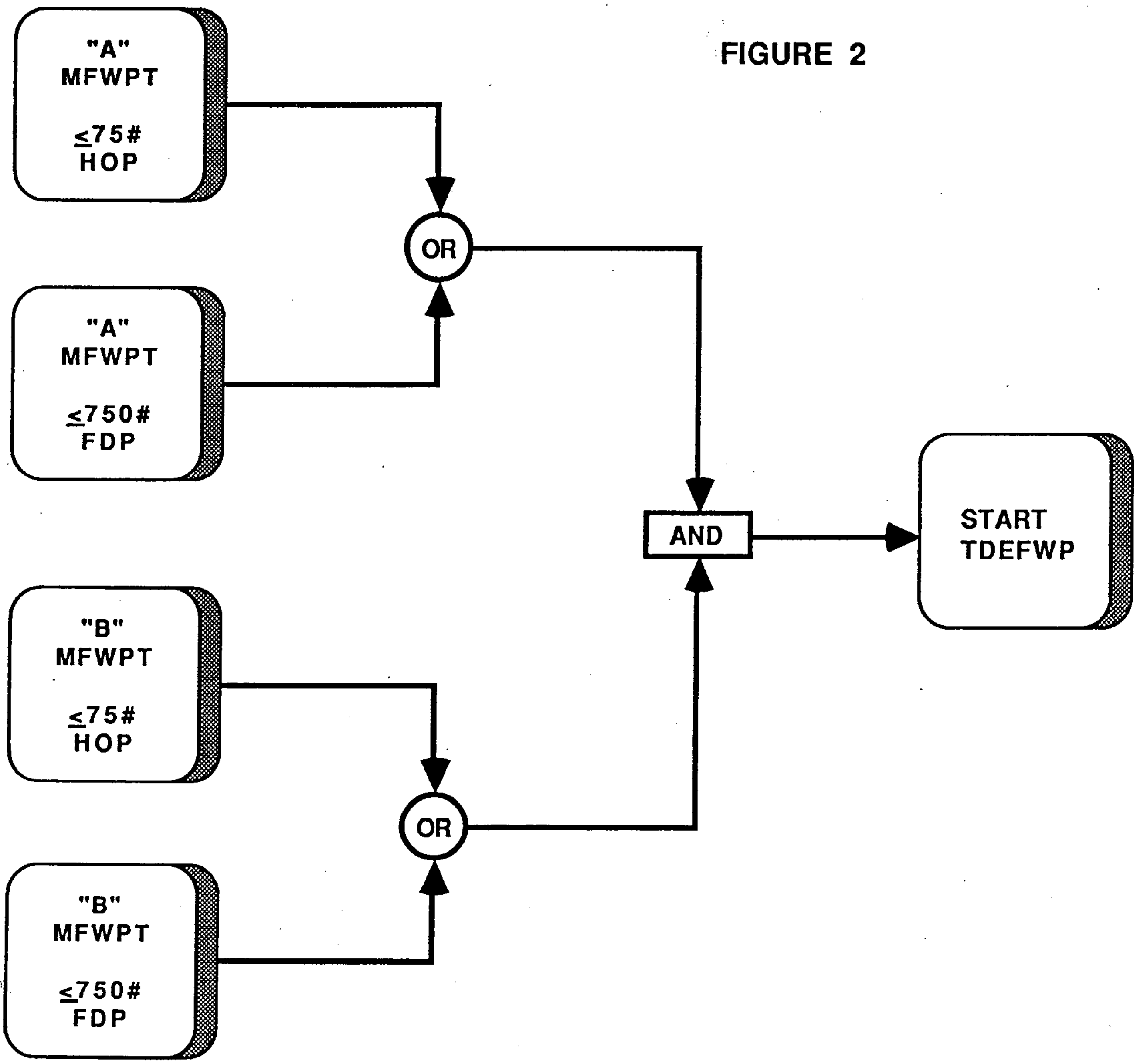
TURBINE DRIVEN
EMERGENCY FEEDWATER PUMP
AUTO START LOGIC

FIGURE 2



HOP = HYDRAULIC OIL PRESSURE

FDP = FEEDWATER DISCHARGE PRESSURE

NORMAL EMERGENCY FEEDWATER
FLOWPATH

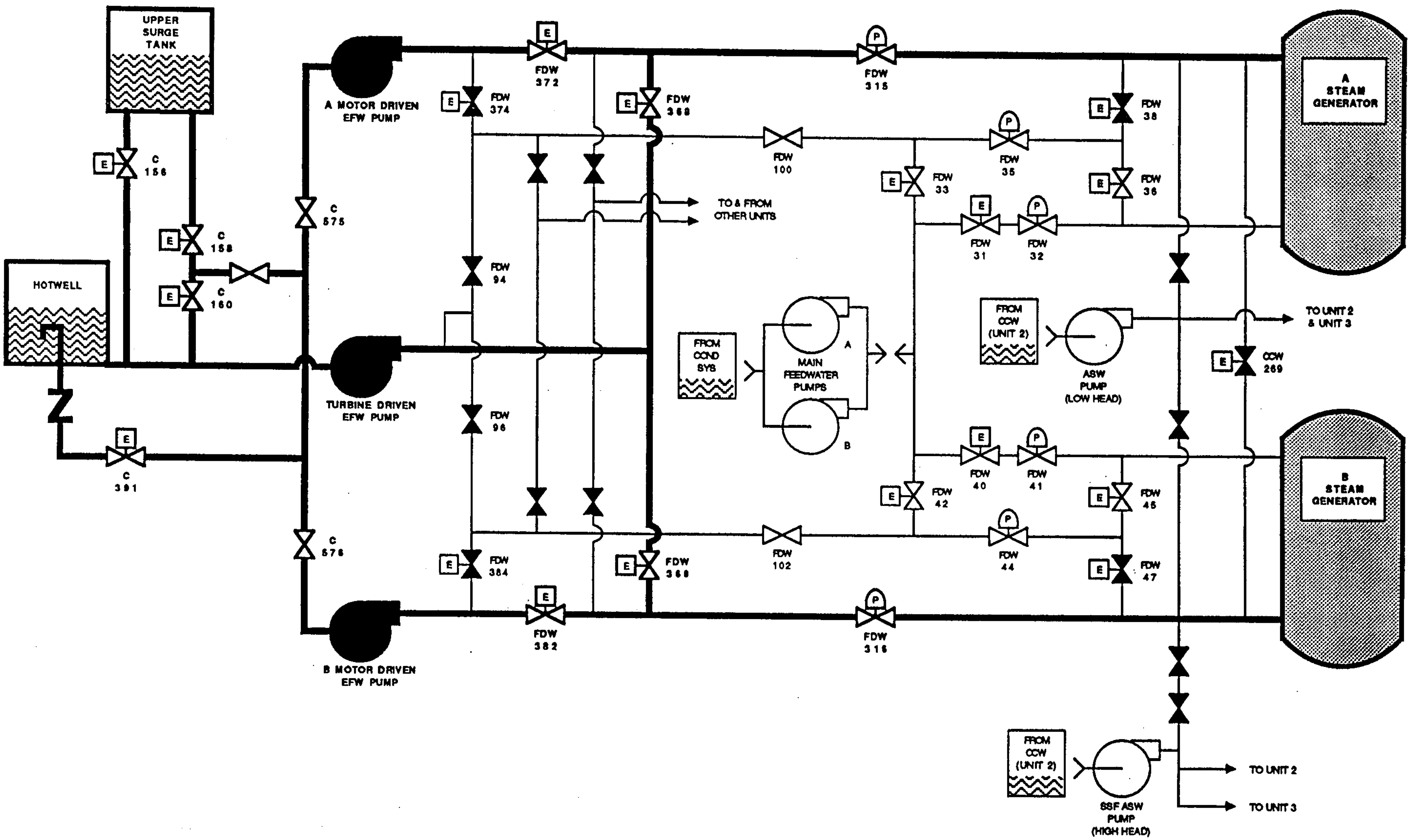
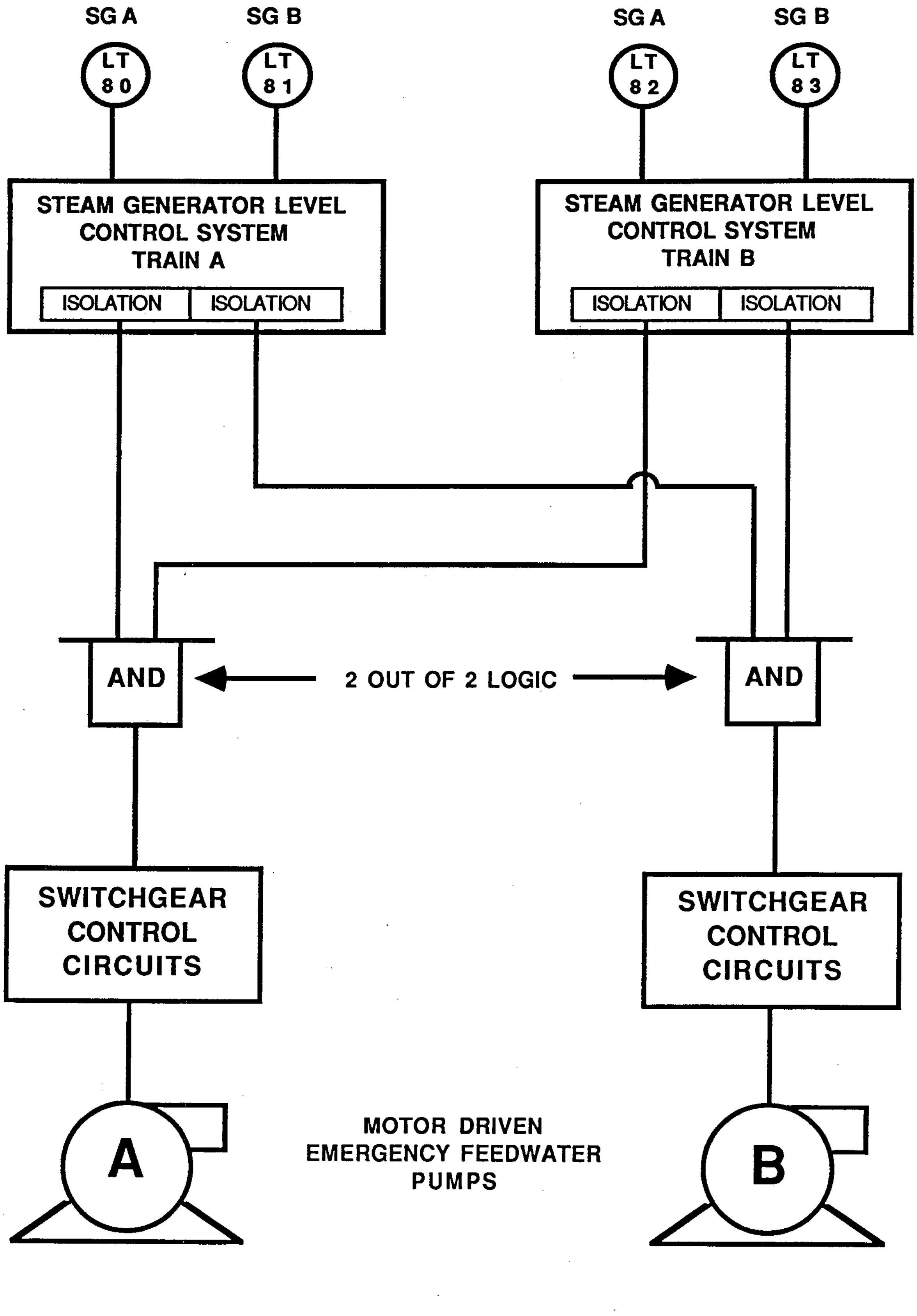


FIGURE 3



SIMPLIFIED FUNCTIONAL DIAGRAM- EMERGENCY FEEDWATER START ON LOW STEAM GENERATOR WATER LEVEL

FIGURE 4

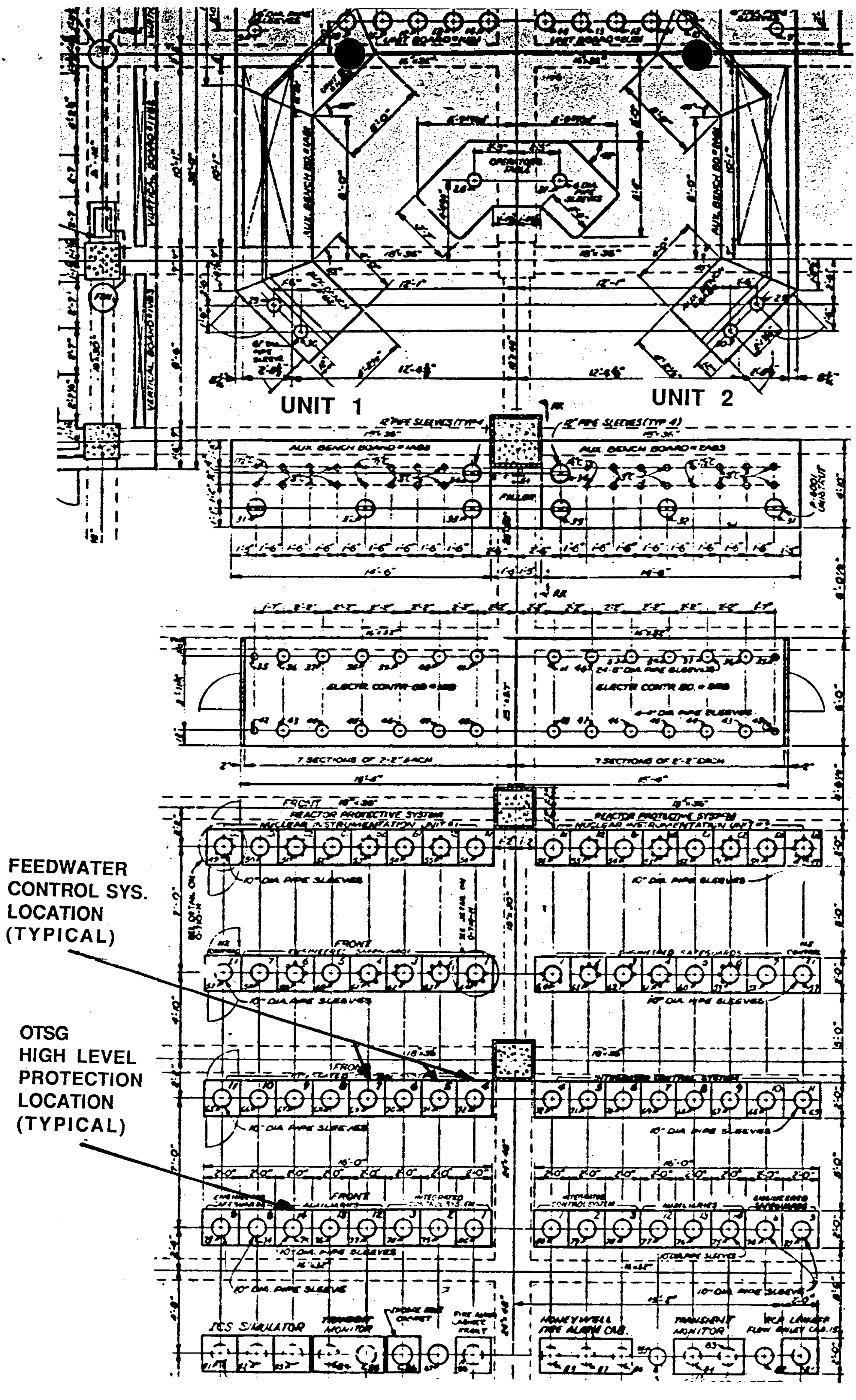


FIGURE 5

CONTROL ROOM LAYOUT- ICS CABINETS

ELEVATION 822' + 0"

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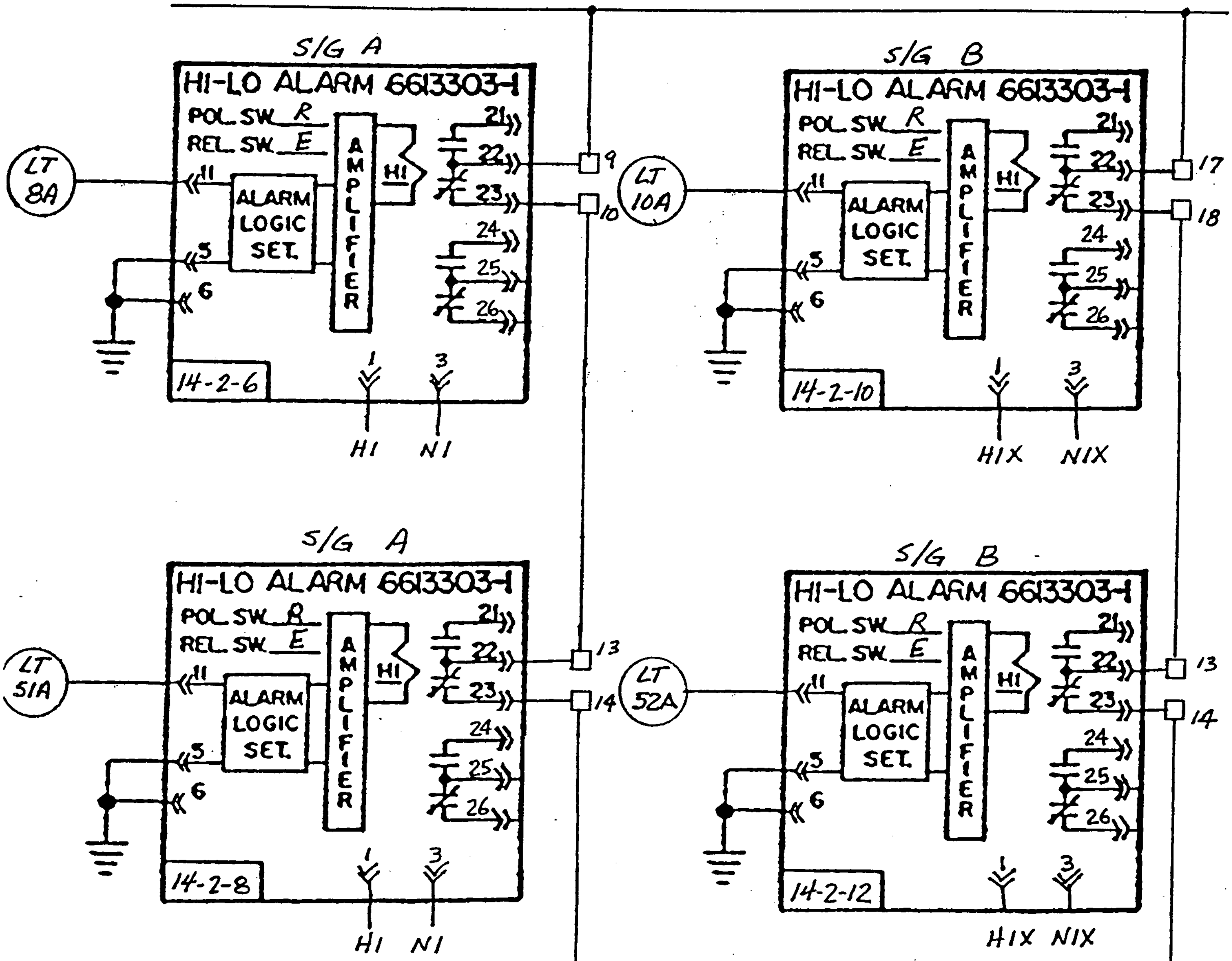
STEAM GENERATOR OVERFILL PROTECTION

PROPOSED MODIFICATIONS SHOWING LOGIC AND POWER SOURCE ARRANGEMENT



NOTES:

1. MODULES 14-2-6&8 ARE POWERED AUTO POWER.
2. MODULES 14-2-10&12 ARE POWERED FROM HAND POWER.
3. MODULES DE-ENERGIZE TO TRIP. RELAY. FPTX1 IS POWERED FROM A SEPARATE SOURCE FROM FPTX.
4. FPTX1 ENERGIZES TO TRIP BOTH MAIN FEEDWATER PUMP TURBINES THE MAIN TURBINE.

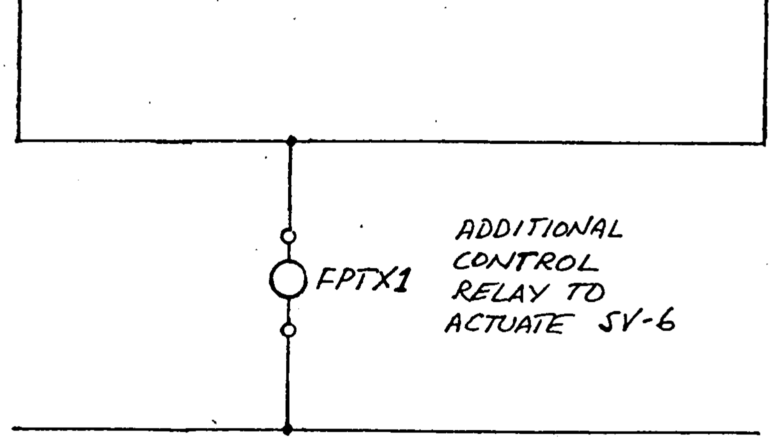


FIGURE 6

PROPOSED MODIFICATIONS FOR FEEDWATER PUMP TURBINE TRIP CIRCUITS

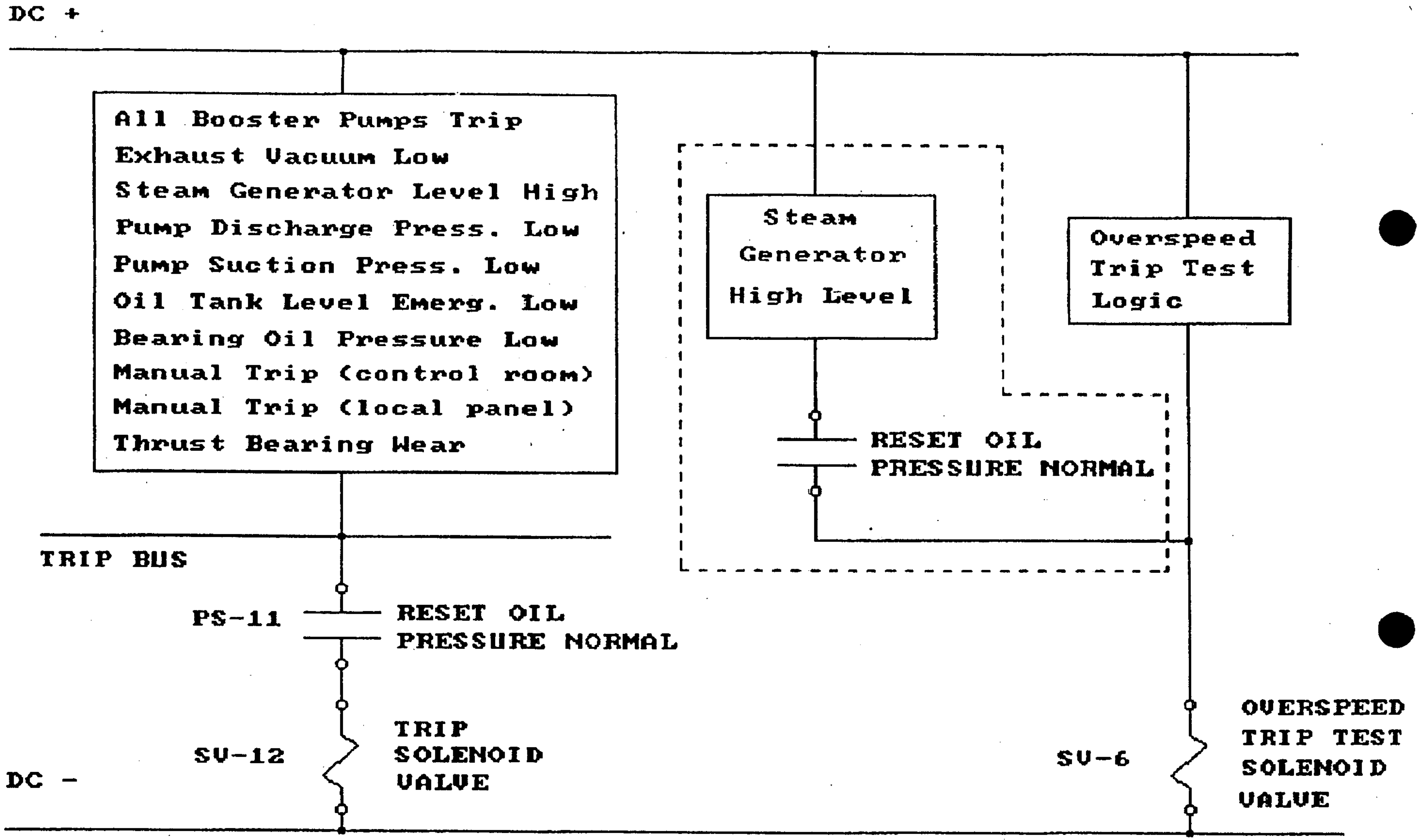


FIGURE 7

OCONEE NUCLEAR STATION

STEAM GENERATOR OVERFILL PROTECTION

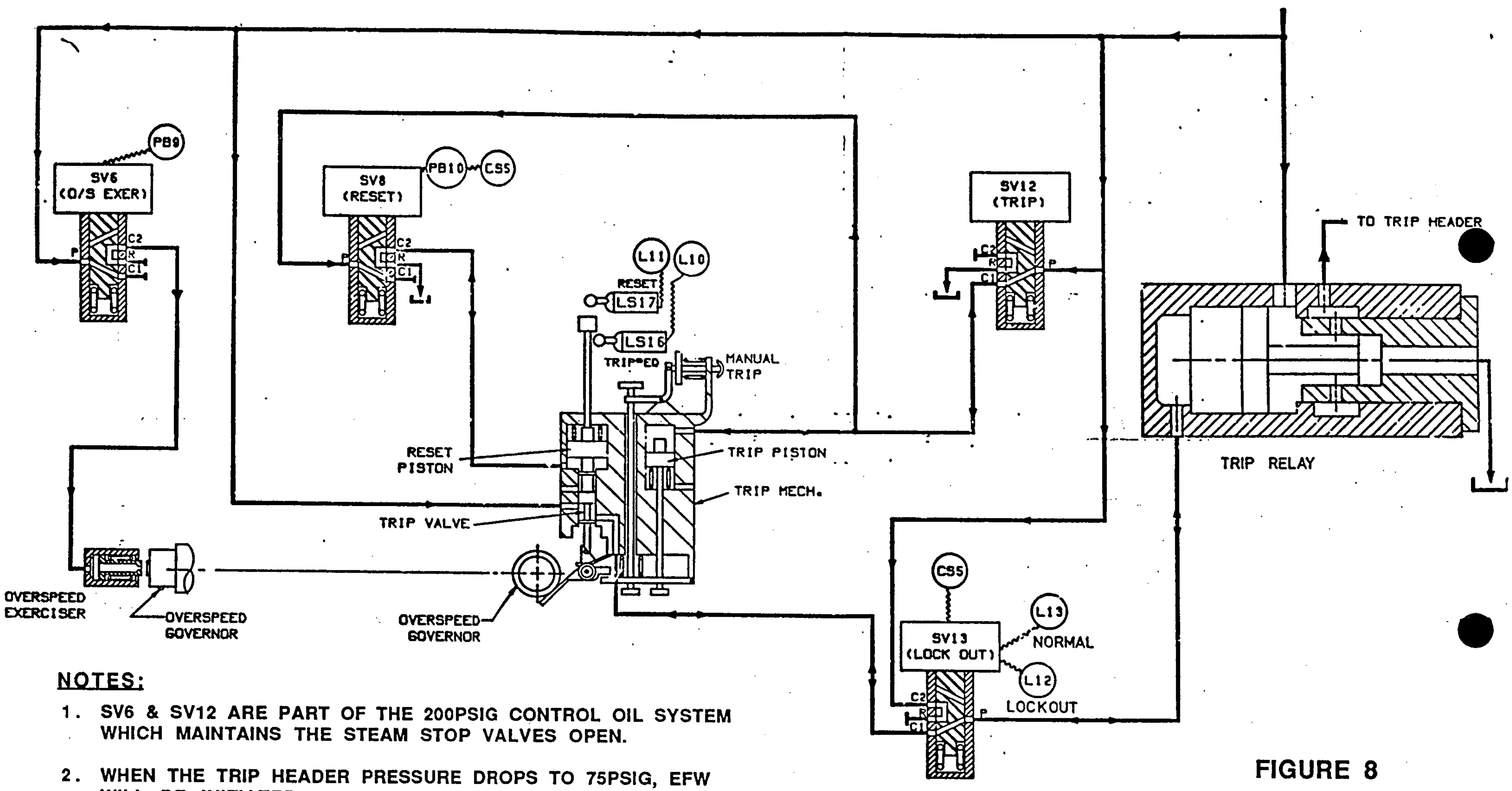


FIGURE 8

MAIN FEEDWATER PUMP TURBINE

CONTROL OIL DIAGRAM

NOTES:

1. SV6 & SV12 ARE PART OF THE 200PSIG CONTROL OIL SYSTEM WHICH MAINTAINS THE STEAM STOP VALVES OPEN.
2. WHEN THE TRIP HEADER PRESSURE DROPS TO 75PSIG, EFW WILL BE INITIATED.
3. THE OVERSPEED EXERCISER IS TESTED WEEKLY AS PART OF NORMAL FEEDWATER PUMP TURBINE MAINTENANCE.
4. SV13 IS INTERLOCKED THRU SV12 VIA INTEGRAL N.C. CONTACTS SO THAT SV13 CAN'T PREVENT A TRIP. THE ADDITION OF SV6 FOR GL 89-19 ASSURES PUMP TRIP.