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March 24, 1983

50-352

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

Subject: Limerick Generating Station, Units 1 and 2 Request for Information from the Power Systems Branch

Reference: Meeting with the Power System Branch Reviewer, E. Tomlinson, and Philadelphia Electric Company on March 9-10, 1983

Dear Mr. Schwencer:

The attached documents are draft question response changes and draft text changes to the FSAR resulting from the discussion with Mr. E. Tomlinson at the referenced meeting. Please note that complete changes to the response to question 430.75 are not provided at this time and will be made available at the end of April, 1983.

These changes will be formally incorporated into the FSAR revision scheduled for April, 1983.

Sincerely,

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Eugene J. Bradley

See Attached Service List

cc: Judge Lawrence Brenner (w/o enclosure)
Judge Richard F. Cole (w/o enclosure)
Judge Peter A. Morris (w/o enclosure)
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Atomic Safety and Licensing Appeal Board (w/o enclosure)
Atomic Safety and Licensing Board Panel (w/o enclosure)
Docket and Service Section (w/o enclosure)

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QUESTION 430.9 (Section 8.1)

In FSAR Section 8.1.6.1.2 you state that the suitability of each diesel generator was confirmed by qualification testing which was generally in conformance with IEEE-323-1971. This is an ambiguous statement. Amend your FSAR to provide detailed information on what qualification testing was conducted and provide justification for any exception taken to the above requirements. Additionally expand your discussion on conformance to Regulatory Guide 1.9 to demonstrate that its requirements and the requirements of ICSB-2 and IEEE 387-1977 are met as pertains to the 300 consecutive start tests.

RESPONSE

Qualification testing is discussed in Sections 3.10 and 3.11. Section 8.1.6.1.2 has been changed to state that the suitability of each diesel generator was confirmed by qualification testing in compliance with NUREG-0588 for Category II equipment. An Environmental Qualification Report that will provide information on the qualification testing performed will be provided in October 1983.

Limerick diesel generators are not required to pass a 300 consecutive start qualification test for the following reasons:

a. IEEE 387-1977, which mandates a 300 start test, is not applicable to Limerick because the purchase specification was issued to Colt prior to the implementation date of the standard (July 1975 vs. June 1977)

b. The trial use version of IEEE 387, issued in 1972 and committed to for Limerick in Section 8.1.6.2, did not mandate a 300 start test.

c. Limerick conforms to Regulatory Guide 1.9, Rev. 0 (3/71), which requires only that "The suitability of each diesel generator ... be confirmed by prototype qualification test data and preoperational tests." Revision 2, which specificially endorses IEEE 387-1977, is applicable only to plants that received a construction permit after December 1979. This is indicated in Section 1.8.

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d. Standard Review Plan 8.3.1 states that diesel generator qualification testing programs are acceptable if they satisfy Position 5 of Regulatory Guides 1.6 and 1.9. Neither of the applicable revisions of these documents require a 300 start prototype test.

The 12-cylinder model 38-TD8-1/8 Colt diesel engine employed at Limerick was qualified to a 100 start test conducted in 1968. This model engine has been used in the following plants that have received Operating Licenses:

Robinson 2
Prairie Island 1 &2
Vermont Yankee
Three Mile Island 1 & 2
Calvert Clifts 1 & 2
Crystal River 3
E.I. Hatch 1 & 2
Duane Arnold
North Anna 1 & 2
Millstone 1 & 2
Farley 1 & 2
Arkansas Nuclear One, 2
Peach Bottom 2 & 3
Fermi 2

Branch Technical Position ICSB-2 (PSB) Revision 1, and Paragraph 6.3 of IEEE 387-1977, both of which require a 300 start test, specifically state that the qualification testing procedures delineated therein are only applicable to diesel generators of a type or size not previously qualified for nuclear plant service. As evidenced by the above, the Limerick units have been qualified and demonstrated to be reliable in nuclear service; therefore, adequate justification exists not to pursue a 300 start test.

The generator used with the engines at each of these installations is as follows:

Manufacturer: Beloit Power Systems/Fairbanks Morse

Model No.: TGZDJ (S/N 700 007 R1-R8)

Type: Single bearing bracket
Brush type - oil lubrication
Dripproof

Rating: 3562 KVA, 2850 KW (continuous)
(2 HOUR EMERGENCY)

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QUESTION 430.36 (Section 8.2.2)

Section 8.2.2.1 of the FSAR discuss grid stability. Your discussion and grid stability analysis is not complete. Provide a revised load flow and stability analysis that also covers the following: (Ref. SRP 8.2)

1. Loss of largest generating station

2. Loss of largest load

3. Loss of most critical transmission line or right of way if insufficient clearance exist between lines or transmission towers.

RESPONSE

Revised transient stability analyses have been completed. These analyses addressed the following three events:

a. Loss of the largest generating station, i.e., loss of Peach Bottom Units 2 & 3

b. Loss of the largest load, i.e., loss of Lukens Steel plant in Coatesville, Pa.

c. Loss of most critical right-of-way, i.e., a three-phase fault on the four transmission lines on the 130-30 right-of-way.

   1. 130-30 line, 138kV

   2. 220-62 line, 230 kV

   3. 5030 line, 500 kV

   4. 5031 line, 500 kV

The transmission system remained stable for all three cases with either one or both Limerick units in service. The loss of both Peach Bottom units was the worst case affecting system frequency. A minimum system frequency of 59.95 H_z occured 0.35 seconds after the trips and it ran out to 0.48 seconds. During this transient, the Limerick units will experience a minimum frequency 59.89 H_z. This is well within the design capabilities of all Limerick electrical equipment.

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QUESTION 430.47 (Section 8.3)

The availability on demand of an emergency diesel generator is dependent upon, among other things, the proper functioning of its controls and monitoring instrumentation. This equipment is generally panel mounted and in some instances the panels are mounted directly on the diesel generator skid. Major diesel engine damage has occurred at some operating plants from vibration-induced wear on skid mounted control and monitoring instrumentation. This sensitive instrumentation is not made to withstand and function accurately for prolonged periods under continuous vibrational stresses normally encountered with internal combustion engines. Operation of sensitive instrumentation under this environment rapidly deteriorates calibration, accuracy and control signal output.

Therefore, except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation should be installed on a free standing floor mounted panel separate from the engine skids, and located on a vibration free floor area. If the floor is not vibration free, the panel shall be equipped with vibration mounts.

Confirm your compliance with the above requirement or provide justification for noncompliance.

RESPONSE

Section 8.3.1.1.4 has been changed to provide the requested information. The diesel generators do not generate harmful torsional vibrations when operating at any speed from 0 to 115% of rated speed.

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The instrumentation and controls which are critical to the operation of the diesels are located in free standing electrical control panels.

The following electrical equipment, however, is located on the diesel-generator skid:

A. the Generator Terminal Box containing connections from the diesel-generator to the local control panel.

B. the Generator Neutral Box containing the connectors from the generator neutral grounding resistor.

C. the Motor Starter and Heater Control panel. All pump motors have automatically controlled magnetic starters and the keepwarm heaters have automatically controlled contactors. The starters and contactors for the following motors and heaters are located in the Starter panel at the generator end of the skid:

- Jacket Coolant Heater
- Jacket Coolant Circulating Pump
- Lube Oil Heater
- Lube Oil Circulating Pump
- Generator Space Heater
- D.C. Auxiliary Fuel Oil Pump

D. the Circuit breaker panelboard. The following AC equipment on the skid is protected by circuit breakers which are found in the circuit breaker panel at the generator end of the skid:

- Jacket Coolant Heater
- Jacket Coolant Circulating Pump
- Lube Oil Heater
- Lube Oil Circulating Pump
- Prelube Pump
- Generator Space Heaters

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E. The Engine Gauge Panel. The following instruments are mounted in the engine gauge panel at the turbocharger end of the skid:

Instrument	Monitoring Function
6 Duplex Pressure Gauges.	1. Jacket water heat exchanger discharge pressure duplexed with air cooler coolant heat exchanger.
	2. Fuel oil pressure upstream and downstream of the line filter in the discharge piping of the engine-driven fuel oil pump
	3. Fuel Oil pressure upstream and downstream of the line filter in the discharge piping of the motor-driven fuel oil pump
	4. Engine suction lube oil pressure duplexed with the engine-driven oil pump discharge pressure.
	5 Upper engine header pressure duplexed with the turbocharger oil pressure
	6. Starting air pressure upstream of both air start valves

2	Differential Pressure Indicators	1. Basket Strainer differential pressure on the engine driven fuel oil pump 2. Basket Strainer differential pressure on the motor-driven fuel oil pump.
1	Simple Pressure Gauge	Scavenging air blower discharge pressure
2	U-tube manometers	1. Crankcase pressure 2. Turbocharger inlet pressure.
3	Duplex Temperature Gauges	1. Engine suction lube oil temperature duplexed with the engine-driven pump discharge lube oil temperature 2. Jacket water temperature on both the engine-driven pump suction and the header discharge. 3. Scavenging air blower discharge temperature duplexed with the air cooler-coolant heat exchanger discharge temperature
1	15-point Pyrometer	Points 1-12 measure the individual cylinder exhaust temperatures, points 13 and 14 measure the turbocharger inlet temperatures, and Point 15 measures the combined exhaust temperature.

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1. Tachometer. Provides local indication of engine RPM.

1. Indicating light Verifies that the local alarm circuits are armed.

Equipment associated with these instruments is housed within the engine gauge panel enclosure and is accessed through a fully-gasketed dust-tight door. The entire panel assembly is mounted in a cradle on isolation springs such that vibration-induced loads do not affect the performance of the instrumentation. Also, no items which are critical to the operation of the diesel under emergency conditions are housed within this enclosure.

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F. the DC Control Relay and Terminal box. The following relays are found in the Relay and Terminal box located at the generator end of the skid:

- Emergency Start relays
- Normal Start relays
- Other Control relays
- Coolant Temperature High Switch
- Coolant Pressure Low Switch
- Lube Oil Temperature High Switch
- Lube Oil Pressure Low Switch
- Alarm relays

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The Relay and Terminal Box is mounted at the generator end of the skid. The box is not mounted on an isolation spring; however, the box is anchored at the floor slab and supported at the top and bottom by two angle brackets.

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¶ The above described methods of mounting have been the manufacturer's standard design for over 20 years. Neither the manufacturer nor the Applicant, whose Peach Bottom units have been in service for about 10 years, have reported any vibration-induced failures in the components mounted on the diesel-generator skid.

The response to question 430.9 lists the other nuclear generating stations where similar diesel-generators are in use.

QUESTION 430.48 (Section 8.3)

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Provide a detailed discussion (or plan) of the level of training proposed for your operators, maintenance crew, quality assurance, and supervisory personnel responsible for the operation and maintenance of the emergency diesel generators. Identify the number and type of personnel that will be dedicated to the operations and maintenance of the emergency diesel generators and the number and type that will be assigned from your general plant operations and maintenance groups to assist when needed.

In your discussion identify the amount and kind of training that will be received by each of the above categories and the type of ongoing training program planned to assure optimum availability of the emergency generators.

Also discuss the level of education and minimum experience requirements for the various categories of operations and maintenance personnel associated with emergency diesel generators.

RESPONSE

For conducting all diesel operations and operational maintenance, Limerick will use only plant operators (PO), with the exception of control room operations conducted by control operators (CO) and assistant control operators (ACO). There will be no operators dedicated to diesel operations to the exclusion of other responsibilities. The aforementioned operators will be trained in appropriate diesel generator operations as part of the normal qualification program for these positions. The number of available POs will be the shift complement of two supplemented by overtime as required. The level of education and experience is defined by the PO position. Most, if not all, of the initial POs will be simulator certified, and many may be RO licensed. Qualification programs for the PO position have not yet been developed but are expected to be similar to programs now in use at Peach Bottom.

Philadelphia Electric Company uses a centralized maintenance concept. Maintenance personnel assigned to Limerick are supplemented when needed (for personnel or for particular areas of expertise) by the centralized group. In addition, maintenance engineers assigned to the centralized group are available. This concept permits the system-wide experience and training of the centralized personnel to be applied at Limerick.

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Maintenance personnel are not dedicated to particular equipment items. Maintenance supervision is responsible for the assignment of personnel in the required crafts who are capable of performing an identified task. The PECo Maintenance Division provides a variety of craft training classes to ensure the availability of qualified craftsmen. If contractor personnel should be used under PECo supervision, such personnel would be members of the building trades crafts.

Maintenance activities will be supervised by personnel who are appropriately qualified by experience or training for the work being performed. Maintenance Division personnel will have benefited from experience obtained as a result of Peach Bottom Atomic Power Station diesel generator maintenance activities utilizing approved maintenance procedures, and the technical expertise of manufacturer's service representatives. This experience should provide competency equivalent to that provided by vendor training programs.

QUESTION 430.60 (Section 9.5.2)

Identify all working stations on the plant site where it may be necessary for plant personnel to communicate with the control room or the emergency shutdown panel during and/or following transients and/or accidents (including fires) in order to mitigate the consequences of the event and to attain a safe cold plant shutdown.

Indicate the maximum sound levels that could exist at each of the above identified working stations for all transients and accident conditions.

RESPONSE

Maximum dB levels have not been established for the remote shutdown locations. The adequacy of the communications system will be verified during the startup test phase when ambient noise is at its normal operating level. All remote shutdown locations which may be used to safely shutdown the plant in the event of a Control Room evacuation are identified in Table 9.5-13. Any locations which may be subsequently identified will be added to this table.

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TABLE 9.5-13

REMOTE EMERGENCY SHUTDOWN LOCATIONS
INTENSITIES OF ILLUMINATION

LOCATION	NORMAL	EMERGENCY AC	EMERGENCY DC
Area 8, El. 289 Panels C201	30	10	3
Area 8, El 200 Pnl. OAC562	20	5	0.5
Area 8, El 239 4kV Switchgear	30	10	3
Area 8. El 304 Pnl. OAC101	20	5	0.5
D/G Bldg, El 217 Panels C514	30	10	3
Various Locations Hand-Operated Valves	10	Hand-Held Lanterns	

Access paths to the above areas are provided with at least 1/2 ft. candle of emergency lighting.

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QUESTION 430.61 (Section 9.5.2)

Describe the performance requirements and tests that the above onsite working stations communication systems will be required to pass in order to be assured that effective communication with the control room or emergency shutdown panel is possible under all conditions.

RESPONSE

During the startup test program when operating ambient noise levels are present, communications between each remote operating location and the control room or remote shutdown room will be tested. At least one communications system of the PABX, PA, or In-Plant Radio System described in Section 9.5.2 will be proven to be adequate for communicating with these remote areas.

9.5.1.4.2 Operational Testing and Inspection

The fire pumps and associated equipment such as batteries, water supply, and fuel systems are periodically tested or inspected in accordance with the Technical Specifications (refer to Chapter 16). The Technical Specifications define periodic test or inspection requirements to ensure operability of the fire Suppression system.

9.5.1.5 Personnel Qualification and Training

The training program for plant personnel and the fire brigade in regard to fire fighting activities will be implemented in accordance with the Fire Protection Program and applicable requirements of the Technical Specifications.

9.5.2 COMMUNICATION SYSTEMS

The communication systems include internal (intra-plant) and external (out-of-plant) systems and provide convenient, effective operational communications between various plant structures and locations and with points outside the station.

9.5.2.1 Design Bases

Various communication systems are provided in the plant to ensure reliable communication during plant startup, operation, shutdown, maintenance, and emergency conditions. The design bases of these systems are:

a. Voice communication between various plant structures and locations is provided with the following characteristics:

   1. Satisfactory voice communication in areas of extreme noise

   2. Three separate communication system with simultaneous conversation possible on each system without interference.

b. Voice communication to points outside the station is provided by a dial telephone system and by a back-up radio system.

c. An evacuation and alarm system is provided to warn personnel of emergency conditions.

d. The communication systems are designed to be operable loss of offsite power.

e. All communication components are non-safety-related seismic Category II components. These components, when located in safety-related areas, are supported on a selective basis to seismic Category IIA requirements as described in Section 3.2. The criteria for this selective basis and the design basis for seismic Category IIA supports are described in Section 3.2.

9.5.2.2 System Description

The plant communication systems consists of the intra-plant public address (PA) system, the private automatic branch exchange (PABX) telephone system, the intra-plant maintenance telephone system, the evacuation alarm and river warning system, and the In-Plant Radio System. Descriptions of these systems are given in the following sections.

The plant communication systems are illustrated in riser diagram form in Figures 9.5.-2 through 9.5-7.

9.5.2.2.1 Intra-Plant Public Address (PA) System

The PA system is a 6-channel system permitting simultaneous usage of a page line and five party lines for intra-plant use. Loudspeakers powered by individual amplifiers are located throughout the plant with muting facilities provided where required. The PA system is provided with a telephone line matching network for operation of the page channel by the PABX system described in Section 9.5.2.2.2.

The PA system is powered from the Division IV diesel bus to provide continous operation under all plant operating conditions.

9.5.2.2.2 Private Automatic Branch Exchange Telephone System (PABX)

The private automatic branch exchange telephone system (PABX) equipment and cabling is supplied and installed by the telephone company. The telephones are located throughout the plant. The power for this system is supplied from the Division I diesel bus.

9.~~8~~5.3.3.4 Intra-Plant Maintenance Telephone System

The intra-plant maintenance telephone system is part of the PABX system consisting of telephone jacks. Portable PABX (dial-type) telephones may be connected to the maintenance telephone jacks.

9.5.2.2.5 In-Plant Radio System

Emergency communications within the plant can be maintained after the loss of the PA and PABX systems through the In-Plant Radio System. This system consists of distributed antennas throughout the plant with a centralized rebroadcast transmitter. Low power walkie-talkies with approximately one watt output are used with this system. The low power of the radios assures that they will not interfere with low level control and instrument circuits. The distributed antenna system will allow radio communications from any location whithin the plant to any other location to within a five mile radius of the plant. The walkie-talkies are battery powered and the distributed antenna system is powered from a source of power diverse from the PA and PABX systems.

9.5.2.3 Safety Evalution

The communication systems are not safety-related and are classified as non-Class IE. When components of the communication systems are located within seismic Category I structures, these components are supported on a selective basis to seismic Category IIA requirements described in Section 3.2. The basis for providing Category IIA supports is to prevent the communication equipment from falling on safety-related equipment and impairing its ability to perform safe shutdown functions during a seismic event.

The systems described above are conventional and have a history of successful operation at similar existing plants. System design considerations include diversity and operational reliability.

Physical and electrical separation is provided between primary and backup systems to minimize the possibility of a single occurrence affecting more than one system.

The communication systems have adequate flexibility to keep plant personnel informed of plant operational status at all times. If one handset station of the PA system is damaged or inaccessible or if extreme background noise prevents its use, multiple handset locations at each plant elevation provide easy access to an alternate handset of the PA system.

Failure of a single PABX telephone does not affect the balance of the PABX telephone system. If failure of the central exchange or some other such failure makes the complete system inoperable, the public address system is used as backup in-plant communication.

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The public address system is powered from a Class IE 440V motor control center through a 480V-120V transformer and a 3-phase, 120V distribution panel. The transformer and panel are seismic Category I and feed only the PA system and fire alarm system which are non-Class IE. The cabling for these systems is routed in independent and separate conduits and no other systems' cables are routed in these conduits. For this reason and reasons of plant safety, this panel remains connected to the Class IE bus during a LOCA. The Class IE 440V motor control center is powered by the Division IV Class 1E 440V load center. The Class 1E 440V motor control center and load center are part of the Class 1E ac power system (Section 8.3.1.1.2). Failures of the fire alarm or PA systems will not affect the Class 1E bus because of the use of overcurrent protection devices and isolation transformers.

The PABX telephone system is powered by a non-Class 1E power source which can be connected to the Division I diesel generator. Failure of any or all of its components will not affect any nuclear safety-related equipment.

During the loss of both offsite power and the diesel generator associated with Division IV bus, communication is maintained by the PABX telephone system. It is not necessary for plant personnel in safety-related areas of the plant to communicate with the control room in ord.r to achieve a safe, cold shutdown of the plant following a design basis seismic event. The failure of any non-seismic communications systems will not adversely affect safe shutdown capability.

9.5.2.4 Inspection and Testing Requirements

The communications system will be tested by a preoperational test (1-P-99.3). Systems described above are conventional and have a history of successful operation at similar existing plants. These systems will be in routine use and maintenance, and this will ensure their availability.

Also, they will be used extensively during the preoperational and startup phases. Any deficiencies will become readily apparent and will be corrected. The power sources, for the private automatic branch exchange telephone system and Class 1E bus for the public address system, are tested separately via the preoperational and startup test program.

9.5.3 LIGHTING SYSTEM

The plant lighting system provides illumination levels required for safe performance of plant operation, security, shutdown, and maintenance duties. Emergency dc lighting is providing in essential areas for the safety of personnel during an ac power failure.

QUESTION 430.62 (Section 9.5.2)

Consider the design basis seismic event with coincident failure of all non-seismic equipment and components. Demonstrate that there will be effective intra-plant communications with all safety related areas to attain a safe, cold plant shutdown following the seismic event.

RESPONSE

Section 9.5.2.3 has been changed to provide the requested information. Following a design basis seismic event with coincident failure of all non-seismic equipment and components, Limerick will attain a safe, cold plant shutdown from the main control room without the use of intra-plant communication because all actions required under this scenario are taken in the Control Room.

QUESTION 430.63 (Section 9.5.2)

Provide a discussion on how effective plant to offsite communications will be available following the design basis seismic event.

RESPONSE

Limerick has two independent offsite communications systems.

The primary system consists of both the PABX telephone system (Section 9.5.2.2.2) and dedicated telephone lines to specific offsite locations (Emergency Plan Section 7.2.6.) The PABX is powered from the Division I diesel generator so that it will continue to operate after loss of offsite power. It is not designed to remain operational after the design basis seismic event. If the PABX fails, it can be bypassed and approximately sixty phone extensions in the plant can be connected to the PECo microwave communications network. This will allow these extension to be directly connected to the Bell of Pa. system.

The backup offsite communications system consists of a radio system that provides communication between the control room and Philadelphia Electric Company Philadelphia Headquarters as well as other generating stations. Radio capability is also provided between the control room and the Montgomery County Office of Emergency Preparedness (Emergency Plan Section 7.2.4) The radio transmitters are powered from a diverse power source than that which powers the PABX. The radio equipment is not designed to withstand the design basis seismic event.

The physical and electrical independence of the two systems provides a high degree of assurance that a design basis seismic event would not cause the loss of offsite communications.

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QUESTION 430.64 (Section 9.5.2)

In FSAR Section 9.5.2.3, you state that the public address system is powered from a Class 1E 440V motor control center. Expand your FSAR to include a discussion of the Class 1E bus that powers the motor control center, and how communications will be maintained assuming a failure of the diesel generator associated with that bus, assuming a loss of offsite power.

RESPONSE

If the Division 4 diesel generator fails with a loss of offsite power, the PA system will be inoperable. In this situation, the PABX and the inplant radio system will remain operational as they are fed from diverse power sources. At least one of these remaining systems will provide adequate communications between all remote operating stations.

QUESTION 430.65 (Section 9.5.3)

Identify the vital areas and hazardous area where emergency lighting is needed for safe shutdown of the reactor and the evacuation of personnel in the event of an accident. Tabulate the lighting system provided in your design to accomodate those areas so identified.

RESPONSE

All remote emergency operating locations are shown in Table 9.5-13. Two separate emergency lighting systems are provided in each of these areas. The AC emergency lighting is supplied from four diesel generators as described in Section 9.5.3.2.2. If the AC emergency lighting system in these areas fails, the DC emergency lighting system will provide lighting levels sufficient to perform the emergency shutdown functions.

AC and DC emergency lighting is also provided to maintain adequate lighting levels for access to and egress from all of the above areas.

FROM SECT. 9.5.3.2.2

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immediately to the 125V dc non-Class 1E station battery source. The 125V dc non-Class 1E station battery source will provide power to the emergency ac-dc lighting system for one hour. All emergency ac-dc lighting fixture are incandescent type.

Emergency lighting is remote structures and areas where the above dc source is not available consists of battery-powered self-contained units.

Emergency dc lighting fixtures and illuminated exit signs are located in the control room, stairways, and along exit routes from each floor throughout the plant.

Table 9.5-12 identifies the illumination intensities for the vital and hazardous areas where emergency lighting is provided for normal plant operation and the evacuation of personnel in the event of an accident. The table provides both the normal and emergency operating conditions for these areas. These illumination levels conform to the IES Lighting Handbook recommended levels. Column 4 of Table 9.5-12 shows the 125V dc power-supplied lighting illumination intensity levels that are maintained in the control room and other areas of the plant between of offsite power and availability of onsite power.

Table 9.5-13 identifies the areas where remote actions are required to safely shutdown the plant in the event of a control room fire, Auxiliary Equipment Room fire, or a failure of the remote shutdown system. The lighting levels provided at these locations is shown.

The emergency ac/dc lighting system provides approximately 10 to 20 percent of the total lighting of the plant. The percentage of emergency lighting fed from each division of Class 1E power is as follows:

a. Division I = 6%
b. Division II = 32%
c. Division III = 12%
d. Division IV = 50%

The emergency lighting load is not divided equally among the four diesel generators due to plant untilization. Emergency lighting, both ac and dc, has been provided for all areas shown in Table 9.5-13. In these areas, the loss of the diesel generator would leave the dc-supplied power system to provide lighting for the remote operations required in those areas as well as access to those areas.

QUESTION 430.65 (Section 9.5.3)

Identify the vital areas and hazardous area where emergency lighting is needed for safe shutdown of the reactor and the evacuation of personnel in the event of an accident. Tabulate the lighting system provided in your design to accomodate those areas so identified.

RESPONSE

All remote emergency operating locations are shown in Table 9.5-13. Two separate emergency lighting systems are provided in each of these areas. The AC emergency lighting is supplied from four diesel generators as described in Section 9.5.3.2.2. If the AC emergency lighting system in these areas fails, the DC emergency lighting system will provide lighting levels sufficient to perform the emergency shutdown functions.

AC and DC emergency lighting is also provided to maintain adequate lighting levels for access to and egress from all of the above areas.

QUESTION 430.66 (Section 9.5.3)

Expand your FSAR to include a discussion of illumination levels in the vital and hazardous areas previously identified. Provide a tabulation of illumination levels in these areas under both normal and emergency operating conditions and show that these levels conform to the IES Lighting Handbook recommended levels.

RESPONSE

Tables 9.5-12 and 9.5-13 have been added and Section 9.5.3.2.2 has been changed to provide the requested information. All lighting levels meet or exceed those recommended in the IES handbook.

QUESTION 430.67 (Section 9.5.3)

Provide the following information for emergency lighting system:

1. What percentage of the total lighting provided is designated as emergency lighting.

2. Identify the source of 1E power to the emergency lighting system, i.e., Train A, B, C or D. If emergency lighting power is obtained from more than one train, give the percentage of emergency lighting power from each. In the latter case, state whether your design is consistent for all vital and hazardous areas, and what effect the loss of a single power train would have on emergency ilumination levels.

RESPONSE

Table 9.5-12 has been added and Section 9.5.3.2.2 has been changed to include the requested information. The effects of the loss of one division of emergency lighting on any of the remote shutdown locations is discussed in the response to question 430.65.

QUESTION 430.68 (Section 9.5.3)

Consider a design basis seismic event coincident with loss of offsite power and failure of all non-seismic equipment/components. Under these conditions, discuss how minimum lighting levels will be maintained in the control room until such time as the emergency diesel generators have come on line and emergency ac lighting has been restored. Using the same conditions, state whether lighting would be required in any other part of the plant for the time intervals between loss of offsite power and availability of onsite power.

RESPONSE

During a design basis seismic event coincident with loss of offsite power and failure of all non-seismic equipment/components, the control room lighting will be maintained by hand held battery-powered lanterns. No operator action is required in any other areas of the plant under this scenario.

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QUESTION 430.72 (Section 9.5.4)

Describe your design provisions made to protect the fuel oil storage tank fill and vent lines from damage by tornado missiles.

RESPONSE

The fill and vent lines located in the tank valve pit have a minimum extension above ground. The vent line for each tank is backed up by a separate vacuum relief valve/line, making the probability of loss of both lines very low. Alternate paths of filling/venting (e.g., manhole of tank) are available for use in the unlikely event of damage by tornado missiles. Cross connections are also provided in the fuel oil supply and return lines to each diesel to allow any diesel to be supplied from any storage tank (Figure 9.5-8). Credible tornado missile damage to the fill line or a vent line would not affect the safe shutdown of the plant.

As an example, if the storage tank 'A' fill or vent lines were damaged so as to make the tank unavailable, and diesel generator 'B' was not available, the following manual operator actions would be taken (Figure 9.5-8): Valves 1045B and 1101A would be closed and valves 1080A, 1080B, 1100A and 1100B would be opened. The 'B' transfer pump would be started and would pump to the 'A' day tank. When the 'A' day tank was full the full flow overflow line would return the diesel oil to the 'B' storage tank. As noted in section 9.5.4.2, the day tank holds sufficient fuel oil for 4 hours of continuous diesel generator operation at full load, and sufficient fuel oil for approximately one hour of full load operation remaining at the point where the low level alarm annunciates. Therefore, ...

QUESTION 430.74 (Section 9.5.4)

DRAFT

Expand your FSAR Section 9.5.4.5 to include a discussion of the testing and calibration which will be used to assure a highly reliable instrumentation, controls, sensors, and alarm system. Also discuss any system interlocks provided.

RESPONSE

Section 9.5.4.5 has been changed to include a reference to the testing and maintenance that will be used to ensure a highly reliable instrumentation, controls, sensors, and alarm system (calibration is a subactivity of testing and maintenance). A discussion of the system interlocks has also been added.

The diesel generator fuel oil storage system will undergo periodic surveillance testing in accordance with the Limerick Technical Specifications written using Section 4.8.1.1.2 of NUREG - 0123 "Standard Technical Specifications for General Electric Boiling Water Reactors (BWR/4)" as a guide.

In addition to the Technical Specification Surveillance Testing program, a comprehensive instrumentation maintenance program will be performed in conjunction with the diesel generation inspection/overhaul. This program will be based on the recommendations of the equipment vendor and operational experience.

DRAFT

QUESTION 430.75 (Sections 3.2, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8)

Diesel generator auxiliary systems piping and components are classified in the FSAR text and Table 3.2.1 as conforming to ASME Section III Class 3, ANSI B31.1, or manufacturer's standard. It is not entirely clear where the respective classifications begin or end. In any event, this is not acceptable. We require the entire diesel generator auxiliary systems to be designed to ASME Section III Class 3, or Quality Group C, in accordance with Regulatory Guide 1.26. Revise your FSAR accordingly. Also, provide the industry standards that were used in the design, manufacture, and inspection of the diesel engine mounted piping and components. Revise the appropriate P&IDs to show where quality group changes occur.

RESPONSE

The diesel generator auxiliary systems are the following:

a. Fuel oil system (Figure 9.5-8)

b. Cooling water system which includes the jacket water cooling loop and the air cooler coolant loop (Figure 9.5-9)

c. Starting system (Figure 9.5-10)

d. Lubrication system (Figure 9.5-11)

e. Combustion air intake and exhaust system (Figure 9.5-12)

Piping and equipment in these systems is provided in accordance with ASME Section III Class 3, ANSI B31.1, and manufacturer's standards as indicated on the above referenced figures, ~~and~~ Table 3.2-1, and Section 3.2.2.d.

All piping and equipment has been designed to withstand seismic accelerations and operating loads, regardless of design code. The manufacturer has developed a highly reliable engine piping system over the 44 years that the design of this basic engine has been in use.

The design code used for each piping seismic segment or component meets or exceeds the commitment made in the Limerick PSAR, Appendix A and Figure A.2.3.

DRAFT

a. Regarding systems important for reactor shutdown, as discussed in paragraph C.1.b (Quality Group B) of the guide, the control rod drive (CRD) system hydraulic control units (HCU) are classified as "special equipment" by GE because the codes and standards of a quality group are not strictly applicable to the HCUs. A detailed discussion is given in the notes of Table 3.2-1.

b. The Quality Group B classification may terminate on some steam system connected piping at the first valve capable of remote manual closure, rather than at a normally, or automatically, closed valve. Additionally, Quality Group B is applied only to piping 2-1/2 inches in diameter and larger, similar to the guidelines of Regulatory Guide 1.29 for application of the seismic Category I classification.

c. The normal spent fuel pool cooling system is primarily Quality Group D. However, as discussed in Section 3.2.1, backup cooling and makeup sources are provided. These sources are at least Quality Group C, as are the connecting portions of the normal cooling system.

d. The standby diesel generator piping is designed as shown in Figures 9.5-9 through 9.5-12. The control structure chilled water system is designed to Quality Group D standards; however, it was subjected to full quality assurance requirements (Q-listed), and was designed to seismic Category I criteria.

e. Instrument tubing downstream of the containment isolation valve of instrument lines connected to the reactor coolant pressure boundary is Quality Group D for instruments that are "passive" (i.e., do not actuate safety systems), rather than Quality Group B or C as discussed in Paragraphs 1.e and 2.c of the guide. This is based on considerations given in Regulatory Guide 1.11 for instrument lines penetrating containment and having two restriction devices.

INSERT NEXT PAGE — MARKED (A)

Structures, systems, and components whose safety functions require conformance to the applicable quality assurance requirements of 10 CFR Part 50, Appendix B, are summarized in Table 3.2-1 under the heading, "Q-List." Quality assurance during construction is discussed in PSAR Appendix D. The quality assurance program during the operational phase is described in Chapter 17.

DRAFT (A)

Insert in Section 3.2.2:

Supplementary material certification, design, and examination requirements have been applied to the off-skid portions of the emerg. diesel aux. systems to assure that their quality is essentially equivalent to ASME Section III, Class 3. The technical differences between ANSI B31.1 and ASME Section III, Class 3 are few. The major differences were addressed by supplemental requirements and are listed below:

ASME III, 3	ANSI B31.1	LGS Supplementary Requirements
1) Requires ASME materials and Certified Material Test Reports (CMTR's) for all piping larger than 3/4" nominal pipe size. Certificates of Compliance may be substituted for CMTR's for piping less than 3/4".	Requires materials which conform to either ASME or ASTM specifications.	ASME materials were procured and CMTR's were supplied
2) Requires seismic design in addition to the B31.1 requirements	Requires design for pressure, temperature and normal operating loads.	Piping is designed to Seismic Category I with minimum wall thicknesses in conformance with ASME III, 3

DRAFT

3)	Requires liquid penetrant, magnetic particle, or radiographic examination for circumferential welds greater than 2" nominal pipe size.	Requires only visual inspection of welds at the design pressure and temperature of the auxiliary systems.	All pipe welds greater than 2" are radiographed
4)	Require pneumatic testing to 1.25 x design pressure	requires initial service leak test	All piping is pneumatically tested to 1.25 X the design pressure.

DRAFT

SYSTEM/COMPONENT [40]

VI DIESEL GENERATOR SYSTEM

1. Fuel oil day tanks and jacket water expansion tanks
2. Diesel generators
3. Tanks, diesel fuel storage
4. Heat exchangers, jacket water and lube oil, air cooler coolant
5. Filters and strainers, lube oil and fuel oil systems
6. Lube oil heater
7. Air receivers
8. Compressors
9. Cooling jacket water heater
10. Drain tank, dirty fuel oil
11. Piping and valves, fuel oil system
12. Piping and valves, diesel lubrication oil system (on and off skid)
13. Piping and valves, diesel starting air system from receiver to diesel skid
14. Piping and valves, intake and exhaust
15. Transfer pumps, fuel oil system
16. Pumps, lube oil
17. Pumps, jacket water cooling
18. Pump motors, fuel oil system
19. Electrical modules, with safety function
20. Pumps, circulating water, pre-lube, air cooler, and standby circulating lube
21. Lube oil storage tanks
22. Air coolers
23. Piping and valves, water system
24. Crankcase evacuation systems, ejectors, separators, and crankcase breathers

leave in table. Delete others and replace with attached.

VII HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS

A. Control Structure

1. Control Room HVAC System
   a. Water chillers (except condenser)

TABLE 3.2-1 (Cont'd)

FSAR SECTION	SOURCE OF SUPPLY [1]*	LOCATION [2]*	QUALITY GROUP CLASSIFICATION [3]*	PRINCIPAL CODES AND STANDARDS [4]*	SEISMIC CATEGORY [5]*	Q-LIST [6]*	COMMENTS
.5.4,9.5.5, .5.6, 9.5.7							
	P	G	-	III-3	I	Y	[47]
	P	G	C	IEEE-387	I	Y	[47]
	P	G	-	III-3	I	Y	[22][47]
	P	G	C	III-3/ TEMA C	I	Y	[47]
	P	G	-	VIII-1/ MF STD	I	Y	[47]
	P	G	-	IV	I	Later	[47]
	P	G	-	III-3	I	Y	[47]
	P	G	-	MF STD	I	N	
	P	G	-	IV	I	Later	[47]
	P	G	-	MF STD	IIA	N	
	P	G,O	-	III-3/B31.1/MF STD	I	Y	[47]
	P	G	-	III-3/B31.1/ MF STD	I	Y	[47]
	P	G	-	III-3/ MF STD	I	Later	[47]
	P	G	-	B31.1/MF STD	I/IIA	Y/N	[44][47]
	P	G,O	-		I	Y	[22]
	P	G	-	MF STD	I	Y	[47]
	P	G	-	MF STD	I	Y	[47]
	P	G,O	-	IEEE-323, 344	I	Y	
	P	G,CS	C	IEEE-323, 344, 279	I	Y	[11], [12]
	P	S	-	MF STD	I	Y	[47]
	P	G		III-3	I	Y	[47]
	P	G,O	-	MF STD	I	Later	[47]
	P	G	-	III-3/ MF STD	I	Y	[19][47]
oil	P	G	-	MF STD	I	Later	
.4.1.1	P	CS	D	VIII-1/	I	Y	

Add the following to this table:

System	Source of Supply	Location	Quality Group	Principle Codes	Seismic Category	Q-list	Note
Fuel Oil Storage and Transfer	P	G	C	III-3, B31.1 MFR STD	I	Y	[U7
Lubrication System	P	G	C	III-3, B31.1 MFR STD	I	Y	[U7
Air Start System	P	G	C	III-3, B31.1, MFR STD	I	Y	[U7
Cooling Water Systems	P	G	C	III-3, B31.1, MFR STD	I	Y	[U7
Air Intake & Exhaust System	P	G	C	III-3, B31.1, MFR STD	I	Y	[U7

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[37]The final survey and measurement of the as-built emergency spillway are conducted under the applicable portions of the quality assurance program to ensure that the geometry and riprap gradation satisfy design requirements.

[38]A complete description of the codes and standards, seismic category, and Q-list status of piping and instrumentation within the spray pond is shown on Figure 9.2-3.

[39]Design codes and standards are under consideration and will be added to this table when finalized.

[40]Specific components that comprise parts of major components with the same design criteria are generally not listed. For example, transformers are a part of load centers or switchgear, and valve operators are a part of motor operated valves.

[41]Raceway systems include conduit, cable trays, and their supports. Raceway firestops and seals are not Q-listed. However, quality control provisions commensurate with Branch Technical Position 9.5-1 are applied to the raceway firestops and seals.

[42]Inverters do not supply power to safety related loads. The Class 1E battery loads are discussed in Section 8.3.2.1.1.4.

[43]Primary, backup and fault current protection devices are subcomponents of switchgear, load centers, motor control centers and distribution panels, which are Q-listed as shown in items X.A, X.B and X.C.

[44]Cast iron exhaust piping beyond the roof penetration is not Q-listed.

[45]Equipment is qualified in accordance with the conformance statements made in Section 7.2, 7.3, 7.4, 7.5 and 7.6 in reference to IEEE-279 paragraph 4.4 and IEEE-323.

[46]Primary containment gas sample lines from the sample taps to and including the outboard containment isolation valves are seismic Category I. Liquid sample lines from the RHR system are seismic Category I up to and including the second system isolation valves. The sample line from the jet pump instrument system is seismic Category I to the PASS isolation valves.

[47]Delineation of applicable codes or standards and seismic category is shown in Figures 9.5-8 through 9.5-12. The basis for classification of non-ASME Section III equipment as Quality Group C is provided in Section 3.2.2.d..

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QUESTION 430.83 (Section 9.5.4)

Figure 9.5.8 shows the fuel fill lines, tank vent lines with flame arrestor, and the vacuum/air release valve and line for all fuel oil storage tanks to be non-seismic. Consider a design basis seismic event and the resultant failure of these lines. Show how failure of these lines will not result in blocking of the vent lines to the storage tanks, will not preclude refueling the tanks as required, and will still prevent entry of deliterious materials into the storage tanks. Revise your FSAR accordingly.

RESPONSE

(designed to Seismic Category I criteria).

Figure 9.5-8 has been changed to indicate that the tank vent lines with flame arrestor, the vacuum/air release valve, and the fill line for all fuel oil storage tanks are seismic Category IIA. They are therefore not expected to crimp when subjected to seismic loads. Alternate vent and fill paths (e.g., manhole of the tank) are available for use in the unlikely event of damage by a seismic event. Cross connections are also provided in the fuel oil supply and return lines to each diesel to allow any diesel to be supplied from any fuel oil storage tank (Figure 9.5-8). Credible fill or vent line damage due to a seismic event would not affect the safe shutdown of the plant.

QUESTION 430.89 (Section 9.5.5)

Revise Tables 9.5-5 and 9.5-6 to include the design margin allowed in the stated capability of the jacket water and air cooler coolant loop heat exchangers. Indicate the measures to preclude long-term corrosion and organic fouling in the diesel engine cooling water system that would degrade system cooling performance, and the compatability of any corrosion inhibitors or antifreeze compounds used with the materials of the system. Indicate if the water chemistry is in conformance with the engine manufacturers recommendations.

RESPONSE

The diesel generator ESW inlet temperature used for design (95°F) is based on the maximum post-LOCA Ultimate Heat Sink temperature (see Section 9.2.6). The use of this temperature in combination with appropriate fouling factors results in a conservative design.

Tables 9.5-5 and 9.5-6 have been changed to indicate the fouling factor on which the jacket water and air cooler coolant loop heat exchanger duties are based, as well as the ESW inlet design temperatures for these heat exchangers. To preclude long-term corrosion and organic fouling in the diesel engine cooling system system, demineralized water is used along with a sodium nitrite solution such as Betz coreseal K-9.

The treated cooling water will be slightly alkaline (pH 8.0 to 9.5), as recommended by the engines manufacturer. This compound has been demonstrated to be compatible with all materials used in the coolant loops.

Antifreeze compounds will not be used in the jacket water and air cooler coolant loops due to the potential for degraded heat exchanger performance. In lieu of antifreeze, Q 430.89 (cont'd) DRAFT

~~The Res.~~

... engine temperatures will be maintained by ~~[illegible]~~ compartment heating, jacket water heating, and lube oil heating (see Sections 9.4.6, 9.5.5, and 9.5.7). Compartment temperatures are normally maintained above 65 °F. If compartment temperatures should drop below 55°F, the condition will be alarmed in the control room and the operators will reestablish normal heating or provide temporary heating. If low temperatures continue to persist such that the keep warm systems can not maintain the water temperature > 90°F and/or lube oil temperature > 105°F additional control room alarms will indicate the condition. The operators would then start the diesel generators to assure that they were maintained in a ready condition. Procedures for low load operation of the diesels will be followed (ie — loading at a min. of 50% power for 1 hour out of 12 hours at low load operation.

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TABLE 9.5-5

DIESEL GENERATOR JACKET WATER COOLING LOOP DESIGN PARAMETERS

EXPANSION TANK	
Quantity	1 per diesel (4 total)
Capacity, each	80 gallons
Design code requirements	ASME Section III, Class 3
ENGINE-DRIVEN WATER PUMP	
Quantity	1 per diesel (4 total)
Type	Centrifugal
Capacity, each	800 gpm
Head	46 psi
Design code requirements	Manufacturer's standard
MOTOR-DRIVEN CIRCULATION PUMP	
Quantity	1 per diesel (4 total)
Type	Centrifugal
Capacity, each	40 gpm
Head	6.5 psi
Motor power rating	1 hp
Design code requirements	Manufacturer's standard
JACKET WATER HEAT EXCHANGER	
Quantity	1 per diesel (4 total)
Type	Shell and tube
Duty, each(1)	3,365,000 Btu/hr
Shell design	
Fluid	Treated water
Flow rate	500 gpm
Design pressure	150 psi
Design temperature	300°F
Tube design	
Fluid (design inlet temperature)	Emergency service water (103.5°F)
Flow rate	700 gpm
Design pressure	150 psi
Design temperature	300°F
Design code requirements	ASME Section III, Class 3 & Commonwealth of Pennsylvania
STANDBY JACKET COOLANT HEATER	
Quantity	1 per diesel (4 total)
Type	Immersion, electric
Rating	15 kW
Design code requirements	ASME IV

(1) Based on a fouling factor of 0.0025

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TABLE 9.5-6

DIESEL-GENERATOR AIR COOLER COOLANT LOOP DESIGN PARAMETERS

AIR COOLER	
Quantity	1 per diesel (4 total)
Type	Shell and tube
Shell design	
Fluid	Treated water
Flow rate	400 gpm
Design pressure	30 psi
Design temperature	300°F
Tube design	
Fluid	Air
Flow rate	15,000 cfm
Design pressure	30 psi
Design temperature	300°F
Design code requirements	Manufacturer's standard
ENGINE-DRIVEN AIR COOLER WATER PUMP	
Quantity	1 per diesel (4 total)
Type	Centrifugal
Capacity, each	400 gpm
Head	35 psi
Design code requirements	Manufacturer's standard
AIR COOLER COOLANT HEAT EXCHANGER	
Quantity	1 per diesel (4 total)
Type	Shell and tube
Duty, each(1)	2,909,000 Btu/hr
Shell design	
Fluid	Treated water
Flow rate	400 gpm
Design pressure	150 psi
Design temperature	300°F
Tube design	
Fluid (design inlet temperature)	Emergency service water (95°F)
Flow rate	700 gpm
Design pressure	150 psi
Design temperature	300°F
Design code requirements	ASME Section III, Class 3, & Commonwealth of Pennsylvania

(1) Based on a fouling factor of 0.0025

QUESTION 430.90 (Section 9.5.5)

DRAFT

Expand your discussion of the instrumentation, controls, sensors and alarms provided for monitoring of the diesel engine cooling water system and describe their function. Discuss the testing necessary to maintain and assure a highly reliable instrumentation, controls, sensors, and alarm system, and where the alarms are annunciated. Identify the temperature, pressure, level, and flow (where applicable) sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe what operator actions are required during alarm conditions to prevent harmful effects to the diesel engine. Discuss the systems interlocks provided. Include the air cooler coolant loop in your discussion.

RESPONSE

Sections 9.5.5.2.1 and 9.5.5.5 have been changed to expand the discussion of the instrumentation, controls, sensors, and alarms provided for monitoring of the diesel engine cooling water system. When an alarm is received, the operator will investigate and initiate appropriate corrective action.

The diesel engine cooling water system will undergo periodic surveillance testing to demonstrate diesel generator operability in accordance with the Limerick Technical Specifications written using Section 4.8.1.1.2 of NUREG - 0123 "Standard Technical Specifications for General Electric Boiling Water Reactors (BWR/4)" as a guide.

In addition to the Technical Specification Surveillance Testing program, a comprehensive instrumentation maintenance program will be performed in conjunction with the diesel generation inspection/overhaul. This program will be based on the recommendations of the equipment vendor and operational experience.

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QUESTION 430.91 (Section 9.5.5)

Describe the provisions made in the design of the diesel engine cooling water system to assure that all components and piping are filled with water.

RESPONSE

Section 9.5.5.2.1 has been changed to provide the requested information.

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WITH 430.91

d. An automatic thermostatic control valve

e. A shell and tube heat exchanger to dissipate the heat from the jacket water (shell side) to ESW (tube side)

f. Alarms, trips, indicators, valves, and piping

The jacket water cooling loop component design parameters are given in Table 9.5-5.

The jacket water cooling system is designed to completely fill without special venting provisions. Initial system fill and any subsequent refills will be done in accordance with the diesel generator operation and maintenance manual. To ensure that all components and piping are maintained full of water, an expansion tank is connected to the pump suction piping. The expansion tank also serves the air cooler coolant loop. The expansion tank outlet nozzle is located approximately 8' above the top of the diesel engine.

The engine-driven jacket water pump discharges the cooling water through the engine passages and the engine jacket header, and delivers it to a three-way thermostatically controlled valve. This valve directs the flow through or around the jacket water heat exchanger and back to the pump suction. Short-circuiting via the keep-warm system (described below) will be minimized by the line sizing of the keep-warm system (1-1/2 inches) compared to the main loop (5 inches).

During engine shutdown periods, a centrifugal circulation pump, driven by a 1 hp ac motor, is designed to circulate the jacket coolant at a rate of 40 gpm through the 15 kW electric heater, the engine-driven pump, the jacket coolant piping, and the cylinder liner jackets. A branch line is provided to supply heated coolant to the air cooler coolant loop to keep it warm as an aid to quick starting.

The circulation pump runs continuously whenever the engine is shut down and maintains adequate water flow for keep-warm conditions when the engine is not operating. Under the control of the coolant heater thermostat, the heater cycles to maintain the keep-warm temperature of the coolant between 110 and 120°F. A relief valve, set at 40 psi, is provided in the coolant discharge line from the heater to protect the heater if the coolant flow is blocked and the heater fails to shut off automatically. A low coolant temperature alarm switch, set at 90°F decreasing, is provided in the coolant discharge line from

430.91

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QUESTION 430.92 (Section 9.5.5)

The diesel generators are required to start automatically on loss of all offsite power and in the event of a LOCA. The diesel generator sets should be capable of operation at less than full load for extended periods without degradation of performance of reliability. Should a LOCA occur with availability of offsite power, discuss the design provisions and other parameters that have been considered in the selection of the diesel generators to enable them to run unloaded (on standby) for extended periods without degradation of engine performance or reliability. Expand your PSAR/FSAR to include and explicitly define the capability of your design with regard to this requirement.

In your response, discuss the length of time the diesel engine can operate unloaded, and discuss your procedures for subsequent loading of the diesel generators to "blow out" accumulated carbon deposits. Show that these procedures are in conformance with manufacturer's recommendations and good operating practice. Confirm that these procedures will be implemented prior to plant startup.

RESPONSE

Section 8.3.1.1.3 has been changed to provide the requested information. The detailed operating procedures for manually loading the diesel generator to either test the unit or to "blow out" any accumulated carbon deposits have been based on the manufacturer's operation and maintenance manual and supplementary recommendations. The review cycle for the procedure included review by two persons with prior operating experience who were licensed at the SRO level. Prior to system turnover to PECo, those procedures will be implemented.

DRAFT

8.3.1.1.3 Standby Power Supply

The standby power supply for each division consists of one diesel-generator set complete with accessories and fuel storage and transfer systems. Each diesel-generator is connected to only one 4 kV Class 1E bus and is interlocked to prevent parallel operation during loss of offsite power. The four Class 1E buses for each reactor unit are operated as separate buses (split bus system) and are not synchronized. Each diesel-generator set is operated independently (from the other sets) and is disconnected from the utility power system, except during tests.

Each unit has four channels of standby power supply and four load divisions. The operation of three out of four channels of the standby power supply is adequate to satisfy minimum Class 1E load demand caused by a LOCA or loss of offsite power sources. A detailed discussion of the load demand on each diesel, which includes load characteristics, load sequencing, bus assignments, etc, is covered in Section 8.3.1.1.3.6.

The diesel-generators are capable of supplying power to the loads necessary to shut down and cool down the associated unit safely. Each diesel-generator is rated at 2850 kW for continuous operation and at 3135 kW for two hours of short-time operation in any 24-hour period. The diesel-generators are selected so that their ratings satisfy the requirements of Regulatory Guide 1.9, as discussed in Section 8.1.6.2. In addition, the diesel generators are capable of operating for extended periods of time at either low load or unloaded in the case of a LOCA occurring with the availability of offsite power. For extended periods of low load operation, the diesel generators are operated at 50 percent load or greater for at least one hour for every 12-hour period that the diesel generators are operated at loads of less than 30 percent. This prevents possible accumulation of combustion and lube oil products in the exhaust system. If a LOCA should occur and offsite power is available, the diesel generators would start automatically and run unloaded. After the offsite power grid, reactor parameters, and support systems have been stabilized, the unloaded diesel generators would be manually stopped and returned to standby. Even though the diesel generators would not be expected to run in this condition for an extended period of time, the capability to manually load the diesel generators to remove possible combustion and lube oil products from the exhaust system is provided.

The following sections discuss the functional aspects of the diesel-generator.

The manufacturer's recommendation will be followed for loading up to 50 percent load.

DRAFT

QUESTION 430.94 (Section 9.5.5)

You state in Section 9.5.5.2 each diesel engine cooling water system is provided with an expansion tank to provide for system expansion. In addition to the items mentioned, the expansion tank is to provide for minor system leaks at pump shafts seals, valve stems and other components, and to maintain required NPSH on the system circulating pump. Provide the size of the expansion tank and location. Demonstrate by analysis that the expansion tank size will be adequate to maintain required pump NPSH and make up water for seven days continuous operation of the diesel engine at full rated load without makeup, or provide a seismic Category I, safety Class 3 make up water supply to the expansion tank.

RESPONSE

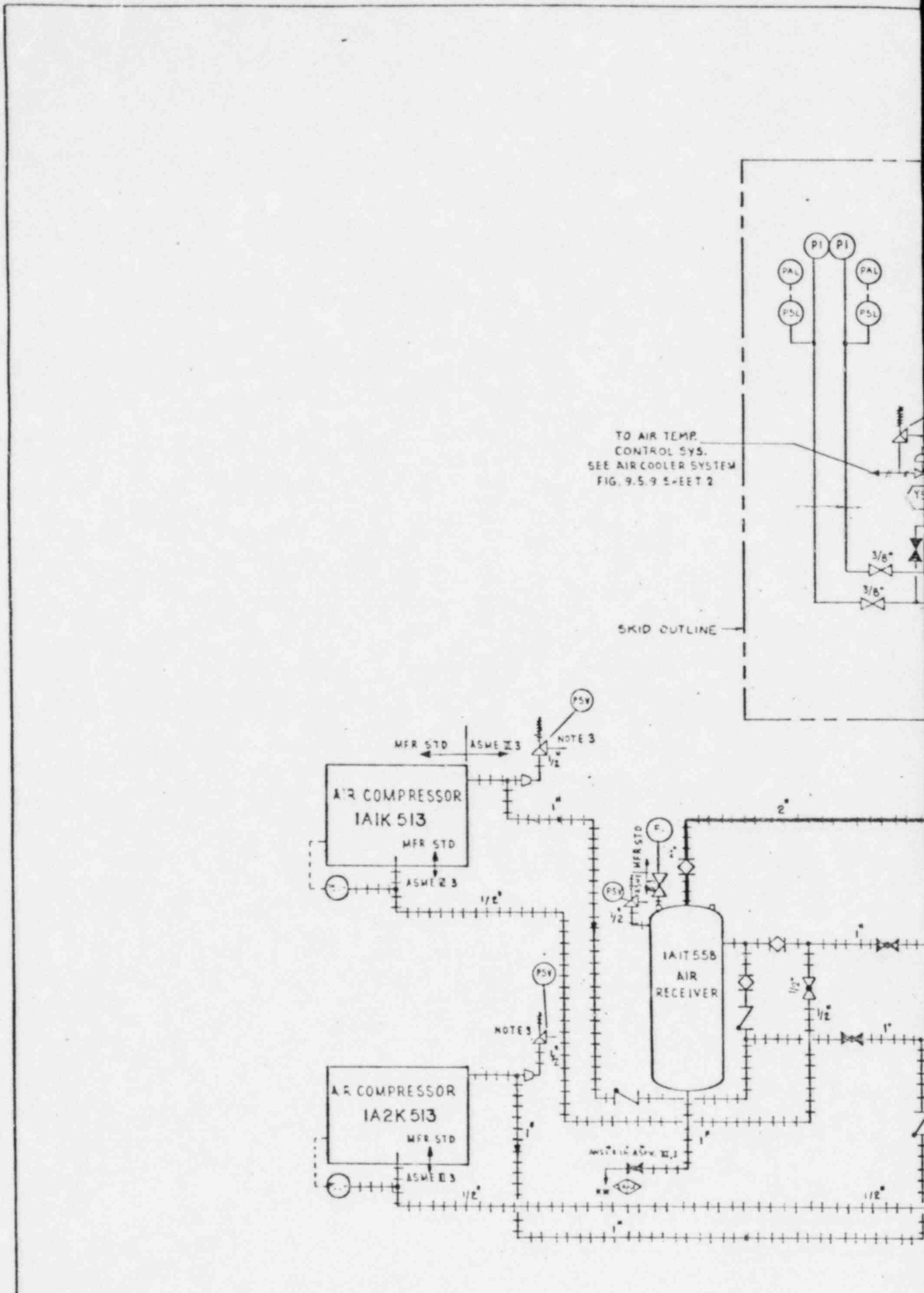
The expansion tank is located at El. 235 ft-1 in., and has a volume of 80 gallons. The diesel generator is located at El. 217 ft. The difference in level between the expansion tank and the pump suction provides a positive static suction head for the pump. The pump has a rotary mechanical seal to prevent excessive leakage of water along the pump shaft. Normal maintenance of valves and system components in accordance with Section 17.2A.2.5 will ensure that leakage rates will be kept below the amount requiring tank makeup within a 7-day period. Operational experience has shown that this is not a problem for the model of diesel generator used at Limerick.

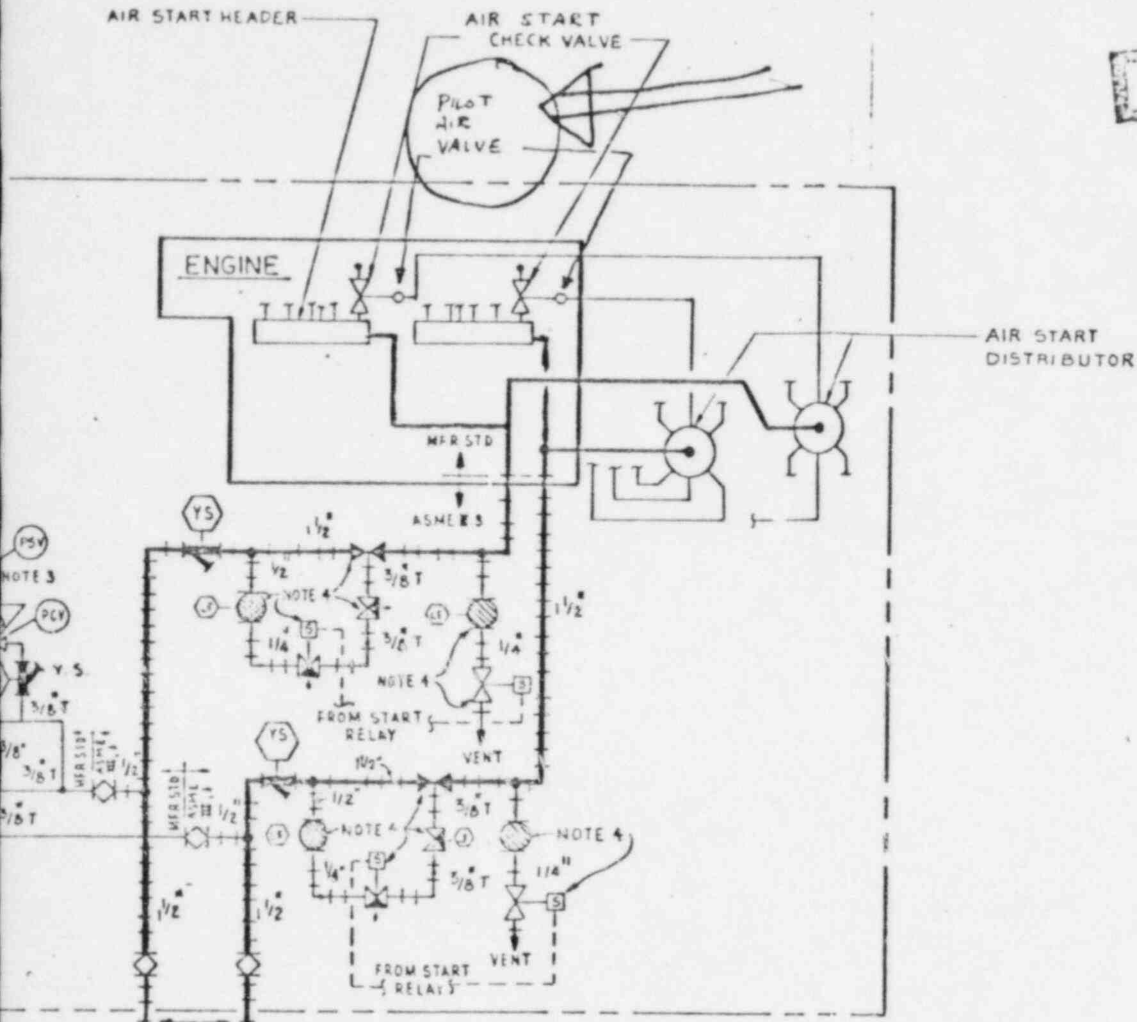
The need for addition of cooling water to the expansion tank is indicated by a local low level alarm and a common control room trouble alarm. A permanently installed, manually-operated makeup water system is provided. In addition, coolant can be added through the tank water treatment connection if the normal makeup system is unavailable.

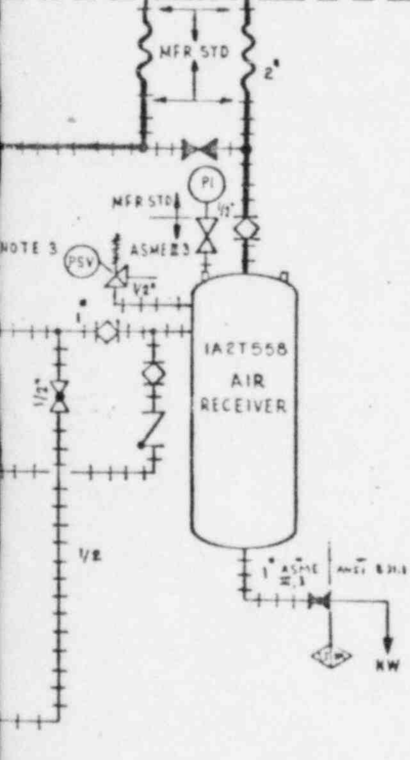
DRAFT (INSERT at end of 3rd para. of 9.5.6.2 of FSAR)

430.99 AIR START SYSTEM

The air distributor supplies air to the correct pilot air valves to match the firing sequence. The pilot air valves activate the air start check valves to allow starting air to the engine cylinders in the proper sequence.


PI
PI
PAL
PAL
PSL
PSL
TO AIR TEMP.
CONTROL SYS.
SEE AIR COOLER SYSTEM
FIG. 9.5.9 SHEET 2
3/8"
3/8"
SKID OUTLINE
PSV
MFR STD
NOTE 3
AIR COMPRESSOR
1A1K513
MFR STD
2"
1"
1/2"
1A1T558
AIR
RECEIVER
PSV
NOTE 3
AIR COMPRESSOR
1A2K513
MFR STD
1/2"
1"





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NOTES

1. LINES SHOWN THUS ┼┼┼┼ ARE DESIGNED TO ASME III CLASS-3 REQUIREMENTS.
2. NON-ASME LINES ARE DESIGNED TO MANUFACTURER'S STANDARDS.
3. RELIEF VALVES (PSV) SHOWN ARE ASME VIII.
4. EQUIPMENT AND COMPONENTS ARE DESIGNED TO MANUFACTURER'S STANDARDS

LIMERICK GENERATING STATION UNITS 1 AND 2 FINAL SAFETY ANALYSIS REPORT	
DIESEL GENERATOR STARTING SYSTEM	
FIGURE 9.5-10	REV. 17, 02/83

430-99

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QUESTION 430.101 (Section 9.5.6)

In the FSAR, you state that the air compressors operate from 225 to PSI to 250 PSI, and that the air receivers have sufficient capacity for 5 engine crank cycles of 10 seconds, each. It is not clear, however, how the entire air start systems operates, and how 5 equal crank cycles of 10 seconds duration can be obtained from the system described in the FSAR and on Figures 9.5-8 and 9.5-10. Therefore, expand your FSAR to include a detailed discussion of a typical engine start cycle. Describe the function of all components in the system, including the engine mounted components and piping, and give the sequence of operation. Provide the engine manufacturer's air start design pressure, and state what measured parameters constitute a successful engine crank cycle, i.e., RPM after 10 seconds, total number of revolutions, etc. State whether the air receiver capacity is calculated at 225 PSI or 250 PSI, and provide calculations supporting system capacity based on 5 crank cycles per receiver. Revise the P&IDs to reflect the expanded FSAR text.

RESPONSE

Sections 9.5.6.2 and 9.5.6.3 and Figure 9.5-10 have been changed to provide the requested information. Tests have been performed to demonstrate the air receiver capacity in lieu of calculations. The test results are available for NRC review.

The filter is sized to ensure continuous full-flow operation for a minimum of 175 hours, using disposable cellulose cartridges. The filter elements are designed to remove particles down to 25-micron size and to absorb water. The filter is provided with a differential pressure indicator and a pressure switch that initiates an alarm on high differential pressure across the filter. A manual bypass is provided.

The lubricating oil cooler is a shell-and-tube heat exchanger with a removable tube bundle and floating head design. The tube may be cleaned without removing any piping.

The strainer is a dual element type sized to ensure continuous full flow operation.

All pumps are of the positive displacement type. The engine-driven pump has sufficient capacity to provide all lubricating oil requirements under full load operating conditions. The ac motor-driven prelube pump, fed from a Class 1E 480V bus, will lubricate all wearing parts prior to a manual start. The circulating pump circulates lube oil from the sump through the electric immersion heater and back to the sump.

The immersion heater is provided to maintain the lube oil temperature at a preset value during standby periods.

The lube oil makeup tank is of the vertical construction type and of sufficient capacity to supply lube oil for at least 175 hours of continuous diesel generator operation.

During diesel generator operations, the lubrication system operates automatically, excluding the makeup and storage provisions. The engine-driven lube oil pump takes suction from the diesel generator sump and delivers the oil through the filter to a three-way thermostatically controlled valve that directs the oil through or around the oil cooler. The oil then flows through a full-flow strainer and back to the engine passages.

Replace with next pg. (INSERT FOR PG 9.5-50)

~~On normal exercising diesel generator start, the prelube pump is started manually and is shut down automatically after 2-1/2 to 3 minutes before the diesel generator is permitted to start~~. On emergency diesel generator start, the prelube pump does not operate because it is not required and would delay the diesel engine start. Periodic testing of the diesel generators will ensure that sufficient oil film is present to allow an automatic

DRAFT

INSERT FOR PG. 9.5-50.

There are two methods of manual operation of the diesel generator, local and remote. These are normally used for surveillance exercising.
In local manual operation, the operator will start the prelube pump which will operate for 2½ to 3 minutes and then automatically shut down. The operator will then start the diesel generator.
In remote manual operation, the operator will put the switch in "start". This will start the prelube pump, which will operate for 3 minutes before an interlock permits the diesel generator to start.

QUESTION 430.114 (Section 9.5.8)

The diesel engine exhaust piping shown on Figure 1.2-36 is not in concurrence with the description in Section 9.5.8. Figure 1.2-36 shows a 45 degree fitting at the end exhaust piping, while the text discusses an elbow at the same location. Revise your FSAR to resolve this inconsistency. Also, expand your FSAR discussion to show how the presence of water, dust, ice, or snow in the exhaust system would be detected and what provisions will be made for removal of same.

RESPONSE

Section 9.5.8.3 and Figure 1.2-36 have been changed to provide the requested information.

Q430.114

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Because of the above described configuration and because the specific gravity of the exhaust gases leaving the exhaust duct is approximately one-third of the standard air specific gravity, exhaust gas contamination of air at the enclosure intake opening will be negligible irrespective of outdoor ambient temperature, wind speed, or direction. The exhaust duct extension, beyond the diesel generator enclosure roof, further improves exhaust gas dispersion. This extension is considered non-safeguard in that it is not required to meet the system design requirements, and in that its failure will not interfere with the exhaust duct gas flow and consequently the performance of the diesel generator.

If the cast iron exhaust pipe were broken by tornado or turbine missiles, small pieces of metal might drop into the exhaust duct, but would not reach the turbocharger because of the duct arrangement and the presence of the exhaust silencer. Large pieces of metal or the entire cast iron pipe might fall on the enclosure roof but would have no destructive effect because the roof is designed to withstand tornado and turbine missiles. For the low probability event of the cast iron pipe breaking off, the vertical discharge velocity and low specific gravity of the exhaust ensure that recirculation would not be a problem.

The engine silencers are provided with drains for elimination of water resulting from condensation or being blown in by the wind. Any dust that might accumulate will be blown out by the exhaust gases during periodic testing.

The drains will be opened periodically by the operators.

The engine silencers are provided with drains for removal of condensation that might collect at this point. Any dust that might accumulate in the exhaust piping will be blown out by the exhaust gases during periodic testing.

The engine is not equipped with alarm or shutdown sensors for abnormal conditions in the intake and exhaust systems because the engines are designed to operate under all specified operating conditions.

9.5.8.4 Tests and Inspections

The system is preoperationally tested in accordance with the requirements of Chapter 14 and periodically tested in accordance with the requirements of Chapter 16. Operability of the combustion air intake and exhaust system is checked during the periodic testing of the diesel generator system.

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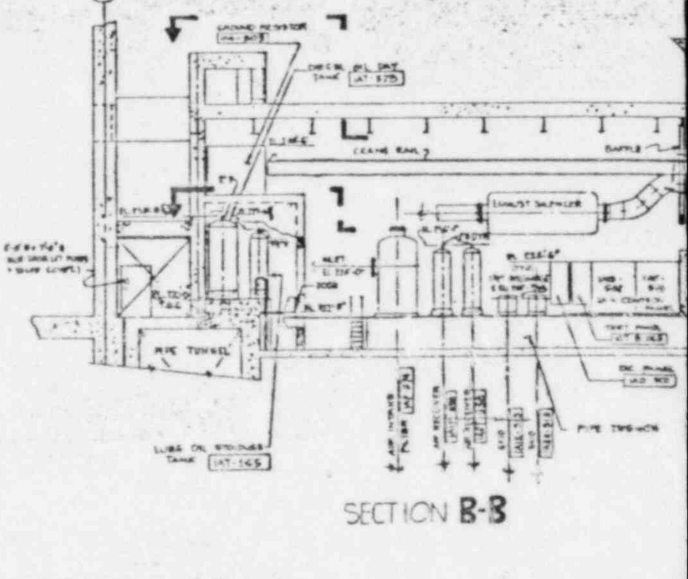
QUESTION 430.116 (Section 9.5.8)

In Section 9.5.8.3 of your FSAR, you state that "the air intake and exhaust gas openings are designed to prevent contamination of the diesel's intake air by exhaust products." Expand your FSAR discussion of this particular design to support the conclusion that contamination will be prevented. Show that the effects of adverse environmental conditions will not cause exhaust gas to recirculate and contaminate the air intakes and effect engine performance.

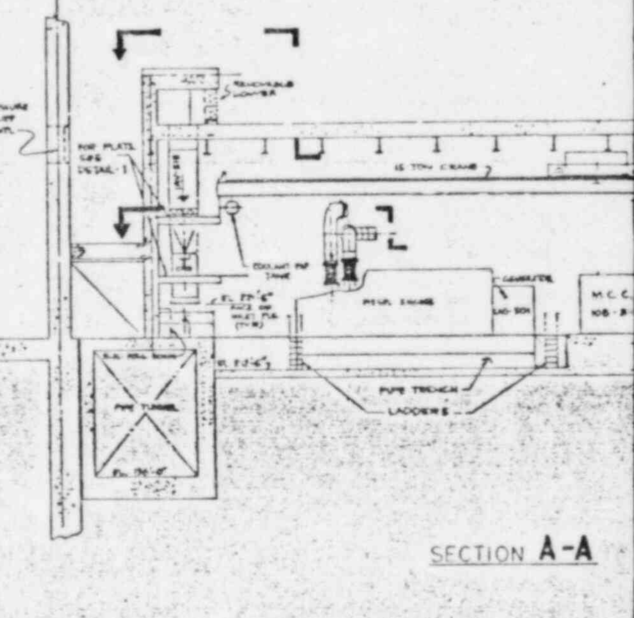
RESPONSE

Sections 9.5.8.2 and 9.5.8.3 and Figures 1.2-36 and 9.5-12 have been changed to provide the requested information.

REFERENCE DRAWINGS	
DWG. NO.	FSAR FIG. NO.
M-145	1.2-35



SECTION B-B



SECTION A-A

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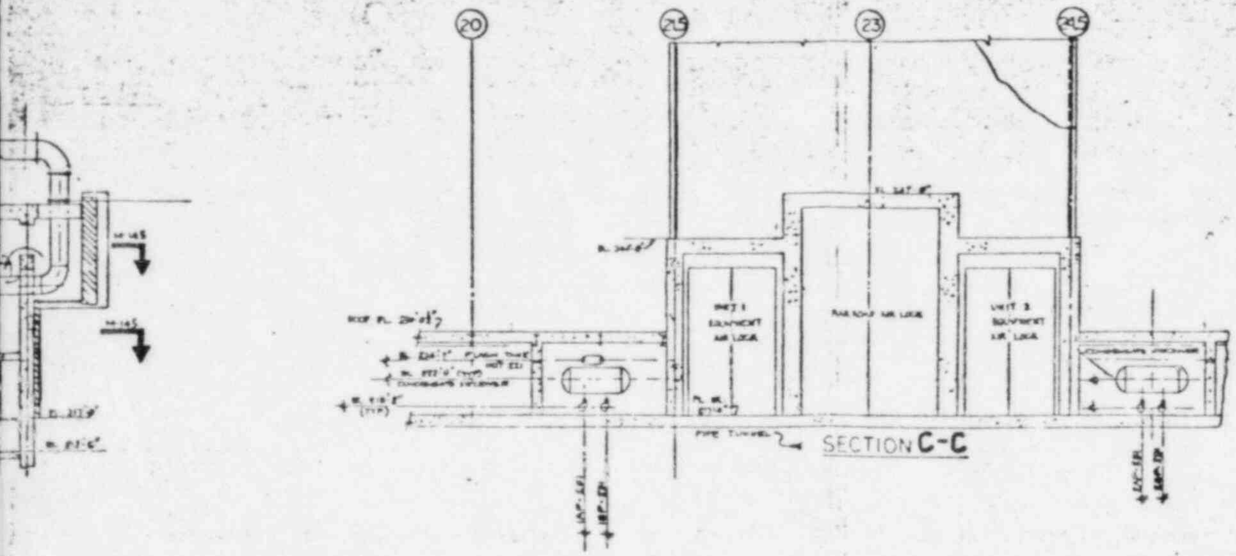
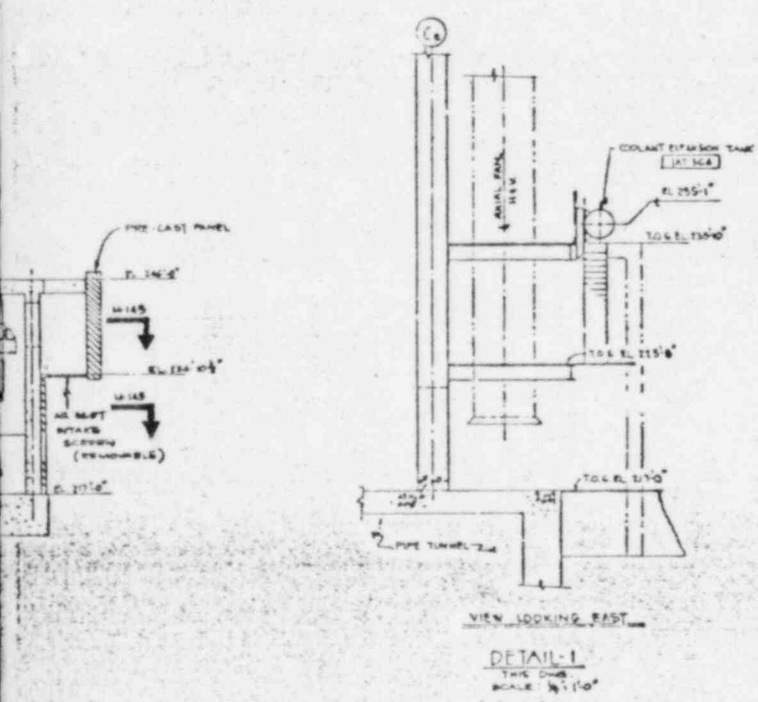


SECTION C-C



VIEW LOOKING EAST

DETAIL-1

NOTE:

USE THIS DRAWING ONLY FOR EQUIPMENT LOCATION DIMENSIONS. OTHER INFORMATION SHOWN MAY NOT BE CURRENT WITH RESPECT TO DRAWINGS WHICH GOVERN CONSTRUCTION.

LIMERICK GENERATING STATION
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GENERAL ARRANGEMENT, DIESEL GENERATOR ENCLOSURE UNITS 1 AND 2, SECTIONS.

FIGURE 1.2-36

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430-116

QUESTION 430.118 (Section 9.5.8)

Experience at some operating plants has shown that diesel engines have failed to start due to accumulation of dust and other deliterious material on electrical equipment associated with starting of the diesel generators (e.g., auxiliary relay contacts, controls switches - etc.). Describe the provisions that have been made in your diesel generator building design, electrical starting system, and combustion air and ventilation air intake design(s) to preclude this condition to assure availability of the diesel generator on demand.

Also describe under normal plant operation what procedure(s) will be used to minimized accumulation of dust in the diesel generator room; specifically address concrete dust control. In your response also consider the condition when Unit 1 is in operation and Unit 2 is under construction (abnormal generaion of dust).

RESPONSE

Section 9.4.6.2 has been changed to provide the requested information on dust control in the D/G building.

The local control boards for the diesel generators contain control switches, auxiliary relays and electrical equipment associated with the generator system. All electrical contacts are enclosed. All auxiliary relays have dust covers and all control switches have internal contact surfaces. The local control panel is constructed of steel with continously welded seams. All doors are gasketed and latched. The doors are louvered to allow ventilation of internally generated heat.

The electrical relay and terminal box is totally enclosed and has a gasketed cover. All relays have dust covers. The race way entrances to all electrical enclosures are sealed to prevent the entrance of dust or water, thus preventing the accumulation of dust on electrical control components.

QUESTION 430.119 (Section 9.5.8)

Refer to the previous question. Expand your discussion of dust control to include the motor control center and other electrical equipment in the diesel generator room. Show that an accumulation of dust dirt not cause failures of any emergency diesel generator support equipment.

RESPONSE

The motor control centers in each diesel generator cell are NEMA type 12 and are rain tight. All raceway entrances are sealed to preclude the entrance of dust or water. These design features prevent the entrance of dust into the MCC's. All other electrical components associated with the D/G in these rooms are protected against dust as described in the response to Question 430.118.

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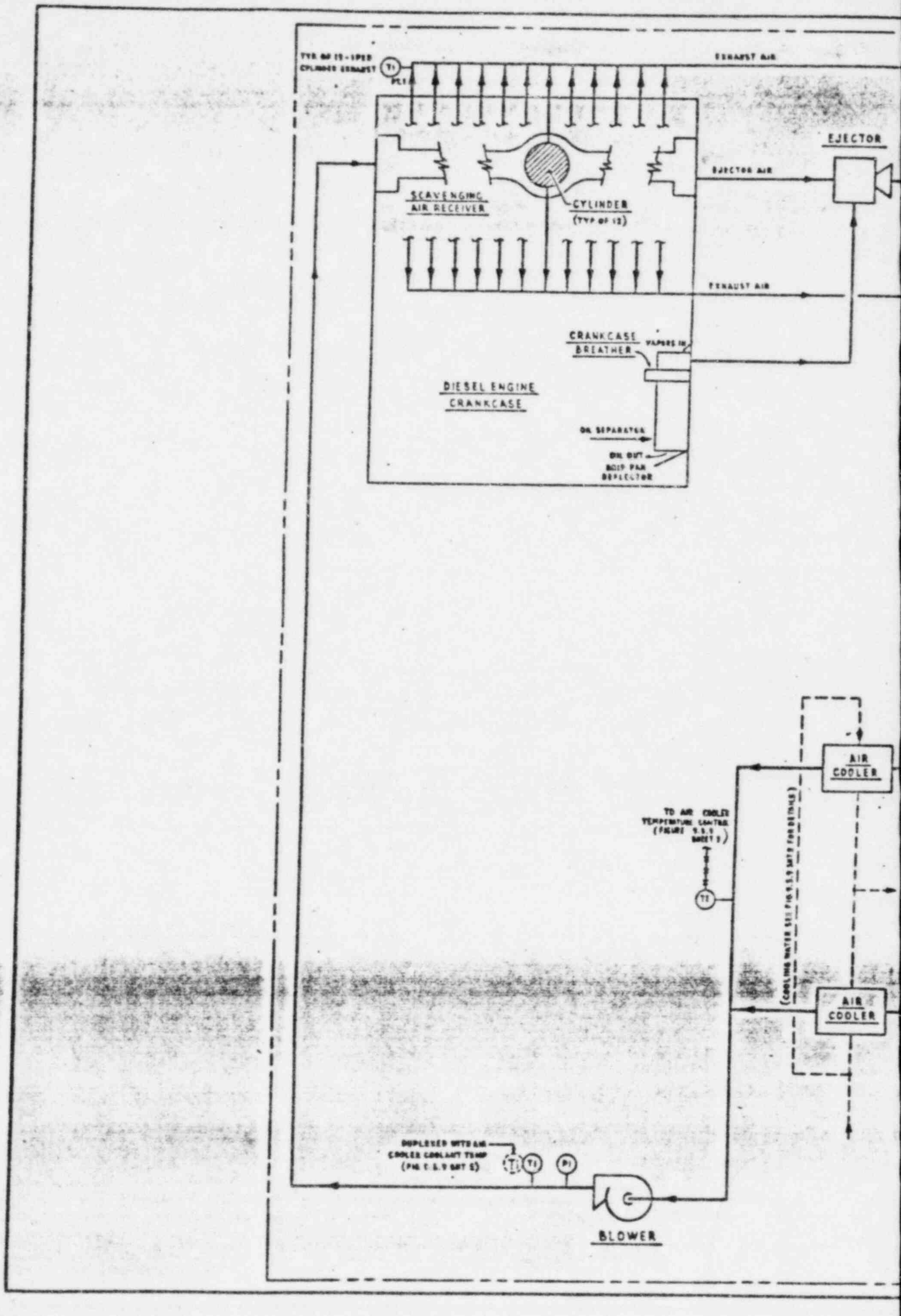
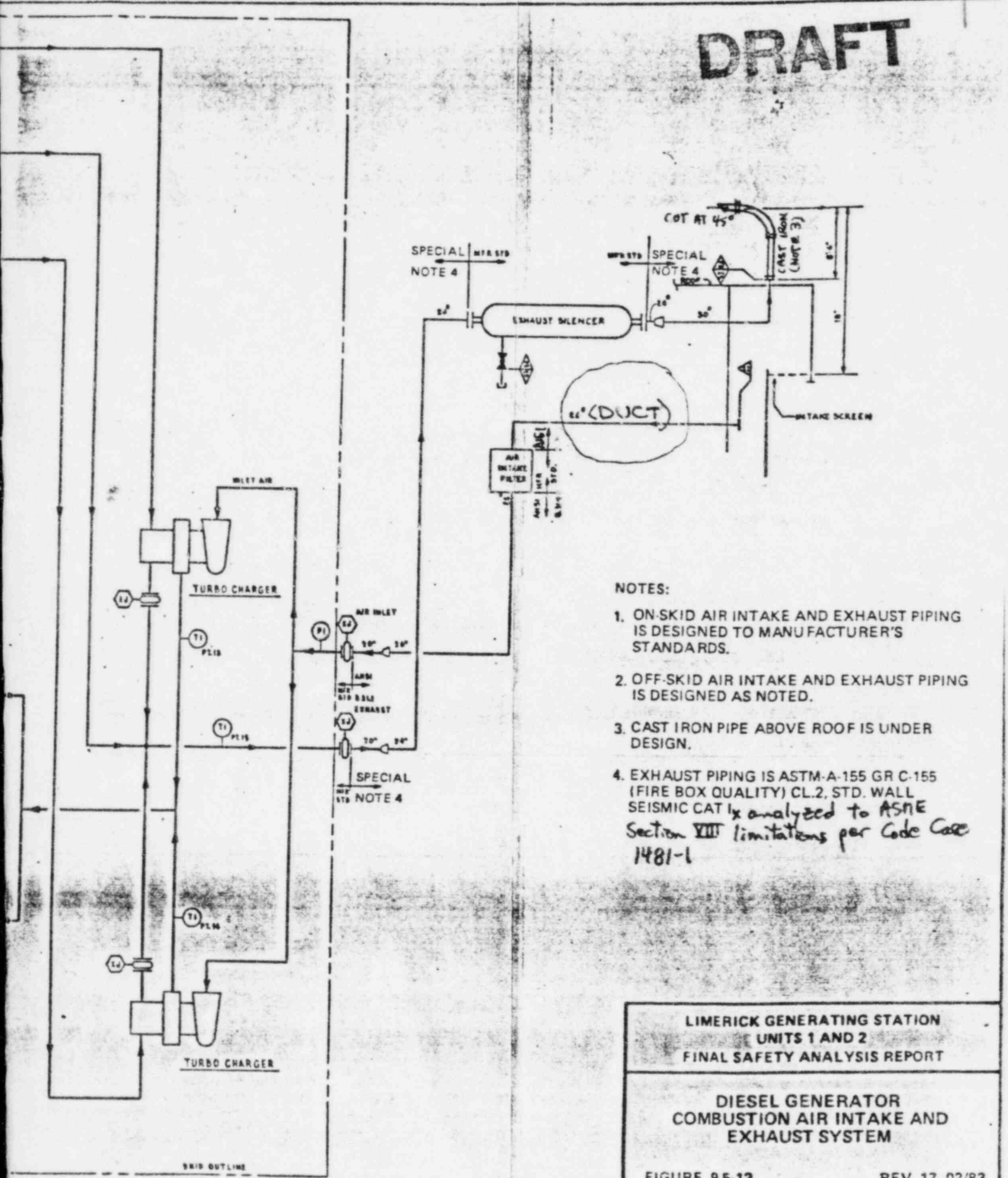
QUESTION 430.121 (Section 9.5.8)

Provide an enlarged P&ID for the emergency diesel engine combustion air intake & exhaust system. On the drawing, clearly indicate all piping, all instrumentation and controls, all components, engine interfaces, building penetrations, quality group classifications for all piping and components, and any locations where quality group classifications change.

RESPONSE

Figure 9.5-12 and Table 3.2-1 have been changed to provide the requested information.


EXHAUST AIR
EJECTOR
EJECTOR AIR
SCAVENGING AIR RECEIVER
CYLINDER
(TYP OF 12)
EXHAUST AIR
CRANKCASE BREATHER
DIESEL ENGINE CRANKCASE
AIR COOLER
AIR COOLER
TI
TI
PI
BLOWER



NOTES:

1. ON-SKID AIR INTAKE AND EXHAUST PIPING IS DESIGNED TO MANUFACTURER'S STANDARDS.
2. OFF-SKID AIR INTAKE AND EXHAUST PIPING IS DESIGNED AS NOTED.
3. CAST IRON PIPE ABOVE ROOF IS UNDER DESIGN.
4. EXHAUST PIPING IS ASTM-A-155 GR C-155 (FIRE BOX QUALITY) CL.2, STD. WALL SEISMIC CAT I x analyzed to ASME Section VIII limitations per Code Case 1481-1

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DIESEL GENERATOR
COMBUSTION AIR INTAKE AND
EXHAUST SYSTEM

FIGURE 9.5-12 REV. 17, 02/83

RELATED TO Q. * 430.116
430.121

QUESTION 430.122 (Section 9.5.8)

Refer to Figure 1.2-1. There are two fuel storage tanks and one lube oil storage tank in close proximity to both Unit 1 and 2 diesel generator building, and on the same side as the combustion air intakes. Consider a fire in one or more of these storage tanks. Show how you will prevent products of combustion from entering the diesel generator combustion air intakes and causing degraded emergency diesel performance, or even failure. Revise your FSAR accordingly.

RESPONSE

Section 9.5.8.3 has been changed to provide the requested information.

In the event of tank rupture, a continued foam application would cover the tank contents contained by an encircling dike. Lube oil storage consists of drum storage inside an enclosure and protected by a wet pipe sprinkler system. This lube oil storage enclosure is located east of the auxiliary boiler enclosure, approximately 60 feet from the nearest Unit 2 diesel generator enclosure air intake. Unit 2 diesel generators, south of

The fuel oil tanks are located at a distance ≥120' from the diesel air intake

The probability of a fire outside the diesel generator enclosure concurrent with a loss of offsite power that would cause products of combustion to foul the diesel air intake is extremely low. A spontaneous main turbine trip would not result from this external fire. A fire in ~~one~~ either of the aux. boiler fuel ~~or lube~~ oil storage tanks outside the enclosure would immediately be alarmed in the control room and would be extinguished by a manually activated foam injection system provided with each tank. The area is protected by a fire hydrant system. Normal local winds would carry combustion products away from the diesel generator intakes as shown in the wind rose in EROL Figures 2.3.2-1 through 2.3.2-3.

Evaluation of the combustion air intake and exhaust system with respect to the following areas is discussed in separate FSAR sections as indicated:

a.	Protection from wind and tornado effects	3.3
b.	Flood protection	3.4
c.	Missile protection	3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	3.6
e.	Environmental design	3.11
f.	Fire protection	9.5.1

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The air intake opening of the diesel generator enclosure and the outlet of the exhaust duct are designed to prevent recirculation of exhaust products and contamination of the diesel intake air. The combustion air intake is located at the diesel generator enclosure air intake plenum. The screened air intake opening of the enclosure is located on the upper part of the south wall and is protected from rain, ice, and snow by a roof overhang (Figure 1.2-36). The exhaust duct is terminated above the roof with a 6-foot piece of cast iron pipe, an elbow, and a 3 foot section cut at a 45 degree angle for protection from rain, ice, and snow. This elbow is 18 feet higher than the enclosure air intake opening.

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QUESTION 430.123 (Section 9.5.8)

Consider ε loss of offsite power with associated reactor trip and cooldown. One emergency diesel engine fails to start, and during operation of the remaining three there is a subsequent exhaust line break on one of the diesels in the area where the exhaust line passes through the air intake space. Show that the operation of the affected emergency diesel will not be impaired by exhaust gas contamination such that the capability for safe shutdown is not compromised. Revise your FSAR accordingly.

RESPONSE

The proposed scenario is an Anticipated Operational Transient, followed by an independent single failure, followed by an independent passive failure of a seismic Category I, Q-listed pipe.

This event combination exceeds the Limerick design basis and NUREG-0800 sections 15.0, 15.2.6.II.4 and 15.2.6.II.6, which only requires consideration of the initiating event combined with the worst single failure.

The exhaust line will be inspected as part of the ISI program.

THE ATTACHED PAGE CHANGES ARE BEING PROVIDED TO CLARIFY THE RESPONSES

TO: Q 430.124
.127
.139.

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the master trip. They provide backup protection if the intercept valves or the normal control devices fail.

10.2.2.4 Extraction System Check Valves

The energy contained in the extraction and feedwater heater system can be of sufficient magnitude to cause overspeed of the turbine-generator following an electrical load rejection or turbine trip. Check valves are installed where necessary to prevent high-energy steam from entering the turbine under these conditions. The extraction system check valves are shown in Figure 10.2-1.

The check valves limit the amount of energy flashing back into the turbine so that the turbine speed increase is held below the maximum value. Power-assisted closure check valves are provided for heaters 3, 4, and 6. Heater 2 is provided with folding disc check valves. Heater 1 has no provision for preventing flashbacks into the turbine, since the distance to the turbine is short and internal energy is low. Heater 5 has no provision for preventing flashbacks into the crossaround piping, since the crossaround/moisture separator system provides adequate capacity to protect the turbine.

The power-assisted check valves have an air piston that acts in opposition to a spring to keep the valve wide open during normal operation. On turbine trip, the extraction relay dump valve closes, venting the air from the piston actuators and thus allowing the springs to assist in closing the check valves.

10.2.2.5 System Operation

A SCHEMATIC DIAGRAM OF THE EHC SYSTEM IS FOUND IN FIGURE 10.2-3 AND A BLOCK DIAGRAM FOR THE TURBINE CONTROL SYSTEM IS SHOWN IN FIGURE 10.2-9

10.2.2.5.1 Control System

The turbine-generator control system is a GE Mark I electrohydraulic control (EHC) system. The speed control unit produces the speed/acceleration error signal that is determined by comparing the desired speed from the reference speed circuit, with the actual speed of the turbine for steady-state conditions. For step changes in speed, an acceleration reference circuit takes over to either accelerate or decelerate the turbine at a selected rate to the new speed. There is no limit to the deceleration. The speed/acceleration error signal is combined with the load requirements on the load control unit to provide the flow signal to the control valves.

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Assuming an electrical load increase due to a system frequency dip with steady steam input to the turbine, the turbine speed decreases. In Figure 10.2-7, two speed sensors SSPU-1 and SSPU-2 pick up the change in speed. This signal is compared with the speed reference at the speed summing amplifiers, and its derivative is compared with the acceleration reference at the acceleration summing amplifier in each of two low value gates ~~(A23 and A26)~~. The resulting outputs are gated together and the controlling signal (SCU) feeds into the load control unit for the control and intercept valves.

In Figure 10.2-8, the signal SCU from the speed control unit (Figure 10.2-7) is compared with the load reference, which is remote manually set, and inputted to the control and intercept valve amplifiers ~~(A48 and A50)~~. These amplifiers provide the position signals for the flow control units of the respective valves which are the final controlling units of the control and intercept valves. A typical valve flow control unit is shown in Figure 10.2-10.

Because of the importance of overspeed protection, the speed control signal has two independent redundant channels. Two independent pulse signals are obtained from magnetic pickups located over a gear-toothed wheel on the turbine shaft. Loss of both speed signals trips the turbine (Section 10.2.2.6).

10.2.2.5.2 Emergency Trip System Functions

The emergency trip system trips the unit closing all valves on the following signals and therefore shuts down the turbine:

a. Turbine approximately 10% above rated speed (on overspeed, the tripping is performed by the mechanical trip valve)

b. Turbine approximately 12% above rated speed while testing the overspeed trip device

c. Vacuum decreases to less than a preselected value

d. Excessive thrust bearing wear

e. Prolonged loss of generator stator coolant at loads in excess of a predetermined value

f. Remote manual trip on the control panel

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g. Loss of hydraulic fluid supply pressure (loss of emergency trip system fluid pressure automatically closes the turbine valves and then energizes the master trip relay to prevent a false restart)

h. Low lubrication oil pressure

i. Loss of both speed signals

j. Loss of both primary and secondary EHC power supplies

k. Operation of the manual mechanical trip at front standard

l. High level in moisture separators

m. High reactor water level

n. Power load unbalance

o. Exhaust hood high temperature

p. Excessive vibration

q. Reverse Power

r. Generator Breaker Opening

To prevent spurious tripping due to single component failure, duplicated or triplicated trip sensing devices are provided and are wired to form a two-out-of-three or a two-out-of-two tripping logic. Therefore, a signal from a single sensing element does not trip the turbine-generator. However, the turbine trips if a malfunction is monitored simultaneously by at least two sensing elements.

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10.2.2.6 Overspeed Protection

For speeds above 100 percent rated speed, the speed control system would fully close the turbine control valves by the time that 107 percent of rated speed is reached and the CIVs would be fully closed by the time that 109 percent of rated speed is reached.

To protect the turbine-generator against overspeed due to failure of the speed control system, two trip devices are provided, either of which when initiated closes the main stop valves, control valves, and combined intermediate valves, thus shutting down the turbine.

These two trip devices are as follows:

a. A mechanical overspeed trip that is initiated if the turbine speed reaches approximately 10% above rated speed

b. An electrical overspeed trip that serves as a backup to the mechanical trip and is initiated at approximately 12% above rated

(Figure 10.2-3 Sheet 1 of 6)

The mechanical overspeed trip device is an unbalanced ring mounted on the turbine shaft and held concentric with it by a spring. When the turbine speed reaches the trip speed (10% above rated) the centrifugal force acting on the ring overcomes the tension of the spring and the ring snaps to an eccentric position. In doing this it strikes the trip finger, which operates the mechanical trip valve. This is a three-way valve that feeds hydraulic fluid (1600 psi) to the lockout valve and, when tripped, blocks the hydraulic fluid supply system and removes the emergency trip system pressure, which causes the main stop valves, control valves, and combined intermediate valves to close. Failure of the hydraulic portion of this trip results in a stop valve closure.

The electrical overspeed trip receives its signal from a 112% speed trip relay (VC 5840) (Figure 10.2-4) operated by the signal sensed by a magnetic pickup from a toothed wheel on the turbine shaft and fed to a power amplifier and megacycle circuit whose output is a dc voltage proportional to speed (Figure 10.2-5).

AN INDEPENDENT

The signal from the speed trip relay energizes the master trip relay XKT1000 (Figure 10.2-5) which then energizes the mechanical trip solenoid MTS and de-energizes the master trip solenoid valves MTSV-A and MTSV-B.

Either one of these actions will trip the turbine, i.e., close the stop, control, and combined intercept valves.

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decreases. In Figure 10.2-7, ~~region C-1,~~ two speed sensors SSPU-1 and SSPU-2 pick up the change in speed. This signal is compared with the speed reference at the speed summing amplifiers, and its derivative is compared with the acceleration reference at the acceleration summing amplifier in each of the two low valve gates ~~(A23 and A26)~~. The resulting outputs are gated together and the controlling signal (SCU) feeds into the load control unit for the control and intercept valves.

In Figure 10.2-8, the signal SCU from the speed control unit (Figure 10.2-7) is compared with the load reference, which is remote manually set, and inputted to the control and intercept valve amplifiers ~~(A48 and A50)~~. These amplifiers provide the position signals for the flow control units of the respective valves which are the final controlling units of the control and intercept valves. A typical valve flow control unit is shown in Figure 10.2-~~7~~ 10.

The recirculation flow control signal is the speed signal minus the speed reference ~~(Figure 10.2-8)~~. This is amplified in the auto-load following unit ~~(Figure 10.2-10)~~ and fed into the reactor recirculation system flow controller. This is the end point of the turbine-generator system control of load following.

The above analysis is based on a generator load increase. A similar discussion also applies to load decrease. The same effect can be obtained if, instead of a change in electrical load, a load reference change is made by the operator because a recirculation flow error signal is achievable in either case.

10.2.3 TURBINE DISC INTEGRITY

10.2.3.1 Material Selection

Turbine wheels and rotors for turbines operating with light water reactors are made from vacuum melted or vacuum degassed Ni-Cr-Mo-V alloy steel by processes that minimize flaw occurrence and provide adequate fracture toughness. Tramp elements are controlled to the lowest practicable concentrations consistent with good scrap selection and melting practices and consistent with obtaining adequate initial and long-life fracture toughness for the environment in which the parts operate. The turbine wheel and rotor materials have the lowest fracture appearance transition temperatures (FATTs) and highest Charpy V-notch energies obtainable, on a consistent basis from water quenched Ni-Cr-Mo-V material at the sizes and strength levels used. Since

TABLE 10.2-2

TURBINE OVERSPEED PROTECTION

DEVICE	DESCRIPTION/FUNCTION	TRIP SETTING	ACTUATING DEVI INTERMEDIATE	
SPEED CONTROL UNIT (2 REDUNDANT SYSTEMS)	COMPARES DESIRED SPEED WITH REFERENCE SPEED. LOAD CONTROL UNIT PROVIDES FLOW SIGNAL TO CONTROL VALVES	ABOVE RATED SPEED CV & CIV START TO CLOSE. CV CLOSED BY 107% OF RATED SPEED. CIV CLOSED BY 107% RATED SPEED		
Overspeed Trip	Unbalanced ring, concentric with shaft, eccentric on overspeed Close mech. trip valve and remove electro-hyd control oil press	110% of rated speed	Mechanical Linkage	Mec va
Backup Overspeed Trip	Toothed wheel magnetic pick-up speed sensor, electronic signal amplifier Close mech. trip valve and master trip solenoid valves; remove electro-hyd control oil press	112% of rated speed	Master Trip Relay	Mec sol & sol (M
Power/ Load Unbalance	Gen current & steam pressure transducers, electronic comparators & control logics Energize CV fast closing solenoids & remove electro-hyd control oil press from the CVs.	40% Unbalanced		

SV = Stop Valve
CV = Control Valve
CIV = Combined Intercept Valve

* SINCE THERE ARE TWO REDUNDANT SYSTEMS, ITS FUNCTION WOULD NOT BE IMPAIRED UNLESS THE ELECTRICAL SIGNAL FROM BOTH WERE LOST. IF THE ELECTRICAL SIGNAL FROM BOTH ARE LOST, THE TURBINE WOULD BE TRIPPED.

* *

)

CE FINAL	ACTUATED VALVE	ACTUATED POSITION	POSTULATED EVENT INCLUDING CONSEQUENCES OF HIGH OR MODERATE ENERGY PIPE RUPTURE	PLANT RESPONSE
	ALL CV ALL CIV	CLOSE	LOSS OF ELECTRICAL SIGNAL * LOSS OF HYDRAULIC PRESSURE	CLOSE ALL SV, CV, AND CIV
hanical trip ve	All SV All CV All CIV	Close	LOSS OF HYDRAULIC PRESSURE	CLOSE ALL SV AND CIV
hanical trip enoid (MTS) aster trip enoids SV-ACB)	All SV All CV All CIV	Close	LOSS OF ELECTRICAL SIGNAL ** LOSS OF HYDRAULIC PRESSURE	CLOSE ALL SV, CIV CLOSE ALL SV, CV, AND CIV
	All CV	Fast Close	LOSS OF ELECTRICAL SIGNAL a) LOSS OF GENERATOR OUTPUT SIGNAL b) LOSS OF TURBINE PRESSURE SIGNAL LOSS OF HYDRAULIC PRESSURE	CLOSE ALL CV NO ACTION CLOSE ALL SV, CV, AND CIV

BACKUP ELECTRICAL OVERSPEED WOULD NORMALLY DEENERGIZE BOTH THE MASTER TRIP SOLENOIDS

LOSS OF SIGNAL TO BOTH WILL TRIP THE TURBINE.

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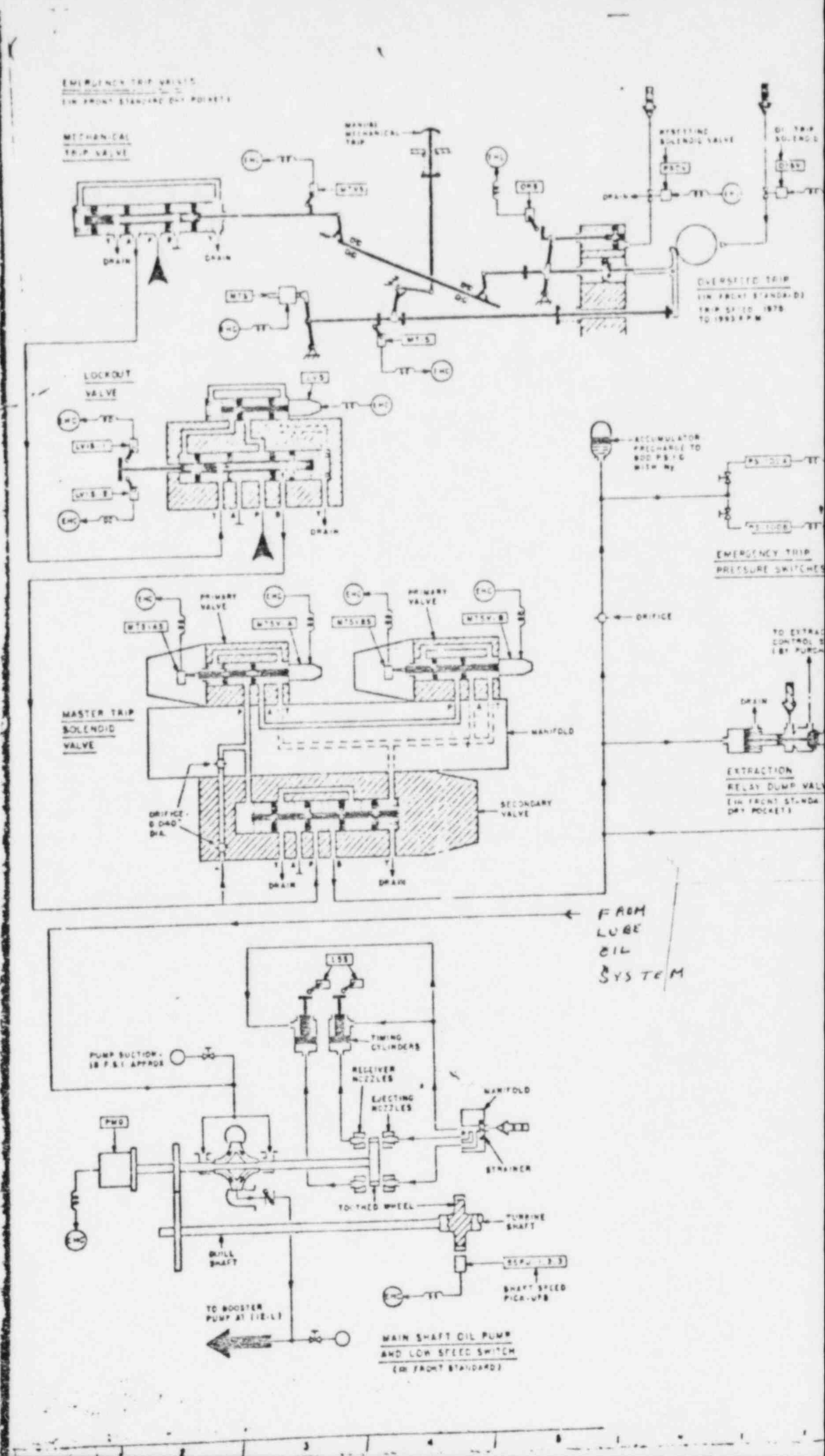
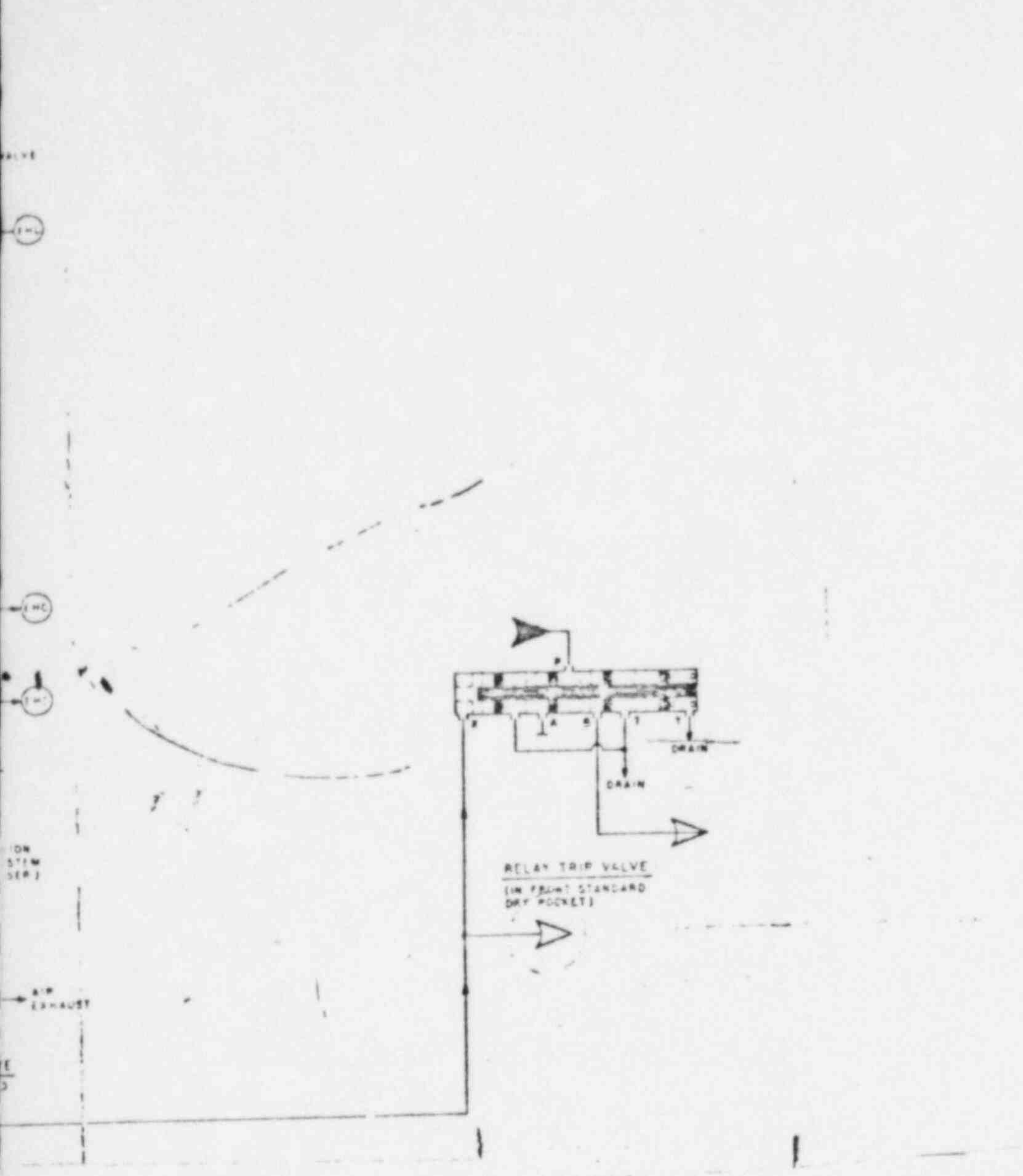

EMERGENCY TRIP VALVES
MECHANICAL TRIP VALVE
DRAIN
OVERSPEED TRIP
LOCKOUT VALVE
EHC
ACCUMULATOR
EMERGENCY TRIP PRESSURE SWITCHES
ORIFICE
PRIMARY VALVE
MASTER TRIP SOLENOID VALVE
MANIFOLD
SECONDARY VALVE
EXTRACTION
FROM LUBE OIL SYSTEM
LSS
TIMING CYLINDERS
RECEIVER NOZZLES
EJECTING NOZZLES
MANIFOLD
STRAINER
PMG
TURBINE SHAFT
BULL SHAFT
SHAFT SPEED PICK-UPS
MAIN SHAFT OIL PUMP
AND LOW SPEED SWITCH
(IN FRONT STANDARD)



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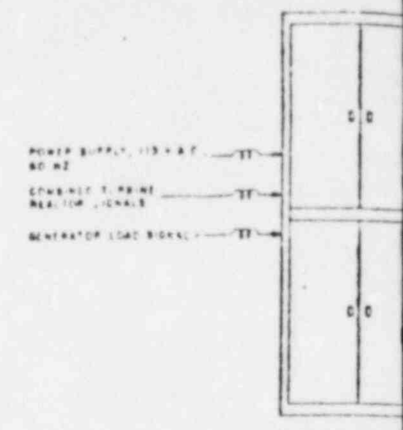
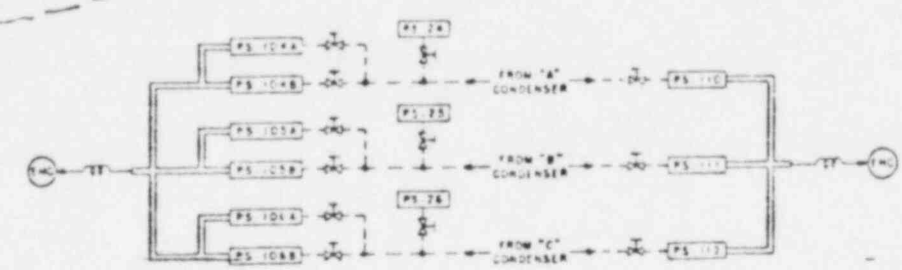
MECHANICAL OVERSPEED TRIP

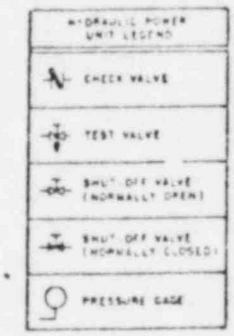
FIGURE 10.2-3 ~~REV. 15, 11/82~~

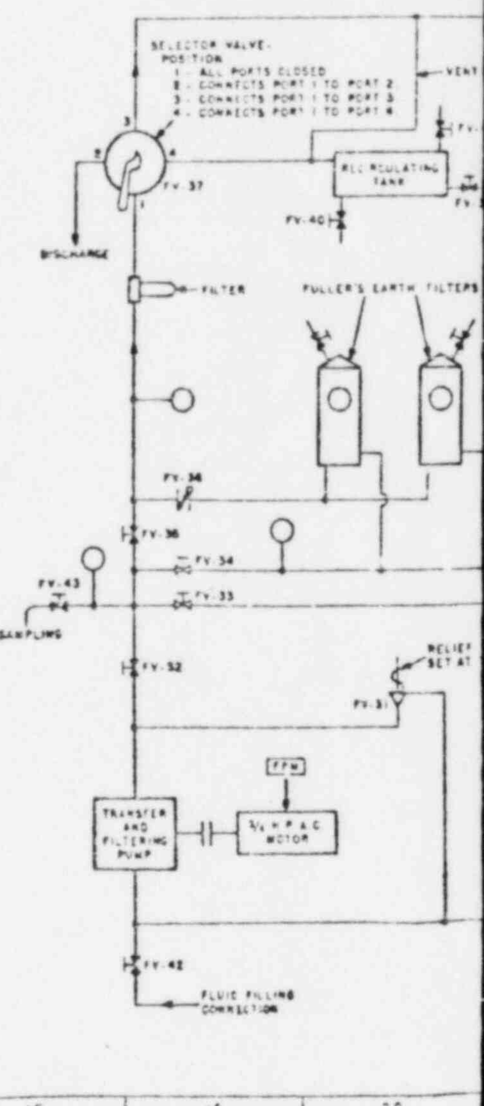


ELECTRO HYDRA
CONTROL CAB



VACUUM PRESSURE SWITCHES





18 19 20

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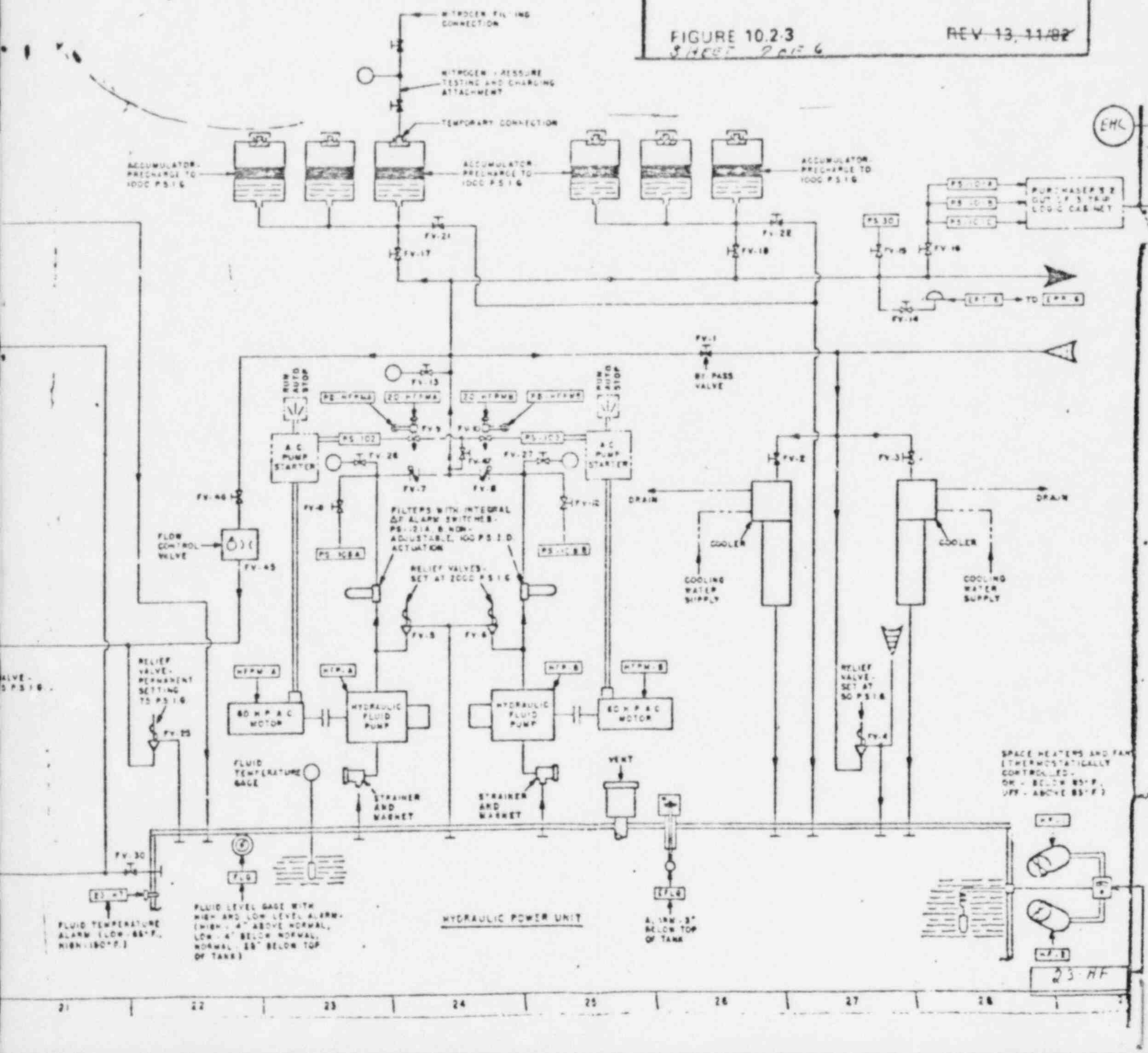
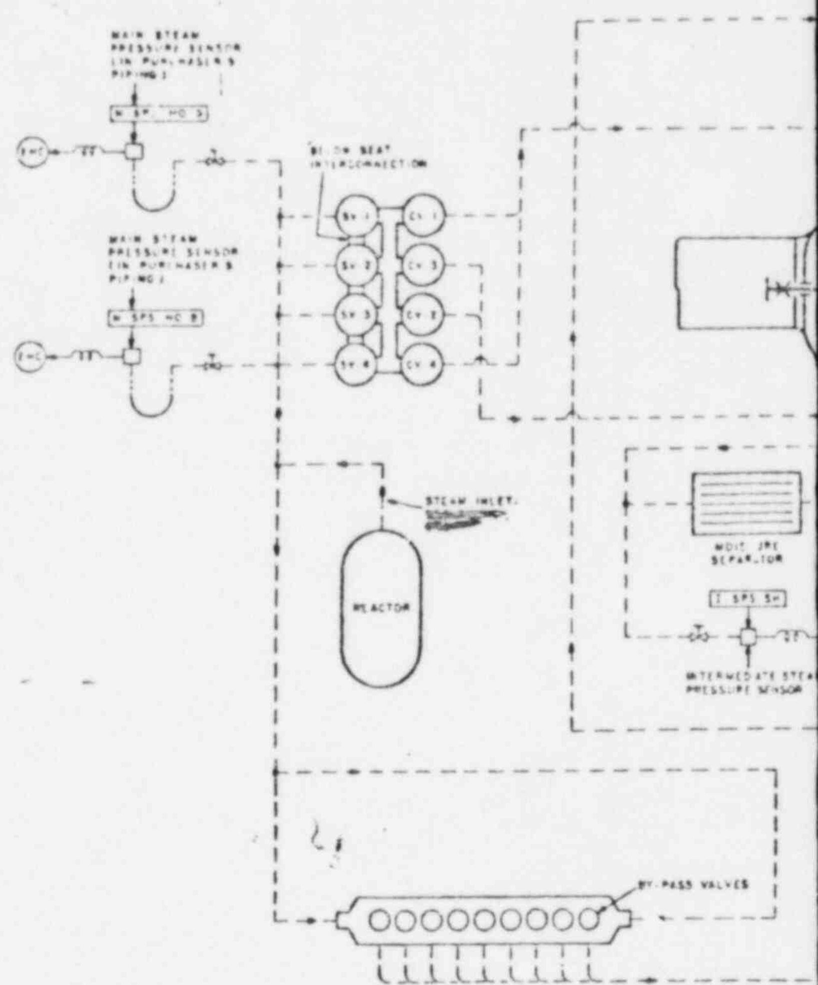
LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

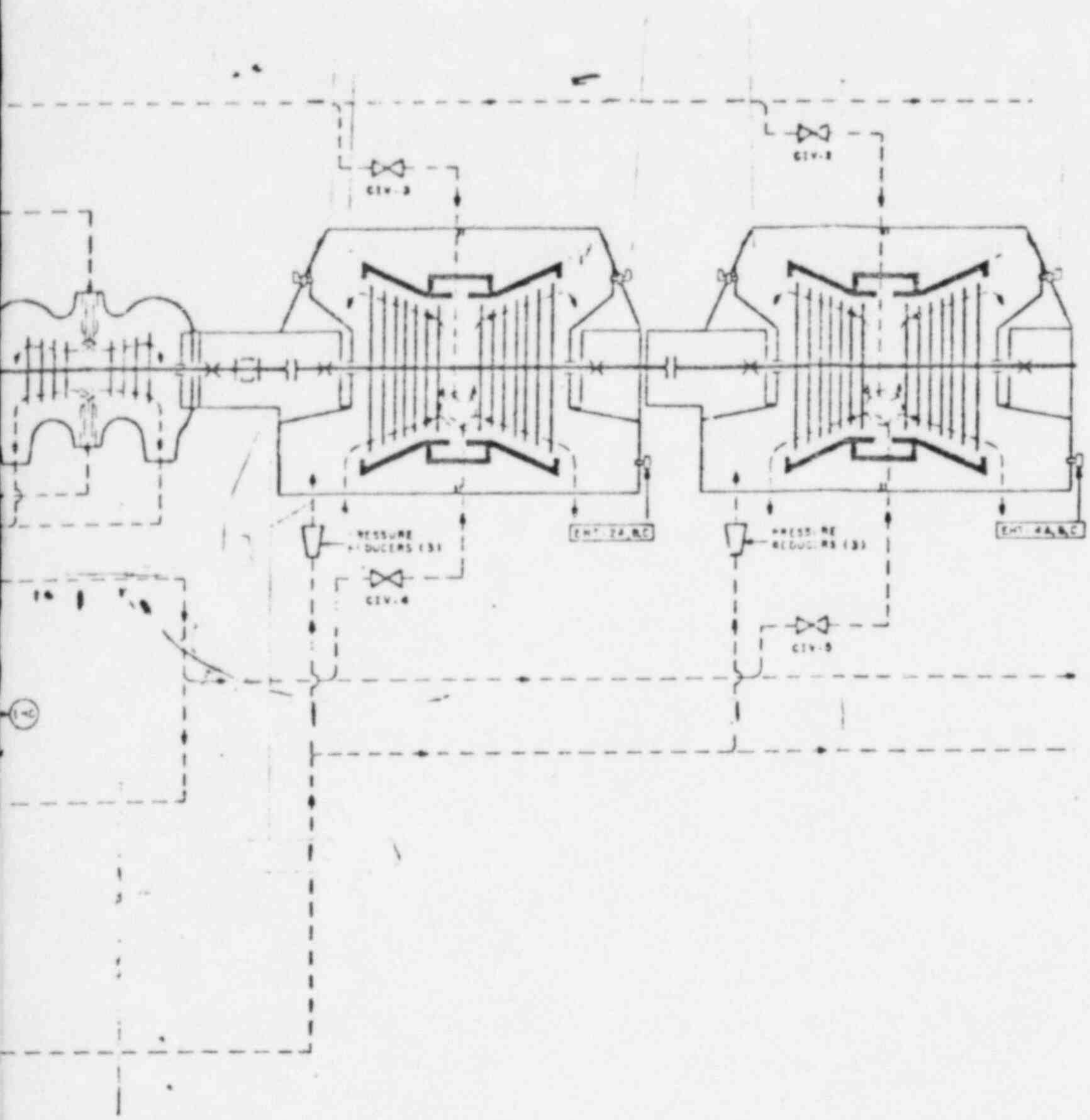
MECHANICAL OVERSPEED TRIP

FIGURE 10.2-3
SHEET 2 OF 6

REV. 13, 11/82




MAIN STEAM PRESSURE SENSOR (IN PURCHASER'S PIPING)
MAIN STEAM PRESSURE SENSOR (IN PURCHASER'S PIPING)
EHC
EHC
SV 1
SV 2
SV 3
SV 4
CV 1
CV 3
CV 2
CV 4
STEAM INLET
REACTOR
MOISTURE SEPARATOR
INTERMEDIATE STEAM PRESSURE SENSOR
BY-PASS VALVES



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LIMERICK GENERATING STATION
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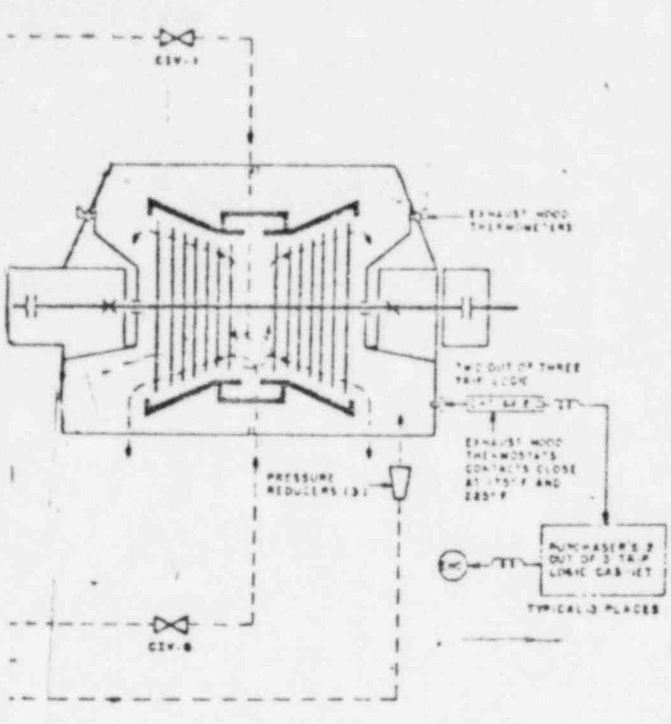
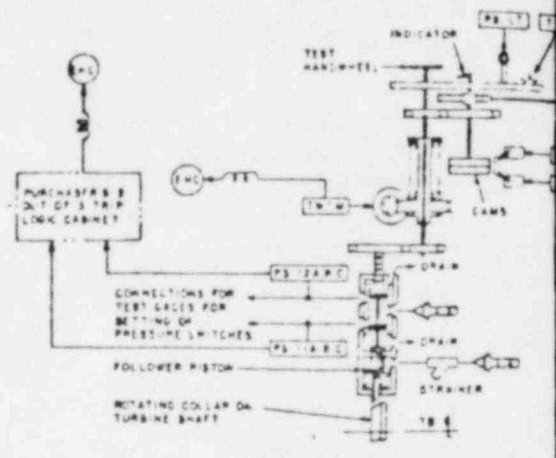
FINAL SAFETY ANALYSIS REPORT

MECHANICAL OVERSPEED TRIP

FIGURE 10.2-3
SHEET 3 OF 3

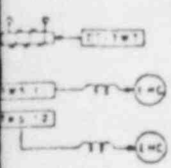
~~REV. 13, 11/82~~

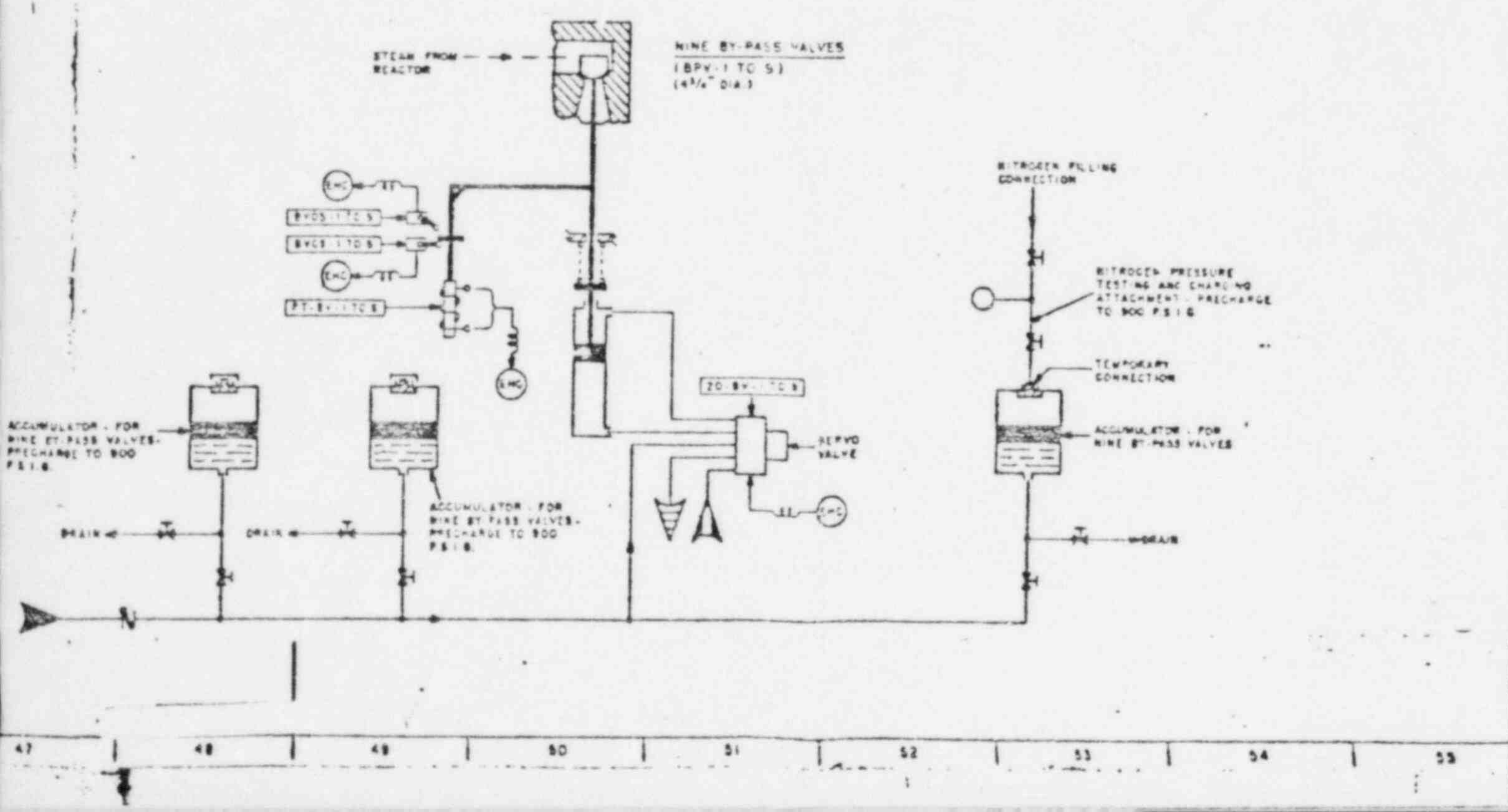




THRUST BEARING WEAR DETECTOR
AND LOW BEARING OIL PRESSURE TRIP
(IN MID-STANDARD)

40 41 42 43 44 45 46





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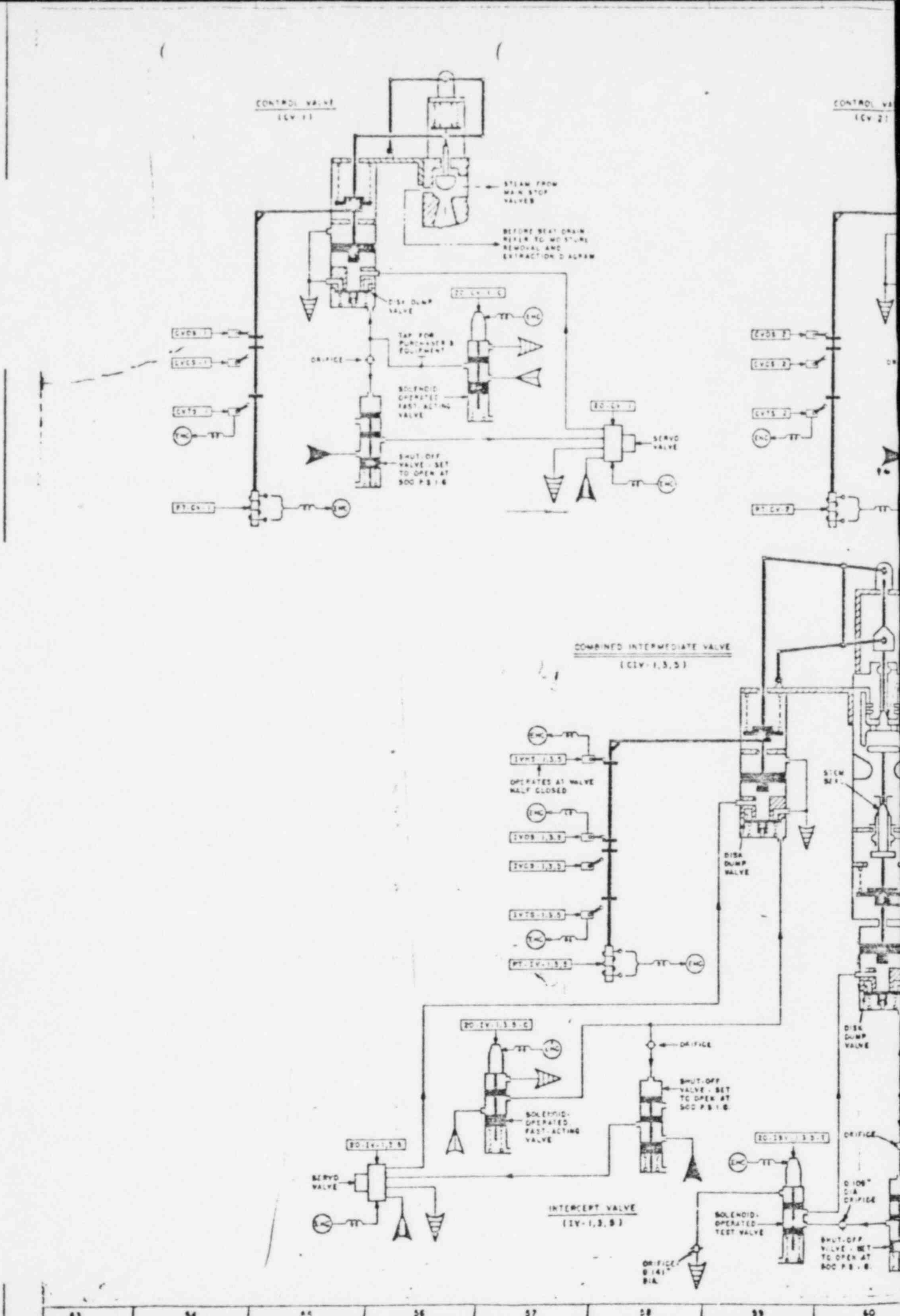
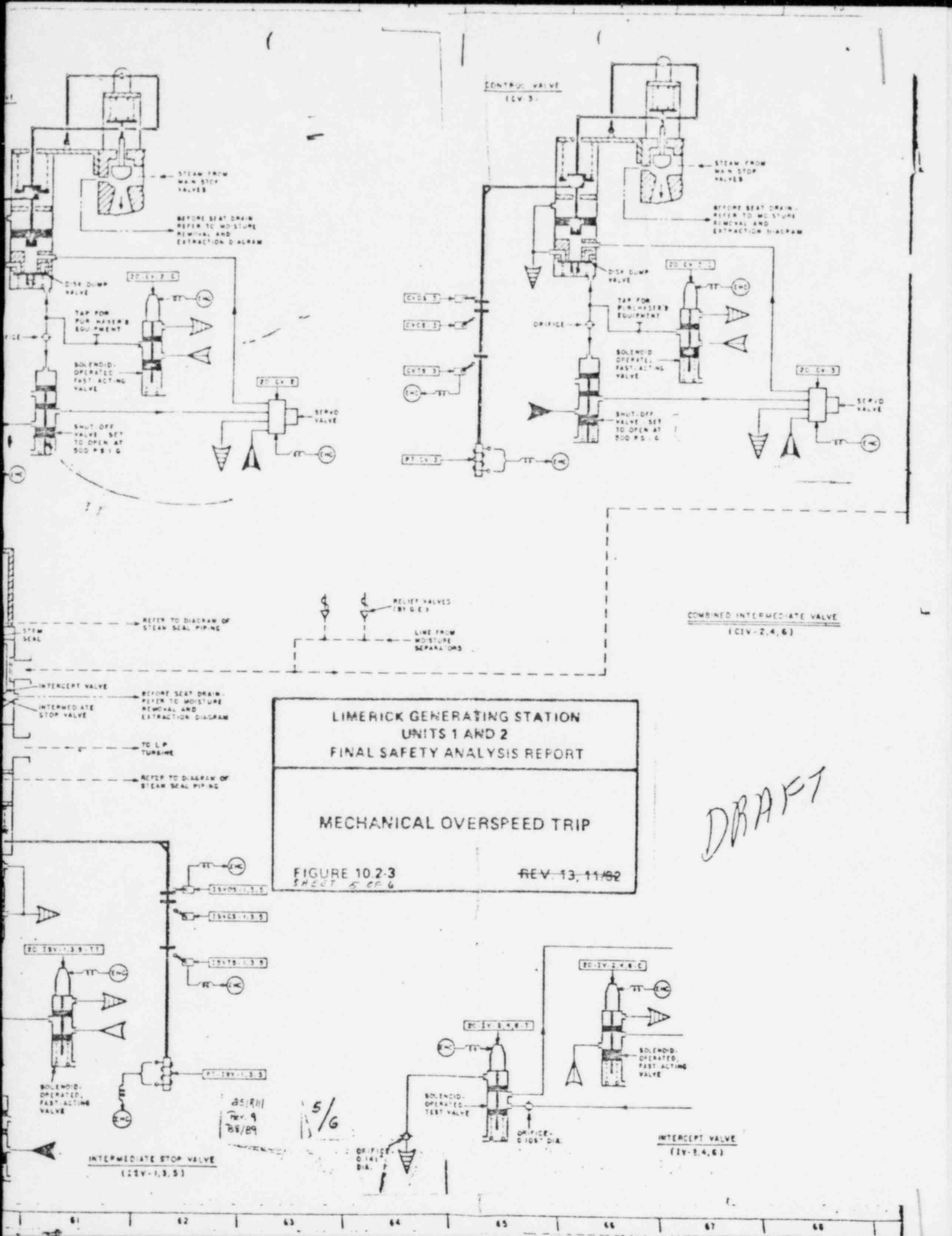
LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

MECHANICAL OVERSPEED TRIP

FIGURE 10.2-3
SHEET 4 OF 6

~~REV. 16, 11/82~~

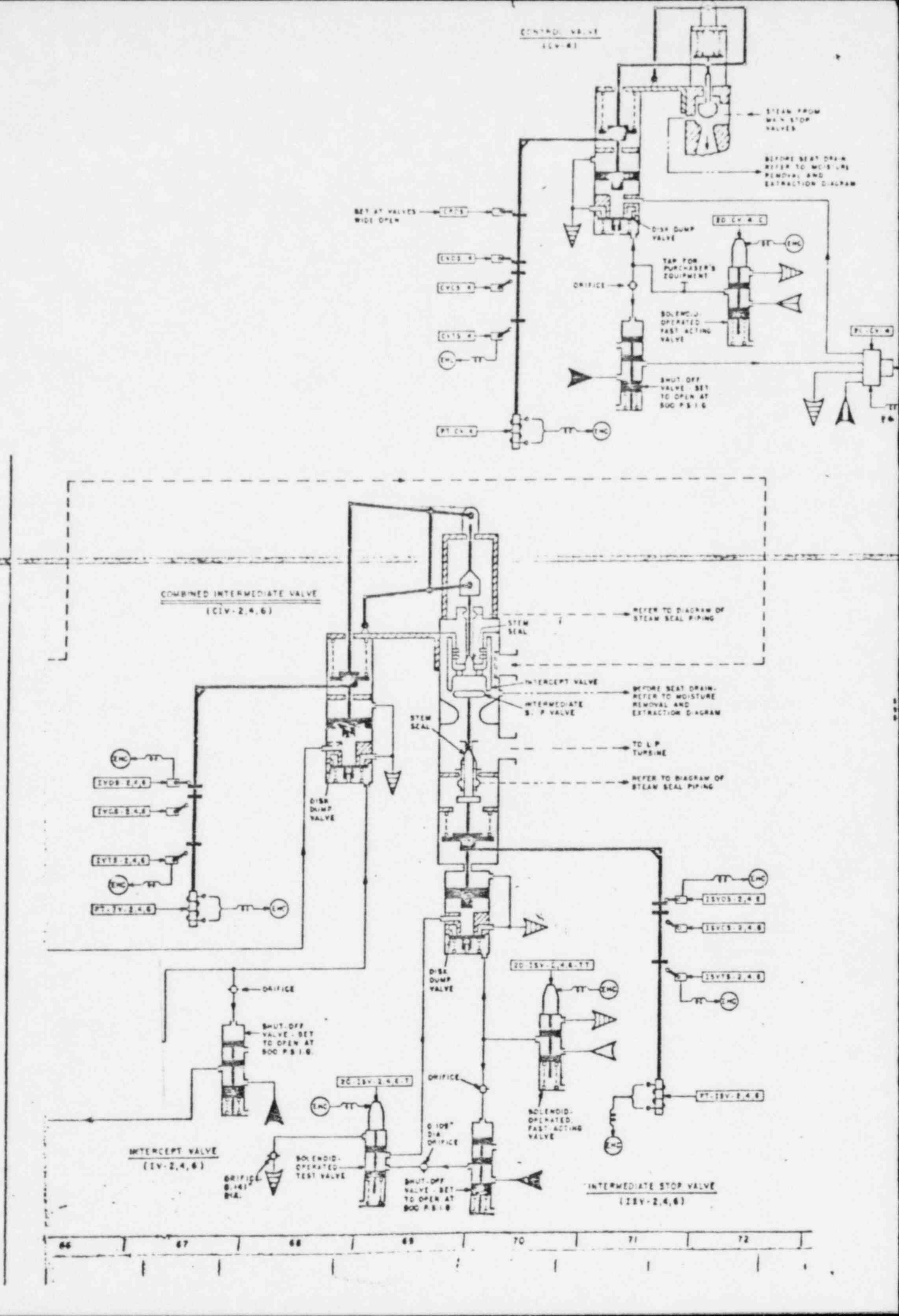

CONTROL VALVE
(CV-1)
STEAM FROM MAIN STOP VALVES
DISK DUMP VALVE
TAP FOR PURCHASER'S EQUIPMENT
ORIFICE
SOLENOID OPERATED FAST-ACTING VALVE
SHUT-OFF VALVE - SET TO OPEN AT 500 P.S.I.G.
SERVO VALVE
COMBINED INTERMEDIATE VALVE
(CIV-1,3,5)
OPERATES AT VALVE HALF CLOSED
DISK DUMP VALVE
SOLENOID-OPERATED FAST-ACTING VALVE
SHUT-OFF VALVE - SET TO OPEN AT 500 P.S.I.G.
SERVO VALVE
INTERCEPT VALVE
SOLENOID-OPERATED TEST VALVE
ORIFICE
DISK DUMP VALVE
53
54
55
56
57
58
59
60

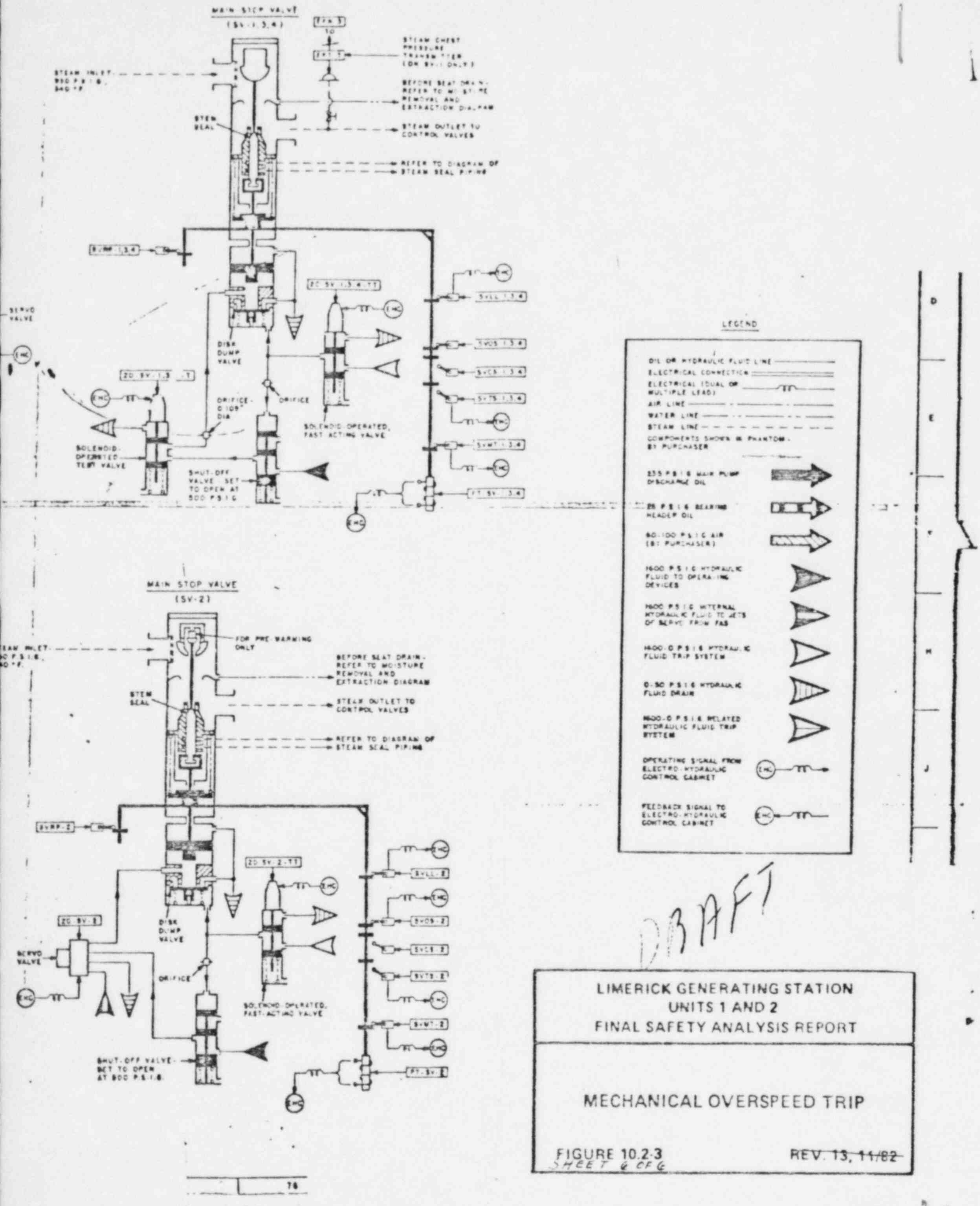


LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

MECHANICAL OVERSPEED TRIP

FIGURE 10.2-3
SHEET 5 OF 6
~~REV. 13, 11/92~~


CONTROL VALVE
STEAM FROM MAIN STOP VALVES
BEFORE SEAT DRAIN REFER TO MOISTURE REMOVAL AND EXTRACTION DIAGRAM
SET AT VALVES WIDE OPEN
DISK DUMP VALVE
TAP FOR PURCHASER'S EQUIPMENT
ORIFICE
SOLENOID OPERATED FAST ACTING VALVE
SHUT OFF VALVE - SET TO OPEN AT 500 P.S.I.G.
EHC
COMBINED INTERMEDIATE VALVE
(CIV-2,4,6)
REFER TO DIAGRAM OF STEAM SEAL PIPING
STEM SEAL
INTERCEPT VALVE
INTERMEDIATE STOP VALVE
BEFORE SEAT DRAIN. REFER TO MOISTURE REMOVAL AND EXTRACTION DIAGRAM
STEM SEAL
TO L.P. TURBINE
REFER TO DIAGRAM OF STEAM SEAL PIPING
IVOS-2,4,6
IVCS-2,4,6
IVTS-2,4,6
PT-IV-2,4,6
DISK DUMP VALVE
ISVOS-2,4,6
ISVCS-2,4,6
ISVTS-2,4,6
PT-ISV-2,4,6
20-ISV-2,4,6-TT
ORIFICE
SHUT-OFF VALVE - SET TO OPEN AT 500 P.S.I.G.
DISK DUMP VALVE
SOLENOID-OPERATED FAST ACTING VALVE
0.109" DIA. ORIFICE
20-ISV-2,4,6-T
SOLENOID-OPERATED TEST VALVE
ORIFICE 0.141" DIA.
SHUT-OFF VALVE - SET TO OPEN AT 500 P.S.I.G.
INTERCEPT VALVE
(IV-2,4,6)
INTERMEDIATE STOP VALVE
(ISV-2,4,6)
66
67
68
69
70
71
72

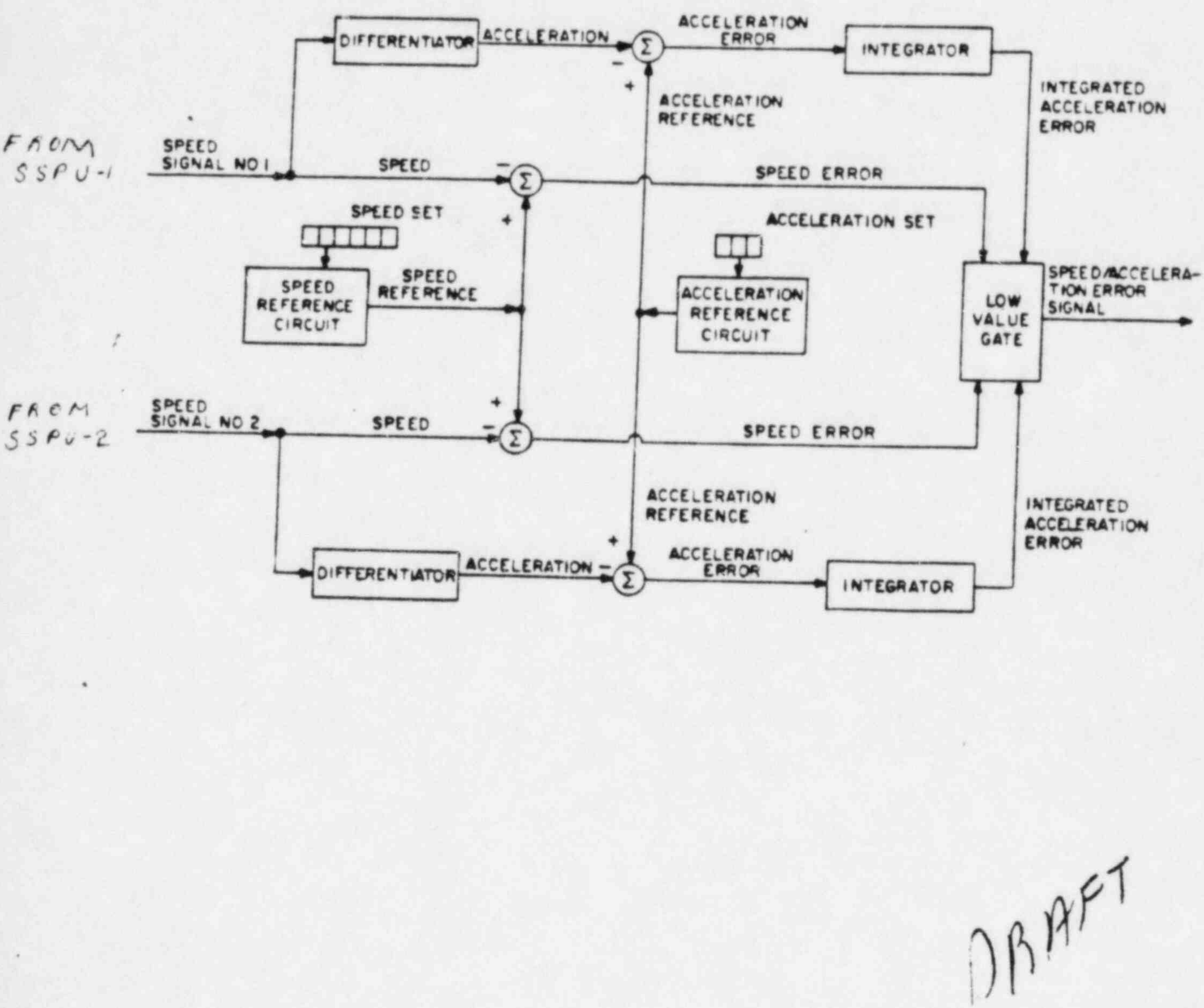


LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

MECHANICAL OVERSPEED TRIP

FIGURE 10.2-3
SHEET 6 OF 6

~~REV. 13, 11/82~~

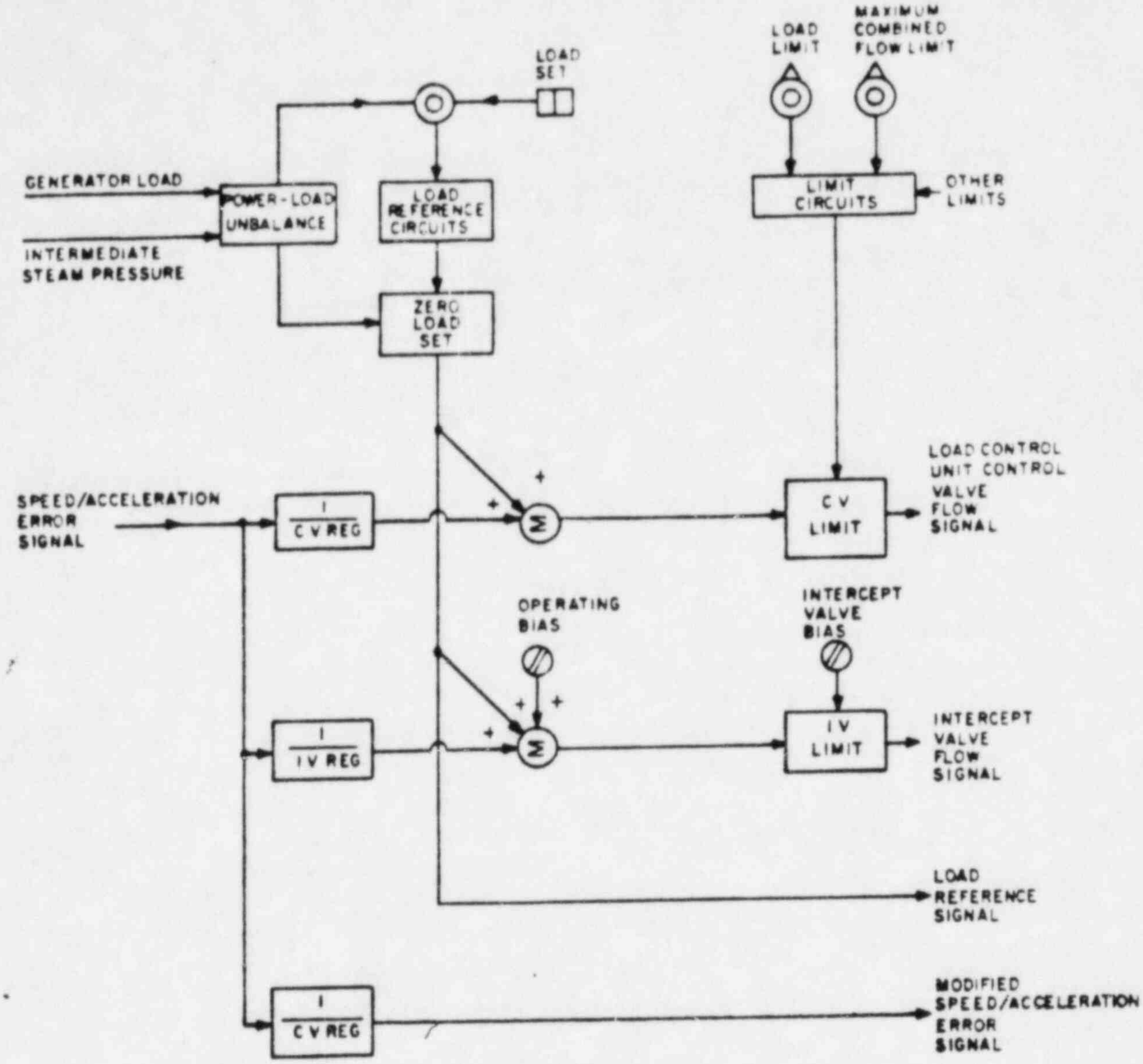


LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

SPEED CONTROL UNIT

FIGURE 10.2-7

~~REV. 13, 11/82~~



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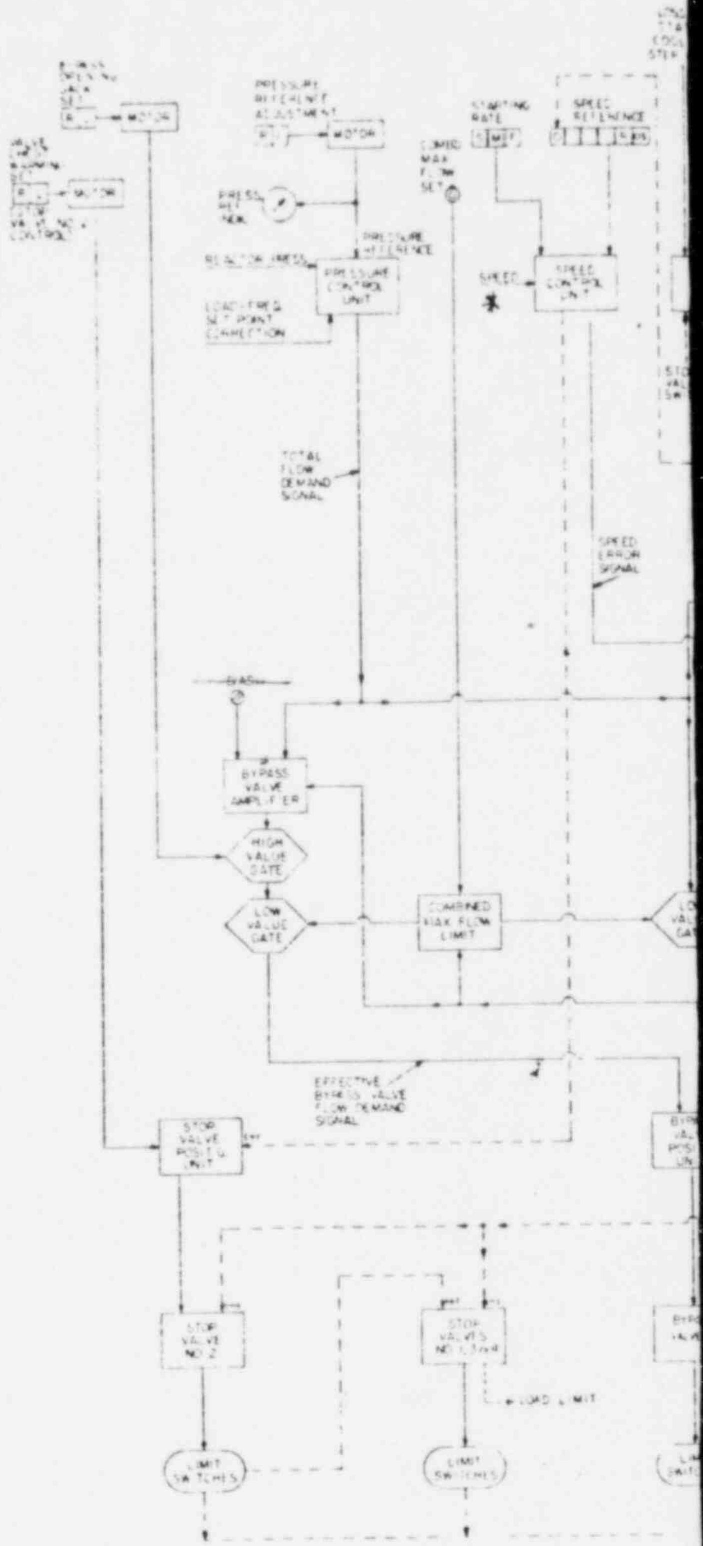
LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

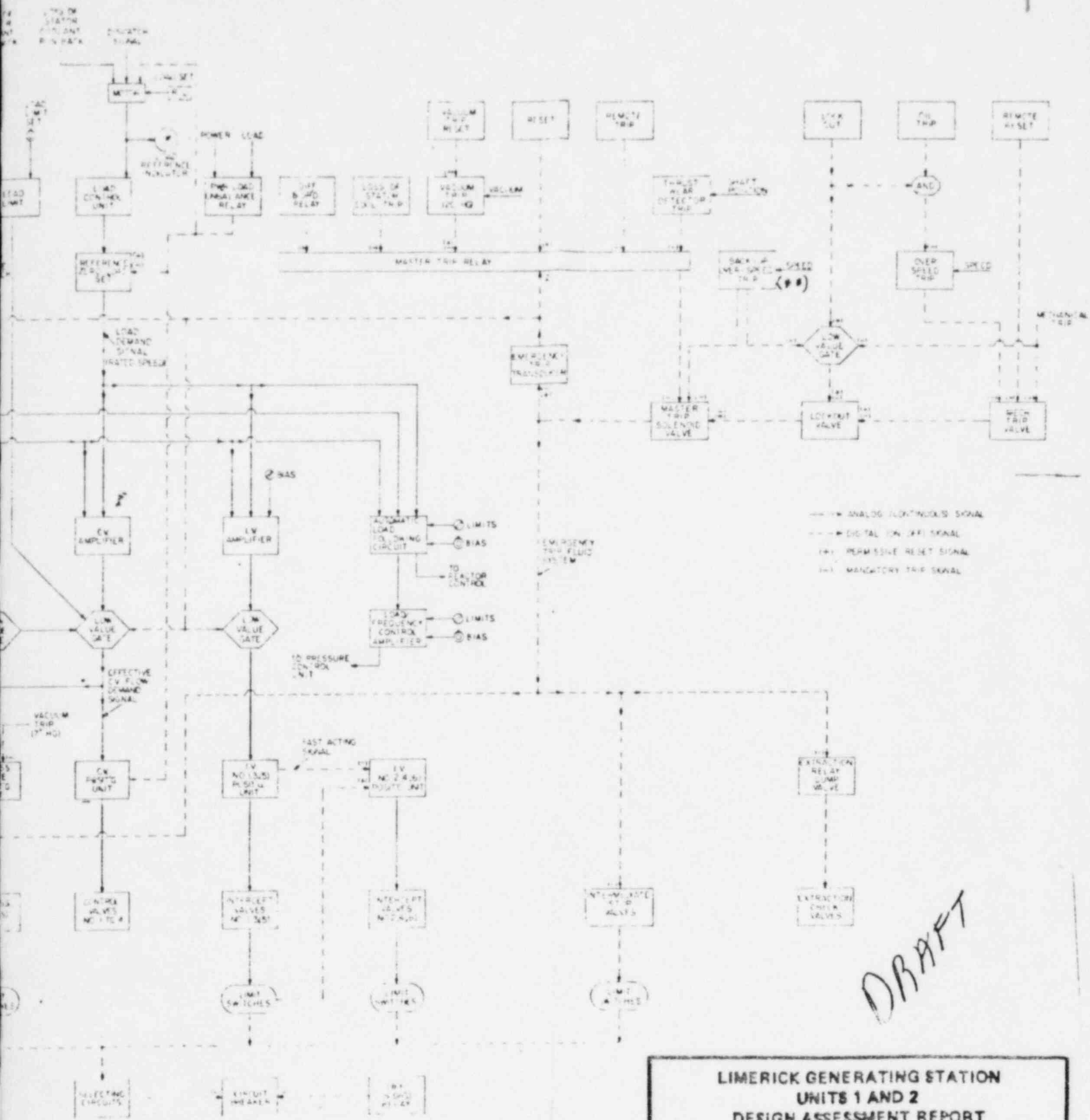
LOAD CONTROL UNIT

FIGURE 10.2-8 ~~REV. 10, 11/82~~



* SPEED CONTROL UNIT HAS TWO REDUNDANT CHANNELS. SPEED INPUT TO EACH IS FROM AN INDEPENDENT PICKUP ON THE 80 TOOTH WHEEL (SSPU-1 AND SSPU-2)

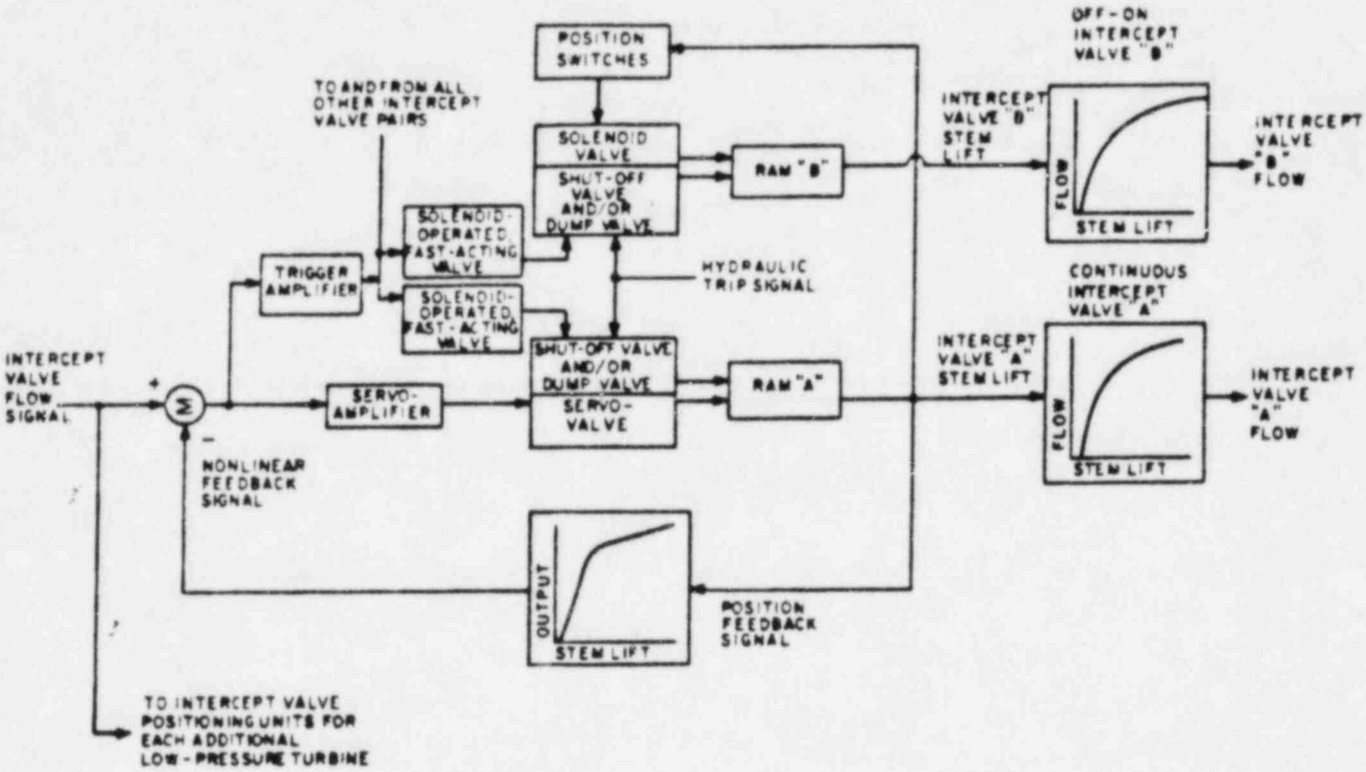
** SPEED INPUT TO THE ELECTRICAL OVERSPEED TRIP IS FROM AN INDEPENDENT PICKUP ON THE 80 TOOTH WHEEL (SSPU-3)



LIMERICK GENERATING STATION
UNITS 1 AND 2
DESIGN ASSESSMENT REPORT

BLOCK DIAGRAM FOR TURBINE CONTROL SYSTEM

FIGURE 10.2-9 ~~REV. 16, 01/83~~



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LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

INTERCEPT VALVE POSITIONING

FIGURE 10.2-10 ~~REV 16, 01/83~~

QUESTION 430.140 (Section 10.4.4)

DRAFT

In Section 10.4.4.4 you have discussed tests and initial field inspection but not the frequency and extent of inservice testing and inspection of the turbine bypass system. Provide this information in the FSAR.

RESPONSE

Section 10.4.4 has been changed to include the requested information.

The turbine bypass system will undergo periodic surveillance testing in accordance with the Limerick Technical Specifications written using Section 4.7.10 of NUREG - 0123 "Standard Technical Specifications for General Electric Boiling Water Reactors (BWR/4)" as a guide.