POINT BEACH NUCLEAR PLANT

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PBF-0090

Either a high generator level or a safety injection signal will close the feedwater bypass valves.

Manual control is provided for each feedwater controller. This unit consists 10 of an auto/manual transfer switch and an analog output control which serves as the valve position signal when in "Manual." The "Automatic" set point is a variable set-point programmed as a function of load but adjustable in the instrument rack.

Other manual control stations are used to position auxiliary feedwater valves.

Auxiliary Feedwater System

The Auxiliary Feedwater System supplies high pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the Reactor Coolant System by secondary side steam release in the event of inoperability of the main feedwater system. The head generated by the pumps is sufficient to deliver feedwater into the steam generators at safety valve pressure. Redundant supplies are provided by using two pumping systems, using different sources of power for the pumps.

The capacity of each system is set so that the steam generators will not boil dry nor will the primary side relieve fluid through the pressurizer relief valve, following a loss of main feedwater flow with a reactor trip.

One system utilizes a steam turbine-driven pump, with the steam capable of being supplied from either or both steam generators. This system supplies 400 gpm of feedwater or 200 gpm to each steam generator. The drive is a single stage turbine, capable of quick starts from cold standby and is directly connected to the pump. The turbine is started by opening either one or both of the isolation valves between the turbine supply steam header and the main steam lines. The turbine bearings are ring lubricated. The pump uses ring lubricated, water jacketed, ball bearings.

The other system is common to both units and utilizes two similar motor-driven pumps, each capable of obtaining its electrical power from the plant emergency diesel generators. This system has a total capacity of 400 gpm and feedwater can be supplied to either or both units.

The Auxiliary Feedwater System is Class I and is designed to ensure that a single fault will not obstruct the system function.

The water supply source for this system is redundant. The main source is by gravity feed from the condensate storage tanks while the backup supply is taken from the plant Service Water System whose pumps are supplied from the diesel generators if station power is lost.

The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Steam driven feedwater pump.

1) Low-low water level in both steam generators in one unit starts the corresponding pump.

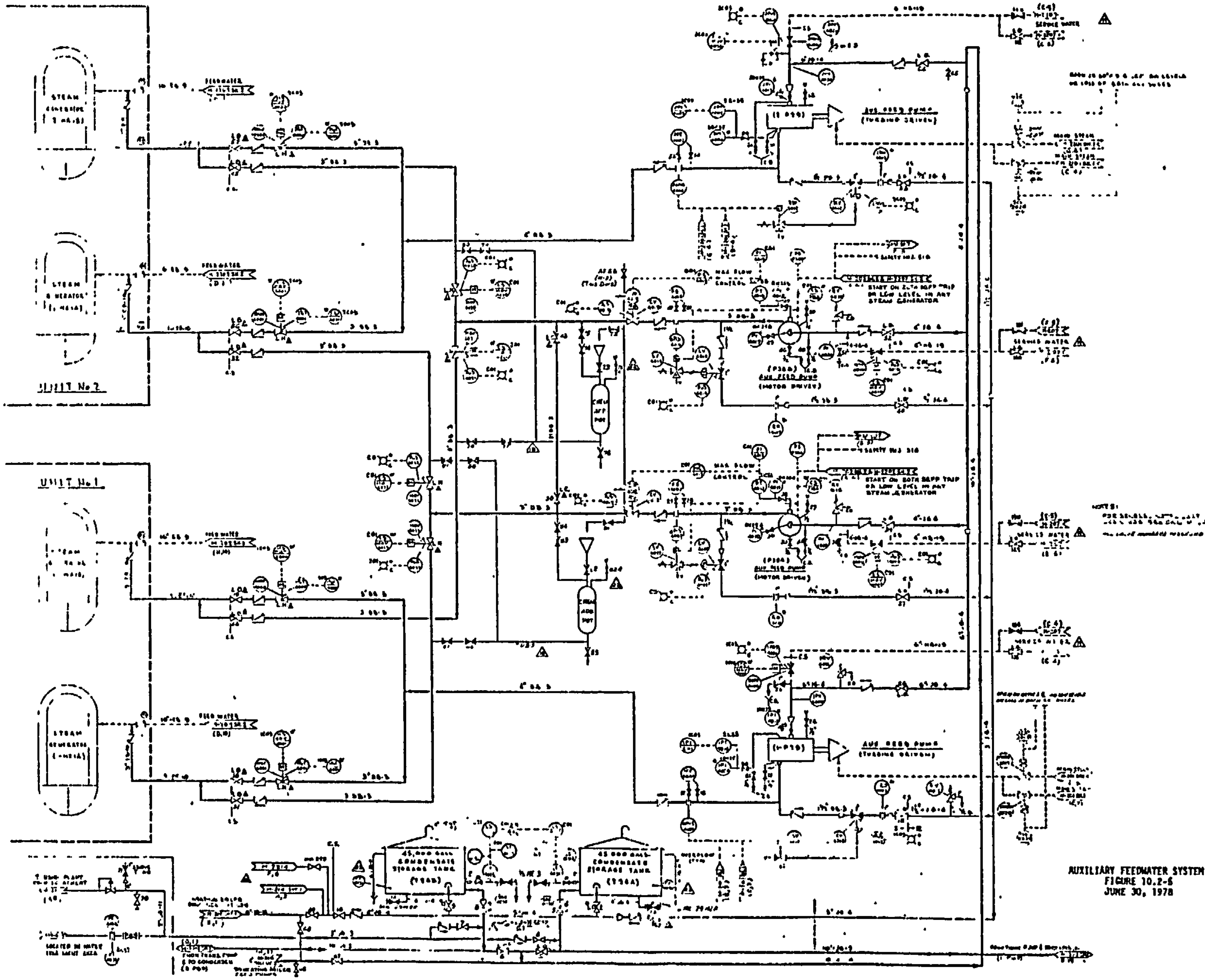
2) Loss of both 4 kv buses supplying the pump motors in one unit starts the corresponding pump.

Motor driven feedwater pumps.

1) Low-low water level in any steam generator.

2) Trip of both main feedwater pumps in one unit.

3) Safeguards Sequence Signal.



AUXILIARY FEEDWATER SYSTEM
FIGURE 10.2-6
JUNE 30, 1978

1982

Auxiliary Feedwater System

The auxiliary feedwater system supplies high-pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability of the main feedwater system. The head generated by the pumps is sufficient to deliver feedwater into the steam generators at safety valve pressure. Redundant supplies are provided by using two pumping systems, using different sources of power for the pumps.

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The auxiliary feedwater system is Class I and is designed to ensure that a single fault will not obstruct the system function.

The water supply source for this system is redundant. The main source is by gravity feed from the condensate storage tanks while the backup supply is taken from the plant service water system whose pumps are powered from the diesel generators if station power is lost.

The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Steam-driven feedwater pump

1. Low-low water level in both steam generators in one unit starts the corresponding pump.

2. Loss of both 4 kv buses supplying the pump motors in one unit starts the corresponding pump.

Motor-driven feedwater pumps

1. Low-low water level in any steam generator.

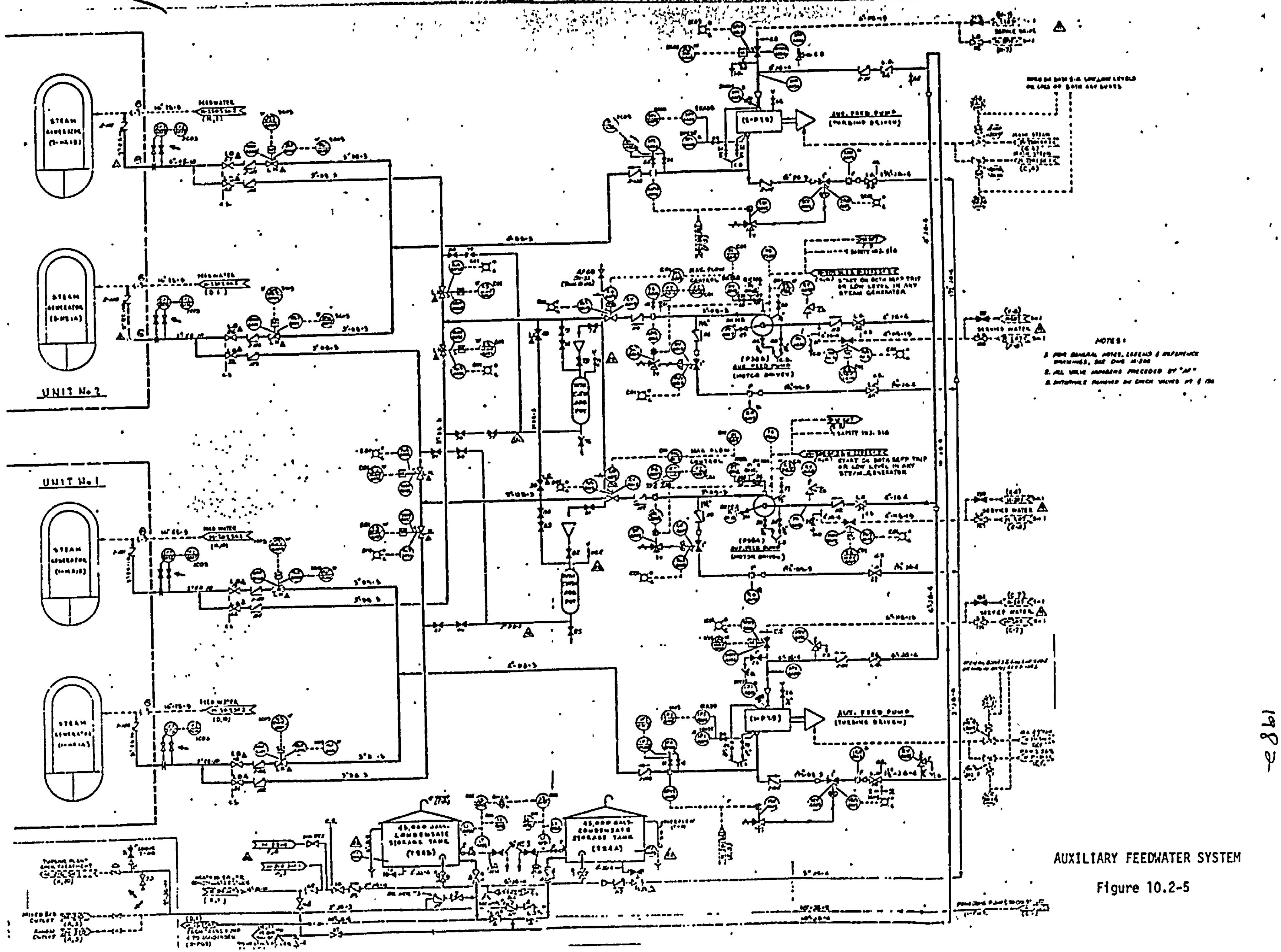
2. Trip of both main feedwater pumps in one unit.

3. Safeguards sequence signal.

Auxiliary feedwater pump flow and direct flow indication for each steam generator is provided in the control room. Flow indication is also available locally at the discharge of each pump.

Circulating Water System

The circulating water intake system, common to both units, is designed to provide a reliable supply of Lake Michigan water, regardless of weather of lake conditions, to the suction of four circulating water pumps, six service water pumps and two fire water pumps. The pumphouse is Class I. The intake structure is located 1750 ft. from the shore in a water depth of 22 ft. The structure consists of two annular rings of 12 in. structural steel H pile driven to a minimum depth of 23 ft. below lake bed and reinforced with walers fabricated from 12 in. structural steel H pile. The annulus is filled with individually placed limestone blocks having two approximately parallel surfaces and weighing between 3 and 12 tons. Concrete pipes in the lower walls of the intake crib prevent ice block-



AUXILIARY FEEDWATER SYSTEM

Figure 10.2-5

1982

The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Steam-driven feedwater pump

1. Low-low water level in both steam generators in one unit starts the corresponding pump.

2. Loss of both 4 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.

Motor-driven feedwater pumps

1. Low-low water level in any steam generator starts its corresponding motor-driven pump.

2. Trip or shutdown of both main feedwater pumps in one unit.

3. Safeguards sequence signal.

Auxiliary feedwater pump flow and direct flow indication for each steam generator is provided in the control room. Flow indication is also available locally at the discharge of each pump.

Circulating Water System

The circulating water intake system, common to both units, is designed to provide a reliable supply of Lake Michigan water, regardless of weather or lake conditions, to the suction of four circulating water pumps, six service water pumps and two fire water pumps. The pumphouse is Class I. The intake structure is located 1750 ft. from the shore in a water depth of 22 ft. The structure consists of two annular rings of 12 in. structural steel H pile driven to a minimum depth of 23 ft. below lake bed and reinforced with walers fabricated from 12 in. structural steel H pile. The annulus is filled with individually placed limestone blocks having two approximately parallel surfaces and weighing between 3 and 12 tons. Large concrete pipes in the lower walls of the south half of the intake

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2. Loss of both 4 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.

Motor-driven feedwater pumps

1. Low-low water level in any steam generator.

2. Trip or shutdown of both main feedwater pumps in one unit.

3. Safeguards sequence signal.

The motor-driven auxiliary feedwater pump discharge motor operated valves (MOV) are configured to operate automatically, based upon the same signals that start the motor-driven pumps. This ensures automatic delivery of auxiliary feedwater flow to an affected unit's steam generators without operator action.

Auxiliary feedwater pump flow and direct flow indication for each steam generator is provided in the control room. Flow indication is also available locally at the discharge of each pump.

Circulating Water System

The circulating water intake system, common to both units, is designed to provide a reliable supply of Lake Michigan water, regardless of weather or lake conditions, to the suction of four circulating water pumps, six service water pumps and two fire water pumps. The pumphouse is Class I. The intake structure is located 1750 ft. from the shore in a water depth of 22 ft. The structure consists of two annular rings of 12 in. structural steel H pile driven to a minimum depth of 23 ft. below lake bed and reinforced with walers fabricated from 12 in. structural steel H pile.

In anticipation of a loss of the condensate storage tank water supply, each auxiliary feedwater pump is configured to automatically trip on a low suction pressure to prevent possible pump damage. A manual override capability exists so that the motor driven pump breakers can be reshut and/or the turbine driven pump steam supply motor operated valves can be reopened which will restart the pumps so that any remaining water from the condensate storage tanks or the backup service water supply can be used.

The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Steam-driven feedwater pump

1. Low-low water level in both steam generators in one unit starts the corresponding pump.

2. Loss of both 4 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.

Motor-driven feedwater pumps

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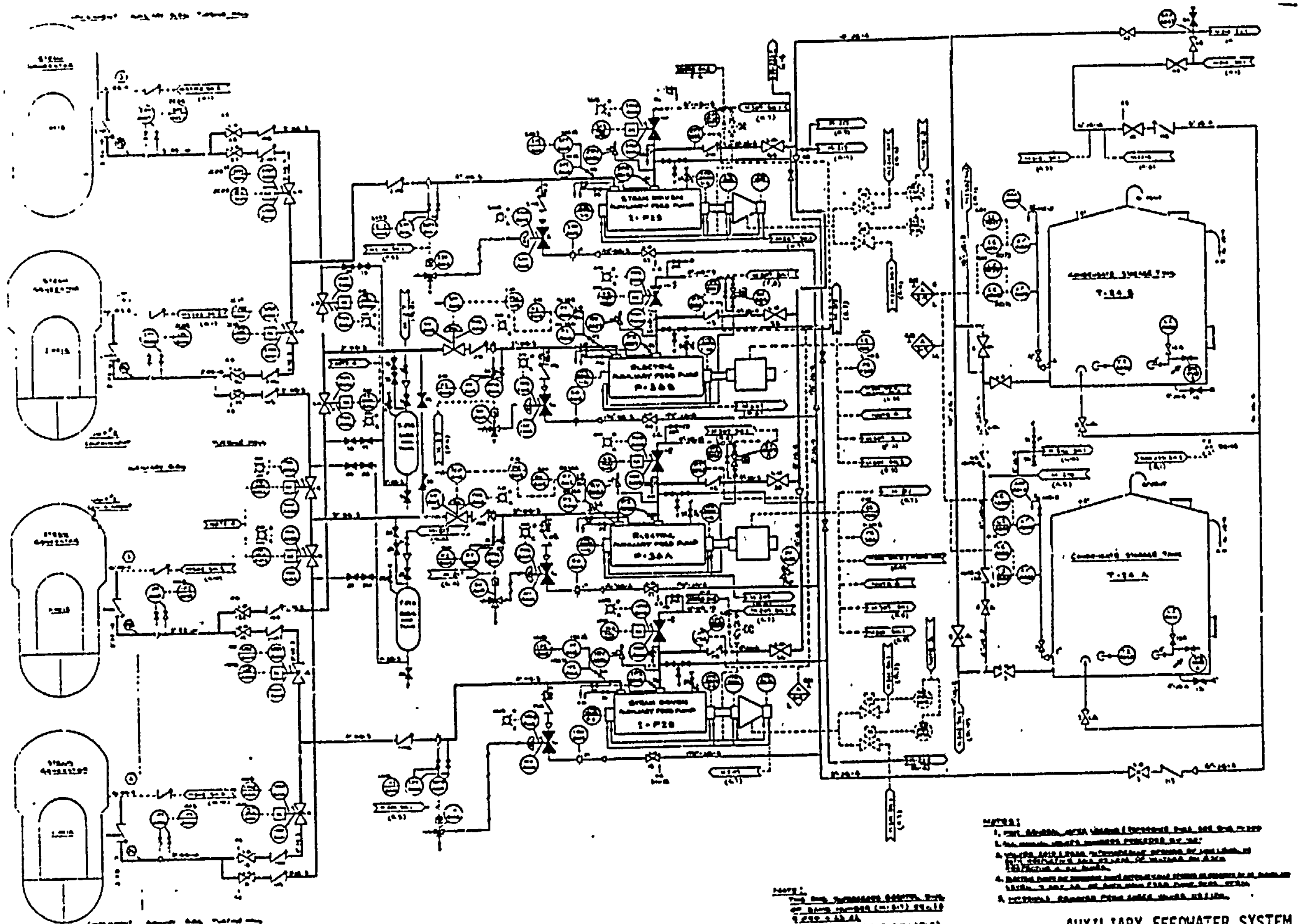
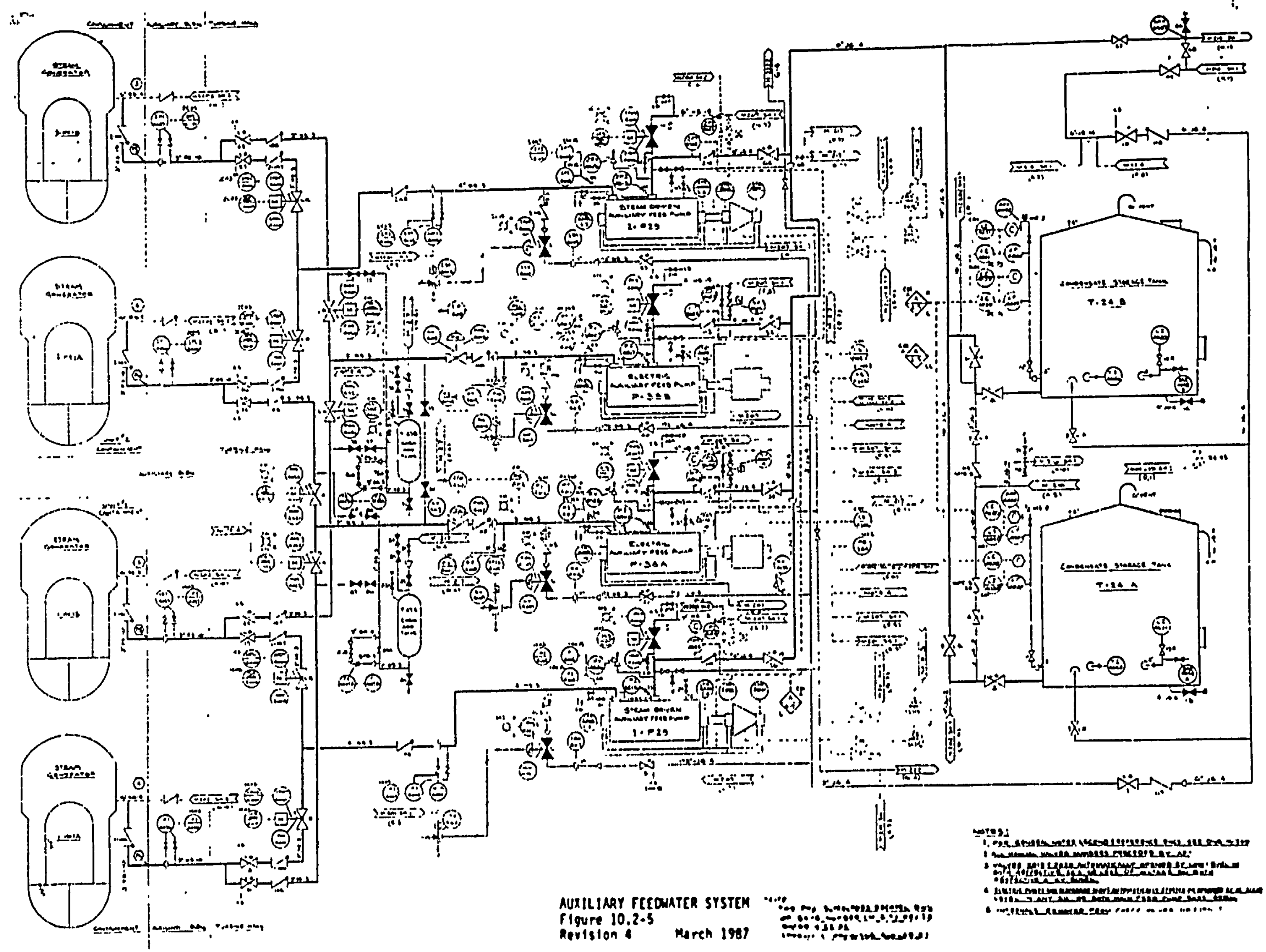
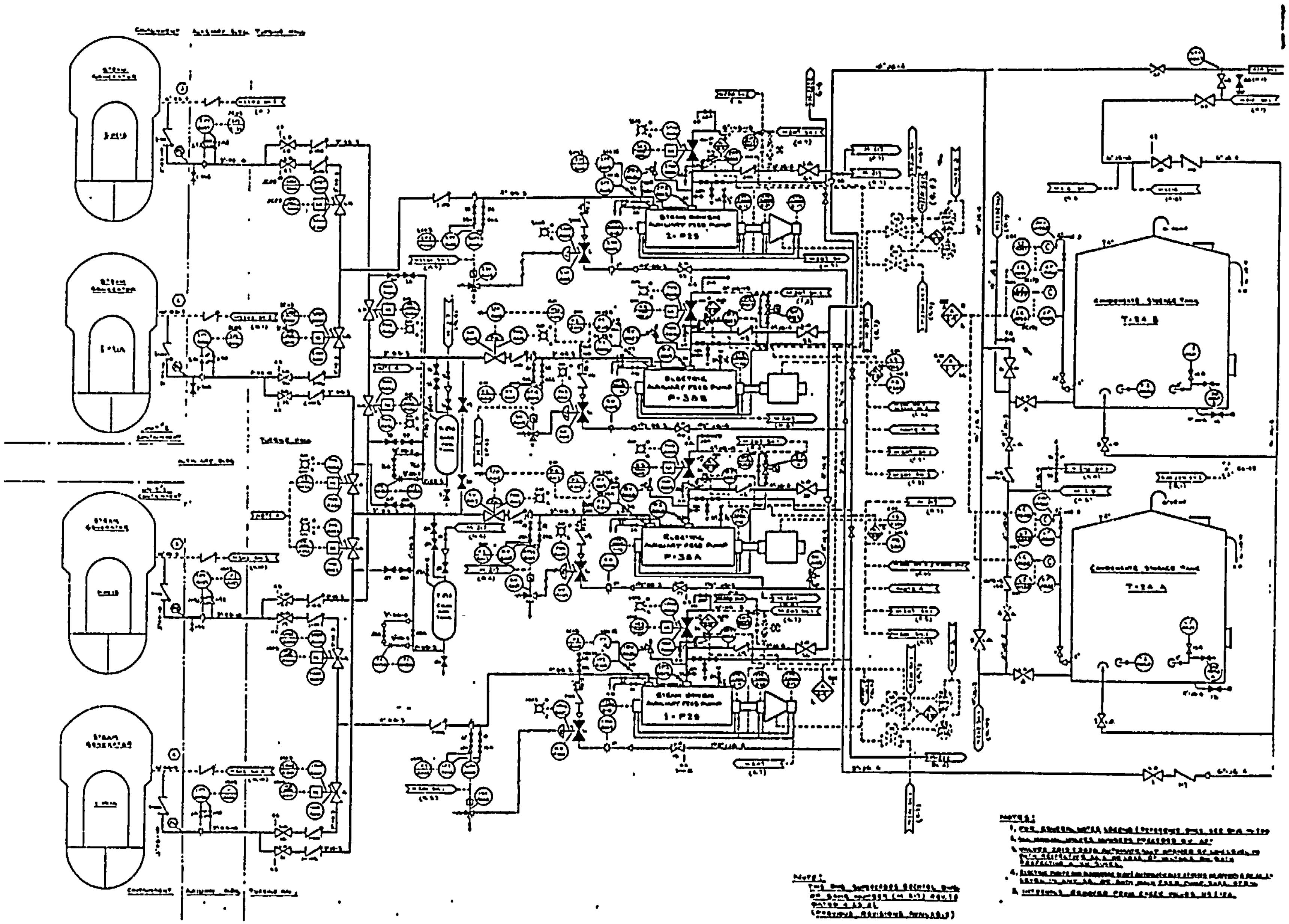


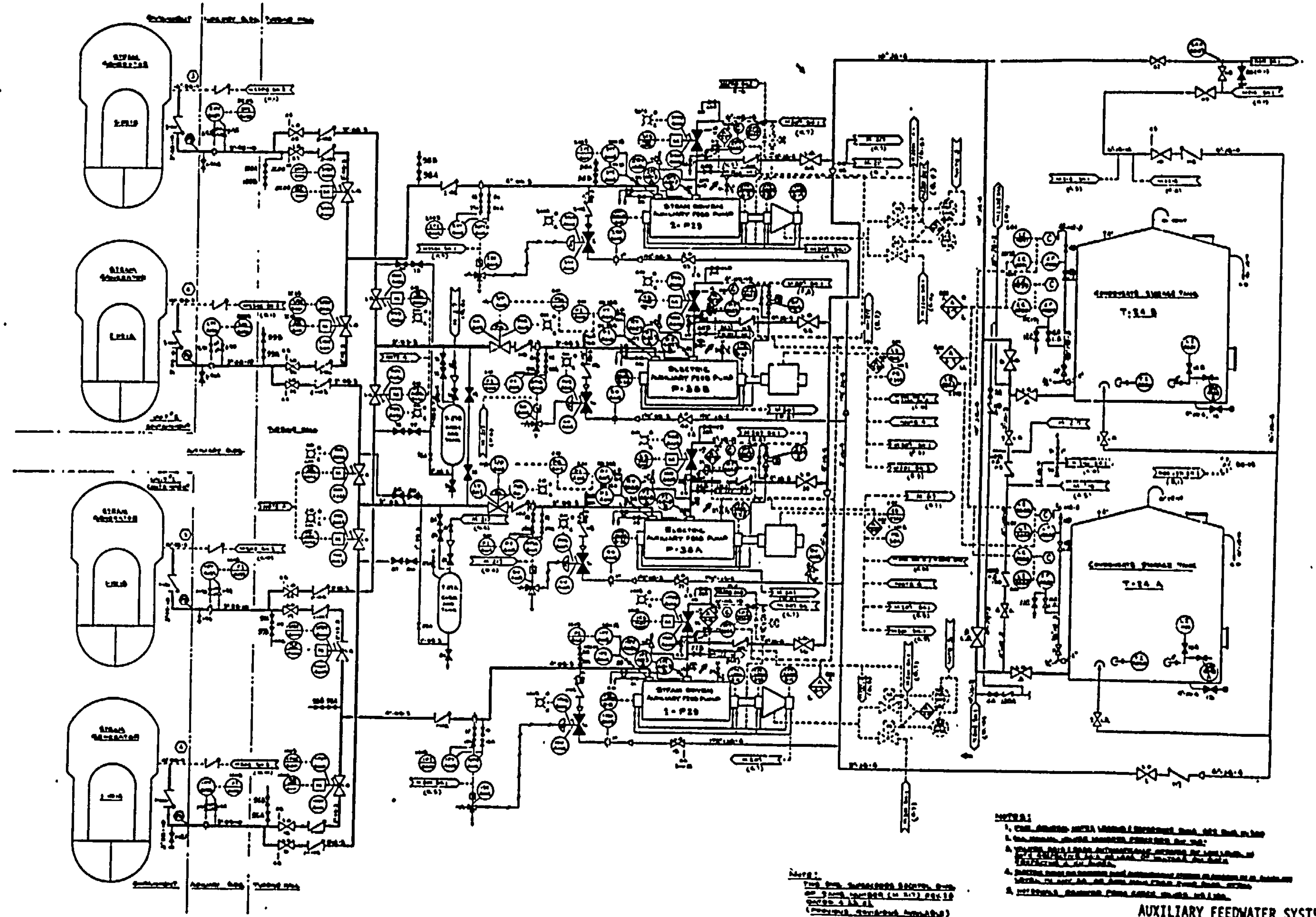
AUXILIARY FEEDWATER SYSTEM
Figure 10.2-5
Revision 3 June 1986



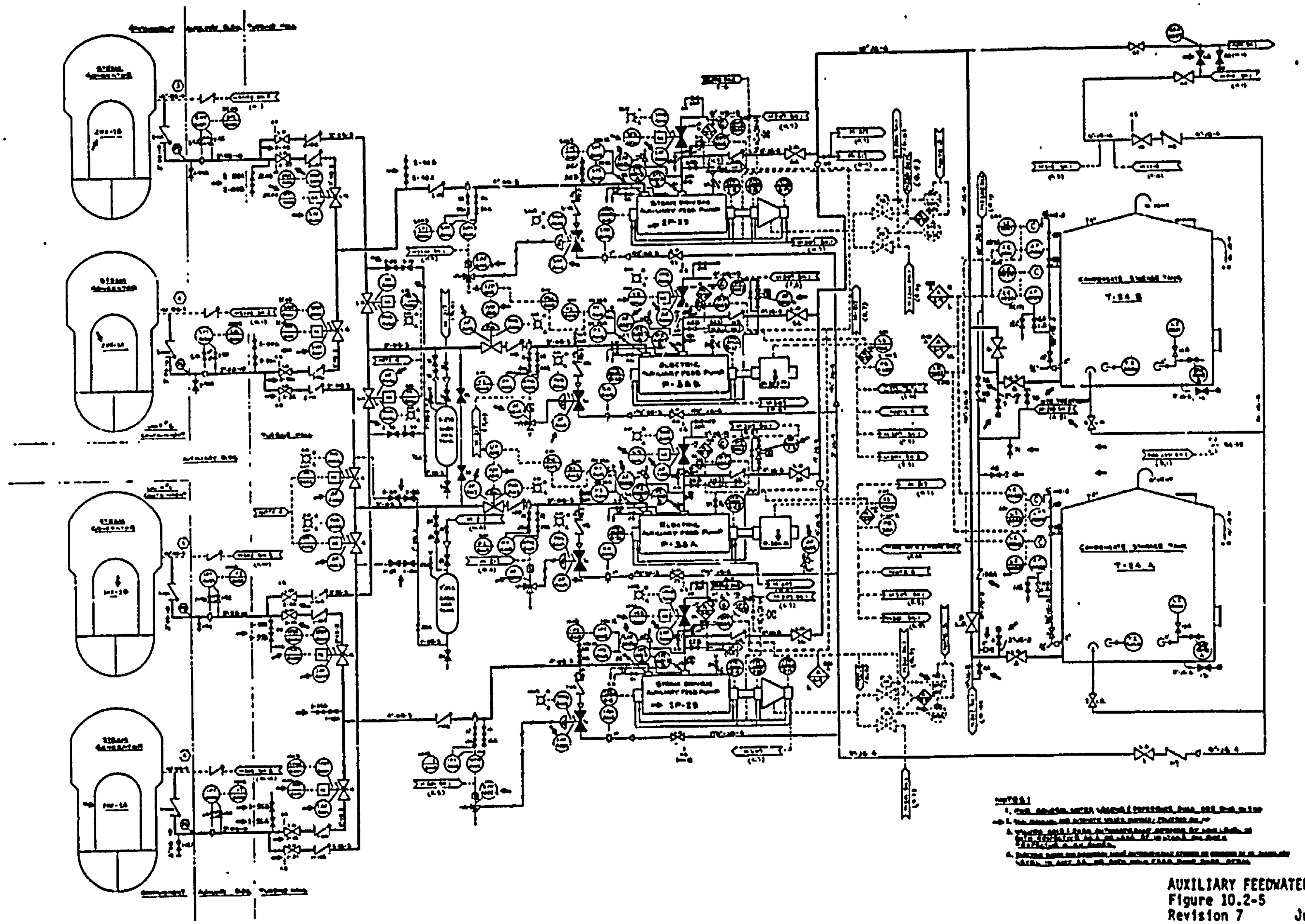
AUXILIARY FEEDWATER SYSTEM
Figure 10.2-5
Revision 4 March 1987



AUXILIARY FEEDWATER SYSTEM
Figure 10.2-5
Revision 5 1988



AUXILIARY FEEDWATER SYSTEM
Figure 10.2-5
Revision 6 1989



AUXILIARY FEEDWATER SYSTEM
Figure 10.2-5
Revision 7 June 1990

Either a high generator level or a safety injection signal will close the feedwater bypass valves.

Manual control is provided for each feedwater controller. This unit consists of an auto/manual transfer switch and an analog output control which serves as the valves position signal when in "Manual." The "Automatic" setpoint is a variable setpoint programmed as a function of load but adjustable in the instrument rack.

Other manual control stations are used to position auxiliary feedwater valves.

Auxiliary Feedwater System

The auxiliary feedwater system supplies high-pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability of the main feedwater system. The head generated by the pumps is sufficient to deliver feedwater into the steam generators at safety valve pressure. Redundant supplies are provided by using two pumping systems, using different sources of power for the pumps.

The capacity of each system is set so that the steam generators will not boil dry nor will the primary side relieve fluid through the pressurizer relief valve, following a loss of main feedwater flow with a reactor trip.

One system utilizes a steam turbine-driven pump, with the steam capable of being supplied from either or both steam generators. This system supplies 400 gpm of feedwater or 200 gpm to each steam generator. The drive is a single-stage turbine, capable of quick starts from cold standby and is directly connected to the pump. The turbine is started by opening either one or both of the isolation valves between the turbine supply steam header and the main steam lines. The turbine bearings are ring lubricated. The pump uses ring lubricated, water jacketed ball bearings.

The other system is common to both units and utilizes two similar motor-driven pumps, each capable of obtaining its electrical power from the plant emergency diesel generators. This sytem has a total capacity of 400 gpm and feedwater can be supplied to either or both units.

The auxiliary feedwater system is Class I and is designed to ensure that a single fault will not obstruct the system function.

The water supply source for this system is redundant. The main source is by gravity feed from the condensate storage tanks while the backup supply is taken from the plant service water system whose pumps are powered from the diesel generators if station power is lost.

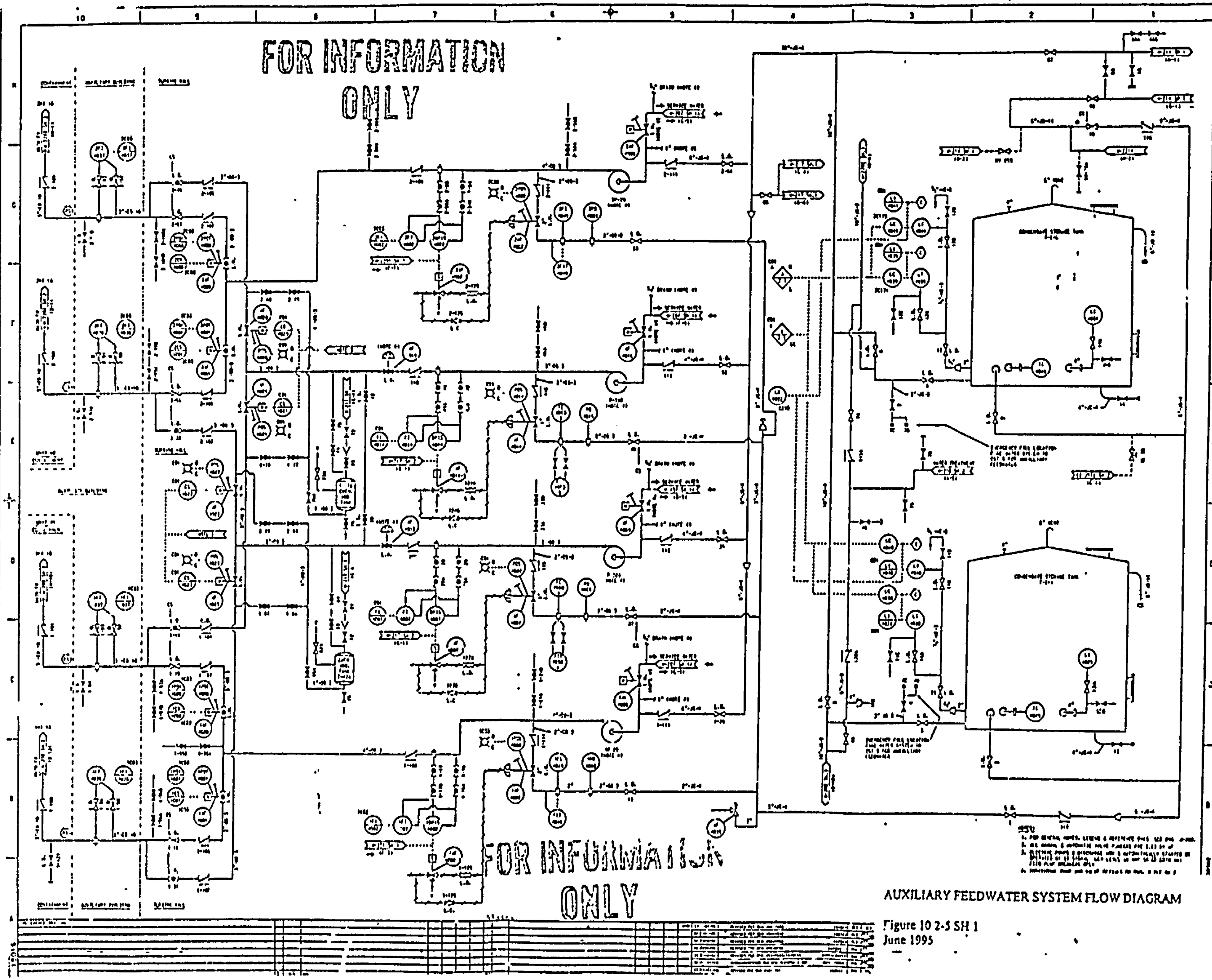
In anticipation of a loss of the condensate storage tank water supply, each auxiliary feedwater pump is configured to automatically trip on a low suction pressure to prevent possible pump damage. A manual override capability exists so that the motor driven pump breakers can be reshut and/or the turbine driven pump steam supply motor operated valves can be reopened which will restart the pumps so that any remaining water from the condensate storage tanks or the backup service water supply can be used.

The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Steam-driven feedwater pump

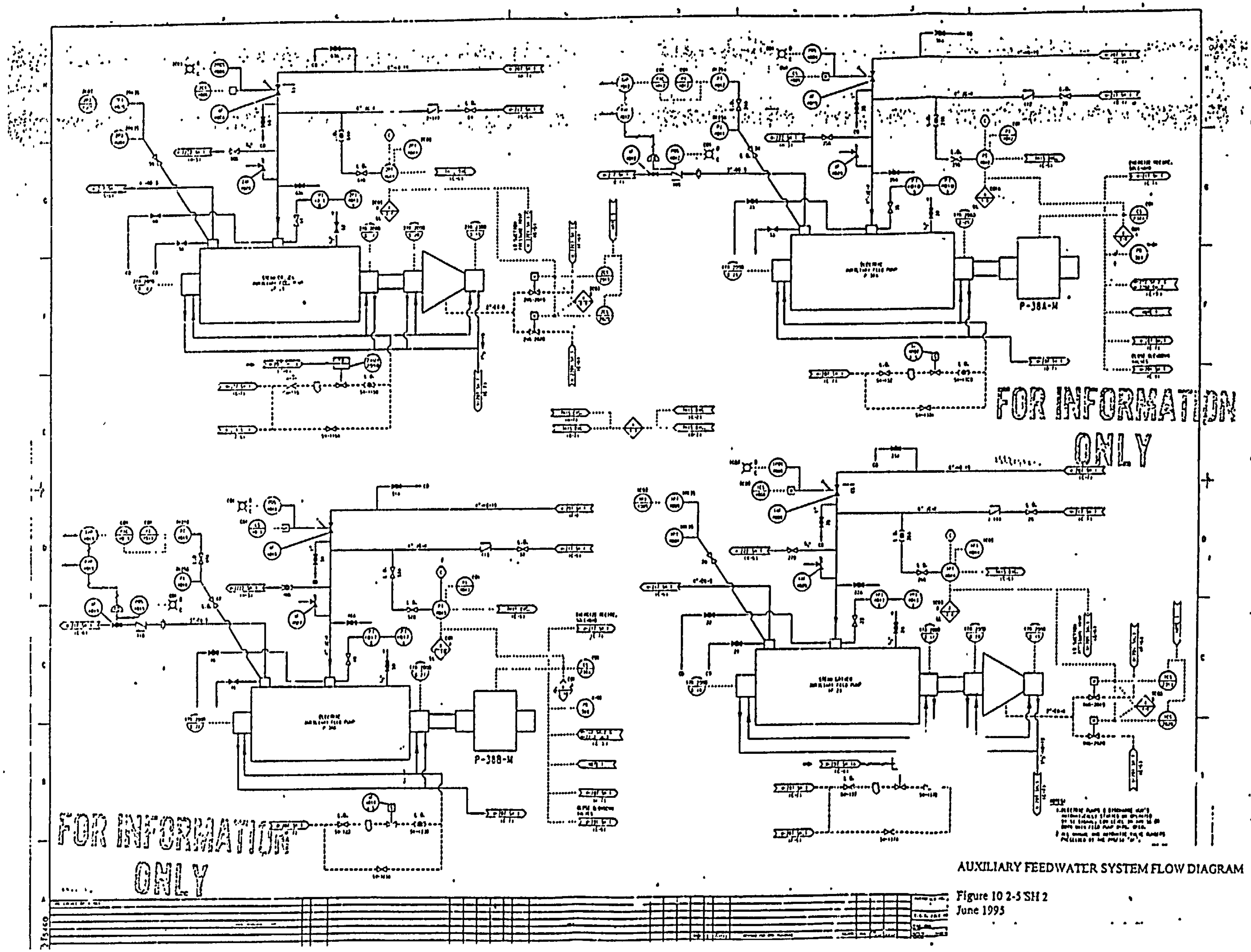
1. Low-low water level in both steam generators in one unit starts the corresponding pump.

2. Loss of both 4 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.



AUXILIARY FEEDWATER SYSTEM FLOW DIAGRAM

Figure 10 2-5 SH 1
June 1995



AUXILIARY FEEDWATER SYSTEM FLOW DIAGRAM

Figure 10.2-5 SH 2
June 1995

FOR INFORMATION

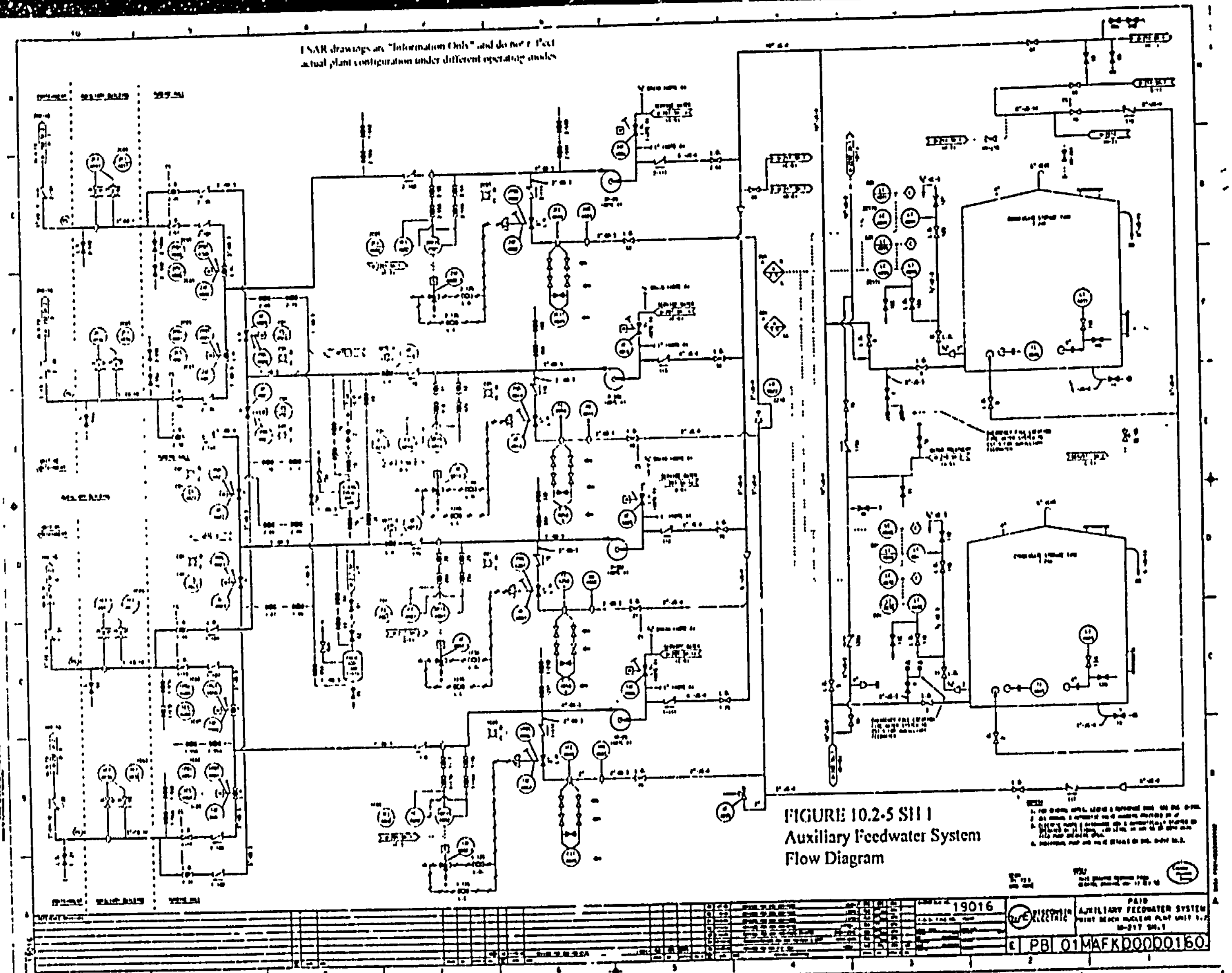


FIGURE 10.2-5 SH 1
Auxiliary Feedwater System
Flow Diagram

June 1997

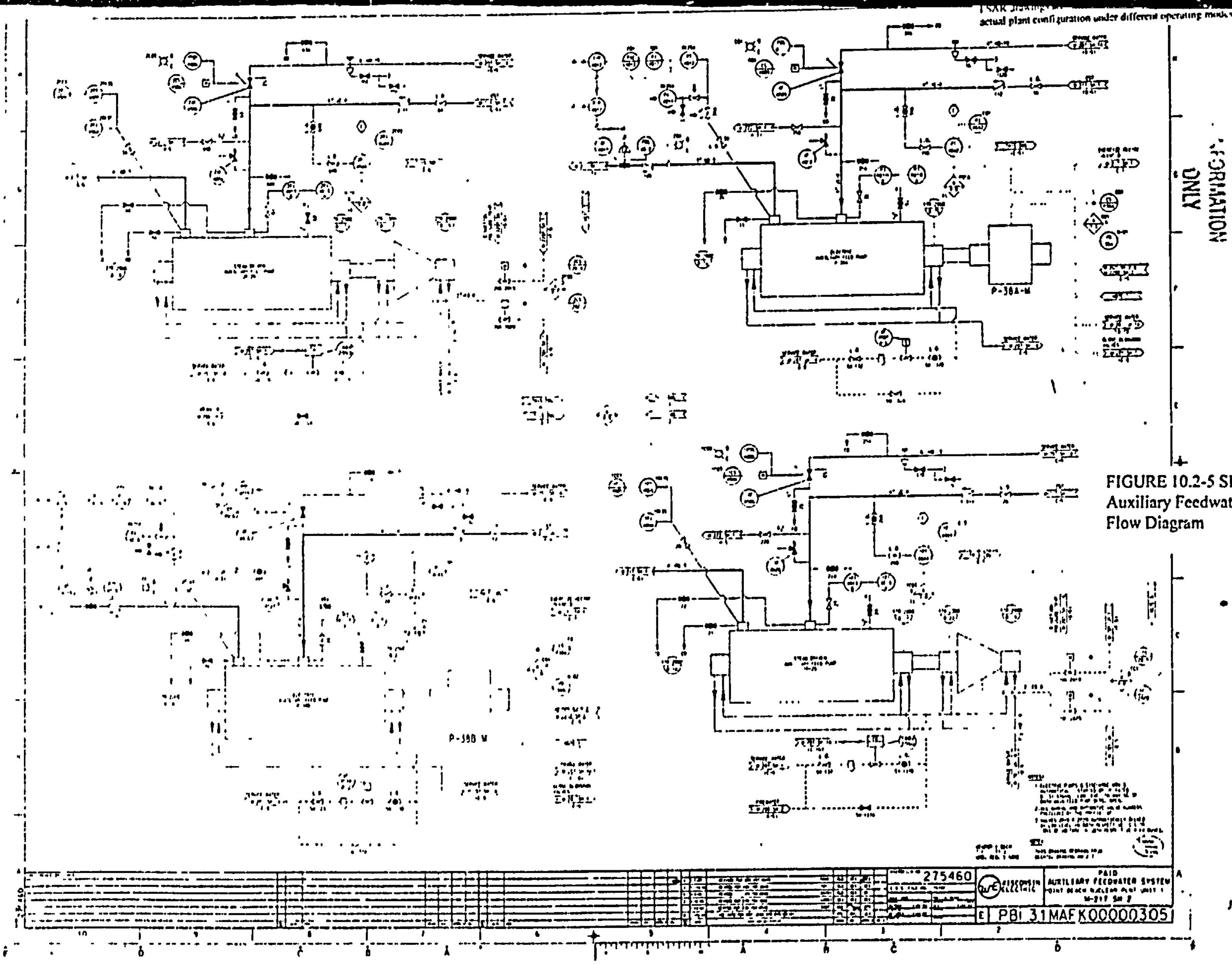


FIGURE 10.2-5 SH 2
Auxiliary Feedwater Syster
Flow Diagram

10.2 AUXILIARY FEEDWATER SYSTEM (AF)

One turbine (per unit) and two electric-driven (shared by the two units) auxiliary feedwater pumps are provided to ensure that adequate feedwater is supplied to the steam generators for heat removal under all circumstances, including loss of power and normal heat sink. Feedwater flow can be maintained until power is restored or reactor decay heat removal can be accomplished by other systems. The auxiliary feedwater system is designed as a Class I system. A backup supply of auxiliary feedwater can be provided from the Class I portion of the service water system by positioning remotely-operated valves from the control room. See Figure10.2-1.

10.2.1 DESIGN BASIS

The auxiliary feedwater system is designed to supply high-pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability or unavailability of the main feedwater system. The system is capable of delivering feedwater into the steam generators of a unit at a flowrate of at least 200 gpm at the pressure of the lowest safety valve (1085 psig) within 60 seconds of initiation.Redundant supplies are provided by two pumping systems using different sources of power for the pumps. The design capacity of each system is set so that the steam generators will not boil dry nor will the primary side relieve fluid through the pressurizer relief valves, following a loss of main feedwater flow with a reactor trip.

The AF system performs the following safety-related functions:

The AF system shall automatically start and deliver adequate AF system flow to maintain adequate steam generator levels during accidents which may result in main steam safety valve opening. Such accidents include: LOSS OF NORMAL FEEDWATER (LONF) and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES (LOAC) events. LONF and LOAC are time-sensitive to AF system start-up (References 1 and 2).

The AF system shall automatically start and deliver sufficient AF system flow to maintain adequate steam generator levels during accidents which require rapid reactor coolant system cooldown to achieve the cold shutdown condition within the limits of the analysis. Such accidents include: STEAM GENERATOR TUBE RUPTURE (SGTR) and MAIN STEAM LINE BREAK (MSLB) (References 1 and 2).

The AF system shall be capable of isolating the AF steam and feedwater supply lines from the ruptured steam generator following a SGTR event (Reference 2).

The AF system also performs the following functions related to regulatory commitments:

In the event of a station blackout (prolonged loss of offsite and onsite AC power) affecting both units, the AF system shall be capable of automatically supplying sufficient feedwater to remove decay heat from both units without any reliance on AC power for one hour (References 3 and 4).

In the event of plant fires, including those requiring evacuation of the control room, the AF system shall be capable of manual initiation to provide feedwater to a minimum of one steam generator per unit at sufficient flow and pressure to remove decay and sensible heat from the reactor coolant system over the range from hot shutdown to cold shutdown conditions. The AF system shall support achieving cold shutdown within 72 hours (References 5, 6, and 7).

10.2.2 SYSTEM DESIGN AND OPERATION

The auxiliary feedwater system consists of two electric motor-driven pumps, two steam turbine-driven pumps, pump suction and discharge piping, and the controls and instrumentation necessary for operation of the system. Redundancy is provided by utilizing two pumping systems, two different sources of power for the pumps, and two sources of water supply to the pumps. The system is categorized as seismic Class I and is designed to ensure that a single fault will not obstruct the system function.

One system utilizes a steam turbine-driven pump for each unit (1/2P-29)with the steam capable of being supplied from either or both steam generators. This system is capable of supplying 400 gpm of feedwater to a unit, or 200 gpm to each steam generator throughormally throttled MOVs AF-4000 and AF-4001. The feedwater flowrate from the turbine-driven auxiliary feedwater pump depends on the throttle position of these MOVs. Check valves are provided to help prevent backflow when the pumps are not in service. Each pump has an AOV (AF-4002) controlled recirculation line back to the condensate storage tanks to ensure minimum flow to dissipate pump heat. The pump drive is a single-stage turbine, capable of quick starts from cold standby and is directly connected to the pump. The turbine is started by opening either one or both of the isolation valves (MS-2019 and MS-2020) between the turbine supply steam header and the main steam lines upstream of the main steam isolation valves. The turbine bearing oil is normally cooled by service water with an alternate source of cooling water from the firewater system.

The other system is common to both units and utilizes two similar motor-driven pumps (P-38A and P-38B), each capable of obtaining its electrical power from the plant emergency diesel generators. Each pump has a capacity of 200 gpm with pump P-38A capable of supplying the A steam generator in either or both units through an AOV back-pressure control valve AF-4012 and normally closed MOVs, AF-4022 and AF-4023, and with pump P-38B capable of supplying the B steam generator in either or both units through an AOV back-pressure control valve AF-4019 and normally closed MOVs AF-4020 and AF-4021. Both back-pressure control valves fail open when instrument air to the valves is lost. The valves are provided with a backup nitrogen supply to provide pneumatic pressure in the event of a loss of instrument air. This backup supply assures that the valves do not move to the full open position which combined with low steam generator pressures may cause the pump motor to trip on time overcurrent due to high flow conditions. Each pump has an AOV, AF-4007 for P-38A and AF-4014 for P-38B, controlled recirculation line back to the condensate storage tanks to ensure minimum flow to dissipate pump heat. The discharge headers also provide piping, valves, and tanks for chemical additions to any steam generator. The pump bearings are ring lubricated and bearing oil is cooled by service water.

The water supply source for the auxiliary feedwater system is redundant. The normal source is by gravity feed from two nominal capacity 45,000 gallon condensate storage tanks while the safety-related supply is taken from the plant service water system whose pumps are powered from the diesel generators if station power is lost.

It is possible that a loss of normal feedwater initiated by a seismic event could also result in the interruption of the normal source of auxiliary feedwater from the condensate storage tanks because the condensate storage tanks are not classified as seismic Class I. The plant operators would be alerted to this problem by receipt of low suction pressure alarms on the auxiliary feedwater pumps. Pump protection is ensured by providing a low suction pressure trip. This trips the motor-driven pump breakersand the turbine-driven pump trip/throttle valves to ensure that the pumps are available, after a loss of condensate suction, to be switched to the safety-related water supply. Switchover to the alternate source of seismically qualified auxiliary feedwater, the service water system, can be accomplished by the operators in five minutes or less.

The auxiliary feedwater system has no functional requirements during normal, at power, plant operation. It is used during plant startup and shutdown and during hot shutdown or hot standby conditions when chemical additions or small feedwater flow requirements do not warrant the operation of the main feedwater and condensate systems.

During normal plant operations, the auxiliary feedwater system is maintained in a standby condition ready to be placed in operation automatically when conditions require. The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Turbine-driven feedwater pumps

1. Low-low water level in both steam generators in one unit starts the corresponding pump.
2. Loss of both 4.16 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.
3. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit starts the corresponding pump. These signals are processed through AMSAC at power levels above 40%.

Motor-driven feedwater pumps

1. Low-low water level in either associated steam generator.
2. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit. These signals are processed through AMSAC at power levels above 40%.
3. Safeguards sequence signal.

The Anticipated Transients Without Scram Mitigating System Actuation Circuit (AMSAC) is further discussed in Appendix A.3.

The motor-driven auxiliary feedwater pump discharge motor operated valves are configured to open automatically, based upon the same signals that start the motor-driven pumps. This ensures automatic delivery of auxiliary feedwater flow to an affected unit's steam generators without operator action. Auxiliary feedwater pump flow and direct flow indication for each steam generator is provided in the control room. Flow indication is also available locally at the discharge of each pump.

10.2.3 SYSTEM EVALUATION

In the event of complete loss of offsite electrical power to the station, decay heat remova would continue to be assured for each unit by the availability of either the turbine-driven auxiliary feedwater pump or one of the two motor-driven auxiliary feedwater pumps, and discharge to the atmosphere via the main steam safety valves or atmospheric relief valves. One motor-driven pump is capable of supplying sufficient feedwater for removal of decay heat from a unit. In this case, feedwater is available from the condensate storage tanks by gravity feed to the auxiliary feedwater pumps. The minimum amount of water in the condensate storage tanks (13,000 gallons per operating unit) ensures the ability to maintain each unit in a hot shutdown condition for at least one hour. When the water in the condensate storage tanks is depleted, suction for the pumps can be shifted to the service water system via remotely operated MOVs from the control room to provide makeup water from the lake for an indefinite time period.

During a Station Blackout (SBO) event, only the turbine-driven pumps would be available for decay heat removal. The turbine-driven pumps are capable of supplying feedwater to the steam generators without an AC power source. The steam supply and auxiliary feedwater discharge valves are powered from diverse sources of vital 125V DC. Cooling water for the pump and turbine bearings can be supplied from the diesel driven firewater pump. The Technical Specification minimum amount of water in the condensate storage tanks, 13,000 gallons per operating unit, provides adequate makeup to the steam generators to maintain each unit in a hot shutdown condition for at least one hour. Further information on the SBO event is provided in Appendix A.1.

In order to meet the design basis, the limiting accident analysis of LOSS OF NORMAL FEEDWATER and LOSS OF ALL AC-POWER TO THE STATION AUXILIARIES, assume that the auxiliary feedwater system provides 200 gpm per unit at 1085 psig within 60 seconds.

These minimum parameters are met or exceeded by system design and verified by required testing. The three other accident analysis which assume auxiliary feedwater initiation for mitigation are LOSS OF EXTERNAL ELECTRICAL LOAD, RUPTURE OF A STEAM PIPE, and STEAM GENERATOR TUBE RUPTURE. For these accidents minimum auxiliary feedwater assumptions are not specified and in the later, auxiliary feedwater isolation to the affected steam generator is assumed. Although the auxiliary feedwater system may be initiated during a SMALL BREAK LOCA, the event has been analyzed with no credit for auxiliary feedwater.

Based on the operating characteristics of the minimum recirculation flow control scheme, a portion of each motor-driven auxiliary feedwater pump's discharge flow will be automatically recirculated to the condensate storage tank for approximately forty-five seconds after the pump starts. The forty-five second time delay in closing the mini-flow recirculation control valves is incorporated in the design to provide for pump cooling during coastdown.

During a postulated failure of the control systems for the AOVs (AF-4007 or AF-4014) that control recirculation flow for the motor-driven auxiliary feedwater pumps, it is assumed that they fail in a non-conservative manner, i.e. full open. In this case, with the pump supplying 200 gpm approximately 89 gpm is diverted back to the condensate storage tank and in excess of 100 gpm is supplied to the steam generator. Assuming the most limiting safety grade failure of one of the turbine-driven auxiliary feedwater pumps, the remaining turbine-driven pump and the two motor-driven pumps would be capable of supplying greater than the design basis 200 gpm per unit within 60 seconds.

A failure analysis has been made and the results for the auxiliary feedwater pumps show that the failure or malfunction of any single active component will not prevent the system from performing its emergency function. Results are presented below.

Malfunction	Comments and Consequences
One AFW pump fails to start (following loss of main feedwater)	Four AFW pumps provided; each steam-driven pump is dedicated to one unit and each motor-driven pump is shared between units. Any three of the four AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units.
Two AFW pumps fail to stop (trip) when required and subsequently run to failure (following a seismic-induced loss of main feedwater event)	Each AFW pump is provided with low suction pressure protection following a seismic event. Evaluations for a seismic-induced LONF event show that any two AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units.

10.2.4 REQUIRED PROCEDURES AND TEST

The AF system components are tested and inspected in accordance with Technical Specification surveillance criteria and frequencies. Testing verifies motor-driven pump operability turbine-driven pump operability including a cold start, and operability of all required MOVs. Control circuits, starting logic, and indicators are verified operable by their respective functional test.

10.2.5 CORRESPONDENCE/COMMITMENTS

1. 10CFR50.48, Fire Protection. The AFW System is required to remove decay heat in the event of a fire.
2. 10CFR.49, Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants. Some AFW System electrical equipment is required to be environmentally qualified.
3. 10CFR50.55a, Codes and Standards. The inservice inspection of the AFW System is governed by this regulation.
4. 10CFR50.63, Loss of all Alternating Current Power. The AFW System must be capable of providing feedwater to the steam generators in the event of the loss of all AC power (Station Blackout).
5. 10CFR50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants. The safety-related portions of the AFW System are governed by this regulation because the AFW System is required to mitigate the consequences of postulated accidents.
6. 10CFR, Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1 1976, Section III.L, Alternative and Dedicated Shutdown Capability. The AFW System is required to remove decay heat in the event of a fire.
7. Regulatory Guide 1.97, Revision 2, dated December 1980 with Errata through July1981, Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident. These requirements are applicable to AFW System instrumentation used to monitor AFW flow and Condensate Storage Tank level.
8. NUREG-0578, Lessons Learned Task Force: Status Report and Short Term Recommendations. These requirements are applicable to AFW System upgrades to improve reliability as a result of TMI-2 lessons.
9. NUREG-0737, Clarification of TMI Action Plan Requirements. These requirements are applicable to AFW System upgrades to improve reliability as a result of TMI-2 lessons.
10. Generic Letter No. 81-14, Seismic Qualification of Auxiliary Feedwater Systems. This generic letter addresses concerns regarding the seismic qualification of AFW Systems.
11. Generic Letter No. 81-21, Natural Circulation Cooldown. This generic letter addresses the requirement that sufficient condensate grade AFW be available to perform a natural circulation cooldown.

12. Generic Letter No. 88-03, Resolution of Generic Safety Issue 93, Steam Binding of Auxiliary Feedwater Pumps. This generic letter addresses the affects of steam binding on the AFW System operability. This issue should be considered as the system is modified.
13. Generic Letter No. 89-10, Safety-Related Motor Operated Valve Testing and Surveillance with Supplements 1, 2, and 3. This generic letter addresses the operability of safety-related motor-operated valves under design basis conditions and requests that licensees establish programs to ensure operability.
14. IE Bulletin No. 80-04, Analysis of PWR Main Steam Line Break with Continued Feedwater Addition. This bulletin addresses the affects of feedwater being added to a depressurized steam generator after a steam line break.
15. IE Bulletin No. 85-01, Steam Binding of Auxiliary Feedwater Pumps. This bulletin addresses the steam binding of AFW pumps due to backleakage of feedwater through check valves. WE committed to check the AFW System piping temperature once per shift.
16. IE Bulletin No. 85-03, Motor-Operated Valve Switch Settings. This bulletin addresses the operability of motor-operated valves with improper switch settings.

10.2.6 REFERENCES

1. WE letter to NRC, "AFW Automatic Initiation and Flow Indication", dated 9/16/81.
2. FSAR, Chapter 14.
3. 10CFR50.63
4. NRC letter to WE, "SER on Station Blackout", dated 10/3/90.
5. 10CFR50.48
6. 10CFR50 Appendix R.
7. PBNP Fire Protection Evaluation Report (FPER).

FSAR drawings are "INFORMATION ONLY" and do not reflect actual plant configuration under different operating modes

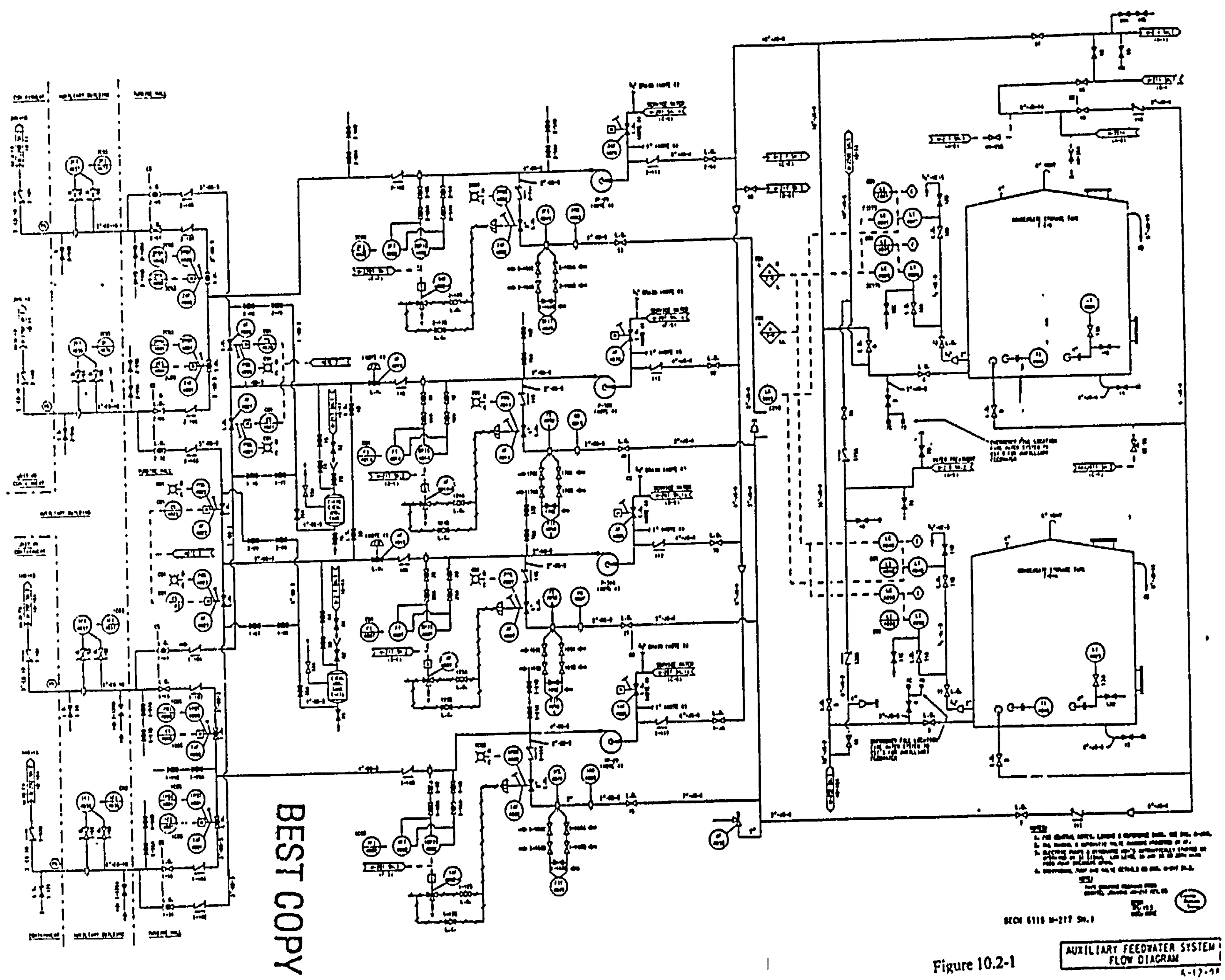


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Figure 10.2-1

... actual plant configuration under different operating modes.

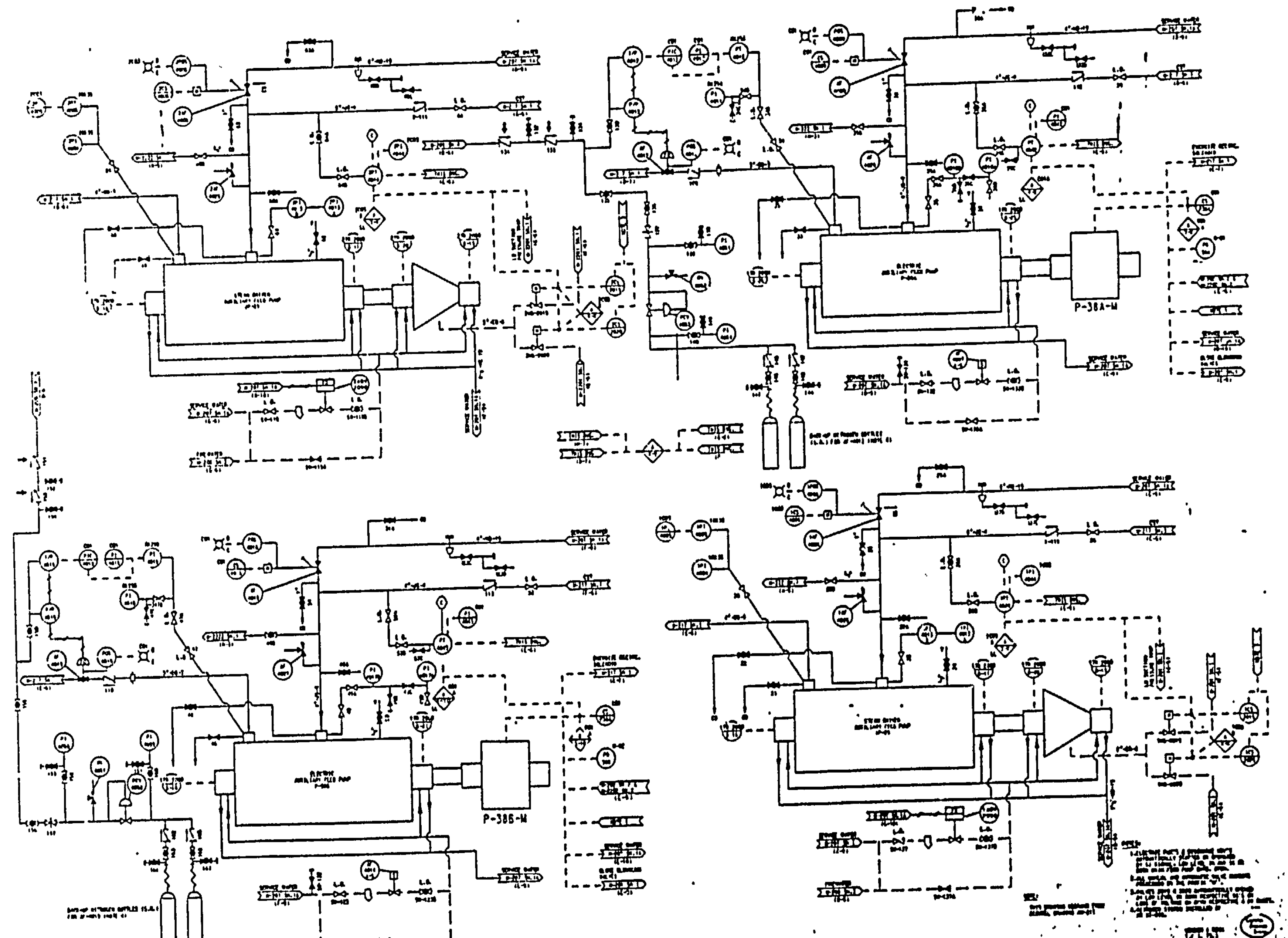

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Figure 10.2-2

AUXILIARY FEEDWATER SYSTEM FLOW DIAGRAM

10.2 AUXILIARY FEEDWATER SYSTEM (AF)

One turbine (per unit) and two electric-driven (shared by the two units) auxiliary feedwater pumps are provided to ensure that adequate feedwater is supplied to the steam generators for heat removal under all circumstances, including loss of power and normal heat sink. Feedwater flow can be maintained until power is restored or reactor decay heat removal can be accomplished by other systems. The auxiliary feedwater system is designed as a Class I system. A backup supply of auxiliary feedwater can be provided from the Class I portion of the service water system by positioning remotely-operated valves from the control room. See Figure10.2-1.

10.2.1 DESIGN BASIS

The auxiliary feedwater system is designed to supply high-pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability or unavailability of the main feedwater system. In order to meet the design basis required in the Loss of Normal Feedwater/Loss of All AC analysis, one motor driven auxiliary feedwater pump provides 200 gpm of flow to one steam generator within 5 minutes following receipt of a low-low steam generator water level setpoint signal. Redundant supplies are provided by two pumping systems using different sources of power for the pumps. The design capacity of each system is set so that the steam generators will not boil dry nor will the primary side relieve fluid through the pressurizer relief valves, following a loss of main feedwater flow with a reactor trip.

The AF system performs the following safety-related functions:

The AF system shall automatically start and deliver adequate AF system flow to maintain adequate steam generator levels during accidents which may result in main steam safety valve opening. Such accidents include; LOSS OF NORMAL FEEDWATER (LONF) and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES (LOAC) events. LONF and LOAC are time-sensitive to AF system start-up (References 1 and 2).

The AF system shall automatically start and deliver sufficient AF system flow to maintain adequate steam generator levels during accidents which require rapid reactor coolant system cooldown to achieve the cold shutdown condition within the limits of the analysis. Such accidents include; STEAM GENERATOR TUBE RUPTURE (SGTR) and MAIN STEAM LINE BREAK (MSLB) (References 1 and 2).

The AF system shall be capable of isolating the AF steam and feedwater supply lines from the ruptured steam generator following a SGTR event (Reference 2).

The AF system also performs the following functions related to regulatory commitments:

In the event of a station blackout (prolonged loss of offsite and onsite AC power) affecting both units. the AF system shall be capable of automatically supplying sufficient feedwater to remove decay heat from both units without any reliance on AC power for one hour (References 3 and 4).

In the event of plant fires, including those requiring evacuation of the control room, the AF system shall be capable of manual initiation to provide feedwater to a minimum of one steam generator per unit at sufficient flow and pressure to remove decay and sensible heat from the reactor coolant system over the range from hot shutdown to cold shutdown conditions. The AF system shall support achieving cold shutdown within 72 hours (References 5, 6, and 7).

10.2.2 SYSTEM DESIGN AND OPERATION

The auxiliary feedwater system consists of two electric motor-driven pumps, two steam turbine-driven pumps, pump suction and discharge piping, and the controls and instrumentation necessary for operation of the system. Redundancy is provided by utilizing two pumping systems, two different sources of power for the pumps, and two sources of water supply to the pumps. The system is categorized as seismic Class I and is designed to ensure that a single fault will not obstruct the system function.

One system utilizes a steam turbine-driven pump for each unit (1/2P-29)with the steam capable of being supplied from either or both steam generators. This system is capable of supplying 400 gpm of feedwater to a unit, or 200 gpm to each steam generator through normally throttled MOVs AF-4000 and AF-4001. The feedwater flowrate from the turbine-driven auxiliary feedwater pump depends on the throttle position of these MOVs. Check valves are provided to help prevent backflow when the pumps are not in service. Each pump has an AOV (AF-4002) controlled recirculation line back to the condensate storage tanks to ensure minimum flow to dissipate pump heat. The pump drive is a single-stage turbine, capable of quick starts from cold standby and is directly connected to the pump. The turbine is started by opening either one or both of the isolation valves (MS-2019 and MS-2020) between the turbine supply steam header and the main steam lines upstream of the main steam isolation valves. The turbine bearing oil is normally cooled by service water with an alternate source of cooling water from the firewater system.

The other system is common to both units and utilizes two similar motor-driven pumps (P-38A and P-38B), each capable of obtaining its electrical power from the plant emergency diesel generators. Each pump has a capacity of 200 gpm with pump P-38A capable of supplying the A steam generator in either or both units through an AOV back-pressure control valve AF-4012 and normally closed MOVs, AF-4022 and AF-4023, and with pump P-38B capable of supplying the B steam generator in either or both units through an AOV back-pressure control valve AF-4019 and normally closed MOVs AF-4020 and AF-4021. Both back-pressure control valves fail open when instrument air to the valves is lost. The valves are provided with a backup nitrogen supply to provide pneumatic pressure in the event of a loss of instrument air. This backup supply assures that the valves do not move to the full open position which combined with low steam generator pressures may cause the pump motor to trip on time overcurrent due to high flow conditions. Each pump has an AOV, AF-4007 for P-38A and AF-4014 for P-38B, controlled recirculation line back to the condensate storage tanks to ensure minimum flow to dissipate pump heat. The discharge headers also provide piping, valves, and tanks for chemical additions to any steam generator. The pump bearings are ring lubricated and bearing oil is cooled by service water.

The water supply source for the auxiliary feedwater system is redundant. The normal source is by gravity feed from two nominal capacity 45,000 gallon condensate storage tanks while the safety-related supply is taken from the plant service water system whose pumps are powered from the diesel generators if station power is lost.

It is possible that a loss of normal feedwater initiated by a seismic event could also result in the interruption of the normal source of auxiliary feedwater from the condensate storage tanks because the condensate storage tanks are not classified as seismic Class I. The plant operators would be alerted to this problem by receipt of low suction pressure alarms on the auxiliary feedwater pumps. Pump protection is ensured by providing a low suction pressure trip. This trips the motor-driven pump breakers and the turbine-driven pump trip/throttle valves to ensure that the pumps are available, after a loss of condensate suction, to be switched to the safety-related water supply. Switchover to the alternate source of seismically qualified auxiliary feedwater, the service water system, can be accomplished by the operators in five minutes or less.

The auxiliary feedwater system has no functional requirements during normal, at power, plant operation. It is used during plant startup and shutdown and during hot shutdown or hot standby conditions when chemical additions or small feedwater flow requirements do not warrant the operation of the main feedwater and condensate systems.

During normal plant operations, 'he auxiliary feedwater system is maintained in a standby condition ready to be placed in operation automatically when conditions require. The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Turbine-driven feedwater pumps

1. Low-low water level in both steam generators in one unit starts the corresponding pump.
2. Loss of both 4.16 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.
3. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit starts the corresponding pump. These signals are processed through AMSAC at power levels above 40%.

Motor-driven feedwater pumps

1. Low-low water level in either associated steam generator.
2. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit. These signals are processed through AMSAC at power levels above 40%.
3. Safeguards sequence signal.

The Anticipated Transients Without Scram Mitigating System Actuation Circuit (AMSAC) is further discussed in FSAR Section 7.4.

The motor-driven auxiliary feedwater pump discharge motor operated valves are configured to open automatically, based upon the same signals that start the motor-driven pumps. This ensures automatic delivery of auxiliary feedwater flow to an affected unit's steam generators without operator action. Auxiliary feedwater pump flow and direct flow indication for each steam generator is provided in the control room. Flow indication is also available locally at the discharge of each pump.

10.2.3 SYSTEM EVALUATION

In the event of complete loss of offsite electrical power to the station, decay heat removal would continue to be assured for each unit by the availability of either the turbine-driven auxiliary feedwater pump or one of the two motor-driven auxiliary feedwater pumps, and discharge to the atmosphere via the main steam safety valves or atmospheric relief valves. One motor-driven pump is capable of supplying sufficient feedwater for removal of decay heat from a unit. In this case, feedwater is available from the condensate storage tanks by gravity feed to the auxiliary feedwater pumps. The minimum amount of water in the condensate storage tanks (13,000 gallons per operating unit) ensures the ability to maintain each unit in a hot shutdown condition for at least one hour. When the water in the condensate storage tanks is depleted, suction for the pumps can be shifted to the service water system via remotely operated MOVs from the control room to provide makeup water from the lake for an indefinite time period.

During a Station Blackout (SBO) event, only the turbine-driven pumps would be available for decay heat removal. The turbine-driven pumps are capable of supplying feedwater to the steam generators without an AC power source. The steam supply and auxiliary feedwater discharge valves are powered from diverse sources of vital 125V DC. Cooling water for the pump and turbine bearings can be supplied from the diesel driven firewater pump. The Technical Specification minimum amount of water in the condensate storage tanks, 13,000 gallons per operating unit, provides adequate makeup to the steam generators to maintain each unit in a hot shutdown condition for at least one hour. Further information on the SBO event is provided in Appendix A.1.

In order to meet the design basis, the limiting accident analysis of LOSS OF NORMAL FEEDWATER and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES, assumes that one motor driven auxiliary feedwater pump provides 200 gpm of flow to one steam generator within 5 minutes following receipt of a low-low steam generator water level setpoint signal.

These minimum parameters are met or exceeded by system design and verified by required testing. The three other accident analysis which assume auxiliary feedwater initiation for mitigation are LOSS OF EXTERNAL ELECTRICAL LOAD, RUPTURE OF A STEAM PIPE, and STEAM

GENERATOR TUBE RUPTURE. For these accidents minimum auxiliary feedwater assumptions are not specified and in the latter, auxiliary feedwater isolation to the affected steam generator is assumed. Although the auxiliary feedwater system may be initiated during a SMALL BREAK LOCA, the event has been analyzed with no credit for auxiliary feedwater.
Based on the operating characteristics of the minimum recirculation flow control scheme, a portion of each motor-driven auxiliary feedwater pump's discharge flow will be automatically recirculated to the condensate storage tank for approximately forty-five seconds after the pump starts. The forty-five second time delay in closing the mini-flow recirculation control valves is incorporated in the design to provide for pump cooling during coastdown.

During a postulated failure of the control systems for the AOVs (AF-4007 or AF-4014) that control recirculation flow for the motor-driven auxiliary feedwater pumps, it is assumed that they fail in a non-conservative manner, i.e. full open. In this case, with the pump supplying 200 gpm approximately 89 gpm is diverted back to the condensate storage tank and in excess of 100 gpm is supplied to the steam generator.

A failure analysis has been made and the results for the auxiliary feedwater pumps show that the failure or malfunction of any single active component will not prevent the system from performing its emergency function. Results are presented below.

Malfunction	Comments and Consequences
One AFW pump fails to start (following loss of main feedwater)	Four AFW pumps provided; each steam-driven pump is dedicated to one unit and each motor-driven pump is shared between units. Any three of the four AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units.
Two AFW pumps fail to stop (trip) when required and subsequently run to failure (following a seismic-induced loss of main feedwater event)	Each AFW pump is provided with low suction pressure protection following a seismic event. Evaluations for a seismic-induced LONF event show that any two AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units.

10.2.4 REQUIRED PROCEDURES AND TEST

The AF system components are tested and inspected in accordance with Technical Specification surveillance criteria and frequencies. Testing verifies motor-driven pump operability, turbine-driven pump operability including a cold start, and operability of all required MOVs. Control circuits, starting logic, and indicators are verified operable by their respective functional test.

10.2.5 CORRESPONDENCE/COMMITMENTS

1. 10CFR50.48, Fire Protection. The AFW System is required to remove decay heat in the event of a fire.
2. 10CFR.49, Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants. Some AFW System electrical equipment is required to be environmentally qualified.
3. 10CFR50.55a, Codes and Standards. The inservice inspection of the AFW System is governed by this regulation.
4. 10CFR50.63, Loss of all Alternating Current Power. The AFW System must be capable of providing feedwater to the steam generators in the event of the loss of all AC power (Station Blackout).
5. 10CFR50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants. The safety-related portions of the AFW System are governed by this regulation because the AFW System is required to mitigate the consequences of postulated accidents.
6. 10CFR, Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1976, Section III.L, Alternative and Dedicated Shutdown Capability. The AFW System is required to remove decay heat in the event of a fire.
7. Regulatory Guide 1.97, Revision 2, dated December 1980 with Errata through July 1981, Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident. These requirements are applicable to AFW System instrumentation used to monitor AFW flow and Condensate Storage Tank level.
8. NUREG-0578, Lessons Learned Task Force: Status Report and Short Term Recommendations. These requirements are applicable to AFW System upgrades to improve reliability as a result of TMI-2 lessons.
9. NUREG-0737, Clarification of TMI Action Plan Requirements. These requirements are applicable to AFW System upgrades to improve reliability as a result of TMI-2 lessons.
10. Generic Letter No. 81-14, Seismic Qualification of Auxiliary Feedwater Systems. This generic letter addresses concerns regarding the seismic qualification of AFW Systems.
11. Generic Letter No. 81-21, Natural Circulation Cooldown. This generic letter addresses the requirement that sufficient condensate grade AFW be available to perform a natural circulation cooldown.

12. Generic Letter No. 88-03 Resolution of Generic Safety Issue 93, Steam Binding of Auxiliary Feedwater Pumps. This generic letter addresses the affects of steam binding on the AFW System operability. This issue should be considered as the system is modified.

13. Generic Letter No. 89-10, Safety-Related Motor Operated Valve Testing and Surveillance with Supplements 1, 2, and 3. This generic letter addresses the operability of safety-related motor-operated valves under design basis conditions and requests that licensees establish programs to ensure operability.

14. IE Bulletin No. 80-04, Analysis of PWR Main Steam Line Break with Continued Feedwater Addition. This bulletin addresses the affects of feedwater being added to a depressurized steam generator after a steam line break.

15. IE Bulletin No. 85-01, Steam Binding of Auxiliary Feedwater Pumps. This bulletin addresses the steam binding of AFW pumps due to backleakage of feedwater through check valves. WE committed to check the AFW System piping temperature once per shift.

16. IE Bulletin No. 85-03, Motor-Operated Valve Switch Settings. This bulletin addresses the operability of motor-operated valves with improper switch settings.

10.2.6 REFERENCES

1. WE letter to NRC, "AFW Automatic Initiation and Flow Indication", dated 9/16/81.
2. FSAR, Chapter 14.
3. 10CFR50.63
4. NRC letter to WE, "SER on Station Blackout", dated 10/3/90.
5. 10CFR50.48
6. 10CFR50 Appendix R.
7. PBNP Fire Protection Evaluation Report (FPER).

10.2 AUXILIARY FEEDWATER SYSTEM (AF)

One turbine (per unit) and two electric-driven (shared by the two units) auxiliary feedwater pumps are provided to ensure that adequate feedwater is supplied to the steam generators for heat removal under all circumstances, including loss of power and normal heat sink. Feedwater flow can be maintained until power is restored or reactor decay heat removal can be accomplished by other systems. The auxiliary feedwater system is designed as a Class I system. A backup supply of auxiliary feedwater can be provided from the Class I portion of the service water system by positioning remotely-operated valves from the control room. See Figure 10.2-1.

10.2.1 DESIGN BASIS

The auxiliary feedwater system is designed to supply high-pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability or unavailability of the main feedwater system. In order to meet the design basis required in the Loss of Normal Feedwater/Loss of All AC analysis, one motor driven auxiliary feedwater pump provides 200 gpm of flow to one steam generator within 5 minutes following receipt of a low-low steam generator water level setpoint signal. Redundant supplies are provided by two pumping systems using different sources of power for the pumps. The design capacity of each system is set so that the steam generators will not boil dry nor will the primary side relieve fluid through the pressurizer relief valves, following a loss of main feedwater flow with a reactor trip.

The AF system performs the following safety-related functions:

The AF system shall automatically start and deliver adequate AF system flow to maintain adequate steam generator levels during accidents which may result in main steam safety valve opening. Such accidents include; LOSS OF NORMAL FEEDWATER (LONF), FSAR Chapter 14.1.10, and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES (LOAC), FSAR Chapter 14.1.11, events. LONF and LOAC are time-sensitive to AF system start-up.

The AF system shall automatically start and deliver sufficient AF system flow to maintain adequate steam generator levels during accidents which require rapid reactor coolant system cooldown to achieve the cold shutdown condition within the limits of the analysis. Such accidents include; STEAM GENERATOR TUBE RUPTURE (SGTR), FSAR Chapter 14.2.4, and MAIN STEAM LINE BREAK (MSLB), FSAR Chapter 14.2.5.

The AF system shall be capable of isolating the AF steam and feedwater supply lines from the ruptured steam generator following a SGTR event.

The AF system also performs the following functions related to regulatory commitments:

In the event of a station blackout (prolonged loss of offsite and onsite AC power) affecting both units, the AF system shall be capable of automatically supplying sufficient feedwater to remove decay heat from both units without any reliance on AC power for one hour (Reference 1).

In the event of plant fires, including those requiring evacuation of the control room, the AF system shall be capable of manual initiation to provide feedwater to a minimum of one steam generator per unit at sufficient flow and pressure to remove decay and sensible heat from the reactor coolant system over the range from hot shutdown to cold shutdown conditions. The AF system shall support achieving cold shutdown within 72 hours (Reference 2).

10.2.2 SYSTEM DESIGN AND OPERATION

The auxiliary feedwater system consists of two electric motor-driven pumps, two steam turbine driven pumps, pump suction and discharge piping, and the controls and instrumentation necessary for operation of the system. Redundancy is provided by utilizing two pumping systems, two different sources of power for the pumps, and two sources of water supply to the pumps. The system is categorized as seismic Class I and is designed to ensure that a single fault will not obstruct the system function.

One system utilizes a steam turbine-driven pump for each unit (1/2P-29)with the steam capable of being supplied from either or both steam generators. This system is capable of supplying 400 gpm of feedwater to a unit, or 200 gpm to each steam generator through normally throttled MOVs AF-4000 and AF-4001. The feedwater flowrate from the turbine-driven auxiliary feedwater pump depends on the throttle position of these MOVs. Check valves are provided to help prevent backflow when the pumps are not in service. Each pump has an AOV (AF-4002) controlled recirculation line back to the condensate storage tanks to ensure minimum flow to dissipate pump heat. The pump drive is a single-stage turbine, capable of quick starts from cold standby and is directly connected to the pump. The turbine is started by opening either one or both of the isolation valves (MS-2019 and MS-2020) between the turbine supply steam header and the main steam lines upstream of the main steam isolation valves. The turbine and pump are normally cooled by service water with an alternate source of cooling water from the firewater system.

The other system is common to both units and utilizes two similar motor-driven pumps (P-38A and P-38B), each capable of obtaining its electrical power from the plant emergency diesel generators. Each pump has a capacity of 200 gpm with pump P-38A capable of supplying the A steam generator in either or both units through an AOV back-pressure control valve AF-4012 and normally closed MOVs. AF-4022 and AF-4023, and with pump P-38B capable of supplying the B steam generator in either or both units through an AOV back-pressure control valve AF-4019 and normally closed MOVs AF-4020 and AF-4021. Both back-pressure control valves fail open when instrument air to the valves is lost. The valves are provided with a backup nitrogen supply to provide pneumatic pressure in the event of a loss of instrument air. This backup supply assures that the valves do not move to the full open position which combined with low steam generator pressures may cause the pump motor to trip on time overcurrent due to high flow conditions. Each pump has an AOV, AF-4007 for P-38A and AF-4014 for P-38B, controlled recirculation line back to the condensate storage tanks to ensure minimum flow to prevent hydraulic instabilities and dissipate pump heat. The discharge headers also provide piping, valves, and tanks for chemical additions to any steam generator. The pump bearings are ring lubricated and bearing oil is cooled by service water.

The water supply source for the auxiliary feedwater system is redundant. The normal source is by gravity feed from two nominal capacity 45,000 gallon condensate storage tanks while the safety-related supply is taken from the plant service water system whose pumps are powered from the diesel generators if station power is lost.

It is possible that a loss of normal feedwater initiated by a seismic event could also result in the interruption of the normal source of auxiliary feedwater from the condensate storage tanks because the condensate storage tanks are not classified as seismic Class I. The plant operators would be alerted to this problem by receipt of low suction pressure alarms on the auxiliary feedwater pumps. Pump protection is ensured by providing a low suction pressure trip. This trips the motor-driven pump breakers and the turbine-driven pump trip/throttle valves 1MS-2082 and 2MS-2082, to ensure that the pumps are available, after a loss of condensate suction, to be switched to the safety-related water supply. Switchover to the alternate source of seismically qualified auxiliary feedwater, the service water system, can be accomplished by the operators in five minutes or less.

The auxiliary feedwater system has no functional requirements during normal, at power, plant operation. It is used during plant startup and shutdown and during hot shutdown or hot standby conditions when chemical additions or small feedwater flow requirements do not warrant the operation of the main feedwater and condensate systems.

During normal plant operations, the auxiliary feedwater system is maintained in a standby condition ready to be placed in operation automatically when conditions require. The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

<u>Turbine-driven feedwater pumps</u>

1. Low-low water level in both steam generators in one unit starts the corresponding pump.

2. Loss of both 4.16 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.

3. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit starts the corresponding pump. These signals are processed through AMSAC at power levels above 40%.

<u>Motor-driven feedwater pumps</u>

1. Low-low water level in either associated steam generator.

2. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit. These signals are processed through AMSAC at power levels above 40%.

3. Safeguards sequence signal.

The Anticipated Transients Without Scram Mitigating System Actuation Circuit (AMSAC) is further discussed in FSAR Section 7.4.

The motor-driven auxiliary feedwater pump discharge motor operated valves are configured to open automatically, based upon the same signals that start the motor-driven pumps. This ensures automatic delivery of auxiliary feedwater flow to an affected unit's steam generators without operator action. Auxiliary feedwater pump flow and direct flow indication for each steam generator is provided in the control room. Flow indication is also available locally at the discharge of each pump.

10.2.3 SYSTEM EVALUATION

In the event of complete loss of offsite electrical power to the station, decay heat removal would continue to be assured for each unit by the availability of either the turbine-driven auxiliary feedwater pump or one of the two motor-driven auxiliary feedwater pumps, and discharge to the atmosphere via the main steam safety valves or atmospheric relief valves. One motor-driven pump is capable of supplying sufficient feedwater for removal of decay heat from a unit. In this case, feedwater is available from the condensate storage tanks by gravity feed to the auxiliary feedwater pumps. When the water in the condensate storage tanks is depleted, suction for the pumps can be shifted to the service water system via remotely operated MOVs from the control room to provide makeup water from the lake for an indefinite time period.

During a Station Blackout (SBO) event, only the turbine-driven pumps would be available for decay heat removal. The turbine-driven pumps are capable of supplying feedwater to the steam generators without an AC power source. The steam supply and auxiliary feedwater discharge valves are powered from diverse sources of vital 125V DC. Cooling water for the pump and turbine bearings can be supplied from the diesel driven firewater pump. The Technical Specification minimum amount of water in the condensate storage tanks, 13,000 gallons per operating unit, provides adequate makeup to the steam generators to maintain each unit in a hot shutdown condition for at least one hour concurrent with a loss of all AC power. Further information on the SBO event is provided in Appendix A.1. (Reference 1)

In order to meet the design basis, the limiting accident analysis of LOSS OF NORMAL FEEDWATER and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES assumes that one motor driven auxiliary feedwater pump provides 200 gpm of flow to one steam generator within 5 minutes following receipt of a low-low steam generator water level setpoint signal.

These minimum parameters are met or exceeded by system design and verified by required testing. The three other accident analyses which assume auxiliary feedwater initiation for mitigation are LOSS OF EXTERNAL ELECTRICAL LOAD, RUPTURE OF A STEAM PIPE, and STEAM GENERATOR TUBE RUPTURE. For these accidents, minimum auxiliary feedwater assumptions are not specified and in the latter two, auxiliary feedwater isolation to the affected steam generator is assumed. Although the auxiliary feedwater system may be initiated during a SMALL BREAK LOCA, the event has been analyzed with no credit for auxiliary feedwater.

Based on the operating characteristics of the minimum recirculation flow control scheme, a portion of each motor-driven auxiliary feedwater pump's discharge flow will be automatically recirculated to the condensate storage tank for approximately forty-five seconds after the pump starts. The forty-five second time delay in closing the mini-flow recirculation control valves is incorporated in the design to provide for pump stability and cooling during coastdown.

A postulated control failure causing a single motor-driven AFW pump recirculation valve (AF-4007 or AF-4014) to fail open will divert approximately 89 gpm pump flow back to the associated steam generator. However, the AFW flow to the steam generators from the other motor-driven pump and the unit turbine-driven pump are not affected by this failure. Similarly, if the control failure causes a single turbine-driven pump recirculation valve (AF-4002) to fail open, the failure will divert approximately 126 gpm of turbine-driven pump flow to the condensate storage tank, but will not affect flow to the steam generators from either motor-driven pump. For either of these control failures, the AFW system will be capable of supplying greater than the required 200 gpm per unit.

A failure analysis has been made and the results for the auxiliary feedwater pumps show that the failure or malfunction of any single active component will not prevent the system from performing its emergency function. Results are presented below.

Malfunction	Comments and Consequences
One AFW pump fails to start (following loss of main feedwater)	Four AFW pumps provided; each steam-driven pump is dedicated to one unit and each motor-driven pump is shared between units. Any three of the four AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units.
Two AFW pumps fail to stop (trip) when required and subsequently run to failure (following a seismic- induced loss of main feedwater event)	Each AFW pump is provided with low suction pressure protection following a seismic event. Evaluations for a seismic-induced LONF event show that any two AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units.

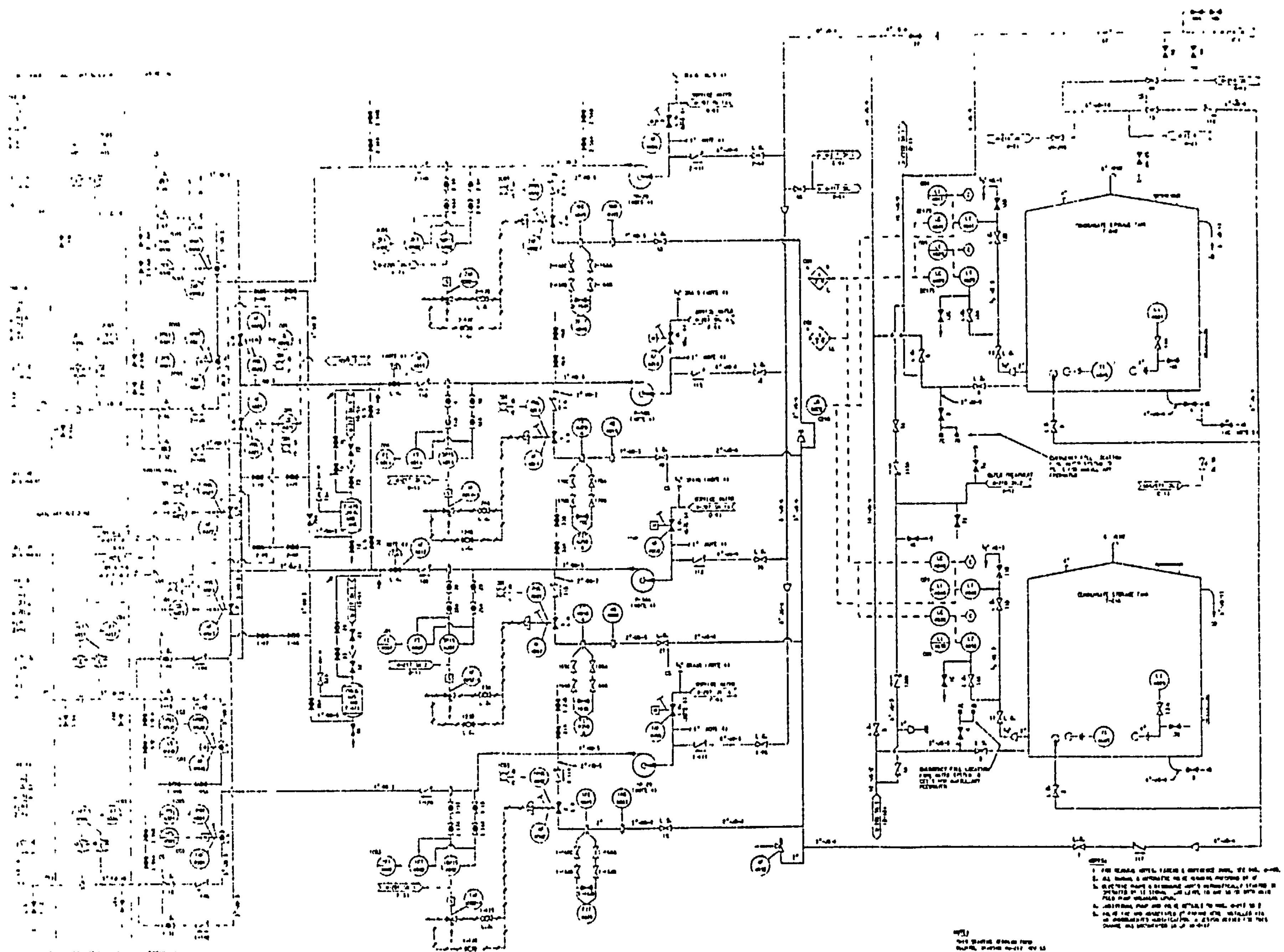
10.2.4 REQUIRED PROCEDURES AND TESTS

The AF system components are tested and inspected in accordance with Technical Specification surveillance criteria and frequencies. Testing verifies motor-driven pump operability, turbine-driven pump operability including a cold start, and operability of all required MOVs. Control circuits, starting logic, and indicators are verified operable by their respective functional test.

10.2.5 REFERENCES

1. FSAR Appendix A.1, Station Blackout

2. PBNP Fire Protection Evaluation Report (FPER)



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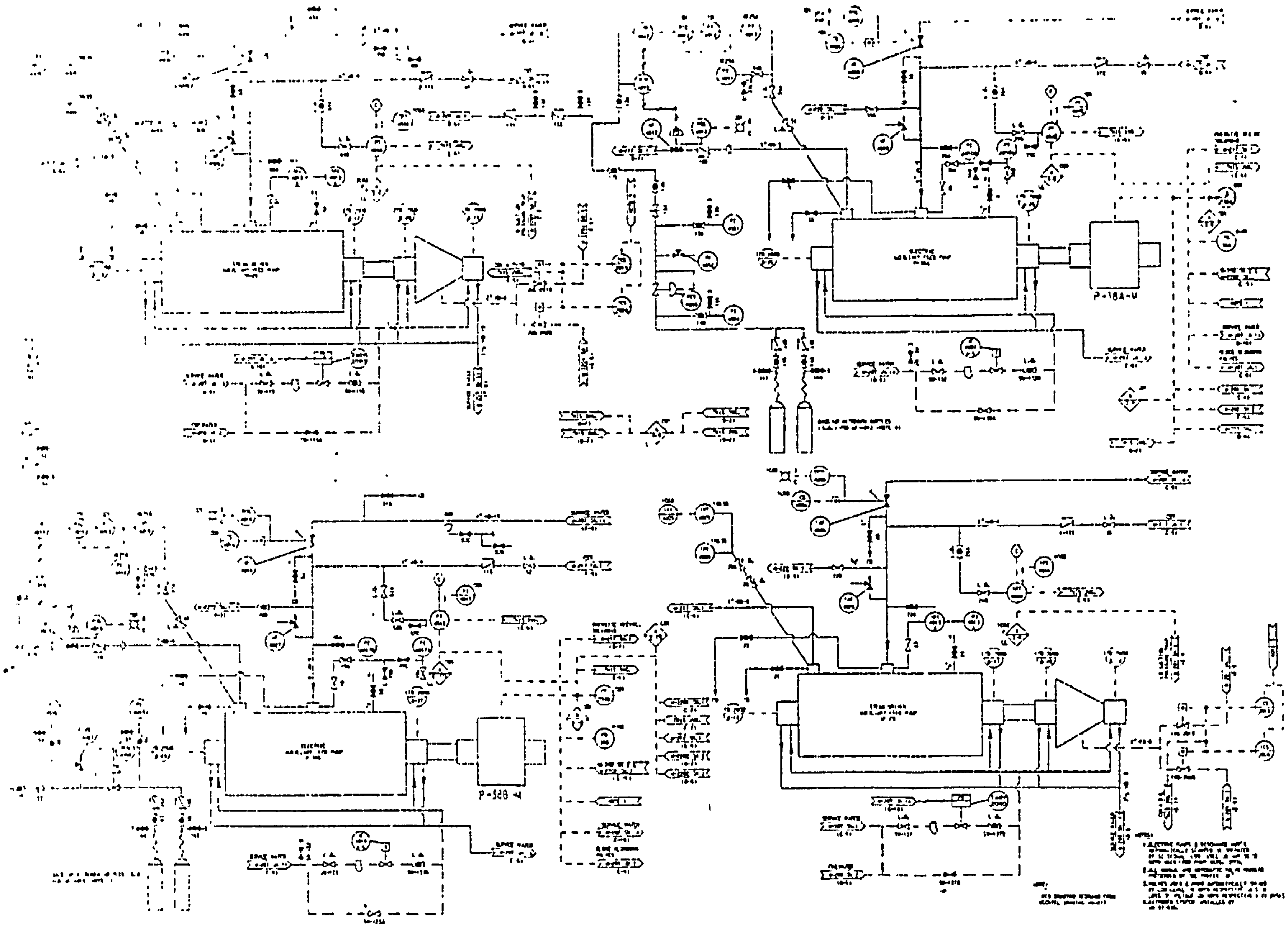
UNIT 1
AUXILIARY FEEDWATER SYSTEM
FLOW DIAGRAM
FIGURE 10.2-1 SH. 1

Fluid drawings are "INFORMATION ONLY" and do not necessarily reflect the most current drawing revision nor actual plant configuration under different operating modes.



BECH 6118 M-217 SH 2

UNITS 1 & 2
AUXILIARY FEEDWATER SYSTEM
FLOW DIAGRAM
FIGURE 10.2-1 SH. 2

Page	Description of Changes
Figure 10.1-1 (Sheets 1-3) Figure 10.1-1A (Sheets 1-2) Figure 10.1-2 (Sheets 1-2) Figure 10.1-2A (Sheet 1) Figure 10.1-3 (Sheet 2) Figure 10.1-3A (Sheets 1-2) Figure 10.1-4 (Sheet 1) Figure 10.1-4A (Sheet 1) Figure 10.1-6 Figure 10.1-6A Figure 10.1-6B (Sheet 2) Figure 10.1-7 Figure 10.1-7A Figure 10.1-8 Figure 10.1-8A	Updated figure to reflect P&ID revision of record in March 2001.
10.2-1	Licensing Basis Change. Clarified text to reflect that the 200 gpm flow can be to a "either" a single steam generator or "split between two steam generators". SE 2000-0070. FCR 00-081 (R. Chapman)
10.2-3	Licensing Basis Change. Added text, "Chemicals may be added using the tanks installed in the discharge headers or via a cart built to carry the chemicals and inject them into the suction headers. The use of the cart is preferred for reasons of personnel safety and ease of addition." SE 2000-0112, FCR 01-002 (J. Hawman) Editorial. Added reference for operator action of five minutes for switchover of AFW source to service water. FCR-00-048 (I. Netzel)
10.2-5	Licensing Basis Change. Clarified to state the application to a unit operating at 1518.5 MWt. SE 2000-0070. FCR 00-081 (R. Chapman) Licensing Basis Change. Clarified text to reflect that the 200 gpm flow can be to a "either" a single steam generator or "split between two steam generators". SE 2000-0070. FCR 00-081 (R. Chapman)
10.2-6	Licensing Basis Change. Clarified to state the application to a unit operating at 1518.5 MWt. SE 2000-0070. FCR 00-081 (R. Chapman) Editorial. Added reference to reference section regarding operator action of five minutes for switchover of AFW source to service water. FCR 00-048 (I. Netzel) Licensing Basis Change. Add new reference. NRC SER on USI A-46. SE 2000-0070. FCR 00-081 (R. Chapman)

10.2 AUXILIARY FEEDWATER SYSTEM (AF)

One turbine (per unit) and two electric-driven (shared by the two units) auxiliary feedwater pumps are provided to ensure that adequate feedwater is supplied to the steam generators for heat removal under all circumstances, including loss of power and normal heat sink. Feedwater flow can be maintained until power is restored or reactor decay heat removal can be accomplished by other systems. The auxiliary feedwater system is designed as a seismic Class I system. A backup supply of auxiliary feedwater can be provided from the seismic Class I portion of the service water system by positioning remotely-operated valves from the control room. See Figure 10.2-1.

10.2.1 DESIGN BASIS

The auxiliary feedwater system is designed to supply high-pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability or unavailability of the main feedwater system. In order to meet the design basis required in the Loss of Normal Feedwater/Loss of All AC analysis, one motor driven auxiliary feedwater pump provides 200 gpm of flow either to one steam generator or split between two steam generators within 5 minutes following receipt of a low-low steam generator water level setpoint signal. Redundant supplies are provided by two pumping systems using different sources of power for the pumps. The design capacity of each system is set so that the steam generators will not boil dry nor will the primary side relieve fluid through the pressurizer relief valves, following a loss of main feedwater flow with a reactor trip.

The AF system performs the following safety-related functions:

The AF system shall automatically start and deliver adequate AF system flow to maintain adequate steam generator levels during accidents which may result in main steam safety valve opening. Such accidents include; LOSS OF NORMAL FEEDWATER (LONF). FSAR Chapter 14.1.10, and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES (LOAC). FSAR Chapter 14.1.11, events. LONF and LOAC are time-sensitive to AF system start-up.

The AF system shall automatically start and deliver sufficient AF system flow to maintain adequate steam generator levels during accidents which require rapid reactor coolant system cooldown to achieve the cold shutdown condition within the limits of the analysis. Such accidents include; STEAM GENERATOR TUBE RUPTURE (SGTR), FSAR Chapter 14.2.4, and MAIN STEAM LINE BREAK (MSLB). FSAR Chapter 14.2.5.

The AF system shall be capable of isolating the AF steam and feedwater supply lines from the ruptured steam generator following a SGTR event.

The AF system also performs the following functions related to regulatory commitments:

In the event of a station blackout (prolonged loss of offsite and onsite AC power) affecting both units, the AF system shall be capable of automatically supplying sufficient feedwater to remove decay heat from both units without any reliance on AC power for one hour (Reference 1).

In the event of plant fires, including those requiring evacuation of the control room, the AF system shall be capable of manual initiation to provide feedwater to a minimum of one steam generator per unit at sufficient flow and pressure to remove decay and sensible heat from the reactor coolant system over the range from hot shutdown to cold shutdown conditions. The AF system shall support achieving cold shutdown within 72 hours (Reference 2).

In the event of an Anticipated Transient Without Scram (ATWS), the AF system shall be capable of automatic actuation by use of equipment that is diverse from the reactor trip system. This is accomplished by the AMSAC system described in FSAR Section 7.4. An AFW pump start delay time of less than equal to 90 seconds is assumed in the ATWS analysis. This delay time consists of a 30 second AMSAC time delay plus a 60 second AF system pump start response time. (Reference 4)

10.2.2 SYSTEM DESIGN AND OPERATION

The auxiliary feedwater system consists of two electric motor-driven pumps, two steam turbine-driven pumps, pump suction and discharge piping, and the controls and instrumentation necessary for operation of the system. Redundancy is provided by utilizing two pumping systems, two different sources of power for the pumps, and two sources of water supply to the pumps. The system is categorized as seismic Class I and is designed to ensure that a single fault will not obstruct the system function.

One system utilizes a steam turbine-driven pump for each unit (1/2P-29) with the steam capable of being supplied from either or both steam generators. This system is capable of supplying 400 gpm of feedwater to a unit, or 200 gpm to each steam generator through normally throttled MOVs AF-4000 and AF-4001. The feedwater flowrate from the turbine-driven auxiliary feedwater pump depends on the throttle position of these MOVs. Check valves are provided to help prevent backflow when the pumps are not in service. Each pump has an AOV (AF-4002) controlled recirculation line back to the condensate storage tanks to ensure minimum flow to dissipate pump heat. The pump drive is a single-stage turbine, capable of quick starts from cold standby and is directly connected to the pump. The turbine is started by opening either one or both of the isolation valves (MS-2019 and MS-2020) between the turbine supply steam header and the main steam lines upstream of the main steam isolation valves. The turbine and pump are normally cooled by service water with an alternate source of cooling water from the firewater system.

The other system is common to both units and utilizes two similar motor-driven pumps (P-38A and P-38B), each capable of obtaining its electrical power from the plant emergency diesel generators. Each pump has a capacity of 200 gpm with pump P-38A capable of supplying the A steam generator in either or both units through an AOV back-pressure control valve AF-4012 and normally closed MOVs, AF-4022 and AF-4023, and with pump P-38B capable of supplying the B steam generator in either or both units through an AOV back-pressure control valve AF-4019 and normally closed MOVs AF-4020 and AF-4021. Both back-pressure control valves fail open when instrument air to the valves is lost. The valves are provided with a backup nitrogen supply to provide pneumatic pressure in the event of a loss of instrument air. This backup supply assures that the valves do not move to the full open position which combined with low steam generator pressures may cause the pump motor to trip on time overcurrent due to high flow conditions. Each pump has an AOV, AF-4007 for P-38A and AF-4014 for P-38B, controlled recirculation line back to the condensate storage tanks to ensure minimum flow to prevent hydraulic instabilities and dissipate pump heat. The discharge headers also provide piping, valves, and tanks for chemical additions to any steam generator. The pump bearings are ring lubricated and bearing oil is cooled by service water. Chemicals may be added using the tanks installed in the discharge headers or via a cart built to carry the chemicals and inject them into the suction headers. The use of the cart is preferred for reasons of personnel safety and ease of addition.

The water supply source for the auxiliary feedwater system is redundant. The normal source is by gravity feed from two nominal capacity 45,000 gallon condensate storage tanks while the safety-related supply is taken from the plant service water system whose pumps are powered from the diesel generators if station power is lost.

It is possible that a loss of normal feedwater initiated by a seismic event could also result in the interruption of the normal source of auxiliary feedwater from the condensate storage tanks because the condensate storage tanks are not classified as seismic Class I. The plant operators would be alerted to this problem by receipt of low suction pressure alarms on the auxiliary feedwater pumps. Pump protection is ensured by providing a low suction pressure trip. This trips the motor-driven pump breakers and the turbine-driven pump trip/throttle valves 1MS-2082 and 2MS-2082, to ensure that the pumps are available, after a loss of condensate suction, to be switched to the safety-related water supply. Switchover to the alternate source of seismically qualified auxiliary feedwater, the service water system. can be accomplished by the operators in five minutes or less (Reference 3).

The auxiliary feedwater system has no functional requirements during normal, at power. plant operation. It is used during plant startup and shutdown and during hot shutdown or hot standby conditions when chemical additions or small feedwater flow requirements do not warrant the operation of the main feedwater and condensate systems.

During normal plant operations, the auxiliary feedwater system is maintained in a standby condition ready to be placed in operation automatically when conditions require. The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Turbine-driven feedwater pumps

1. Low-low water level in both steam generators in one unit starts the corresponding pump.
2. Loss of both 4.16 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.
3. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit starts the corresponding pump. These signals are processed through AMSAC at power levels above 40%.

Motor-driven feedwater pumps

1. Low-low water level in either associated steam generator.
2. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit. These signals are processed through AMSAC at power levels above 40%.
3. Safeguards sequence signal.

The Anticipated Transients Without Scram Mitigating System Actuation Circuit (AMSAC) is further discussed in FSAR Section 7.4.

The motor-driven auxiliary feedwater pump discharge motor operated valves are configured to open automatically, and the steam generator blowdown isolation valves are configured to close automatically, based upon the same signals that start the motor-driven pumps. This ensures automatic delivery of design basis auxiliary feedwater flow to an affected unit's steam generators without operator action. Auxiliary feedwater pump flow and direct flow indication for each steam generator is provided in the control room. Flow indication is also available locally at the discharge of each pump.

10.2.3 SYSTEM EVALUATION

In the event of complete loss of offsite electrical power to the station, decay heat removal would continue to be assured for each unit by the availability of either the turbine-driven auxiliary feedwater pump or one of the two motor-driven auxiliary feedwater pumps, and discharge to the atmosphere via the main steam safety valves or atmospheric relief valves. One motor-driven pump is capable of supplying sufficient feedwater for removal of decay heat from a unit operating at a power of 1518.5 MWt. In this case, feedwater is available from the condensate storage tanks by gravity feed to the auxiliary feedwater pumps. When the water in the condensate storage tanks is depleted, suction for the pumps can be shifted to the service water system via remotely operated MOVs from the control room to provide makeup water from the lake for an indefinite time period.

During a Station Blackout (SBO) event, only the turbine-driven pumps would be available for decay heat removal. The turbine-driven pumps are capable of supplying feedwater to the steam generators without an AC power source. The steam supply and auxiliary feedwater discharge valves are powered from diverse sources of vital 125V DC. Cooling water for the pump and turbine bearings can be supplied from the diesel driven firewater pump. The Technical Specification minimum amount of water in the condensate storage tanks, 13,000 gallons per operating unit, provides adequate makeup to the steam generators to maintain each unit in a hot shutdown condition for at least one hour concurrent with a loss of all AC power. Further information on the SBO event is provided in Appendix A.1. (Reference 1)

In order to meet the design basis, the limiting accident analysis of LOSS OF NORMAL FEEDWATER and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES assumes either that one motor driven auxiliary feedwater pump provides 200 gpm of flow to one steam generator or split between two steam generators within 5 minutes following receipt of a low-low steam generator water level setpoint signal.

These minimum parameters are met or exceeded by system design and verified by required testing. The three other accident analyses which assume auxiliary feedwater initiation for mitigation are LOSS OF EXTERNAL ELECTRICAL LOAD, RUPTURE OF A STEAM PIPE, and STEAM GENERATOR TUBE RUPTURE. For these accidents, minimum auxiliary feedwater assumptions are not specified and in the latter two, auxiliary feedwater isolation to the affected steam generator is assumed. Although the auxiliary feedwater system may be initiated during a SMALL BREAK LOCA, the event has been analyzed with no credit for auxiliary feedwater.

Based on the operating characteristics of the minimum recirculation flow control scheme, a portion of each motor-driven auxiliary feedwater pump's discharge flow will be automatically recirculated to the condensate storage tank for approximately forty-five seconds after the pump starts. The forty-five second time delay in closing the mini-flow recirculation control valves is incorporated in the design to provide for pump stability and cooling during coastdown.

A postulated control failure causing a single motor-driven AFW pump recirculation valve (AF-4007 or AF-4014) to fail open will divert approximately 89 gpm pump flow from the associated steam generator back to the Condensate Storage Tank. However, the AFW flow to the steam generators from the other motor-driven pump and the unit turbine-driven pump are not affected by this failure. Similarly, if the control failure causes a single turbine-driven pump recirculation valve (AF-4002) to fail open, the failure will divert approximately 126 gpm of turbine-driven pump flow to the condensate storage tank, but will not affect flow to the steam generators from either motor-driven pump. For either of these control failures, the AFW system will be capable of supplying greater than the required 200 gpm per unit.

A failure analysis has been made and the results for the auxiliary feedwater pumps show that the failure or malfunction of any single active component will not prevent the system from performing its emergency function. Results are presented below.

Malfunction	Comments and Consequences
One AFW pump fails to start (following loss of main feedwater)	Four AFW pumps provided; each steam-driven pump is dedicated to one unit and each motor-driven pump is shared between units. Any three of the four AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units.
Two AFW pumps fail to stop (trip) when required and subsequently run to failure (following a seismic- induced loss of main feedwater event)	Each AFW pump is provided with low suction pressure protection following a seismic event. Evaluations for a seismic-induced LONF event show that any two AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units operating at 1518.5 MWt.

10.2.4 REQUIRED PROCEDURES AND TESTS

The AF system components are tested and inspected in accordance with Technical Specification surveillance criteria and frequencies. Testing verifies motor-driven pump operability, turbine-driven pump operability including a cold start, and operability of all required MOVs. Control circuits, starting logic, and indicators are verified operable by their respective functional test.

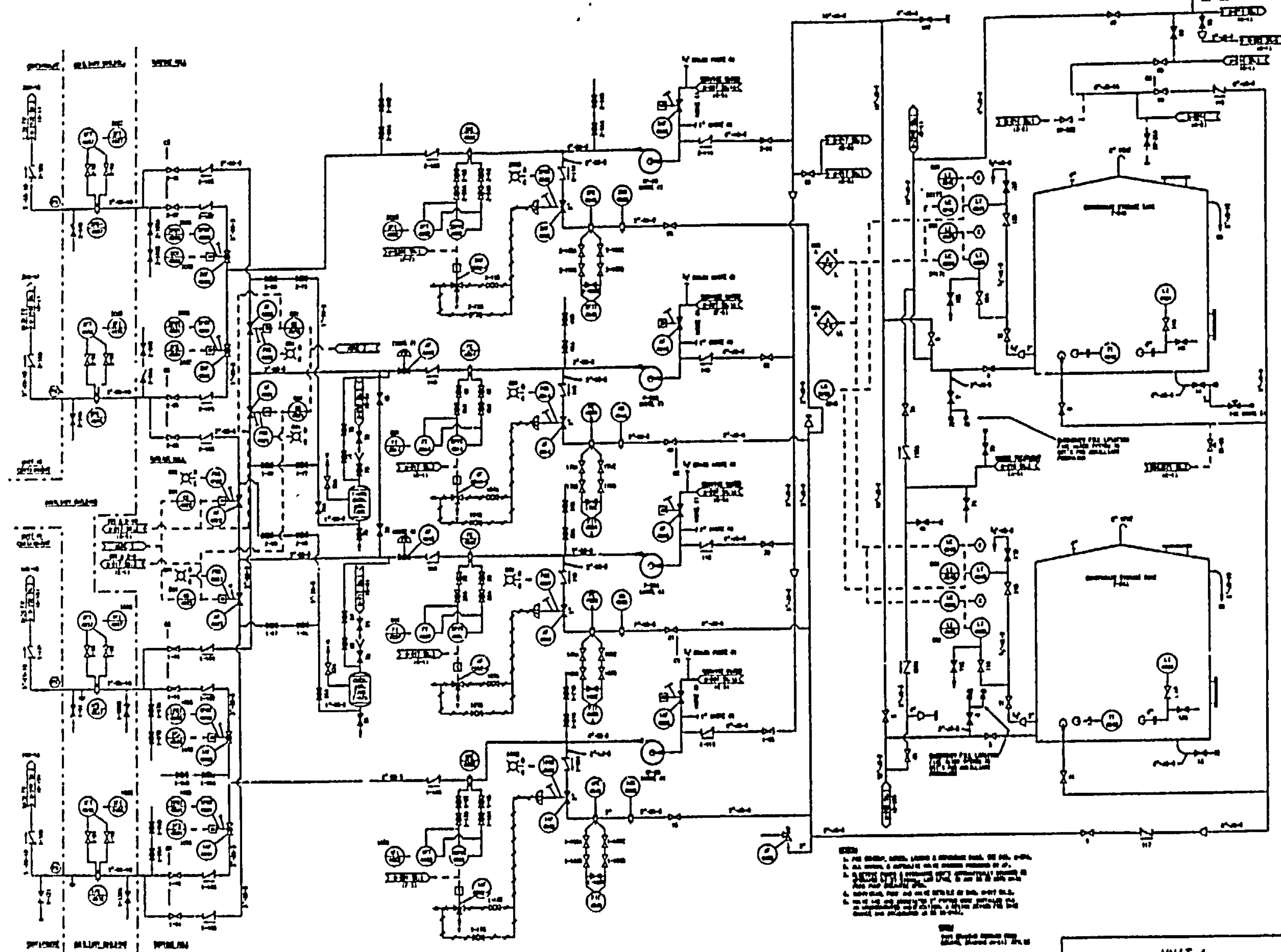
10.2.5 REFERENCES

1. FSAR Appendix A.1, Station Blackout

2. PBNP Fire Protection Evaluation Report (FPER)

3. NRC SER "Safety Evaluation on the Resolution of Unresolved Safety Issue A-46 at Point Beach Nuclear Plant Units 1 and 2 (TAC Nos. M69472 and M69473)", Enclosure page 3 of 10, dated July 7, 1998

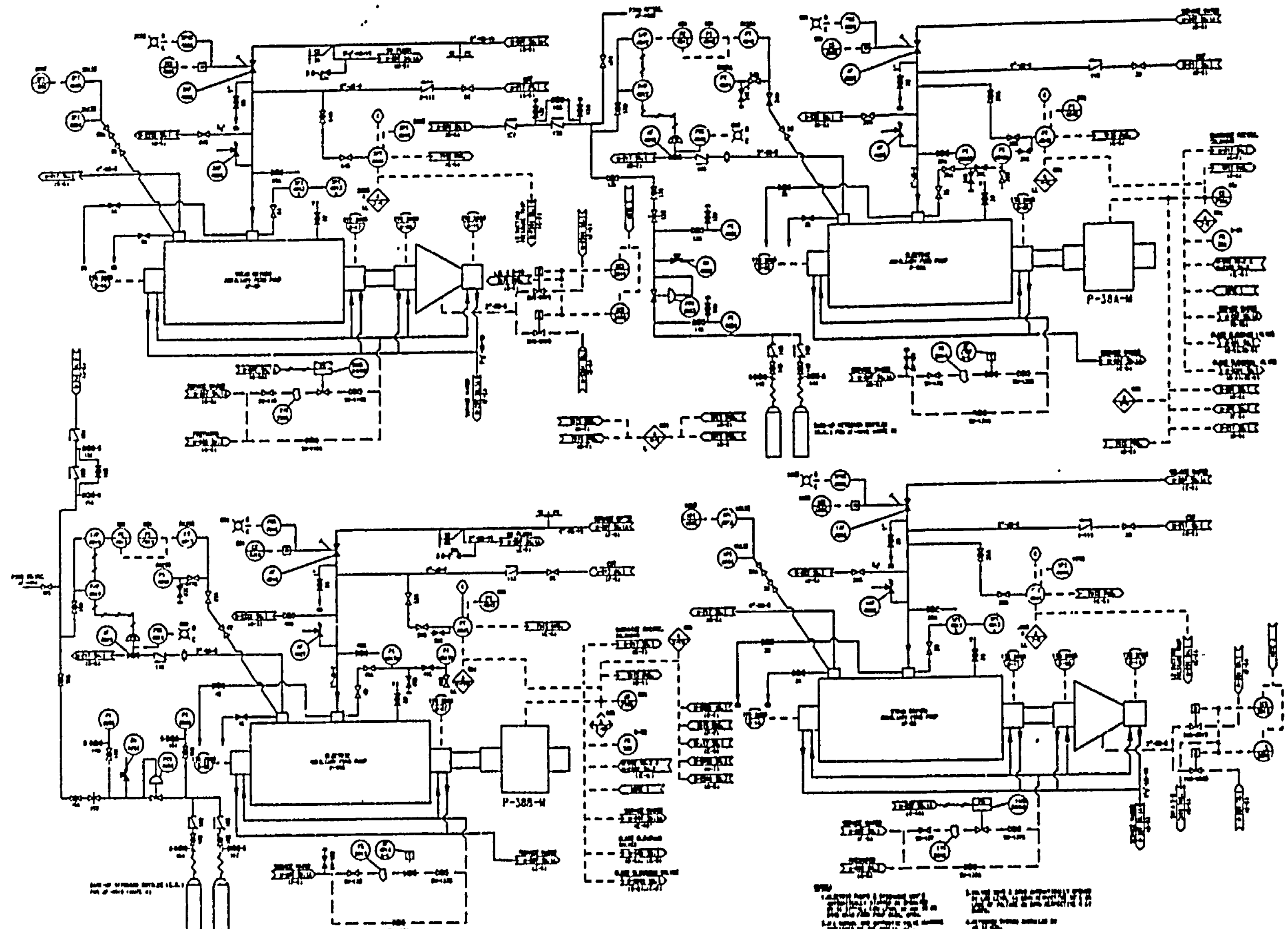
4. NRC SER "ATWS RULE (10 CFR 50.62) TACS 59128 and 59129," August 4, 1988.



BECH 6118 M-217 SH.1

UNIT 1
AUXILIARY FEEDWATER SYSTEM
FLOW DIAGRAM
FIGURE 10.2-1 SH.1

FSAR drawings are "INFORMATION ONLY" and do not necessarily reflect the most current drawing revision nor actual plant configuration under different operating modes.



FSAR drawings are "INFORMATION ONLY" and do not necessarily reflect the most current drawing revision nor actual plant configuration under different operating modes.

BECH 6118 M-217 SH.2

UNITS 1 & 2
AUXILIARY FEEDWATER SYSTEM
FLOW DIAGRAM
FIGURE 10.2-1 SH.2

10.2 AUXILIARY FEEDWATER SYSTEM (AF)

One turbine (per unit) and two electric-driven (shared by the two units) auxiliary feedwater pumps are provided to ensure that adequate feedwater is supplied to the steam generators for heat removal under all circumstances, including loss of power and normal heat sink. Feedwater flow can be maintained until power is restored or reactor decay heat removal can be accomplished by other systems. The auxiliary feedwater system is designed as a Class I system. A backup supply of auxiliary feedwater can be provided from the Class I portion of the service water system by positioning remotely-operated valves from the control room. See Figure 10.2-1.

10.2.1 DESIGN BASIS

The auxiliary feedwater system is designed to supply high-pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability or unavailability of the main feedwater system. In order to meet the design basis required in the Loss of Normal Feedwater/Loss of All AC analysis, one motor driven auxiliary feedwater pump provides 200 gpm of flow either to one steam generator or split between two steam generators within 5 minutes following receipt of a low-low steam generator water level setpoint signal. Redundant supplies are provided by two pumping systems using different sources of power for the pumps. The design capacity of each system is set so that the steam generators will not boil dry nor will the primary side relieve fluid through the pressurizer relief valves, following a loss of main feedwater flow with a reactor trip.

The AF system performs the following safety-related functions:

The AF system shall automatically start and deliver adequate AF system flow to maintain adequate steam generator levels during accidents which may result in main steam safety valve opening. Such accidents include; LOSS OF NORMAL FEEDWATER (LONF), FSAR Chapter 14.1.10, and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES (LOAC), FSAR Chapter 14.1.11, events. LONF and LOAC are time-sensitive to AF system start-up.

The AF system shall automatically start and deliver sufficient AF system flow to maintain adequate steam generator levels during accidents which require rapid reactor coolant system cooldown to achieve the cold shutdown condition within the limits of the analysis. Such accidents include: STEAM GENERATOR TUBE RUPTURE (SGTR), FSAR Chapter 14.2.4, and MAIN STEAM LINE BREAK (MSLB), FSAR Chapter 14.2.5.

The AF system shall be capable of isolating the AF steam and feedwater supply lines from the ruptured steam generator following a SGTR event.

The AF system also performs the following functions related to regulatory commitments:

In the event of a station blackout (prolonged loss of offsite and onsite AC power) affecting both units, the AF system shall be capable of automatically supplying sufficient feedwater to remove decay heat from both units without any reliance on AC power for one hour (Reference 1).

In the event of plant fires, including those requiring evacuation of the control room, the AF system shall be capable of manual initiation to provide feedwater to a minimum of one steam generator per unit at sufficient flow and pressure to remove decay and sensible heat from the reactor coolant system over the range from hot shutdown to cold shutdown conditions. The AF system shall support achieving cold shutdown within 72 hours (Reference 2).

10.2.2 SYSTEM DESIGN AND OPERATION

The auxiliary feedwater system consists of two electric motor-driven pumps, two steam turbine-driven pumps, pump suction and discharge piping, and the controls and instrumentation necessary for operation of the system. Redundancy is provided by utilizing two pumping systems, two different sources of power for the pumps, and two sources of water supply to the pumps. The system is categorized as seismic Class I and is designed to ensure that a single fault will not obstruct the system function.

One system utilizes a steam turbine-driven pump for each unit (1/2P-29) with the steam capable of being supplied from either or both steam generators. This system is capable of supplying 400 gpm of feedwater to a unit, or 200 gpm to each steam generator through normally throttled MOVs AF-4000 and AF-4001. The feedwater flowrate from the turbine-driven auxiliary feedwater pump depends on the throttle position of these MOVs. Check valves are provided to help prevent backflow when the pumps are not in service. Each pump has an AOV (AF-4002) controlled recirculation line back to the condensate storage tanks to ensure minimum flow to dissipate pump heat. The pump drive is a single-stage turbine, capable of quick starts from cold standby and is directly connected to the pump. The turbine is started by opening either one or both of the isolation valves (MS-2019 and MS-2020) between the turbine supply steam header and the main steam lines upstream of the main steam isolation valves. The turbine and pump are normally cooled by service water with an alternate source of cooling water from the firewater system.

The other system is common to both units and utilizes two similar motor-driven pumps (P-38A and P-38B), each capable of obtaining its electrical power from the plant emergency diesel generators. Each pump has a capacity of 200 gpm with pump P-38A capable of supplying the A steam generator in either or both units through an AOV back-pressure control valve AF-4012 and normally closed MOVs, AF-4022 and AF-4023, and with pump P-38B capable of supplying the B steam generator in either or both units through an AOV back-pressure control valve AF-4019 and normally closed MOVs AF-4020 and AF-4021. Both back-pressure control valves fail open when instrument air to the valves is lost. The valves are provided with a backup nitrogen supply to provide pneumatic pressure in the event of a loss of instrument air. This backup supply assures that the valves do not move to the full open position which combined with low steam generator pressures may cause the pump motor to trip on time overcurrent due to high flow conditions. Each pump has an AOV, AF-4007 for P-38A and AF-4014 for P-38B, controlled recirculation line back to the condensate storage tanks to ensure minimum flow to prevent hydraulic instabilities and dissipate pump heat. The discharge headers also provide piping, valves, and tanks for chemical additions to any steam generator. The pump bearings are ring lubricated and bearing oil is cooled by service water. Chemicals may be added using the tanks installed in the discharge headers or via a cart built to carry the chemicals and inject them into the suction headers. The use of the cart is preferred for reasons of personnel safety and ease of addition.

The water supply source for the auxiliary feedwater system is redundant. The normal source is by gravity feed from two nominal capacity 45,000 gallon condensate storage tanks while the safety-related supply is taken from the plant service water system whose pumps are powered from the diesel generators if station power is lost.

It is possible that a loss of normal feedwater initiated by a seismic event could also result in the interruption of the normal source of auxiliary feedwater from the condensate storage tanks because the condensate storage tanks are not classified as seismic Class I. The plant operators would be alerted to this problem by receipt of low suction pressure alarms on the auxiliary feedwater pumps. Pump protection is ensured by providing a low suction pressure trip. This trips the motor-driven pump breakers and the turbine-driven pump trip/throttle valves 1MS-2082 and 2MS-2082, to ensure that the pumps are available, after a loss of condensate suction, to be switched to the safety-related water supply. Switchover to the alternate source of seismically qualified auxiliary feedwater, the service water system, can be accomplished by the operators in five minutes or less (Reference 3).

The auxiliary feedwater system has no functional requirements during normal, at power, plant operation. It is used during plant startup and shutdown and during hot shutdown or hot standby conditions when chemical additions or small feedwater flow requirements do not warrant the operation of the main feedwater and condensate systems.

During normal plant operations, the auxiliary feedwater system is maintained in a standby condition ready to be placed in operation automatically when conditions require. The auxiliary feedwater pumps are automatically started on receipt of any of the following signals:

Turbine-driven feedwater pumps

1. Low-low water level in both steam generators in one unit starts the corresponding pump.

2. Loss of both 4.16 kv buses supplying the main feedwater pump motors in one unit starts the corresponding auxiliary feedwater pump.

3. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit starts the corresponding pump. These signals are processed through AMSAC at power levels above 40%.

Motor-driven feedwater pumps

1. Low-low water level in either associated steam generator.

2. Trip or shutdown of both main feedwater pumps or closure of both feedwater regulating valves in one unit. These signals are processed through AMSAC at power levels above 40%.

3. Safeguards sequence signal.

The Anticipated Transients Without Scram Mitigating System Actuation Circuit (AMSAC) is further discussed in FSAR Section 7.4.

The motor-driven auxiliary feedwater pump discharge motor operated valves are configured to open automatically, based upon the same signals that start the motor-driven pumps. This ensures automatic delivery of auxiliary feedwater flow to an affected unit's steam generators without operator action. Auxiliary feedwater pump flow and direct flow indication for each steam generator is provided in the control room. Flow indication is also available locally at the discharge of each pump.

10.2.3 SYSTEM EVALUATION

In the event of complete loss of offsite electrical power to the station, decay heat removal would continue to be assured for each unit by the availability of either the turbine-driven auxiliary feedwater pump or one of the two motor-driven auxiliary feedwater pumps, and discharge to the atmosphere via the main steam safety valves or atmospheric relief valves. One motor-driven pump is capable of supplying sufficient feedwater for removal of decay heat from a unit operating at a power of 1518.5 MWt. In this case, feedwater is available from the condensate storage tanks by gravity feed to the auxiliary feedwater pumps. When the water in the condensate storage tanks is depleted, suction for the pumps can be shifted to the service water system via remotely operated MOVs from the control room to provide makeup water from the lake for an indefinite time period.

During a Station Blackout (SBO) event, only the turbine-driven pumps would be available for decay heat removal. The turbine-driven pumps are capable of supplying feedwater to the steam generators without an AC power source. The steam supply and auxiliary feedwater discharge valves are powered from diverse sources of vital 125V DC. Cooling water for the pump and turbine bearings can be supplied from the diesel driven firewater pump. The Technical Specification minimum amount of water in the condensate storage tanks, 13,000 gallons per operating unit, provides adequate makeup to the steam generators to maintain each unit in a hot shutdown condition for at least one hour concurrent with a loss of all AC power. Further information on the SBO event is provided in Appendix A.1. (Reference 1)

In order to meet the design basis, the limiting accident analysis of LOSS OF NORMAL FEEDWATER and LOSS OF ALL AC POWER TO THE STATION AUXILIARIES assumes either that one motor driven auxiliary feedwater pump provides 200 gpm of flow to one steam generator or split between two steam generators within 5 minutes following receipt of a low-low steam generator water level setpoint signal.

These minimum parameters are met or exceeded by system design and verified by required testing. The three other accident analyses which assume auxiliary feedwater initiation for mitigation are LOSS OF EXTERNAL ELECTRICAL LOAD, RUPTURE OF A STEAM PIPE, and STEAM GENERATOR TUBE RUPTURE. For these accidents, minimum auxiliary feedwater assumptions are not specified and in the latter two, auxiliary feedwater isolation to the affected steam generator is assumed. Although the auxiliary feedwater system may be initiated during a SMALL BREAK LOCA, the event has been analyzed with no credit for auxiliary feedwater.

Based on the operating characteristics of the minimum recirculation flow control scheme, a portion of each motor-driven auxiliary feedwater pump's discharge flow will be automatically recirculated to the condensate storage tank for approximately forty-five seconds after the pump starts. The forty-five second time delay in closing the mini-flow recirculation control valves is incorporated in the design to provide for pump stability and cooling during coastdown.

A postulated control failure causing a single motor driven AFW pump recirculation valve (AF-4007 or AF-4014) to fail open will divert approximately 89 gpm pump flow back to the associated steam generator. However, the AFW flow to the steam generators from the other motor-driven pump and the unit turbine-driven pump are not affected by this failure. Similarly, if the control failure causes a single turbine-driven pump recirculation valve (AF-4002) to fail open, the failure will divert approximately 126 gpm of turbine-driven pump flow to the condensate storage tank, but will not affect flow to the steam generators from either motor-driven pump. For either of these control failures, the AFW system will be capable of supplying greater than the required 200 gpm per unit.

A failure analysis has been made and the results for the auxiliary feedwater pumps show that the failure or malfunction of any single active component will not prevent the system from performing its emergency function. Results are presented below.

Malfunction	Comments and Consequences
One AFW pump fails to start (following loss of main feedwater)	Four AFW pumps provided; each steam-driven pump is dedicated to one unit and each motor-driven pump is shared between units. Any three of the four AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units.
Two AFW pumps fail to stop (trip) when required and subsequently run to failure (following a seismic- induced loss of main feedwater event)	Each AFW pump is provided with low suction pressure protection following a seismic event. Evaluations for a seismic-induced LONF event show that any two AFW pumps provide the required feedwater flow to remove sufficient decay heat from both units operating at 1518.5 MWt.

10.2.4 REQUIRED PROCEDURES AND TESTS

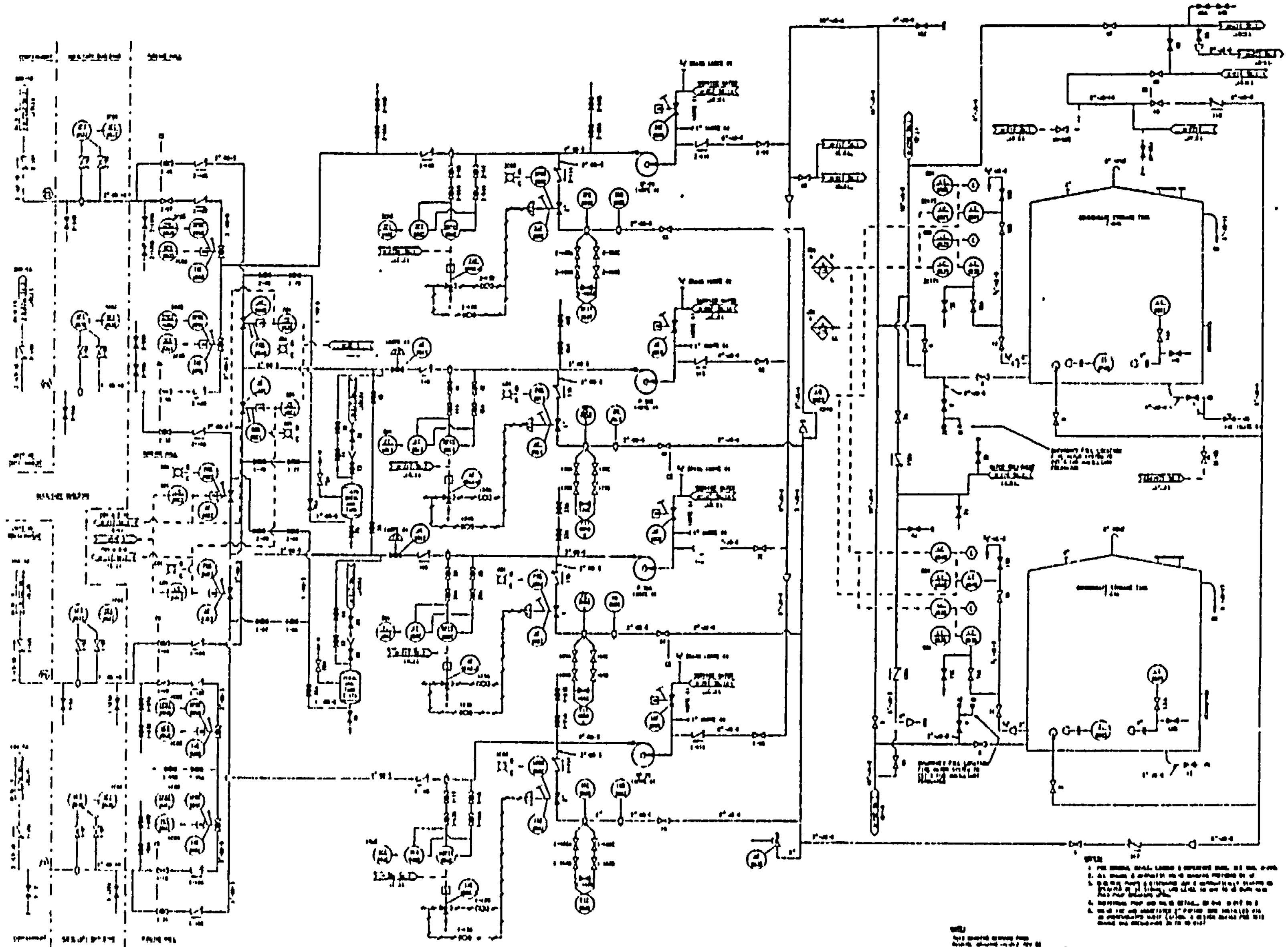
The AF system components are tested and inspected in accordance with Technical Specification surveillance criteria and frequencies. Testing verifies motor-driven pump operability, turbine-driven pump operability including a cold start, and operability of all required MOVs. Control circuits, starting logic, and indicators are verified operable by their respective functional test.

10.2.5 REFERENCES

1. FSAR Appendix A.1, Station Blackout

2. PBNP Fire Protection Evaluation Report (FPER)

3. NRC SER "Safety Evaluation on the Resolution of Unresolved Safety Issue A-46 at Point Beach Nuclear Plant Units 1 and 2 (TAC Nos. M69472 and M69473)". Enclosure page 3 of 10, dated July 7, 1998.



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UNIT 1
AUXILIARY FEEDWATER SYSTEM
FLOW DIAGRAM
FIGURE 10.2-1 SH.1

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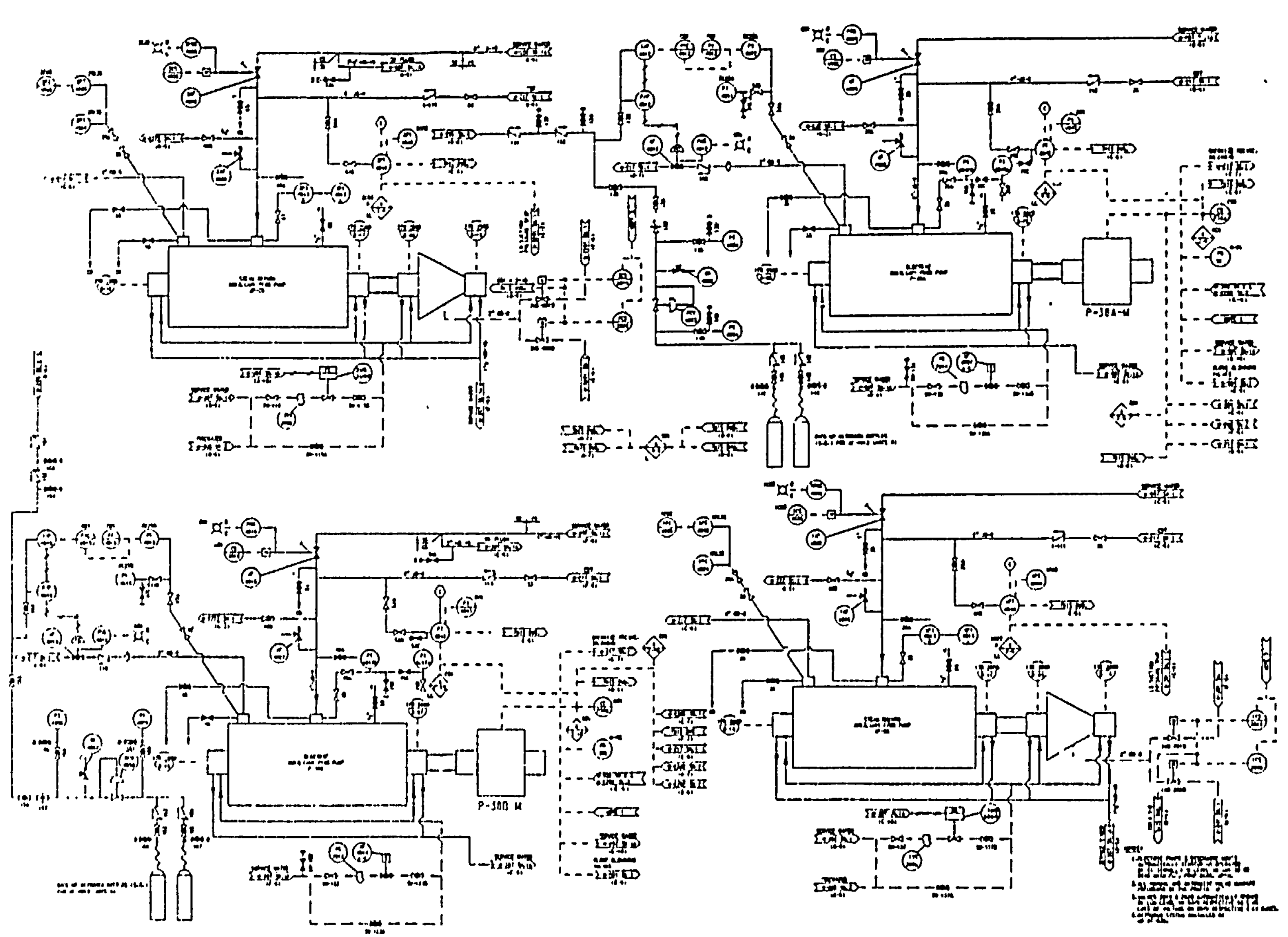

BECH 6110 M-217 SH.2

UNITS 1 & 2
AUXILIARY FEEDWATER SYSTEM
FLOW DIAGRAM
FIGURE 10.2-1 SH.2

Page	Description of Changes
10.2-2	Licensing Basis Change. Added discussion of the ATWS function for the AF system, including assumed AF system delay times. Although this information is already part of the Point Beach licensing basis, adding it to the FSAR is not considered an editorial change per NP 5.1.8. NRC SER (NPC-37920), "Compliance with ATWS Rule 10 CFR 50 62", FCR 01-052 (J. Olvera).
10.2-4	Licensing Basis Change. Revised description of SG blowdown valve close logic that was modified per MR 01-052. SG blowdown valves close automatically on an auto start of the motor driven AF pumps. SER 2001-0034, FCR 01-037 (C. Drescher).
10.2-6	Editorial Change. Revise first sentence to specify that the flow path of the AF recirculation line is to the Condensate Storage tank, not back to the steam generator. FCR 01-039 (J. P. Schroeder)
10.2-6	Licensing Basis Change. Added Reference No. 4, the NRC SER on the PBNP compliance with the ATWS Rule. Although this information is already part of the Point Beach licensing basis, adding it to the FSAR is not considered an editorial change per NP 5.1.8. NRC SER (NPC-37920), "Compliance with ATWS Rule 10 CFR 50.62", FCR 01-052 (J. Olvera).
Figure 10.2-1 Sheets 1-2	Updated figure to reflect approved P&ID changes of record on February 15, 2002.

CHAPTER 11

Page	Description of Changes
11.1-6	Licensing Basis Change. Change "Technical Specification 15.7.6" to "Control Manual (RECM)". The administrative requirements have been moved to the RECM section of the REMCAP. NRC SER 2001-0007, FCR 01-041 (J. Sell).
Figure 11.1-1	Updated figure to reflect approved P&ID changes of record on February 15, 2002.
Figure 11.1-2	Updated figure to reflect approved P&ID changes of record on February 15, 2002.
Figure 11.2-1 Sheets 1-3	Updated figure to reflect approved P&ID changes of record on February 15, 2002.
Figure 11.2-4	Updated figure to reflect approved P&ID changes of record on February 15, 2002.
11.8-1	Editorial Change. Revised "Nuclear Power Business Unit" to "Point Beach Nuclear Plant." FCR 02-013 (D. Black).
11.8-1	Licensing Basis Change. Revised "Technical Specifications" to "the PBNP Technical Requirements Manual (TRM). Section 3.7.4." NRC SER 2001-007. FCR 01-041 (J. Sell).

CHAPTER 12

Page	Description of Changes
12.2-1	Editorial Change. Added text referring to the added References 1 and 2. FCR 02-014 (D. Black).
12.2-1	Licensing Basis Change. Added discussion that the Site Vice-President is responsible for both Point Beach and the Kewaunee Nuclear Power Plant, and that NMC is the authorized licensee for Kewaunee. NRC SER 2000-007, FCR 02-014 (D. Black).