Attachment 12 to

GNRO-2012/00039

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GRAND GULF
NUCLEAR STATION

LESSON PLAN

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TRAINING PROGRAM:

GENERAL PLANT SYSTEMS TRAINING

TITLE:

STANDBY SERVICE WATER (SSW) – P41

☐ Minor Revision ☒ Major Revision

REASON FOR REVISION: GPST Project per TEAR GGNS-2002-577.

THIS DOCUMENT REPLACES: GG-1-LP-ESP-P4100.02, Rev. 2

REVIEW / APPROVAL:

PREPARED BY: [signature] DATE: 4·2·03

REVIEWED BY: [signature] DATE: 4-2-03
Fully Qualified Instructor

APPROVED BY: [signature] DATE: 4/3/03
Training Supervisor

TECHNICAL REVIEW: [signature] DATE: 5/2/03
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REFERENCES:

1. ACAD 92-008, Guidelines for Training and Qualification of Maintenance Personnel
2. ACAD 93-008, Guidelines for Training and Qualification of Radiological Protection Technicians
3. ACAD 97-012, Guidelines for Training and Qualification of Chemistry Technicians
4. ACAD 98-004, Guidelines for Training and Qualification of Engineering Personnel
5. System Operating Instruction, 04-1-01- P41-1, Standby Service Water System
6. UFSAR, Section 9.2.1, Standby Service Water System
7. GGNS Technical Specifications and Technical Requirements Manual
8. O&MR 140

TEACHING TIME: 3 - 4 Hours

HANDOUTS:

1. Copy of lesson plan and figures

EQUIPMENT: Overhead Projector/Presentation Device

ELECTRONIC FILE LOCATION: j:\train\gpst\systems\p41\

SUGGESTED ENHANCED LEARNING ACTIVITIES (optional):

Hold That Thought:

> At the beginning of the class, have students count off. At various points throughout the presentation, the instructor, with the roll of dice or numbers drawn from a mug, asks the numbered student to begin the summarization of a selected and previously covered objective. The numbered student begins by stating or writing only five words related to the objective, as in an opening statement (e.g., the purpose of the pump). With the second roll of dice or number drawn, the instructor selects a student to continue the objective summarization, adding another five words (e.g., is to circulate water from). This action continues until the class and instructor agree a satisfactory objective summary has been provided.

TERMINAL OBJECTIVES

This lesson plan provides the trainee with the knowledge necessary to understand the contribution of the Standby Service Water System (SSW) and its components/subsystems to the integrated operation of the Grand Gulf Nuclear Station (GGNS).

ENABLING OBJECTIVES

Upon completion of this lesson, the student is expected to perform the following objectives. Performance will be from memory on a written examination unless otherwise indicated by a particular objective. Successful completion will be demonstrated by a score of ≥ 80% on the examination.

- State/Identify the purpose/function of the system. (1)
- State/Identify system and major component design and selected Technical Specification bases. (2)
- Given a simplified drawing, describe or trace the flow path for each mode of operation of the Standby Service Water System (SSW). (3)
- State/Identify the purpose/function of the following major components and equipment: (4)
  - SSW cooling tower basins (4.1)
  - SSW blowdown lines (4.2)
  - SSW cooling towers and fans (4.3)
  - SSW fill tank (4.4)
  - SSW pumps (4.5)
- Identify the building in which the following major components and equipment are located: (5)
  - SSW cooling tower basins (5.1)
  - SSW blowdown lines (5.2)
  - SSW cooling towers and fans (5.3)
  - SSW fill tank (5.4)
  - SSW pumps (5.5)
- Describe the operation/modes of operation for the system and major components. (6)

- Explain the basic interrelationship of this system with other plant systems. (7)

- Explain/Describe the importance of the Standby Service Water System (SSW) to plant safety and/or radioactivity containment from the following perspectives: (8)

  - How the system protects fission product barriers. (8.1)
  - If the system is Maintenance Rule Risk Significant and/or currently is in an (a)(1) status, discuss why. (8.2)
  - If the system is directly associated with an event analyzed in the UFSAR Chapter 15 Accident Analyses, briefly describe the event, including how it is mitigated. (8.3)

- For selected Technical Specification Limiting Conditions for Operation (LCO), determine their impact on plant operations for given conditions including safety limits and their bases and/or applicability. (9)

- For selected Operating Experience (OE) related to the (system) describe the concern of the event and its impact on GGNS plant operations. (10)

- State/Identify the components that can be supplied by: (11)

  - SSW loop A (11.1)
  - SSW loop B (11.2)
  - SSW loop C (11.3)

- State/Identify the automatic actions that will occur for all SSW Systems for the following: (12)

  - LPCS/LPCI/HPCS initiation (12.1)
  - HPCS/LPCS/RHR pump start/E51-F045 opening (12.2)
  - Diesel Start (12.3)
  - SSW manual initiation (12.4)
  - Loss of offsite power (12.5)

O&MR 140

INTRODUCTION

Review the terminal and enabling objectives with the class.

Review class ground rules.

Encourage the students to ask questions.

PURPOSE/FUNCTION

State/Identify the purpose/function of the system. (1)

1 The purposes of the SSW System are to:

Remove heat from the plant auxiliaries that require cooling water during an emergency shutdown of the plant.

Act as the ultimate heat sink for decay heat removal.

Provide a means of flooding the Drywell and the Containment.

Provide cooling water to essential plant components during a normal cooldown.

SYSTEM DESIGN BASES

State/Identify system and major component design and selected Technical Specification bases. (2)

2 The Standby Service Water System:

Containing the plant ultimate heat sink (UHS), is an essential auxiliary supporting system which is designed to remove heat from plant auxiliaries that are required for a safe reactor shutdown

Is designed to preclude leakage to the environment of radioactive contamination that may enter the SSW System from the Residual Heat Removal (RHR) System.

Provides a means of flooding the drywell and containment, if required, during the post-LOCA (Loss of Coolant Accident) period.

Worst single active failure is loss of one diesel generator.

Is designed to perform its cooling function following a LOCA, automatically and without operator action, assuming a single active or passive failure coincident with a loss of offsite power.

2 The SSW system is designed to perform its required function for all modes of system operation. Analysis of system operation has determined the following assumptions as the critical mode for evaluating the capability of the SSW system to perform its safety function:

LOCA occurs.

Total loss of offsite power.

The worst single active failure which, for this analysis, is the loss of one of the two standby diesel generators which removes one of the standby service water loops from operation.

No makeup water is available to the SSW cooling tower basins for 30 days.

Worst 30-day site meteorology for heat rejection.

These assumptions will result in the greatest heat rejection rate for the ultimate heat sink during the most severe meteorology for cooling tower heat rejection. All other modes are less severe with respect to heat rejection from the UHS and are considered to be enveloped by this analysis.

SYSTEM OVERVIEW

Discuss Human Performance Tools and Traps and Operational Events

Figures 1, 2 and 3

Given a simplified drawing, describe or trace the flow path for each mode of operation of the Standby Service Water System (SSW). (3)

3 The Standby Service Water (SSW) System consists of two forced draft cooling towers, two SSW pumps, one High Pressure Core Spray (HPCS) service water pump, and instrumentation necessary for providing a reliable source of heat rejection for plant components that require cooling during a normal or emergency plant shutdown or in the event of a reactor isolation. The Standby Service Water System is the ultimate heat sink for removal of reactor decay heat.

Makeup for both standby service water basins is provided automatically by the Plant Service Water (PSW) System. In the event the PSW System is not available, the service water basins contain enough water to ensure the availability of the system for 30 days.

MAJOR COMPONENT DESCRIPTION

Cooling Towers Basins

Address appropriate Equipment Reliability issues, current or historical, during presentation material in this section. Consult Equipment Reliability Home page as required.

State/Identify the purpose/function of the following major components and equipment: (4) • SSW cooling tower basins (4.1) Identify the building in which the following major components and equipment are located: (5) • SSW cooling tower basins (5.1) Describe the operation/modes of operation for the system and major components. (6)

Figures 1 and 2

4.1, 5.1 The cooling tower basins, located northwest of the Control Building, serve as the ultimate heat sink.

With a combined volume of approximately 15 million gallons, the system can operate for at least 30 days without requiring any makeup water.

In order to prohibit debris from entering the basins through the cooling tower openings, a screen is provided over the sump from which the service water pumps take suction.

- The screen openings are sized to filter any debris which could block a system flowpath and prevent adequate cooling water from reaching a heat exchanger.

6 Normally, basin water level is maintained by makeup valve LV-F504A(B) which supplies water from the Plant Service Water System.

- Makeup valve F504A(B) is located in the respective SSW Basin valve room.

A siphon line, installed between the basins and in operation at all times, equalizes the basin levels.

If the level of one basin decreases below that of the other, water flows to the basin with the lower level.

Basin transfer lines, originally designed to transfer inventory between the basins, are no longer used.

These transfer lines, connected to the SSW Pump discharge lines, contain transfer isolation valves F007A(B). A plant modification terminated the lines downstream of the respective transfer valve such

that flow through the line returns back to the originating basin. The transfer lines to the opposite basin are grouted shut.

SSW blowdown lines

> State/Identify the purpose/function of the following major components and equipment: (4)
>
> - SSW blowdown lines (4.2)
>
> Identify the building in which the following major components and equipment are located: (5)
>
> - SSW blowdown lines (5.2)
>
> Describe the operation/modes of operation for the system and major components. (6)

Chemistry control discussed later.

[4.2] Periodically, the addition of chemicals to the SSW System is required for control of scaling, biological growth, and general corrosion. Over time, the accumulation of fouling agents may require that the system be blown down to assist in water chemistry control.

Figures 1 and 2

[5.2] To accommodate the required blowdown, lines are connected to the SSW pump discharge lines with the blowdown flow routed to the plant discharge basin.

[6] To control the blowdown, each line is equipped with two blowdown isolation valves, F015A(B) and F016A(B), located in the respective SSW A and B pump rooms.

- [6] The blowdown valves automatically close on a LOCA or manual initiation of the respective loop of SSW.
- [6] With a LOCA signal present, the blowdown valves cannot be reopened until the LOCA signal has been reset.

SSW cooling towers and fans

State/Identify the purpose/function of the following major components and equipment: (4)

- SSW cooling towers and fans (4.3)

Identify the building in which the following major components and equipment are located: (5)

- SSW cooling towers and fans (5.3)

Describe the operation/modes of operation for the system and major components. (6)

The original design included two cells for Unit 1 and two cells for Unit 2 in each cooling tower.

4.3, 5.3 Associated with each SSW basin is a forced draft cooling tower and associated fans for cooling the water returning to the basin.

- Each SSW cooling tower is divided into four cooling cells, two for each unit.
- Each cooling cell contains its own cooling fan and drift eliminators, and is rated at 115.5 X 10^6 BTU/hr.
- As SSW is returned to the basin cooling towers through spargers, the cooling tower fans draw air through the sparger spray to remove the heat.

As stated earlier, each SSW cooling tower is divided into four cooling cells, with two cells for each unit, and a cooling fan for each cooling cell.

Figures 1 and 2

5.3 Fans C003A and C003B, located in SSW cooling tower A, are powered from ESF LCC 15BA5.

5.3 Fans C003C and C003D, located in SSW cooling tower B, are powered from ESF LCC 16BB5.

6 SSW cooling tower fans **A and B** are operated from the Control Room.

Both fans auto start on any **SSW System A** auto start signal.

6 SSW cooling tower fans **C and D** are operated from the Control Room.

Both fans auto start on any **SSW System B** auto start signal.

All four cooling tower fans are tripped by motor protection devices and stop on a loss of ESF bus voltage, but automatically restart when ESF bus voltage is restored.

If a standby service water auto start signal is present, these fans cannot be manually stopped until the start signal is reset.

SSW fill tank

State/Identify the purpose/function of the following major components and equipment: (4)

- SSW fill tank (4.4)

Identify the building in which the following major components and equipment are located: (5)

- SSW fill tank (5.4)

Describe the operation/modes of operation for the system and major components. (6)

Figures 1, 2 and 3

4.4, 5.4 The 550 gallon SSW fill tank, located in Area 9 on the 208' level in the Auxiliary Building, maintains the SSW and HPCS service water pump discharge lines filled to minimize water hammer when the systems initiate.

6 SSW fill tank outlet isolation valve F113 is controlled from the Control Room.

Auto closes on a LOCA or manual initiation of SSW Loop A.

Interlocked closed on a LOCA signal and cannot be manually opened until the LOCA signal is reset.

Makeup to the fill tank is supplied from the Plant Service Water System through makeup valve LV-F500.

SW Pumps

State/Identify the purpose/function of the following major components and equipment: (4)

- SSW pumps (4.5)

Identify the building in which the following major components and equipment are located: (5)

- SSW pumps (5.5)

Describe the operation/modes of operation for the system and major components. (6)

Figures 1, 2 and 3

4.5 Cooling water is pumped from the cooling tower basins by three SSW pumps, Pumps A and B, and the HPCS service water pump, Pump C, to the

essential components based upon plant conditions.

SSW Pumps A and B are vertical, centrifugal type pumps, rated at 12,000 gpm at a head of 270 feet.

SSW Pump C is a vertical, centrifugal type pump, rated at 1300 gpm at a head of 175 feet.

5.5 Pumps A and C are located in the SSW A basin pump house and Pump B is located in the SSW B basin pump house.

Power supplies for the SSW pumps are as follows:

- Pump A, 15AA
- Pump B, 16AB
- Pump C, 17B01

6 SSW Pumps A and B are operated from the Control Room.

Auto start on an SSW auto start signal from the respective loop logic.

- Cannot be manually stopped with the handswitch until the auto start signal is reset.

6 SSW Pumps A and B automatically trip on either of the following:

Motor protection device actuation.

Associated loss of ESF bus voltage or ESF bus load shedding.

- Pump will restart automatically by the ESF bus load sequencing logic after the associated bus voltage is restored.

Figure 3

6 The HPCS Service Water Pump, SSW Pump C, is also operated from the Control Room. .

Auto starts after a 10 second time delay by any of the following:

- Low Reactor water level, -41.6"
- High Drywell pressure, +1.39 psig
- HPCS Pump running
- HPCS Diesel Generator running
- Depressing the HPCS System manual initiation pushbutton.

Once auto started, manual tripping is inhibited until the auto start signal is cleared and reset.

On a loss of bus voltage, the pump stops but will restart immediately once voltage is restored.

SSW Loops A and B

> State/identify the components that can be supplied by SSW Loop A. (11.1)
>
> State/identify the components that can be supplied by SSW Loop B. (11.2)

Figures 1 & 2

11.1, 11.2 See Figures 1 & 2 to determine SSW Loop A/B loads

SSW Pump Discharge Valves

> Describe the operation/modes of operation for the system and major components. (6)

The SSW Pump A(B) discharge valve F001A(B)is operated from the Control Room.

6 F001A(B) automatically opens on an SSW System A(B) auto start signal after the SSW Pump A(B) breaker closes.

- With an auto start signal present, F001A(B) cannot be manually closed until the signal has been reset.

SSW Return to the Cooling Towers

Water from the SSW Loop A(B) loads is returned to SSW Cooling Tower A(B) through return valve F005A(B).

6 F005A(B) automatically opens on an SSW System A(B) auto start signal after the SSW Pump A(B) breaker closes.

- With an auto start signal present, F005A(B) cannot be manually closed until the signal has been reset.

6 F005A(B) can be manually throttled to the desired position during normal system startup (i.e., no auto start signal present).

SSW Pump Recirculation Lines

The SSW Pump A(B) recirculation valve F006A(B) automatically opens when the following conditions are present unless a LOCA signal or a Containment Spray initiation signal is present:

- An SSW System A(B) auto start signal due to a component start **and** F014A(B) or F068A(B) is closed (not full open).

F014A(B) normally closed and F068A(B) normally open.

F006A(B) automatically closes when the following conditions are present:

- An SSW System A(B) auto start signal due to a component start **and** F014A(B) and F068A(B) are full open.
- A LOCA signal or a containment spray signal.
  - With a LOCA signal or Containment Spray initiation signal present, F006A(B) cannot be manually opened until the LOCA and Containment Spray initiation logics have been manually reset.

Figures 1 and 2

The SSW Pump A(B) recirculation line contains a second motor-operated valve, F002A(B), which is deenergized and locked in a throttled position.

This throttled open valve, in conjunction with F006A(B), maintains pump discharge pressure below the pump discharge relief valve set pressure.

SSW Pump Motor Bearing Oil Cooler Supply

Figures 1 and 2

The SSW Pump A(B) motor bearing oil cooler supply line is connected to the SSW Pump A(B) discharge line through a normally open manual isolation valve.

Flow through this cooler passes directly back to the basin without passing through the Cooling Tower.

SSW to Diesel Generators 11 and 12

SSW flow through the Standby Diesel Generator 11(12) jacket water cooler is controlled by diesel cooling water supply valve F018A(B).

The F018A(B) automatically opens on a LOCA signal, SSW Loop A(B) manual initiation signal, or when Diesel Generator 11(12) is running at greater than 200 rpm.

- With a LOCA or diesel start signal present, F018A(B) cannot be closed until the auto open signal has been reset.

SSW to the FPCCU Heat Exchangers

Figures 1 and 2 More details provided in the Component Cooling Water System (P42) Lesson Plan.

SSW Loop A(B) functions as an alternate source of cooling water for Fuel Pool Cooling and Cleanup (FPCCU) Heat Exchanger A(B).

On low CCW flow through FPCCU Heat Exchanger A(B), CCW to the heat exchanger automatically isolates.

The SSW valves are **manually opened** by their respective handswitches, provided the CCW valves are closed.

SSW to the Drywell Purge Compressors

Drywell Purge Compressor A(B) receives cooling water from SSW Loop A(B) through valves F159A(B), F160A(B) and F168A(B).

All three isolation valves automatically open on a LOCA signal or SSW Loop A(B) manual initiation.

Once auto opened by a LOCA signal, the valves are NOT interlocked open, and can be closed, if necessary to isolate the Containment, by using the valve's associated handswitch.

- Overriding a valve closed with a LOCA signal present energizes the white override light associated with that valve.

SSW Supply to RHR

RHR Heat Exchangers 1A(1B) and 2A(2B) are isolated by F014A(B) and F068A(B).

F014A(B) and F068A(B) automatically open on a LOCA signal, SSW Loop A(B) manual initiation signal, or when Containment Spray is manually or automatically initiated.

- With a LOCA or Containment Spray initiation signal present, the valves cannot be closed until the auto open signal has been reset.

The RHR Pump A seal cooler is supplied by SSW Loop A through normally open manual inlet and outlet isolation valves.

The RHR Pump B and C seal coolers are both supplied by SSW Loop B through normally open manual inlet and outlet isolation valves.

Figure 2

SSW to RHR for Containment Flooding

The Containment Flooding mode of RHR provides a last resort method of flooding the core, Drywell, and Containment with Standby Service Water following a LOCA.

SSW enters the "B" loop of RHR downstream of the heat exchanger outlet valve and flows to the Reactor via the "B" Low Pressure Coolant

Injection (LPCI) line.

- Provides the capacity to flood the Vessel, Drywell, and Containment to a level higher than the top of the active fuel.

SSW to the Service Air and Instrument Air Compressors

Turbine Building Cooling Water (TBCW) is the normal supply to the Service Air and Instrument Air Compressors.

TBCW flow through the air compressors returns to the TBCW System via P43-F289, controlled from a local panel in the Water Treatment Building mezzanine area.

- F289 auto closes on a loss of offsite power.

Figures 2

SSW Loop B is the alternate source of cooling water to the compressors through supply valves F155A and F155B and return valve F154.

SSW to Drywell Chiller Condensers and CCW Heat Exchangers

Figures 2

The normal source of cooling water to the Drywell Chiller Condensers and Component Cooling Water (CCW) Heat Exchangers is the PSW system.

This supply line also provides cooling water to the plant chillers via P44-F115.

From the drywell chillers and CCW heat exchangers, PSW returns through P44-F011, also operated using a local handswitch, and P44-F068.

The alternate cooling water supply to the Drywell Chillers and CCW Heat Exchangers is SSW through P44-F054 and P44-F042, returning through P44-F067.

Upon receipt of a LOP signal, with no LOCA signal, PSW isolates and SSW unisolates to supply the Drywell Chillers and CCW Heat Exchangers.

P44-F115 and P44-F011 auto close.

Concurrently, P44-F042, P44-F054, and P44-F067 auto open.

When P44-F067 starts to open, P44-F068 also auto closes.

With a LOP or LOCA signal present, the valves cannot be manually repositioned until both the initiating condition and the LSS panel have been reset.

If a LOCA signal is received following receipt of a LOP, P44-F042, P44-F054, and P44-F067 auto close to isolate SSW to the Drywell Chillers and CCW Heat Exchangers.

SSW to Control Room Air Conditioning Units and Various Room Coolers

Control Room Air Conditioning Unit A is normally supplied by the PSW System through PSW supply valves F125 and F066A, and PSW return valve F074A.

Can be supplied by SSW Loop A through supply valve F064A and return valve F081A.

The PSW and SSW valves for control room A/C unit A are also controlled by the SSW Loop A Control Logic so that, when an initiation signal is generated, the PSW valves automatically close and the SSW valves automatically open.

- The initiation signal is generated on a LOCA, SSW Loop A manual initiation, or a loss of offsite power.
- With a LOP or LOCA signal present, the valves cannot be manually repositioned until both the initiating condition and the LSS panel have been reset.

Figures 2

The normal supply of cooling water for **Control Room Air Conditioning Unit B and "ESF B" electrical switchgear room coolers** is from the Plant Service Water System through supply isolation valve F066B and return isolation valves F074B and F189.

As an alternate source of cooling water, SSW Loop B can supply Control Room Air Conditioning Unit B and the "ESF B" switchgear room coolers through supply valve F064B and return valve F081B.

The PSW and SSW valves for Control Room A/C Unit B and the "ESF B" switchgear room coolers are also controlled by the SSW Loop B Control Logic so that, when an initiation signal is generated, the PSW valves automatically close and the SSW valves automatically open.

- The initiation signal is generated on a LOCA, SSW Loop B manual initiation, or a loss of offsite power.
- With a LOP or LOCA signal present, the valves cannot be manually repositioned until the both the initiating condition and the LSS panel have been reset.

Figures 1

The normal supply of cooling water for the **"ESF A" electrical switchgear room coolers** is from the Plant Service Water System through supply isolation valve F239 and return isolation valves F241 and F240.

SSW Loop A functions as an alternate source of cooling water for the **"ESF A" electrical switchgear room coolers.**

All five valves are also controlled by SSW Loop A Control Logic so that, when an initiation signal is generated, the PSW valves automatically close and the SSW valves automatically open.

- The initiation signal is generated on a LOCA, SSW Loop A manual initiation, or a loss of offsite power.
- With a LOCA or LOP signal present, the valves cannot be repositioned until the both the initiating condition and the LSS panel have been reset.

SSW Loop A and B supply cooling water to the **FPCCU pump room cooler** through normally open inlet and outlet manual isolation valves.

Each SSW loop supplies a separate cooling coil within the room cooler.

The FPCCU pump room cooler is a backup to the Auxiliary Building Ventilation System for supplying cooling to the FPCCU pump room.

The FPCCU pump room cooler auto starts on high room temperature.

- On a loss of normal ventilation due to a LOCA or LOP, SSW Loop A and B auto start to supply cooling to the FPCCU pump room cooler.

Figure 1

The **RHR A room cooler** is supplied by SSW Loop A through normally open manual inlet and outlet isolation valves.

Figure 2

The **RHR B and C room coolers** are both supplied by SSW Loop B through normally open manual inlet and outlet isolation valves.

Figure 1

SSW Loop A supplies the **Low Pressure Core Spray (LPCS) room cooler** through normally open manual inlet and outlet isolation valves.

Figure 1

The **RCIC System room cooler** receives cooling water from SSW A through normally open manual inlet and outlet isolation valves.

SSW Radiation Monitoring

The SSW Loop A(B) return line is provided with a radiation monitor which continuously measures, indicates and records levels of radioactivity in the SSW return water, possibly resulting from a tube leak in the RHR or FPCCU Heat Exchangers.

For sampling purposes, the Radiation Monitoring System draws a sample from, and returns the water to, the SSW A(B) return header at Area 9(10), Elevation 93'.

Figures 3

SSW Loop C

State/identify the components that can be supplied by SSW Loop C. (11.3)

11.3 The components supplied by SSW Loop C are detailed in Figure 3.

Water from the HPCS Service Water Pump is supplied to SSW Loop C loads through locked-open, manually operated, discharge valve F013.

Water returns to SSW basin A through SSW Loop C return valve F011.

An auto start signal from SSW Loop C control logic initiates cooling water flow through Loop C by opening the loop C return valve and starting the High Pressure Core Spray service water pump after a 10 second time delay.

With an auto start signal present, F011 is interlocked open until the condition clears and the HPCS logic is reset.

SSW flow to the **Standby Diesel Generator 13 jacket water coolers** is supplied through normally open manual inlet and outlet isolation valves.

The **HPCS pump room cooler** is supplied by SSW Loop C through normally open manual inlet and outlet isolation valves.

With only SSW Loop C operating, SSW basin A functions in a natural draft mode.

SSW Initiation Logic and System Response

State/identify the automatic actions that will occur for all SSW Systems for the following: (12)

- LPCS/LPCI/HPCS initiation (12.1)
- HPCS/LPCS/RHR pump start/E51-F045 opening (12.2)
- Diesel Start (12.3)
- SSW manual initiation (12.4)
- Loss of offsite power (12.5)

SSW Logic

A LOP is not an auto start. It results in a component start.

The SSW logics A and B have three types of auto starts. They are:

12.2, 12.3 Auto start from a component start.

- Provides cooling water to the component that needs it.
- The pump can not be shutdown until the start signal has been cleared.

12.1 Auto start from a LOCA signal via the Load Shedding and Sequencing System.

- Provides cooling water to all divisional components.
- The SSW System cannot be shutdown until both the initiation signal and the LSS panel have been reset.

12.2 SSW manual initiation from the pushbuttons.

- Simultaneously depress both pushbuttons to initiate the division.
- Cooling water is provided to all divisional equipment.
- The system can be shutdown at any time because the logic is not

sealed in.

The SSW A logic system automatically initiates on any of the following component start signals:

- RHR A pump breaker closed
- LPCS pump breaker closed
- E51-F045 not full closed
- Diesel Generator 11 speed >200 rpm

The SSW A logic system also automatically initiates on any of the following LOCA signals from LSS:

- ≤ -150.3" RPV water level
- ≥ +1.39 psig Drywell pressure
- LPCS/RHR A manual initiation

The SSW B logic system automatically initiates on any of the following component start signals:

- RHR B pump breaker closed
- RHR C pump breaker closed
- Diesel Generator 12 speed >200 rpm

The SSW B logic system also automatically initiates on any of the following LOCA signals from LSS:

- ≤ -150.3" RPV water level
- ≥ +1.39 psig Drywell pressure
- RHR B/C manual initiation

The SSW C logic system automatically initiates on any of the following signals:

- HPCS pump breaker closed
- Diesel Generator 13 speed >800 rpm.
- Any HPCS initiation signal
  - ≤ -41.6" RPV water level
  - ≥ +1.39 psig Drywell pressure
  - HPCS System manual initiation

The power supply to each division's initiation logic is its respective 125V DC bus.

SSW A System Response

12.2, 12.3 When SSW A auto starts due to a component start, the following events occur:

SSW Pump A starts

SSW A Cooling Tower Fans start

SSW A Pump House Ventilation starts

F001A (pump discharge) and F005A (return) open

F006A (recirc) opens

F018A (D/G inlet) opens if D/G started

12.1, 12.4 When SSW A auto starts due to a LOCA signal (LSS start) or manual SSW initiation, the following events occur:

SSW Pump A starts

SSW A Cooling Tower Fans start

SSW A Pump House ventilation starts

F001A (pump discharge) and F005A (return) open

F006A (recirc) closes

F015A and F016A (blowdown) close

F018A (D/G inlet) opens

F014A and F068A (RHR Hx SSW inlet and outlet) open

F159A, F160A, and F168A (SSW to/from DW purge compressor) open

F239, F240, and F241 (PSW to/from ESF room coolers) close

F237 and F238 (SSW to/from ESF room coolers) open

F066A and F074A (PSW to/from control room A/C) close

F064A and F081A (SSW to/from control room A/C) open

F125 (PSW to Control Room A/C's and ESF room coolers) closes

F113 (fill tank outlet) closes

12.5 SSW A also provides a specific response to a LOP signal from LSS. D/G 11 auto starts due to the loss of power and the following events occur:

SSW components align as per SSW A auto start due to a component start (D/G 11).

F125 (PSW to Control Room A/C's and ESF room coolers) closes

F066A and F074A (PSW to/from control room A/C) close

F239, F240, and F241 (PSW to/from ESF room coolers) close

F064A and F081A (SSW to/from control room A/C) open

F237 and F238 (SSW to/from ESF room coolers) open

SSW B System Response

12.2, 12.3 When SSW B auto starts due to a component start, the following events occur:

SSW Pump B starts

SSW B Cooling Tower Fans start

SSW B Pump House Ventilation starts

F001B (pump discharge) and F005B (return) open

F006B (recirc) opens

F018B (D/G inlet) opens if D/G started

12.1, 12.2 When SSW B auto starts due to a LOCA signal (LSS start) or manual SSW initiation, the following events occur:

SSW Pump B starts

SSW B Cooling Tower Fans start

SSW B Pump House ventilation starts

F001B (pump discharge) and F005B (return) open

F006B (recirc) closes

F015B and F016B (blowdown) close

F018B (D/G inlet) opens

F014B and F068B (RHR Hx SSW inlet and outlet) open

F159B, F160B, and F168B (SSW to/from DW purge compressor) open

F154, F155A, and F155B (SSW to/from air compressors) close

P44-F042, P44-F054, and P44-F067 (SSW to/from CCW Hx/DW Chillers) close

F064B and F081B (SSW to/from control room A/C and ESF room coolers) open

F066B and F074B (PSW to/from control room A/C and ESF room coolers) close

F189 (PSW from Control Room A/C's and ESF room coolers) closes

12.5 SSW B also provides a specific response to a LOP signal from LSS. D/G 12 auto starts due to the loss of power and the following events occur:

SSW components align as per SSW B auto start due to a component start (D/G 12).

F189 (PSW from Control Room A/C's and ESF room coolers) closes

F066B and F074B (PSW to/from control room A/C and ESF room coolers) close

F064B and F081B (SSW to/from control room A/C and ESF room coolers) open

P44-F115 and P44-F011 (PSW to/from CCW Hx/DW Chillers) close

P44-F042, P44-F054, and P44-F067 (SSW to/from CCW Hx/DW Chillers) open

P44-F068 (PSW from DW Chillers) closes when P44-F067 starts to open

P43-F289 (PSW from air compressors) closes

F155A and F155B (SSW to air compressors) open

F154 (SSW from air compressors) opens when F155A and F155B start to open

SSW C System Response

12.1, 12.2 When SSW C auto starts, no matter what the signal, the following events occur:

F011 (return) opens

SSW C pump starts (10 second time delay)

Chemistry Control

The Standby Service Water chemical treatment program focuses on 3 areas of concern: corrosion, scale formation and biological fouling.

Corrosion inhibitors are chosen based on system metallurgy and are batch added to the SSW basins based on analytical results. In addition, general corrosion in the SSW systems is minimized by maintaining the water slightly alkaline. The pH is controlled with acid or caustic additions.

Scale formation, which acts as an insulator on heat exchanger tubes, is mitigated with the addition of dispersants. Dispersants are designed to hold the various salts in solution and prevent them from plating out on heat transfer surfaces.

Biological fouling is controlled as if each SSW system were 2 subsystems, the piping and the basin. One biocide is added directly to the system piping twice during each system's "work week" following each 24 hour run. The basin is treated with a different biocide (bleach) in much the same manner that a swimming pool is treated.

Other than the addition of biocides, chemical additions to the SSW systems are performed infrequently. Basin blowdown, although available, is rarely employed.

SYSTEM INTERRELATIONSHIPS

Explain the basic interrelationship of this system with other plant systems. (7)

Process Radiation Monitoring System, D17

7 The Process Radiation Monitoring (PRM) System takes a sample of the SSW water (loops A and B only) and determines if a leak has occurred between one of the cooled components and the SSW System.

If the PRM System is lost, it will not affect the operation of the SSW System.

Instrument Air System, P53

7 The Instrument Air System provides air for the operation of various air-operated valves within the Standby Service Water System.

Loss of Instrument Air causes all of the air-operated valves to fail closed. This results in a loss of makeup water to the cooling tower basins and the standby service water fill tank.

Loss of Instrument Air also results in a closure signal to air-operated valves F239 and F240, PSW to/from ESF A electrical switchgear room coolers.

Remote Shutdown System, C61

7 The Remote Shutdown System provides controls for remote operation (outside the control room) of various components within the Standby Service Water System.

Loss of the Remote Shutdown System prevents any operation of the Standby Service Water System from the remote shutdown panel. The SSW System can still be safely operated from the control room.

Load Shedding and Sequencing System, R21

7 The Load Shedding and Sequencing System sends a LOCA signal (low reactor water level -150.3 inches, high drywell pressure 1.39 psig, or manual ECCS initiation) or loss of offsite power signal to SSW Control Logics A and B.

Loss of Load Shedding and Sequencing System does not permit the low reactor water level or the high drywell pressure signals to initiate SSW. However, loss of this system cannot prevent manual initiation or auto initiation by other means, such as an RHR pump running or a diesel generator running.

Plant Service Water System, P44

7 The PSW System provides makeup water to both the basins and the fill tank.

Loss of the Plant Service Water System does not adversely affect the operation of the Standby Service Water System since it can operate for at least 30 days without makeup.

It could however affect the SSW fill tank water level. There is a backup supply of water to the fill tank from the Makeup Water Treatment System.

125V DC System, L11

7 The 125V DC System provides 125V DC electrical power for control and indication circuits within the Standby Service Water System.

Loss of 125 VDC to the logic causes the logic to initiate; however, the SSW pumps and cooling tower fans cannot auto start without control power.

IMPORTANCE TO PLANT SAFETY AND RADIOACTIVE CONTAINMENT

Explain/Describe the importance of the Standby Service Water System (SSW) to plant safety and/or radioactivity containment from the following perspectives: (8)

- How the system protects fission product barriers. (8.1)
- If the system is Maintenance Rule Risk Significant and/or currently is in an (a)(1) status, discuss why. (8.2)
- If the system is directly associated with an event analyzed in the UFSAR Chapter 15 Accident Analyses, briefly describe the event, including how it is mitigated. (8.3)

8.1 SSW is:

- an essential supporting system designed to remove heat from plant auxiliaries that are required for safe shutdown,
- the ultimate heat sink for decay heat removal, and
- a means to flood the containment.

As a support system it is critically importance to plant safety. It supports the protection of all three fission product barriers.

SSW has no specific radioactivity containment design function.

It supports RHR which, in turn, supports the containment structure during an accident (Containment Spray and Suppression Pool Cooling).

Its importance to radioactivity containment is critical from a support standpoint.

Current (a)(1) System Listing

Systems in Scope to the Rule at GGNS

8.2 Consult the Maintenance Rule Home Page under Systems Engineering for the latest classifications of systems as Maintenance Rule, (a)(1) systems and if the system is Maintenance Rule Risk Significant and/or currently is in an (a)(1) status, and discuss why if applicable.

The Standby Service Water (P41) system is Maintenance Rule Risk Significant because it performs the following accident mitigation support function as assumed in the GGNS PRA, and as directed by the Emergency Procedures: ultimate heat sink (emergency cooling water supply) and alternate source of low pressure injection.

8.3 SSW system is not directly associated with an event analyzed in the UFSAR Chapter 15 Accident Analyses. It is assumed to fulfill its safety function of heat removal during accidents such as a loss of coolant accident for the duration and support long term heat removal from the reactor and spent fuel pool.

SELECTED TECHNICAL SPECIFICATIONS

For selected Technical Specification Limiting Conditions for Operation (LCO), determine their impact on plant operations for given conditions including safety limits and their bases and/or applicability. (9)

9 Briefly discuss/explain LCO 3.7.1

- LCO statement/heading
- Applicability
- Selected Actions, including Condition, Required Action, and Completion Time

Selected Surveillance

3.7.1, Standby Service Water (SSW) and Ultimate Heat Sink (UHS)

TR 3.7.1, Standby Service Water (SSW) and Ultimate Heat Sink (UHS) – Shutdown

3.7.2, High Pressure Core Spray (HPCS) Service Water (SWS)

TR 3.7.2, High Pressure Core Spray (HPCS) Service Water (SWS) – Shutdown

INDUSTRY EVENTS

For selected Operating Experience (OE) related to the (system) describe the concern of the event and its impact on GGNS plant operations. (10)

Human Performance Tools and Traps

When you see these traps	Get these tools
Time pressure	Effective Communication
Distraction/interruption	Questioning attitude
Multiple tasks	Place keeping
Overconfidence	Self check
Vague or interpretive guidance	Peer check
First shift/late shift	Knowledge
Peer pressure	Procedures
Change/off normal	Job briefing
Physical environment	Coaching
Mental stress (home or work)	Turnover

O&MR 140

10 O&MR 140 concerns a water hammer event which occurred at Susquehanna and resulted in damage to three pipe supports. The Emergency Service Water (ESW) system was operating with 36 inch motor operated bypass valves open to the spray pond with spray nozzles bypassed. A loss of offsite power tripped the ESW pumps and allowed ESW piping to gravity drain to the spray pond. Emergency diesel generators started and the bypass valves closed. ESW pumps auto started simultaneously resulting in water entering the partially drained system and subsequent water hammer.

No action taken since design should preclude significant draining and the potential for waterhammer.

For GGNS, the following scenario was identified as a sequence which could possibly lead to a water hammer event:

"When the SSW System is in its normal mode of operation and a LOSP (loss of offsite power) occurs, the SSW pump will stop and all SSW valves will remain in position. After the SSW pump coasts down, the

system will begin to drain through the spray nozzles in the SSW cooling tower and through the SSW pump bearing oil cooler. This draining will continue until emergency power is supplied from the EDG, ~20 seconds after LOSP. Even though the SSW system is draining while awaiting the supply of emergency power, the SSW fill tank should maintain the system sufficiently filled until the SSW pump is back in service. Piping near the pump discharge will remain filled regardless of the period of time required to return power to the pumps. The short period of time between LOSP and start of the D/G will preclude significant draining and the potential for waterhammer.

SUMMARY

Review objectives.

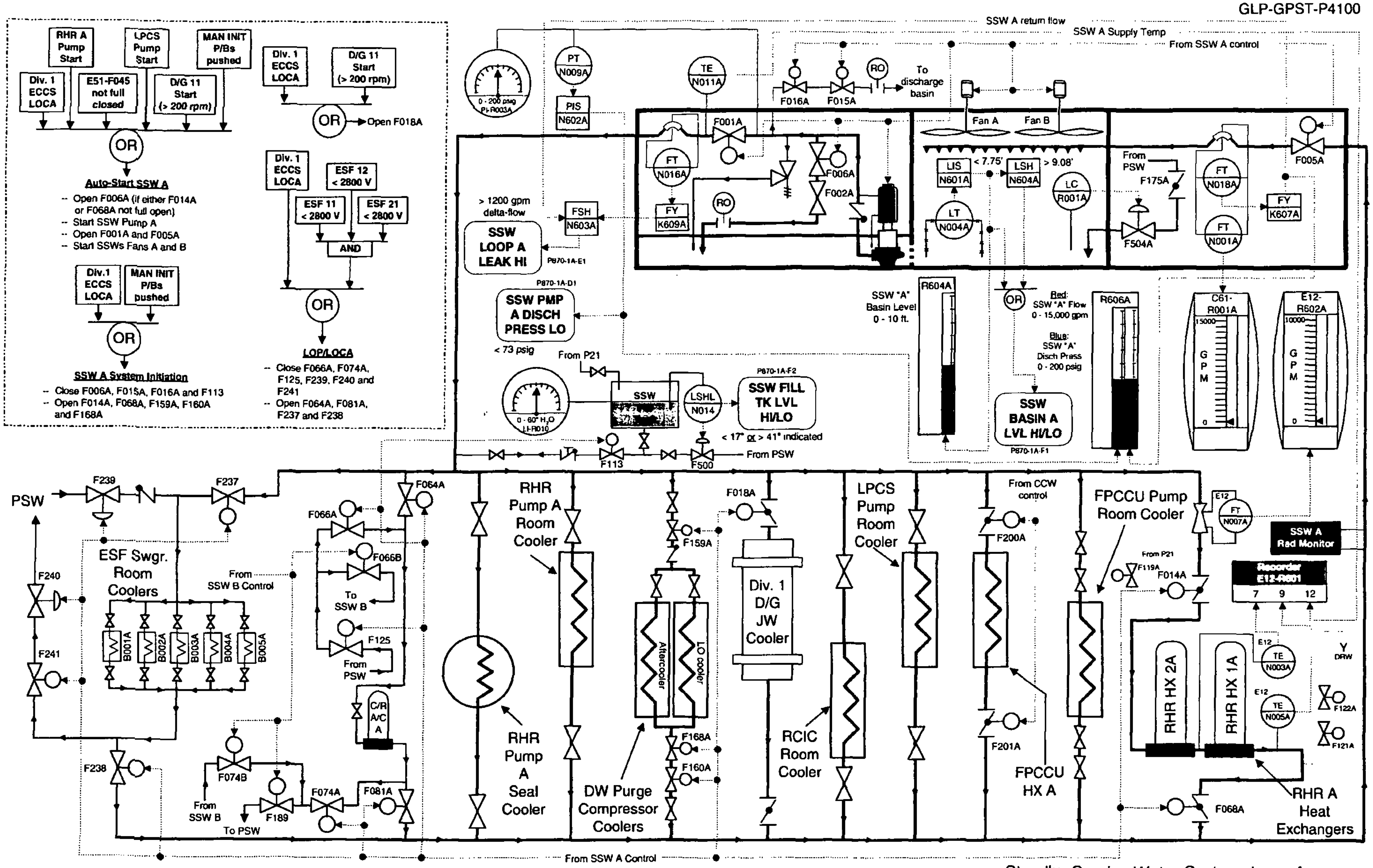
Solicit questions from the class.

LIST OF FIGURES

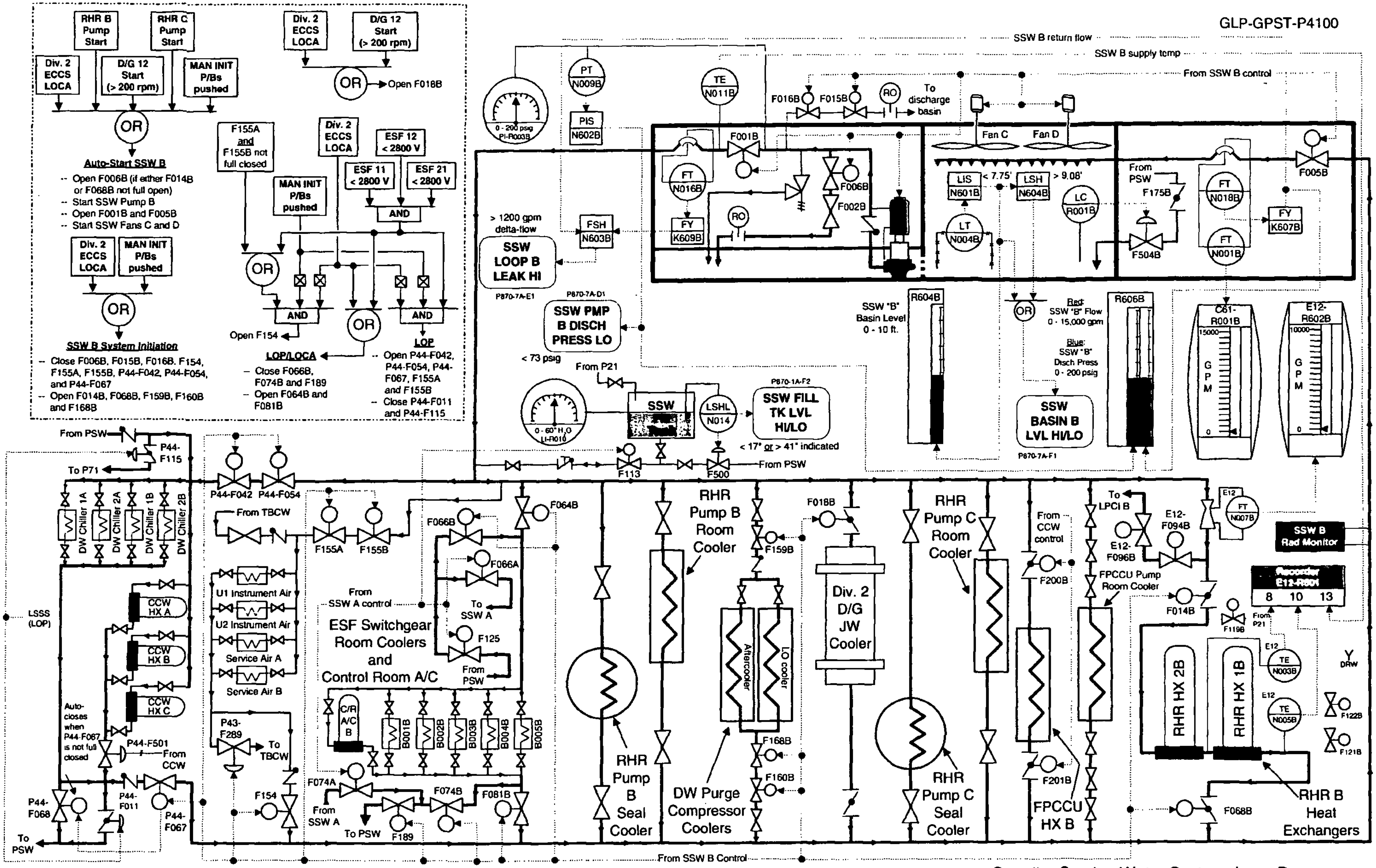
Figure 1 Standby Service Water System, Loop A

Figure 2 Standby Service Water System, Loop B

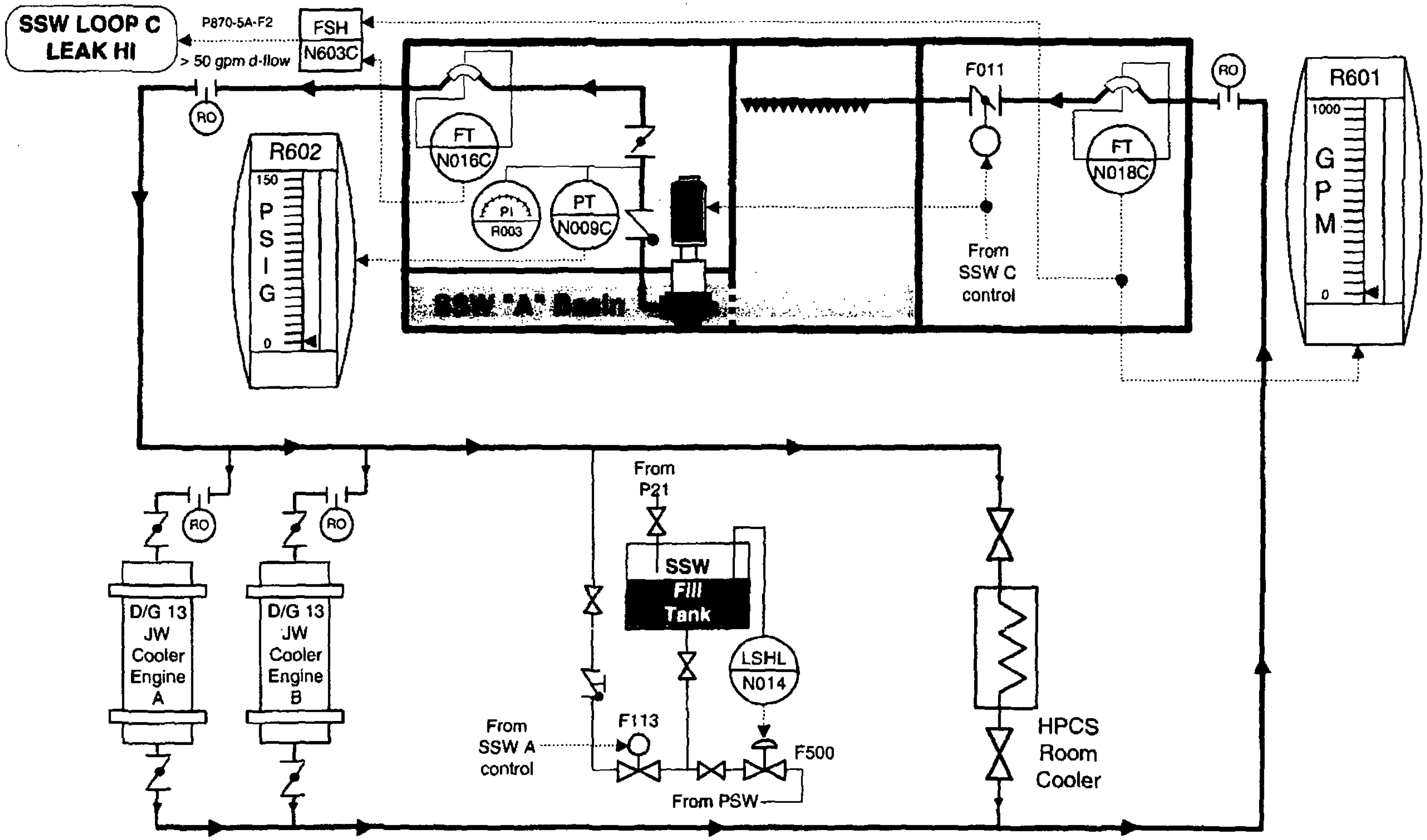
Figure 3 Standby Service Water System, Loop C



Standby Service Water System, Loop A
Figure 1



Standby Service Water System, Loop B
Figure 2



Standby Service Water System, Loop C
Figure 3