INSTRUMENTATION:

- o RCS pressure indication
- o Core exit TCs temperature indication
- o RVLIS indication
- o RCP status indication
- o RCP support conditions status indications

CONTROL/EQUIPMENT:

- o RCP switches
- o RCP support equipment controls

KNOWLEDGE:

- o Understanding of RVLIS function, configuration, and interpretation
- o Due to the less restrictive SI termination and reinitiation criteria provided in this guideline the operator should be especially alert for any decrease in RCS subcooling or vessel level that warrants SI reinitiation

PLANT-SPECIFIC INFORMATION:

- o (R.12) The sum of temperature and pressure measurement system errors, including allowances for normal channel accuracies, translated into temperature using saturation tables, plus 50°F.
- o (R.13) The sum of temperature and pressure measurement system errors, including allowances for normal channel accuracies and post accident transmitter errors, translated into temperature using saturation tables, plus 50°F.
- o (R.01) The sum of temperature and pressure measurement system errors, including allowances for normal channel accuracies, translated into temperature using saturation tables.
- o (R.02) The sum of temperature and pressure measurement system errors, including allowances for normal channel accuracies and post accident transmitter errors, translated into temperature using saturation tables.
- o (K.02) RVLIS full range value which is top of core, including allowances for instrument uncertainties.
- o (L.08) RVLIS dynamic range value corresponding to an average system void fraction of 25 percent with 1 RCP running, including allowances for instrument uncertainties.
- o (L.07) RVLIS dynamic range value corresponding to an average system void fraction of 25 percent with 2 RCPs running, including allowances for instrument uncertainties.
- o (L.06) RVLIS dynamic range value corresponding to an average system void fraction of 25 percent with 3 RCPs running, including allowances for instrument uncertainties.
- o (L.05) RVLIS dynamic range value corresponding to an average system void fraction of 25 percent with 4 RCPs running, including allowances for instrument uncertainties.
- o Support conditions and means for starting an RCP
- o If RVLIS is not available, RCS subcooling based on core exit TCs is sufficient for terminating SI since a 50°F margin has been added to instrument uncertainties. This 50°F margin allows sufficient time for operator action to reinitiate SI before core uncovery.
- o As long as the RVLIS dynamic range uncertainty for the Westinghouse RVLIS design is less than +/-6%, the uncertainty does not need to be included in the calculation of the plant-specific EOP setpoints.

I. **PROGRAM:**

Watts Bar Operator Training

II. **COURSE:**

A. License Training

B. License Requalification

III. **TITLE:**

Function Restoration Guidelines FR-P.1 & 2, Pressurized Thermal Shock

IV. **LENGTH OF LESSON:**

A. License training 2 Hours

License REQUAL time will be determined after objectives are identified.

V. **TRAINING OBJECTIVES:**

AUO	RO	SRO	STA	
	X	X	X	1. Given a set of plant conditions, use the FR-P, Pressurized Thermal Shock Status Tree to identify and implement the appropriate Function Restoration Procedure (FR-P.1 or P.2).
	X	X	X	2. Identify the major actions of FR-P.1, Pressurized Thermal Shock, and explain the basis for performing each major action.
	X	X	X	3. Explain why minimum detectable flow is maintained to each S/G of all the S/Gs are faulted.
	X	X	X	4. Justify the basis for using a less restrictive SI termination criteria when performing FR-P.1.
	X	X	X	5. Explain why an RCP should be restarted if SI cannot be terminated while performing FR-P.1, Pressurized Thermal Shock.
	X	X	X	6. Given a set of plant conditions, use the procedure FR-P.1 or P.2 to identify any applicable cooldown and/or pressure limitations.

V. **TRAINING OBJECTIVES:** (continued)

AUO	RO	SRO	STA	
	X	X	X	7. Explain the basis for a "soak" period as required by FR-P.1, Pressurized Thermal Shock.
	X	X	X	8. Discuss the basis for using RCS T-cold when analyzing the FR-P status tree to determine if PTS or cold overpressure concerns exist.
	X	X	X	9. Explain the basis for returning to the instruction in effect after identifying that RCS pressure $\leq$ 150 psig and RHR is delivering flow when performing step 1 of FR-P.1.
	X	X	X	10. Given a set of plant conditions, use FR-P.1, FR-P.2 and the Critical Safety Function Status Trees to correctly diagnose and implement: Action Steps, RNOs, Foldout Pages, Notes and Cautions.
	X	X	X	11. Identify the major actions of FR-P.2, Cold Overpressure Condition, and explain the basis for performing each major action.
	X	X	X	12, Explain the purpose for and basis of each step in FR-P.1 and FR-P.2.

FR-P.1 REVIEW

Steps 7-11: Terminate SI if Conditions Satisfied

7. Check ECCS in service

- **Any high-head SI pump running –or-**
- **Flow thru BIT**

RNO:

If SI has already been reset, go to step 16.

(Steps 8-15 terminate SI)

FR-P.1

FR-P.1 Steps, Notes, Cautions **Objective 4, 5, 10, 12**

Discuss actions and bases for the steps, notes, cautions, and RNOs in FR-P.1. A copy of FR-P.1 should be used for discussion of steps, notes, cautions, and RNO actions. 3-OT-STG-FRP should be used to review/discuss FR-P.1 step bases information.

- Step 7 checks if any high-head SI pump running or CCPs injecting through the BIT to determine if SI termination steps need to be performed.

TVA FR-P.1 REVIEW

Steps 7-11: Terminate SI if Conditions Satisfied

7. **Check ECCS in service**
8. **Check SI termination criteria**
   - **RVLIS > 60% with NO RCP running, -Or-**

     RVLIS > 63% with ANY RCP running.
   - **RCS subcooling > 115 °F [135 °F ADV].**

FR-P.1

FR-P.1 Steps, Notes, Cautions **Objective 4, 5, 10, 12**

Discuss actions and bases for the steps, notes, cautions, and RNOs in FR-P.1. A copy of FR-P.1 should be used for discussion of steps, notes, cautions, and RNO actions. 3-OT-STG-FRP should be used to review/discuss FR-P.1 step bases information.

- Step 8 Note – Either Loop 1 or 2 pzr spray valve is effective for Loop 2 RCP in service or Loops 1, 3, & 4 RCPs in service.
- Step 8 determines if full flow SI is required based on plant conditions.
  - The combination of minimum subcooling and sufficient RVLIS level, to cover the core, represent less restrictive SI termination criteria than the SI termination criteria in other EOPs since, for an imminent PTS condition, SI flow may have contributed to the RCS cooldown or may prevent a subsequent reduction if RCS pressure.
  - The RNO for this step directs restart of one RCP if RCS subcooling >65°F [85°F ADV] and RVLIS requirements not met. An RCP restart is attempted in order to mix the cold incoming SI water and the warm reactor coolant water and thereby decrease the likelihood of a PTS condition.

RNO:

Perform the following:

1) IF RCS subcooling greater than 65°F [85□□F ADV] AND NO RCP running, THEN REFER TO Table 1, RCP Emergency Restart Criteria.

2) Start RCP(s) oil lift pump two minutes prior to starting RCP.

3) When start conditions established, THEN:

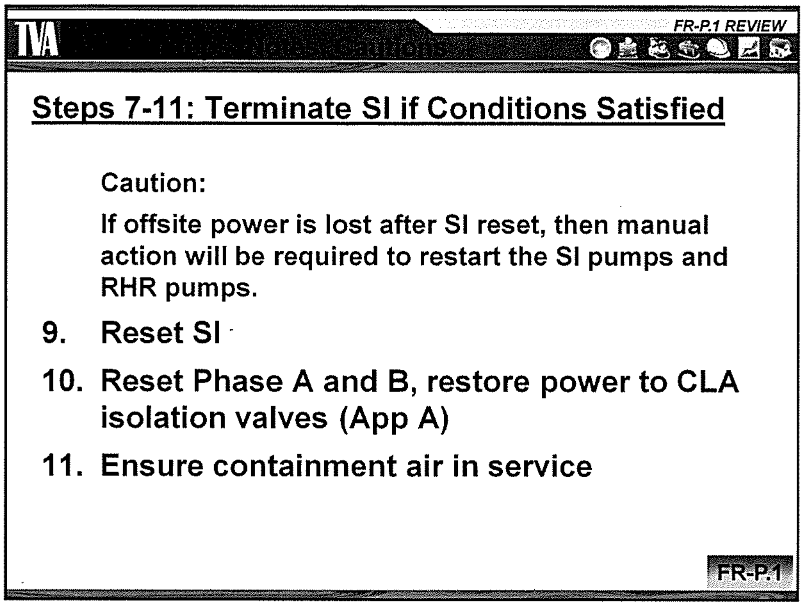
a) Start one RCP, loop 2 preferred.

b) IF Loop 2 RCP can NOT be started, THEN START ALL other RCPs.

c) Stop RCP(s) oil lift pump one minute after RCP start.

d) Continue ECCS Flow.

e) Go to Note prior to Step 28.

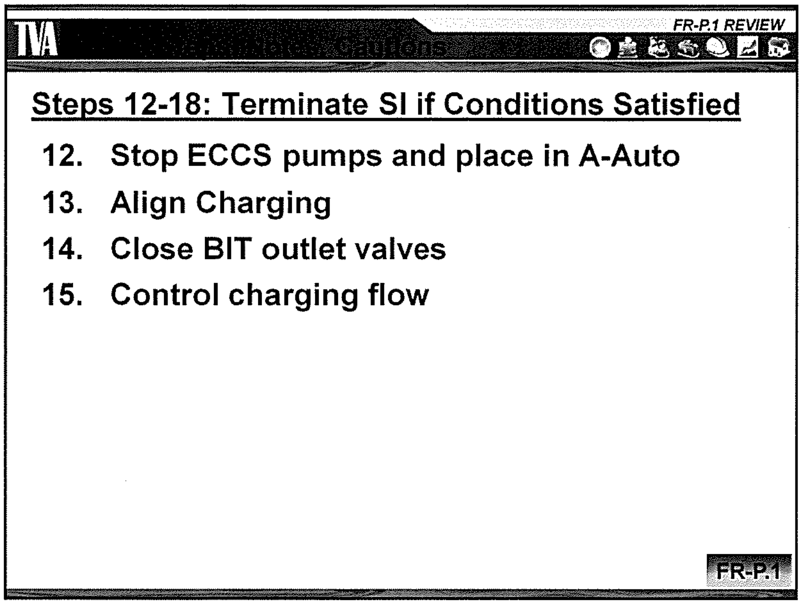


FR-P.1 Steps, Notes, Cautions **Objective 4, 5, 10, 12**

Discuss actions and bases for the steps, notes, cautions, and RNOs in FR-P.1. A copy of FR-P.1 should be used for discussion of steps, notes, cautions, and RNO actions. 3-OT-STG-FRP should be used to review/discuss FR-P.1 step bases information.

- Step 9 directs reset of the SI signal to allow the operator to realign or stop safeguards equipment.
- Step 10 directs reset of Phase A and B to allow realignment of containment isolation valves and safeguards equipment during subsequent steps. Phase B allows restoration of control air to containment which will allow charging/letdown restoration.

  Power is restored to CLA isolation valves in preparation to isolate the accumulators in subsequent steps.
- Step 11 restores control air to containment allowing control of air-operated equipment inside containment.



FR-P.1 Steps, Notes, Cautions **Objective 5, 10, 12**

Discuss actions and bases for the steps, notes, cautions, and RNOs in FR-P.1. A copy of FR-P.1 should be used for discussion of steps, notes, cautions, and RNO actions. 3-OT-STG-FRP should be used to review/discuss FR-P.1 step bases information.

- Step 12 stops all ECCS pumps, except one CCP, and places them in A-Auto, reducing RCS injection that could contribute to RCS overpressure.
- Step 13 aligns the charging flow path to allow normal control of RCS makeup.
- Step 14 stops injection flow to the RCS through the BIT, enabling the normal charging path to control RCS makeup flow.
- Step 15 controls charging flow to maintain proper PZR level and RCP seal injection flow.

TVA FR-P.1 REVIEW

Steps 12-18: Terminate SI if Conditions Satisfied

16. Check SI termination criteria

a. RVLIS > 60% with NO RCP running, -Or-

RVLIS > 63% with ANY RCP running.

b. RCS subcooling > 65 °F [85 °F ADV].

FR-P.1

FR-P.1 Steps, Notes, Cautions **Objective 5, 10, 12**

Discuss actions and bases for the steps, notes, cautions, and RNOs in FR-P.1. A copy of FR-P.1 should be used for discussion of steps, notes, cautions, and RNO actions. 3-OT-STG-FRP should be used to review/discuss FR-P.1 step bases information.

- Step 16 checks SI termination criteria, RVLIS and RCS subcooling, to determine if ECCS flow needs to be reinitiated. The RNO directs manually starting ECCS pumps as necessary. With inadequate RVLIS level and subcooling >65°F the RNO attempts to restart an RCP to mix the cold incoming SI water and the warm reactor coolant water.

RNO:

a. PERFORM the following:

1) IF RCS subcooling greater than 65 °F [85 °F ADV] AND NO RCP running, THEN START one RCP, loop 2 preferred.

• REFER TO Table 1, RCP Emergency Restart Criteria.

2) Manually START ECCS pumps as necessary.

3) ** GO TO Note prior to Step 28.

b. Manually START ECCS pumps as necessary. ** GO TO Note prior to Step 28.

27. W/E15 EG2.4.6 027

Given the following conditions:

- A large break LOCA has occurred on Unit 1.
- The crew is performing E-1, "Loss of Reactor or Secondary Coolant," with the ECCS aligned for cold leg recirculation.
- The operating crew determines the criteria for entering FR-Z.2, "Containment Flooding," is met.

Which ONE of the following identifies...

(1) how FR-Z.2 entry conditions being met affects the use of the Emergency Procedure network

and

(2) the mitigation strategy associated with sampling the sump when FR-Z.2 is implemented?

A. (1) Implementation of FR-Z.2 is required.
(2) To ensure shutdown margin is being maintained, since non-borated water has entered the containment sump.

B. (1) Implementation of FR-Z.2 is at the discretion of the crew.
(2) To ensure shutdown margin is being maintained, since non-borated water has entered the containment sump.

C✓ (1) Implementation of FR-Z.2 is required.
(2) To determine the level of activity, to allow the TSC to determine if excess sump water can be transferred to tanks outside of containment.

D. (1) Implementation of FR-Z.2 is at the discretion of the crew.
(2) To determine the level of activity, to allow the TSC to determine if excess sump water can be transferred to tanks outside of containment.

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because the FR-Z.2 entry is due to an Orange Path condition which requires immediate entry into the procedure and if water level is high enough to meet entry conditions, then the source is from an unborated supply and SDM would be affected and a potential concern.*

B. *Incorrect, Plausible because there is an FR-Z entry due to a Yellow Path condition which does allow crew discretion for entry into the procedure and if water level is high enough to meet entry conditions, then the source is from an unborated supply and SDM would be affected and a potential concern.*

C. *Correct, FR-Z.2 is entered due to an Orange Path condition which requires immediate entry into the procedure and the sump is sampled to determine activity in order that the TSC can evaluate where to transfer the water for storage.*

D. *Incorrect, Plausible because there is an FR-Z entry due to a Yellow Path condition which does allow crew discretion for entry into the procedure and sampling the sump to determine activity in order that the TSC can evaluate where to transfer the water for storage is correct.*

Question Number: 27

Tier: 1 **Group** 2

K/A: W/E15 EG2.4.6
Containment Flooding
Emergency Procedures / Plan
Knowledge of EOP mitigation strategies.

Importance Rating: 3.7 / 4.7

10 CFR Part 55: 41.10 / 43.5 / 45.13

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of the mitigation strategy for implementing FR-Z.2, Containment Flooding, and the strategy used in the procedure to allow determination of how to dispose/store the water when ready for transfer from containment.

Technical Reference: FR-0, Status Trees, Revision 0014
FR-Z.2, Containment Flooding, Revision 0007
WOG Emergency Procedure FR-Z.2 Background Document, Revision 2

Proposed references to be provided: None

Learning Objective: 3-OT-FRZ0001
12. List the three major action categories of FR-Z.2, Containment Flooding.

Cognitive Level:
Higher ___
Lower X

Question Source:
New ___
Modified Bank X
Bank ___

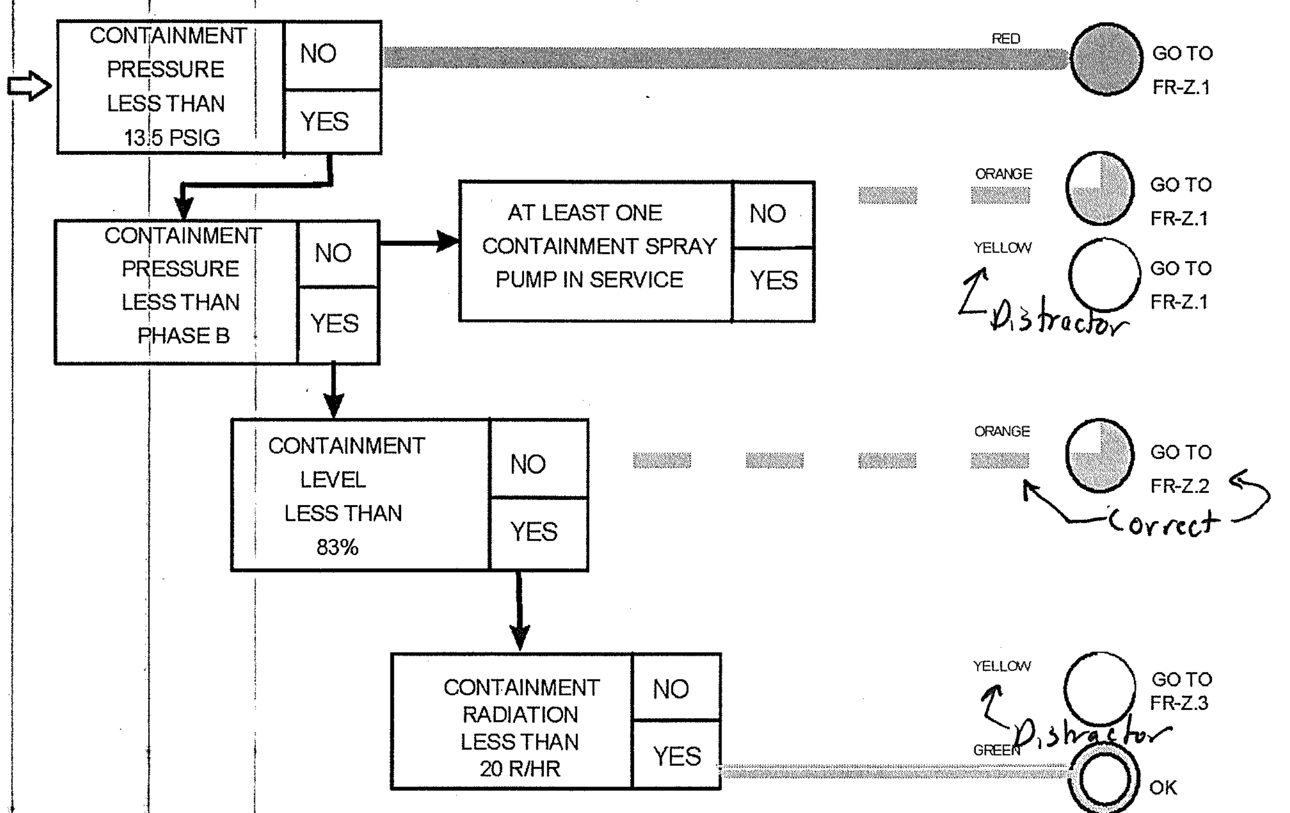
Question History: WBN Bank question W/E15 EK1.2 027 modified.

Comments: W/E15 EK1.2 027 used on the WBN 5/2009 Exam

Attachment 1
(Page 7 of 8)

Monitoring Critical Safety Functions

CONTAINMENT
FR-Z



COLOR	PROC

Watts Bar Nuclear Plant

Unit 1

Emergency Operating Instruction

FR-Z.2

Containment Flooding

Revision 0007

Quality Related

Level of Use: Continuous Use

Effective Date: 12-20-2010

Responsible Organization: OPS, Operations

Prepared By: Nicholas Armour

Approved By: Brian McIlnay

Current Revision Description

Minor/editorial revision: Converted to Word 2007 (PCR 4892).

1.0 PURPOSE

This Instruction provides actions to respond to containment flooding.

2.0 SYMPTOMS AND ENTRY CONDITIONS

2.1 Indications

Cntmt Sump level greater than 83% (14.4 ft).

2.2 Transitions

FR-0, Status Trees, FR-Z in ORANGE condition.

Step	Action/Expected Response	Response Not Obtained
3.0	**OPERATOR ACTIONS**	
1.	**IDENTIFY** and **ISOLATE** unexpected source of water: a. ERCW. b. CCS. c. High pressure fire protection. d. Primary water. e. DI water. f. SFP cooling water.	
2.	**CHECK** cntmt sump activity and chemistry:	
	a. **CHECK** RHR suction aligned from RWST.	a. **IF** RHR suction is aligned to the cntmt sump, **THEN**: 1) **NOTIFY** Chemistry to sample from RHR system. 2) ** **GO TO** Step 3.
	b. **NOTIFY** Chemistry to sample cntmt sump.	

Step	Action/Expected Response	Response Not Obtained

3. **NOTIFY** TSC to evaluate the following:
   - Stopping leakage into cntmt.
   - Operational problems with equipment located below water level.
   - Water transfer from cntmt sump to Aux Bldg.; e.g., Passive Sump, HUT, Waste Tanks, etc.
   - Water transfer to RWST, PWST, etc.

4. **RETURN TO** Instruction in effect.

End of Section

STEP DESCRIPTION TABLE FOR FR-Z.2 Step 1

STEP: Try To Identify Unexpected Source Of Water To Sump

PURPOSE: To identify unexpected source of water in sump

BASIS:

This step instructs the operator to try to identify the unexpected source of the water in the containment sump. Containment flooding is a concern since critical plant components necessary for plant recovery may be damaged and rendered inoperable. A water level greater than the design basis flood level provides an indication that water volumes other than those represented by the emergency stored water sources (e.g., RWST, accumulators, etc.) have been introduced into the containment sump. Typical sources which penetrate containment are service water, component cooling water, primary makeup water and demineralized water. All possible plant specific sources which penetrate containment should be included in this step. These systems provide large water flow rates to components inside the containment and a major leak or break in one of these lines could introduce large quantities of water into the sump. Identification and isolation of any broken or leaking water line inside containment is essential to maintaining the water level below the design basis flood level.

ACTIONS:

Try to identify unexpected sources of water to the sump

INSTRUMENTATION:

Plant specific instrumentation to identify unexpected sources of water to the sump

CONTROL/EQUIPMENT:

N/A

KNOWLEDGE:

N/A

PLANT-SPECIFIC INFORMATION:

Sources of water which supply components inside containment

STEP DESCRIPTION TABLE FOR FR-Z.2 Step 2

STEP: Check Containment Sump Activity Level

PURPOSE: To determine the radioactivity level of the sump fluid

BASIS:

The step instructs the operator to determine the activity level in the containment sump water in order to provide information concerning the possible transfer of containment sump water to plant storage tanks outside the containment. The transfer of containment sump water from the containment to other plant storage tanks may be desirable in order to minimize the potential for flooding of critical plant components inside the containment. However, the ultimate disposition of this water outside the containment will depend, in large part, on the level of radioactivity in the water. The method of sampling the containment sump water is plant dependent. Appropriate precautions should be observed due to the potential for high radioactivity.

ACTIONS:

Check containment sump activity level

INSTRUMENTATION:

Plant specific sampling instrumentation

CONTROL/EQUIPMENT:

Plant specific sampling controls/equipment

KNOWLEDGE:

N/A

PLANT-SPECIFIC INFORMATION:

Method of obtaining a sump fluid sample

STEP DESCRIPTION TABLE FOR FR-Z.2 Step 3

STEP: Notify Plant Engineering Staff Of Sump Level And Activity Level To Obtain Recommended Action

PURPOSE: To notify plant engineering staff of sump level and activity level

BASIS:

The step instructs the operator to provide the plant engineering staff with information concerning the containment sump level and information on the radioactive content of the water. The plant specific design and layout will affect the options available to the plant engineering staff regarding the potential transfer of containment sump water outside containment. The design considerations include:

1) location of critical plant components in relation to containment sump water level,

2) location, size and shielding of outside containment storage tanks, and

3) pump and line routing from the containment sump to various storage tanks.

The plant engineering staff should evaluate the event and provide specific recommendations to the operators concerning the high containment sump water levels.

ACTIONS:

Notify the plant engineering staff of sump level and activity level to obtain recommended action

INSTRUMENTATION:

N/A

CONTROL/EQUIPMENT:

N/A

STEP DESCRIPTION TABLE FOR FR-Z.2 (Cont) Step 3

KNOWLEDGE:

N/A

PLANT-SPECIFIC INFORMATION:

Plant personnel comprising "plant engineering staff"

W/E15 EK1.2 027

WBN BANK QUESTION

Given the following plant conditions:

- A large break LOCA has occurred.
- Accumulators have discharged and are isolated.
- ES-1.3, "Transfer to Containment Sump" has been completed.
- Containment sump level is now at 84% and slowly rising.
- The SM directs performance of FR-Z.2, "Containment Flooding."
- FR-Z.2 requires that the containment sump be sampled.

Which ONE of the following describes (1) where the sample is taken from and (2) the reason for sampling the sump?

	(1)	(2)
A.	RHR System	To determine the level of activity, to allow the TSC to determine if excess sump water can be transferred to tanks outside of containment.
B.	Containment Sump	To determine the level of activity, to allow the TSC to determine if excess sump water can be transferred to tanks outside of containment.
C.	RHR System	To ensure shutdown margin is being maintained, since non-borated water has entered the containment sump.
D.	Containment Sump	To ensure shutdown margin is being maintained, since non-borated water has entered the containment sump.

I. **PROGRAM:**

Watts Bar Operator Training

II. **COURSE:**

A. License Prep

B. Certification

C. License Operator Requalification

III. **TITLE:**

Function Restoration Guidelines FR-Z.1, .2, & .3

IV. **LENGTH OF LESSON:**

A. License Prep 2 Hour

B. Certification 2 Hour

Licenser operator REQUAL time will be determined after objectives are identified.

V. **TRAINING OBJECTIVES:**

AUO	RO	SRO	STA	
	X	X	X	1. Given a set of plant conditions, use the FR-Z status tree to determine which, if any, Containment Function Restoration Procedure should be implemented.
	X	X	X	2. Discuss the reasons that ECA-1.1, Loss of RHR Sump Recirculation, is given priority over FR-Z.1, High Containment Pressure for directing Containment Spray Operation.
	X	X	X	3. Analyze a given set of plant conditions and determine if RHR containment spray should be placed in service.
	X	X	X	4. Explain why all RCPs are stopped during the performance of FR-Z.1, High Containment Pressure.
	X	X	X	5. Discuss why any Faulted S/G is isolated during the performance of FR-Z.1.

V. **TRAINING OBJECTIVES:** (continued)

AUO	RO	SRO	STA	
				6. Deleted
	X	X	X	7. Identify all sources of water to the containment which might cause containment flooding.
	X	X	X	8. Given a set of plant conditions, use FR-Z.1, FR-Z.2, FR-Z.3 and the Critical Safety Function Status Trees to correctly diagnose and implement: Action Steps, RNOs, Foldout Pages, Notes and Cautions.
	X	X	X	9. Explain the purpose for and basis of each step in FR-Z.1, FR-Z.2, and FR-Z.3.
	X	X	X	10. List the two major action categories of FR-Z.1, High Containment Pressure
	X	X	X	11. List the two major action categories of FR-Z.2, Containment Flooding.
	X	X	X	12. List the three major action categories of FR-Z.3, High Containment Radiation.

28. 003 G2.1.20 028

Given the following:

- Unit 1 is in Mode 5 preparing for an RCS heatup.
- RCP #2 is in service.
- RCP #4 has experienced the following start and run times as part of a maintenance PMT:
  - 1615 - started but stopped before it reached rated speed.
  - 1655 - started and then stopped after a 10 minute run.
  - 1740 - started and then stopped after a 10 minute run.
- The time is now 1800 and RCP #4 is ready to be placed in service.

Which ONE of the following identifies the earliest time the pump can be started and the breaker handswitch that will be used to start the RCP motor?

	Time	Handswitch
A.	1820	1-HS-68-73AA, RCP 4 NORMAL BKR & LIFT PMP
B.	1820	1-HS-68-73BA, RCP 4 ALTERNATE BKR & XFER SELECTOR
C.	1850	1-HS-68-73AA, RCP 4 NORMAL BKR & LIFT PMP
D.✓	1850	1-HS-68-73BA, RCP 4 ALTERNATE BKR & XFER SELECTOR

DISTRACTOR ANALYSIS:

A. Incorrect, Plausible because 1820 would be the correct time if there had not been 3 starts within the past 2 hours as the minimum time the pump would have been required to be idle would be 30 minutes and while 1-HS-68-73AA, RCP 4 NORMAL BKR & LIFT PMP, is used with the stated conditions to start the lift pump, it is not used not to start the RCP motor. The normal breaker is the breaker that is closed while the unit is running during normal power operations.

B. Incorrect, Plausible because 1820 would be the correct time if there had not been 3 starts within the past 2 hours as the minimum time the pump would have been required to be idle would be 30 minutes and because the pump being started from the Alternate Breaker handswitch is correct.

C. Incorrect, Plausible because 1850 is the earliest time the RCP will be restarted because the RCP is to remain idle for at least 1 hour before a fourth start or attempted start is made and while 1-HS-68-73AA, RCP 4 NORMAL BKR & LIFT PMP, is used with the stated conditions to start the lift pump, it is not used to start the RCP motor. The normal breaker is the breaker that is closed while the unit is running during normal power operations.

D. Correct, As identified in the precaution below, the pump should remain idle for at least 1 hour (which will be completed at 1850). While both of the handswitches are required to be used to place the RCP in service with the stated conditions, when the RCP motor is to be started the alternate breaker handswitch will be used because below 15% power, the station service supply from the unit has not been restored.

SOI-68.02 **PRECAUTIONS AND LIMITATIONS**

E. RCP Maximum Starting Duty limits:

1. For Restart after any period running or attempted start where motor failed to achieve full speed before it is stopped: Motor must be idle at least 30 min before restart.
2. Consecutive Starts: In any 2 hr period: Maximum of 3 starts with minimum 30 min idle period before each restart. When 3 starts (or attempted starts) are made in 2 hrs, then a fourth start should NOT be made until motor is idle at least 1 hr.

Question Number: 28

Tier: 2 **Group:** 1

K/A: 003 G2.1.20
Reactor Coolant Pump System (RCPS)
Conduct of Operations
Ability to interpret and execute procedure steps.

Importance Rating: 4.6 / 4.6

10 CFR Part 55: 41.10 / 43.5 / 45.12

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the ability to interpret the procedure requirements when starting a RCP to return it to service after it has encountered previous starts.

Technical Reference: SOI-68.02, Reactor Coolant Pumps, Revision 0034

Proposed references to be provided: None

Learning Objective: 3-OT-SYS068B
12. Identify the RCPs' Normal and Alternate Power Supplies
15. Identify the RCP Motor Start Limits.

Cognitive Level:
Higher X
Lower ___

Question Source:
New ___
Modified Bank X
Bank ___

Question History: WBN bank question SYS068B.15 004 modified

Comments:

3.0 PRECAUTIONS AND LIMITATIONS

A. Continuous RCP operation is prohibited until RCS is filled and vented per GO-10.

B. Start one RCP at a time allowing approx 5 minutes between starts.

C. RCP Vibration Limits [C.4]:

1. SHAFT (as recorded on 0-Pn1-52-R139, Aux Inst Rm):
Trip: greater than 15 mils AND rate of rise
greater than 1 mil/hr, OR
greater than 20 mils

2. FRAME (taken by Mech Engineer Tech Group at Vibration Monitor Test Cabinet 1-JB-292-3241) [NW of TBBP el 737 Aux Bldg]:
Normal: less than 3 mils
Trip: 5 mils

D. In Mode 4 or 5 with loops filled, no RCP shall be started unless secondary water temperature of each SG is 50°F or less above each RCS cold leg.

E. RCP Maximum Starting Duty limits:

1. For Restart after any period running or attempted start where motor failed to achieve full speed before it is stopped: Motor must be idle at least 30 min before restart.

2. Consecutive Starts: In any 2 hr period: Maximum of 3 starts with minimum 30 min idle period before each restart. When 3 starts (or attempted starts) are made in 2 hrs, then a fourth start should NOT be made until motor is idle at least 1 hr.

↑ Correct

F. Do not restart RCPs in modes 1 and 2.

G. When RCS is greater than 150°F, backup power shall be available to continue CCS flow to the Thermal Barriers.

H. If CCS is lost to the motor bearing oil coolers, RCP operation may continue for 10 minutes.

I. CCS to an Idle RCP is to remain in service at least 30 min, or until RCS is less than 150°F.

J. If all RCPs trip during a dilution operation, one RCS loop could fill with unborated water. Resumption of flow in that loop could flush unborated water to the core and cause a rapid change in shutdown margin. [C.1,3,5,6]

Date________ **INITIALS**

5.0 STARTUP (continued)

[18] **IF** starting RCP 1, **THEN**

ENSURE Pzr spray, 1-PCV-68-340D, is **CLOSED**. ________

[19] **IF** starting RCP 2, **THEN**

ENSURE Pzr spray, 1-PCV-68-340B, is **CLOSED**. ________

[20] **ANNOUNCE** RCP start on PA system. ________

NOTE

Below 15% power with station service NOT transferred, the Alternate handswitch is used to start RCP.

[21] **START** selected RCP (**N/A** HSs **NOT** used):

NOMENCLATURE	LOCATION	POSITION	UNID	PERF INITIAL
RCP 1 NORMAL BKR & LIFT PUMP	1-M-5	PUSH IN, THEN START	1-HS-68-8AA	
RCP 1 ALTERNATE BKR & XFER SELECTOR	1-M-5	PUSH IN, THEN START	1-HS-68-8BA	
RCP 2 NORMAL BKR & LIFT PUMP	1-M-5	PUSH IN, THEN START	1-HS-68-31AA	
RCP 2 ALTERNATE BKR & XFER SELECTOR	1-M-5	PUSH IN, THEN START	1-HS-68-31BA	
RCP 3 NORMAL BKR & LIFT PUMP	1-M-5	PUSH IN, THEN START	1-HS-68-50AA	
RCP 3 ALTERNATE BKR & XFER SELECTOR	1-M-5	PUSH IN, THEN START	1-HS-68-50BA	
RCP 4 NORMAL BKR & LIFT PUMP	1-M-5	PUSH IN, THEN START	1-HS-68-73AA	
RCP 4 ALTERNATE BKR & XFER SELECTOR	1-M-5	PUSH IN, THEN START	1-HS-68-73BA	

SYS068B.15 004

WBN BANK QUESTION

During an RCS sweep in Mode 5, the #2 RCP had the following start and run times:

- 1300 - started and ran 5 minutes.
- 1335 - started and ran 10 minutes.
- 1415 - started and ran 10 minutes.

Which of the following is the time at which the pump can be started again per procedure.

a. 1445

b. 1455

c. 1515

d.✓ 1525

I. PROGRAM

Watts Bar Operator Training

II. COURSES

A. License Training

B. Non-License Training

■

III. TITLE

Reactor Coolant Pumps

IV. LENGTH OF LESSON

A. License Training 2 Hours
B. Non-License Training 4 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
	X	X	X	01. State the Reactor Coolant Pump (RCP) Design basis per FSAR 5.5.1.
	X	X	X	02. Locate MCR Controls and Indications for the RCPs, including: a. Normal & Alternate control handswitches. b. Cooling water and thermal barrier supplies. ■ c. Bearing temp; Seal water supply, leakoff, water temp, and ΔP.
	X	X	X	03. Given the RCS condition/status and number of RCPs/RHR pumps in service, use Tech Specs to determine if operability requirements are met and if actions are required.
X	X	X	X	04. Describe the Purpose and Flowpath of the RCP Thermal Barrier.
X	X	X	X	05. Describe the RCPs' Seal Injection System, including: a. Flowpath/Components b. Flowrate c. Purpose
X	X	X	X	06. List the RCP Seal #1 normal ΔP <u>and</u> required minimum ΔP.
X	X	X	X	07. Give the Purpose of the #1 Seal Bypass Valve, and list conditions that must be met before the valve is opened
X	X	X	X	08. Identify the Conditions requiring closure of the #1 Seal Leak-off Valve, and the Effects of closing the leak-off valve

AUO	RO	SRO	STA	
	X	X	X	09. Describe the Purpose and Interlocks of the RCP Oil Lift System
X	X	X	X	10. Explain the Purpose of the RCP Flywheel
X	X	X	X	11. Describe how Reverse Rotation of an idle RCP is prevented
X	X	X	X	12. Identify the RCPs' Normal and Alternate Power Supplies
	X	X	X	13. List and Explain the limitation for RCP operation without Component Cooling Water (CCS) aligned
	X	X	X	14. Describe the Conditions which must be met to continue RCP operation Without Seal Injection Flow
	X	X	X	15. Identify the RCP Motor Start Limits.
X	X	X	X	16. Correctly Locate the following: a. RCP Start Buses and RCP Boards. b. RCP Seal and Seal Piping arrangement. c. Oil Lift Pump. d. Motor Cooling Water Supply and Return Valves. e. Thermal Barrier Booster Pumps (TBBPs) and Piping. f. RCP Oil level Sight Glasses. g. RCP Motor Heater. h. RCP Motor Cooler.

29. 003 K6.02 029

Given the following:

- Unit 1 is in Mode 3 with the RCS at normal operating temperature and pressure.
- Annunciator 100-D, RCP SEAL LEAK OFF FLOW HI, alarms.
- The #4 RCP seal leak off temperature has begun to slowly rise.

Which ONE of the following identifies...

(1) the operation of the #4 RCP #2 seal

and

(2) if 'RCP Immediate Trip Criteria' is currently met?

A.✓ (1) The # 2 seal will transition to a film riding mode of operation as the #1 seal fails.
(2) Is met.

B. (1) The # 2 seal will transition to a rubbing face mode of operation as the #1 seal fails.
(2) Is met.

C. (1) The # 2 seal will transition to a film riding mode of operation as the #1 seal fails.
(2) Is **NOT** met.

D. (1) The # 2 seal will transition to a rubbing face mode of operation as the #1 seal fails.
(2) Is **NOT** met.

DISTRACTOR ANALYSIS:

A. *Correct, The #2 seal does transition to a film riding mode of operation following the failure of the #1 seal and with 'the seal flow high and the seal leak off temperature starting to rise', the RCP 'Immediate Trip' criteria is met.*

B. *Incorrect, Plausible because the #2 seal does transition but the stated transition is the opposite of what actually occurs and the RCP 'Immediate Trip' criteria currently being met is correct.*

C. *Incorrect, Plausible because the #2 seal transitioning to a film riding seal is correct and because if the seal leak off temperature had not been rising the 'Immediate Trip' criteria would not currently be met.*

D. *Incorrect, Plausible because the #2 seal does transition but the stated transition is the opposite of what actually occurs and because if the seal leak off temperature had not been rising the 'Immediate Trip' criteria would not currently be met.*

Question Number: 29

Tier: 2 **Group:** 1

K/A: 003 K6.02
Reactor Coolant Pump System (RCPS)
Knowledge of the effect of a loss or malfunction on the following will have on the RCPS:
RCP seals and seal water supply

Importance Rating: 2.7 / 3.1

10 CFR Part 55: 41.7 / 45/5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of the effect an RCP #1 seal failure has on the #2 seal on the pump and also the evaluation of pump seal conditions to determine if a pump shutdown is required.

Technical Reference: ARI-95-101, Reactor Coolant Pumps, Revision 0033
AOI-24, RCP Malfunctions During Pump Operation, Revision 0029
N3-68-4001, Reactor Coolant System, Revision 0030

Proposed references None

to be provided:

Learning Objective: 3-OT-AOI2400

10. Given a set of plant conditions, use AOI-24 to correctly:
    a. Recognize Entry Conditions.
    b. Identify Required Actions.
    c. Respond to Contingencies (RNO).
    d. Observe and Interpret Cautions and Notes.
11. Given a set of conditions, determine if RCP shutdown is required using AOI-24, Attachment 2.

Cognitive Level:

Higher	X
Lower	

Question Source:

New	
Modified Bank	
Bank	X

Question History: WBN bank question SYS068B.05 013 with choices relocated and conditions/wording changed in the stem and all choices.

Comments:

100-D

RCP SEAL LEAK OFF FLOW HI

(Page 1 of 1)

Source

RCP 1: 1-FS-62-11
RCP 2: 1-FS-62-24
RCP 3: 1-FS-62-37
RCP 4: 1-FS-62-50

Setpoint

4.8 gpm

Probable Cause:

A. No. 1 seal damage
B. No. 1 seal NOT fully seated
C. Loss of seal injection water followed by high seal temperature

Corrective Action:

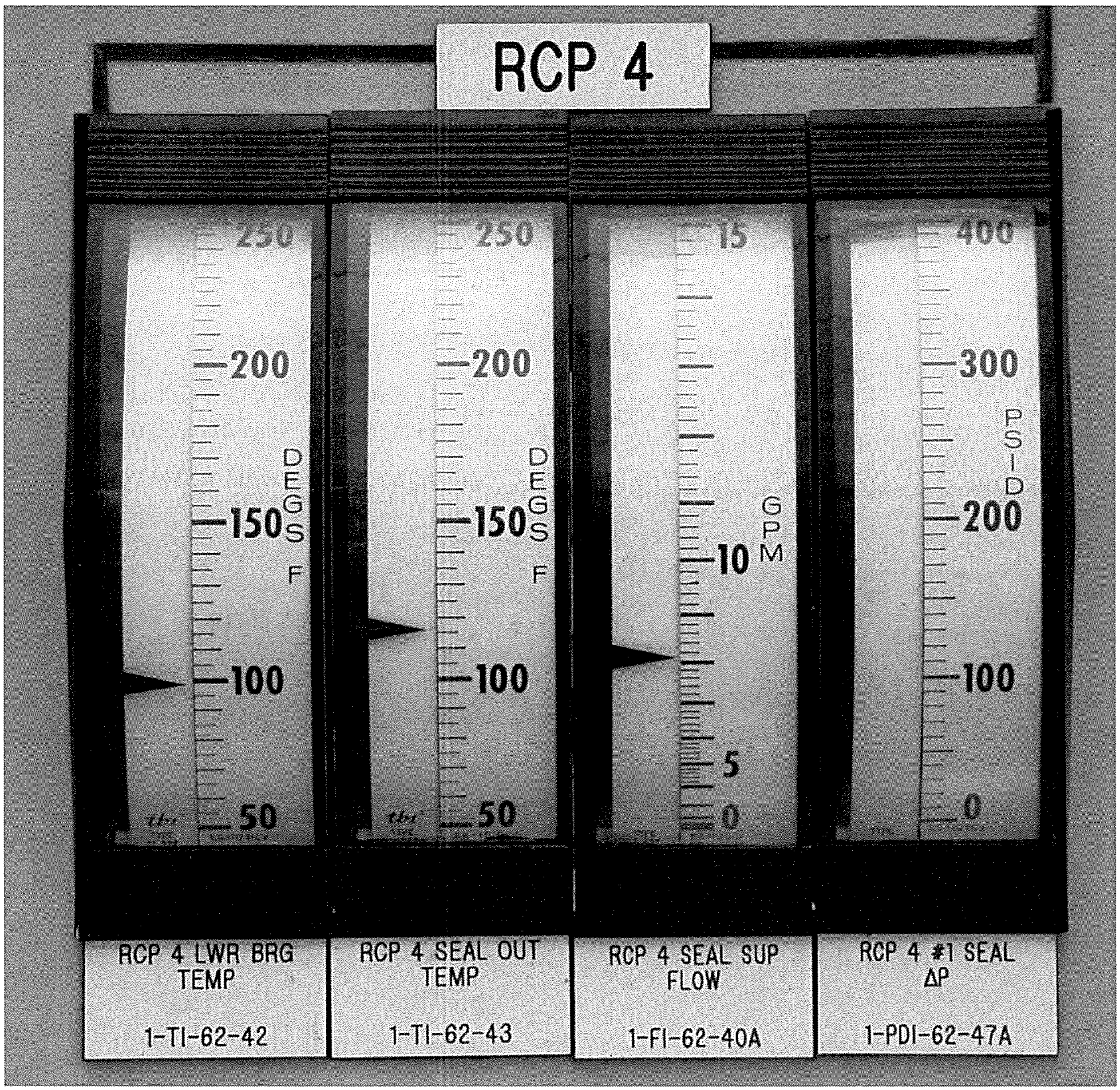
[1] **VERIFY** high leakoff flow condition of affected RCP(s) with the following instruments:

RCP	RECORDER	PEN/TRACE	ICS POINT
1	1-FR-62-24	Red	F1018A
2	1-FR-62-24	Blue	F1020A
3	1-FR-62-50	Red	F1022A
4	1-FR-62-50	Blue	F1024A

[2] **IF** high leakoff is confirmed, **THEN**
GO TO AOI-24, *RCP MALFUNCTIONS DURING PUMP OPERATION.*

References:

1-47W610-62-1
AOI-24


RCP 4
250
200
150
100
50
DEGS F
250
200
150
100
50
DEGS F
15
10
5
0
GPM
400
300
200
100
0
PSID
RCP 4 LWR BRG TEMP
1-TI-62-42
RCP 4 SEAL OUT TEMP
1-TI-62-43
RCP 4 SEAL SUP FLOW
1-FI-62-40A
RCP 4 #1 SEAL ΔP
1-PDI-62-47A

Attachment 2
(Page 1 of 1)

RCP IMMEDIATE SHUTDOWN CRITERIA

NOTE Exceeding any of the following setpoints will require an immediate pump shutdown. Operating limits can be found in SOI 68.02. This list is immediate shutdown criteria only.

A. Shaft vibration greater than 20 mils or 15 mils with a rate of rise equal to 1 mil/hr (alarm at 15 mils). [Indicators located on 0-PNL-52-R139, Aux Inst Rm.]

B. Frame vibration greater than 5 mils or 3 mils with a rate of rise of 0.2 mil/hr. [Readings taken by Maint. at Aux Bldg L-Panels, el.737.]

C. Motor windings temp greater than 302°F.

D. Motor bearing temp greater than 195°F.

E. Pump bearing temp greater than 225°F.

F. Loss of CCS to oil coolers for greater than 10 minutes.

G. No. 1 seal outlet temp greater than 225°F.

CORRECT

H. No. 1 seal flow HIGH with rising pump bearing or #1 seal leakoff temperatures.

I. No. 1 seal ΔP less than or equal to 200 psid.

3.2.3 Reactor Coolant Pumps (continued)

6. Radial Bearing Assembly

   The radial bearing consists of a two-piece horizontally split housing, a bearing cartridge, and a journal. It is lubricated and cooled by injection water. The spherical inside diameter of the housing mates with a surface on the bearing cartridge that is overlaid with a cobalt-based alloy. Carbon-graphite rings are shrunk in the bearing cartridge and form the bearing surface. The bearing operates against a journal shrunk on the shaft. This journal is made of stainless steel overlaid with a cobalt-based alloy.

B. Seal System

The pump seal system consists of three different controlled-leakage seals within a seal housing, and features the assembly of the Number 2 and Number 3 seals in a single cartridge so that they may be installed or removed together.

1. Number 1 Seal

   The Number 1 seal is the main controlled-leakage seal of the pump. It is a hydrostatically balanced, film-riding face seal, consisting of a seal runner which rotates with the shaft and a nonrotating seal ring enclosed by the seal housings. Both the runner and ring have an aluminum-oxide or silicon-nitride faceplate clamped to a stainless steel holder.

   Seal Injection water flows through the separation between the two faceplates, the amount of separation being controlled by the face contours and system pressure. Separation will be maintained and no surface contact will occur as long as minimum operating pressures are maintained. Part of the leakage up through the Number 1 seal (normally injection water) supplies the Number 2 seal, while the excess flow is piped to the VCT through the Number 1 seal leak-off pipe.

2. Number 2 Seal

   The Number 2 seal is a rubbing-face seal, consisting of a carbon-graphite insert assembled with a shrink fit into a retaining ring. This assembly is attached to a seal ring base with spring-loaded pins. Both the retaining ring and the seal ring are made from stainless steel forgings. The assembly is pinned to prevent rotation but allows motion in the axial direction. The insert rubs on a chrome-carbide-coated stainless steel forged runner, which rotates with the shaft. The leakage through the Number 2 seal is piped to RCDT through the Number 2 seal leak-off pipe.

   When subjected to high pressure (which would occur should the Number 1 seal fail), the Number 2 seal is designed to convert from a rubbing-face to a film-riding seal. This conversion happens because the runner deflects as operating pressure increases.

SYS068B.05 013 WBN BANK QUESTION

Given the following plant conditions;

- The Unit is at 42% power, and increasing.
- The #1 RCP seal leak off flow indication is rising.
- The #1 RCP lower radial bearing temperature has begun to slowly rise.

Which of the following describes the RCP seals, and the condition of the RCP?

a. The # 2 seal will transition to a film riding mode of operation as the #1 seal fails, and the RCP may continue to run indefinitely.

b. The # 2 seal will transition to a rubbing face mode of operation as the #1 seal fails, and the RCP may continue to run indefinitely.

c. The # 2 seal will transition to a rubbing face mode of operation as the #1 seal fails, and the RCP must be removed from service.

d.✓ The # 2 seal will transition to a film riding mode of operation as the #1 seal fails, and the RCP must be removed from service.

I. PROGRAM

Watts Bar Operator Training

II. COURSE

A. License Training
B. Non-license Training

III. TITLE

AOI-24, RCP Seal Malfunctions during Pump Operation

IV. LENGTH OF LESSON

License Training 1 Hour
Non-License Training 1 Hour

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	01. Demonstrate knowledge of the Purpose/Goal of AOI-24.
X	X	X	X	02. Indicate how much leakage could result from total seal failure at full RCS pressure, describe action to mitigate the consequences of this leakage.
	X	X	X	03. Identify Alarms associated with RCP seal malfunctions.
X	X	X	X	04. List 4 Indications of RCP seal malfunctions per AOI-24.
				05. Deleted Objective
X	X	X	X	06. Assuming injection water to an RCP is lost and pump lower bearing temperature is above alarm setpoint, state what precautionary measure must be observed when restoring seal injection.
X	X	X	X	07. Given an RCP seal Standpipe Hi level alarm, describe how to calculate #2 seal leak-off rate from the Radwaste Panel.
	X	X	X	08. Explain why RCP Seal Standpipe Level Hi/Lo alarm comes in on #3 Seal leak-off Hi flow.

V. TRAINING OBJECTIVES (continued)

AUO	RO	SRO	STA	
	X	X	X	09. Identify the parameters listed in AOI-24 that require the RCP to be shutdown
	X	X	X	10. Given a set of plant conditions, use AOI-24 to correctly: a. Recognize Entry Conditions. b. Identify Required Actions. c. Respond to Contingencies (RNO). d. Observe and Interpret Cautions and Notes.
	X	X		11. Given a set of conditions, determine if RCP shutdown is required using AOI-24, Attachment 2.
	X	X		12. Describe basic Operator Actions to shut down an RCP.

VI. TRAINING AIDS

A. Marker Board & Markers
B. Multimedia/Overhead projector(s)

VII. MATERIALS

Attachment(s):
Attachment 1 - RCP Seal Flows
Attachment 2 - AOI-24, RCP Seal Malfunctions during Pump Operation (Latest Rev)
Attachment 3 - SOER 82-5, Reactor Coolant Pump Seal Failure

VIII. REFERENCES

ENGINEERING SYSTEM DESCRIPTION(S)		
Number	Title	Rev.
N3-62-4001	Chemical and Volume Control System	29
N3-68-4001	Reactor Coolant System	28
WBN FSAR		
Section	**Title**	**Amend.**
9.3.4	Chemical and Volume Control System	NA
Chapters 3, 5, 6, 7, 9, 15	Reactor Coolant System	NA
DRAWINGS		
Plant Drawings	**Title**	**Rev.**
	None	

- ►Three general classes of conditions are addressed by AOI-24:
  - ►Conditions requiring immediate pump shutdown or pump trip.
  - ►This condition, which includes high #1 seal leakoff flow that results in rising RCP lower bearing or #1 seal outlet temperature, requires an immediate reactor trip if in Mode 1 or 2.

Information to Instructor

TVA

AOI-24, Section 3.3, #1 Seal Leakoff Flow High

1) MONITOR #1 seal leakoff equal to or greater than 6.0 gpm. (Annunciator alarms at 4.8 gpm)

2) MONITOR RCPs lower bearing and #1 seal outlet temp STABLE or DROPPING

Information to Instructor

NOTE: The numbering of steps corresponds to the numbering of AOI steps. A copy of AOI-24 should be used for detailed substeps and RNO actions.

CAUTION: A seal leakoff rise to greater than 2.0 gpm AFTER experiencing low leakoff of less than 0.8 gpm may indicate seal degradation. Plant Management should be notified of leakoff trends.

Note 1: Anytime #1 seal leakoff flow exceeds the values shown on Attachment 1, system engineering should be requested to perform an evaluation of the #1 seal condition.

Note 2: During plant startup after seal maintenance, the #1 seal may require 24 hours of run time before the seal seats fully and operates normally.

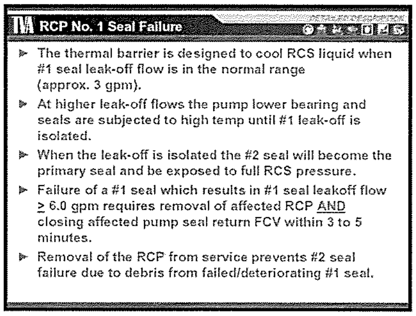
Note 3: The #1 seal return should be isolated between 3 and 5 minutes after tripping an RCP to allow for pump coastdown.

1 Additional Info: Seal leak-off high range indicator scale is 0-6 gpm. Since 6 gpm is the maximum indicated leak-off flow, the only way to determine the impact of flow > 6 gpm is to monitor the effect on RCP lower bearing and #1 seal outlet temperature, and the effect on #2 seal leak-off flow.
Contact should be made with Engineering to install temporary flow indication if leakage exceeds 6 gpm. Westinghouse technical bulletin states, "If the total #1 seal flow exceeds 8.0 gpm or temperatures begin to rise, proceed with immediate shutdown….." Since we can't read 8 gpm, we rely on temperature.

2 Additional Info: In the condition where the lower bearing or #1 seal outlet temperatures are rising, leak-off flow is greater than seal injection flow (nominally 8 gpm). Rising temperatures indicate RCS flow up through the thermal barrier at a rate greater than the cooling capacity of the thermal barrier (~3 gpm). (Implying leak-off is 11 gpm or higher).
If either of these conditions exist, then the reactor is tripped, the RCP stopped, and the #1 seal return valve is closed. This action should stop the leakage by forming the #2 seal to its film-riding mode, thus reversing the heatup of the seal package and pump bearing due to high flow and resultant high temperatures. The pump is stopped prior to isolating the seal leak-off in order to avoid the possibility of forcing debris from the failed seal or the RCS up through the #2 seal while the pump is rotating.

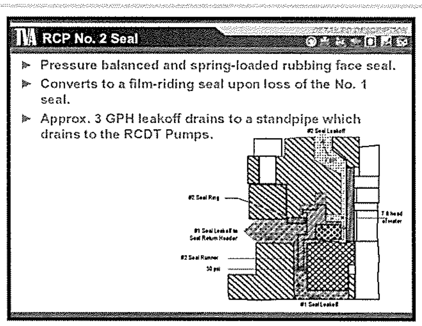
OBJECTIVE 8

SLIDE 39



11. Discuss the impact of a #1 seal failure on RCP operation.
    - The thermal barrier is designed to cool RCS liquid when #1 seal leak-off flow is in the normal range (approx. 3 gpm).
    - At higher leak-off flows the pump lower bearing and seals are subjected to high temp until #1 leak-off is isolated.
    - When leak-off is isolated the #2 seal will become the primary seal and be exposed to full RCS pressure.
    - Failure of a #1 seal which results in #1 seal leakoff flow ≥ 6.0 gpm requires removal of affected RCP AND closing affected pump seal return FCV within 3 to 5 minutes.
    - Removal of the RCP from service prevents #2 seal failure due to debris from failed/deteriorating #1 seal
    - Hyperlink to the Human Performance Tools and Traps home page and select Procedure Use and Adherence. Emphasize the importance of use of AOIs to address these conditions.

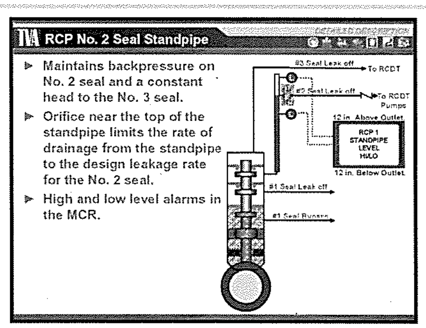
SLIDE 40



RCP #2 Seal

1. Discuss the function, operation and design characteristics of the RCP #2 Seal.
    - Pressure balanced and spring-loaded rubbing face seal.
    - Converts to a film-riding seal upon loss of the No. 1 seal.
    - Approx. 3 GPH leakoff drains to a standpipe which drains to the RCDT Pumps.

SLIDE 41



2. Discuss the function and operation of the RCP No. 2 Seal Standpipe.
    - Maintains backpressure on No. 2 seal and a constant head to the No. 3 seal.
    - Orifice near the top of the standpipe limits the rate of drainage from the standpipe to the design leakage rate for the No. 2 seal.
    - High and low level alarms in the MCR.Window XA-55-5B, Window 95-C.
      RCP X STANDPIPE LEVEL HI/LO.
      HI - 12 in. above outlet.
      LO - 12 in. below outlet.

I. PROGRAM

Watts Bar Operator Training

II. COURSES

A. License Training

B. Non-License Training

■

III. TITLE

Reactor Coolant Pumps

IV. LENGTH OF LESSON

A. License Training 2 Hours
B. Non-License Training 4 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
	X	X	X	01. State the Reactor Coolant Pump (RCP) Design basis per FSAR 5.5.1.
	X	X	X	02. Locate MCR Controls and Indications for the RCPs, including: a. Normal & Alternate control handswitches. b. Cooling water and thermal barrier supplies. ■ c. Bearing temp; Seal water supply, leakoff, water temp, and ΔP.
	X	X	X	03. Given the RCS condition/status and number of RCPs/RHR pumps in service, use Tech Specs to determine if operability requirements are met and if actions are required.
X	X	X	X	04. Describe the Purpose and Flowpath of the RCP Thermal Barrier.
X	X	X	X	05. Describe the RCPs' Seal Injection System, including: a. Flowpath/Components b. Flowrate c. Purpose
X	X	X	X	06. List the RCP Seal #1 normal ΔP <u>and</u> required minimum ΔP.
X	X	X	X	07. Give the Purpose of the #1 Seal Bypass Valve, and list conditions that must be met before the valve is opened
X	X	X	X	08. Identify the Conditions requiring closure of the #1 Seal Leak-off Valve, and the Effects of closing the leak-off valve

AUO	RO	SRO	STA	
	X	X	X	09. Describe the Purpose and Interlocks of the RCP Oil Lift System
X	X	X	X	10. Explain the Purpose of the RCP Flywheel
X	X	X	X	11. Describe how Reverse Rotation of an idle RCP is prevented
X	X	X	X	12. Identify the RCPs' Normal and Alternate Power Supplies
	X	X	X	13. List and Explain the limitation for RCP operation without Component Cooling Water (CCS) aligned
	X	X	X	14. Describe the Conditions which must be met to continue RCP operation Without Seal Injection Flow
	X	X	X	15. Identify the RCP Motor Start Limits.
X	X	X	X	16. Correctly Locate the following: a. RCP Start Buses and RCP Boards. b. RCP Seal and Seal Piping arrangement. c. Oil Lift Pump. d. Motor Cooling Water Supply and Return Valves. e. Thermal Barrier Booster Pumps (TBBPs) and Piping. f. RCP Oil level Sight Glasses. g. RCP Motor Heater. h. RCP Motor Cooler.

30. 004 A2.06 030

Given the following:

- Unit 1 is operating at 100% power after restart following a refueling outage.

- Rod Control in MANUAL.

- VCT level is currently at 32%.

- An AUO places an un-borated mixed bed demineralizer in service.

Which ONE of the following identifies...

(1) expected change in VCT level if no operator action is taken and the condition is allowed to persist

and

(2) the corrective action the RO will take that will stop the event in progress?

A. (1) Remain constant.
(2) Place 1-HS-62-79A, LTDN HI TEMP DIVERT, to 'V.C. TK'.

B. (1) Remain constant.
(2) Initiate normal boration per AOI-34, "Immediate Boration."

C✓ (1) Rise over time.
(2) Place 1-HS-62-79A, LTDN HI TEMP DIVERT, to 'V.C. TK'.

D. (1) Rise over time.
(2) Initiate normal boration per AOI-34, "Immediate Boration."

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because, unlike an inadvertent dilution due to makeup, no inventory is directly added to the VCT due to the unborated mixed bed and placing 1-HS-62-79A to the VCT position will divert letdown around the demin that is the source of the problem.*

B. *Incorrect, Plausible because, unlike an inadvertent dilution due to makeup, no inventory is directly added to the VCT due to the unborated mixed bed and AOI-3, Malfunction of Reactor Makeup Control, does refer operators to AOI-34 to borate the RCS, however it will not stop the event in progress.*

C. *Correct, the dilution event in progress does not add any inventory but it will increase Tavg which will cause pressurizer level to increase above setpoint, which will lower charging and place more coolant into the VCT. Also, placing 1-HS-62-79A to the VCT position will divert letdown around the demin that is the source of the problem.*

D. *Incorrect, Plausible because the dilution event in progress does not add any inventory but it will increase Tavg which will cause pressurizer level to increase above setpoint, which will lower charging and place more coolant into the VCT. Also plausible because AOI-3, Malfunction of Reactor Makeup Control, does refer operators to AOI-34 to borate the RCS, however it will not stop the event in progress.*

Question Number: 30

Tier: 2 **Group:** 1

K/A: 004 A2.06
Chemical and Volume Control System
Ability to (a) predict the impacts of the following malfunctions or operations on the CVCS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:
Inadvertent boration/dilution.

Importance Rating: 4.2 / 4.3

10 CFR Part 55: 41.5 / 43.5 / 45.3 / 45.5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of the operation of CVCS, i.e. how charging will respond as Tavg and pressurizer level change and that effect on VCT level and knowledge of how to stop an unborated mixed bed from diluting the RCS through

K/A Match: K/A is matched because the question requires knowledge of the operation of CVCS, i.e. how charging will respond as Tavg and pressurizer level change and that effect on VCT level and knowledge of how to stop an unborated mixed bed from diluting the RCS through the CVCS.

Technical Reference: AOI-3, "Malfunction of Reactor Makeup Control," Rev. 0029

Proposed references to be provided: None

Learning Objective: 3-OT-AOI0300
04. List 3 ways Inadvertent Dilution could occur.
06. Explain the effect placing an unborated Mixed Bed Demin in service can have on RCS Boron Concentration.

Cognitive Level:
Higher X
Lower ___

Question Source:
New X
Modified Bank ___
Bank ___

Question History: New question for the WBN 10/2011 NRC exam.

Comments:

Step	Action/Expected Response	Response Not Obtained

3.2 Inadvertent Dilution (continued)

CAUTION Charging flow path should be isolated when Letdown is taken out of service.

3.	**PLACE** 1-HS-62-79A, Ltdn Hi Temp Divert to VC TK.	**CLOSE** 1-FCV-62-69 and 1-FCV-62-70, LETDOWN FLOW ISOLATION. **IF** leakage from Mixed Bed is suspected, **THEN**: **CLOSE** 1-ISV-62-901 and 1-ISV-62-902 to isolate 'A' Mixed Bed [A3T/713]. **OR** **CLOSE** 1-ISV-62-908 and 1-ISV-62-909 to isolate 'B' Mixed Bed [A3T/713].

NOTE A letdown temperature drop can reduce RCS boron concentration by changing the demin bed boron equilibrium.

4.	**CHECK** letdown temp stable: • 1-TI-70-191, LTDN HX RET TEMP. • 1-TI-62-78, Letdown HX Outlet Temp. • 1-TI-62-131, VCT Outlet Temp.	**STABILIZE** letdown and CCS temp.

I. PROGRAM

Watts Bar Operator Training

II. COURSE

A. License Training

B. Licensed Requalifcation

C. NAUO Requalifcation

III. TITLE

AOI-3, Malfunction of Reactor Makeup Control

IV. LENGTH OF LESSON

License Training 1.0 Hour

License Requalification and NAUO Requalification times will be determined after objectives are identified.

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. Describe the Purpose/Goal of AOI-3.
	X	X	X	2. Describe the main concern(s) for Inadvertent Dilution at power.
	X	X	X	3. List 3 Symptoms of Inadvertent Dilution during Shutdown.
X	X	X	X	4. List 3 ways Inadvertent Dilution could occur.
X	X	X	X	5. Explain required Local Action if Primary Water flow to blender can not be terminated from MCR.
X	X	X	X	6. Explain the effect placing an unborated Mixed Bed Demin in service can have on RCS C_B
X	X	X	X	7. With Refueling in progress, determine correct response of personnel in Cntmt to a PA announcement for Cntmt evacuation.

31. 004 A2.21 031

Given the following:

- Unit 1 is operating at 100% power.
- Letdown flow is 120 gpm.
- Chemistry request the cation bed be placed in service at a 50 gpm flow rate.

Which ONE of the following identifies...

(1) the affect on the Cation Bed if full letdown flow was aligned through the bed

and

(2) the valve that will be used to set the requested flow rate at 50 gpm through the cation bed in accordance with SOI-62.04, "CVCS Purification System?"

A. (1) Design flow would **NOT** be exceeded.
(2) 1-ISV-62-916, CVCS CATION DEMIN BED OUTLET

B. (1) Design flow would be exceeded.
(2) 1-ISV-62-916, CVCS CATION DEMIN BED OUTLET

C. (1) Design flow would **NOT** be exceeded.
(2) 1-ISV-62-922, CVCS MIXED BED DEMIN OUTLET

D✓ (1) Design flow would be exceeded.
(2) 1-ISV-62-922, CVCS MIXED BED DEMIN OUTLET

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because the design flow rate of each of the CVCS Mix Beds is 120 gpm and if this rating had been applied to the Cation Bed the flow rate of the full letdown flow would not have been exceeded. Second part also plausible because throttling the outlet valve on a component is a typical way of establishing a flow rate through a component and the flow rate would be changed through the cation bed if 1-ISV-62-916, CVCS CATION DEMIN OUTLET were throttled.*

B. *Incorrect, Plausible because design flow of the cation bed being exceeded is correct and because throttling the outlet valve on a component is a typical way of establishing a flow rate through a component and the flow rate would be changed through the cation bed if 1-ISV-62-916, CVCS CATION DEMIN OUTLET were throttled.*

C. *Incorrect, Plausible because the design flow rate of each of the CVCS Mix Beds is 120 gpm and if this rating had been applied to the Cation Bed the flow rate of the full letdown flow would not have been exceeded. Also plausible because throttling 1-ISV-62-916, CVCS MIXED BED DEMIN OUTLET, is correct.*

D. *Correct, The design flow rate of the cation bed is 75 gpm. The full 120 gpm letdown flow through the cation bed would exceed the design flow of the bed. In accordance with SOI-62.04, 1-ISV-62-922, CVCS MIXED BED DEMIN OUTLET, is used after the cation bed inlet and outlet valves are opened to establish the required flow rate. The valve is parallel to the cation bed in the system flow path. Throttling this valve in the close direction forces flow through the cation bed.*

Question Number: 31

Tier: 2 **Group:** 1

K/A: 004 A2.21
Chemical and Volume Control System
Ability to (a) predict the impacts of the following malfunctions or operations on the CVCS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:
Excessive letdown flow, pressure, and temperatures on ion exchange resins (also causes).

Importance Rating: 2.7 / 2.7

10 CFR Part 55: 41.5 / 43.5 / 45.3 / 45.5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of the impact of placing an established letdown flow through a CVCS ion exchanger (cation bed) and how flow will be throttled to protect the demin bed from failure.

Technical Reference: SOI-62.04, "CVCS Purification System," Rev. 0057

Proposed references to be provided: None

Learning Objective: 3-OT-SYS062
20. Discuss the function of the CVCS mixed bed and cation bed demineralizers.

Cognitive Level:
Higher ____
Lower X

Question Source:
New X
Modified Bank ____
Bank ____

Question History: New question for the WBN 10-2011 NRC exam

Comments:

Date ________

8.2 Place Cation Bed in Service

[1] **ENSURE** CB FILLED and VENTED per Section 8.1. ________

[2] **PERFORM** the following:

NOMENCLATURE	LOCATION	POSITION	UNID	PERF INITIAL	VERIFIER INITIAL
CVCS CATION DEMIN BED INLET	A3T/713	CLOSED	1-ISV-62-915		CV
CVCS CATION DEMIN BED OUTLET	A3T/713	CLOSED	1-ISV-62-916		CV
CVCS CATION DEMIN BED VENT	A3T/713	CLOSED	1-VTV-62-917		CV
CVCS CATION DEMIN BED RESIN FILL	A5U/737	CLOSED	1-ISV-62-918		CV
CVCS CATION DEMIN BED RESIN DISCH	A7U/713	CLOSED	1-ISV-62-919		CV
CVCS CATION DEMIN BED DRAIN	A3T/713	CLOSED	1-DRV-62-920		CV
CVCS CATION BED FLUSH	A3T/713	CLOSED	1-FLV-62-921		CV

[3] **ENSURE** 1-ISV-62-922, CVCS MIXED BED DEMIN OUTLET [A3T/713], is OPEN. ________

[4] **REVIEW** Attachment 1, Resin Status Sheet to ensure CB is FILLED and BORATED. ________

________ CV

[5] **NOTIFY** SRO of intent to place CB in service, and its current boron concentration as recorded on Attachment 1, Resin Status Sheet. ________

CAUTION
Cation Bed may need to be flushed to minimize reactivity effects if cation bed boron concentration varies more than 20 ppm from that of the RCS boron concentration or if a new cation bed is being placed in service.

[6] **OPEN** 1-ISV-62-915, CVCS CATION DEMIN BED INLET. ________

________ CV

Date ________

8.2 Place Cation Bed in Service (continued)

[7] **IF** flush is desired for cation bed, **THEN**

GO TO Section 8.7, Flushing Cation Bed to Adjust Boron Prior to Use. ________

CORRECT

CAUTION

Maximum Cation Bed flow is 75 gpm. May be read locally at 1-FI-62-113 (Panel 1-L-57 at A3T/713).

[8] **(ρ) SLOWLY OPEN** 1-ISV-62-916, CVCS CATION DEMIN BED OUTLET. DISTRACTOR ________

________ CV

CORRECT

[9] **SLOWLY THROTTLE** CLOSE 1-ISV-62-922, CVCS MIXED BED DEMIN OUTLET, until desired cation bed flow rate achieved. ________

________ CV

[10] **RECORD** Time, Date, and Flowrate when CB was placed in service on Attachment 1, Resin Status Sheet. ________

[11] **NOTIFY** Chemistry of Time, Date, and Flowrate when CB was placed in service. ________

End of Section

3.0 PRECAUTIONS AND LIMITATIONS

A. Resin damage may occur if demin inlet temp exceeds 140°F.

B. Mixed Bed Demins must be borated before placing in service, or borated slowly while placing in service to avoid rapid reduction of Reactor Coolant System (RCS) boron concentration (C_B).[2] Where use of new resin is a part of a planned RCS boron concentration control evolution, work shall be controlled to ensure that adequate reactivity control systems are maintained operable at all times.

C. When resin addition is in progress, transfer line plugging can occur if a sufficient flow of water is not maintained.

D. Spent resin sluice line can be a source of considerable radiation exposure during resin transfer due to pipe routing and lack of shielding around pipe.[C.1]

E. When Reactor Coolant Filter is bypassed, flow though the demins should be Secured or Diverted to HUT to prevent potential Resin intrusion into RCS.

F. Demineralizer flow limits: DISTRACTION

1. MB Demins normal design flow is 20 to 120 gpm.

2. Cation Demin design flow is ≤75 gpm. CORRECT

G. When performing operations on demins, care should be exercised to maintain a letdown flow path at all times.

H. Work in Radiological Control Area (RCA) requires the use of existing RWPs and may require additional ALARA Preplans. Failure to follow posted Rad control requirements can cause unnecessary radiation exposure. Radiological Protection should be notified of work with potential to change radiological conditions.

I. Instrument Maintenance department should be notified to ensure required instruments will be in service, as necessary, to support system operation.

J. Demineralizers containing macroporous resin have the potential for particulate loading and subsequent release when flow is reestablished.

K. Steps that directly affect reactivity will be preceded with the Greek symbol (ρ).

L. Steps within this instruction may require venting, draining, or breaching radioactive components or systems to the atmosphere. Appropriate protection controls must be established to prevent the spread of contamination and avoid the generation of airborne radioactivity.

I.PROGRAM

Watts Bar Operator Training

II. COURSES

A. License Training

B. . Non-License Training

III. TITLE

Chemical and Volume Control System

IV. LENGTH OF LESSON

A. License Training 6 Hours
B. Non-License 6 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. Explain the major functions of the CVCS system as described in FSAR section 9.3.4
X	X	X	X	2. Explain the functions of the following subsystems of CVCS: ■ Charging, letdown and seal injection water. ■ Chemical control, purification, and makeup. ■ Chemical shim (boron concentration) and reactor coolant makeup.
X	X	X	X	3. Explain the purpose and capacity of the excess letdown system.
X	X	X	X	4. Using a block diagram of CVCS, explain system flow balance.
X	X	X	X	5. Describe all interlocks (opening and closing) for: ■ Letdown isolation valves (FCV 62-69, 70, 77) ■ Letdown orifice isolation valves (FCV 62-72, 73, 74, 76)

AUO	RO	SRO	STA	
X	X	X	X	6. Describe the function/purpose of the following CVCS equipment: ■ Regenerative Hx. ■ Letdown Hx. ■ Letdown Orifices ■ Rx Coolant Filter ■ Holdup Tanks ■ Volume Control Tank ■ Centrifugal Charging Pump ■ Seal Water Injection Filters ■ RCP Seal Standpipe ■ Number 1 Seal Bypass ■ Seal Water Filter ■ Seal Water Hx. ■ Excess Letdown Hx.
X	X	X	X	7. Explain the function and operation of the letdown pressure control valve PCV-62-81.
X	X	X	X	8. Explain the function and operation of the three way temperature divert valve TCV-62-79.
X	X	X	X	9. Explain the function and operation of the three way divert valve LCV-62-118.
X	X	X	X	10. Explain the VCT level program.
X	X	X	X	11. Explain the reason for maintaining > 17 psig H2 pressure in the VCT relative to RCP operation.
X	X	X	X	12. Explain the automatic actuation logic and interlocks associated with the VCT outlet valves, FCV-62-132 and 133 and the CCP suction valves from the RWST, FCV-62-135 and 136.
X	X	X	X	13. Describe the CCPs. Include capacity and power supplies.
X	X	X	X	14. Explain how to locally control charging flow using the following equipment: ■ CCP discharge valve FCV-62-93 ■ Charging header FCV-62-89 ■ FCV-62-93 bypass
X	X	X	X	15. Explain the conditions that must exist to allow opening of the RCP No. 1 seal bypass (FCV-62-53) after receiving a high temp alarm on the RCP lower bearing or leakoff, in accordance with SOI-68.02.

AUO	RO	SRO	STA	
X	X	X	X	16. List the CVCS relief valves, with setpoints and relief paths for each.
X	X	X	X	17. Describe the indications of a leaking or stuck open letdown relief valve, RV-62-662.
X	X	X	X	18. Explain the reason for adding hydrazine and lithium hydroxide to the RCS and when it should be added.
X	X	X	X	19. Discuss the process for placing a hydrogen or nitrogen blanket on the VCT and adjusting VCT pressure, in accordance with SOI-62.01.
X	X	X	X	20. Discuss the function of the CVCS mixed bed and cation bed demineralizers.
X	X	X	X	21. Describe three conditions that require bypassing the CVCS demineralizers.
X	X	X	X	22. Discuss resin breakthrough and relate the consequences to the RCS.
X	X	X	X	23. Explain the precautions regarding placing an unborated mixed bed demineralizer in service, in accordance with SOI-62.01.
X	X	X	X	24. Explain the necessity for checking the CCP breaker after each operation, in accordance with SOI-62.01.
X	X	X	X	25. Explain why a change in RCS boron concentration is required during plant operation.
				26. Objective deleted.
X	X	X	X	27. Describe the boric acid blender.
X	X	X	X	28. Describe the modes of operation of the CVCS Boron Concentration and Reactor Makeup Control System.
X	X	X	X	29. Discuss how to perform manual immediate boration, include when this is necessary.
X	X	X	X	30. Discuss how chemicals are injected into the RCS.
X	X	X	X	31. Given a set of plant parameters or indications diagnose conditions and/or problems relative to the CVCS.
	X	X	X	32. Regarding Technical Specifications and Technical Requirements for this system: ■ Identify the conditions and required actions with completion time of one hour or less. ■ Explain the Limiting Conditions for Operation, Applicability, and Bases. ■ Given a status/set of plant conditions, apply the appropriate Technical Specifications and Technical Requirements.

A U O	R O	S R O	S T A	
	X	X	X	33. [Discuss recent plant events involving gas intrusion into systems providing safety injection or boron injection functions.]
	X	X	X	34. [Discuss the effects of gas intrusion on accident response.]
	X	X	X	35. [Discuss the primary causes of gas intrusion to include design deficiencies, operating deficiencies, and maintenance deficiencies.]
				36. Deleted.
	X	X	X	37. Explain why seal water supply temperature is monitored at the RCP via RCP lower bearing temperatures.

32. 005 A1.01 032

Given the following plant conditions:

- Unit 1 is in Mode 5, midloop operation.
- RHR Train A in service at a flow rate of 2100 gpm.
- The RCS temperature is stable at 126°F.
- The operator throttles open 1-FCV-74-32, RHR HXS BYPASS.

Which ONE of the following identifies how the RCS temperature and the RHR flow rate indicated on 1-M-6?

	RCS Temperature	RHR Flow
A.	Decreases	Increases
B.	Decreases	Decreases
C.✓	Increases	Increases
D.	Increases	Decreases

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because the typical thought process is when bypassing a heat exchanger less heat will be picked up allowing the temperature to drop and because of where the flow is measured the indicated flow rate increasing is correct.*

B. *Incorrect, Plausible because the typical thought process is when bypassing a heat exchanger less heat will be picked up allowing the temperature to drop and because there is a flow element on the flow through the heat exchanger that would sense a lower flow but it is not the flow element that provides the indication on the control board.*

C. *Correct, with the valve being opened further (until it is stopped by a restricting device placed on the valve during midloop operations), more flow to bypass the RHR HX. Less flow through the heat exchanger results in less cooling allowing RCS temperature to increase. Since total flow is measured downstream of where the HX Bypass connects to the HX discharge line (less overall system resistance), the flow indication will rise.*

D. *Plausible because the RCS temperature increasing is correct and because there is a flow element on the flow through the heat exchanger that would sense a lower flow but it is not the flow element that provides the indication on the control board.*

Question Number: 32

Tier: 2 **Group** 1

K/A: 005 A1.01
Residual Heat Removal System
Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RHRS controls including:
Heatup/cooldown rates

Importance Rating: 3.5 / 3.6

10 CFR Part 55: 41.5 / 45.5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the ability to predict and/or monitor changes in the RCS cooldown rate and RHR system flow rates associated with operating the RHRS controls,

Technical Reference: 1-47W810-1 R19
1-47W811-1 R55

Proposed references to be provided: None

Learning Objective: 3-OT-SYS074A

13. Explain how the RCS temperature is controlled using the RHR System.
22. Explain the Normal RHR Cooldown mode by way of a simplified drawing.

Cognitive Level:

- **Higher** ____
- **Lower** X

Question Source:

- **New** ____
- **Modified Bank** ____
- **Bank** X

Question History: SQN bank question 005 A1.01 001 used on the SQN 4/2007 exam with changes in stem conditions and the question statement and 2nd part of distractors B and D changed. Not sufficient change to call bank modified.

Comments:

005 A1.01 001

SQN BANK QUESTION

Given the following plant conditions:

- Plant cooldown in progress using two trains of RHR.
- The flow is 2500 gpm per train.
- The RCS cooldown rate is 25°F per hour.
- RCS temperature is 250°F.
- The demand signal is RAISED on 1-FCV-74-32, RHR Heat Exchanger Bypass Valve.

Which ONE (1) of the following describes the effect on RCS cooldown rate and on total indicated RHR system flow?

	RCS Cooldown Rate	**Indicated RHR Flow**
A.	INCREASES	INCREASES
B.	INCREASES	REMAINS CONSTANT
C.✓	DECREASES	INCREASES
D.	DECREASES	REMAINS CONSTANT

I. PROGRAM

Watts Bar Operator Training

II. COURSES

A. NOTP License Training

B. License Certification

C. AUO Requal

D. License Operator Requal

III. TITLE

Residual Heat Removal System

IV. LENGTH OF LESSON

A. NOTP 8 Hours
B. License Certification 4 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	01. State the purpose/function of the RHR System in accordance with FSAR section 5.5.7.
X	X	X	X	02. Sketch the RHR System, including both trains from suction to hot and cold leg injection
X	X	X	X	03 State the plant conditions including reactivity effects that must be met prior to placing the RHR System in service in accordance with SOI-74.01.
X	X	X	X	04. State the safety-related or emergency functions of the RHR System in accordance with the RHR System Description.
X	X	X	X	05. Describe each of the modes of the RHR System.
X	X	X	X	06. Identify the systems with which the RHR System interfaces.
X	X	X	X	07. Describe the RHR pumps, including power supply, logic, and capacity.
X	X	X	X	08. State the conditions that will result in an auto start of the RHR Pump Room Cooling System in accordance with the RHR System Description.
X	X	X	X	09. State the conditions that will result in an auto start of the RHR pumps in accordance with the RHR System Description.
	X	X	X	10. The plant has just entered Mode 3 with crosstie valves FCV-33 & 35 closed. Determine if Tech Spec operability requirements are met and what actions, if any, are required.
X	X	X	X	11. Describe the auto operation of the RHR pump mini-flow valves.
X	X	X	X	12. Describe the affect of a Safety Injection Signal on the RHR Hx outlet valves.

AUO	RO	SRO	STA	
X	X	X	X	13. Explain how the RCS temperature is controlled using the RHR System.
	X	X	X	14. An RCS cooldown is in progress at a rate of 30°F/Hr with both trains of RHR in service. Describe how you would increase the cooldown rate to 50°F/ Hr while maintaining the same RHR flow rate in accordance with SOI-74.01. Also include control room indications of pump conditions.
X	X	X	X	15. State the interlocks associated with the RHR Pump inlet valves (FCV-74-3 & -21) in accordance with the RHR System Description.
X	X	X	X	16. State the interlocks associated with the RCS loop 4 HL suction valves to RHR (FCV-74-1 & -2) in accordance with the RHR System Description.
X	X	X	X	17. State the interlocks associated with the RCS loop 4 HL suction bypass valves (FCV-74-8 & -9) in accordance with the RHR System Description.
X	X	X	X	18. State the design basis and setpoint of the RHR suction piping relief valve, in accordance with FSAR Section 5.5.7.3.3.
X	X	X	X	19. State the design basis of the RHR System in accordance with FSAR Section 5.5.7.1.
X	X	X	X	20. Explain why, at low RCS pressures, it is necessary to use RHR for letdown capability.
X	X	X	X	21. Explain the RHR alignment as it pertains to standby emergency core cooling by drawing a simplified drawing.
X	X	X	X	22. Explain the Normal RHR Cooldown mode by way of a simplified drawing.
X	X	X	X	23. The RCS is being cooled down at 50°F/Hr using RHR cooling. Identify parameters and limitations in accordance with the Press and Temp Limits Report (PTLR) that must be observed.
X	X	X	X	24. State the three sources of heat load when conducting an RCS cooldown with the RHR system.
X	X	X	X	25. Deleted
X	X	X	X	26. State two plant conditions which require that only one train of RHR cooling be in service.
X	X	X	X	27. With the RCS in a solid water condition and letdown from the RHR system, explain the operator actions required to increase the RCS pressure.
X	X	X	X	28. With the RCS in a solid water condition and letdown from the RHR system, describe the response of FCV 62-81, Letdown Pressure Control valve, when the operating RHR pump is stopped, include the net effect on the RCS pressure.
X	X	X	X	29. While on RHR Mid-loop operation, FCV-63-1 can be used to makeup to the RCS from the RWST. Determine what cautions must be observed when adding RCS makeup in this manner.

AUO	RO	SRO	STA	
X	X	X	X	30. Explain, by use of a simplified drawing, the RHR Injection Mode after an SI signal.
X	X	X	X	31. Plant conditions are such that an AUTO swapover to the RHR containment sump is required. Describe the automatic sequence of events including the initiating setpoints.
X	X	X	X	32. Delete
X	X	X	X	33. By use of a simplified drawing, describe the RHR Recirculation Mode after 3 hours of cold leg injection.
X	X	X	X	34. Explain from where the RHR System takes suction during a severe loss of RCS coolant accident (LOCA).
X	X	X	X	35. Identify the procedure used to control the operation of the RHR System during mid-loop at WBN.
X	X	X	X	36. Describe the methods available at WBN for monitoring RCS level during mid-loop operation on RHR.
X	X	X	X	37. [Identify what possible discrepancies could occur in indicated level during a loss of RHR capability. (SOER 88-003, Rec. 3a).]
X	X	X	X	38. [Briefly describe the response to a loss-of-core cooling flow with no indication of core coolant temp, include method to determine heatup rate. (SOER 88-003, Rec. 3a, 3b & 3d).]
X	X	X	X	39. [Briefly describe indications of RHR pump cavitation and actions needed to restore core cooling flow. (SOER 88-003, Rec. 3c and IN 89-067).]
X	X	X	X	40. Regarding Technical Specifications and Technical Requirements for this system: a. Identify the conditions and required actions with completion time of one hour or less. b. Explain the Limiting Conditions for Operation, Applicability, and Bases. c. Given a status/set of plant conditions, apply the appropriate Technical Specifications and Technical Requirements.
X	X	X	X	41. Deleted.

AUO	RO	SRO	STA	
X	X	X	X	42. Describe the in-plant location of: a. RHR Pumps and Pump Rooms b. RHR Heat Exchangers c. RHR Sump Recirc Valve Vault d. Control Room Switches, Alarms, and Indications e. FCV-74-1 & -2 (RCS HL Loop 4 to RHR Valves) f. FCV-74-8 & -9 (RCS HL Loop 4 to RHR Bypass Valves) g. FCV-74-3 & -21 (RHR Pump Inlet Valves) h. FCV-74-12 & -24 (RHR Pump Miniflow Valves) i. FCV-74-16 & -28 (RHR Htx Outlet Valves) j. FCV-74-32 (RHR Htx Bypass Valve) k. FCV-74-36 & -37 (Manual Isolation Valves to FCV-74-32) l. FCV-63-1 (RWST to RHR Valve) m. FCV-63-72 & -73 (Containment Sump to RHR Valve) n. FCV-72-40 & -41 (RHR Containment Spray) o. FCV-74-33 & -35 (RHR Heat Exchanger Outlet Crosstie)
X	X	X	X	43. Identify the power supplies to the pressure boundary isolation valves of the RHR System.

33. 006 K5.07 033

Given the following:

- Unit 1 was operating at 100% power when a reactor trip and SI with loss of offsite power occurred 20 minutes ago.
- Pressurizer pressure dropped to 1750 psig, then recovered five minutes later to 2235 psig.

Current conditions:

- Offsite power has been restored.
- Pressurizer level is currently at 68% and stable.
- RCS cold leg temperatures are 561°F and stable.
- RCS hot leg temperature is 590°F and slowly decreasing.
- RVLIS indicates 96%.
- All SGs are at 1125 psig and controlled by the SG PORVs.
- ES 1.1, "SI Termination," is being performed and is at the step for determining RCP status.

Which ONE of the following identifies the impact of the above conditions on RCP restart?

A. RCP restart is **NOT** allowed; The cold ECCS water injected to the RCS cold legs could result in reactor restart.

B. RCP restart is **NOT** allowed; The cold ECCS water injected to the RCS cold legs could result in a pressure surge in the RCS.

C. RCP restart is allowed only after an engineering analysis of the boration from ECCS injection during natural circulation operation.

D✓ RCP restart is allowed; Natural circulation flow has been established and has removed the cold ECCS water from the cold legs.

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because the cold ECCS water would be stagnant in the Cold Legs resulting in a large mass of cold water being sent into the core when the RCP was started which results in a pressure increase. There is a Caution in SOI-68.02 that addresses an "expected pressure transient inadvertently lifting a Pzr PORV" following dilution during the restart of an RCP, but it is not for the conditions in the question. Also a precaution in GO-6 stating "If all RCPs are stopped for greater than 5 minutes AND RCS temperature is greater than the charging and seal injection temperature, do **NOT** restart a pump UNTIL a Pzr steam bubble exists. This will minimize a pressure transient due to the previously injected cold water when the first RCP is started." Again different than conditions in the question.*

B. *Incorrect, Plausible because if natural circulation was not established the cold ECCS water would be stagnant in the Cold Legs resulting in a large mass of cold water being rapidly heated when the RCP was started which results in a positive reactivity addition. There is a Caution in SOI-68.02 that addresses the "Resumption of flow in that loop could flush unborated water to the core and cause a rapid change in shutdown margin", but it is not for the conditions in the question.*

C. *Incorrect, Plausible because of a Precaution in SOI-68.02 stating "Starting a RCP following a natural circulation cooldown during which boration of the RCS took place, can result in a rapid boron dilution of the reactor core. Reactor engineering staff should be consulted for analysis prior to RCP start." But from the conditions in the stem a cooldown has not been performed.*

D. *Correct, the conditions indicate natural circulation is occurring which would have resulted in the cold ECCS flow being mixed with the warmer RCS water and moved from the cold legs through the reactor coolant system.*

Question Number: 33

Tier: 2 **Group:** 1

K/A: 006 K5.07
Emergency Core Cooling System
Knowledge of the operational implications of the following concepts as they apply to ECCS:
Expected temperature levels in various locations of the RCS due to various plant conditions

Importance Rating: 2.7 / 3.0

10 CFR Part 55: 41.5 / 45.7

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of the operational implications of restarting an RCP following the injection of cold ECCS into the RCS while the RCS is at normal operating conditions during a loss of forced RCS flow.

Technical Reference: ES-1.1, SI Termination, Revision 0017
SOI-68.02, Reactor Coolant Pumps, Revision 0034
GO-6, Unit Shutdown From Hot Standby To Cold Shutdown, Revision 0047

Proposed references to be provided: None

Learning Objective: 3-OT-EOP0100

8. Given a set of plant conditions, use E-1, ES-1.1, ES-1.2, ES-1.3, and ES-1.4 to correctly diagnose and implement: Action Steps, RNOs, Foldout Pages, Notes, and Cautions.

3-OT-GO0600

4. State the precautions and operating requirements for the Reactor Coolant Pumps (RCPs) when performing a cooldown to Cold Shutdown per GO-6.

Cognitive Level:

Higher	X
Lower	

Question Source:

New	
Modified Bank	X
Bank	

Question History: Prairie Island 1 bank question 006 K507 in INPO bank

Comments:

Step	Action/Expected Response	Response Not Obtained

CAUTION If seal injection and thermal barrier cooling had previously been lost to any RCP, that pump should not be started prior to TSC evaluation.

NOTE Either Loop 1 or 2 pzr spray valve is effective for Loop 2 RCP in service or for Loops 1, 3, & 4 RCPs in service.

25. **DETERMINE** RCP status:

Action/Expected Response	Response Not Obtained
a. **CHECK** RCP(s) RUNNING to provide normal pzr spray.	a. **ESTABLISH** normal pzr spray, Loop 2 preferred: 1) **IF** RVLIS less than 95%, **THEN:** • **RAISE** pzr level greater than 90%, OR UNTIL level stops rising. • **RAISE** RCS subcooling to greater than 95°F [115°F ADV]. • **CONTROL** pzr heaters as necessary. 2) **ESTABLISH** RCP restart conditions (Loop 2 OR 1, 3, and 4): • **REFER TO** Table 1, RCP Emergency Restart Criteria. 3) **START** RCP(s) oil lift pump two minutes prior to starting RCP.

N/A RVLIS 96%

Step continued on next page.

Step	Action/Expected Response	Response Not Obtained

4) **WHEN** RCP restart conditions established,
THEN
START Loop 2 RCP to provide normal pzr spray.

IF Loop 2 RCP can NOT be started,
THEN
START ALL other RCPs.

5) **STOP** RCP(s) oil lift pump one minute after RCP start.

6) **IF** no RCP(s) can be started,
THEN
MONITOR natural circulation:

- RCS subcooling greater than 65°F [85°F ADV].
- S/G press controlled or dropping.
- T-hot stable or dropping.
- Incore T/Cs stable or dropping.
- T-cold at saturation temp for S/G press.

IF natural circulation **NOT** established,
THEN
DUMP steam at a greater rate.

3.0 PRECAUTIONS AND LIMITATIONS (continued)

2. If all RCPs are stopped and the RCS is being cooled by RHR, a non-uniform RCS temp distribution may occur.

3. Ensure SG-to-RCS ΔT is less than 50°F before starting an RCP.[C.2]

U. When RCS temp is above 160°F, at least one RCP shall be operating.

V. Ear Protection must be worn in the area where the RCPs are running.

W. Notify System Engineer when RCP Heater Breaker is opened during Mode 5 or 6. Heaters protect motor windings from moisture intrusion. This information reproduced on a placard posted on Rx Vent Bds 1A-A (C7B/8B) and 1B-B (C7B/8B).

X. During plant cooldown, only two RCPs may be operated below RCS temp of 160°F.

Y. For plant heatup, only one RCP may be operated below 80°F and only two RCPs may be operated between 80 and 105°F. Exception: Four RCPs may be operated below 105°F for approximately 5 minutes for sweeping and venting.

Z. Starting a RCP following a natural circulation cooldown during which boration of the RCS took place, can result in a rapid boron dilution of the reactor core. Reactor engineering staff should be consulted for analysis prior to RCP start. [C.6]

DISTRACTOR

AA. Evaluate circumstances which would require starting an RCP when COMs is armed, no other RCPs are running, and the RCS pressure is near the COMs setpoint. This may result in the expected pressure transient inadvertently lifting a Pzr PORV.

3.1 PRECAUTIONS (continued)

6. Plant evolutions that may cause pressurizer level or RCS pressure or temperature to become unstable should be prohibited during approach to solid water operations.

7. If pressurizer level, RCS pressure or temperature, or charging flow become unstable during approach to solid water operations, pressurizer level should be reduced to less than 80% and investigate cause.

8. Configuration changes to either CVCS or RHR should be prohibited during approach to solid water operations.

9. 1-PCV-62-81, LETDOWN PRESSURE CONTROL, should be maintained near the middle of its control range during approach to solid water operations.

10. RHR inlet is **NOT** to be isolated from the RCS UNLESS there is a Pzr bubble or charging pumps are stopped. This ensures a relief path when the RCS pressure is low.

11. When water solid with RHR letdown in service, 1-FCV-62-83, RHR LETDOWN FLOW CONTROL should be FULLY OPEN, and RCS pressure controlled by 1-PCV-62-81, LETDOWN PRESSURE CONTROL. During this Mode, the normal letdown system must remain in service, with all orifices open. DISTRACTION

12. If all RCPs are stopped for greater than 5 minutes AND RCS temperature is greater than the charging and seal injection temperature, do **NOT** restart a pump UNTIL a Pzr steam bubble exists. This will minimize a pressure transient due to the previously injected cold water when the first RCP is started.

13. If all RCPs are stopped and the RCS is being cooled down by the RHR HXs, a non-uniform RCS temperature distribution may occur. Do **NOT** start an RCP UNLESS a Pzr steam bubble exists.

14. When RCS pressure is being maintained by Letdown through PCV-62-81, changes to the flow through the RHR loop by throttling valves or starting/stopping RHR pumps will cause RCS pressure changes, e.g., stopping an RHR pump will raise RCS pressure by 100 to 150 PSIG.

E. Operational components of the RHR system should **NOT** be taken out of service for elective maintenance following a reactor shutdown until the decay heat rate is sufficiently low to be readily handled by other systems or methods.[C.7]

3.1 PRECAUTIONS (continued)

O. Cool down

1. Operators are encouraged to cooldown the plant on a continuous cooldown rate instead of stepwise rate (e.g., rapid RCS cooldown followed by nearly constant temperature for the balance of the hour). Stepwise cooldowns may promote Reactor Vessel embrittlement.[C.2]

2. Cooldown rate affects Pzr level. Net charging must be maintained as high as practical to offset the effects of cooldown and letdown flow.

3. During RCS cooldown and depressurization above 350°F, maintaining RCS Subcooling between 75 and 125°F ensures adequate Subcooling.

4. During unit cooldown, all SGs should be connected to the steam header to assure uniform RCS cooldown.[C.3]

5. CVCS letdown flow should be maximized with the demineralizer in service before cooldown, and continued throughout shutdown. Letdown may be reduced to 45 gpm If necessary to support cooldown and maintain PZR level, but should be restored to maximum when level can be maintained.

6. When performing activities with RCS support systems during and after the cooldown, be alert to potential circumstances or conditions that may introduce lower boron concentration solutions to the core.[C.6, C.15] DISTRACTION

P. Steps within this instruction may require venting, draining, or breaching radioactive components or systems to the atmosphere. Appropriate radiation protection controls must be established to prevent the spread of contamination and avoid the generation of airborne radioactivity.

006 K5.07 | 9/30/2004

Prairie Island 1 | **Exam Level** R

Mark Question | Print Record | New Search | Exit

Question

Given the following conditions:

-A reactor trip and SI with loss of offsite power occurred.
-All equipment operates as designed.
-Pressurizer pressure drops to 1750 psig, then recovers one minute later to 2250 psig
-Pressurizer level has increased to 48%
-RCS cold leg temperatures are 545 F and stable
-RCS hot leg temperature is 582 F and slowly decreasing
-Both SGs are at 1005 psig controlled by the SG PORVs
-Offsite power is now available and non safeguard buses have been energized.
-Twenty minutes has elapsed since the reactor trip.
-SI has been terminated per ES 0.2, "SI Termination."
-Step 23 of ES 0.2 directs the start of one RCP.

What is the impact of the above conditions on RCP restart?

Answer: a.The RCP can be started, natural circulation flow has been established and has removed the cold ECCS water from the cold legs.

Distracter 1 b.The RCP can be started, natural circulation flow has NOT been established but ECCS flow did not occur to the RCS.

Distracter 2 c.RCP restart is not allowed, the reactivity addition from cold ECCS water in the RCS cold legs could result in reactor restart.

Distracter 3 d.RCP restart is not allowed, the RCS will overpressurize upon RCP restart when cold ECCS water is heated.

Distracter Analysis:

Answer:

Distracter 1:

Distracter 2:

Distracter 3:

I. **PROGRAM:**

Watts Bar Operator Training

II. **COURSE:**

A. License Training

B. License Operator Requal

III. **TITLE:**

E-1, Loss of Reactor or Secondary Coolant

IV. **LENGTH OF LESSON:**

A. License training — 3 Hours

B. License Operator Requal — License operator REQUAL time will be determined after objectives are identified.

V. **TRAINING OBJECTIVES:**

AUO	RO	SRO	STA	
	X	X	X	1. Describe the purpose of procedure E-1 as listed in Section 1.0 of the procedure.
	X	X	X	2. Explain the basis for tripping the RCPs in an accident situation given the following conditions: a. RCS press less than 1500 psig b. Phase B isolation signal initiated.
	X	X	X	3. List the condition that must be checked and satisfied before removing a RCP from service in accident conditions due to low RCS pressure (< 1500 psig).
	X	X	X	4. Explain the basis for the continuous action step to monitor containment pressure and stop the CS pumps when containment pressure is verified less than 2.0 psig.
	X	X	X	5. For a given H_2 concentration in containment determine if the H_2 igniter should be energized and explain why or why not.

V. **TRAINING OBJECTIVES:** (continued)

AUO	RO	SRO	STA	
	X	X	X	6. Explain the basis for isolating the CLAs when RCS press decreases to less than 250 psig.
	X	X	X	7. Explain the reason for transfer to Hot Leg recirc following a LOCA including the location of the worst case break for this concern.
	X	X	X	8. Given a set of plant conditions, use E-1, ES-1.1, ES-1.2, ES-1.3, and ES-1.4 to correctly diagnose and implement: Action Steps, RNOs, Foldout Pages, Notes, and Cautions.
	X	X	X	9. List the four parameters (not setpoints) that must be verified prior to SI termination.
	X	X	X	10. Determine the correct procedure transition if during the SI termination steps of ES-1.1 it is determined that PZR level cannot be maintained using the normal charging flowpath.
	X	X	X	11. Explain the basis for waiting for a faulted S/G to complete depressurization before checking RCS press stable or increasing following the establishment of normal charging and prior to stopping any running SI pumps.
	X	X	X	12. Discuss the purpose of ES-1.2 Post LOCA Cooldown and Depressurization.
	X	X	X	13. Justify the procedure step to shutdown the RHR pumps if RCS pressure is greater than 150 psig.
	X	X	X	14. Identify the procedural transition required if any S/G level continues to increase with feedflow isolated.

V. **TRAINING OBJECTIVES:** (continued)

AUO	RO	SRO	STA	
	X	X	X	15. Explain the basis for limiting the RCS cooldown rate to 100°F in one hour.
	X	X	X	16. Discuss the requirement to check RCS subcooling greater than 65°F prior to RCS depressurization.
	X	X	X	17. Describe how depressurization of the RCS might result in the capability to maintain PZR level when PZR level could not be maintained prior to depressurization.
	X	X	X	18. Analyze and explain the process that leads to a new RCS equilibrium pressure following the shutdown of an ECCS pump during the ES-1.2 reduction sequence.
	X	X	X	19. Explain why subcooling is minimized following the alignment of normal charging in procedure ES-1.2.
	X	X	X	20. Discuss and justify the priority of usage given to procedure ES-1.3, Transfer to RHR Containment Sump.
	X	X	X	21. Justify the ES-1.3 procedural requirement to shutdown the SI pumps if RCS press increase to greater than 1350 psig while aligned for sump recirc.
	X	X	X	22. Identify and explain the basis of the interlock on the RHR pump discharge to the SI and CCP suction (FCV-63-8 and 11).
	X	X	X	23. State from memory the action required if offsite power is lost following transfer to RHR containment sump cold leg recirc. Explain the basis for the required action.

V. **TRAINING OBJECTIVES:** (continued)

AUO	RO	SRO	STA	
	X	X	X	24. Discuss the basis for ensuring the CCP suction from the RWST (LCV-62-135 and 136) handswitches are left in the A-Auto position following transfer to cold leg recirc in procedure ES-1.3.
	X	X	X	25. Explain why procedure ES-1.3 directs the operator to leave the containment spray pumps aligned to the RWST until RWST level is less than 8%.
	X	X	X	26. Identify the action required if RWST level decreases to 8% during swapover to CL sump recirc.
	X	X	X	27. Explain the basis for limiting temperature above current conditions after transition to SI termination. (SOER 94-001, Rec. 4b.)
X	X	X	X	28. Describe the actions in ES-1.1, SI Termination, required in the event that SI does not reset.

I. PROGRAM

Watts Bar Operator Training

II. COURSE

License Training
Non-License Training

III. TITLE

GO-6, Unit Shutdown From Hot Standby to Cold Shutdown

IV. LENGTH OF LESSON

License Training	3 Hours
Non-License Training	3 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
	X	X	X	1. Explain the reason for each Precaution and Limitation listed in GO-6.
	X	X	X	2. Briefly state the reason for borating the Reactor Coolant System (RCS) prior to cooldown. State the limits for the Reactor Coolant System /Pressurizer (PZR) ΔC_B and explain the preferred method for equalizing the RCS/PZR C_B.
	X	X	X	3. Discuss the major steps for taking the unit from Hot Standby to Cold Shutdown per GO-6.
	X	X	X	4. State the precautions and operating requirements for the Reactor Coolant Pumps (RCPs) when performing a cooldown to Cold Shutdown per GO-6.
	X	X	X	5. Describe the manual block and automatic reset of the "Low PZR Pressure SI" at <1970 (P-11).

V. TRAINING OBJECTIVES (Continued)

A U O	R O	S R O	S T A	
	X	X	X	6. Identify the cooldown/heatup limits for the RCS and PZR, and given plant conditions, use the cooldown, heatup, and pressure limitations curves to determine that the plant is operating within limits.
	X	X	X	7. State the limit and basis on ΔT between the Pressurizer Spray Nozzle and fluid.
	X	X	X	8. State what conditions must exist in order to place Residual Heat Removal (RHR) in service during cooldown per GO-6.
	X	X	X	9. Describe the precautions and basis on solid water Residual Heat Removal operations.
	X	X	X	10. Discuss the operation of 1-PCV-62-81 to maintain RCS pressure and Letdown flow when in a solid water condition.

VI. TRAINING AIDS

A. Marker Board and Markers
B Multimedia/Overhead projector(s)

VII. MATERIALS

A. Attachments

Attachment 1 - GO-6, Unit Shutdown From Hot Standby To Cold Shutdown
Attachment 2 - [INPO SOER 94-2, Boron Dilution Events in PWRs.]
Attachment 3 - 1-SI-68-44, RCS Pressure/Temperature Limits
Attachment 4 - WBN PERs 77176, 77699, 79910

34. 007 K5.02 034

The pressurizer (PZR) cold cal level is at 40% with a nitrogen blanket present.

Which ONE of the following choices completes the statement below?

When establishing a steam bubble, in accordance with GO-1, "Unit Startup From Cold Shutdown To Hot Standby," the pressurizer administrative maximum heat-up rate limit is ___(1)___ and the PORVs are closed and placed in P-AUTO when ___(2)___.

	(1)	(2)
A.	75°F in one hour	Letdown flow exceeds charging flow
B.✔	75°F in one hour	PZR Liquid Temperature reaches 235°F
C.	100°F in one hour	Letdown flow exceeds charging flow
D.	100°F in one hour	PZR Liquid Temperature reaches 235°F

DISTRACTOR ANALYSIS:

A. Incorrect, Plausible because GO-1 identifies the administrative heatup rate is 75°F and there is a note prior to Step [10.18] in Section 5.2.1 stating "When letdown flow is ABOVE charging flow, and RCS pressure is either stable or slowly rising, a PZR steam bubble is forming." This would apply during bubble formation from solid water conditions which is different than the conditions in the question stem.

B. Correct, GO-1(Rev 0070) Section 5.2.1 has a Caution prior to step [4] stating "Administrative PZR maximum heatup-rate is 75°F in 1 hour. 100°F in 1 hour shall NOT be exceeded. (TR 3.4.2)" and Step [8] states "When 1-TI-68-319, PZR LIQUID TEMP, reaches 230-240°F, then close PORVs, and place in P-AUTO.

C. Incorrect, Plausible because 100°F is identified in the same Caution statement but it is the Tech Requirement limit not the administrative limit. Also there is a note prior to Step [10.18] in Section 5.2.1 stating "When letdown flow is ABOVE charging flow, and RCS pressure is either stable or slowly rising, a PZR steam bubble is forming." This would apply during bubble formation from solid water conditions which is different than the conditions in the question stem.

D. Incorrect, Plausible because 100°F is identified in the same Caution statement but it is the Tech Requirement limit not the administrative limit. Also plausible because closing the PORVs if the temperature is 235°F is correct in accordance Step [8] which states "When 1-TI-68-319, PZR LIQUID TEMP, reaches 230-240°F, then close PORVs, and place in P-AUTO.

Question Number: 34

Tier: 2 **Group** 1

K/A: 007 K5.02
Pressurizer Relief Tank/Quench Tank System (PRTS)
Knowledge of the operational implications of the following concepts as they apply to PRTS:
Method of forming a steam bubble in the PZR

Importance Rating: 3.1 / 3.4

10 CFR Part 55: 41.5 / 45.7

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of the changes in conditions (operational implications) due to forming a steam bubble in the pressurizer when starting with a nitrogen blanket in the pressurizer.

Technical Reference: GO-1, Unit Startup From Cold Shutdown to Hot Standby, Revision 0070

Proposed references to be provided: None

Learning Objective: 3-OT-GO0100
5. Describe the basic steps necessary to establish a steam bubble in the Pressurizer (Pzr) with or without a Nitrogen blanket.

Cognitive Level:
- **Higher** ___
- **Lower** X

Question Source:
- **New** ___
- **Modified Bank** X
- **Bank** ___

Question History: Question 007 K5.02 034 used on WBN 05/2009 exam modified by changing the first part of the question. The correct answer position relocated from C to B.

Comments:

Date ___________ Initials

5.2.2 Establish Pressurizer Bubble with Nitrogen Blanket

[1] **ENSURE** PZR level is between 20% and 60% [1-LI-68-321, PZR-COLD CAL LEVEL]. _________

[2] **ENSURE** PORV **AND** BLOCK valves OPEN. _________

[3] **INITIATE** applicable sections of 1-SI-68-44, RCS Temperature/Pressure Limits and Pressurizer Temperature Limits. _________

CORRECT DISTRACTOR

CAUTION

Administrative PZR maximum heatup rate is 75°F in 1 hour. 100°F in 1 hour shall NOT be exceeded. (TR 3.4.2)

NOTES

1) PZR heater backup control group 1C should be on when RCS pressure is below its automatic setpoint.
2) PZR heater(s) may be energized or deenergized at Unit Operator discretion to maintain optimal heatup rate within allowable limits.

[4] **ENERGIZE** all available PZR heaters. _________

NOTES

1) Pressurizer Relief Tank (PRT) pressure and temperature should be monitored during venting. Normal pressure range is 6.5 to 8 psig and temperature is less than 112°F.
2) Pressurizer PORV flow should be verified by ACOUSTIC MONITORS, 1-XI-96-340A and 1-XI-68-334 [0-M-25].

[5] **CHECK** a rise in the PZR relief line temperature indicators when PZR steaming begins. _________

[6] **MAINTAIN** PRT temperature below high temperature alarm setpoint using spray and drain operation. _________

[7] **IF** PRT pressure approaches 8 psig, **THEN**

VENT via 1-PCV-68-301, PRT VENT TO WDS VENT HDR. _________

Date __________ Initials

5.2.2 Establish Pressurizer Bubble with Nitrogen Blanket (continued)

[8] **WHEN** 1-TI-68-319, PZR LIQUID TEMP, REACHES 230 to 240°F, **THEN** — correct

CLOSE PORVs, **AND**

PLACE in P-AUTO. ________

[9] **ENERGIZE** PZR heaters as needed to MAINTAIN RCS pressure. ________

[10] **ADJUST** Charging and Letdown to maintain between 25 and 30% cold cal PZR level. ________

[11] **GO TO** Section 5.3. ________

End of Section

Date __________ **Initials**

5.2.1 Transition to Solid Water Operation (continued)

[10.17] **INITIATE** PZR heatup by performing the following:

[10.17.1] **PLACE** 1-PIC-68-340A, PZR **PRESS** MASTER **CONTROL**, in MANUAL and drive output to zero. ________

[10.17.2] **ENERGIZE** all available PZR heaters. ________

[10.17.3] **CONTROL** PZR heatup rate using PZR heaters and spray. ________

Distraction

NOTES

1) When letdown flow is above charging flow and RCS pressure is either stable OR slowly rising, a PZR steam bubble is forming
2) 1-LI-68-321, PZR COLD CAL LEVEL, should be used to check level UNTIL RCS reaches 350°F.
3) It is desirable to maintain all heaters energized to ensure a constant outflow through PZR surge line.

[10.18] **BEFORE** exceeding 250°F, OBTAIN Chemistry concurrence that PZR chemistry is acceptable for operation above 250°F. ________

[10.19] **WHEN** PZR is between 425 and 430°F, **THEN**

ADJUST Charging and Letdown to slowly lower PZR level to between 25 and 30% while maintaining RCS pressure with heaters and spray. ________

007 K5.02 034

WBN BANK QUESTION

The pressurizer (PZR) cold cal level is at 40% with a nitrogen blanket present.

Which ONE of the following choices completes the statement below?

When establishing a steam bubble, in accordance with GO-1, "Unit Startup From Cold Shutdown To Hot Standby," the first indication of steaming from the PZR to the Pressurizer Relief Tank is verified by observing a rise in ____(1)_____ and a steam bubble is first confirmed when _____(2)_______.

	(1)	(2)
A.	relief line temperature.	Letdown flow exceeds charging flow.
B.	Pressurizer Relief Tank level.	Letdown flow exceeds charging flow.
C.✓	relief line temperature.	PZR Liquid Temperature reaches 235F.
D.	Pressurizer Relief Tank level.	PZR Liquid Temperature reaches 235F.

I. PROGRAM

Watts Bar Operator Training

II. COURSE

A. License Training

III. LESSON TITLE

GO-1, Unit Startup From Cold shutdown To Hot Standby

IV. LENGTH OF LESSON

License Training 3 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
	X	X	X	1. Define the six reactor operating modes.
	X	X	X	2. Identify the maximum allowable Reactor Coolant System (RCS) Heatup rate per GO-1.
	X	X	X	3. Describe the major steps necessary to heat the unit, from Cold Shutdown to Hot Standby, as discussed in class.
	X	X	X	4. Identify the temperature and pressure limits for having Residual Heat Removal (RHR) System Suction aligned to RCS per GO-1.
	X	X	X	5. Describe the basic steps necessary to establish a steam bubble in the Pressurizer (Pzr) with or without a Nitrogen blanket.
	X	X	X	6. Explain how RCS temperature, pressure, and inventory are controlled per this instruction.
	X	X	X	7. Explain, as described in GO-1, the operating precautions for the Reactor Coolant Pumps (RCPs).
	X	X	X	8. Describe the conditions requiring Cold Overpressure Protection System (COPS) to be armed and operable per GO-1.

35. 008 A3.02 035

Given the following plant conditions:

- Unit 1 is at 100% power with Thermal Barrier Booster Pump (TBBP) 1B running.

- TBBP handswitches on 0-M-27 are aligned with:

  1-HS-70-131A, THRM BAR BSTR PMP 1A (TBBP) is 'PULL A-P AUTO'.

  1-HS-70-130A, THRM BAR BSTR PMP 1B (TBBP) is 'IN A AUTO'.

- Loss of Offsite Power occurs.

Which ONE of the following identifies how the TBBPs will respond during the blackout relay sequencing to restore equipment?

A.✓ Only the 1A TBBP will restart.

B. Only the 1B TBBP will restart.

C. Both of the TBBPs will restart.

D. Neither of the TBBPs will restart.

DISTRACTOR ANALYSIS:

A. Correct, The normal alignment of the TBBPs is with the handswitches in A-P AUTO which allows the pumps to restart following a Blackout. With the TBBP 1B not in the A-P AUTO position, the pump cannot restart following the blackout. Only the TBBP 1A will restart.

B. Incorrect, Plausible if the conclusion is that the pump that was running will be the pump that restarts. Similar to the ERCW pump logic where running pump is selected to restart following a blackout.

C. Incorrect, Plausible because both pump handswitches are in an Auto position and the A-AUTO function can be mistakenly determined to be for the automatic restart.

D. Incorrect, Plausible because both pump handswitches are in a position for the accident signal (A-Auto signal), but the accident signal is not to restart on a blackout; it is to trip the pumps on a Phase B containment isolation signal.

Question Number: 35

Tier: 2 **Group** 1

K/A: 008 A3.02
Component Cooling Water System (CCWS)
Ability to monitor automatic operation of the CCWS, including:
Operation of the CCW pumps, including interlocks and the CCW booster pump

Importance Rating: 3.2 / 3.2

10 CFR Part 55: 41.7 / 45.5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the ability to predict the TBBP(s) (which are the CCW booster pumps) that will be running following a change in plant conditions with a defined control switch alignment.

Technical Reference: SOI-70.01, Component Cooling Water (CCS) System, Revision 0068
1-47W611-70-3 R4

Proposed references to be provided: None

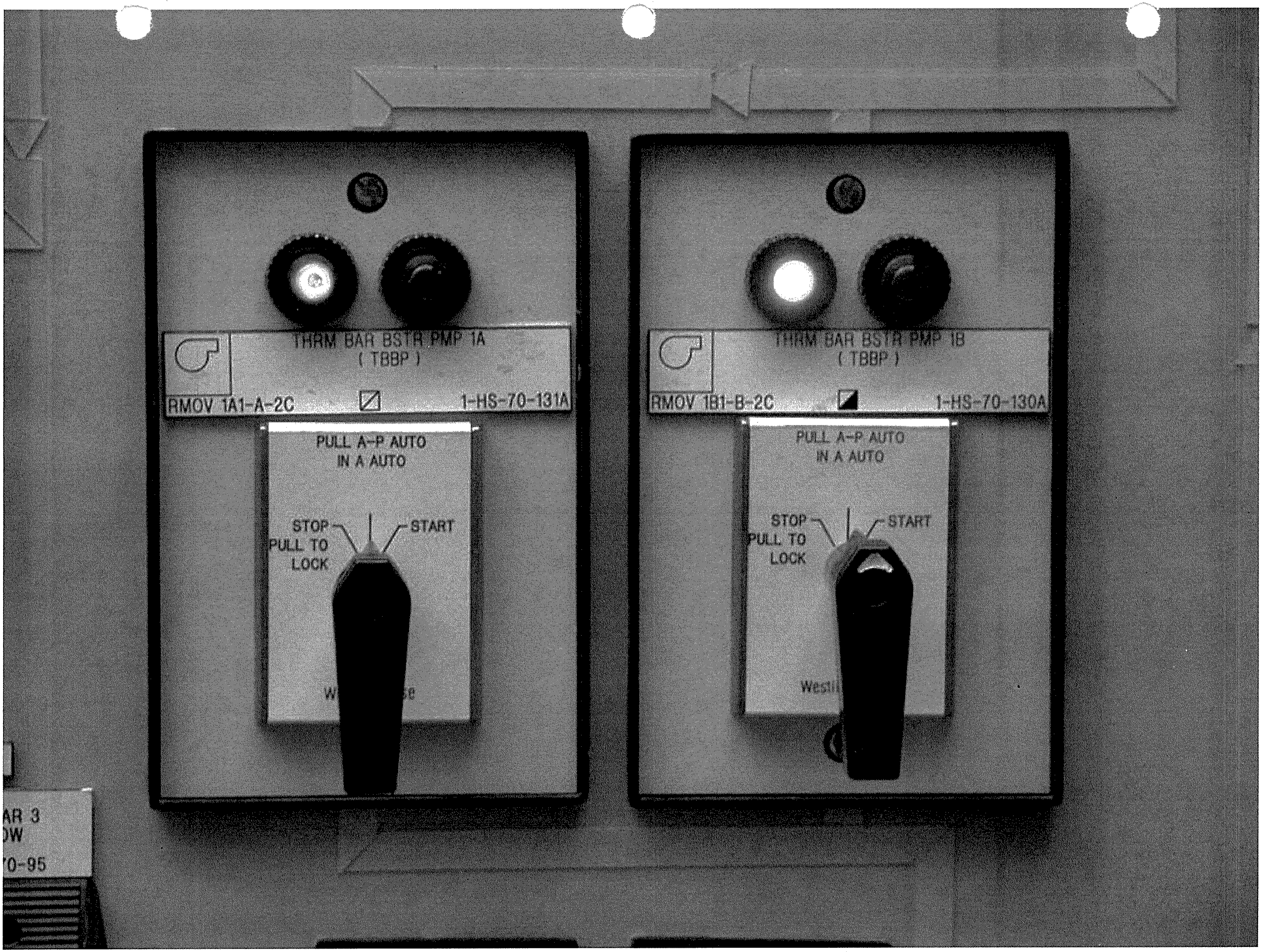
Learning Objective: 3-OT-SYS070A
4. Explain the logic associated with each valve/pump control in the CCS.
8. Describe the thermal barrier system; include purpose, pump capacity, and logic.

Cognitive Level:
Higher X
Lower ___

Question Source:
New ___
Modified Bank X
Bank ___

Question History: WBN question SYS070A.19 004 modified.

Comments:


THRM BAR BSTR PMP 1A
(TBBP)
RMOV 1A1-A-2C
1-HS-70-131A
PULL A-P AUTO
IN A AUTO
STOP
PULL TO
LOCK
START
THRM BAR BSTR PMP 1B
(TBBP)
RMOV 1B1-B-2C
1-HS-70-130A
PULL A-P AUTO
IN A AUTO
STOP
PULL TO
LOCK
START

3.0 PRECAUTIONS AND LIMITATIONS

A. CCS design press is 150 psig. Design Temp is 200°F.

B. Normal CCS Supply Header (Hx outlet) temp is 60°F to 95°F for "A" Hx. and 40°F to 95°F for "B" and "C" Heat exchangers. When ERCW inlet temperature is below 60°F, supply temperature may be lower than 40°F for the "B" and "C" heat exchangers and lower than 60°F for "A" heat exchanger but should be maintained as close to normal as possible by throttling ERCW flow. Additional limitations are discussed in Section 6.0.

C. CCS Pump flow: Minimum is 900 gpm; Maximum is 6800 gpm per pump.

D. C-S Pump Local Throwover Switch must **NOT** be operated if either Red light on the panel is on, indicating one of the 480V SD Bd ACBs is CLOSED. Switch Transfer may require Tech Spec LCO 3.7.7 entry.

E. Chemicals added to CCS for corrosion control are TOXIC. The Material Safety Data Sheets for the chemicals added to CCS (i.e. sodium molybdate, sodium hydroxide and Cobratec TT50), have precautions necessary for handling treated CCS water.

F. When heat load is on CCS, ERCW must be in service to CCS Hx(s).

G. CCS misaligned to SFP Hx(s) causes water interchange between Unit 1 and Unit 2.

H. To avoid CCS Hx tube vibration and excessive load, do **NOT** exceed shell design flow of 12000 gpm.

I. All CCS Pumps start on a Blackout if handswitch is in A-P AUTO; however while U2 is in deferred status and Pump 2B-B is aligned with Pump C-S, Header 2A low press auto-start signal is disconnected from Pump 2B-B, and the SI Signal is disconnected from both U2 Pumps.

J. Before operating Train B equipment, flow must be established in 1B Header.

K. If a CCS loop is SHUT DOWN, associated Rad monitor will alarm on low flow.

L. Discharge of various relief valves is routed to station drainage.

M. Thermal Barrier Booster Pumps trip on Cntmt ∅B Isol signal, and Cntmt Isol Valves for Thermal Barriers, and RCP upper and lower oil coolers **CLOSE**. If power is lost to either TBBP (Rx MOV Bd) the ∅B seal-in is lost and the pump can restart with no flow path.

N. When isolating CCS-supplied Hx, the primary side must be isolated and allowed to cool below 200°F BEFORE isolating CCS flow.

Date________ **INITIALS**

5.4 Placing Thermal Barrier Booster Pumps in Service

[1] **ENSURE** Section 5.1 and 5.3 COMPLETE. ________

[2] **ENSURE** the following valve OPEN: ________

NOMENCLATURE	LOC	POSITION	UNID	PERF INITIAL
THERMAL BAR SUP CIV - ∅B	0-M-27B	OPEN	1-HS-70-133A	
THERMAL BAR SUP CIV - ∅B	0-M-27B	OPEN	1-HS-70-134A	
THERMAL BAR RET CIV - ∅B	0-M-27B	OPEN	1-HS-70-87A	
THERMAL BAR RET CIV - ∅B	0-M-27B	OPEN	1-HS-70-90A	

[3] **START** either of the following (**N/A** pump **NOT** started):

NOMENCLATURE	LOCATION	POSITION	UNID	PERF INITIAL
THRM BAR BSTR PMP 1A (TBBP)	0-M-27B	START	1-HS-70-131A	
THRM BAR BSTR PMP 1B (TBBP)	0-M-27B	START	1-HS-70-130A	

[4] **MONITOR** rise in flow to approximately 160 gpm on 1-FI-70-81, TH BAR RET HDR FLOW [0-M-27B]. ________

Date________ **INITIALS**

5.4 Placing Thermal Barrier Booster Pumps in Service (continued)

[5] **IF** TBBP 1A is available or running, **THEN**

ENSURE 1-HS-70-130A, THRM BAR BSTR PMP 1B (TBBP) in A-P AUTO if available. [C.1] _________

_________ IV

[6] **IF** TBBP 1B is available or running, **THEN**

ENSURE 1-HS-70-131A, THRM BAR BSTR PMP 1A (TBBP) in A-P AUTO if available. [C.1] _________

_________ IV

[7] **INDEPENDENTLY VERIFY** the following:

NOMENCLATURE	LOC	POSITION	UNID	VERIF INITIAL
THERMAL BAR SUP CIV - ∅B	0-M-27B	OPEN	1-HS-70-133A	IV
THERMAL BAR SUP CIV - ∅B	0-M-27B	OPEN	1-HS-70-134A	IV
THERMAL BAR RET CIV - ∅B	0-M-27B	OPEN	1-HS-70-87A	IV
THERMAL BAR RET CIV - ∅B	0-M-27B	OPEN	1-HS-70-90A	IV

End of Section

SYS070A.19 004

WBN BANK QUESTION

Given the following plant conditions:

- Unit in service with TBBP 1A-A running.
- Loss of Offsite Power occurs.
- Shutdown boards are re-energized by diesel generators.

Which of the following alignments of the Thermal Barrier Booster Pump would result in both pumps sequencing on?

a.✓ 1A-A TBBP control switch in A-P-AUTO
1B-B TBBP control switch in A-P-AUTO

b. 1A-A TBBP control switch in A-P-AUTO
1B-B TBBP control switch in A-AUTO

c. 1A-A TBBP control switch in A-AUTO
1B-B TBBP control switch in A-P-AUTO

d. 1A-A TBBP control switch in A-AUTO
1B-B TBBP control switch in A-AUTO

The correct answer is A

I. PROGRAM

Watts Bar Operator Training

II. COURSES

A. License Training

B. NOTP

C. License Operator Requal

D AUO Requal

III. TITLE

Component Cooling System

IV. LENGTH OF LESSON

A. Licensed Training 1.5 hours

B. NOPT 3.0 hours

License Requalification and NAUO Requalification times will be determined after objectives are identified

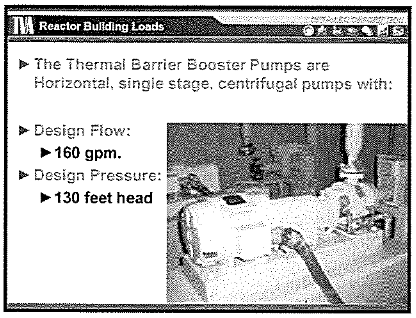
V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. State the design basis of the Component Cooling Water System (CCS) in accordance with FSAR section 9.2.2.
X	X	X	X	2. Sketch a basic drawing of the CCS, include all pumps, major heat exchangers, and blocks showing major uses of CCS.
X	X	X	X	3. Describe the CCS pumps, include power supply, pump type, capacity, lubrication, and logic.
X	X	X	X	4. Explain the logic associated with each valve/pump control in the CCS.
X	X	X	X	5. Explain the operation, purpose, and location of the C-S CCS Pump power supply transfer switch.
X	X	X	X	6. Describe the CCS heat exchangers, include cooling medium.

AUO	RO	SRO	STA	
X	X	X	X	7. Given a tube rupture in a CCS heat exchanger, describe the resulting flow path.
X	X	X	X	8. Describe the thermal barrier system; include purpose, pump capacity, and logic.
X	X	X	X	9. Describe the CCS Surge Tanks; include purpose, capacity, and method of makeup to them.
X	X	X	X	10. Explain how the CCS pumps are sealed and how the seal leakage return unit operates.
X	X	X	X	11. Identify ten (10) uses of CCS during normal and post accident conditions.
X	X	X	X	12. Identify the automatic actions that occur upon detection of CCS high radiation.
	X	X	X	13. Describe the actions which must be taken if CCS is lost to the RCP motors.
X	X	X	X	14. [Identify two indications of biofouling in a heat exchanger. (SOER 84-1, Rec. 4)]
	X	X	X	15. Describe the effect of a loss of CCS to the major equipment supply headers: a. Miscellaneous equip. & Reactor Bldg. Headers b. ESF Equipment Header A c. ESF Equipment Header B d. Spent Fuel Pit Supply Header
	X	X	X	16. Regarding Technical Specifications and Technical Requirements for this system: a. Identify the conditions and required actions with completion time of one hour or less. b. Explain the Limiting Conditions for Operation, Applicability, and Bases. c. Given a status/set of plant conditions, apply the appropriate Technical Specifications and Technical Requirements.

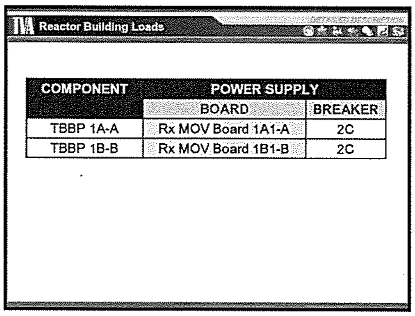
AUO	RO	SRO	STA	
X	X	X	X	17. Identify the in-plant location of each of the following: a. Component Cooling Water Pumps. b. Component Cooling Water Heat Exchangers. c. Thermal Barrier Booster Pumps. d. Component Cooling System Surge Tanks. e. Seal Leakage Return Tank and Pumps. f. C-S CCS Pump Power Supply Throw-over Switch. g. CCS Flood Mode Spool Pieces. h. RHR Heat Exchangers.
	X	X	X	18. Correctly locate all control room controls and indications associated with the Component Cooling System.
	X	X	X	19. Given a set of plant conditions, determine the correct response of the CCS system.
	X	X	X	20. Given a CCS instrument and failure mode, identify how the instrument will respond and what interlock(s) or control function(s) will be affected, including effects on system/component operation.
	X	X	X	21. Given a loss of instrument air/control power, determine the effect on the following valves: a. Surge tank make up valve. b. Surge tank vent valve. c. Letdown HEAT EXCHANGER. temp. control valve.
	X	X	X	22. Explain how the failure of CCS or its support systems could lead to core damage.
	X	X	X	23. [Identify the action(s) to be taken by the Operator if significant heat exchanger degradation due to fouling is detected. (SOER 84-1, Rec. 4)]

SLIDE 73



- The Thermal Barrier Booster Pumps are Horizontal, single stage, centrifugal pumps with:
- Design Flow:
  - 160 gpm.
- Design Pressure:
  - 130 feet head.

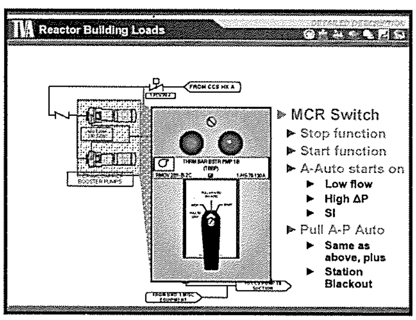
SLIDE 74



- Power Supplies:
  - TBBP 1A-A - Rx MOV Board 1A1-A.
  - TBBP 1B-B - Rx MOV Board 1B1-B.

Hyperlink to the Industrial Safety homepage and select Arc Flash Hazard Calculation and Required Protection

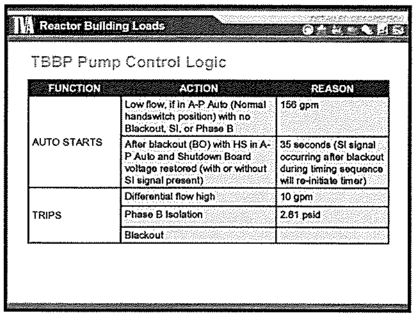
SLIDE 75



2. Discuss the MCR controls associated with Thermal Barrier Booster Pumps.

- Stop function.
- Start function.
- A-Auto starts on:
  - Low flow.
  - High ΔP.
  - SI.
- Pull A-P Auto:
  - Same as above, plus.
  - Station Blackout.

SLIDE 76



Reactor Building Loads

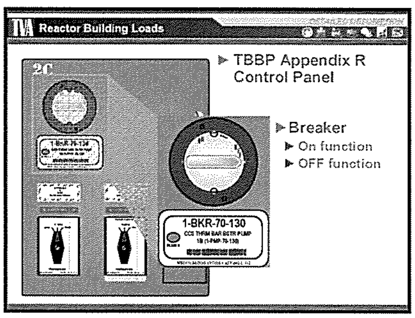
TBBP Pump Control Logic

FUNCTION	ACTION	REASON
AUTO STARTS	Low flow, if in A-P Auto (Normal handswitch position) with no Blackout, SI, or Phase B	156 gpm
	After blackout (BO) with HS in A-P Auto and Shutdown Board voltage restored (with or without SI signal present)	35 seconds (SI signal occurring after blackout during timing sequence will re-initiate timer)
TRIPS	Differential flow high	10 gpm
	Phase B Isolation	2.81 psid
	Blackout	

- AUTO STARTS
  - Low flow, if in A-P Auto (Normal handswitch position) with no Blackout, SI, or Phase B
  - After blackout (BO) with HS in A-P Auto and Shutdown Board voltage restored (with or without SI signal present)
- TRIPS
  - Differential flow high.
  - Phase B Isolation.
  - Blackout.

COMMITMENT: Hyperlink to the OE homepage and select SQN-II-S-92-100, Dual Unit Reactor Trip

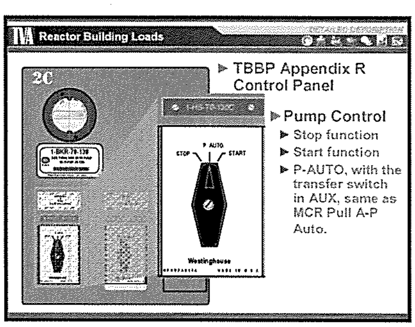
SLIDE 77



3. Discuss the function and operation of the TBBP Appendix R Control Panel.

- Breaker:
  - On function.
  - OFF function.

SLIDE 78



- Pump Control
  - Stop function.
  - Start function.
  - P-AUTO, with the transfer switch in AUX, same as MCR Pull A-P Auto.

36. 010 A1.09 036

Given the following:

- Unit 1 is operating at 100% power.
- Abnormal RCS leakage has been detected.
- One of the pressurizer PORVs is suspected to have seat leakage.

Without any additional operator action, which ONE of the following identifies...

(1) the MCR indication that would be used to identify the leaking PORV

and

(2) how long the crew has to close the PORV Block valve if the PORV is determined to be declared inoperable?

	(1)	(2)
A.	TAILPIPE TEMPS on 1-M-4	1 hour
B.	TAILPIPE TEMPS on 1-M-4	30 minutes
C.✓	PZR VALVES ACOUSTIC MONITOR on 0-M-25	1 hour
D.	PZR VALVES ACOUSTIC MONITOR on 0-M-25	30 minutes

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because there is a PORV tailpipe indication on 1-M-4 along with indications for each of the 3 safety valve tailpipe temperatures, but the PORV indicator is on the common tailpipe from both PORVs Tech Spec and allowing one hour to close the block valve is correct.*

B. *Incorrect, Plausible because there is a PORV tailpipe indication on 1-M-4 along with indications for each of the 3 safety valve tailpipe temperatures, but the PORV indicator is on the common tailpipe from both PORVs and there are Tech Spec 3.4 actions required to be completed within 30 minutes (e.g. restore minimum temperature for criticality).*

C. *Correct, there are flow indicating LEDs on the PZR Valves Acoustic Monitor for each PORV that will indicate which valve is leakage through and Tech Specs require the PORV Block valve to be closed within 1 hour.*

D. *Incorrect, Plausible because the PZR Valves Acoustic Monitor which has LED indicating flow each of the PORVs is correct and there are Tech Spec 3.4 actions required to be completed within 30 minutes (e.g. restore minimum temperature for criticality).*

Question Number: 36

Tier: 2 **Group** 1

K/A: 010 A1.09
Pressurizer Pressure Control System (PZR PCS)
Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the PZR PCS controls including:
Tail pipe temperature and acoustic monitors

Importance Rating: 3.4 / 3.7

10 CFR Part 55: 41.5 / 45.5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the ability to monitor changes in parameters associated with PORV tailpipes and interpret the information to accurately determine which PORV is leaking.

Technical Reference: MCR photos
ARI-88-94, Reactor Coolant System, Revision 0022
Tech Spec LCO 3.4.11, Pressurizer Power Operated

Technical Reference: MCR photos
ARI-88-94, Reactor Coolant System, Revision 0022
Tech Spec LCO 3.4.11, Pressurizer Power Operated Relief Valves (PORVs)

Proposed references to be provided: None

Learning Objective: 3-OT- SYS068K

3. Correctly locate control room controls and indications associated with the Acoustic Monitoring System, including:
   a. alarm
   b. panel
   c. LED's
   d. power switch
   e. individual valve indications
   f. tail pipe temperature indications

Cognitive Level:

Higher ____
Lower X

Question Source:

New ____
Modified Bank X
Bank ____

Question History: WBN bank question SYS068K.03 001 modified

Comments:

89-A

Source
1-TS-68-331

Setpoint
235°F

PZR PORV LINE TEMP HI

(Page 1 of 1)

Probable Cause: A. One or both PZR PORVs open or leaking through

NOTE
This alarm may come in due to other valves connected to the PRT, such as PZR Safeties, open or leaking through.

Corrective Action:

[1] **CHECK** 1-TI-68-331, PZR PORV LINE TEMP [1-M-4], to confirm alarm.

[2] **ENSURE** PZR pressure below PZR PORV lift setpoint **AND** **CHECK** PZR PORVs CLOSED.

[3] **IF** PZR PORVs indicate CLOSED, **THEN**:

[3.1] **CHECK** Acoustic monitors [0-M-25] for indication of leaking PZR PORV.

[3.2] **OBTAIN** SRO permission to determine affected PZR PORV by manipulating the respective block valves.

[3.3] **MONITOR** the following for indication of leakage:

- 1-LI-68-300, PRT LEVEL
- 1-PI-68-301, PRT PRESS
- 1-TI-68-309, PRT TEMP

[3.4] **IF** PORV(s) partially open, **THEN** **REFER TO** AOI-18, Malfunction of Pressurizer Pressure Control System.

[4] **REFER TO** AOI-6, Small Reactor Coolant System Leak.

[5] **REFER TO** Tech Specs.

References:

1-47W610-68-5
AOI-6
AOI-18
Tech Specs

91-A

Source	**Setpoint**	**PZR PORV/SAFETY OPEN**
<u>PORV</u> 1-XE-68-340A 1-XE-68-334 <u>Safety</u> 1-XE-68-363 1-XE-68-364 1-XE-68-365	25% flow through PORV/ Safety Valve (0.25 indication on Acoustic Monitor)	(Page 1 of 1)

Probable Cause:

A. PZR PORV or Safety leaking through or open

Corrective Action:

[1] **CHECK** PZR pressure to determine if PZR PORV/Safety should be open.

[2] **CHECK** other indications to determine if PZR PORV or Safety is open:

- Windows 89-A and 89-B
- 1-TI-68-328 [1-M-4] - Safety
- 1-TI-68-329 [1-M-4] - Safety
- 1-TI-68-330 [1-M-4] - Safety
- 1-TI-68-331 [1-M-4] - PORV

[3] **ENSURE** PZR PORV and Safeties CLOSED when PZR pressure is below lift setpoint.

[4] **IF** PZR PORV is **NOT** closed when PZR pressure is below lift setpoint, **THEN**:

[4.1] **CLOSE** associated PZR PORV block valve.

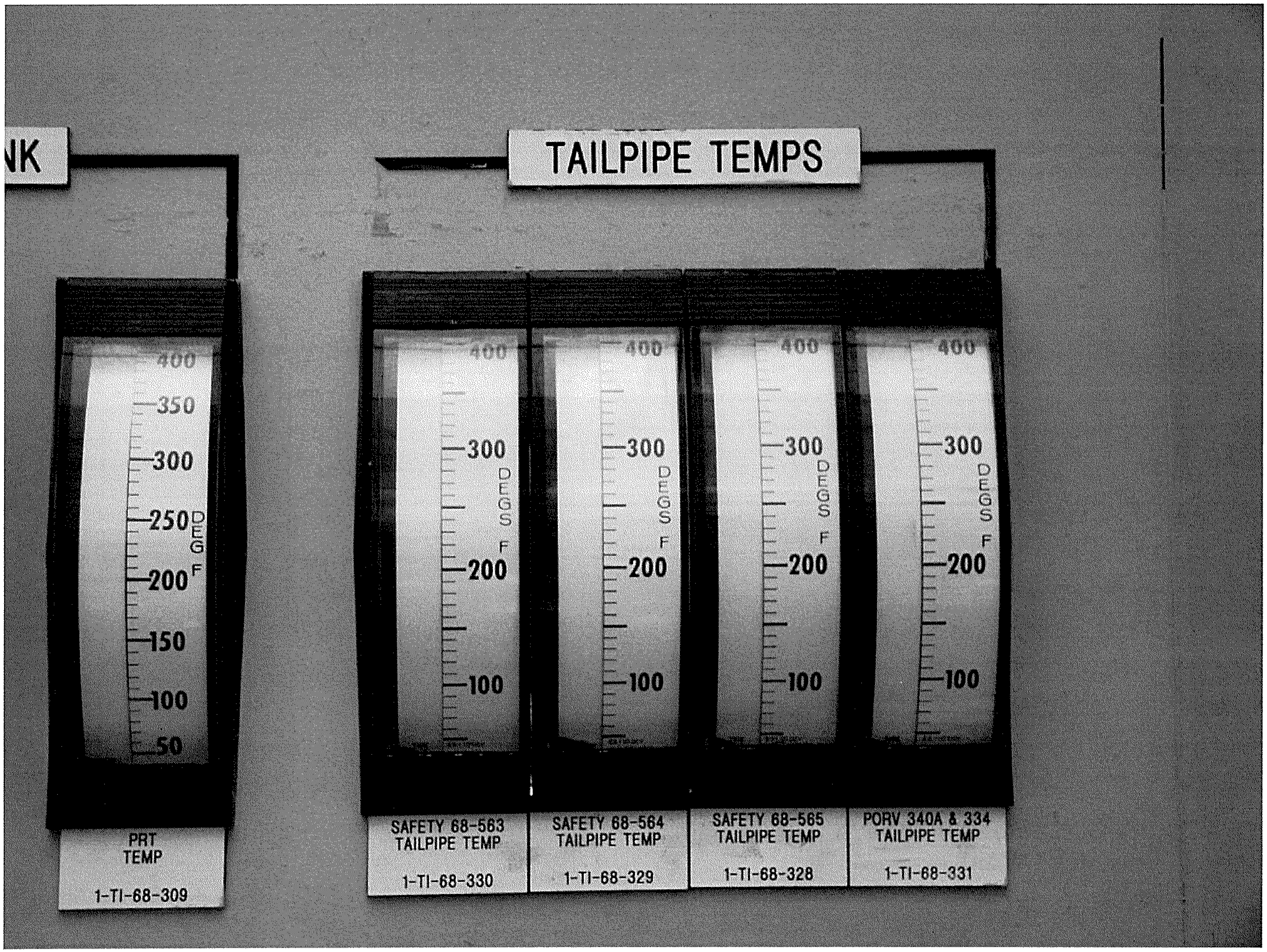
[4.2] **NOTIFY** SRO.

[4.3] **REFER TO** AOI-18, Malfunction of Pressurizer Pressure Control System.

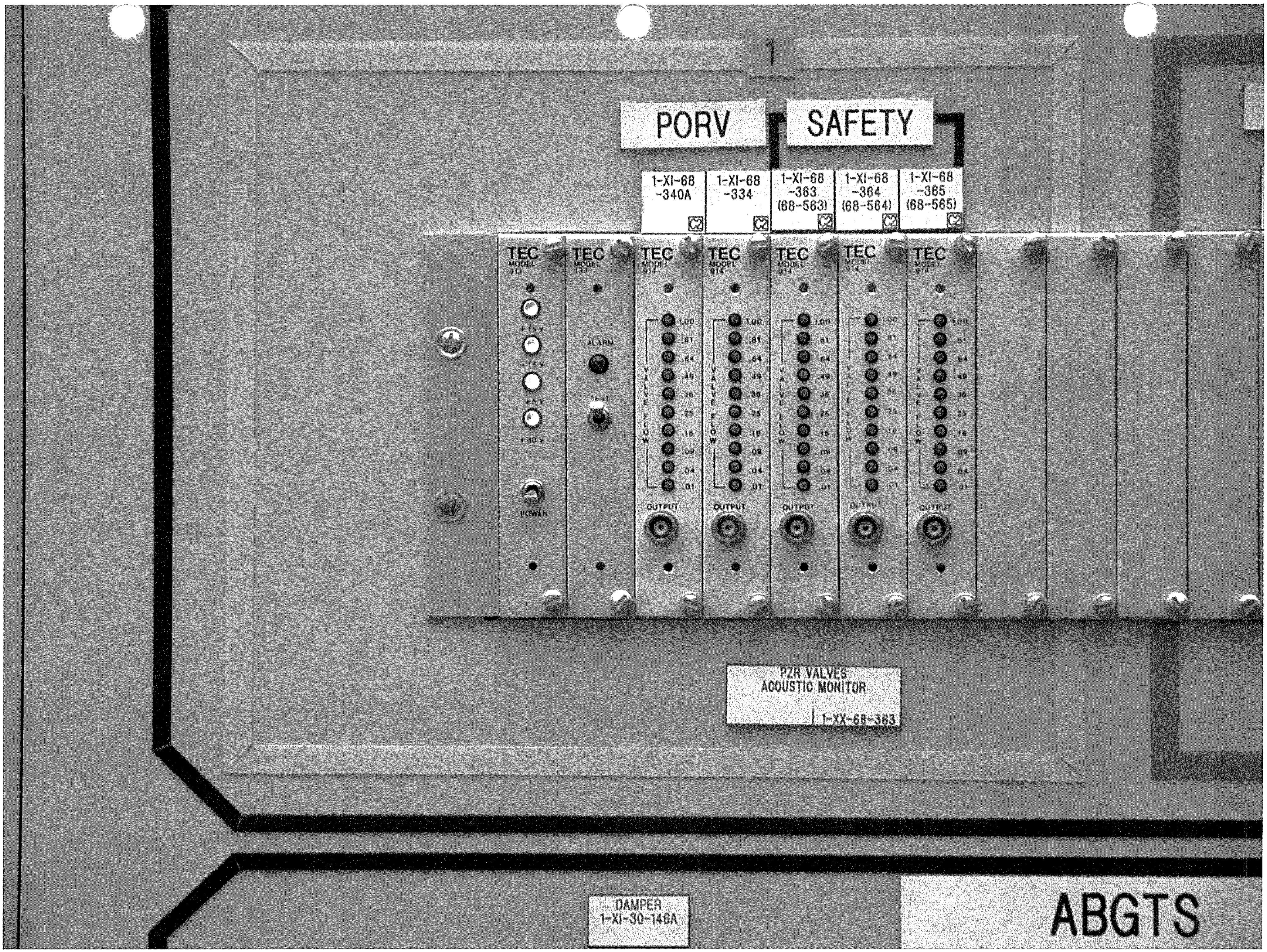
[4.4] **REFER TO** Tech Specs.

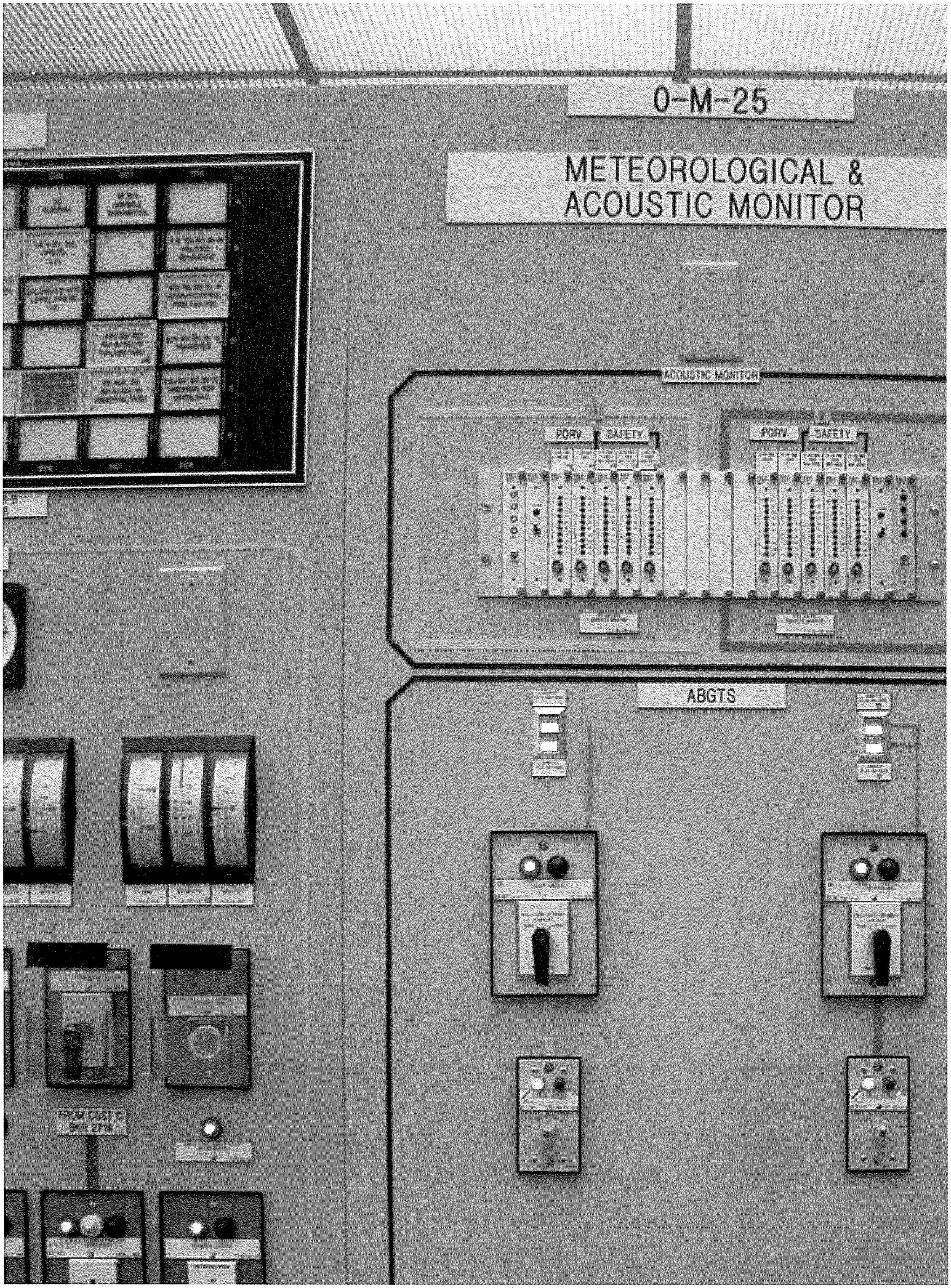
References:

1-47W610-68-5
AOI-18



COMMON INDICATOR


1
PORV
SAFETY
1-XI-68 -340A
1-XI-68 -334
1-XI-68 -363 (68-563)
1-XI-68 -364 (68-564)
1-XI-68 -365 (68-565)
TEC MODEL 913
+15 V
−15 V
+5 V
+30 V
POWER
TEC MODEL 133
ALARM
TEC MODEL 914
VALVE FLOW
1.00
.81
.64
.49
.36
.25
.16
.09
.04
.01
OUTPUT
PZR VALVES ACOUSTIC MONITOR
1-XX-68-363
DAMPER 1-XI-30-146A
ABGTS


0-M-25
METEOROLOGICAL &
ACOUSTIC MONITOR
ACOUSTIC MONITOR
PORV
SAFETY
PORV
SAFETY
ABGTS
FROM CSST C
BKR 2714

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.11 Pressurizer Power Operated Relief Valves (PORVs)

LCO 3.4.11 Each PORV and associated block valve shall be OPERABLE.

APPLICABILITY: MODES 1, 2, and 3.

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each PORV.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more PORVs inoperable and capable of being manually cycled.	A.1 Close and maintain power to associated block valve.	1 hour
B. One PORV inoperable and not capable of being manually cycled.	B.1 Close associated block valve.	1 hour
	AND	
	B.2 Remove power from associated block valve.	1 hour
	AND	
	B.3 Restore PORV to OPERABLE status.	72 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One block valve inoperable.	C.1 Place associated PORV in manual control.	1 hour
	AND	
	C.2 Restore block valve to OPERABLE status.	72 hours
D. Required Action and associated Completion Time of Condition A, B, or C not met.	D.1 Be in MODE 3.	6 hours
	AND	
	D.2 Be in MODE 4.	12 hours
E. Two PORVs inoperable and not capable of being manually cycled.	E.1 Close associated block valves.	1 hour
	AND	
	E.2 Remove power from associated block valves.	1 hour
	AND	
	E.3 Be in MODE 3.	6 hours
	AND	
	E.4 Be in MODE 4.	12 hours
F. Two block valves inoperable.	F.1 Place associated PORVs in manual control.	1 hour
	AND	
		(continued)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. (continued)	F.2 Restore one block valve to OPERABLE status.	2 hours
G. Required Action and associated Completion Time of Condition F not met.	G.1 Be in MODE 3. AND G.2 Be in MODE 4.	6 hours 12 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.11.1	-------------------------------NOTE------------------------------- Not required to be met with block valve closed in accordance with the Required Action of Condition B or E. --- Perform a complete cycle of each block valve.	92 days
SR 3.4.11.2	Perform a complete cycle of each PORV.	18 months

SYS068K.03 001 WATTS BAR BANK QUESTION

Given the following conditions:

- RCS leakage has been detected
- The OATC reports that he suspects a leaking Pzr PORV

Which of the following could be used by the crew to identify the leaking PORV?

a. Acoustic monitor indications on 1-M-4

b. PORV/Safety valve tailpipe temperature indications on ICS

c.✓ Acoustic monitor LED indications on 0-M-25

d. PORV/Safety valve tailpipe temperature alarms on 1-M-5

The correct answer is C.

a. *Incorrect - there are no acoustic monitor indications on M-4, only a common alarm on M-5.*
b. *Incorrect - PORV tailpipe temperature will rise from a leaking PORV - a single tailpipe indication for both PORVs exist on ICS.*
c. *Correct - LED indications for varying leakage values are located on the common acoustic monitor panel on 0-M-25.*
d. *Incorrect - there is a common tailpipe temperature alarm on 1-M-5 for all PORVs and Safeties.*

<u>REFERENCES:</u>
3-OT-STG-068K
AOI-6

K/A 010 A1.09 [3.4/3.7]
002 K4.05 [3.8/4.2]

SYS068C.11 006

WBN BANK QUESTION

Given the following conditions:

- Abnormal RCS leakage has been detected.
- The OAC reports he suspects a leaking Pzr PORV.

Which of the following would be used to identify which PORV is leaking?

a. PORV OPEN and CLOSED indicating lights LIT at the same time

b. PORV tailpipe temperature indication rising

c. PRT temperature and pressure rising

d.✓ PORV tailpipe acoustic monitor lights LIT

The correct answer is D

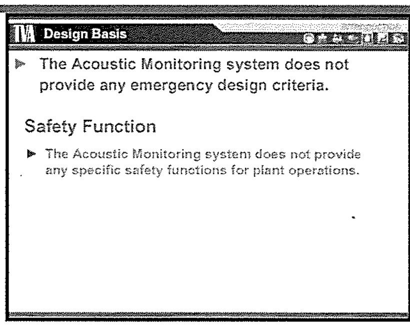
K/A: 002000K405 [3.8 / 4.2]

Reference: 3-OT-SYS068C

History: SQN NRC Exam 09/19/97

Level: Memory

SLIDE 4



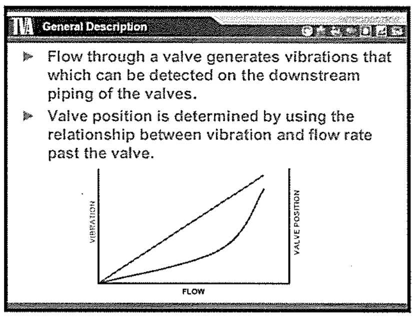
Design Basis

1. The Acoustic Monitoring system does not provide any emergency design criteria.

Safety Function

1. The Acoustic Monitoring system does not provide any specific safety functions for plant operations.

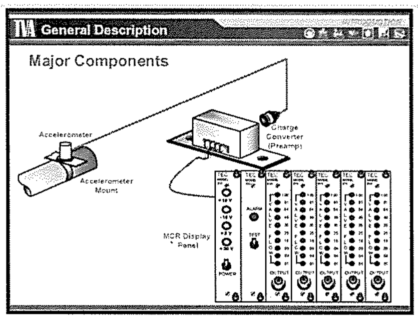
SLIDE 5



General Description

2. Overview the basic theory of operation of the Acoustic Monitoring system.
   - Flow through a valve generates vibrations that can be detected on the downstream piping of the valves.
   - Valve position is determined by using the relationship between vibration and flow rate past the valve.

SLIDE 6

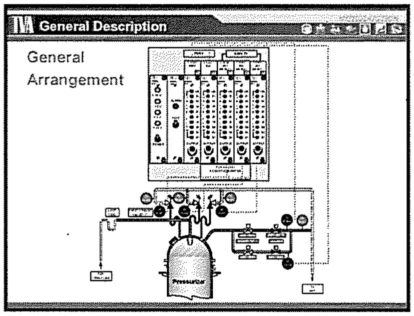


3. Preview the major components of the Acoustic Monitoring system.
   - Accelerometer Mount.
   - Accelerometer.
   - Charge Converter (Preamp).
   - MCR Display.
   - **Optional**: Question class on how an accelerometer works.

     Answer: The accelerometer sensor is a piezoelectric device. It utilizes the phenomena that certain crystals emit a charge or voltage when stressed. This charge is proportional to the acceleration level caused by the turbulent fluid flow in the piping downstream of the associated valve.

SLIDE 7

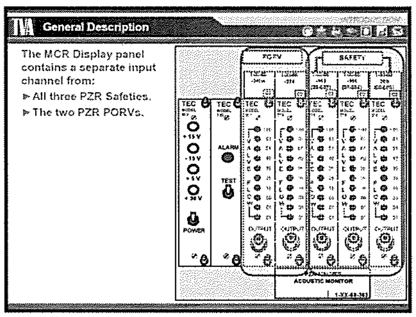
OBJECTIVE 2



4. Discuss the General Arrangement of the Acoustic Monitoring system field equipment.
   - One Accelerometer for each Pressurizer Safety, and PORV.
   - Each accelerometer feeds a separate Flow Monitoring Module on the MCR display panel.

SLIDE 8

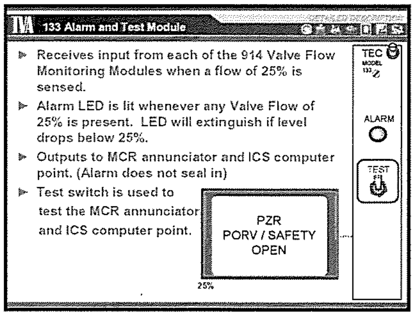
OBJECTIVE 3



5. Discuss the General Arrangement of the Acoustic Monitoring system MCR display panel.
   - Located on MCR control panel 0-M-25.
   - The MCR Display panel contains a separate input channel from each Pressurizer Safety, and PORV.
   - Panel also houses the power supply module and the Alarm Test module.
   - **Optional**: Question the class if one valve is open/leaking thru will it affect the indications for the other valves.

     Answer: Since all PZR Safety Valves and PORVs have a common downstream pipe connection prior to entering the Pressurizer Relief Tank (PRT), when a single accelerometer senses that one valve is not fully closed the other valve accelerometers will be exposed to some associated dynamic stress in the common piping. The LED display for the valve that is not fully closed will have a larger signal being generated, and thus, more LEDs will be lit.

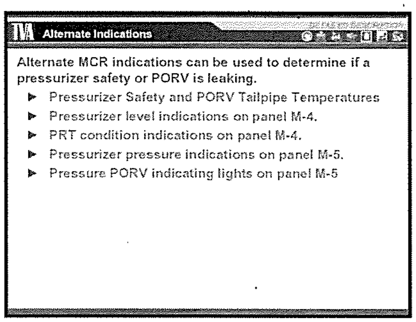
SLIDE 15



133 Alarm and Test Module

1. Discuss the function, operation and indications associated with the 914 Valve Flow Monitoring Module.
   - Receives input from each of the 914 Valve Flow Monitoring Modules when a flow of 25% is sensed.
   - Alarm LED is lit whenever any Valve Flow of 25%.
   - Outputs to MCR annunciator and ICS computer point.
   - Test switch is used to test the MCR annunciator and ICS computer point.
   - **Optional**: Use ARI 1-XA-55-5A window 91A to discuss response to alarm.

SLIDE 16



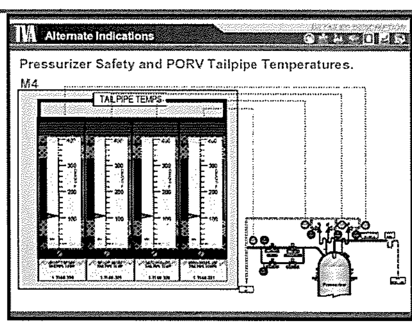
Alternate Indications

1. Discuss the alternate MCR indications that can be used to determine if a pressurizer safety or PORV is leaking.
   - Pressurizer Safety and PORV Tailpipe Temperatures.
   - Pressurizer level indications on panel M-4.
   - PRT condition indications on panel M-4.
   - Pressurizer pressure indications on panel M-5.
   - Pressure PORV indicating lights on panel M-5.

OE – Link to OE Homepage and discuss PER-31350 as it relates to using multiple indications to validate annunciators. This also reinforces SER-3-05 for using multiple indications.

NOTE: Each of these indications will be discussed in detail subsequent slides.

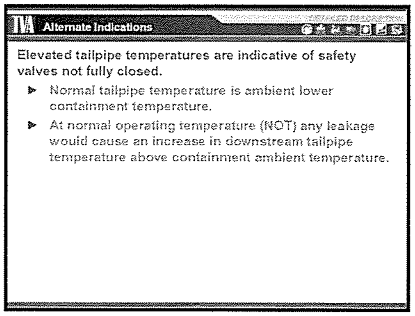
SLIDE 17



Pressurizer Safety and PORV Tailpipe Temperatures

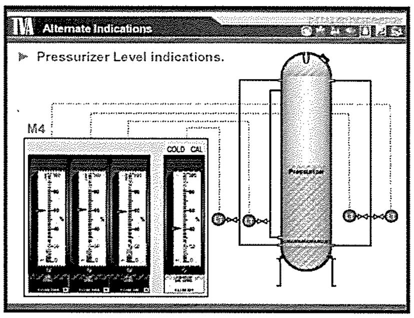
1. Discuss the MCR indications for Pressurizer Safety and PORV Tailpipe Temperature available on panel M5.
   - Pressurizer tailpipe temperature for each of the three pressurizer safeties. (TI-68-328, TI-68-329 and TI-68-330,)
   - Common tailpipe temperature for thePORVS (TI-68-331)

SLIDE 18



2. Discuss how elevated tailpipe temperatures can be used to indicate a safety valve or PORV is not fully closed.
   - Normal tailpipe temperature is ambient lower containment temperature.
   - At normal operating temperature (NOT) any leakage would cause an increase in downstream tailpipe temperature above containment ambient temperature.

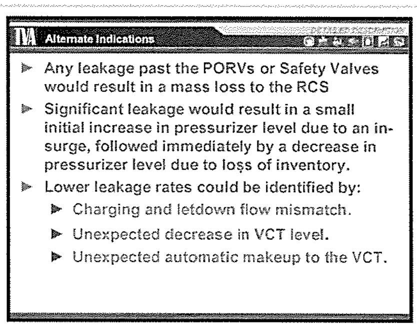
SLIDE 19



Pressurizer Level Indications

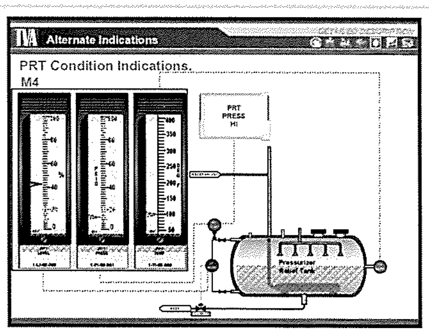
3. Discuss the MCR indications for Pressurizer Level available on panel M4.
   - Three channels of hot calibrated pressurizer level. (LI-68-320, LI-68-335A and LI-68-339A)
   - Pressurizer cold calibrated level indicator (TI-68-321).

SLIDE 20



4. Discuss how pressurizer level can be used to indicate a safety valve or PORV is not fully closed.
   - Any leakage past the PORVs or Safety Valves would result in a mass loss to the RCS
   - Significant leakage would result in a small initial increase due to an in-surge, followed immediately by a decrease in pressurizer level due to loss of inventory.
   - Lower leakage rates could be identified by:
     - Charging and letdown flow mismatch.
     - Unexpected decrease in VCT level.
     - Unexpected automatic makeup to the VCT.

SLIDE 21



PRT Condition Indications

5. Discuss the MCR indications for the PRT available on panel M4.
   - PRT Level. (LI-68-300)
   - PRT Pressure (PI-68-301)
   - PRT Temperature (TI-68-309).

I. PROGRAM

Watts Bar Operator Training

II. COURSES

License Training

Non-Licensed Training

III. TITLE

Acoustic Monitoring System

IV. LENGTH OF LESSON

A. License Training 2 Hours
B. NOTP 2 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. State the function of the Acoustic Monitoring System as described in this lesson plan.
	X	X	X	2. List valves monitored by the Acoustic Monitoring System
	X	X	X	3. Correctly locate control room controls and indications associated with the Acoustic Monitoring System, including: a. alarm b. panel c. LED's d. power switch e. individual valve indications f. tail pipe temperature indications

37. 010 K6.04 037

Unit 1 is operating at 100% power when the following sequence of events occurs:

- Pressurizer Power Operated Relief Valve (PORV) 1-PCV-68-334 opens and fails to reseat when closed.
- Pressurizer PORV Block valve, 1-FCV-68-332, for PORV 334 cannot be closed.
- Pressurizer Relief Tank (PRT) pressure begins to slowly rise.
- The PRT pressure continues to rise until the PRT ruptures.

Which ONE of the choices below completes the following two statements?

1-PCV-68-301, PRT VENT TO WDS VENT HDR, will automatically close when the PRT pressure reaches _____________ psig.

When the PRT ruptures, the PORV tailpipe temperature will ___________.

	1-PCV-68-301 closes	PORV Tailpipe Temperature
A.	2.0 psig	begin to drop
B.	2.0 psig	rise at a faster rate
C.✔	8.0 psig	begin to drop
D.	8.0 psig	rise at a faster rate

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because 2.0 psig is the pressure that the vent header must be maintained less than when venting the PRT due to high pressure (ARI 88-C) and when the PRT rupture diaphragm blows the PORV tailpipe temperature starting to drop is correct.*

B. *Incorrect, Plausible because 2.0 psig is the pressure that the vent header must be maintained less than when venting the PRT due to high pressure (ARI 88-C) and because the leakage flow rate will rise when the PRT ruptures, the applicant may conclude that the temperature will start rising at a faster rate.*

C. *Correct, 1-PCV-68-301 will automatically close when the PRT pressure reaches 8.0 psig and as demonstrated during the TMI event, when the PRT rupture diaphragm blows the PORV tailpipe temperature will start to drop.*

D. *Incorrect, Plausible because 1-PCV-68-301 automatically closing when the PRT pressure reaches 8.0 psig is correct and because the leakage flow rate will rise when the PRT ruptures, the applicant may conclude that the temperature will start rising at a faster rate.*

Question Number: 37

Tier: 2 **Group** 1

K/A: 010 K6.04
Pressurizer Pressure Control System
Knowledge of the effect of a loss or malfunction of the following will have on the PZR PCS:
PRT

Importance Rating: 2.9 / 3.2

10 CFR Part 55: 41.7 / 45.7

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of PRT conditions and how a loss of the PRT will affect indications in the pressurizer pressure control system.

Technical Reference: ARI-88-94, Reactor Coolant System, Revision 0022
1-47W813-1, R43
Steam Tables

Proposed references to be provided: None

Learning Objective: 3-OT-SYS068C
11. Describe the indication an operator has that a PORV is open or leaking through.

Cognitive Level:
Higher ____
Lower X

Question Source:
New ____
Modified Bank X
Bank ____

Question History: WBN bank question 010 K6.04 036 used on 05/2009 exam modified.

Comments:

88-C

Source
1-PS-68-301

Setpoint
8.0 psig

PRT PRESS HI

(Page 1 of 2)

Probable Cause:

A. Any of the following valves open or leaking through:
- PZR PORVs or Safeties
- RHR Pumps suction or discharge reliefs
- RCP seal water supply relief
- SI Pumps discharge or recirc line reliefs
- CS Pumps suction reliefs
- Letdown relief
- Rx vessel head vent
- Charging Pump suction relief

B. N_2 regulator malfunction

NOTE
1-PCV-68-301 will auto-close at 8 psig to prevent over pressurizing the vent header.

CORRECT

Corrective Action:

[1] **CHECK** 1-PI-68-301, PRT PRESS [1-M-4], to confirm alarm.
[2] **ENSURE** 1-PCV-68-301 CLOSED.
[3] **CHECK** the following for indication of flow:
- PZR Safety line temperature 1-TI-68-330, -329, and -328 [1-M-4]
- PZR PORV line temperature 1-TI-68-331 [1-M-4]
- PZR PORV ans Safety acoustic indication [0-M-25]

[4] **CHECK** RV Head Vent Isol Vlaves 1-FSV-68-394, -395, -396, and -397 CLOSED.
[5] **MONITOR** the following for indication of leakage to PRT [1-M-4]:
- 1-LI-68-300, PRT LEVEL
- 1-TI-PRT TEMP

Continued on Next Page

88-C

PRT PRESS HI

(Page 2 of 2)

Corrective Action: (Continued)

[6] **DISPATCH** Operator to perform the following:
- **CHECK** for indication of lifting relief valves.
- **CHECK** N_2 pressure regulator 1-PCV-68-304 CLOSED **AND** **ISOLATE** regulator, if necessary.

[7] **REDUCE** PRT level and temperature to normal as necessary per SOI-68.01.

[8] **REDUCE** PRT pressure to approximately 6.5 psig as follows:

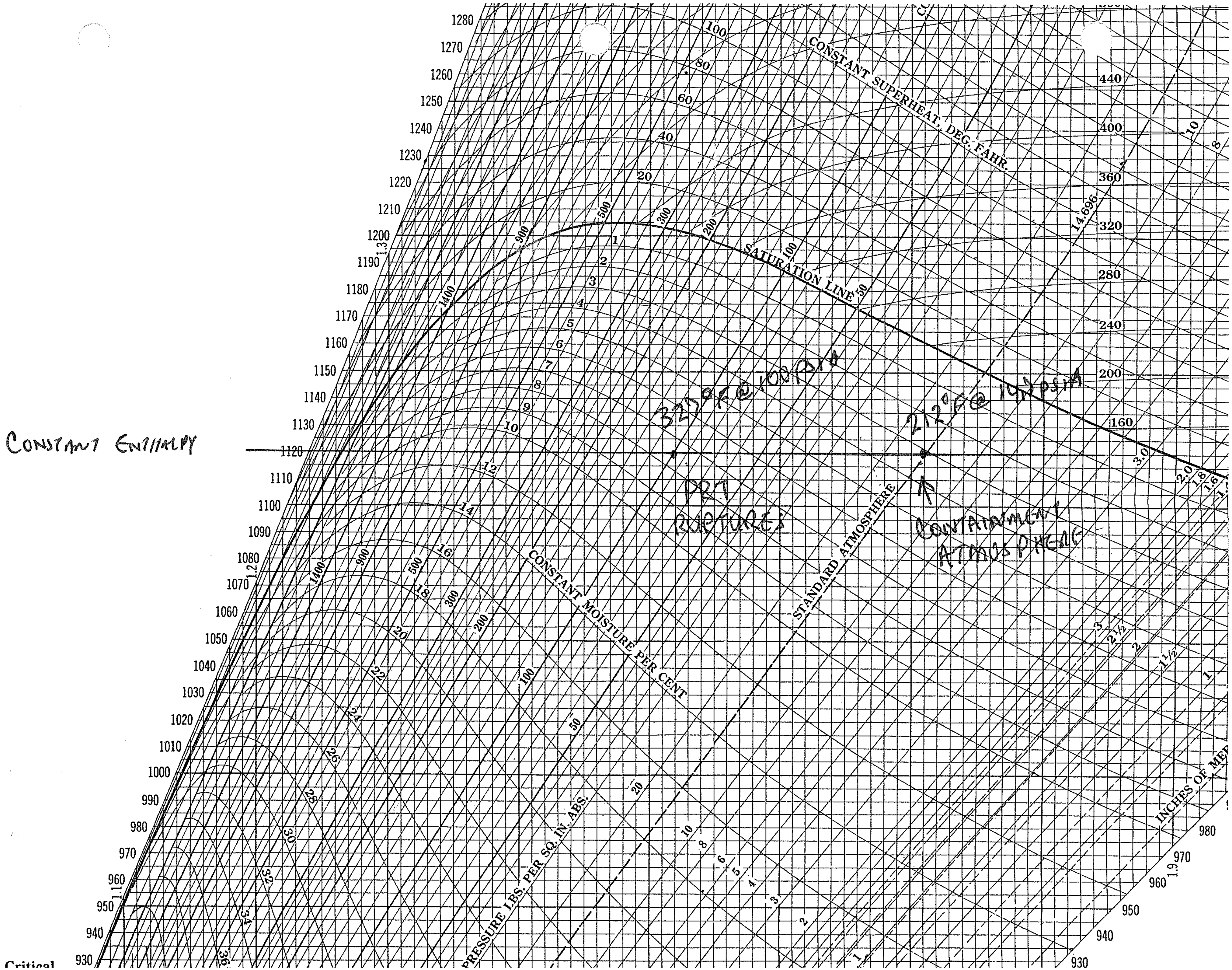
[8.1] **STATION** Operator at panel 0-L-2 to monitor vent header pressure and start Waste Gas Compressor if necessary.

[8.2] **HOLD** 1-HS-68-301A, PRT VENT TO WDS VENT HDR, in the OPEN position as long as the following conditions exist:
- Vent Header pressure is less than 2 psig. DISTRACTOR
- PRT pressure is greater than 6.5 psig.

[8.3] **ENSURE** 1-HS-68-301A in the CLOSED position.

[9] **REFER TO** Tech Specs.

References:
1-45W600-57-16
1-47W610-68-6
1-47W611-68-1
SOI-68.01
Tech Specs



CONSTANT SUPERHEAT, DEG. FAHR.
SATURATION LINE
CONSTANT MOISTURE PER CENT
STANDARD ATMOSPHERE
PRESSURE LBS. PER SQ. IN. ABS.
14.696
CONSTANT ENTHALPY
322°F @ 100 PSIA
212°F @ 14.7 PSIA
PRT RUPTURES
CONTAINMENT ATMOSPHERE
Critical

Table 18
(Page 1 of 1)

Pressurizer Relief Tank Design Parameters

Design pressure, psig	
Internal	100
External	15
Design temperature, °F	340
Normal operating pressure, psig	3
Volume, ft^3	1800
Normal water volume, ft^3	1350
Normal gas volume, ft^3	450
Number of rupture disks	2
Rupture disc relief capacity lb/hr	800,000 each
Rupture disc release pressure, psig	
Nominal	91
Range	86 - 100
Cooling time required following design maximum discharge, hr.	approx. 1
Number of spray nozzles	5
Total Spray Flow, gpm	150

010 K6.04 036 WBN BANK QUESTION

Unit 1 is operating at 100% power when the following sequence of events occurs:

- PZR Power Operated Relief Valve (PORV) 1-PCV-68-334 opens and sticks open.
- PZR PORV Block valve, 1-FCV-68-332 cannot be closed.
- Pressurizer Relief Tank (PRT) is at 43 psig and continues to rise.

Which ONE of the following completes the following statement?

The PRT rupture disc will blow when pressure reaches ____________ psig, at which point Pressurizer Power Operated Relief Valve tailpipe temperature will ____________.

	PRT Rupture Disc Setpoint	PORV Tailpipe Temperature
A.	85 psig	Remain the same.
B.✓	85 psig	Lower
C.	100 psig	Remain the same.
D.	100 psig	Lower

DISTRACTOR ANALYSIS

a. Incorrect. Plausible, since the rupture disc blows at 85 psig. The applicant misapplies the constant enthalpy process and concludes that PORV outlet temperature rises.

b. CORRECT. The rupture disc blows at 85 psig and per the TMI lessons learned, and basic thermodynamic principles, PORV outlet temperature will lower.

c. Incorrect. Plausible, since 100 PSIA is equivalent to 85 PSIG, and the applicant may recall inappropriate units. The applicant misapplies the constant enthalpy process and concludes that PORV outlet temperature rises.

d. Incorrect. Plausible, since 100 PSIA is equivalent to 85 PSIG, and the applicant may recall inappropriate units. Per the TMI lessons learned, and basic thermodynamic principles, PORV outlet temperature will lower.

Question Number: **36**

K/A: 010 K6.04
Knowledge of the effect of a loss or malfunction of the following will have on the PZR PCS: PRT

Tier:	**2**	**RO Imp:**	**2.9**	**RO Exam:**	**36**	**Cognitive Level:**	**Low**
Group:	**1**	**SRO Imp:**	**n/a**	**SRO Exam:**	**36**	**Source:**	**New**

Applicable 10CFR55 Section: (CFR: 41.7 / 45.7)

Learning Objective: 3-OT-SYS068C, Obj. 11: Describe the indication an operator has that a PORV is open or leaking through.

References: INPO Bank question; ARI 88-C, "PRT Press Hi."

K/A: 010 K6.04
Knowledge of the effect of a loss or malfunction of the following will have on the PZR PCS: PRT

I. PROGRAM

Watts Bar Operator Training

II. COURSES

A. License Training

B. . Non-License Training

III. TITLE

PZR, PZR Pressure Control System/ PZR Level Control System, and PRT

IV. LENGTH OF LESSON

A. License Training 4 Hours
B. Non-License 6 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. Identify the three (3) main purposes of the Pressurizer.
X	X	X	X	2. Describe the major components of the Pressurizer.
X	X	X	X	3. Describe the purposes of the Manual Bypass Pressurizer Spray Throttle Valves.
X	X	X	X	4. Identify the normal setpoint required to auto open the PZR Relief Valves (PORVs).
X	X	X	X	5. Identify each setpoint and resulting automatic action for the Pressurizer Pressure Program.
	X	X	X	6. State the basis for the low pressure reactor trip, as stated in Tech Specs Section 2.1.1.
	X	X	X	7. State the basis for the high pressure reactor trip, as stated in Tech Specs Section 2.1.1.
	X	X	X	8. Describe the operation of the master pressure controller.
	X	X	X	9. Describe what control room indication would alert the operator that the pressurizer spray valves were open.
	X	X	X	10. Describe the method of control for the power operated relief valves.
	X	X	X	11. Describe the indication an operator has that a PORV is open or leaking through.
X	X	X	X	12. Identify the program setpoints, and describe any automatic actions relative to the pressurizer level program.

AUO	RO	SRO	STA	
X	X	X	X	13. Describe the basis for the program setpoints of the pressurizer level program circuit.
X	X	X	X	14. Explain the basis for programming the level vs. maintaining the level constant in the pressurizer.
X	X	X	X	15. Describe the response to a deviation from pressurizer level program.
X	X	X	X	16. Explain the purpose of the PRT.
X	X	X	X	17. Identify the components which drain into the Pressurizer Relief Tank.
	X	X		18. Deleted.
	X	X		19. Deleted
X	X	X	X	20. Describe the in-plant location of major system components, instrumentation, controls, and piping/header arrangements.
X	X	X	X	21. Describe the flow path of sources of supply, discharges, vents, drains, leakoff, and connections/penetrations that intertie this system to other systems.
X	X	X	X	22. Explain the operation of major system components.
X	X	X	X	23. Deleted
	X	X	X	24. Deleted

38. 012 K2.01 038

Which ONE of the following identifies the plant electrical boards that supply power to the listed components on Unit 1?

	SSPS Train B Reactor Trip Breaker 48v UV coil	Reactor Trip Bypass Breaker A (BYA) Control Power Circuit
A.✓	120v AC Vital Instrument Power Boards II and IV	125V DC Vital Battery Board I
B.	120v AC Vital Instrument Power Boards II and IV	125V DC Vital Battery Board II
C.	120v AC Vital Instrument Power Board II ONLY	125V DC Vital Battery Board I
D.	120v AC Vital Instrument Power Board II ONLY	125V DC Vital Battery Board II

DISTRACTOR ANALYSIS:

A. Correct, 120v AC Vital Instrument Power Boards II and IV supply the 48v Reactor Trip Undervoltage relay through an auctioneered circuit and the 125V DC Battery Board II is the control power to BYA.

B. Incorrect, Plausible because the 120v AC Vital Instrument Power Boards II and IV supplying the 48v reactor Trip Undervoltage relay through an auctioneered circuit is correct and the 125V DC Battery Board II is the control circuit power supply Train B reactor trip breakers and BYA receives trip signal from Train B circuits.

C. Incorrect, Plausible because the 120v AC Vital Instrument Power Boards II is the only power supply to other components in SSPS Train B (e.g. Slave relays) and the 125V DC Battery Board I is the control power supply to BYA.

D. Incorrect, Plausible because the 120v AC Vital Instrument Power Boards II is the only power supply to other components in SSPS Train B (e.g. Slave relays) and the 125V DC Battery Board II is the control circuit power supply Train B reactor trip breakers and BYA receives trip signals from Train B SSPS Reactor Trip circuits.

Question Number: 38

Tier: 2 **Group** 1

K/A: 012 K2.01
Reactor Protection System
Knowledge of bus power supplies to the following:
RPS channels, components, and interconnections.

Importance Rating: 3.3 / 3.7

10 CFR Part 55: 41.7

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the knowledge of the bus power supplies to Reactor Protection System components

Technical Reference: 1-45W600-99-1 R7
N3-99-4003, Reactor Protection System, Revision 0021

Proposed references to be provided: None

Learning Objective: 3-OT-SYS099A
2. Sketch a basic drawing of the Solid State Protection System.

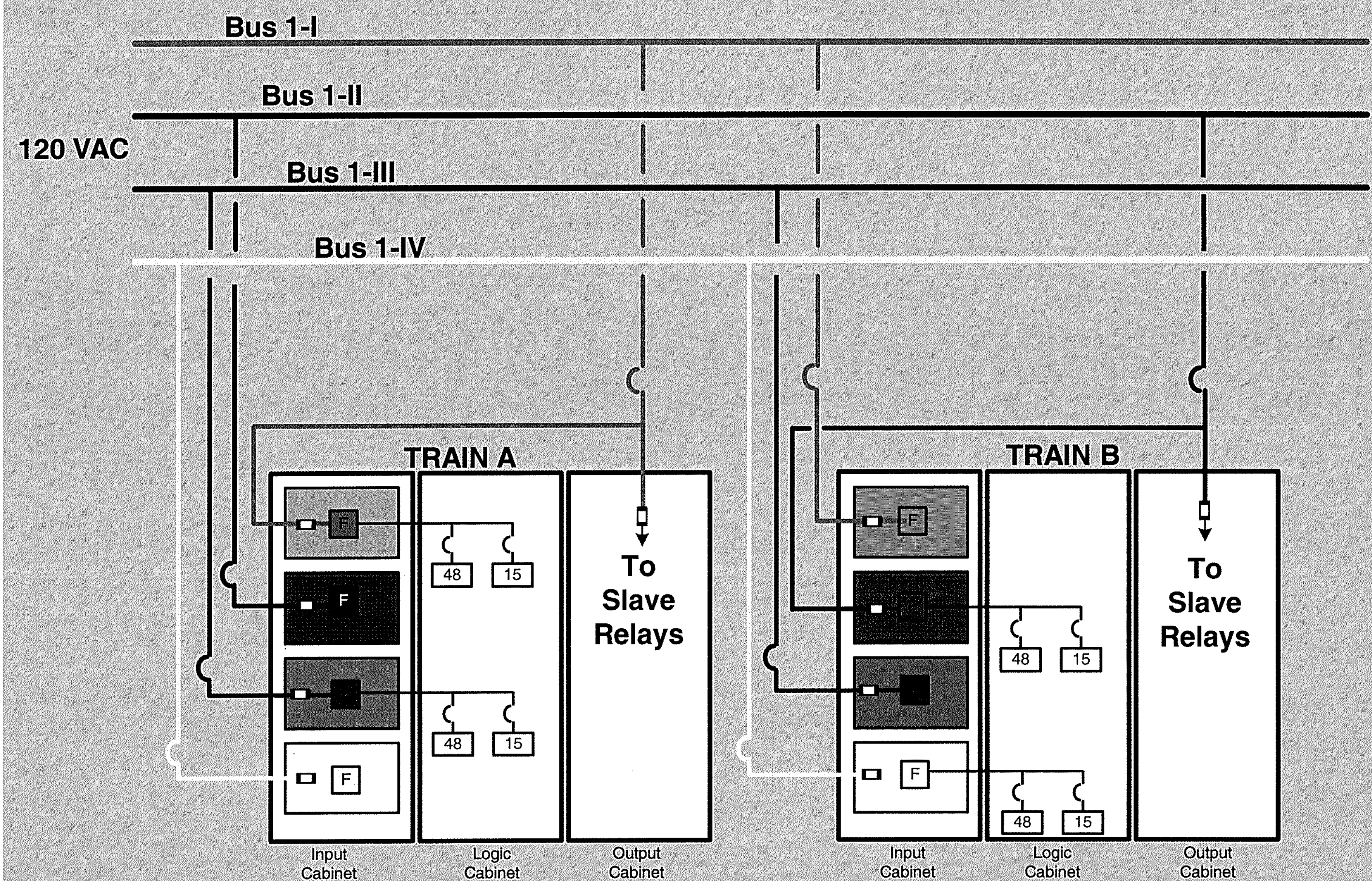
Cognitive Level:
- **Higher** ____
- **Lower** X

Question Source:
- **New** X
- **Modified Bank** ____
- **Bank** ____

Question History: New question for the WBN 10/2011 NRC exam.

Comments:

Power Supply



2.2.8 Separation, Fire Protection, or Intrazonal Protection Requirements (continued)

Channel independence shall be carried throughout the system extending from the sensor through to the devices actuating the protective function. Physical separation shall be used to achieve separation of redundant transmitters. Separation of wiring shall be achieved using separate wireways, cable trays, conduit runs and containment penetrations for each redundant channel set. Redundant equipment shall be separated by locating equipment in different protection rack sets. Each redundant channel set shall be energized from a separate ac power feed, which shall be fed from vital inverters and battery-backed (see Reference 7.2.6).

Separate routing shall be maintained for the four basic Reactor Protection System channel sets, sensing signals, comparator output signals, and power supplies for such systems. The separation of these four channel sets shall be maintained from sensors to instrument racks to logic system cabinets.

Separate routing of the reactor trip and ESFAS signals from the redundant logic system cabinets shall be maintained. In addition they are separated from the four process protection sets by spatial separation, by provision of barriers, or by separate cable trays or wireways.

The Reactor Protection System shall be protected from fire by physical separation and portions of the Fire Protection System (Reference 7.2.16). Additional requirements for fire protection and detection are found in WB-DC-40-62 (Reference 7.2.13) and N3-13-4002 (Reference 7.2.5). The Eagle 21 Process Protection System cabinets shall be designed in accordance with the requirements of IEEE 384-1981 (Reference 7.3.24).

2.2.9 Electrical Power Requirements

Redundant 120-Vac Class 1E electrical power shall be supplied to the Reactor Protection System. Each input protection channel and output train shall be energized from a separate battery backed ac power feed (see Reference 7.2.6).

The Reactor Protection System equipment shall obtain power from a static inverter and shall be designed to accept the possible voltage and frequency variations associated with the regulated static inverter output. The specified regulated output of the static inverter is 120 Vac ±2% and 60 Hz ±0.5 Hz. The allowed total harmonic distortion is 5%.

A. Power Distribution

Train A and Train B Solid State Protection System (SSPS) shall receive power from the four 120V ac vital instrumentation busses. The channel I through IV busses shall enter their respective input cabinet compartments through fuses in the compartments. In the input compartments, the busses shall be used to operate relays driven by external contacts. Two of the four busses shall run through line noise filters at the rear of the input compartment into the dc power supplies in the logic cabinet. In Train A, busses I and III shall feed the power supplies and bus I shall feed the slave relays and in Train B, busses II and IV shall feed the power supplies and bus II shall feed the slave relays. Separate feeds shall be brought into the output cabinet for the slave relays to avoid running unfiltered lines through the logic cabinet.

2.2.9 Electrical Power Requirements (continued)

The two 48V dc and 15V dc power supplies in one train shall be auctioneered to form one 48 and one 15V dc bus. A zero volt bus or circuit common bus shall be formed by connecting the (-)48 and (-)15V lines. The zero volt bus in trains A and B shall not be connected. Computer and control board demultiplexers shall be powered by their own 48 and 15V dc power supplies that are isolated from the power supplies in the trains.

Specific Requirements

Power and Input/Output Requirements of SSPS Equipment

Characteristic	Approximate Values
Power Requirements	
Train A or B	120V ac, 60 Hz (Reference 7.5.7)
Control Board Demux	120V ac, 60 Hz
Computer Demux	120V ac, 60 Hz
Signal Inputs	
Instrument Comparators	OV, or (118V ac, 60 Hz)
Field Contacts	Contact closure to 118V ac, 60 Hz
Control Board Inputs	Contact closure to logic ground
Outputs	
UV Output	+48V Normal, OV Trip
Safeguards Outputs	Relay Contacts
Multiplex Signals	Pulse trains: 0 and 15V levels
Demultiplexed Signal	ON: +48V; OFF: OV (to computer or interface relays in Control Board Demultiplexer Cabinet

B. Control Rod Drive System Power Requirements

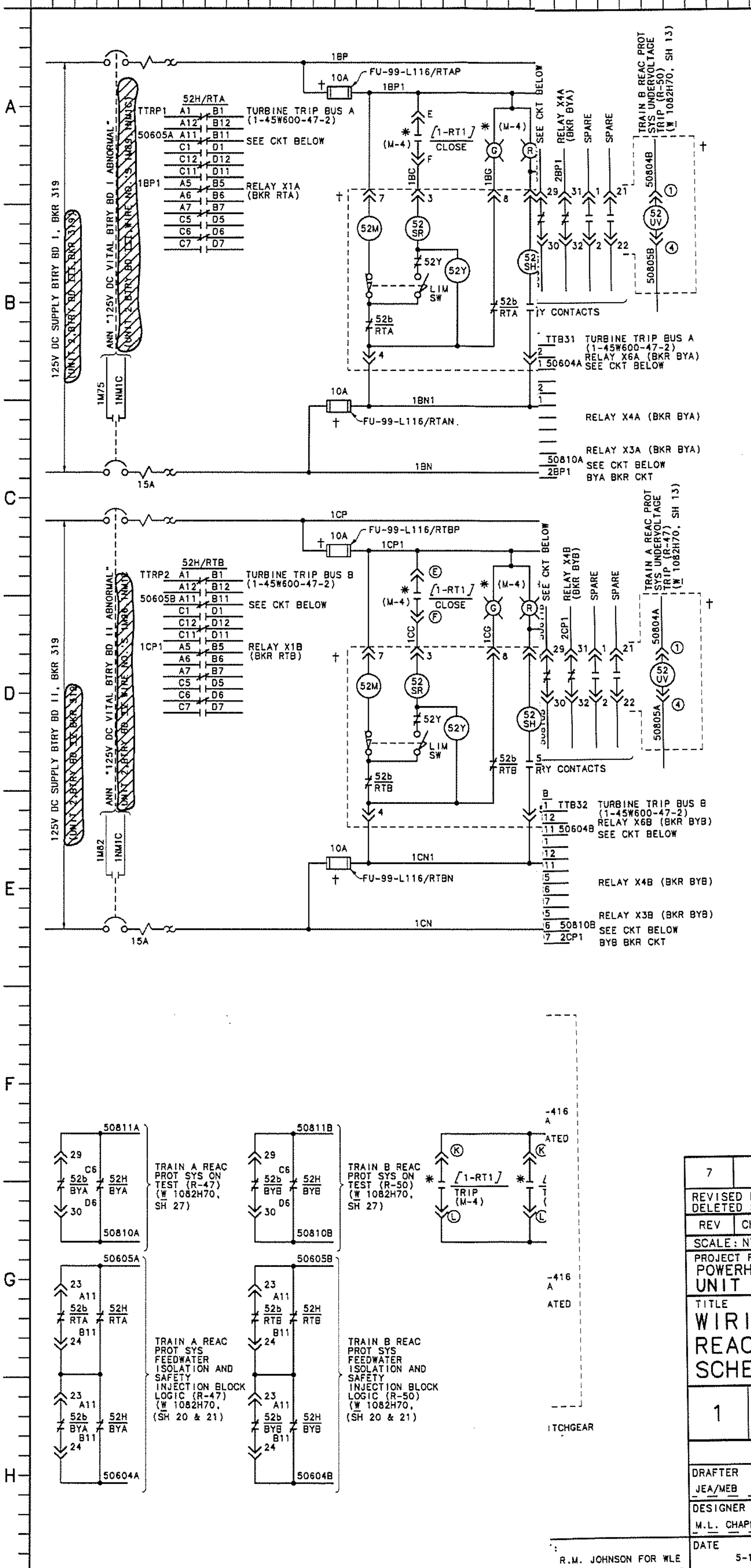
The electrical requirements for the Control Rod Drive System can be found in N3-85-4003 (Reference 7.2.14).

2.2.10 Instrumentation and Control Requirements

Instrumentation and controls shall be provided to monitor and maintain essential reactor facility operating variables such as neutron flux, primary coolant pressure, temperature, and control rod positions within prescribed ranges.

The non-neutronic process and containment instrumentation shall measure temperatures, pressure, flows, and levels in the Reactor Coolant System, steam systems, containment, and auxiliary systems. Process variables which are required on a continuous basis for the startup, power operation, and shutdown of the plant shall be monitored in a controlled access area. The quantity and types of process instrumentation provided shall be adequate for safe and orderly operation of all systems and processes over the full operating range of the plant.

Independent and redundant channels shall be combined through isolators in logic circuits. Protection interlocks, initiation signals such as Safety Injection System, containment isolation, and turbine runback shall further assist in plant protection during operation.



NOTES:

1. DESIGNATIONS ENCLOSED WITH BRACKETS [ ] ARE MANUFACTURER'S DEVICE NUMBERS PER TVA CONTRACT 71C60-54114-1. DESIGNATIONS ENCLOSED WITH PARENTHESIS () ARE PANEL NUMBERS WHERE DEVICES ARE LOCATED.
2. CONTROL SWITCH PIN LETTERS INSIDE A CIRCLE ARE ON SWITCH MODULE CONNECTOR P2; ALL OTHERS ARE ON P1.
3. CIRCUIT BREAKER NOMENCLATURE:
   - 52M----SPRING CHARGING MOTOR
   - 52SR----SPRING RELEASE COIL
   - 52SH----SHUNT TRIP COIL
   - 52Y----ANTI-PUMP RELAY
   - 52UV----UNDERVOLTAGE TRIP COIL
   - 52H----CELL SWITCH (SHOWN IN TEST OR DISCONNECTED POSITION)
4. NORMAL OPERATION OF THE REACTOR TRIP SWITCHGEAR IS WITH THE REACTOR TRIP BREAKERS RTA AND RTB IN SERVICE AND THE BYPASS BREAKERS BYA AND BYB WITHDRAWN. THE BYPASS BREAKER FOR EACH TRAIN WILL BE CLOSED ONLY WHEN THE RESPECTIVE REACTOR TRIP BREAKER IS TO BE TESTED, AND ONLY ONE BYPASS BREAKER MAY BE CLOSED AT ONE TIME. IF BOTH BYPASS BREAKERS ARE CLOSED AT ONE TIME, EACH WILL TRIP THE OTHER, RESULTING IN A REACTOR TRIP. AT THE SAME TIME THE SSPS WILL TRIP ALL FOUR BREAKERS THROUGH THE UNDERVOLTAGE COILS, PROVIDING A REDUNDANT REACTOR TRIP.
5. THE UNDERVOLTAGE COIL FOR EACH BYPASS BREAKER IS CONTROLLED FROM THE OPPOSITE TRAIN OF THE CONTROL CIRCUIT FOR THAT BREAKER.
6. BREAKER DISCONNECT PIN NUMBERS INSIDE A CIRCLE ARE ON A SPECIAL CONNECTOR MOUNTED INSIDE THE BREAKER COMPARTMENT.
7. FOR GENERAL NOTES, INCLUDING TECHNICAL INFORMATION ABOUT CIRCUIT DESIGN, SEE DRAWING 1-45W600-0-1.
8. FOR INPUTS TO THE PLANT COMPUTER, THE COMPUTER POINT IS EQUIVALENT TO THE WIRE NUMBER WITHOUT THE "+" OR "-" SIGN.

REFERENCE DRAWINGS:

1-47W611-99-1---REACTOR PROTECTION SYS LOGIC DIAGRAM
45B640-----------SWITCH DEVELOPMENT
9124D47---------W SCHEMATIC DIAGRAM

SYMBOLS:

* ---DEVICE LOCATED IN MAIN CONTROL ROOM
† ---DEVICE LOCATED IN REACTOR TRIP SWITCHGEAR (L-116)
---RESISTORS ARE 1KΩ, 1%, 2.5W

THIS CONFIGURATION CONTROL DRAWING SUPERSEDES UNIT 1 AS CONSTRUCTED DRAWING 45W600-99-1 REVISION J.

REV	CHANGE REF	PREPARER	CHECKER	APPROVED	DATE
7	D-50301 ADMIN	MAF	JEW	DLO	1-18-01

REVISED PER DCA D50301-3552-0. (STG 34) DELETED SYSTEM BOUNDARIES PER ADMIN.

SCALE: NTS EXCEPT AS NOTED

PROJECT FACILITY: POWERHOUSE UNIT 1

TITLE:

WIRING DIAGRAM REACTOR PROTECTION SYSTEM SCHEMATIC DIAGRAMS

1 — WATTS BAR NUCLEAR PLANT, TENNESSEE VALLEY AUTHORITY — Q

DESIGN		INITIAL ISSUE	ENGINEERING APPROVAL
DRAFTER: JEA/MEB	CHECKER: C.N. CLABOUGH	RO ISSUE PER WBEP 5.17 & RIMS B26 '90 1205 376	1 HOWARD CORNWELL
DESIGNER: M.L. CHAPMAN	REVIEWER: R.L. FORESTER		2 S.M. ENRIQUEZ
DATE: 5-17-91	85 E	1-45W600-99-1	3 C.C. LYKE FOR MCB

R.M. JOHNSON FOR WLE

R7

PRINT SIZE F / H — BR OR PROJ AB CE EE ME NE FE HE SE TE BL BF WB SQ

NED DRAWING

CONFIGURATION CONTROL DRAWING

I. PROGRAM

Watts Bar Operator Training

II. COURSES

A. License Training

B. Non-License Training

III. TITLE

Reactor Protection System (RPS)

IV. LENGTH OF LESSON

A.	License Training	6 hours
1.	Non-License Training	6 hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. Explain the purpose of the Reactor Protection System.
X	X	X	X	2. Sketch a basic drawing of the Solid State Protection System.
	X	X	X	3. Describe the actions that take place when a reactor trip is generated at 100% power.
X	X	X	X	4. Identify the functions which rely on ESFAS for initiation.
X	X	X	X	5 Explain how the fire pumps would be affected by an SI signal.
X	X	X	X	6 Briefly describe the inputs to the SSPS.
X	X	X	X	7 Deleted.
X	X	X	X	8 Briefly discuss the input relays, Logic Section and Output Section of the SSPS.
X	X	X	X	9 Explain how the two trains of SSPS are interconnected.
	X	X	X	10 Describe the two ways by which the SSPS opens the Reactor Trip breakers.
X	X	X	X	11 Describe the four basic outputs of the SSPS.
X	X	X	X	12 Explain the purpose of the reactor trip bypass breakers and how their use is made fail safe.

AUO	RO	SRO	STA	
	X	X	X	13 Describe the causes of "General Warning" on SSPS
	X	X	X	14 Identify where "General Warning" indications can be found.
	X	X	X	15 Identify the SSPS equipment which can be tested.
	X	X	X	16 Describe operator actions prior to allowing testing of SSPS train.
X	X	X	X	17 Identify the Reactor trips and give setpoints and list logic required for the Reactor trips.
	X	X	X	18 Given the condition/status of the Reactor Protection system/component and the appropriate sections of Tech Specs, determine if operability requirements are met and what actions, if any, are required.
X	X	X	X	19 Deleted
X	X	X	X	20 Deleted
	X	X	X	21 Deleted

39. 013 K4.19 039

Given the following:

- Unit 1 has been shutdown for a refueling outage.
- GO-6, "Unit Shutdown from Hot Standby to Cold Shutdown," is in progress.
- The lowest RCS Tcold temperature and pressure trend is:

Time	Temp	Pressure
0500	349°F	395 psig
0530	337°F	380 psig
0600	324°F	345 psig
0630	302°F	340 psig
0700	280°F	340 psig
0730	257°F	340 psig
0800	235°F	340 psig
0830	214°F	340 psig
0900	199°F	330 psig
0930	185°F	330 psig

Which ONE of the following is the earliest of the identified times that one of the Centrifugal Charging Pumps is required to be tagged with its breaker racked down and the reason for the requirement?

	Time	Reason
A.	0600	to be in compliance with TR 3.1.3 - Charging Pump, Shutdown.
B.✓	0600	to be in compliance with LCO 3.4.12 - Cold Overpressure Mitigation System.
C.	0900	to be in compliance with TR 3.1.3 - Charging Pump, Shutdown.
D.	0900	to be in compliance with LCO 3.4.12 - Cold Overpressure Mitigation System.

DISTRACTOR ANALYSIS:

A. Incorrect, Plausible because 0600 is the correct time and because TR-3.1.3 does address having one Centrifugal Charging Pump but it is not to limit the number to one pump. It is to ensure there is at least one pump operable.

B. Correct, One of the Centrifugal Charging Pumps is required to be made inoperable and tagged with a Hold Order prior to the lowest Tcold dropping below 325°F (which happens at 0600) and the reason is to be in compliance with the COMs Tech Spec in order to prevent over-pressurizing the RCS.

C. Incorrect, Plausible because there is a four hour allowance to make the pump inoperable after entering Mode 4 and the four hour window does expire at 0900; but the 4 hours is only applicable if the lowest Tcold is maintained at 325°F or higher. Also plausible because TR-3.1.3 does address having one Centrifugal Charging Pump but it is not to limit the number to one pump. It is to ensure there is at least one pump operable.

D. Incorrect, Plausible because there is a four hour allowance to make the pump inoperable after entering Mode 4 and the four hour window does expire at 0900; but the 4 hours is only applicable if the lowest Tcold is maintained at 325°F or higher. Also plausible because the reason being to comply with the COMs Tech Spec in order to prevent over-pressurizing the RCS is correct.

Question Number: 39

Tier: 2 **Group:** 1

K/A: 013 K4.19
Engineered Safety Features Actuation System (ESFAS)
Knowledge of ESFAS design feature(s) and/or interlock(s) which provide for the following:
Reason for opening breaker on high-head injection pump

Importance Rating: 3.0* / 3.4*

10 CFR Part 55: 41.7

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of the why one high head injection pump is required to have its breaker open and placed in a non-operating position.

Technical Reference: GO-6, Unit Shutdown From Hot Standby To Cold Shutdown, Revision 0047

Technical Reference: GO-6, Unit Shutdown From Hot Standby To Cold Shutdown, Revision 0047
Tech Spec LCO 3.4.12, Cold Overpressure Mitigation System, Amendment 55
Tech Requirement TR-3.1.3, Charging Pump, Shutdown, Revision 38

Proposed references to be provided: None

Learning Objective: 3-OT-GO0600
3. Discuss the major steps for taking the unit from Hot Standby to Cold Shutdown per GO-6.

Cognitive Level:
- **Higher** X
- **Lower** ___

Question Source:
- **New** ___
- **Modified Bank** X
- **Bank** ___

Question History: WBN bank question GO0600.03 012 modified for the WBN 10/2011 NRC exam.

Comments:

Date________ **INITIALS**

5.4 Unit Cooldown to Between 330 and 340°F (continued)

CAUTION

In Mode 4, at least two RCPs shall be in operation when the Rod Control System is capable of rod withdrawal, and at least one RCP or RHR Pump in operation when Rod Control System is **NOT** capable of rod withdrawal (TS 3.4.6).[C.3]

[10] **WHEN** RCS temperature reaches 350°F, **PERFORM** the following:

[10.1] **LOG** Mode 4 entry in the Operator's Narrative Log. ________

[10.2] **ANNOUNCE** entry into Mode 4 using Plant P/A system. ________

CAUTION

In Mode 4, 5 or 6 with the Reactor Vessel head on, the Cold Overpressure System (COPS) shall be operable with a maximum of one Charging Pump and no SI Pumps capable of injecting into the RCS, and the accumulators isolated (T.S. 3.4.12).

DISTRACTOR:
0900 would be 4 hour

[10.3] **WITHIN** 4 hours after entering MODE 4 from MODE 3, AND before the temperature of one or more RCS CL dropping below 325°F, **THEN**

CORRECT

PERFORM the following:

[10.3.1] **PLACE** ONE CCP handswitch in PULL-TO-LOCK (**N/A** pump to remain in service):

NOMENCLATURE	POSITION	UNID	PERF INITIALS
CCP A-A (ECCS)	P-T-L	1-HS-62-108A	
CCP B-B (ECCS)	P-T-L	1-HS-62-104A	

Date________ **INITIALS**

5.4 Unit Cooldown to Between 330 and 340°F (continued)

[10.3.2] **PLACE** both SI Pumps handswitches in PULL-TO-LOCK:

NOMENCLATURE	POSITION	UNID	PERF INITIALS
SI PMP A (ECCS)	P-T-L	1-HS-63-10A	
SI PMP B (ECCS)	P-T-L	1-HS-63-15A	

[10.3.3] **ISSUE** Hold Order on SI Pumps and disabled CCP. ________

[10.3.4] **IF** only one PORV is available for purposes of complying with LCO 3.4.12, **THEN**

ENSURE RHR suction relief valve is available to serve as the second relief valve (in addition to the PORV) to meet LCO 3.4.12 (COMS). ________

[10.4] **DISABLE** alarm windows 85F and 124E for RVLIS USING SOI-55.01 in accordance with OPDP-4. ________

[10.5] **ENSURE** Instrument Maintenance (IM) PERFORMS the following within 12 hours after the unit has been 350°F or less (**N/A** if completed in last 31 days):

A. 1-SI-68-192 COMPLETE. ________

B. 1-SI-68-193 COMPLETE. ________

CORRECT LCO

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.12 Cold Overpressure Mitigation System (COMS)

LCO 3.4.12 A COMS System shall be OPERABLE with a maximum of one charging pump and no safety injection pump capable of injecting into the RCS and the accumulators isolated and either a or b below.

a. Two RCS relief valves, as follows:

1. Two power operated relief valves (PORVs) with lift settings within the limits specified in the PTLR, or

2. One PORV with a lift setting within the limits specified in the PTLR and the RHR suction relief valve with a setpoint ≥ 436.5 psig and ≤ 463.5 psig.

b. The RCS depressurized and an RCS vent capable of relieving > 475 gpm water flow.

---NOTES---

1. Two charging pumps may be made capable of injecting for less than or equal to one hour for pump swap operations.

2. Accumulator may be unisolated when accumulator pressure is less than the maximum RCS Pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in the PTLR.

APPLICABILITY: MODES 4 and 5,
MODE 6 when the reactor vessel head is on.

ACTIONS

-----NOTE-----
LCO 3.0.4.b is not applicable when entering MODE 4.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more safety injection pumps capable of injecting into the RCS.	A.1 Initiate action to verify no safety injection pumps are capable of injecting into the RCS.	Immediately
B. Two or more charging pumps capable of injecting into the RCS.	B.1 Initiate action to verify a maximum of one charging pump is capable of injecting into the RCS.	Immediately
C. An accumulator not isolated when the accumulator pressure is greater than or equal to the maximum RCS pressure for existing cold leg temperature allowed in the PTLR.	C.1 Isolate affected accumulator.	1 hour

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action and associated Completion Time of Condition C not met.	D.1 Increase RCS cold leg temperature to > 350°F. OR D.2 Depressurize affected accumulator to less than the maximum RCS pressure for existing cold leg temperature allowed in the PTLR.	12 hours 12 hours
E. One required RCS relief valve inoperable in MODE 4.	E.1 Restore required RCS relief valve to OPERABLE status.	7 days
F. One required RCS relief valve inoperable in MODE 5 or 6.	F.1 Restore required RCS relief valve to OPERABLE status.	24 hours
G. Two required RCS relief valves inoperable. OR Required Action and associated Completion Time of Condition A, B, D, E, or F not met. OR COMS inoperable for any reason other than Condition A, B, C, D, E, or F.	G.1 Depressurize RCS and establish RCS vent.	8 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.12.1	Verify no safety injection pumps are capable of injecting into the RCS.	Within 4 hours after entering MODE 4 from MODE 3 prior to the temperature of one or more RCS cold legs decreasing below 325°F. AND 12 hours thereafter
SR 3.4.12.2	Verify a maximum of one charging pump is capable of injecting into the RCS.	Within 4 hours after entering MODE 4 from MODE 3 prior to the temperature of one or more RCS cold legs decreasing below 325°F. AND 12 hours thereafter
SR 3.4.12.3	Verify each accumulator is isolated.	12 hours

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.4.12.4	---------------------------NOTE--------------------------- Only required to be performed when complying with LCO 3.4.12.b. -- Verify RCS vent open.	12 hours for unlocked open vent paths AND 31 days for locked open vent paths
SR 3.4.12.5	Verify PORV block valve is open for each required PORV.	72 hours
SR 3.4.12.6	Verify both RHR suction isolation valves are locked open with operator power removed for the required RHR suction relief valve.	31 days
SR 3.4.12.7	---------------------------NOTE--------------------------- Required to be met within 12 hours after decreasing RCS cold leg temperature to ≤ 350°F. -- Perform a COT on each required PORV, excluding actuation.	31 days
SR 3.4.12.8	Perform CHANNEL CALIBRATION for each required PORV actuation channel.	18 months

DISTRACTOR

TR 3.1 REACTIVITY CONTROL SYSTEMS

TR 3.1.3 Charging Pump, Shutdown

TR 3.1.3 One charging pump in the boron injection flow path required by TR 3.1.1 shall be OPERABLE and capable of being powered from an OPERABLE emergency power source.

APPLICABILITY: MODES 4, 5, and 6.

--NOTE--

For Mode 4, Technical Specification LCO 3.0.4.b is not applicable to ECCS high head (centrifugal charging) subsystem.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Required charging pump inoperable. OR Required charging pump not capable of being powered by an OPERABLE emergency power source.	A.1 Suspend CORE ALTERATIONS. AND A.2 Suspend positive reactivity additions.	Immediately Immediately

TECHNICAL SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
TSR 3.1.3.1	Verify required charging pump's developed head at the test flow point is $\geq$ the required developed head.	In accordance with Inservice Testing Program

GO0600.03 012

WBN Bank Question

Given the following plant conditions;

- The Unit is being cooled down in preparation for a refueling outage per GO-6, Unit Shutdown From Hot Standby To Cold Shutdown.

Which of the following is when GO-6 will direct both SI pump hand switches be placed in Pull to Lock, and the associated breakers tagged?

a.✓ Before any RCS Cold Leg temperature drops below 325°F.

b. After RCS Tavg drops below 325°F.

c. Within 4 hours after RCS temperature reaches 325°F.

d. Before any RCS Cold Leg temperature drops below 350°F.

The correct answer is A

I. PROGRAM

Watts Bar Operator Training

II. COURSE

License Training
Non-License Training

III. TITLE

GO-6, Unit Shutdown From Hot Standby to Cold Shutdown

IV. LENGTH OF LESSON

License Training	3 Hours
Non-License Training	3 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
	X	X	X	1. Explain the reason for each Precaution and Limitation listed in GO-6.
	X	X	X	2. Briefly state the reason for borating the Reactor Coolant System (RCS) prior to cooldown. State the limits for the Reactor Coolant System /Pressurizer (PZR) ΔC_B and explain the preferred method for equalizing the RCS/PZR C_B.
	X	X	X	3. Discuss the major steps for taking the unit from Hot Standby to Cold Shutdown per GO-6.
	X	X	X	4. State the precautions and operating requirements for the Reactor Coolant Pumps (RCPs) when performing a cooldown to Cold Shutdown per GO-6.
	X	X	X	5. Describe the manual block and automatic reset of the "Low PZR Pressure SI" at <1970 (P-11).

V. TRAINING OBJECTIVES (Continued)

AUO	RO	SRO	STA	
	X	X	X	6. Identify the cooldown/heatup limits for the RCS and PZR, and given plant conditions, use the cooldown, heatup, and pressure limitations curves to determine that the plant is operating within limits.
	X	X	X	7. State the limit and basis on ΔT between the Pressurizer Spray Nozzle and fluid.
	X	X	X	8. State what conditions must exist in order to place Residual Heat Removal (RHR) in service during cooldown per GO-6.
	X	X	X	9. Describe the precautions and basis on solid water Residual Heat Removal operations.
	X	X	X	10. Discuss the operation of 1-PCV-62-81 to maintain RCS pressure and Letdown flow when in a solid water condition.

VI. TRAINING AIDS

A. Marker Board and Markers
B Multimedia/Overhead projector(s)

VII. MATERIALS

A. Attachments

Attachment 1 - GO-6, Unit Shutdown From Hot Standby To Cold Shutdown
Attachment 2 - [INPO SOER 94-2, Boron Dilution Events in PWRs.]
Attachment 3 - 1-SI-68-44, RCS Pressure/Temperature Limits
Attachment 4 - WBN PERs 77176, 77699, 79910

40. 022 K4.05 040

Given the following:

- Unit 1 was operating at 100% power when a design basis LOCA occurred.

Which ONE of the following identifies systems directly providing Containment Cooling during the first minute following the Phase B containment isolation?

A.✓ Containment Spray and Ice Condenser

B. Air Return Fans and Containment Spray

C. Containment Ventilation System and Ice Condenser

D. Air Return Fans and Containment Ventilation System

DISTRACTOR ANALYSIS:

A. Correct, both the containment spray and the ice condenser will be providing containment cooling during the first minute after a Phase B isolation resulting from a design basis LOCA. Containment Spray starts at the Phase B setpoint of 2.8 psid and the ice doors open due to differential pressure between upper and lower containment.

B. Incorrect, Plausible because the containment spray providing cooling during the first minute is correct and while the Air Return Fans do provide cooling during a design basis LOCA by forcing air recirculation between upper and lower containment, they do not start until 9 minutes after the accident.

C. Incorrect, Plausible because while the containment ventilation systems do cool the containment during normal operations, they are tripped during a design basis LOCA and because the Ice Condenser providing cooling during the first minute is correct.

D. Incorrect, Plausible because while the Air Return Fans do provide cooling during a design basis LOCA by forcing air recirculation between upper and lower containment, they do not start until 9 minutes after the accident and the containment ventilation systems do cool the containment during normal operations, but are tripped during a design basis LOCA.

Question Number: 40

Tier: 2 **Group:** 1

K/A: 022 K4.05

K/A: 022 K4.05
Containment Cooling System (CCS)
Knowledge of CCS design feature(s) and/or interlock(s) which provide for the following:
Containment cooling after LOCA destroys ventilation ducts

Importance Rating: 2.6* / 2.7

10 CFR Part 55: 41.7

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because a design basis LOCA could damage the ventilation duct work in lower containment and the question requires knowledge of the design features (systems) that would provide containment cooling immediately following the accident initiation.

Technical Reference: N3-30RB-4002, Reactor Building Ventilation System, Revision 0022
N3-61-4001, Ice Condenser System, Revision 0018
WBN FSAR Amendment 8

Proposed references to be provided: None

Learning Objective: 3-OT-SYS061A

1. State the design basis of the Ice Condenser System in accordance with FSAR section 6.7.
2. State the function of the Ice Condenser System in accordance with the system description.

3-OT-SYS072A

01. Explain the design basis of the Containment Spray System in accordance with FSAR section 6.2.2.

Cognitive Level:

Higher ____
Lower X

Question Source:

New ____
Modified Bank X
Bank ____

Question History: Surry bank question used on the 2003 exam modified for use on WBN 10/2011 exam.

Comments:

3.1.2 Containment Air Cooling System (CACS) (continued)

Standby CRDM coolers may be operated to supplement lower compartment cooling. In this case, a damper downstream of the CRDM will be closed and a damper allowing lower compartment air to enter the CRDM cooler will be opened. Normally the dampers are in the opposite position.

The UCC system includes four fan-coil units located in the upper compartment at El 801.69. Each unit consists of a plenum, three air cooling coils, vaneaxial fan, instruments and controls. (See Ref. 7.1.3)

The upper containment air is recirculated and cooled during normal reactor operation. The system is designed for three of the four UCCs to operate with one on standby. (See Ref. 7.1.3)

Thermocouples (considered part of the ERCW system), sense return air temperature and provide input to the temperature indicating controllers to modulate valves in the ERCW lines of each cooler. Coolers ERCW flow is controlled to maintain the air temperatures below 120°F in the lower compartment and 110°F in the upper compartment.

The instrument room cooling system consists of two 100% capacity air conditioning systems. Each system includes a serviceable, hermetically packaged water chilling unit and chilled water circulating pump in the auxiliary building penetration room El 692, a fan-coil unit with supply ductwork located in the instrument room, chilled water piping and circulating pump with containment isolation valves, instruments, and controls (for details see 3.2.1l).

The minimum required wall thicknesses for the chilled water piping are established in Ref. 7.4.7. This calculation accounts for corrosion/erosion and manufacturing tolerances.

Piping inside and outside containment has been evaluated for breaks and no requirements for leak detection in chilled water piping have been identified (Ref. 7.4.40).

Each chilled water penetration through containment is provided with two isolation globe valves, one located inside and one outside containment. These valves are pneumatic-cylinder operated and are designed to close fail safe within time limits specified in Ref. 7.2.4.

3.1.3 Containment Air Return System

The containment air return system includes two 100% capacity fans, located in equipment spaces outside of the crane wall, each of which exhaust air from individual ductwork and a common hydrogen collection header. The fans exhaust air from the upper compartment into the accumulator rooms in the lower compartment.

The air return fans are designed to start automatically after 9±1 minutes following a Phase B containment isolation signal (Ref. 7.4.42). Each fan is a direct-drive vaneaxial type with a design capacity of 41,690 cfm (Ref. 7.1.3).

3.1.3 Containment Air Return System (continued)

Both fans can be started manually, or automatically upon receiving the containment isolation signal, drawing air from the containment dome, from the reactor cavities, and from the ten dead-ended (pocketed) spaces in containment where there is potential for the accumulation of hydrogen. The ten dead-ended spaces are the four steam generator enclosures, the pressurizer enclosure, the four accumulator spaces and the instrument room. Each fan will mix 1,690 cfm (Ref. 7.1.3) from the enclosed areas in the lower compartment to the general lower compartment atmosphere to prevent excessive localized hydrogen build-up following a MSLB or LOCA.

For hydrogen concentration limits inside containment see Ref. 7.2.17.

Air recirculated by the fans will flow into the lower compartment through the annular equipment areas and ports provided for pressure equalization. The air, along with any steam produced by the accident will leave the lower compartment through the ice condenser doors where the steam will be condensed for as long as sufficient ice remains.

The air return system also includes heavy-duty backdraft dampers to prevent back flow from the lower compartment to the upper compartment under a differential pressure of 15 psig (Ref. 7.4.43). The dampers are counterbalanced to open when the differential pressure across the fan is such that flow from the upper to the lower compartment is assured. The dampers are normally closed (with no airflow). (See Ref. 7.2.10 for details.)

Ductwork associated with the fans consists of hydrogen collectors from the reactor cavity, the containment dome, shared collection headers from the lower compartment, the pressurizer compartment, and the steam generator compartments.

3.1.4 Containment Vent System

The containment venting, for continuous pressure relief, is performed during modes 1-5, by opening the containment isolation (CI) valves FCV-30-40 and -37. This allows continuous venting of containment air into the Annulus through one of the Containment Vent Air Cleanup Units (CVACU)s, which are equipped with HEPA and charcoal filters. The airflow from containment into the Annulus is provided by the motive force of the differential pressure between the containment and the Annulus. This air mixes with the Annulus atmosphere before the AVC fan discharges it into the AB exhaust stack via the suction-side duct of the AB FHA exhaust fans. As an alternate to using the normal vent pathway, for containment pressure relief, either the pair of lower compartment purge lines (one supply and one exhaust), or one of the two pairs of upper compartment purge lines (one supply and one exhaust) may be used. The use of these alternate lines may require re-balancing of the supply duct airflow, as needed, to preclude a containment pressure rise. When an upper, or the lower, compartment purge line is used, the Containment Vent System must be isolated.

The Containment Vent System shall be isolated, during mode 6, by closing the valves FCV-30-40 and FCV-30-37 (Refer to subSection 4.20).

3.2 Component Description

3.2.1 Major Component Description

Note: The following is vendor data which describe the performance characteristics for

3.2.1 Major Component Description (continued)

major system components. For more detailed information and component requirements, the appropriate contract should be referenced. The information included in this section shall be updated upon any modification, addition, or replacement of existing equipment. The data represent the manufacturers' rated capacities and not to be construed as required design values. Refer to Section 3.1 and Table 9.6 for design values.

A. Purge Supply Fans

TVA Contract No.	-	76K35-83246-1
Manufacturer	-	H. K. Porter Company, Incorporated
Capacity	-	14,000 cfm at 9.5" Static Pressure
Type	-	Belt-Driven Centrifugal
Motor	-	50 hp
Seismic	-	Category I

B. Purge Exhaust Fans

TVA Contract No.	-	76K35-83246-1
Manufacturer	-	H. K. Porter Company, Incorporated
Capacity	-	14,000 cfm at 10.75" Static Pressure
Type	-	Belt-Driven Centrifugal
Motor	-	50 hp
Seismic	-	Category I

C. Purge Filter Assembly

TVA Contract No.	-	74C37-83103
Manufacturer	-	Cryenco, Division of CTI
Prefilter Section	-	40% Efficiency, NBS Dust Spot Method 0.2" Pressure Drop; Functional at temperatures up to 500°F, withstand gamma dose of 109 rads
High-Efficiency Filters	-	99.97% Efficiency. 0.30-Micron Hot DOP Test, 1.0" Pressure Drop
Carbon Absorber Section	-	99.95% Efficiency, Removal of Elemental Iodine; 1.0" Pressure Drop; Ignition temperature 620°F; withstand gamma dose of 109 rads
ACU Pressure Drop	-	2.2" clean, 4.7" dirty (Ref. 7.4.14)
Air Flow Rate	-	14,000 cfm
Seismic	-	Category I

D. Butterfly Isolation Valves

TVA Contract No.	-	76K51-83264-1
Manufacturer	-	Posi-Seal International, Incorporated

1.0 SUMMARY

The Ice Condenser System (ICS) is designed to absorb thermal energy released in the event of a loss-of-coolant accident (LOCA) or a high energy line break (HELB), for the purpose of limiting the peak pressure in the containment (CNTMT). The ICS will limit CNTMT pressure to below its design pressure for all pipe break sizes up to and including a double-ended severance[1]. A sodium tetraborate solution produced by ice-melt helps absorb and retain iodine released during an accident and serves as neutron absorber and a heat transfer medium for cooling of the reactor core following the postulated accident. In the event of LOCA or HELB, the ice-melt solution serves as a heat sink for lower CNTMT as it breaks into droplets during the free fall from the ICS floor drain to the sump. Thus, the ICS plays no role in the normal operation of the plant, but serves only to mitigate the consequences of a LOCA or HELB.

The ICS is designed to provide a flow passage between the lower compartment holding the reactor coolant system (RCS) and the upper CNTMT compartment during accident conditions, and to act as a static, insulated cold storage compartment during normal operation.

It consists of three parts: lower plenum, ice bed, and upper plenum (see Figure 1). The lower plenum consists of lower inlet doors which swing in during a LOCA or HELB to allow steam to enter the ice condenser, the ice condenser floor, the lower support structure, and turning vanes which change the direction of the steam 90° to direct it upward to the ice bed.

The ice bed is a mass of sodium tetraborate ice stored in cylindrical ice baskets located between the lower and upper plenums, and over a 300° arc between the CNTMT vessel wall and crane wall. Steam flows through and is condensed on the ice bed.

The upper plenum consists of both intermediate and top deck doors, both of which open in a LOCA or HELB. Also located in the upper plenum are the air handling units (AHUs) which keep the ice condenser area cooled.

Auxiliary subsystems are provided to make and load borated ice for initial inventory and subsequent maintenance, and to provide refrigeration to remove heat associated with the various functions, such as the making, conveying, and storage of ice. Figure 2 shows a simplified flow diagram of the system, from initial filling of the system with the glycol to the deposition of the ice in the ice baskets.

The system description is based on general information provided by Ref. 7.I.I through 7.I.15, 7.5.4 through 7.5.11, and 7.2.20.

2.0 DESIGN CRITERIA

2.1 Functions

2.1.1 Safety Functions

A. Design Basis Events (DBEs)

The ICS shall be required to mitigate the DBEs defined below and in WB-DC-40-64 (Ref. 7.2.18)

6.2 CONTAINMENT SYSTEMS

6.2.1 Containment Functional Design

6.2.1.1 Design Bases

6.2.1.1.1 Primary Containment Design Bases

The containment is designed to assure that an acceptable upper limit of leakage of radioactive material is not exceeded under design basis accident conditions. For purposes of integrity, the containment may be considered as the containment vessel and containment isolation system. This structure and system are directly relied upon to maintain containment integrity. The emergency gas treatment system and Reactor Building function to keep out-leakage minimal (the Reactor Building also serves as a protective structure), but are not factors in determining the design leak rate.

The containment is specifically designed to meet the intent of the applicable General Design Criteria listed in Section 3.1. This section, Chapter 3, and other portions of Chapter 6 present information showing conformance of design of the containment and related systems to these criteria.

The ice condenser is designed to limit the containment pressure below the design pressure for all reactor coolant pipe break sizes up to and including a double-ended severance. Characterizing the performance of the ice condenser requires consideration of the rate of addition of mass and energy to the containment as well as the total amounts of mass and energy added. Analyses have shown that the accident which produces the highest blowdown rate into a condenser containment will result in the maximum containment pressure rise; that accident is the double-ended guillotine or split severance of a reactor coolant pipe. The design basis accident for containment analysis based on sensitivity studies is therefore the double-ended guillotine severance of a reactor coolant pipe at the reactor coolant pump suction. Post-blowdown energy releases can also be accommodated without exceeding containment design pressure.

The functional design of the containment is based upon the following accident input source term assumptions and conditions:

1. The design basis blowdown energy of 346.3 x 10^6 Btu and mass of 549.7 x 10^3 lb put into the containment (See Section 6.2.1.3.6).

2. A core power of 3459 MWt (plus 0.6% allowance for calorimetric error) (See Section 6.2.1.3.6).

3. The minimum engineered safety features are (i.e., the single failure criterion applied to each safety system) comprised of the following:

   a. The ice condenser which condenses steam generated during a LOCA, thereby limiting the pressure peak inside the containment (see Section 6.7).

   b. The containment isolation system which closes those fluid penetrations not serving accident-consequence limiting purposes (see Section 6.2.4).

   c. The containment spray system which sprays cool water into the containment atmosphere, thereby limiting the pressure peak (particularly in the long term - see Section 6.2.2).

   d. The emergency gas treatment system (EGTS) which produces a slightly negative pressure within the annulus, thereby precluding out-leakage and relieving the post-accident thermal expansion of air in the annulus (see Section 6.5.1).

   e. The air return fans which return air to the lower compartment (See Section 6.8).

Consideration is given to subcompartment differential pressure resulting from a design basis accident discussed in Sections 3.8.3.3, 6.2.1.3.9, and 6.2.1.3.4. If a design basis accident were to occur due to a pipe rupture in these relatively small volumes, the pressure would build up at a faster rate than in the containment, thus imposing a differential pressure across the wall of these structures.

Parameters affecting the assumed capability for post-accident pressure reduction are discussed in Section 6.2.1.3.3.

Three events that may result in an external pressure on the containment vessel have been considered:

1. Rupture of a process pipe where it passes through the annulus.

2. Inadvertent air return fan operation during normal operation.

3. Inadvertent containment spray system initiation during normal operation.

The design of the guard pipe portion of hot penetrations is such that any process pipe leakage in the annulus is returned to the containment. All process piping which has potential for annulus pressurization upon rupture is routed through hot penetrations. Section 6.2.4 discusses hot penetrations.

Inadvertent air return fan operation during normal operation opens the ice condenser lower inlet doors, which in turn, results in sounding an alarm in the MCR.

The logic and control circuits of the containment spray system are such that inadvertent containment spray would not take place with a single failure. The spray pump must start and the isolation valve must open before there can be any spray. In addition, the Watts Bar containment is so designed that even if an inadvertent spray occurs, containment integrity is preserved without the use of a vacuum relief.

The containment spray system is automatically actuated by a hi-hi containment pressure signal from the solid state protection system (SSPS). To prevent inadvertent automatic actuation, four comparator outputs, one from each protection set are processed through two coincidence gates. Both coincidence gates are required to have at least two high inputs before the output relays, which actuate the containment spray system, are energized. Separate output relays are provided for the pump start logic and discharge valve open logic. Additional protection is provided by an interlock between the pump and discharge valve, which requires the pump to be running before the discharge valve will automatically open.

Section 3.8.2 describes the structural design of the containment vessel. The containment vessel is designed to withstand a net external pressure of 2.0 psi. The containment vessel is designed to withstand the maximum expected net external pressure in accordance with ASME Boiler and Pressure and Vessel Code Section III, paragraph NE-7116.

6.2.1.2 Primary Containment System Design

The containment consists of a containment vessel and a separate Shield Building enclosing an annulus. The containment vessel is a freestanding, welded steel structure with a vertical cylinder, hemispherical dome, and a flat circular base. The Shield Building is a reinforced concrete structure similar in shape to the containment vessel. The design of these structures is described in Section 3.8.

The design internal pressure for the containment is 13.5 psig, and the design temperature is 250°F. The design basis leakage rate is 0.25 weight percent/24 hr. The design methods to assure integrity of the containment internal structures and sub-compartments from accident pressure pulses are described in Section 3.8.

6.2.1.3 Design Evaluation

6.2.1.3.1 Primary Containment Evaluation

1. The leaktightness aspect of the secondary containment is discussed in Section 6.2.3. The primary containment's leaktightness does not depend on the operation of any continuous monitoring or compressor system. The leak testing of the primary containment and its isolation system is discussed in Section 6.2.6.

2. The acceptance criteria for the leaktightness of the primary containment are such that at containment design pressure, there is a 25% margin between the acceptable maximum leakage rate and the maximum permissible leakage rate.

6.2.1.3.2 General Description of Containment Pressure Analysis

The time history of conditions within an ice condenser containment during a postulated loss of coolant accident can be divided into two periods for calculation purposes:

1. The initial reactor coolant blowdown, which for the largest assumed pipe break occurs in approximately 10 seconds.

2. The post blowdown phase of the accident which begins following the blowdown and extends several hours after the start of the accident.

During the first few seconds of the blowdown period of the reactor coolant system, containment conditions are characterized by rapid pressure and temperature transients. It is during this period that the peak transient pressures, differential pressures, temperature and blowdown loads occur. To calculate these transients a detailed spatial and short time increment analysis was necessary. This analysis was performed with the Transient Mass Distribution (TMD) computer code with the calculation time of interest extending up to a few seconds following the accident initiation (See Section 6.2.1.3.4).

Physically, tests at the ice condenser Waltz Mill test facility have shown that the blowdown phase represents that period of time in which the lower compartment air and a portion of the ice condenser air are displaced and compressed into the upper compartment and the remainder of the ice condenser. The containment pressure at or near the end of blowdown is governed by this air compression process. The containment compression ratio calculation is described in Section 6.2.1.3.4.

Containment pressure during the post blowdown phase of the accident is calculated with the LOTIC code which models the containment structural heat sinks and containment safeguards systems.

6.2.1.3.3 Long-Term Containment Pressure Analysis

Early in the ice condenser development program it was recognized that there was a need for modeling of long-term ice condenser containment performance. It was realized that the model would have to have capabilities comparable to those of the dry containment (COCO) model. These capabilities would permit the model to be used to solve problems of containment design and optimize the containment and safeguards systems. This has been accomplished in the development of the LOTIC code[1].

The model of the containment consists of five distinct control volumes; the upper compartment, the lower compartment, the portion of the ice bed from which the ice has melted, the portion of the ice bed containing unmelted ice, and the dead ended compartments. The ice condenser control volume with unmelted ice is further subdivided into six subcompartments to allow for maldistribution of break flow to the ice bed.

The conditions in these compartments are obtained as a function of time by the use of fundamental equations solved through numerical techniques. These equations are solved for three distinct phases in time. Each phase corresponds to a distinct physical characteristic of the problem. Each of these phases has a unique set of simplifying assumptions based on test results from the ice condenser test facility. These phases are the blowdown period, the depressurization period, and the long term.

The most significant simplification of the problem is the assumption that the total pressure in the containment is uniform. This assumption is justified by the fact that after the initial blowdown of the reactor coolant system, the remaining mass and energy released from this system into the containment are small and very slowly changing. The resulting flow rates between the control volumes will also be relatively small. These small flow rates then are unable to maintain significant pressure differences between the compartments.

SURRY BANK QUESTION

..022K4.05.1 | 3/14/2003

Surry 1 | **Exam Level** R

Mark Question | Print Record | New Search | Exit

Question

Which one of the following systems directly provides Containment Cooling during the first minute following a design basis LOCA?

Answer: Containment Spray System.

Distracter 1 Service Water System.

Distracter 2 Containment Ventilation System.

Distracter 3 Recirc Spray flowing through at least 2 RSHX's.

Distracter Analysis:

Answer: C. Correct the Containment Spray System cools and depressurizes containment during a DBLOCA.

Distracter 1: A. Incorrect, SW cools the RSHX's but containment is cooled by 45 degree RWST water from the Containment Spray System.

Distracter 2: B. Incorrect, containment ventilation cools the containment during normal operations but not during a DBLOCA.

Distracter 3: D. Incorrect, The Recirc spray system aids in cooling the containment but it is designed to provide for core cooling after a DBLOCA.

I. PROGRAM

Watts Bar Operator Training

II. COURSES

CERTIFICATION
NOTP
LICENSED OPERATOR REQUAL
AUO REQUAL

III. TITLE

Ice Condenser System

IV. LENGTH OF LESSON

Certification	1.5 hours
Non-Licensed Training	2 hours
NOTP	2.0 HOURS

LICENSED OPERATOR AND AUO REQUAL TIMES WILL BE DETERMINED WHEN OBJECTIVES ARE IDENTIFIED

V. TRAINING OBJECTIVES

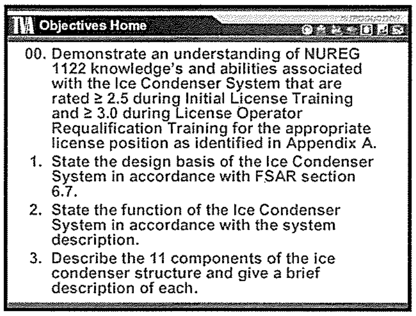
AUO	RO	SRO	STA	
X	X	X	X	1. State the design basis of the Ice Condenser System in accordance with FSAR section 6.7.
X	X	X	X	2. State the function of the Ice Condenser System in accordance with the system description.
X	X	X	X	3. Describe the 11 components of the ice condenser structure and give a brief description of each.
X	X	X	X	4. Discuss the ice condenser drains, include how they are sealed and where they drain.
X	X	X	X	5. Sketch a profile of the ice condenser and indicate how steam flow will be directed from lower containment to upper containment.
X	X	X	X	6. Describe the ice condenser doors and state at what pressures they open.
X	X	X	X	7. Discuss which doors in the ice condenser have position indication.

AUO	RO	SRO	STA	
X	X	X	X	8. Describe the ice condenser instrumentation, as outlined in this lesson plan, and give two locations where ice condenser temperatures can be read.
X	X	X	X	9. Describe how the ice condenser is cooled; include the temperature range and areas that have cooling coils.
X	X	X	X	10. Describe the glycol chiller; include power supply, logic and capacity.
X	X	X	X	11. State the glycol chiller outlet temperature.
X	X	X	X	12. State the purpose of the glycol circulation system.
X	X	X	X	13. List and describe all the major components in the glycol system.
X	X	X	X	14. Discuss the normal arrangement of the 6 glycol pumps and chillers.
X	X	X	X	15. Describe the glycol pumps; include power supply, logic and capacity.
X	X	X	X	16. Describe the logic for the glycol containment isolation valves.
X	X	X	X	17. Given a loss of instrument air/control power, determine the effect on the following valve: a. FCV-61-194
X	X	X	X	18. Discuss what provisions have been made for glycol expansion after the glycol system is isolated from the containment.
X	X	X	X	19. Explain how glycol is added to the glycol system.
X	X	X	X	20. Describe how the glycol system and the ice system interface.
X	X	X	X	21. Explain how to place a glycol pump in service.
X	X	X	X	22. Discuss how to place a glycol chiller in service.
X	X	X	X	23. List the checks to be made on a glycol chiller that is in service.

AUO	RO	SRO	STA	
	X	X	X	24. Regarding Technical Specifications and Technical Requirements for this system: a. Identify the conditions and required actions with completion time of one hour or less. b. Explain the Limiting Conditions for Operation, Applicability, and Bases. c. Given a status/set of plant conditions, apply the appropriate Technical Specifications and Technical Requirements.
	X	X	X	25. Correctly locate control room controls and indications associated with the Ice Condenser System, including: a. Ice Condenser Lower Inlet Door Monitor b. Ice Bed Temperature Monitor

1 INTRODUCTION

SLIDES 2-7



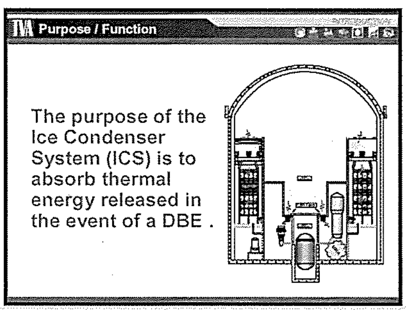
NOTE: Objectives 21-23 should be addressed during review of operating procedures.

Learning Goals

1. Preview learning objectives.
   - To develop the knowledge, skills and ability to operate the Ice Condenser System (ICS) in a safe and efficient manner.
2. Discuss the purpose and scope of the ICS system lesson.
3. Discuss the importance of the ICS system to plant operation.

OBJECTIVE 2

SLIDE 8



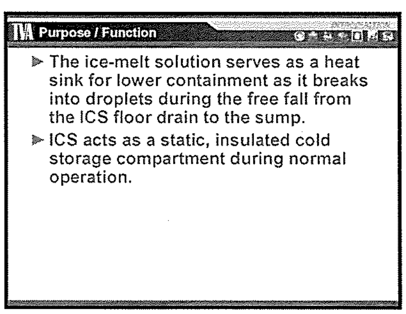
Introduction

Purpose and Function

Discuss the functions of the Ice Condenser system (ICS).

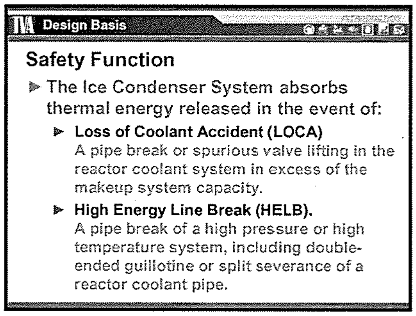
- The purpose of the ICS is to absorb thermal energy released in the event of a DBE.

SLIDE 9



- The ice-melt solution serves as a heat sink for lower containment as it breaks into droplets during the free fall from the ICS floor drain to the sump.
- ICS acts as a static, insulated cold storage compartment during normal operation.

SLIDE 10

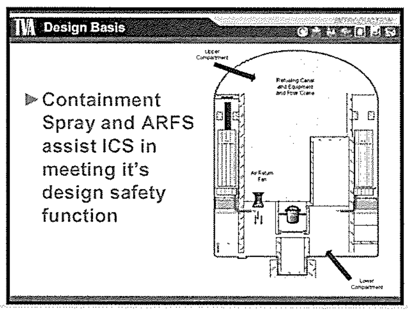


Safety Function

4. Discuss the safety function provided by the ICS system.

- The Ice Condenser System absorbs thermal energy released in the event of:
    - Loss of Coolant Accident (LOCA)
      A pipe break or spurious valve lifting in the reactor coolant system in excess of the makeup system capacity.
    - High Energy Line Break (HELB).
      A pipe break of a high pressure or high temperature system, including double-ended guillotine or split severance of a reactor coolant pipe.

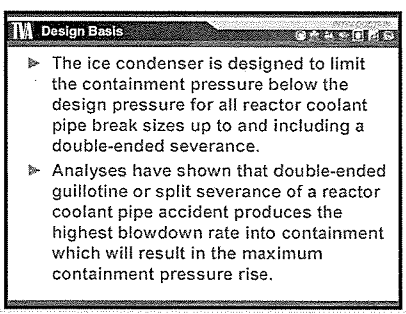
SLIDE 11



- Containment Spray and ARFS assist ICS in meeting its design safety function.

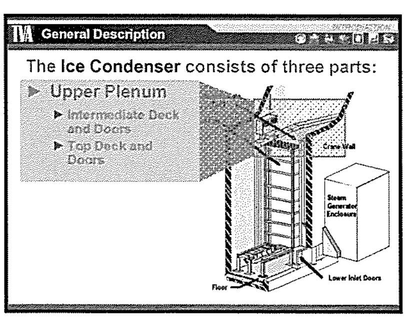
OBJECTIVE 1

SLIDE 12



- The ice condenser is designed to limit the containment pressure below the design pressure for all reactor coolant pipe break sizes up to and including a double-ended severance.
- Analyses have shown that double-ended guillotine or split severance of a reactor coolant pipe accident produces the highest blow down rate into containment which will result in the maximum containment pressure rise.

SLIDE 13



General Description

1. Discuss the three main parts of the ice condenser.

- Upper Plenum.
    - Intermediate Deck and Doors.
    - Top Deck and Doors.

I. PROGRAM

A. Watts Bar Operator Training

II. COURSES

A. License Training

B. NOTP

C. License Requalification

D. AUO Requalification

III. TITLE

A. Containment Spray System

IV. IV. LENGTH OF LESSON

A. License Training 2 Hour

B. NOTP 4 Hours

License Requalification and AUO Requalification times will be determined after objectives are identified.

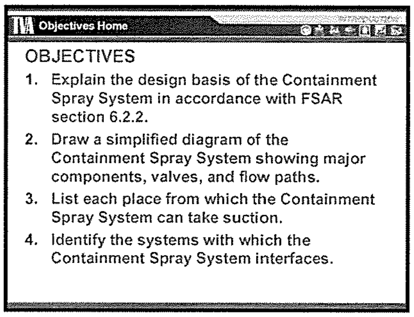
V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	01. Explain the design basis of the Containment Spray System in accordance with FSAR section 6.2.2.
X	X	X	X	02. Draw a simplified diagram of the Containment Spray System showing major components, valves, and flow paths.
X	X	X	X	03. List each place from which the Containment Spray System can take suction.
X	X	X	X	04. Identify the systems with which the Containment Spray System interfaces.
X	X	X	X	05. Describe the Containment Spray Pumps, include power supply, logic, capacity and type.
X	X	X	X	06. Describe the auto start signals for the Containment Spray Pump room coolers.
X	X	X	X	07. Describe the Containment Spray Heat Exchanger.
	X	X	X	08. Describe the logic (interlocks) on the Containment Spray suction, discharge header, and containment sump valves.
X	X	X	X	09. Identify the power supplies to the major valves of the Containment Spray System.
X	X	X	X	10. Describe the auto operation of the Containment Spray mini-flow valves.
				11. Deleted.
X	X	X	X	12. Describe the auto action that must be verified after each Containment Spray Pump breaker operation.

AUO	RO	SRO	STA	
	X	X	X	13. Regarding Technical Specifications and Technical Requirements for this system: a. Identify the conditions and required actions with completion time of one hour or less. b. Explain the Limiting Conditions for Operation, Applicability, and Bases. c. Given a status/set of plant conditions, apply the appropriate Technical Specifications and Technical Requirements.
X	X	X	X	14. Describe the in plant location of the following: a. Containment Spray Pumps b. Containment Spray Hx's c. Containment Spray Header d. Containment Spray Pumps RWST Suction e. Containment Spray Pumps Sump f. Containment Spray Pump Mini flow g. Containment Spray System Test Line Flow Indicator h. RHR Spray Hdr Isolation MOV's i. Containment's two 14 inch Drain Lines Between Upper and Lower Containment
	X	X	X	15. Correctly locate all control room controls and indications associated with the Containment Spray System.
	X	X	X	16. Given a set of plant conditions, determine the correct response of the Containment Spray System.
	X	X	X	17. Deleted.
X	X	X	X	18. Describe how corrosion is controlled in the Containment Spray system during lay-up.
X	X	X	X	19. Identify the basis, requirements and interlocks required to place the RHR spray in service.
	X	X	X	20. Explain Tech Spec bases for Containment Spray components and parameters governed by Tech Specs.

1 INTRODUCTION

SLIDES 2-6



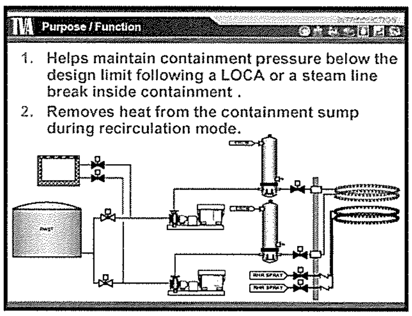
NOTE: Objectives 14, 15 and 16 are global objectives that are covered throughout this lesson.

Learning Goals

1. Preview learning objectives.
   - Brief statement to cue the instructor on the scope of the objectives. Example as follows:
   - To develop the knowledge, skills and ability to operate the Containment Spray System (CSS) system in a safe and efficient manner.

SLIDE 7

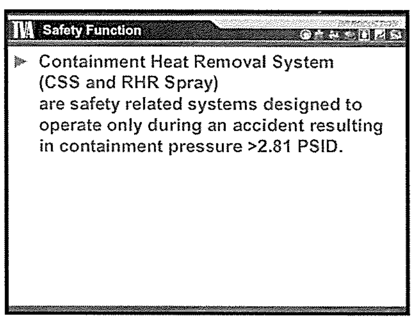
OBJECTIVE 1



Purpose / Function

1. Discuss the functions of the purpose and function of the CSS.
   - Helps maintain containment pressure below the design limit following a LOCA or a steam line break inside containment.
   - Removes heat from the containment sump during recirculation mode.

SLIDE 8

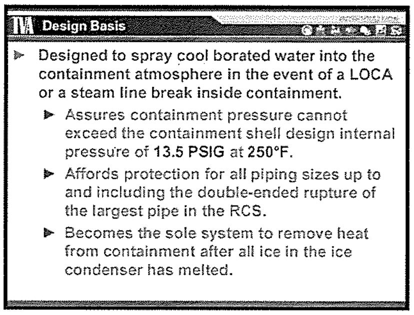


Safety Function

1. Discuss the Safety Function associated with the CS system.
   - Containment Heat Removal System (CSS and RHR Spray) are safety related systems designed to operate only during an accident resulting in containment pressure >2.81 PSID.

SLIDE 9

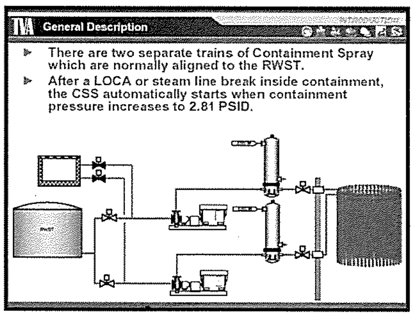
OBJECTIVE 1



Design Basis

1. Discuss the design basis of the CSS system.
   - Designed to spray cool borated water into the containment atmosphere in the event of a LOCA or a steam line break inside containment.
     - Assures containment pressure cannot exceed the containment shell design internal pressure of 13.5 PSIG at 250°F.
     - Affords protection for all piping sizes up to and including the double-ended rupture of the largest pipe in the RCS.
     - Becomes the sole system to remove heat from containment after all ice in the ice condenser has melted.

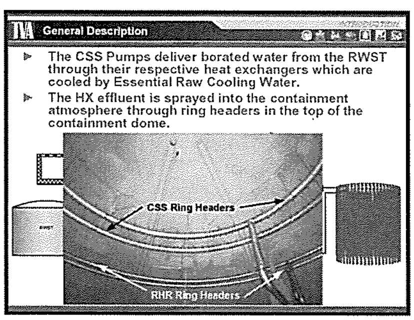
SLIDE 10



General Description

1. Overview the basic function of the CSS system the conditions that initiate a spray actuation and the system response.
   - There are two separate trains of Containment Spray which are normally aligned to the RWST.
   - After a LOCA or steam line break inside containment, the CSS automatically starts when containment pressure increases to 2.81 PSID.

SLIDE 11



- The CSS Pumps deliver borated water from the RWST through their respective heat exchangers which are cooled by Essential Raw Cooling Water.
- The HX effluent is sprayed into the containment atmosphere through ring headers in the top of the containment dome.

41. 025 A4.01 041

Given the following:

- Unit 1 is operating at 100% power when a LOCA occurs.
- A Safety Injection has been actuated.
- Containment pressure is 1.1 psig and slowly rising.

Which ONE of the following identifies the expected position of 1-FCV-61-110, GLYCOL COOLED FLOOR RETURN HEADER ISOL?

A.✓ CLOSED due to a containment isolation signal.

B. CLOSED due to an Auxiliary Building isolation signal.

C. OPEN unless the containment pressure rises to Hi-Hi setpoint.

D. OPEN unless Glycol Storage Tank level reaches Lo-Lo setpoint.

DISTRACTOR ANALYSIS:

A. Correct because the valve should be closed due to the safety injection signal actuating a Phase A containment isolation which automatically closes the valve.

B. Incorrect, Plausible because an isolation signal generated from the safety injection signal did close the valve but it is the containment isolation not the Auxiliary Building isolation (both of which are generated when a safety Injection occurs) and the most of the glycol system is located in the Aux Building.

C. Incorrect, Plausible because as the containment pressure continues to rise a Phase B isolation will occur at 2.8 psig. This signal closes other valves. Also plausible because the current containment pressure is below the HI containment pressure setpoint (1.5 psig).

D. Incorrect, Plausible because there are valves that automatically close when the Glycol Expansion tank reaches a Lo-Lo level. (e.g. 1-FCV-61-193B).

Question Number: 41

Tier: 2 **Group** 1

K/A: 025 A4.01
Ice Condenser System
Ability to manually operate and/or monitor in the control room:
Ice condenser isolation valves

Importance Rating: 3.0* / 2.7*

10 CFR Part 55: 41.7 / 45.5 to 45.8

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the ability to determine the expected position of a valve in the ice condenser glycol flow path during off-normal plant conditions.

Technical Reference: 1-47W611-63-1 R13
1-47W611-61-2 R6
1-47W611-88-1 R24
1-47w611-30-6 R13

Proposed references to be provided: None

Learning Objective: 3-OT-SYS061A
16. Describe the logic for the glycol containment isolation valves.

Cognitive Level:
- **Higher** X
- **Lower**

Question Source:
- **New** X
- **Modified Bank**
- **Bank**

Question History: New question for the WBN 10-2011 NRC exam

Comments:

I. PROGRAM

Watts Bar Operator Training

II. COURSES

CERTIFICATION
NOTP
LICENSED OPERATOR REQUAL
AUO REQUAL

III. TITLE

Ice Condenser System

IV. LENGTH OF LESSON

Certification	1.5 hours
Non-Licensed Training	2 hours
NOTP	2.0 HOURS

LICENSED OPERATOR AND AUO REQUAL TIMES WILL BE DETERMINED WHEN OBJECTIVES ARE IDENTIFIED

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. State the design basis of the Ice Condenser System in accordance with FSAR section 6.7.
X	X	X	X	2. State the function of the Ice Condenser System in accordance with the system description.
X	X	X	X	3. Describe the 11 components of the ice condenser structure and give a brief description of each.
X	X	X	X	4. Discuss the ice condenser drains, include how they are sealed and where they drain.
X	X	X	X	5. Sketch a profile of the ice condenser and indicate how steam flow will be directed from lower containment to upper containment.
X	X	X	X	6. Describe the ice condenser doors and state at what pressures they open.
X	X	X	X	7. Discuss which doors in the ice condenser have position indication.

AUO	RO	SRO	STA	
X	X	X	X	8. Describe the ice condenser instrumentation, as outlined in this lesson plan, and give two locations where ice condenser temperatures can be read.
X	X	X	X	9. Describe how the ice condenser is cooled; include the temperature range and areas that have cooling coils.
X	X	X	X	10. Describe the glycol chiller; include power supply, logic and capacity.
X	X	X	X	11. State the glycol chiller outlet temperature.
X	X	X	X	12. State the purpose of the glycol circulation system.
X	X	X	X	13. List and describe all the major components in the glycol system.
X	X	X	X	14. Discuss the normal arrangement of the 6 glycol pumps and chillers.
X	X	X	X	15. Describe the glycol pumps; include power supply, logic and capacity.
X	X	X	X	16. Describe the logic for the glycol containment isolation valves.
X	X	X	X	17. Given a loss of instrument air/control power, determine the effect on the following valve: a. FCV-61-194
X	X	X	X	18. Discuss what provisions have been made for glycol expansion after the glycol system is isolated from the containment.
X	X	X	X	19. Explain how glycol is added to the glycol system.
X	X	X	X	20. Describe how the glycol system and the ice system interface.
X	X	X	X	21. Explain how to place a glycol pump in service.
X	X	X	X	22. Discuss how to place a glycol chiller in service.
X	X	X	X	23. List the checks to be made on a glycol chiller that is in service.

AUO	RO	SRO	STA	
	X	X	X	24. Regarding Technical Specifications and Technical Requirements for this system: a. Identify the conditions and required actions with completion time of one hour or less. b. Explain the Limiting Conditions for Operation, Applicability, and Bases. c. Given a status/set of plant conditions, apply the appropriate Technical Specifications and Technical Requirements.
	X	X	X	25. Correctly locate control room controls and indications associated with the Ice Condenser System, including: a. Ice Condenser Lower Inlet Door Monitor b. Ice Bed Temperature Monitor

42. 026 A1.06 042
Which ONE of the following describes the auto start logic for the Containment Spray Pump room cooler?

A. ONLY auto start is when the Containment Spray pump starts.

B. ONLY auto start is when the room temperature increases to 95°F.

C✓ Will auto start when either the Containment Spray pump starts or the room temperature increases to 95°F.

D. Will auto start when room temperature increases to 95°F ONLY if the Containment Spray pump is running.

DISTRACTOR ANALYSIS:

A. Incorrect, Plausible because the cooler does start when pump starts but also starts when room temp increases to 95°F.

B. Incorrect, Plausible because the cooler does start when room temp increases to 95°F, but also starts on pump start.

C. Correct, Logic for auto start of the containment spray pump room cooler is the pump starting or the room temperature increasing to 95°F.

D. Incorrect, Plausible because the start of the pump and the temperature are starting conditions for the room cooler but it is either, not both. The logic is 'OR' not 'AND'.

Question Number: 42

Tier: 2 **Group** 1

K/A: 026 A1.06
Containment Spray System (CSS)
Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CSS controls including:
Containment spray pump cooling

Importance Rating: 2.7 / 3.0

10 CFR Part 55: 41.5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the ability to predict the changes in Containment Spray Pump cooling associated with operating the CSS system and controls.

Technical Reference: 1-45W760-72-1 R13
1-45W760-30-19 R9

Proposed references to be provided: None

Learning Objective: 3-OT-SYS072A
06. Describe the auto start signals for the Containment Spray Pump room coolers.

Cognitive Level:
- **Higher** ___
- **Lower** X

Question Source:
- **New** ___
- **Modified Bank** ___
- **Bank** X

Question History: SQN bank question with the correct answer relocated.

Comments:

SUN BANK QUESTION

026 A1.06 043

Which ONE of the following describes the auto start logic for the Containment Spray room cooler?

A. Only auto starts when the associated pump starts.

B. Only auto start is on increasing room temperature at 95°F.

C. Only auto starts when room temperature increases to 95°F with the associated pump running.

D✓ Only auto starts when associated pump starts OR when room temperature increases to 95°F.

I. PROGRAM

A. Watts Bar Operator Training

II. COURSES

A. License Training

B. NOTP

C. License Requalification

D. AUO Requalification

III. TITLE

A. Containment Spray System

IV. IV. LENGTH OF LESSON

A. License Training 2 Hour

B. NOTP 4 Hours

License Requalification and AUO Requalification times will be determined after objectives are identified.

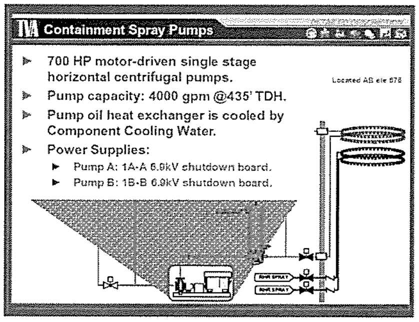
V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	01. Explain the design basis of the Containment Spray System in accordance with FSAR section 6.2.2.
X	X	X	X	02. Draw a simplified diagram of the Containment Spray System showing major components, valves, and flow paths.
X	X	X	X	03. List each place from which the Containment Spray System can take suction.
X	X	X	X	04. Identify the systems with which the Containment Spray System interfaces.
X	X	X	X	05. Describe the Containment Spray Pumps, include power supply, logic, capacity and type.
X	X	X	X	06. Describe the auto start signals for the Containment Spray Pump room coolers.
X	X	X	X	07. Describe the Containment Spray Heat Exchanger.
	X	X	X	08. Describe the logic (interlocks) on the Containment Spray suction, discharge header, and containment sump valves.
X	X	X	X	09. Identify the power supplies to the major valves of the Containment Spray System.
X	X	X	X	10. Describe the auto operation of the Containment Spray mini-flow valves.
				11. Deleted.
X	X	X	X	12. Describe the auto action that must be verified after each Containment Spray Pump breaker operation.

AUO	RO	SRO	STA	
	X	X	X	13. Regarding Technical Specifications and Technical Requirements for this system: a. Identify the conditions and required actions with completion time of one hour or less. b. Explain the Limiting Conditions for Operation, Applicability, and Bases. c. Given a status/set of plant conditions, apply the appropriate Technical Specifications and Technical Requirements.
X	X	X	X	14. Describe the in plant location of the following: a. Containment Spray Pumps b. Containment Spray Hx's c. Containment Spray Header d. Containment Spray Pumps RWST Suction e. Containment Spray Pumps Sump f. Containment Spray Pump Mini flow g. Containment Spray System Test Line Flow Indicator h. RHR Spray Hdr Isolation MOV's i. Containment's two 14 inch Drain Lines Between Upper and Lower Containment
	X	X	X	15. Correctly locate all control room controls and indications associated with the Containment Spray System.
	X	X	X	16. Given a set of plant conditions, determine the correct response of the Containment Spray System.
	X	X	X	17. Deleted.
X	X	X	X	18. Describe how corrosion is controlled in the Containment Spray system during lay-up.
X	X	X	X	19. Identify the basis, requirements and interlocks required to place the RHR spray in service.
	X	X	X	20. Explain Tech Spec bases for Containment Spray components and parameters governed by Tech Specs.

SLIDE 16

OBJECTIVE 5

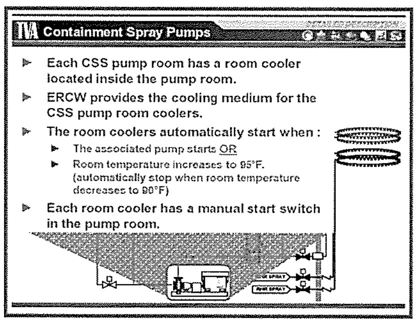


Containment Spray Pumps

1. Discuss the design parameters associated with the CS pumps.
   - 700 HP motor-driven single stage horizontal centrifugal pumps.
   - Pump capacity: 4000 gpm @435' TDH.
   - Pump oil heat exchanger is cooled by Component Cooling Water.
   - Power Supplies:
     - Pump A: 1A-A 6.9kV shutdown board.
     - Pump B: 1B-B 6.9kV shutdown board.

SLIDE 17

OBJECTIVE 6

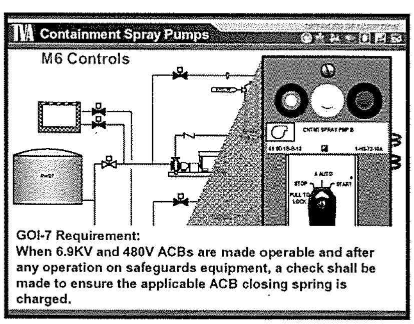


2. Describe the function and operation of the CS pump room coolers
   - Each CSS pump room has a room cooler located inside the pump room.
   - ERCW provides the cooling medium for the CSS pump room coolers.
   - The room coolers automatically start when :
     - The associated pump starts <u>OR</u>
     - Room temperature increases to 95°F. (automatically stop when room temperature decreases to 90°F)
   - Each room cooler has a manual start switch in the pump room.

OE – Link to OE homepage and discuss Wolf Creek OE 17667, Foreign Material in CS Room Cooler Event.

SLIDE 18

OBJECTIVE 12



3. Discuss the MCR controls associated with the CSS Pumps and the GOI-7 requirements for checking the closing spring on 6.9KV and 480V ACBs.
   - When 6.9KV and 480V ACBs are made operable and after any operation on safeguards equipment, a check shall be made to ensure the applicable ACB closing spring is charged.

43. 026 A4.05 043
Given the following:

- Containment spray pumps are running after automatically starting during a LOCA.

- Containment pressure has dropped and the procedure directs the pumps be stopped.

Which ONE of the following identifies the <u>minimum</u> signals required to be reset to allow the Containment Spray pumps to remain off when their control switches are returned to 'A AUTO' after the pumps are stopped?

A.✓ Containment Spray, only

B. Phase B and Containment Spray, only

C. Safety Injection and Containment Spray, only

D. Safety Injection, Phase B and Containment Spray

<u>DISTRACTOR ANALYSIS:</u>

A. Correct, In accordance with the references, the minimum actions required to stop Containment Spray pumps and place them in AUTO is to reset the Containment Spray signal.

B. Incorrect, Plausible because the Phase B is a signal required to be reset once it has been actuated and it would be actuated with the conditions in the question, however, only the Containment Spray signal is required to be reset to allow the spray pumps to be removed.

C. Incorrect, Plausible because Safety Injection is a signal required to be reset once it has been actuated and it would be actuated with the conditions in the question, however, only the Containment Spray signal is required to be reset to allow the spray pumps to be removed.

D. Incorrect, Plausible because Safety Injection and Phase B are signals that are required to be reset once they have been actuated and both would be actuated with the conditions in the question, however only the Containment Spray signal is required to be reset to allow the spray pumps to be removed.

Question Number: 43

Tier: 2 **Group** 1

K/A: 026 A4.05
Containment Spray System (CSS)
Ability to manually operate and/or monitor in the control room:
Containment spray reset switches

Importance Rating: 3.5 / 3.5

10 CFR Part 55: 41.7 / 45.5 to 45.8

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the ability to operate the switches required to allow the containment spray pumps to be stopped and placed in AUTO after starting due to a accident signal.

Technical Reference: 1-47W611-72-1 R8
1-47W611-88-1 R24
E-1, Loss of Reactor or Secondary Coolant,
Revision 0016

Proposed references to be provided: None

Learning Objective: 3-OT-SYS072A
05. Describe the Containment Spray Pumps, include power supply, logic, capacity and type.
16. Given a set of plant conditions, determine the correct response of the Containment Spray System.

Cognitive Level:
Higher ____
Lower __X__

Question Source:
New ____
Modified Bank ____
Bank __X__

Question History: Turkey point question 026 A4.05 9 (used on a Turkey Point Audit exam) in 2008 changed to make applicable to WBN but not significantly modified.

Comments:

Step	Action/Expected Response	Response Not Obtained
9.	**DETERMINE** if cntmt spray should be stopped:	
	a. **MONITOR** cntmt pressure less than 2.0 psig.	a. **WHEN** cntmt pressure is less than 2.0 psig, **THEN** **PERFORM** Substeps 9b thru e.
	b. **CHECK** at least one cntmt spray pump RUNNING.	b. **IF** both spray pumps stopped, **THEN** ** **GO TO** Step 10.
	c. **RESET** cntmt spray signal.	
	d. **STOP** cntmt spray pumps, **AND** **PLACE** in A-AUTO.	
	e. **CLOSE** cntmt spray discharge valves 1-FCV-72-2 and 1-FCV-72-39.	
10.	**ENSURE** both pocket sump pumps STOPPED [M-15]:	**PLACE** breakers OFF for pumps that fail to stop:
	• 1-HS-77-410.	• 480V AB Com MCC A compt 2C.
	• 1-HS-77-411.	• 480V AB Com MCC A compt 5A.

Q #43 026A4.05

A LOCA caused Containment pressure to increase to 21 psig.

Which ONE of the following identifies the minimum actions required to stop Containment Spray pumps and place them in Standby?

Reset:

A. Phase B lockout relays.

B. SI and reset Phase B lockout relays.

C. Containment Spray.

D. SI and reset Containment Spray.

NOTE:

LOCA:	Loss of Coolant Accident
SI:	Safety Injection
Psig:	pounds per square inch gauge

I. PROGRAM

A. Watts Bar Operator Training

II. COURSES

A. License Training

B. NOTP

C. License Requalification

D. AUO Requalification

III. TITLE

A. Containment Spray System

IV. IV. LENGTH OF LESSON

A. License Training 2 Hour

B. NOTP 4 Hours

License Requalification and AUO Requalification times will be determined after objectives are identified.

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	01. Explain the design basis of the Containment Spray System in accordance with FSAR section 6.2.2.
X	X	X	X	02. Draw a simplified diagram of the Containment Spray System showing major components, valves, and flow paths.
X	X	X	X	03. List each place from which the Containment Spray System can take suction.
X	X	X	X	04. Identify the systems with which the Containment Spray System interfaces.
X	X	X	X	05. Describe the Containment Spray Pumps, include power supply, logic, capacity and type.
X	X	X	X	06. Describe the auto start signals for the Containment Spray Pump room coolers.
X	X	X	X	07. Describe the Containment Spray Heat Exchanger.
	X	X	X	08. Describe the logic (interlocks) on the Containment Spray suction, discharge header, and containment sump valves.
X	X	X	X	09. Identify the power supplies to the major valves of the Containment Spray System.
X	X	X	X	10. Describe the auto operation of the Containment Spray mini-flow valves.
				11. Deleted.
X	X	X	X	12. Describe the auto action that must be verified after each Containment Spray Pump breaker operation.

AUO	RO	SRO	STA	
	X	X	X	13. Regarding Technical Specifications and Technical Requirements for this system: a. Identify the conditions and required actions with completion time of one hour or less. b. Explain the Limiting Conditions for Operation, Applicability, and Bases. c. Given a status/set of plant conditions, apply the appropriate Technical Specifications and Technical Requirements.
X	X	X	X	14. Describe the in plant location of the following: a. Containment Spray Pumps b. Containment Spray Hx's c. Containment Spray Header d. Containment Spray Pumps RWST Suction e. Containment Spray Pumps Sump f. Containment Spray Pump Mini flow g. Containment Spray System Test Line Flow Indicator h. RHR Spray Hdr Isolation MOV's i. Containment's two 14 inch Drain Lines Between Upper and Lower Containment
	X	X	X	15. Correctly locate all control room controls and indications associated with the Containment Spray System.
	X	X	X	16. Given a set of plant conditions, determine the correct response of the Containment Spray System.
	X	X	X	17. Deleted.
X	X	X	X	18. Describe how corrosion is controlled in the Containment Spray system during lay-up.
X	X	X	X	19. Identify the basis, requirements and interlocks required to place the RHR spray in service.
	X	X	X	20. Explain Tech Spec bases for Containment Spray components and parameters governed by Tech Specs.

44. 039 K5.08 044

Given the following plant conditions:

- At EOL, a reactor startup is in progress following a 6-day outage.

- The Reactor Engineer has provided an ECP which predicts the reactor going critical at 120 steps on Control Bank D.

Which ONE of the following conditions will result in the critical rod height being HIGHER than the value predicted by the ECP?

A. A dilution of 500 gallons is performed.

B. Feedwater flow is increased to all SGs due to a controller malfunction.

C. Steam Dump Controller 1-PIC-1-33 fails, resulting in a steam pressure decrease of 50 psig.

D.✔ An improperly performed step in the Post Maintenance Test procedure results in the closure of all MSIVs.

DISTRACTOR ANALYSIS:

A. Incorrect, A dilution results in a positive reactivity addition. This causes the critical rod height to be lower than the ECP.

B. Incorrect, An increase in feedwater flow results in a drop in RCS temperature. The drop in RCS temperature results in a positive reactivity addition. This causes critical rod height to be lower than the ECP.

C. Incorrect, A drop in pressure resulting from the failure of 1-PIC-1-33 causes a drop in RCS temperature. The drop in RCS temperature results in a positive reactivity addition. This causes critical rod height to be lower than the ECP.

D. Correct, The closure of the MSIVs results in an increase in steam pressure, and causes the SG PORVs to lift. This results in an increase in RCS temperature, which results in a negative reactivity addition. This causes critical rod height to be HIGHER than the ECP.

Question Number: 44

Tier: 2 **Group** 1

K/A: 039 K5.08
Main and Reheat Steam System (MRSS)
Knowledge of the operational implications of the following concepts as the apply to the MRSS:
Effect of steam removal on reactivity

Importance Rating: 3.6 / 3.6

10 CFR Part 55: 41.5 / 45.7

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the knowledge of how changing steam flow (e.g. SG PORVs vs Steam Dump setpoints) affects Tavg and how that change in Tavg affects reactivity.

Technical Reference: GO-2, Reactor Startup, Revision 0039
3-OT-GO0200, Revision 7

Proposed references to be provided: None

Learning Objective: 3-OT-GO0200
8. Given conditions indicative of an erroneous Estimated Critical Position (ECP) calculation during the initial pull to critical, describe what steps should be taken by the operator and why.

3-OT-SIP1100
2. Describe the six variables which affect the Estimated Critical Condition.

Cognitive Level:
Higher X
Lower ____

Question Source:
New ____
Modified Bank ____
Bank X

Question History: WBN Bank question 039 K5.08 044

Comments:

Date________ Initials_____

5.3 Reactor Startup (continued)

NOTE

T_{AVG} will vary as a function of reactor power until the unit is greater than 15% turbine load (C5) and the T_{avg} program is maintained by AUTO or manual rod control. The TAVG-TREF deviation alarm is expected as reactor power approaches 7% RTP.

[31] **(ρ) ADJUST** Control Rods or RCS C_B to RAISE Reactor power, at a rate of less than 1 dpm, to between 1 and 4%. _________

CAUTION

IF AFW is controlling levels in one or more SGs, THEN Reactor power must be maintained within AFW capability (less than 4% power).

[32] **STABILIZE** Reactor power between 1 and 4%: _________

[32.1] **MAINTAIN** RCS Steam Dumps in Pressure Mode, set at 84% (1092 psig.), or SG PORVs set at 84%. _________

[32.2] **(ρ) FOLLOW** Xenon by Rod movement or Boration to maintain control banks ABOVE the LO INSERTION LIMIT. _________

X. LESSON BODY	INSTRUCTOR NOTES
12. CHECK Shutdown Banks fully withdrawn, AND CHECK the ROD BANK UPDATE was updated on the ICS Computer (ROD BANK UPDATE is on NSSS Screen).	
13. ENSURE the following are completed as required: • TI-34.04 • 1-SI-47-76 • 1-SI-47-77	
14. ENSURE a member of Operations Management Staff who is NOT a member of the operating crew, is present in the control room during the approach to criticality.	
15. ANNOUNCE Reactor startup over P/A (N/A if previously performed).	
CAUTION 1: Do not exceed +1 DPM.	
CAUTION 2: If the approach to criticality is suspended or delayed the core shall be maintained sufficiently subcritical to avoid inadvertent criticality.	<u>Suggested questions</u>: What parameters and which direction of change would insert positive reactivity? Boron – decrease Xenon – decrease RCS temp – decrease FW flow rate – increase Steaming rate – increase
16. INITIATE Reactor Startup by performing the following: a. INITIATE Inverse Count Rate Ratio monitoring (ICRR). b. RECORD both SR NIS readings for ICRR base counts.	

X. LESSON BODY	INSTRUCTOR NOTES
c. Pzr-RCS C_B difference should be less than or equal to 50 ppm and is maintained by use of Pzr heaters and spray.	For a more dilute Pzr an outsurge would cause a positive reactivity insertion and possible Reactor power change. For a more borated Pzr, an outsurge could cause MTC to go positive at the Beginning-Of-Life (BOL).
d. Reactor Engineering should be contacted for guidance on core operating recommendations during unusual power maneuvers such as startup at End of Life (EOL).	
e. After refueling, NIS indications may be inaccurate until calibrated at higher power levels. NIS calibration procedures will adjust PRM trip setpoints lower than normal to ensure excore detectors protect against an overpower condition.	[SOER 90-3] [Redundant indications of reactor power should be used until confidence is established in the Power Range (PR) indicators.]
• Normally, reduced by 50% or less if startup is after refueling or if activities have occurred which could cause non-conservative NIS response.	GO-2, Section 5.3, Caution prior to Step 6 lists ΔT and Turbine Power as alternate indications of power level.
f. In Mode 2 (less than or equal to 5%), sudden temperature decreases, or C_B changes greater than 10 ppm, should be avoided.	**Objective 2** Reactivity Management Effects
The operator should be alert to secondary steam flow to avoid cooling the RCS below the Minimum Temperature for Criticality of greater than or equal to 555°F, and/or causing a spurious Safety Injection.	**Objective 2** Could cause spurious Safety Injections. T.S. Limit is 551°F while GO-2 requires 555°F to account for inaccuracies.
• A negative moderator temperature coefficient provides more stable reactor operation because it inhibits power changes from continuing in either direction (i.e. increase or decrease).	**Objective 2**

X. LESSON BODY	INSTRUCTOR NOTES
• Normally boron concentration changes should not have a significant affect on the reactor. If counts double, (i.e., halving the shutdown reactivity) it is significant.	**Objective 2**
• Moderator temperature increases at higher boron concentrations may add positive reactivity.	**Objective 2**
• A critical reactor has the capability of heating the moderator suddenly; therefore, a bubble in the Pzr is required to prevent overpressurization of the RCS	**Objective 2**
g. All jumper installation and removal shall be in accordance with 0-PI-OPS-1.1, Jumper Control Process.	
h. In Mode 2, trip function of all Turbine Driven Main Feedwater Pumps (TDMFWP) is required when one or more (TDMFWP) is supplying feedwater to the Steam Generators. Refer to Tech Spec 3.3.2 condition J.	
2. Limitations	
a. In Mode 2 with K_{eff} less than 1.0, or in Mode 3 or 4, Shutdown Margin shall be maintained greater than or equal to 1600 pcm (T.S. 3.1.1).	
b. In Mode 3, at least two RCPs shall be operable with two loops in operation when the Rod Control System is capable of rod withdrawal and at least one RCP in operation when the Rod Control System is not capable of rod withdrawal (T.S. 3.4.5).	
c. SOURCE RANGE HI FLUX AT SHUTDOWN alarm shall be in operation any time the Reactor is shutdown with fuel in the Reactor vessel.	

WBN Bank Question

1. 039 K5.08 044

Given the following plant conditions:

- At EOL, a reactor startup is in progress following a 6-day outage.
- The Reactor Engineer has provided an ECP which predicts the reactor going critical at 120 steps on Control Bank D.

Which ONE of the following conditions will result in the critical rod height being HIGHER than the value predicted by the ECP?

A. A dilution of 500 gallons is performed.

B. Feedwater flow is increased to all SGs due to a controller malfunction.

C. Steam Dump Controller 1-PIC-1-33 fails, resulting in a steam pressure decrease of 50 psig.

D.✓ An improperly performed step in the Post Maintenance Test procedure results in the closure of all MSIVs.

DISTRACTOR ANALYSIS:

A. *Incorrect, A dilution results in a positive reactivity addition. This causes the critical rod height to be lower than the ECP.*

B. *Incorrect, An increase in feedwater flow results in a drop in RCS temperature. The drop in RCS temperature results in a positive reactivity addition. This causes critical rod height to be lower than the ECP.*

C. *Incorrect, A drop in pressure resulting from the failure of 1-PIC-1-33 causes a drop in RCS temperature. The drop in RCS temperature results in a positive reactivity addition. This causes critical rod height to be lower than the ECP.*

D. *Correct, The closure of the MSIVs results in an increase in steam pressure, and causes the SG PORVs to lift. This results in an increase in RCS temperature, which results in a negative reactivity addition. This causes critical rod height to be HIGHER than the ECP.*

I. PROGRAM

WATTS BAR OPERATOR TRAINING

II. COURSE

LICENSE TRAINING
LICENSE REQUAL

III. TITLE

GO-2, REACTOR STARTUP

IV. LENGTH OF LESSON

LICENSE TRAINING 3 Hours

LICENSE OPERATOR REQUAL TIME WILL BE DETERMINED WHEN OBJECTIVES ARE IDENTIFIED.

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
	X	X	X	1. Identify the reason for each prerequisite and precaution discussed in this lesson or provided in GO-2.
	X	X	X	2. Discuss the reactivity management concerns when performing GO-2, Reactor Startup identified in this lesson plan.
	X	X	X	3. State the actions required should an unexplained source range count rate increase occur while performing a reactor startup per GO-2.
	X	X	X	4. Identify the major steps the operator must follow to take the unit from HOT STANDBY (Mode 3) at normal operating temperature and pressure to between 1 and 4% reactor power (Mode 2).
	X	X	X	5. Explain why 0.5 cps is required on the highest reading source range detector prior to pulling the Reactor critical.
	X	X	X	6. [Identify the means/indications used by the Operator to prevent premature criticality during reactor startup SOER 88-2, Rec. 2]

V. TRAINING OBJECTIVES (Continued)

A U O	R O	S R O	S T A	
	X	X	X	7. Explain the actions taken when power level reaches 1.66×10^{-4} % on 1/2 Intermediate Range (IR) monitors.
	X	X	X	8. Given conditions indicative of an erroneous Estimated Critical Position (ECP) calculation during the initial pull to critical, describe what steps should be taken by the operator and why.

VI. TRAINING AIDS

Marker Boards and Markers

VII. MATERIALS

A. Appendix

1. None

B. Attachments, Handouts (Latest Revision) One copy of each of the following for each participant:

1. Attachment 1, GO-2, Reactor Startup
2. Attachment 2, [INPO SOER 88-2, Premature Criticality Events During Reactor Startup] (12 Pages)
3. Attachment 3, Power Point Presentation

I. PROGRAM
Watts Bar Operator Training

II. COURSE
LICENSE TRAINING

III. TITLE
ESTIMATED CRITICAL POSITION

IV. LENGTH OF LESSON
LICENSE TRAINING 2 HOURS

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
	X	X	X	1. Explain why the operator should not rely solely on 1-SI-0-11, "Estimated Critical Position," when taking the reactor critical.
	X	X	X	2. Describe the six variables which affect the Estimated Critical Condition.
	X	X	X	3. Identify the two ways that changes in the Reactor Coolant System Average Temperature are accounted for in the ECP calculation.
	X	X	X	4. Explain how the ECP is derived from the difference in the summations of Reactivity Worths (previous minus estimated).
	X	X	X	5. Identify two ways in which Xenon worth can be determined for both the previous and estimated conditions.
	X	X	X	6. Identify two conditions requiring the ECP to be calculated with a fixed rod control position.
	X	X	X	7. Explain how previous reactor power distributions can effect integral rod worth.
	X	X	X	8. Explain the change in Total Power Defect experienced from BOL to EOL.

VI. TRAINING AIDS

A. Marker Boards and Markers
B. Multimedia/Overhead Projector(s)

45. 059 A3.03 045

Given the following:

- Unit 1 is operating at 550 MWe.
- Operators have placed the second main feed pump in service.
- Annunciator 49-E, MN/STBY FWP SUCTION NPSH LO, alarms.
- The operating crew determines Main Feed Pump Suction pressure to be 120 psig.

Which ONE of the following identifies the action required by the Annunciator Response Instruction?

A. If suction pressure cannot be restored to greater than 250 psig, a turbine trip is required.

B✓ Suction pressure is low and needs to be raised but currently is above the minimum required.

C. Unless suction pressure is restored to greater than 250 psig, a trip of one MFP is required.

D. Unless suction pressure is restored to greater than annunciator 49-E setpoint, a trip of both MFPs is required.

DISTRACTOR ANALYSIS:

A. Incorrect, Plausible because 250 psig is the minimum required MFP suction pressure for loads greater than 600 MWe. If both MFPs were required to be tripped, a turbine trip would be required.

B. Correct, the minimum suction pressure for the MFPs is 100 psig when operating at less than 600 MWe and 250 psig when operating at greater than 600 MWe. With the unit at 550 MWe the pressure is above the minimum required pressure but as evidenced by the alarm, it is lower than normal and needs to be increased.

C. Incorrect, Plausible because if the load had been greater than 600 MWe and suction pressure could not be maintained above 250 psig, a trip of one of the MFP would be required by the ARI.

D. Incorrect, Plausible because both of the main feed water pumps would be required to be tripped if the required minimum suction pressure could not be maintained but this alarm is a differential pressure not the actual suction pressure to the MFPs.

Question Number: 45

Tier: 2 **Group** 1

K/A: 059 A3.03
Main Feedwater (MFW) System
Ability to monitor automatic operation of the MFW, including:
Feedwater pump suction flow pressure

Importance Rating: 2.5 / 2.6

10 CFR Part 55: 41.7 / 45.5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the knowledge of the response to an alarm associated with low MFP suction pressure.

Technical Reference: SOI-2&3.01, Condensate And Feedwater System, Revision 0112
ARI-43-49, CNDS & Condenser, Revision 0013

Proposed references to be provided: None

Learning Objective: 3-OT-SYS003A
14. Evaluate precautions and limitations necessary for operation of the Feedwater System per SOI-2 & 3.01, "CONDENSATE AND FEEDWATER SYSTEM".

Cognitive Level:
Higher X
Lower ___

Question Source:
New X
Modified Bank ___
Bank ___

Question History: New question for the WBN 10-2011 NRC exam

Comments:

49-E

Source	Setpoint	
1-PS-2-129A	100 psid	**MN/STBY FWP SUCTION NPSH LO**

(Page 1 of 2)

NOTE

1-PS-2-129A receives a signal from 1-PM-2-129 which compares MFPs suction (1-PT-2-129, high side) to Heater A2 shell press (1-PT-5-31A, low side).

Probable Cause:

A. Increasing load
B. Loss of Condensate System pumps
C. Associated pump recirc valve open
D. Feedwater heater isolation

Corrective Action:

[1] **MONITOR** MFWP suction press on 1-PI-2-129 [1-M-3].

[2] **ENSURE** the following pumps/flow paths are operating as required by current unit load and plant conditions:

- Hotwell Pumps
- Condensate Demin Pumps
- Condensate Booster Pumps
- No. 7 HDT Pumps
- No. 3 HDT Pumps

[3] **IF** unable to recover suction pressure by restoring required Condensate flow,
THEN
REFER TO AOI-39, RAPID LOAD REDUCTION, to reduce Turbine load.

Continued on next page

49-E

MN/STBY FWP SUCTION NPSH LO

(Page 2 of 2)

Corrective Action: (Continued)

NOTE

The low suction press limits given in the table below are conservative, and allow time for the operator to attempt recovery actions.

[4] **IF** unable to recover suction pressure by restoring required Condensate flow or reducing load, **THEN**
PERFORM the following:

Correct Distracter

Turbine Load	Suction pressure Limit	Action
Less than or equal to 600MW	100 psig	**TRIP** one MFP ** **GO TO** AOI-16
Greater than 600MW	250 psig	**TRIP** one MFP ** **GO** TO AOI-16

References:
1-47W610-2-3
1-47W610-5-1
1-47W611-2-2
AOI-16

3.0 PRECAUTIONS AND LIMITATIONS (continued)

5. A feedwater isolation (FWI) signal will cause the SMFP miniflow valves to fully open. The valves will return to their modulated position on FWI signal reset, or they can be controlled manually. This design change was made to give the miniflow valves a “head start” open signal on FWI to limit the delta pressure transient across the valves for improvement of operation and service life.

6. The following are monitored during Standby MFP operation. Pump is manually tripped if manufacturer’s limit is reached and no auto-trip occurs.

PARAMETER	MANUFACTURER’S LIMIT
Low Suction Press	100 psig (below 50% load) 250 psig (50% load or above)
High Discharge Press	1363 psig
Low Bearing Oil Press	8 psig or less (Auto Trip) 10 psig or less (Auto Trip)
High Bearing Metal Temp	225°For more (Journal & Thrust)

7. If SBMFP vibration is greater than or equal to 5 mils, evaluate Unit load reduction to allow removal of pump from service. If vibration reaches 10 mils, immediately trip the pump.

8. The following guidance may be used to start or stop the SBMFP during hot weather:

NOTE

The “MFPT CONDENSER VACUUM LO” alarm [Window 55-D] comes in at 12.5” Hg vacuum (17.5” HgA). This corresponds to a MFPT condenser drain temperature of ≈185°F.

If the SBMFP is in service due to elevated hotwell and circulating water temperatures, the following guidance may be used to remove the SBMFP from service as water temperatures drop:

The SBMFP may be secured if any of the following conditions exist:

a. Both MFPT condensers are ≤12.5 in. HgA, **OR**

b. Hotwell pump discharge temperature drops to ≤129°F, **OR**

3.0 PRECAUTIONS AND LIMITATIONS (continued)

c. C zone main condenser back pressure drops to ≤ 5.0 in. HgA, **OR**

d. CCW inlet temperature drops to ≤ 87°F (should be secured prior to ≤ 67°F) with all 4 CCW pumps in service, **OR**

e. MFPT Condenser drain temperature ≤171°F.

If the SBMFP is **NOT** in service, the following guidance may be used to place the SBMFP in service as water temperatures rise:

The SBMFP should be placed in service if any of the following conditions exist:

f. Either MFPT condensers are >15.4 in. HgA, **OR**

g. Hotwell pump discharge temperature achieves the maximum allowable condensate polisher inlet temperature of 140°F, **OR**

h. C zone main condenser back pressure achieves the alarm setpoint when operating above 90% power, **OR**

i. Plant power is power limited due to C Zone main condenser back pressure exceeding the associated alarm setpoint, **OR**

j. MFPT Condenser drain temperature >180°F.

9. All jumper installation and removal shall be in accordance with 0-PI-OPS-1.1, Jumper Control Process.

H. MFWPs/MFPTs

1. MFPTs and MFPs Motor, Gear, and Pump Lube systems should be heated to 140 to 160°F oil leaving the bearings before placing RCW in service to the oil coolers. Oil temp alarm is 170°F. This helps limit startup vibration.

2. The MFPT turning gear is **NOT** designed to be "rolled off" like the main turbine. Any action or evolution that could spin the MFP turbine while the turning gear is in operation could result in damage if the turning gear is **NOT** removed from service. Example: Unisolating the manual valves to the HP or LP steam supply.

3. MFP suction press should be kept as low as possible to help prevent exceeding the discharge piping design pressure of 1230 psig. However, short duration disch press up to 1363 psig is acceptable.

I. PROGRAM

Watts Bar Operator Training

II. COURSES

License Training

NOTP

License Requalification

NAUO Requalification

III. TITLE

Main Feedwater System

IV. LENGTH OF LESSON

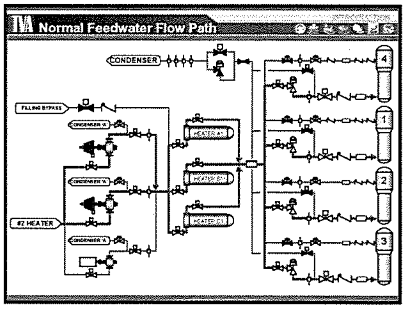
A. License Training 3 Hours
B. NOTP 3 Hours
License Requalification and NAUO Requalification times will be determined after objectives are identified.

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. Describe the purpose of the Feedwater System.
X	X	X	X	2. Describe the flow path per SOI-2 & 3.01, Condensate And Feedwater System, or the lesson body through the feedwater system for the following a. Long Cycle Recirculation b. Normal Alignment
X	X	X	X	3. Describe the Main Feed Pumps as to type, capacity, and steam supply.
X	X	X	X	4. Explain the operation of the Main Feed Pump automatic recirculation valve.
X	X	X	X	5. List the conditions which will cause the main Feed Pumps to automatically trip.
X	X	X	X	6. Describe the MFPT Speed Control Program.
X	X	X	X	7. Describe the Standby Main Feed Pump as to type, capacity, and power supply.
X	X	X	X	8. Explain the operation of the Standby Main Feed Pump automatic recirculation valve.
X	X	X	X	9. Identify the permissives required to be met before the Standby Main Feed Pump can be automatically or manually started.
X	X	X	X	10. Evaluate the conditions that will cause a Standby Main Feed Pump to trip.
X	X	X	X	11. Identify the Feedwater Isolation Signals.

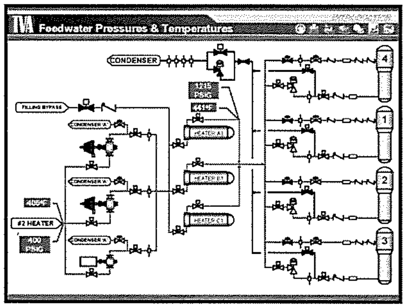
AUO	RO	SRO	STA	
X	X	X	X	12. List the equipment affected by a Feedwater Isolation Signal.
X	X	X	X	13. Describe the three steps to reset FW Isolation Signal.
X	X	X	X	14. Evaluate precautions and limitations necessary for operation of the Feedwater System per SOI-2 & 3.01, "CONDENSATE AND FEEDWATER SYSTEM".
X	X	X	X	15. List the normal, full load condensate pressures and temperatures after each of the major components from the main feed pump suction to the Steam Generators.
X	X	X	X	16. Describe the inplant location of all major pumps, heat exchangers, and valves of the Feedwater system.*
X	X	X	X	17. Deleted. (Objective moved to SYS046A)
X	X	X	X	18. Demonstrate the contrasting differences in Long Cycle De-Aeration and Long Cycle Operation.

*Objective 16 is accomplished during plant walkdowns of the system. The student is responsible for this information.



4. Use the slide to illustrate and discuss the Main Feedwater system Normal Feedwater Flow Path.

SLI



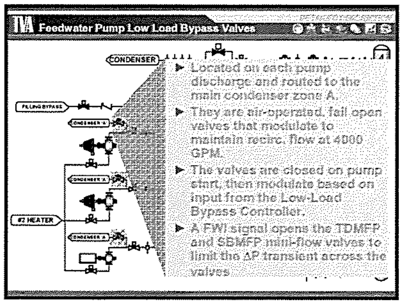
Feedwater Pressures & Temperatures

1. Discuss the normal, full load condensate pressures and temperatures after each of the major components from the main feed pump suction to the Steam Generators.
   - MFP Inlet temperature – approx. 405 °F.
   - MFP Inlet pressure – approx. 400 PSIG.
   - #1 heater outlet temperature – approx. 441 °F.
   - #1 heater outlet pressure – approx. 1215 PSIG.

END OF INTRODUCTION

OBJECTIVE 4

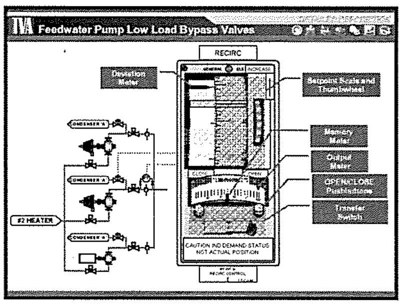
SLIDE 18



Feedwater Pump Low Load Bypass Valves

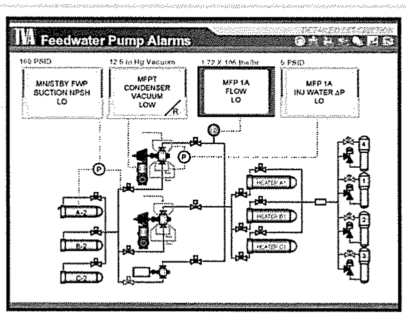
1. Discuss the function and operation of the Feedwater Pump Low Load Bypass Valves.
   - Located on each pump discharge and routed to the main condenser zone A.
   - They are air-operated, fail open valves that modulate to maintain recirc. flow at 4000 GPM.
   - The valves are closed on pump start, then modulate based on input from the Low-Load Bypass Controller.
   - A FWI signal opens the TDMFP and SBMFP mini-flow valves to limit the ΔP transient across the valves

SLIDE 19



2. Discuss the MCR controls associated with the Feedwater Pump Low Load Bypass Valves.

SLIDE 20



3. Discuss the MCR alarms and setpoints associated with the Main Feedwater Pumps. (note 1A pump alarms are listed. Instructor should point out to the students that the 1B pump alarms also exist and that their setpoints are the same as 1A).
   - Annunciator window XA-55-3A, Window 49-E "MN/STBY FWP SUCTION NPSH LO" (100 PSID)
   - Annunciator window XA-55-3B, Window 55-D "MFPT CONDENSER VACUUM LOW" (12.5 in Hg Vacuum)
   - Annunciator windowXA-55-3C, Window 57-A "MFP 1A FLOW LO" (1.72 X 10^6 lbs/hr lowering)
   - Annunciator window XA-55-3B, Window 50-E "MFP 1A INJ WATER ΔP LO" (5 PSID)

46. 061 A3.04 046
Given the following:

- Unit 1 was at 100% power with the TD AFW pump unavailable.
- S/G #2 experiences a steam line break inside containment.
- S/G #2 conditions are as follows:
  - Level is currently 12% WR.
  - Pressure is 80 psig.
- No operator action has been taken on the AFW system.

Which ONE of the following identifies which, if any, Motor Driven AFW level control valves will be closed automatically?

Note: 1-LCV-3-156 is MD AFW PUMP 1A-A SG 2 LEVEL CONTROL
1-LCV-3-156A is SG 2 AUX FEEDWATER 1-LCV-3-156 BYPASS

A.✓ ONLY 1-LCV-3-156

B. ONLY 1-LCV-3-156A

C. Both 1-LCV-3-156 and 1-LCV-3-156A

D. Neither 1-LCV-3-156 nor 1-LCV-3-156

DISTRACTOR ANALYSIS:

A. Correct, 1-LCV-3-156 automatically closes at 500 psig decreasing pressure to protect the MD AFW LCV from cavitation.

B. Incorrect, Plausible if the applicant believes that the 2" bypass line is the line that isolates on low pressure.

C. Incorrect, Plausible because 1-LCV-3-156 does automatically close on lowering pressure and there are conditions that will close both the main and bypass valves in the feedwater system (e.g. high level in the steam generator as well as feedwater isolation automatically closes both valves in the main feedwater system.)

D. Incorrect, Plausible because, while 1-LCV-3-156 does automatically close, the applicant could incorrectly conclude that pressure is not low enough to cause the isolation.

Question Number: 46

Tier: 2 **Group** 1

K/A: 061 A3.04
Auxiliary / Emergency Feedwater (AFW) System
Ability to monitor automatic operation of the AFW, including:
Automatic AFW isolation.

Importance Rating: 4.1 / 4.2

10 CFR Part 55: 41.7 / 45.5

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the knowledge of the automatic setpoints which would isolate portions of the AFW system from the steam generators.

Technical Reference: N3-3B-4002, Auxiliary Feedwater System, Rev. 0016
SOI-3.02, Auxiliary Feedwater, Revision 0049

Proposed references to be provided: None

Learning Objective: 3-OT-SYS003B
22. Identify the initiating signals that swap the Motor Driven Pumps LCV's from normal to the bypass LCV.

Cognitive Level:
- **Higher** X
- **Lower** ___

Question Source:
- **New** X
- **Modified Bank** ___
- **Bank** ___

Question History: New question for the WBN 10-2011 NRC exam

Comments:

3.0 PRECAUTIONS AND LIMITATIONS (continued)

K. After each AFWP start, 6.9kV ACB closing spring must be checked to ensure it is charged.[C.10]

L. An operator with no other duties will be assigned to initiate AFW any time the auto initiation circuits are inoperable. Engineering or Maintenance personnel must notify the Shift Manager (SM) if this condition exists.[C.8]

M. Excessive RCS cooldown is possible when using AFW System.

N. Any time Turbine Driven or Motor Driven AFW Pumps are running, oil level and temperature should be checked frequently. Pumps must be TRIPPED if pump bearing oil temperature exceeds 165°F and cause of overheating determined, and corrected prior to pump resuming operation.

O. Turbine Bearing Oil pressure should be above 15 psig, and Turbine Bearing Oil temperature below 180°F. TD AFW Pump should be TRIPPED if Turbine Bearing Oil Temperature exceeds 200°F.

P. When SGs are above 212°F, backleakage to the AFW system can lead to pump steam binding. AUO rounds require periodic checking of the pumps for this condition. Venting is required until the cause is found and corrected whenever this condition occurs. [C.1, C.2, C.4, C.6, C.7]

Q. 4" LCVs from M-D AFWPs auto close when Feedwater header pressure drops below 500 psig to prevent cavitation damage to LCV.

R. Low flow operation of both motor and turbine driven AFW pumps must be minimized to prevent possible degradation of pump impeller. Main Feedwater System should be utilized for low flow conditions if available.

S. The minimum pressure that the backup nitrogen supply bottles can reach and still supply the required volume to cycle one train of LCVs five times is 1085 psig. Bottles should be changed out when pressure lowers to 1200 psig or below.

T. With the additional recirculation line in service, use of the Motor-driven pump(s) (if available), is preferred over the use of the Turbine-driven pump during low flow conditions when the AFW demand is within the capability of the Motor-driven pump(s).

U. SGBD isolation will initially raise indicated Calorimetric Power associated with the resulting feedwater flow transient. It may take several minutes for Calorimetric Power and Feedwater Flow to stabilize at their new lower values.[C.11]

3.3.2 Turbine-Driven Pump (TDP) (continued)

D. TDP speed, and therefore capacity, are governed by pump flow. The TDP flow signal is relayed to a flow controller (FIC-46-57), which provides a 10 to 50 mA signal to the turbine governor system. 10 mA corresponds to a rated low speed of 2076 rpm, and 50 Ma corresponds to rated high speed of 3950 rpm. The governor system uses this electrical signal to position the governor valve (GV) via hydraulic-mechanical controls (see subSection 3.3.9) so that system flow demand is satisfied. With the control in "Auto" flow is no greater than 850 gpm (plus or minus control loop inaccuracies). Manual speed control is also provided to enable the operator to control speed from 2076 to 3950 rpm (Refs. 7.5.7 and 7.4.15). Use of the speed control in combination with the LCVs allow the operator to control the flow from 0 to 720 gpm. The 850 gpm reflects controller inaccuracies to assure a minimum of 720 gpm.

E. The TDP reaches maximum speed within a few seconds and, the potential exists for tripping the turbine during startup due to overspeed. The governor system is equipped with a ramp generator, which controls turbine acceleration rate up to a speed determined by flow controller output. That is, turbine speed could go to the high speed associated with the 50 mA flow controller signal if necessary to satisfy flow demand, or it could go to a lower speed if this satisfies flow demand. In either case, acceleration during starting is controlled by the ramp generator so that overspeed trip is avoided.

F. As TDP discharge and steam inlet pressure change with SG conditions, the appropriate milliamp signal will be sent to the turbine to maintain required pump flow. See Table 8 for the pump flow and head this unit was designed to provide (See Section 3.3.7 for overspeed trip).

3.3.3 MDP Pressure Control Valves (PCVs)

A. A 4" PCV in the discharge of each MDP throttles closed to create sufficient backpressure to prevent pump run-out when SG pressures are low (during cooldown or for a faulted SG). This avoids potential for pump cavitation damage. The PCV throttles closed in response to lowered differential pressure (DP) across the pump. It continues to close until a predetermined pump DP, corresponding to an acceptable operating point on the pump curve is achieved. The PCV will control flow to less than 700 gpm. The value used for MSLB analysis assumed failure of this controller.

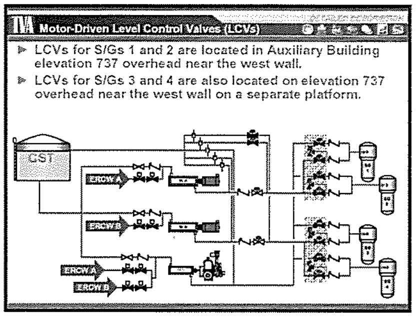
B. The PCVs are safety-grade air operated valves (AOVs) and have trained air supplies (Ref. 7.2.2). The train A MDP's PCV is supplied by train A air, and the train B pump's PCV is supplied by train B air. Remote manual controls for these valves are in the ACR, which duplicates the MCR functions. Transfer switches are provided to shift control of these valves from the MCR to the ACR to provide electrical isolation of the MCR upon evacuation of the MCR.

3.3.4 MDP Level Control Valves (LCVs)

A. The 4" LCVs are AOVs powered by separate trains of ACA (see Ref. 7.2.2) and 1E dc power. These valves are normally closed (energized solenoid) which begin to modulate (de-energized solenoid) to automatically control SG level by regulating MDP flow whenever the associated MDP is operating. These valves close when their associated downstream pressure switches (PS) sense feedwater header pressure less than their setpoint which is intended to prevent cavitation damage to the LCV.

AUO	RO	SRO	STA	
X	X	X	X	8. Describe the automatic opening signal for the ERCW supply valves to the AFW system.
X	X	X	X	9. Identify the power supplies to the Motor-Driven AFW pumps.
X	X	X	X	10. Identify the A-Auto start signals of the Motor-Driven AFW pumps.
X	X	X	X	11. Describe the automatic actuations that occur when an AFW pump is started.
X	X	X	X	12. Explain the reasons (bases) for precautions associated with AFW operation as described in SOI-3.02. (**NOTE 3**)
X	X	X	X	13. Describe the caution associated with opening the ERCW supply valves as stated in SOI-3.02.
X	X	X	X	14. Describe the normal and alternate steam supplies to the Turbine-Driven AFW Pump.
X	X	X	X	15. Describe the sequence of events that occur on a steam supply swapover.
X	X	X	X	16. Identify the isolation signals of the steam supply valves (FCV-1-17 &18) to the Turbine-Driven AFW pump.
X	X	X	X	17. Identify the Turbine-Driven Auxiliary Feedwater pump Auto start signals.
X	X	X	X	18. List the trips on the Auxiliary Feedwater Pumps and include any local steps to resetting them.
X	X	X	X	19. Identify the pressure at which the Motor-Driven AFW pump discharge pressure control valve should be set.
X	X	X	X	20. Identify what the S/G level setpoint is for the AFW system LCV's.
X	X	X	X	21. Explain how to manually control S/G levels with the Motor-Driven Auxiliary Feedwater pumps LCV's.
X	X	X	X	22. Identify the initiating signals that swap the Motor-Driven Pumps LCV's from normal to the bypass LCV.
	X	X	X	23. Using plant drawings, determine the effect of a loss of instrument air/control power on the following valves/components: a. MDAFWP regulating valve (main and bypass) b. TDAFWP regulating valve c. AFW pumps.
X	X	X	X	24. [Identify the problem that disables the AFW pumps and describe Watts Bar's solution to the problem. (SOER 84-3, Rec. #1-4)]

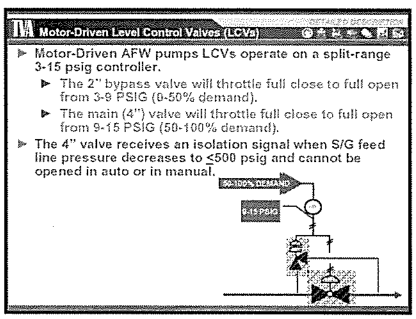
SLIDE 41



- LCVs for S/Gs 1 and 2 are located in Auxiliary Building elevation 737 overhead near the west wall.
- LCVs for S/Gs 3 and 4 are also located on elevation 737 overhead near the west wall on a separate platform

SLIDE 42

OBJECTIVE 22



- Motor-Driven AFW pumps LCVs operate on a split-range 3-15 psig controller.
  - The 2" bypass valve will throttle full close to full open from 3-9 PSIG (0-50% demand).
  - The main (4") valve will throttle full close to full open from 9-15 PSIG (50-100% demand).
- The 4" valve receives an isolation signal when S/G feed line pressure decreases to ≤500 psig and cannot be opened in auto or in manual.

47. 061 K4.02 047

Given the following:

- Unit 1 is operating at 4% power.
- Main Feed Pump 'B' is in service.
- Main Feed Pump 'A' is **NOT** reset.
- All Steam Generator levels are at 38% NR.

Which ONE of the following identifies the status of the AFW Pumps immediately after Main Feedwater Pump 'B' trips?

A. Only the TDAFW pump has automatically started.

B. Only the MDAFW pumps have automatically started.

C.✓ Both the MDAFW pumps and TDAFW Pump have automatically started.

D. Neither the MDAFW pumps nor TDAFW Pump have automatically started.

DISTRACTOR ANALYSIS:

A. Incorrect, Plausible because there is a condition (blackout) where only the TD AFW pump would be automatically started immediately.

B. Incorrect, Plausible because there is a condition (level low in only one steam generator) where only the MD AFW pump would be automatically started immediately.

C. Correct, When the MFPT 1B trips, the control circuit will see both MFPTs as tripped due to MFPT 1A not being reset. Both MFPTs tripped is a condition that will start both MD AFW pumps and the TD AFW pump.

D. Incorrect, Plausible because none of the AFW pumps would have been started if MFPT 1A had been reset when MFPT 1B tripped and because the steam generator levels are above the level required to start any AFW pump.

Question Number: 47

Tier: 2 **Group** 1

K/A: 061 K4.02
Auxiliary / Emergency Feedwater (AFW) System

K/A: 061 K4.02
Auxiliary / Emergency Feedwater (AFW) System
Knowledge of AFW design feature(s) and/or interlock(s) which provide for the following:
AFW automatic start upon loss of MFW pump, S/G level, blackout, or safety injection

Importance Rating: 4.5 / 4.6

10 CFR Part 55: 41.7

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of AFW design features and/or interlocks which provide for starting the AFW pumps upon loss of MFW pump.

Technical Reference:
1-47W611-3-1 R12
1-47W611-3-3 R12
1-47W611-3-4 R18
SOI-3.02, Auxiliary Feedwater System, Revision 0049

Proposed references to be provided: None

Learning Objective: 3-OT-SYS003B
10. Identify the A-Auto start signals of the Motor-Driven AFW pumps.

Cognitive Level:
- **Higher** X
- **Lower** ____

Question Source:
- **New** ____
- **Modified Bank** X
- **Bank** ____

Question History: Robinson bank question 000054AA1.02 (used on Robinson 2008 exam) modified to make applicable to WBN.

Comments:

6.0 NORMAL OPERATION

AFW provides a RCS heat sink during cooldown and when the Main Feedwater (MFW) System is unavailable. AFW is normally in "STANDBY" subject to the following AUTO-STARTS:

	MOTOR-DRIVEN PUMPS		TURBINE-DRIVEN PUMP
1	Loss of both MFW Pumps	1	Loss of both MFW Pumps — CORRECT
2	Lo-Lo Level in any SG (<17%)	2	Lo-Lo Level in 2/4 SGs
3	Safety Injection	3	Safety Injection — DISTRACT
4	Blackout After 25sec. T.D.	4	Blackout immediate
5	AMSAC	5	AMSAC

After starting, the respective Level Control Valves (LCVs) automatically maintain SG levels at 38%. 200,000 gal in the CST will maintain the unit at HOT STANDBY for 2 hours, followed by a 4 hour cooldown to 350°F, while dumping steam to atmosphere concurrent with total loss of offsite power. If an additional supply to AFW is needed, ERCW discharge headers can be aligned to AFW Pumps suction automatically on low suction pressure or manually by the operator.

With the additional recirculation line in service, use of the Motor-driven pump(s) (if available), is preferred over the use of the Turbine-driven pump during low flow conditions when the AFW demand is within the capability of the Motor-driven pump(s).

Applicable attachments are performed at discretion of operations Superintendent or designee. Attachments will normally be performed for system alignment verification in Mode 5 or when alignment verifications needed.

SGBD isolation will initially raise indicated Calorimetric Power associated with the resulting feedwater flow transient. It may take several minutes for Calorimetric Power and Feedwater Flow to stabilize at their new lower values.

7.0 SHUTDOWN

AFW System remains in STANDBY alignment.

10. Given the following:

- The Reactor is at 4% RTP in preparation for Turbine startup.
- Main Feedwater Pump "A" is under clearance for maintenance.
- Main Feedwater Pump "B" is operating.
- Narrow range Steam Generator levels are at 44%.

Which ONE (1) of the following statements describes the AFW Pump status immediately after Main Feedwater Pump "B" trips?

A. The MDAFW and SDAFW Pumps must be manually started.

B. The MDAFW Pumps have auto started but the SDAFW Pump must be manually started if required.

C. The SDAFW Pump has auto started but the MDAFW Pumps must be manually started if required.

D. The MDAFW and SDAFW Pumps have auto started.

I. PROGRAM

Watts Bar Operator Training

II. COURSES

License Training

NOTP

License Requalification

NAUO Requalification

III. TITLE

Auxiliary Feedwater System

IV. LENGTH OF LESSON

A. License Training 4 Hours
B. NOTP 4 Hours
License Requalification and NAUO Requalification times will be determined after objectives are identified.

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. State the design basis of the AFW system in accordance with FSAR section 10.4.9.
X	X	X	X	2. State the function of the AFW system in accordance with the System Description Manual.
X	X	X	X	3. Describe how the Auxiliary Feedwater pumps are protected from low flow conditions.
X	X	X	X	4. Identify the steam generators that each AFW pump supplies.
X	X	X	X	5. Describe the Reserve Auxiliary Feedwater Capacity in the CST's and include how it is ensured.
	X	X	X	6. Identify the required CST volume needed for AFW operation as stated in Tech Specs and the basis for this volume.
	X	X	X	7. Identify in which Modes the CST and the AFW System are governed by Tech Specs.

AUO	RO	SRO	STA	
X	X	X	X	8. Describe the automatic opening signal for the ERCW supply valves to the AFW system.
X	X	X	X	9. Identify the power supplies to the Motor-Driven AFW pumps.
X	X	X	X	10. Identify the A-Auto start signals of the Motor-Driven AFW pumps.
X	X	X	X	11. Describe the automatic actuations that occur when an AFW pump is started.
X	X	X	X	12. Explain the reasons (bases) for precautions associated with AFW operation as described in SOI-3.02. (**NOTE 3**)
X	X	X	X	13. Describe the caution associated with opening the ERCW supply valves as stated in SOI-3.02.
X	X	X	X	14. Describe the normal and alternate steam supplies to the Turbine-Driven AFW Pump.
X	X	X	X	15. Describe the sequence of events that occur on a steam supply swapover.
X	X	X	X	16. Identify the isolation signals of the steam supply valves (FCV-1-17 &18) to the Turbine-Driven AFW pump.
X	X	X	X	17. Identify the Turbine-Driven Auxiliary Feedwater pump Auto start signals.
X	X	X	X	18. List the trips on the Auxiliary Feedwater Pumps and include any local steps to resetting them.
X	X	X	X	19. Identify the pressure at which the Motor-Driven AFW pump discharge pressure control valve should be set.
X	X	X	X	20. Identify what the S/G level setpoint is for the AFW system LCV's.
X	X	X	X	21. Explain how to manually control S/G levels with the Motor-Driven Auxiliary Feedwater pumps LCV's.
X	X	X	X	22. Identify the initiating signals that swap the Motor-Driven Pumps LCV's from normal to the bypass LCV.
	X	X	X	23. Using plant drawings, determine the effect of a loss of instrument air/control power on the following valves/components: a. MDAFWP regulating valve (main and bypass) b. TDAFWP regulating valve c. AFW pumps.
X	X	X	X	24. [Identify the problem that disables the AFW pumps and describe Watts Bar's solution to the problem. (SOER 84-3, Rec. #1-4)]

AUO	RO	SRO	STA	
X	X	X	X	25. Describe the changes that take place when the Turbine-Driven AFW pump transfer switch (XS-46-57) is placed in "Aux" position.
X	X	X	X	26. Identify the steps to gain local control of the Turbine-Driven Auxiliary Feedwater pump and SG levels.
	X	X	X	27. Describe how to take manual control of the Turbine-Driven AFW pump from the control room.
X	X	X	X	28. [Describe how to reset an electrical and mechanical overspeed trip on the Turbine-Driven AFW pump, both electrically and locally (SOER-82-08, Rec. 4)]
X	X	X	X	29. Explain the purpose of each controller and indicator on the local Control panel for the Turbine-Driven AFW Pump.
X	X	X	X	30. [Identify three (3) contributing factors that have left the Trip and Throttle valve in a tripped position when the Operators thought it was reset and describe controls put in place at WBN to keep this from occurring. (SOER 82-8, Rec. #4)]
X	X	X	X	31. [Identify the dominant causes of failures leading to significant losses of AFW. (SOER 86-1)
	X	X	X	32. [Identify three possible adverse effects which could occur if the AFW pump turbine overspeeds (SOER-89-01)]
X	X	X	X	33. Sketch the Auxiliary Feedwater System, beginning at the CST's and ending at the SG's. (**NOTE 1**)
X	X	X	X	34. List each main isolation valve in the suction line of the Auxiliary Feedwater System and state in which building it is located. (**NOTE 1**)
X	X	X	X	35. List each of the checks that should be made on the Auxiliary Feedwater Pumps normally and while running.

AUO	RO	SRO	STA	
X	X	X	X	36. Describe the in-plant location of the following: (**NOTE 1**) a. Auxiliary Feedwater Pumps b. Auxiliary Feedwater Level Control Valves c. Flood Mode Spool Pieces d. Auxiliary Feedwater Supply Valves e. Steam Supply Valves to Turbine-Driven Auxiliary Feedwater Pumps f. Turbine-Driven Auxiliary Pump Trip and Throttle Valve g. Motor-Driven AFW Recirc Valves
	X	X	X	37. Correctly locate control room controls and indications associated with the AFW system, including: (**NOTE 2**) a. AFWPs b. AFW regulating valve c. S/G level d. CST level

NOTE 1: Objective accomplished during walk downs of the system. Student is responsible for this information.

NOTE 2: Objective accomplished during simulator demo of the system. Student is responsible for this information.

NOTE 3: Use latest revision of SOI-3.02 for discussion of the precautions and limitations for AFW.

48. 062 A2.01 048
Given the following:

- Unit 1 is operating at 60% power.
- 480V Shutdown Board 1A2-A de-energizes due to an internal fault.

Which ONE of the following identifies...

(1) how the loss of the board affects the operation of the unit

and

(2) the action required to mitigate the impact of the condition?

A. (1) Increasing Main Turbine Oil temperature.
(2) Place 1-TIC-24-69, MTOT TEMP TEMP CONTROL, in MAN and open the TCV.

B✓ (1) Loss of most radiation monitor rate meters in the MCR.
(2) Transfer Instrument Power Rack A to ALTERNATE.

C. (1) A turbine trip due to Stator Cooling Water Temperature
(2) Transfer Instrument Power Rack A to ALTERNATE.

D. (1) Increasing Generator Hydrogen temperature.
(2) Place 1-TIC-24-48, GENERATOR H2 TEMP CONTROL, in manual and open the TCV.

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because of loss of the main turbine oil temperature control would result if the 480V Shutdown Board 1B2-B had been lost resulting in a loss of Instrument Power Rack B instead of loss of the Instrument Power Rack A. Placing the controller to manual would have allowed the operator to manually control the oil temperature.*

B. *Correct, the loss of the board will result in a loss of power to the Instrument Power Rack A which will result in a loss of power for most of the radiation monitor rate meters in the main control room and the power can be restored by transferring the rack power to alternate which allows the rate meters to then be reset.*

C. *Incorrect, Plausible because the Stator Cooling water temperature control loop is supplied from the Instrument Power Rack A but its loss does not result in a loss of cooling for the system. However, a 480V Shutdown Board 1B2-B resulting in a loss of hydrogen cooling will cause the Stator Cooling Water system to heatup causing an automatic turbine trip unless the Rack B is swapped to alternate or manual control of Hydrogen temperature is established.*

D. *Incorrect, Plausible because of loss of the generator hydrogen temperature control would result if the 480V Shutdown Board 1B2-B had been lost resulting in a loss of Instrument Power Rack B instead of loss of the Instrument Power Rack A. Placing the controller to manual would have allowed the operator to manually control the generator hydrogen temperature.*

Question Number: 48

Tier: 2 **Group:** 1

K/A: 062 A2.01
AC Electrical Distribution System
Ability to (a) predict the impacts of the following malfunctions or operations on the ac distribution system; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:
Types of loads that, if de-energized, would degrade or hinder plant operation.

Importance Rating: 3.4 / 3.9

10 CFR Part 55: 41.5 / 43.5 / 45.3 / 45.13

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires knowledge of secondary side loads that are affected by the loss of a 480V

K/A Match: K/A is matched because the question requires knowledge of secondary side loads that are affected by the loss of a 480V shutdown board and the actions required to mitigate the consequence of the affect.

Technical Reference: AOI-43.01, Loss of Unit 1 Train A Shutdown Board, Revision 0009
1-45W700-1 R31 1-45W600-35-1 R12
1-45W600-35-2 R11 1-45W600-35-4 R11
1-45W1646-3 R18 1-45W1646-4 R23
1-45W600-47-6 R6

Proposed references to be provided: None

Learning Objective: 3-OT-AOI4300
2. Analyze alarms and indications for loss of a 6.9kV Shutdown Board, and evaluate their importance to system operation per AOI.

Cognitive Level:
Higher X
Lower ____

Question Source:
New X
Modified Bank ____
Bank ____

Question History: New question for the WBN 10/2011 NRC exam

Comments:

3.5.4 Compensatory Actions - Loss of 480V SD BD 1A2-A

NOTE Appendix A provides list of Unavailable Equipment resulting from a loss of 480V SD BD 1A2-A.

Step	Action/Expected Response	Response Not Obtained
1.	**MONITOR** 480V SD BD 1A2-A supply sources, **WHEN** power supply AVAILABLE, **THEN ** GO TO** Section 3.5.2 Step 5.	
2.	**ENSURE** Unit 1 Instrument Power A Rack selected to ENERGIZED feeder (amber light ON) [1-M-7] AND **RESET** Radiation Monitor modules and alarms on 0-M-12.	
3.	**MONITOR** containment upper and lower compartment average air temperatures are within limits: • S/R 3.6.5.1, Computer Point U9019 • S/R 3.6.5.2, Computer Point U9020	**START** containment cooling fans as needed to maintain temp. within limits: (SOI-30.03) • CRD Mech Cooler Fans • Lower Compartment Cooler Fans • Upper Compartment Cooler Fans
4.	**ENSURE** Aux Bldg General Supply and Exhaust Fans in-service as required to maintain ventilation and pressure (SOI-30.05).	
5.	**ENSURE** MCR Air Conditioning Unit B-B in-service (SOI-31.01).	

Step	Action/Expected Response	Response Not Obtained
3.5.2	**Energize 480V SD BD 1A2-A (continued)**	
11.	**CHECK** voltage available from 480V SD XFMR 1A-A on 480V SD BD 1A2-A secondary inst. voltmeter. [480V SD BD 1A2-A C/4A]	**PERFORM** ONE of the following actions: • **IF** conditions allow, **THEN ENERGIZE** 480V SD XFMR 1A-A by closing 1-BKR-212-A-A [6.9kV SD BD 1A-A Cmpt 5], **OR** • ** **GO TO** Section 3.5.4, Compensatory Actions for Long Term Loss of 480V SD BD 1A2-A.
12.	**CHECK** 1-BKR-212-A2/1B-A, Normal Supply Breaker 52N, OPEN. [C/1B]	
13.	**CLOSE** 1-BKR-211-A2/4B-A, ALT Supply Breaker 54E.	
14.	**CHECK** 440 to 515 volts on 480V SD BD 1A2-A Voltmeter. [C/5A]	
15.	**ENSURE** the following a. Unit 1 Instrument Power A Rack aligned to Normal feeder (amber light ON). [1-M-7]. b. Radiation Monitor modules and alarms on 0-M-12 RESET.	
16.	**RETURN TO** procedure in effect.	

End of Section

I. PROGRAM

Watts Bar Operator Training

II. COURSE

License Training

III. TITLE

AOI-43, Loss of 6.9KV Shutdown Board

IV. LENGTH OF LESSON

License Training 1.5 Hours

NOTP 1.0 Hours

V. TRAINING OBJECTIVES

AUO	RO	SRO	STA	
	X	X	X	1. Demonstrate ability to recognize a loss of any 6.9KV Shutdown Board.
	X	X	X	2. Analyze alarms and indications for loss of a 6.9KV Shutdown Board, and evaluate their importance to system operation per AOI.
	X	X	X	3. Given plant conditions, determine if Tech Spec entry is required, what actions(s) must be taken, and the bases for those actions.
	X	X	X	4. Demonstrate ability/knowledge of AOI, by: a. Recognizing Entry conditions b. Responding to Actions c. Responding to Contingencies (RNO) d. Responding to Notes/Cautions
X	X	X	X	5. Discuss methods of restoring power to a 6.9KV Shutdown Board
X	X	X	X	6. Describe the Purpose/Goal of AOI-43, Loss of 6.9KV Shutdown Board.

49. 063 G2.1.25 049

Given the following:

- Unit 1 is operating at 100% power.
- A battery discharge test is in progress on 125v DC Battery IV and the 125v DC Battery Board V is connected to the 125v DC Battery Board IV.
- 0-SI-0-3, "Weekly Log," is being performed.

Using 0-SI-0-3, Appendix A, which ONE of the following identifies the status of the 125v DC Battery Board IV and the 120v AC Vital Inverter 2-IV?

REFERENCE PROVIDED

	125v DC Battery Board IV	Vital Inverter 2-IV
A.	Operable	Inoperable
B.	Operable	Operable
C.✓	Inoperable	Inoperable
D.	Inoperable	Operable

DISTRACTOR ANALYSIS:

A. *Incorrect, Plausible because the 125V DC Battery Board IV can remain operable when connected to 125v DC Vital Battery Board V and there is a charger on the board. However, charger V is not a qualified charger. Also, because the inverter being inoperable due to not having a DC power supply is correct.*

B. *Incorrect, Plausible because the 125V DC Battery Board IV can remain operable when connected to 125v DC Vital Battery Board V and there is a charger on the board. However, charger V is not a qualified charger. Also, because the inverter is in service, has an available supply from Bat Bd IV. The applicant must understand the meaning of available and if misapplied then the inverter could be determined to be operable in error.*

C. *Correct, When the 125V DC Battery V is being used to supply one of the 125v DC Vital Battery Boards, the 125V DC Battery Charger V must be disconnected from the 125v DC Battery Board V and a spare charger aligned to the Battery Board being supplied. Also, for the inverter to be operable it must be aligned to a DC power supply. The completed charts show that the 125V DC Battery Charger V remains connected with no spare charger connected and that the inverter is not aligned to a DC supply.*

D. *Incorrect, Plausible because the 125V DC Battery Board IV being inoperable is correct due to the charger alignments and because the inverter is in service, has a power supply (connected to the Instrument Power Board) and has an available supply from Bat Bd IV. The applicant must understand the meaning of available and if misapplied then the inverter could be determined to be operable in error.*

Question Number: 49

Tier: 2 **Group:** 1

K/A: 063 G2.1.25
D.C. Electrical Distribution
Conduct of Operations
Ability to interpret reference materials, such as graphs, curves, tables, etc.

Importance Rating: 3.9 / 4.2

10 CFR Part 55: 41.10 / 43.5 / 45.12

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires ability to extract information from completed tables in a surveillance procedure to determine the status of the D.C. Electrical Distribution system and the 120v AC vital system it supports.

Technical Reference: 0-SI-0-3, Weekly Log, Revision 0045
Tech Spec 3.8.7, Inverters-Operating
1-45W700-1 R31

Proposed references to be provided: 0-SI-0-3, Weekly Log, Appendix A , Rev 0042 pages 9 and 10 with Notes removed from page 10

Learning Objective: 3-OT-SYS057P
11. State the 125V DC Vital system parameters governed by TS

Cognitive Level:
- **Higher** X
- **Lower** ___

Question Source:
- **New** X
- **Modified Bank** ___
- **Bank** ___

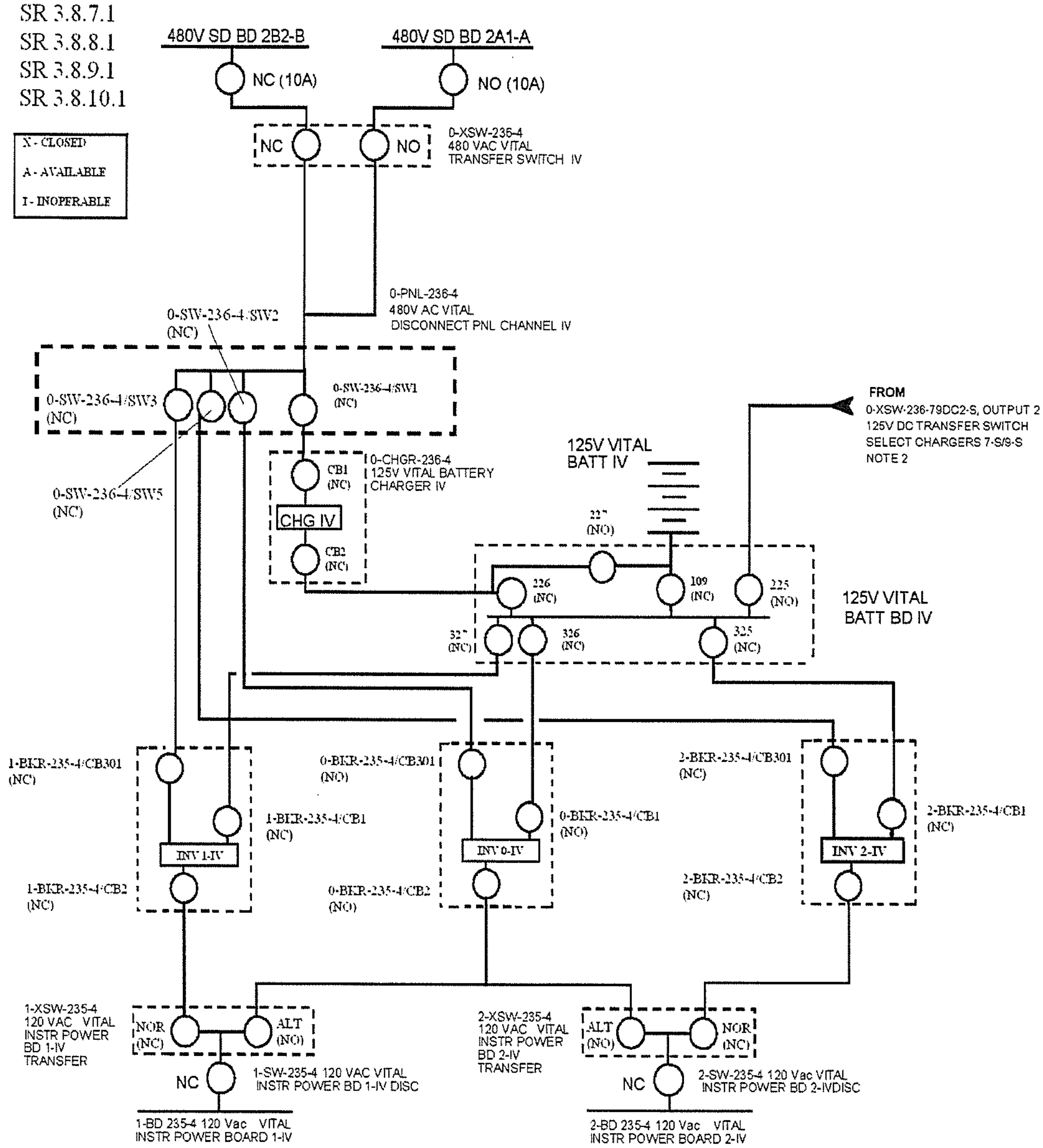
Question History: New question for the WBN 10/2011 NRC exam

Comments:

Appendix A
(Page 9 of 24)

SR 3.8.4.3
SR 3.8.5.1
SR 3.8.7.1
SR 3.8.8.1
SR 3.8.9.1
SR 3.8.10.1

X - CLOSED
A - AVAILABLE
I - INOPERABLE



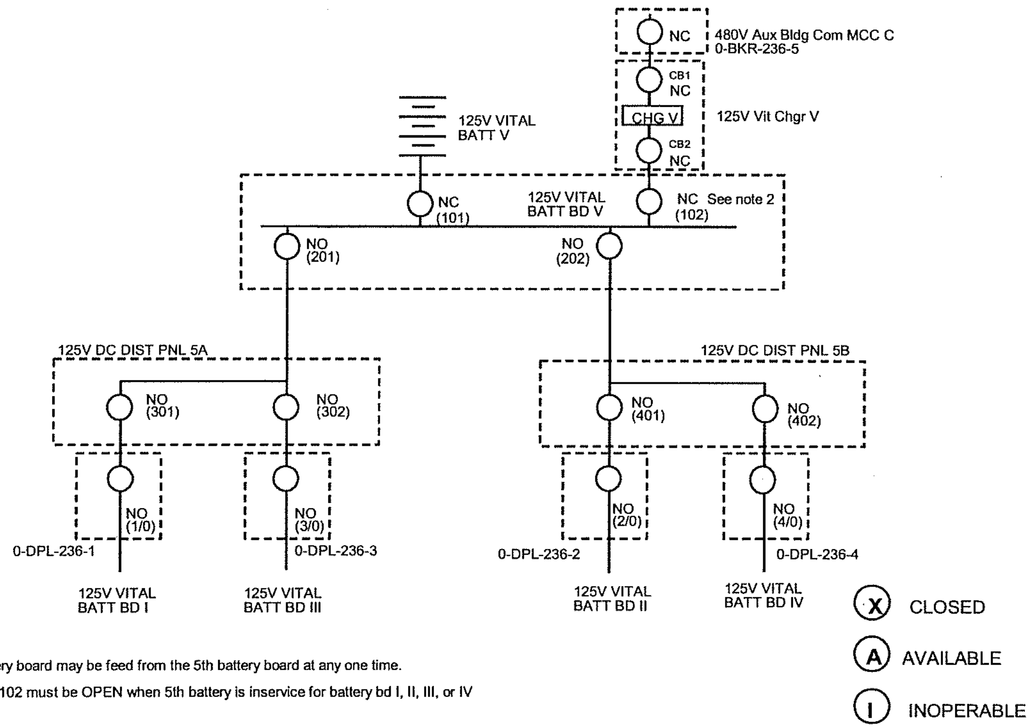
NOTE (1) In Modes 5&6 only one train of ac /dc PWR is required, if this train is not required this page may be N/A.
(2) When 7-S or 9-S charger is connected to Batt Bd then verify assoc. train Transfer Switches are closed and Alt bkrs are open.

INITIALS OF DATA COLLECTOR: ______________ DATE ____________

REMARKS: ____

Appendix A
(Page 10 of 24)

SR 3.8.9.1
SR 3.8.10.1



NOTE 1: Only one battery board may be feed from the 5th battery board at any one time.

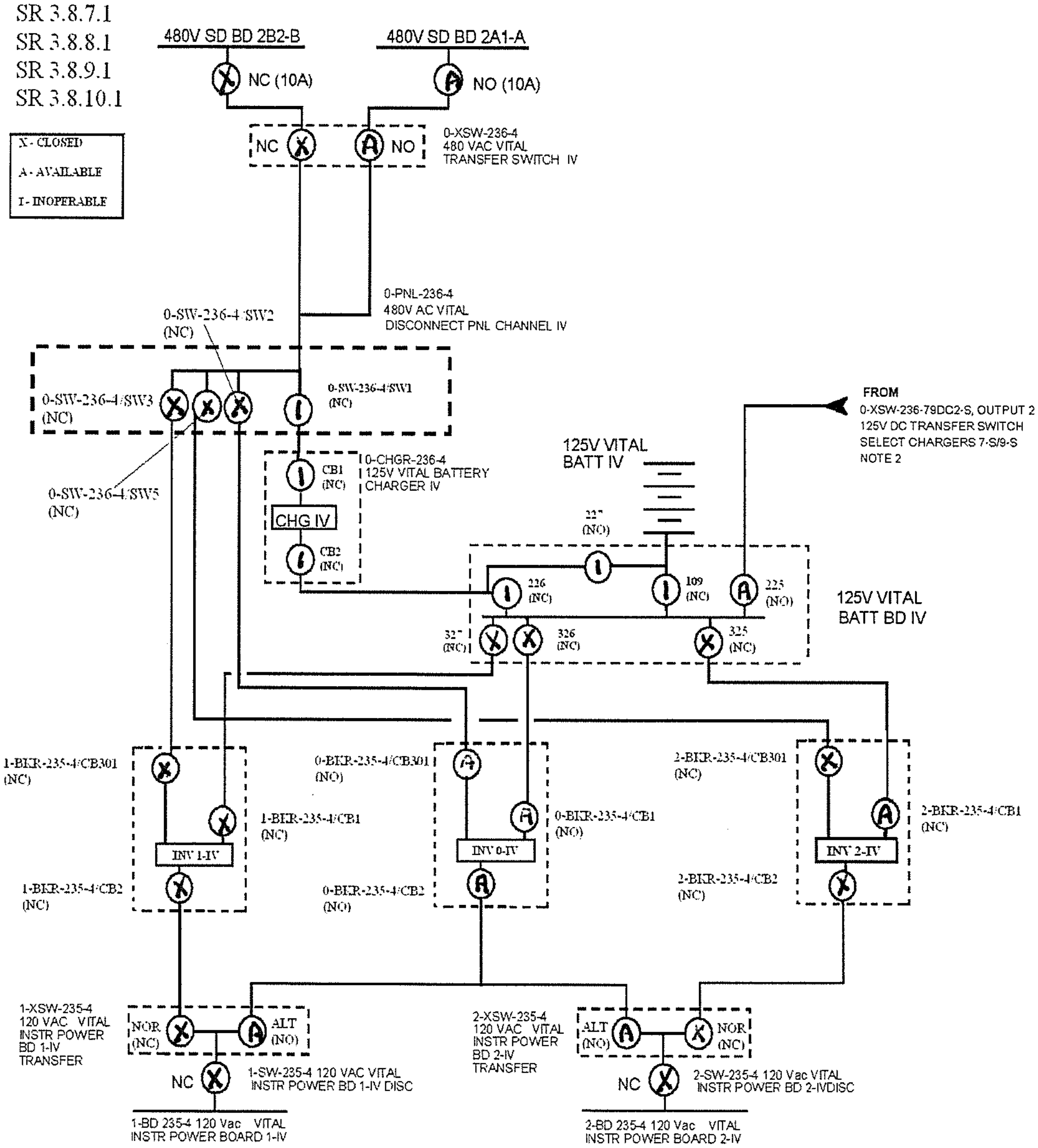
NOTE 2: 0-BKR-236-5/102 must be OPEN when 5th battery is inservice for battery bd I, II, III, or IV

INITIALS OF DATA COLLECTOR: ____________ DATE ____________

REMARKS: ________________________________

Appendix A
(Page 9 of 24)

SR 3.8.4.3
SR 3.8.5.1
SR 3.8.7.1
SR 3.8.8.1
SR 3.8.9.1
SR 3.8.10.1



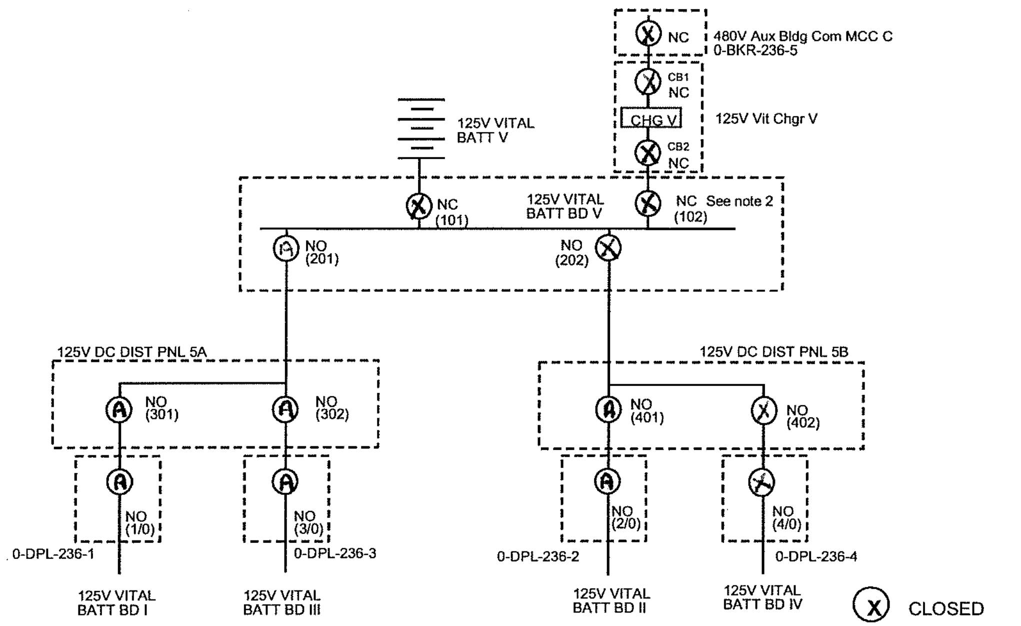
NOTE (1) In Modes 5&6 only one train of ac /dc PWR is required. if this train is not required this page may be N/A.
(2) When 7-S or 9-S charger is connected to Batt Bd then verify assoc. train Transfer Switches are closed and Alt bkrs are open.

INITIALS OF DATA COLLECTOR: [signature] DATE ____________

REMARKS: ____

Appendix A
(Page 10 of 24)

SR 3.8.9.1
SR 3.8.10.1



NOTE 1: Only one battery board may be feed from the 5th battery board at any one time.

NOTE 2: 0-BKR-236-5/102 must be OPEN when 5th battery is inservice for battery bd I, II, III, or IV

INITIALS OF DATA COLLECTOR: ____________ DATE ____________

REMARKS: ____________

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.7.1	Verify correct inverter voltage, frequency, and alignment to required AC vital bus and from associated vital battery board and 480 V shutdown board.	7 days

I. **PROGRAM:** WATTS BAR OPERATOR TRAINING

II. **COURSE:**

A. NOTP
B. LICENSED REQUALIFICATION
C. NAUO REQUALIFICATION
D. ILT

III. **TITLE:**

PLANT DC SYSTEMS

IV. **LENGTH OF LESSON:**

A.	NOTP	2.0 HOURS
B.	LICENSE REQUALIFICATION	2.0 HOURS
C.	NAUO REQUALIFICATION	2.0 HOURS
D.	ILT	2.0 HOURS

V. **TRAINING OBJECTIVES:**

AUO	RO	SRO	STA	
X	X	X	X	1. Describe the 125v Vital, 250v, 48v and 24v battery systems in terms of the following: a. Purpose b. Number and location of batteries c. Deleted d. Location and normal and alternate supplies to associated battery chargers. e. Number and location of battery boards. f. Normal and alternate supplies to battery boards. g. Typical feeds from battery boards.
X	X	X	X	2. Describe the separation of the 125v Vital DC System into channels, including numbering, colors and to which unit they generally supply.
X	X	X	X	3. Identify which plant batteries are grounded.
				4. Deleted.
X	X	X	X	5. Describe or draw the single line for the 125v Vital DC System.

V. **TRAINING OBJECTIVES:** (continued)

AUO	RO	SRO	STA	
	X	X	X	6. Explain how the operator can tell if the 125v Vital Charger or the 125v Vital Battery is supplying power to the 125v Vital Battery Boards.
X	X	X	X	7. Explain why the BO reset switch (located at the 6.9kv SD logic panel) must be held in RESET until the affected 6.9kv SD DC Bus is energized.
X	X	X	X	8. Identify the failure position (open, closed, or "as is") of a 6.9kv or 480V Shutdown Board breaker upon loss of control power to that board.
X	X	X	X	9. Describe the status of the breaker indication lights for equipment fed from 6.9kv or 480V Shutdown Boards when control power is lost to the boards.
		X	X	10. Given the condition/status of the 125V DC Vital system/component and the appropriate sections of Tech Specs, determine if operability requirements are met and what actions, if any, are required.
X	X	X	X	11. State the 125V DC Vital system parameters governed by TS.
X	X	X	X	12. Describe or draw the single line of the 250v DC System.
X	X	X	X	13. Explain how the 250v DC Turbine Bldg Distribution Boards auto transfers on undervoltage.
				14. Deleted.
				15. Deleted.

V. **TRAINING OBJECTIVES:** (continued)

AUO	RO	SRO	STA	
	X	X	X	16. Correctly locate control room controls and indications associated with the 125v DC Vital system, including: a. Alarms b. Voltmeters c. Ammeters
X	X	X	X	17. Describe the in-plant location of: a. 125v Vital Batteries b. 125v Vital Battery Boards c. 125v D/G Batteries d. 250v Batteries e. 250v Battery Boards f. 250v Turbine Bldg Distribution Bds g. 125v Vital Battery Chargers h. 125v Vital Inverters i. 48v Telephone Battery j. 48v Plant Battery k. 24v CAP Battery

TRAINING OBJECTIVES

AUO	RO	SRO	STA	
X	X	X	X	1. Describe the 125v Vital, 250v, 48v and 24v battery systems in terms of the following: a. Purpose b. Number and location of batteries c. Deleted d. Location and normal and alternate supplies to associated battery chargers. e. Number and location of battery boards. f. Normal and alternate supplies to battery boards. g. Typical feeds from battery boards.
X	X	X	X	2. Describe the separation of the 125v Vital DC System into channels, including numbering, colors and to which unit they generally supply.
X	X	X	X	3. Identify which plant batteries are grounded.
				4. Deleted.
X	X	X	X	5. Describe or draw the single line for the 125v Vital DC System.
	X	X	X	6. Explain how the operator can tell if the 125v Vital Charger or the 125v Vital Battery is supplying power to the 125v Vital Battery Boards.
X	X	X	X	7. Explain why the BO reset switch (located at the 6.9kv SD logic panel) must be held in RESET until the affected 6.9kv SD DC Bus is energized.

AUO	RO	SRO	STA	
X	X	X	X	8. Identify the failure position (open, closed, or "as is") of a 6.9kv or 480V Shutdown Board breaker upon loss of control power to that board.
X	X	X	X	9. Describe the status of the breaker indication lights for equipment fed from 6.9kv or 480V Shutdown Boards when control power is lost to the boards.
		X	X	10. Given the condition/status of the 125V DC Vital system/component and the appropriate sections of Tech Specs, determine if operability requirements are met and what actions, if any, are required.
X	X	X	X	11. State the 125V DC Vital system parameters governed by TS.
X	X	X	X	12. Describe or draw the single line of the 250v DC System.
X	X	X	X	13. Explain how the 250v DC Turbine Bldg Distribution Boards auto transfers on undervoltage.
				14. Deleted.
X	X	X	X	15. Deleted.
	X	X	X	16. Correctly locate control room controls and indications associated with the 125v DC Vital system, including: a. Alarms b. Voltmeters c. Ammeters

AUO	RO	SRO	STA	
X	X	X	X	17. Describe the in-plant location of: 1. 125v Vital Batteries 2. 125v Vital Battery Boards 3. 125v D/G Batteries 4. 250v Batteries 5. 250v Battery Boards 6. 250v Turbine Bldg Distribution Bds 7. 125v Vital Battery Chargers 8. 125v Vital Inverters 9. 48v Telephone Battery 10. 48v Plant Battery 11. 24v CAP Battery

Charger V also has an equalize timer which must be set to the desired time *before* the FLOAT / EQUALIZE switch is placed in EQUALIZE. When the timer times out, the charger will automatically revert to float operation. Charger V operating voltages are also slightly different (refer to SOI-236.05), with a float voltage of 138.5-Vdc and an equalize voltage of 144.5-Vdc.

Charger V is not safety related and is not in service when battery V is substituted for one of the four channel batteries. Normally one of the spare chargers will be connected to battery V in this instance. The normal charger will be connected to the normal battery, but can be connected to battery V, if desired.

Table 1 - 125VDC Vital Battery Charger Power

Objective 1.d, 2

TRAIN A	NOR AC	BU AC	COLOR	STBY CHRGR
I	480V SD Bd 1A2-A	480V SD Bd 1B1-B	RED	6-S and 8-S
III	480V SD Bd 2A2-A	480V SD Bd 2B1-B	BLUE	7-S and 9-S
TRAIN B				
II	480V SD Bd 1B2-B	480V SD Bd 1A1-A	BLACK	6-S and 8-S
IV	480V SD Bd 2B2-B	480V SD Bd 2A1-A	YELLOW	7-S and 9-S
SPARE CHARGER				
6-S and 8-S	480V RX MOV Bd 1A2-A	480V Rx MOV Bd 1B2-B	NA	N/A

loads for 4 hours, with a loss of all AC power, while maintaining a minimum terminal voltage of 105V DC. The minimum terminal voltage during the first minute is 113V DC. As the state of charge degrades, the terminal voltage will decrease more rapidly and at a voltage < 105 VDC but well before 0 VDC cells will reverse and the battery will fail.

Battery V may be electrically connected to substitute for one of the other batteries and the channel will be considered OPERABLE if the battery surveillances are current for battery V.

Vital Battery V is comprised of 62 lead calcium cells manufactured by Allied C&D Power systems. It is rated at 2320 ampere hours over an 8 hour period.

Each Battery room is equipped with its own ventilation and heating system, maintaining room temperature between 60°F and 104°F. The forced air movement also purges the room of H_2 gas released from the batteries while charging.

2.1.1.2 Vital Battery Chargers

Objective 1.d, 17

Each battery has its own independent charger located on Elevation 772' in the Aux Building. Each is provided with both a Normal and an Alternate AC power supply. The charger is only considered OPERABLE when it is aligned to the normal supply.

Each unit also has two spare battery chargers that may be aligned to either train battery for that unit. So long as it is connected to the same train AC source, the battery subsystem is OPERABLE using the spare charger. The Unit 1 chargers are designated 6-S and 8-S the unit 2 chargers are 7-S and 9-S

The chargers can perform both normal float charging and higher voltage equalize charging of the battery. During float operation the charger output voltage is 133 – 137 VDC, and during equalize it is 138 – 140 VDC. The FLOAT / EQUALIZE push button on the charger selects the mode of operation.

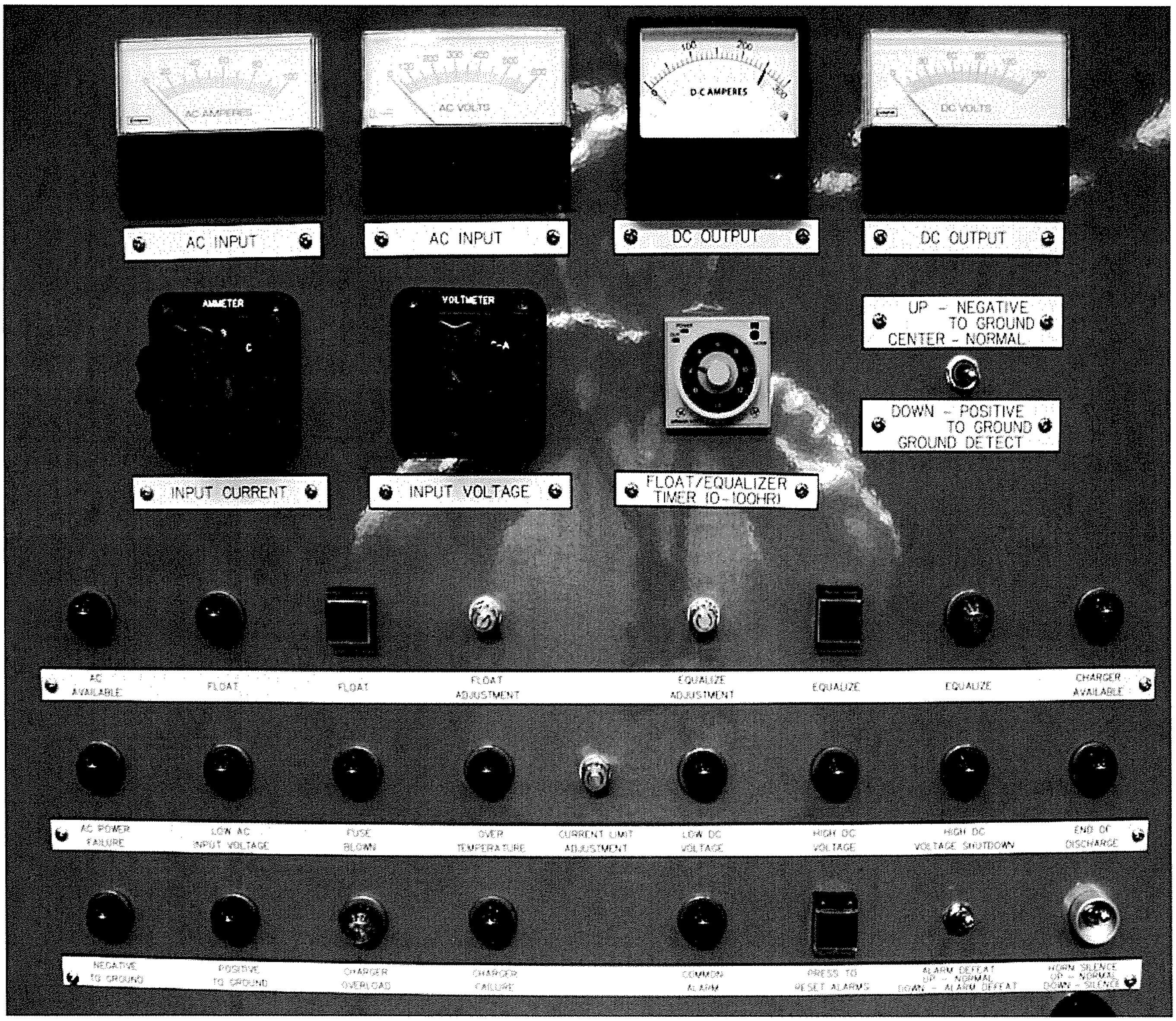


Figure 1 - Typical for Spare Chargers 6-S, 7-S, 8-S and 9-S

50. 063 K3.02 050
Given the following

- Unit 1 was operating at 100% power when a safety injection occurred.
- Eighteen (18) seconds after Safety Injection, a loss of 125v Vital DC Power Channel II occurs.

Which ONE of the following identifies the current status of RHR pump 1B-B?

A. RHR pump 1B-B is **NOT** running but can be started from the MCR handswitch.

B. RHR pump 1B-B is **NOT** running and can **NOT** be started from the MCR handswitch.

C. RHR pump 1B-B is running and can be stopped from the MCR handswitch.

D✓ RHR pump 1B-B is running but can **NOT** be stopped from the MCR handswitch.

DISTRACTOR ANALYSIS:

A. Incorrect, Plausible if the time delays associated with the pump starting with a blackout present are used. The delay times would exceed the 18 seconds (DG Start and RHR blackout time delay relay) and there are 3 other Vital DC boards available to supply the control power. One of which does supply the breaker but it is a manual transfer, not an automatic transfer.

B. Incorrect, Plausible since RHR pump 1A-A cannot be started or stopped from the control room handswitch after the loss of 125v DC Vital channel II and because if a blackout signal had been concurrent with the SI condition, then the DG start time and pump start delay time would have exceeded the time prior to the loss of the control power.

C. Incorrect, Plausible because the pump being running is correct and there are 3 other channels of 125v DC available that could have been determined to be the control power supply for the pump's breaker.

D. Correct, RHR pump 1A-A would have started immediately when the Safety injection was initiated but after the 125v DC Channel II power was lost, the pump could not be stopped from its handswitch in the main control room.

Question Number: 50

Tier: 2 **Group** 1

K/A: 063 K3.02
D.C. Electrical Distribution
Knowledge of the effect that a loss or malfunction of the DC electrical system will have on the following:
Components using DC control power

Importance Rating: 3.5 / 3.7

10 CFR Part 55: 41.7 / 45.6

10CFR55.43.b: Not applicable

K/A Match: K/A is matched because the question requires the applicant to know a major breaker supplied with control power from 125v DC Vital Channel II and how a loss of the power supply to the control power affects the ability to start and stop the component.

Technical Reference: AOI-21.02, Loss of DC Vital Battery Bd II, Revision 0021
1-45W724-2 R24
1-45W760-74-1 R12

Proposed references to be provided: None

Learning Objective: 3-OT-SYS057A
8. Identify the failure position (open, closed, or 'as is') of a 6.9kv or 480v Shutdown Board breaker upon loss of control power to that board.

Cognitive Level:
Higher X
Lower ___

Question Source:
New ___
Modified Bank X
Bank ___

Question History: Surry bank question 063 K3.02 used during 10-2009. Modified for use at WBN. Changes in the stem made a different answer correct.

Comments:

1.0 PURPOSE

This instruction provides actions to respond to a loss of 125V DC Vital Battery Board II. The instruction will stabilize the unit following a Rx trip It also provides a list of major equipment which may be affected.

2.0 SYMPTOMS

2.1 Alarms

A. 125 DC VITAL CHGR/BATT II ABNORMAL [18-A].

B. 125 DC VITAL BATT BD II ABNORMAL [18-B].

C. 6.9 SD BD 1B-B UV/OV/CONTROL PWR FAILURE [13-B].

D. 480 SD BD 1B1-B/1B2-B FAILURE/ABN [11-D].

E. C & SS AIR COMPR SEQUENCER UNDERVOLTAGE [42-E].

F. TURB RUNBACK SYS CNTL PWR UNDERVOLTAGE [27-E].

G. 6.9 KV SWGR D CONTROL PWR UV [504-C].

2.2 Indications

A. Voltmeter (1-EI-57-96) when 1-XS-57-96 is selected to Bd II and ammeter (1-EI-57-93) for 125V Battery Bd II, on 1-M-1, indicates ZERO.

B. Breaker indicating lights for equipment feeding from 6.9kV SD BD 1B-B and 480V SD BDs 1B1-B/1B2-B will be dark (ACBs electrically inoperable).

4.0 DISCUSSION

125V DC Vital Battery Board II supplies the following feeds to the listed control buses:

6.9KV Shutdown Board 1B-B normal feed to the NORMAL bus alternate feed to the EMERGENCY bus;

480V Shutdown Boards 1B1-B and 1B2-B normal feed to the NORMAL bus alternate feed to the EMERGENCY bus;

6.9KV Shutdown Board 2B-B alternate feed to the NORMAL bus normal feed to the EMERGENCY bus;

480V Shutdown Boards 2B1-B and 2B2-B alternate feed to the NORMAL bus normal feed to the EMERGENCY bus.

In general, 125V DC Vital Battery Board II supplies power for Unit 1 Train B equipment. The loss of control power causes breakers on the affected boards (normally Unit 1,Train B 6.9kV and 480V SD Boards) to fail "as is". As a result, it will be necessary to use alternate control power if breaker operation is needed. Also, the loss of power to solenoid valves will cause Main Feedwater and Main Steam to be terminated and the Reactor will trip.

Safe shutdown is maintained with all four S/G PORVs and AFW System (Turbine driven pump will feed all 4 S/Gs, 1A-A MDAFW Pump will feed S/Gs 1 & 2 only; also loop 2 S/G PORV will lose indication lights and auto opening on high rate of pressure rise but modulation control with PIC will still be operable). Cooldown control from less than 350°F to cold shutdown is via the Residual Heat Removal System.

SURRY BANK QUESTION

References Provided to Applicant
none

Answer: D
49. 0063 K3.02 2
A loss of 'A' DC Bus occurs followed by a Safety Injection. Which ONE of the following is correct regarding the operation of 1-SI-P-1A ('A' Low Head Safety Injection Pump)?

A. 1-SI-P-1A is NOT running but can be started from the MCR.

B. 1-SI-P-1A is NOT running and can NOT be started from the MCR.

C. 1-SI-P-1A is running and can be stopped from the MCR.

D. 1-SI-P-1A is running but can NOT be stopped from the MCR.

K/A
DC Electrical Distribution.
Knowledge of the effect that a loss or malfunction of the DC Electrical System will have on the following: Components using DC control power.

K/A Match Analysis
Requires the applicant to know the major breakers supplied control power from 1A DC Bus.

Answer Choice Analysis
A. In-Correct but plausible since the 'A' LHSI pump will not be running. It cannot be started from the MCR. Plausible if the candidate believes that all 480 V components utilize internal power for control power and forgets that LCC 480V components utilize DC power.

B. Correct

C. In-Correct but plausible see distactor 'A'.

D. In-Correct but plausible if the candidate believes that since the charging springs are charged and one breaker operation is normally permitted the breaker will close, but the loss of DC power will prevent opening the breaker.

Supporting References
ND-90.3-LP-6, 125 VDC Distribution, Rev. 018, Obj. D

References Provided to Applicant
none

I. **PROGRAM:** WATTS BAR OPERATOR TRAINING

II. **COURSE:**

A. NOTP
B. LICENSED REQUALIFICATION
C. NAUO REQUALIFICATION
D. ILT

III. **TITLE:**

PLANT DC SYSTEMS

IV. **LENGTH OF LESSON:**

A.	NOTP	2.0 HOURS
B.	LICENSE REQUALIFICATION	2.0 HOURS
C.	NAUO REQUALIFICATION	2.0 HOURS
D.	ILT	2.0 HOURS

V. **TRAINING OBJECTIVES:**

AUO	RO	SRO	STA	
X	X	X	X	1. Describe the 125v Vital, 250v, 48v and 24v battery systems in terms of the following: a. Purpose b. Number and location of batteries c. Deleted d. Location and normal and alternate supplies to associated battery chargers. e. Number and location of battery boards. f. Normal and alternate supplies to battery boards. g. Typical feeds from battery boards.
X	X	X	X	2. Describe the separation of the 125v Vital DC System into channels, including numbering, colors and to which unit they generally supply.
X	X	X	X	3. Identify which plant batteries are grounded.
				4. Deleted.
X	X	X	X	5. Describe or draw the single line for the 125v Vital DC System.

V. **TRAINING OBJECTIVES:** (continued)

AUO	RO	SRO	STA	
	X	X	X	6. Explain how the operator can tell if the 125v Vital Charger or the 125v Vital Battery is supplying power to the 125v Vital Battery Boards.
X	X	X	X	7. Explain why the BO reset switch (located at the 6.9kv SD logic panel) must be held in RESET until the affected 6.9kv SD DC Bus is energized.
X	X	X	X	8. Identify the failure position (open, closed, or "as is") of a 6.9kv or 480V Shutdown Board breaker upon loss of control power to that board.
X	X	X	X	9. Describe the status of the breaker indication lights for equipment fed from 6.9kv or 480V Shutdown Boards when control power is lost to the boards.
		X	X	10. Given the condition/status of the 125V DC Vital system/component and the appropriate sections of Tech Specs, determine if operability requirements are met and what actions, if any, are required.
X	X	X	X	11. State the 125V DC Vital system parameters governed by TS.
X	X	X	X	12. Describe or draw the single line of the 250v DC System.
X	X	X	X	13. Explain how the 250v DC Turbine Bldg Distribution Boards auto transfers on undervoltage.
				14. Deleted.
				15. Deleted.