Draft Submittal
(Pink Paper)

CATAWBA APRIL 2003 EXAM
50-413 & 50-414/2003-301

MARCH 31 - APRIL 4 &
APRIL 30, 2003

DRAFT COMBINED RO/SRO WRITTEN EXAM

(PART 1 OF 3)

Bank Question: 999 **Answer: A**

1 Pt(s) Unit 2 is operating at 23% power. Given the following events and conditions:

- 120VAC panel 2ERPA fails

Which of the following statements is correct?

REFERENCES PROVIDED: AP-29 Encl I4

A. DIG 2A cannot be run in manual and it will run in auto due to an emergency start signal.

B. D/G 2A cannot be run in manual and it will not run in auto due to an emergency start signal,

C. DIG 2A can be run in manual and it will not run in auto due to an emergency start signal.

D. DIG 2A can be run in manual and it will run in auto due to an emergency start signal.

Distracter Analysis:

A. Correct:
B. Incorrect: D/G 2A will run in auto due to an emergency start signal
Plausible: D/G 2A cannot be run in manual
C. Incorrect: D/G 2A cannot be run in manual and will run in auto due to an emergency start signal
Plausible: D/G2A cannot be run in manual and will run in auto due to an emergency start signa1
D. Incorrect: D/G 2A cannot be run in manual
Plausible: D/G 2A will run in auto due to an emergency start signal

Level: SRO&RO

KA: APE 057 AA106 (3.5/3.5)

Level of Knowledge: Comprehension

Lesson Plan Objective: EPL Obj: IS

Source: New

Resources:

1. **AP-29 Page** 108-111 PROVIDED

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the Vital Instrumentation and Control System	X	X	X	X	
2	Describe the operation of Kirk-Key interlocks	X	X	X	X	
3	Describe the operation of Battery Chargers	X	X	X	X	
4	Describe the operation of Batteries	X	X	X	X	
5	Describe the operation of Static Inverters	X	X	X	X	
6	Describe the operation of Manual Bypass Switches	X	X	X	X	
7	Describe the operation of Auctioneering Diode Assemblies	X	X	X	X	
8	Describe the basic actions required of an NLO for a loss of Vital or Auxiliary Control Power per AP/1/A/5500/29 (Loss of Vital or Auxiliary Control Power)	X	X			
9	Describe operation of the Vital I & C system when configured for normal alignment	X	X	X	X	X
10	Describe operation of the Vital I & C system when configured for a battery charger being removed from service	X	X	X	X	X
11	Describe operation of the Vital I & C system when configured for a battery being removed from service	X	X	X	X	X
12	Describe operation of the Vital I & C system when configured for an equalizing charge on a battery	X	X	X	X	X
13	Describe operation of the Vital I & C system when configured for an Inverter being removed from service	X	X	X	X	X
14	Sketch channel A of the Vital I & C system per training drawing CN-SYS-EL-EPL-I1	X	X	X	X	
15	Evaluate the impact a failure of any Vital I & C component will have on unit operation	X	X	X	X	X
16	Describe the Ground Detection controls and indications used at Catawba Nuclear Station	X	X	X	X	X
17	Describe how a ground is indicated OR the ground detection devices used at Catawba Nuclear Station	X	X	X	X	X
18	Given appropriate plant conditions, [illegible] y the Limits and Precautions [illegible] OP/1/A 335[illegible] (125 V[illegible] VAC Vitai Instrument and Control Power System	X	X	X	X	X

6. **The following status lights are energized:**
   - __ 2SI-16, A13 "NS Sys CPCS Trn A Inhibit"
   - __ 2SI-16, A/4 "VX Sys CPCS Trn A Inhibit".
7. **CA System:**
   - __ 2CAP5090 (Aux Feedwater flow 2A SIG) fails low
   - __ 2CAP5100 (Aux Feedwater flow 28 SIG) fails low.
8. **Diesel Generator 2A:**
   - __ 2FD-22 (DIG Eng Fuel Oil Bay Tnk 2A Fill) fails closed
   - __ DIG 2A can not be run in manual. It will run in auto due to an emergency start signal but the Low-Low Lube Oil Pressure trip logic is reduced from 2/3 to 1/2
   - The following VD dampers fail open:
     - __ 2DSF-D-2 (Diesel Bldg Return Air Damper 2A2)
     - __ 2DSF-D-4 (Diesel Bldg return Air Damper 2A1).
   - The following VD dampers fail closed:
     - __ 2DSF-D-1 (Diesel Bldg Outside Air Darnper 2A2)
     - __ 2DSF-D-3 (Diesel Bldg Outside Air Damper 2A1).
9. EMF **System:**
   - The following are inoperable:
     - __ 2EMF-53A (2WL-825A and 2WL867A will close when power is restored to ERPA)
     - __ Chart recorder 2MICR5380 (Cont Radiation, Unit Vent Radiation).
10. **EHM System:**
    - __ Chart recorder 2MICR5340(Cont Sump WIR bevel, H2 Analysis, Cont W/R Press) is inoperable.

Bank Question: 998 *Answer: D*

1 Pts

Unit 1 was operating at 100% power.

Which one of the following malfunctions could occur and still have train **A** of KC remain operable?

A. **1A2 KC pump has failed**

B. **1A surge tank has been drained**

C. **1A KC heat exchanger is being cleaned**

D. **1A ND heat exchanger KC side has a flow blockage**

Distracter Analysis: Tech Spec 3.7.7 bases states:

A CCW train is considered OPERABLE when:
a. Both pumps and associated surge tank are OPERABLE; and
b. The associated piping, valves, heat exchanger, and instrumentation and controls required *to* perform the safety related function are OPERABLE. The isolation of CCW from other components or systems not required for safety may render *those* components or systems inoperable but does not affect the OPERABILITY of the CGW System

A. **Incorrect** Required **to** have BOTH KC pumps operable – each pump has 50% capacity
Plausible: the 1B KC pump remains operable

B. **Incorrect:** Required to have the associated surge tank operable
Plausible: The pumps have sufficient NPSHA with the surge ***tank*** empty provided the piping up ***to*** the *tank* is filled (per Tech–Spec Bases 3.7.7

C. **Incorrect:** when cleaning the Hx, the HX is drained
Plausible: KC flow is routed through the 1B Hx to maintain KC system flow while cleaning

D. **Correct: Although** the 1A ND HX would be inoperable, the 1A KC train remains operable.

Level: RO&SRO

K/A: ***SYS*** 008 G2.2.25 (2.5/3.7)

Lesson Plan Objective: KC Obj: 13

Source: New

Level of Knowledge: comprehension

References:
1.OP-CN-PSS-KC pages 13, 19
2. Tech Spec 3.7.7 bases

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the KC System.	X	X	X	X	
2	Describe how the KC System is cooled.	X	X	X	X	
3	Describe the normal flowpath of the KC System, including each header and the type of loads serviced by each.	X	X	X	X	X
4	Explain what happens in the KC System during: - Safety injection (Ss) - Phase A Containment Isolation (St) - Phase B Containment Isolation (Sp) - Blackout - bow bow KC Surge Tank bevel	X	X	X	X	X
5	Given appropriate plant conditions, apply limits and precautions associated with OP/1(2)/A/6400/005 (Component Cooling Water System)	X	X	X	X	X
6	State the typical values of the KC pump discharge pressure, KC Hx outlet temperature and KC pump flow.	X	X	X	X	X
7	State the basic actions required of an NLO for a loss of Component Cooling Water and why.	X	X			
8	Describe KC system makeup.	X	X			
9	Draw a block diagram of the KC system per the KC System Simplified Drawing.	X	X			
10	Explain when the Chemistry group is to be notified concerning the KC system.	X	X	X	X	X
11	Describe the purpose of the EMF's associated with the KC System and what is indicated by a high level radiation alarm.	X	X	X	X	X
12	List the instrumentation available in the control room for the KC System.			X	X	
13	When given a set of plant conditions and access to reference materials, determine the actions necessary to comply with Tech Spec/SLC's.			X	X	X
14	Discuss the supplementary actions for the loss of KC AP.			X	X	X

b) NCDT and **Excess** Letdown Hx's

1) Flow controlled

2) Containment isolation for excess letdown is controlled from the NV board.

H. KC Drain header and Drain Sump

1. Containment drain isolations will close on St.

2. KC Drain Header Loop Seal

a) Located outside containment downstream of drain header containment penetration.

b) Allows drain header to **be** aligned during all modes of operation.

3. One 500 gal. steel lined covered sump per unit.

a) 2 pumps **per** sump - Aux. Bldg 522'

b) Able to discharge to:

1) NR Chiller Surge Tank

2) Other Unit's Sump

3) KC Surge Tank

4) Mixing and Settling Tank

2.2 Operation

A. Technical Specifications and Selected Licensee Commitments (OBJ. #13)

1. Refer to Technical Specification 3.7.7(Component Cooling Water (CCW) System) and Bases.

2. Refer **to** Selected Licensee Commitments 16.7-10 (Radiation Monitoring For Plant Operations)

B. KC System Limits and Precautions and Special Lineups.

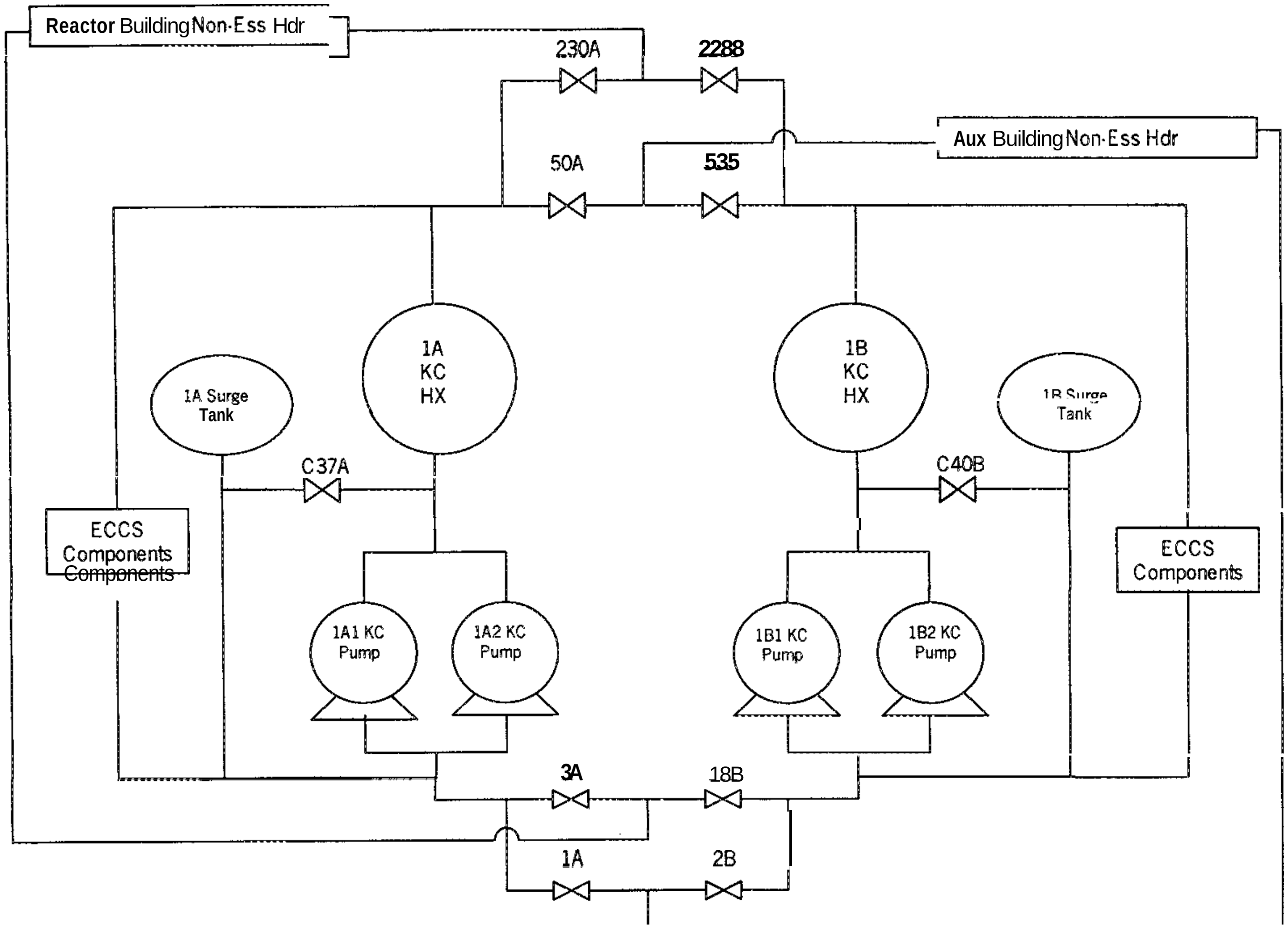
1. Review Limits and Precautions per OP/1/A/6400/05 (OBJ. #5)

2. KC System Alignment for KC Heat Exchanger Cleaning (O-C95-169)

a) Alignment is used to maintain the "availability" of all essential heat loads associated with the KC Train having its heat exchanger cleaned.

b) The KC Train containing the Heat Exchanger which is not being cleaned supplies all Train A and B component loads.

KC System Simplified Drawing



BASES

APPLICABLE SAFETY ANALYSES (continued)

assumed (Ref. 1). This 120°F limit is to prevent thermal degradation of the large pump motors supplied with cooling water from the CCW System.

The CCW System is designed to perform its function with a single failure of any active component, assuming a loss of offsite power.

The CCW System also functions to cool the unit from RHR entry conditions (T_{cold} < 350°F), to MODE 5 (T_{cold} < 200°F), during normal and post accident operations. The time required to cool from 350°F to 200°F is a function of the number of CCW and RHR trains operating. One CCW train is sufficient to remove decay heat during subsequent operations with T_{cold} < 200°F. This assumes a maximum service water temperature of 100°F occurring simultaneously with the maximum heat loads on the system.

The CCW System satisfies Criterion 3 of 10 CFR 50.36 (Ref. 2).

LCO

The CCW trains are independent of each other to the degree that each has separate controls and power supplies and the operation of one does not depend on the other. In the event of a DBA, one CCW train is required to provide the minimum heat removal capability assumed in the safety analysis for the systems to which it supplies cooling water. To ensure this requirement is met, two trains of CCW must be OPERABLE. At least one CCW train will operate assuming the worst case single active failure occurs coincident with a loss of offsite power.

A CCW train is considered OPERABLE when:

a. Both pumps and associated surge tank are OPERABLE; and

b. The associated piping, valves, heat exchanger, and instrumentation and controls required to perform the safety related function are OPERABLE.

The isolation of CCW from other components or systems not required for safety may render those components or systems inoperable but does not affect the OPERABILITY of the CCW System.

Bank **Question:** *363.1* Answer: A

1 Pt(s) Unit 2 is in mode *6* **and** refueling operations **are** currently in progress. Given the following events and conditions:

- The Fuel Handling Manipulator Crane Operator (FHMCO) has indexed the mast **over** the location where fuel assembly **M-8** will be inserted.
- **All** conditions/indications on the fuel handling manipulator crane are satisfied for inserting the fuel assembly located at **H-8,** in accordance with procedure.

Which one of the following statements describes the responsibility of the "Operator at the Controls", associated with inserting the fuel assembly'?

A. Receives notification of assembly insertion from the Fuel Handling SRO, and tracks core response **to** reactivity changes,

B. Relays information concerning core reactivity from the control room to the Fuel Handling SRO prior to unlatching ***the*** assembly.

C. Grants permission to the FHMCO for inserting the fuel assembly from the control **room** via the engineer communicating with the refueling crew.

D. Verifies proper 1/m plot results and gives permission **to** the Fuel Handling SRO ***to*** unlatch the assembly.

Distracter Analysis:

A. Correct:
B. Incorrect: RE relays information to the FHSRO
Plausible: The infomation is gathered in the CR
C. Incorrect: the **FHSRO authorizes** inserting the assembly.
Plausible: if the candidate **thinks** the refueling is controlled from the CR
D. Incorrect: the FHSRO authorizes inserting the assembly - monitor 1/**m** process periodically.
Plausible: this would bc the logical practice if the **OATC was** in charge.

Level: RO&SRO

KA: G 2.2.27 *(2.4 13.5)*

Lesson Plan Objective: FHS SEQ 11

Source: **Bank**

Level of **knowledge:** memory

References:
1. OP-CN-FH-FHS **pages 17**
2. NSD 304 **page 13**
3. NSD 414 **page 5**

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
10	Describe the interlocks associated with the fuel handling auxiliaries. • List the requirements for bypassing fuel handling interlocks			X	X	X
11	Given appropriate plant conditions, apply limits and precautions associated with related station procedures.			X	X	X
12	Describe the function and use of the refueling circuit of the sound powered phone system during refueling.			X	X	X
13	State from memory all T.S actions for the applicable systems, subsystems and components which require remedial action to be taken in less than 1 hour.			X	X	
14	Describe the automatic actions associated with 1EMF-17 and 2EMF-2 Reactor Building Refueling Bridge Monitor			X	X	X

1) Sounds containment evacuation alarm

2) Containment evacuation alarm is blocked when both source range high flux trips are blocked.

c) Symptom for entry to AP/025 (Damaged Spent Fuel).

6. Limits and Precautions of Fuel Handling Bridges (Obj. #11)

a) Refer to latest copy of OP/1-2/A/6550/006 (Transferring Fuel with the Spent Fuel Manipulator Crane) and OP/1-2/A/6550/007 (Reactor Buiiding Manipulator Crane Operation).

E. Mast Travel Within Refueling Cavity (Obj. #7)

1. Bridge and Trolley positions are mutually interlocked to limit the fuel mast to a path of travel that clears the guide stud in the core area, and travel is limited to an area over the core.

a) To travel to the transfer system, *fuel* must be on centerline of the transfer system.

b) Mast cannot be moved off the centerline until bridge reaches end of travel.

c) Bridge and trolley can be moved over RCC change fixture area (Not used).

d) Bridge and trolley tracks have index marks for pfoper positioning.

F. Selected License Commitments (Obj. #6)

1. Commitments for opefation and surveillance (Rx. **Bldg.** Cranes). (SLC 16.9.29)

2. Bases for SLC **16.9-19.**

2.3 Fuel Handling Auxiliaries

A. The Catawba Nuclear Station is **served** with systems which support the overall refueling operation. These Fuel Handling Auxiliaries provide for:

1. Handling of New Fuei from receipt to deposit in New Fuel elevator. Refer to latest copy of AP/0/A/5500/33, (Damaged or Missing Tamper Seals on Special Nuclear Material Shipments) (Obj. #2))

2. Transfer of New Fuel from the New Fuei Storage Vault to the New Fuei elevator.

3. Transfer of assemblies from the Reactor Building to the Spent Fuel Pool and vice versa.

2. Fuel handlers and Reactor Engineers must be aware of Technical Specification limits placed on storage locations in the SFP building.
3. Fuel movement/control component movement shall be performed in accordance with approved, in-hand, procedures. These procedures must provide controls to ensure the prevention of mispositioned Fuel Assemblies or Control Components.
4. Procedural controls shall be in place to ensure that the required shutdown margin as defined by Technical Specification is maintained.

Reactivity management during Defueling/Refueling:

1. Fuel movement sequence shall be reviewed and approved by a Qualified Reactor Engineer.
2. 1/m plots or count rate trending with specified maximum thresholds shall he performed during core reload
3. Reactor Systems Engineering support shall be on site and available to the control room/refueling booth during core reload in order to provide technical assistance to the Licensed Operators. A Licensed Operator will track core response to reactivity changes.
4. Core reload shall be considered an Infrequently Performed Test Evolution (IPTE). (see NSD 213)
5. A Qualified Reactor Engineer shall evaluate alternate fuel assembly moves in the core. The Refueling SRO shall approve all moves.

Reactivity management during Dry Cask Storage evolutions:

1. Verify Dry Cask Storage Qualifications Curve is correct.
2. A Qualified Reactor Engineer must approve all fuel moves.

304.6.6.2 Startup Operations

Scope: The following controls apply during reactor startups from the source range to criticality.

Special attention should be given to control of and the effects of "locked out" or "out of service" computer points.

Verify cycle specific constants are incorporated into applicable software and procedures for the particular stage in core life.

- A Qualified Reactor Engineer shall be in the control room during the approach to criticality in order to assist Licensed Operators in tracking of core response to reactivity changes and to provide technical assistance.
- Estimated Critical Predictions and 1/m plots shall be used to assist Licensed Operators in controlling the rate of reactivity insertion. Count rate trending with specified maximum thresholds may be used in lieu of 1/m plots during an initial cycle dilution, prior to initiating an approach to criticality.
- Estimated Critical Positions (ECPs) and Estimated Critical Borons (ECBs) shall be performed independently by a Qualified Reactor Engineer and a Licensed Operator.
- Licensed Operators shall be cautioned to expect criticality at all times during reactivity additions.
- Startups shall be treated as Infrequently Performed Test Evolutions (IPTE) and controlled as such. (see NSD 213)
- Conduct of operations governing the approach to criticality shall include the following:
  1. Pre-job briefing before the approach to criticality.
     - An emphasis on Licensed Operator's responsibility for the core.
     - An emphasis on the need for conservative actions and strict compliance with approved procedures

414.2.6 FUEL HANDLING ADVISORS (VENDOR)

A. Provide expertise for fuel handling activities (including industry knowledge).

B. Participate as an active member of the Fuel Handling Team.

C. Can do the following:

- Review procedures.
- Provide "hands on" skills as requested by the Fuel Handling Coordinator.

414.2.7 OPERATIONS SHIFT MANAGER (OSM)

A. During fuel movement, fuel receipt, special projects, and dry cask storage:

1. Ensure SRO's/RO's are cognizant of all fuel handling activities in progress or planned.
2. Maintain awareness of any activities that could impact fuel handling activities and ensure appropriate fuel handling personnel are aware of these activities.
3. Ensure appropriate response and notifications to any abnormal fuel handling event.
4. Has ultimate responsibility for the safety of the reactor core and fuel stored on site.

414.2.8 CONTROL ROOM SRO AND RO

A. During fuel movement, fuel receipt, special projects, and dry cask storage:

1. Monitor the Nuclear Instrumentation during core alterations.
2. Implement any responses required by Abnormal Procedures.
3. Log, verify, and maintain Technical Specification for Mode 6, Core Alterations, and other Technical Specifications for Spent Fuel Building activities.
4. Maintain awareness of fuel handling and Spent Fuel Building activities (i.e. - logging, turnover, etc.).
5. Maintain awareness of core configuration during core alterations.

414.2.9 LICENSED SRO RESPONSIBLE FOR FUEL HANDLING

A. During core alterations:

1. Shall "directly observe" and provide oversight of fuel handling activities which are considered core alterations. The Fuel Handling SRO must be in the Reactor Building in order to "directly observe".
2. Shall have an active SRO License or a SRO license limited to fuel handling.
3. Ensure all fuel handling activities are performed in a safe and efficient manner in accordance with approved procedures.
4. Maintain a working knowledge of procedures and Technical Specifications associated with fuel handling and command immediate action as required.
5. Ensure corrective action is initiated for problems occurring on their assigned shift.
6. Ensure communications are handled in a professional manner during core alterations.
7. Approve use of fuel handling bypass interlocks as necessary when not specified by an approved procedure.

1 Pt(s) Unit 1 was operating at 100% with the pressurizer level controller in the 1-2 position. Given the following initial response:

- Charging flow reduces to minimum
- Backup heaters immediately energize
- Actual level begins to decrease

Which one of the following failures has occurred to cause **this** plant response?

A. **PZR** level channel **1** detector reference leg has ruptured

B. **PZR** level channel **1** detector variable leg has ruptured

C. **PZR** level channel **2** detector reference leg has ruptured

D. **PZR** level channel **2** detector variable leg has ruptured

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Distracter Analysis:

A. Correct answer - a leak in the reference leg causes the pressurizer channel to sense a high level condition - which causes the system response as indicated. Actual pressurizer level decreases initially due to charging flow decreasing while letdown remains in service.

E. Incorrect: - variable leg rupture causes channel 1 to sense a low PZR level - actual level will increase not decrease initially
Plausible: - if the candidate thinks that this will cause a high level

C. Incorrect: - will cause channel 2 to sense a high level - will not get heaters deenergizing - only get a high level alarm
Plausible: - if the candidate confuses the plant response for channel 2 - thinks that channel 2 controls

D. Incorrect: - pressurizer level would increase not decrease
Plausible: - if the candidate confuses the direction of the pressurizer level failure or doesn't recognize plant response - this is very similar to a channel 1 high failure only the actual level increase instead of decreases

Level: RO&SRO

KA: APE 028 K1.01 (2.8*/3.1*)

Lesson Plan Objective: ILE Obj: *6*

Source: Bank

Level of knowledge: analysis

References:
1. OP-CN-IC-ILE page 15, 16

OBJECTIVES

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the Pressurizer Level Control (ILE) System.			X	X	
2	Describe the pressurizer level control program including values and signal sources for program development.			X	X	X
3	Describe why a cold calibrated channel is required.			X	X	
4	Describe the response of ILE system to a deviation of pressurizer level from program value.			X	X	X
5	Discuss control room controls and indications associated with ILE.			X	X	X
6	Describe ail automatic functions, alarm and control, that occur when pressurizer level deviates from program level, including setpoint changes and level channel failures.			X	X	X
7	Describe protection signals, trips, interlocks and permissives associated with ILE including setpoints.			X	X	X
8	Describe the actions which must be taken to restore pressurizer heater operation following a pressurizer low level heater cutoff.			X	X	X
9	Explain ILE system operation during startup, shutdown and normal operation.			X	X	
10	Given appropriate plant conditions, apply the limits and precautions associated with the ILE system.			X	X	X
11	Given a set of specific plant conditions and access to reference materials, determine the actions necessary to comply with Tech Specs/SLCs.			X	X	X
12	Given a set of specific plant conditions and required procedures, apply the rules of usage and outstanding PPRBs to identify the correct procedure flow path and necessary actions.			X	X	X

TIME: 2.0 HOURS

d) High level — greater than or equal to 70% of Level Span

e) High level alert 1/3 — 92% of Level Span

B. Limits and Precautions - When any pressurizer water level channel is removed from service the PRESSURIZER LEVEL CONTROL SELECT switch should be set such that an alternate channel is used for control action.

2.6 System Operations

A. Unit Startup **(OBJ. #9)**

1. Before startup, the reactor coolant loops and pressurizer are filled completely with water.
2. After venting is complete, the Reactor Coolant System is pressurized.
3. When pressurizer temperature exceeds saturation temperature for existing pressure, a steam bubble is formed while pressure is maintained at the desired value (approx. 50 psig).
4. Pressurizer level is reduced manually until the no-load PZR level is reached.
5. Level control may be switched to manual to maintain water level during heatup. Charging and letdown are controlled using additional controls associated with the Chemical and Volume Control System. Refer to descriptions of this system for further operating information.

B. Normal Operation **(OBJ. #9)**

1. During normal operation, pressurizer level is maintained automatically with the pressurizer level control system controlling NV-294 to maintain level at programmed level.

C. Unit Shutdown **(OBJ. #9)**

1. Pressurizer heaters are de-energized and spray flow is manually controlled to cool the pressurizer.
2. Charging flow will be controlled to raise PZR level to approximately 85% level. Cooldown of PZR is accomplished with ND spray.

D. Abnormal Operation **(OBJ. #12)**

1. Electrical Faults

   a) Controlling Channel fails high

      1) Charging flow reduced to minimum rapidly
      2) Backup heaters come on immediately.
      3) Level drops steadily until low level reached (assuming no operator action). NV-1A closes (NV-2A remains open)
      4) Letdown secures at less than 17% from Backup Channel

5) Heaters off at less than 17% from Backup Channel
6) Level will begin to rise after L/D secures until high level trip setpoint is reached. (Assuming no operator action)
7) Operator Action - Switch level control select to operable channel.

b) Controlling Channel fails low
1) Letdown isolation immediately
2) Heaters off immediately. NV2A closes (NVIA remains open)
3) Full Charging flow established rapidly
4) High level trip when setpoint is reached. (Assuming no operator action)
5) Operator Action - Switch level control select to operable channel

c) Backup Controlling Channel fails high
1) No effect
2) Operator action - Switch level control select to operable channel

d) Backup Controlling Channel fails low
1) Letdown Isolation immediately. NV-1A closes (NV-2A remains open)
2) Heaters off immediately
3) Level increases slowiy
4) Charging flow will reduce to minimum
5) Level will begin to rise after L/D secures until high level trip setpoint is reached. (Assuming no operator action)
6) Operator Action - Switch level control select to operable channel

e) Any channel failed high if not selected
1) No Effect

f) Any channel failed low if not selected
1) Noeffect

g) T_{avg} fail high
1) No effect at 100% power
2) Less than 200% power, level will rise steadily to 55% Pzr lvl
3) Operator action - Defeat defective T_{avg} channel

h) T_{avg} fail low
1) No effect (auctioneered Hi is used by the circuitry)

Bank Question: 508.1 **Answer: D**

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1 Pts

Unit 2 is responding to a main steam line break inside containment. Given the following events and conditions:

- containment pressure is 0.1 psig
- The pressurizer is solid
- ES-I.1 (*Safety Injection Termination*) has been implemented

Which one of the following statements correctly describes the status of the ECCS systems upon successful completion of ES-1.1?

A. One NS pump running **to** provide containment pressure control

B. One ND pump running to provide adequate heat removal

C. One NI pump running to provide adequate inventory control

D. One NV pump running to provide a normal charging lineup

Distracter Analysis:

A. Incorrect: NS pumps are secured in ES-1.1, step **14**
Plausible: If candidate does not know major actions of ES- .1

B. Incorrect: ND pumps are secured in ES-1.1, step 1
Plausible: If candidate does not know major actions of ES- .1

C. incorrect: NI pumps are secured in ES-1.1, step 1l
Plausible: If candidate does not know major actions of ES-1.1

D. Correct:

Level: RO&SRO

WA: APE WE01 EK3.3 (3.8/4.0))

Lesson Plan Objective: EP2 Obj: 2,9

Source: Mod NRC Catawba 1999

Level of Knowledge: memory

References:
1. OP-CN-EP-EP2 page 9
2. ES-1.1pages 10-12

LP OBJECTIVES

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the Purpose of EP/1/A/5000/E-1 (Loss of Reactor or Secondary Coolant)			X	X	X
2	State the Purpose of EP/1/A/5000/ES-1.1 (SI Termination)			X	X	X
3	State the Purpose of EP/1/A/5000/ES-1.2 (Post LOCA Cooldown and Depressurization)			X	X	X
4	State the Purpose of EP/1/A/5000/ES-1.3 (Transfer to Cold Leg Recirculation)			X	X	X
5	State the Purpose of EP/1/A/5000/ES-1.4 (Transfer to Hot Leg Recirculation)			X	X	X
6	State the Purpose of EP/1/A/5000/ECA-1.1 (Loss of Emergency Coolant Recirculation)			X	X	X
7	State the Purpose of EP/1/A/5000/ECA-1.2 (LOCA Outside Containment)			X	X	X
8	Explain the Bases of the Major Actions of EP/1/A/5000/E-1 (Loss of Reactor or Secondary Coolant)			X	X	X
9	Explain the Bases of the Major Actions of EP/1/A/5000/ES-1.1 (SI Termination)			X	X	X
10	Explain the Bases of the Major Actions of EP/1/A/5000/ES-1.2 (Post LOCA Cooldown and Depressurization)			X	X	X
11	Explain the Bases of the Major Actions of EP/1/A/5000/ES-1.3 (Transfer to Cold Leg Recirculation)			X	X	X
12	Explain the Bases of the Major Actions of EP/1/A/5000/ES-1.4 (Transfer to Hot Leg Recirculation)			X	X	X
13	Explain the Bases of the Major Actions of EP/1/A/5000/ECA-1.1 (Loss of Emergency Coolant Recirculation)			X	X	X
14	Explain the Bases of the Major Actions of EP/1/A/5000/ECA-1.2 (LOCA Outside Containment)			X	X	X
15	Explain Enclosure 1 (Foldout Page) actions of EP/1/A/5000/E-1 (Loss of Reactor or Secondary Coolant)			X	X	X

2. ES-1.1, (Si Termination) is entered from E-0, (Reactor Trip or Safety Injection); E-1, (Loss of Reactor or Secondary Coolant); or FR-H.1, (Response to boss of Secondary Heat Sink), when the specified criteria was satisfied. Following the termination of SI and stabilization of the plant, ES-1.1 is exited to a plant recovery procedure based on the availability of the NC pumps and whether a plant cooldown is required.

B. Major Action Summary

1. Sequentially Reduce SI Flow

a) The appropriate criteria for reducing SI flow should have been satisfied prior to entry into ES-1.1. The operator will reset the SI and Containment Isolation Signals to allow him to manually operate the safeguards components. One charging pump is stopped and NC pressure is checked. If NC pressure decreases after the charging pump is stopped then leak flow or NC system shrink is greater than Si flow and transition is made to E-1, (Loss of Reactor or Secondary Coolant) for further action and diagnosis. Stable or increasing NC pressure indicates that one charging pump flow is adequate and normal charging is aligned. Pressurizer level is controlled with charging flow. If Pressurizer level cannot be maintained, injection flow is realigned and transition made to ES-1.2 (Post LOCA Cooldown and Depressurization), If normal charging can maintain Pressurizer bevel, then the operator checks NC pressure to determine if he can stop the NI pumps. If NC pressure is stable or increasing and greater than the shutoff head of the NI pumps, then both pumps are stopped. If criteria for stopping the NI pumps cannot be satisfied then transition is made to ES-1.2 for further action. If both NI pumps can be stopped, then the operator will also stop the ND pumps and continue in ES-I.1 to realign and control the plant.

2. Verify SI Flow Not Required

a) After the SI pumps are stopped, the operator will verify that SI flow *is* no longer required by verifying NC subcooling and pressurizer level. If NC subcooling is less than required, SI pumps are manually started and a transition is made to E-I, (boss of Reactor or Secondary Coolant). If Pressurizer level is less than required, charging flow is controlled to maintain level. If this is not possible SI pumps are manually started and a transition is made to E-I.

3. Realign the Plant to Pre-SI Configuration

a) When the operator verifies that SI flow is not required, the plant is realigned into a pre-SI configuration and pressurizer level, NC pressure, and NC T-hots are stabilized.

4. Maintain the Want in a Stable Condition

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
10. Control **charging as follows:**	
__ a. Control charging flow to maintain Pzr level stable.	
__ **b.** Verify **Pzr** level - STABLE **OR** INCREASING.	b. IF Pzr level is decreasing, THEN: 1) Open the following valves: • 1NI-9A (NV Pmp C/L Inj Isol) __ • 1NI-10B (NV Pmp C/L Inj Isol). 2) Close the following valves: __ • 1NV-312A (Chrg Line Cont Isol) __ • 1NV-314B (Chrg bine Cont Isol) __ 3) ___ ___ EP/1/A/5000/ES-1.2 (Post LOCA Cooldown And Depressurization),
11	
a. Verify the following conditions are satisfied: __ • NC pressure - STABLE **OR** INCREASING __ • NC pressure - GREATER THAN 1620 PSIG.	**a.** Perform the following: __ 1) __ any S/G is faulted, _____ do not continue until faulted S/G depressurization stops. __ 2) __ no S/G is faulted —— conditions for stopping NI pumps cannot be satisfied after faulted S/G depressurization stops, ________ ___ EP/1/A/5000/ES-1.2 (Post LOCA Cooldown And Depressurization).
__ b. Stop NI pumps.	
12.	

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
13.	
__ a. NC subcooling based on core exit T/Cs - GREATER THAN 0°F.	a. Perform the following: __ 1) Manually start S/I **pumps** and align valves **as** necessary to restore NC subcooling. __ 2) ___ ___ EP/1/A/5000/E-1 (Loss Of Reactor Or Secondary Coolant).
__ b. Pzr level - GREATER THAN **11%** (**20%** ACC).	b. Perform the following: __ 1) Control charging flow *to* restore Pzr level to greater than 11% (20% ACC). **2)** __ Pzr level cannot be maintained greater than 11% (20% ACC), ____: __ a) Manually **start** S/I **pumps** and align valves as necessary to restore Pzr level. __ b) ___ ___ EP/1/A/5000/E-1 (Loss *Of* Reactor Or Secondary Coolant).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
14.	
___ a. At least one NS pump - ON.	**a.** Perform the following: ___ 1) ___ ___ ___ ___ an NS pump(s) **starts** while in this arocedure, _____ perform **Step 14.** ___ 2) ___ ___ **Step 15.**
b. Verify the following valves - OPEN: ___ • 1FW-27A (NB Pump I A Suct From FWST) ___ • 1FW-55B (ND Pump 1B Suct From FWST).	**b.** Perform the following: ___ 1) _____ containment pressure is less than 1 PSIG, _____ perform Steps 14.d through 14.g. ___ 2) ___ ___ Step 15.
___ c. Containment pressure - LESS THAN **2.4** PSIG.	c. Perform the following: ___ 1) _____ containment pressure is less than 2.4 PSIG, _____ perform Step 14. ___ 2) ___ ___ Step 15
___ d. Verify operating NS pump(s) - HAVE REMAINED RUNNING SINCE INITIAL PHASE B SIGNAL.	___ d. _ ***NS*** pump(s) has previously been stopped, __________ Step 15.
___ e. Reset NS.	
___ f. Stop NS pumps.	
g. **Close** the following valves: ___ • 1NS-29A (NS Spray Hdr 1A Cont **Isol)** ___ • 1NS-32A (NS Spray Hdr 1A Cont **Isol)** ___ • INS-158 (NS Spray Hdr 1B Cont **Isol)** ___ • 1NS-12B (NS Spray Hdr 1B Cant **Isol).**	

MODIFIED: NRC CATAWBA 1999

Bank Question: 508 ***Answer: C***

1 Pt(s) Which one of the following statements correctly describes the status of the ECCS system upon successful completion of ES-I. 1 (Safety Injection Termination) following a steam line break if the ECCS system worked as designed?

A. **one NI pump running**

B. **one ND pump running**

C. **one NV pump running**

D. **one NS pump running**

Distracter Analysis:

A. **Incorrect:** **NI pumps** are secured in ES-1.1, step I I
Plausible: If candidate does not know **major** actions of ES-1.1

E. **Incorrect:** ND pumps are secured in ES-1.1, step 12
Plausible: Ifcandidate does not know major actions of ES-1.1

C. **Correct answer**

D. **Incorrect:** NS pumps are secured in ES-1.1, step 14
Plausible: if candidate does not know major actions of E§-I .I

Bank Question: 507 ***Answer: B***

I Pt(s)

Unit 2 is responding to a LOCA into the Auxiliary Building in ECA-1.2 (*LOCA **Outside** of Containment*). Upon completion of BCA-1.2, NC system pressure continues to decrease.

Which one of the following statements correctly describes the correct major action to assure proper method of removing decay heat under these conditions?

A. **Transition back to E-1 (*Loss of Reactor or Secondary Coolant).***

B. **Transition to ECA-1.1 (*Loss of Emergency Coolant Recirculation).***

C. **Transition to ES-1.2 *(Post LOCA cooldown and Depressurization*).**

D. **Transition** to **ES-1.3 (*Transition to Cold Leg Recirc*).**

Distracter Analysis: This question does not require the candidate to memorize procedure transitions. Instead, the candidate is expected to logically assess conditions (LOCA into the AUX BLD that cannot be isolated – pressure continues to decrease after completion **of** ECA-1.2) and deduce that the containment sump inventory is still being lost. The only correct procedure would be ECA-1.1 to address this problem. **All** other procedure transitions do not **work.**

A. **Incorrect:** Not the correct procedural transition if the NC system pressure continues to decrease (ie *leak* path not isolated).
Plausible: 'phis IS the correct procedure if the NC system pressure was stable ***or*** increasing.

B. **Correct:** continuing loss of inventory means that there may be insufficient water in containment for recirculation cooling

C. **Incorrect:** Transition to ES-1.2 not allowed, as the leak is not isolated.
Plausible: The name of the procedure is appropriate for the situation.

D. **Incorrect:** Transition to ES-1.3 not in accordance with the major action steps.
Plausible: Although many actions are the same, it is not the correct procedure.

Level: RO&SRO

KA: WE4 EA2.1 (3.4/4.3)

Lesson **Plan** Objective: EP2 Obj: ***6,*** 13

Source: Bank

Level of knowledge: comprehension

References:
1. OP-CN-EP-EP2 **page 12**
2. ECA-**1.2 page** 6

LP OBJECTIVES

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the Purpose of EP/1/A/5000/E-1 (Loss of Reactor or Secondary Coolant)			X	X	X
2	State the Purpose of EP/1/A/5000/ES-1.1 (SI Termination)			X	X	X
3	State the Purpose of EP/1/A/5000/ES-1.2 (Post LOCA Cooldown and Depressurization)			X	X	X
4	State the Purpose of EP/1/A/5000/ES-1.3 (Transfer to Cold Leg Recirculation)			X	X	X
5	State the Purpose of EP/1/A/5000/ES-1.4 (Transfer to Hot Leg Recirculation)			X	X	X
6	State the Purpose of EP/1/A/5000/ECA-1.1 (Loss of Emergency Coolant Recirculation)			X	X	X
7	State the Purpose of EP/1/A/5000/ECA-1.2 (LOCA Outside Containment)			X	X	X
8	Explain the Bases of the Major Actions of EP/1/A/5000/E-1 (Loss of Reactor or Secondary Coolant)			X	X	X
9	Explain the Bases of the Major Actions of EP/1/A/5000/ES-1.1 (SI Termination)			X	X	X
10	Explain the Bases of the Major Actions of EP/1/A/5000/ES-1.2 (Post LOCA Cooldown and Depressurization)			X	X	X
11	Explain the Bases of the Major Actions of EP/1/A/5000/ES-1.3 (Transfer to Cold Leg Recirculation)			X	X	X
12	Explain the Bases of the Major Actions of EP/1/A/5000/ES-1.4 (Transfer to Hot Leg Recirculation)			X	X	X
13	Explain the Bases of the Major Actions of EP/1/A/5000/ECA-1.1 (Loss of Emergency Coolant Recirculation)			X	X	X
14	Explain the Bases of the Major Actions of EP/1/A/5000/ECA-1.2 (LOCA Outside Containment)			X	X	X
15	Explain Enclosure 1 (Foldout Page) actions of EP/1/A/5000/E-1 (Loss of Reactor or Secondary Coolant)			X	X	X

A. Overview

1. Purpose: This procedure provides actions for transferring the safety injection system from the cold leg recirculation made to the hot leg recirculation mode.

2. ES-1.4 is entered from E-I (Loss of Reactor or Secondary Coolant) where the plant specific time for transferring to hot leg recirculation is reached. In this case a break in the NC system has occurred which is large enough to reduce the NC pressure to less than the shutoff head of the ND pumps. After the transfer has been completed the operator should return to E-I.

B. Major Action Summary

1. Align SI Flowpath for Hot **Leg** Recirculation

   a) Hot Leg recirculation is implemented to terminate boiling in the core and to prevent boron precipitation in the core.

C. Use the "Enhanced Background Document" for detailed step description.

2.6 EP/1/A/5000/ECA-1.1 (Loss of Emergency Coolant Recirculation)

A. Overview

1. Purpose: This procedure provides actions when emergency coolant recirculation capability is lost. This is defined as the inability to inject from the sump Fo the NC system using an ND pump.

2. ECA-1.1 can be entered from E-I, (boss *of* Reactor or Secondary Coolant), when cold leg recirculation cannot be verified to be available. Entry is made from ES-1.3, (Transfer to Cold beg Recirculation), when at least one flowpath from the sump cannot be established or maintained. **Also** entry can be made from ECA-1.2, (LOCA Outside Containment) when a LOCA outside containment cannot be isolated. If recirculation is restored at any time, the operator should return to the procedure and step in effect. If recirculation is not restored upon procedure completion the plant **staff** is consulted.

B. Major Action Summary

1. Continue attempts to Restore Emergency Coolant Recirculation.

   a) The operator is to try to restore the equipment needed for recirculation in order to avoid performing any extreme recovery actions. These actions will be continued throughout the procedure.

2. Increase/Conserve FWST Level

   a) Makeup **is** added to the FWST and FWST outflow is minimized by stopping any unnecessary containment spray pumps and decreasing SI pump flowrate.

3. Depressurize SGs to Cooldown and Depressurize the NC System

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
2. (Continued)	
c. Isolate NI header to cold legs as follows:	
1) Verify following NI pump miniflow valves - OPEN:	___ 1) Stop NI pumps.
___ • 1NI-115A (NI Pump 1A Miniflow Isol)	
___ • 1NI-144A (NI Pump 1B Miniflow Isol)	
___ • 1NI-147B (NI Pump Miniflow Hdr To FWST Isol).	
___ 2) Place the "PWR DISCON FOR 1NI-162A" in "ENABLE.	
___ 3) Close 1NI-162A (NI To C-Legs Inj Hdr Isol).	
___ 4) Verify NC pressure - INCREASING.	4) Perform the following:
	___ a) Open 1NI-162A.
	___ b) Place the "PWR DISCON FOR 1NI-162A" in "DISCON".
	___ c) **IF** the NI pumps were stopped, **THEN** start NI pumps.
3. Verify leak path is isolated as follows:	
___ a. NC pressure - INCREASING.	___ a. **GO TO** EP/1/A/5000/ECA-1.1 (Loss Of Emergency Coolant Recirculation).
___ b. Initiate actions as required to complete leak isolation.	
___ c. **GO TO** EP/1/A/5000/E-1 (Loss Of Reactor Or Secondary Coolant).	

END

Bank Question: 501 ***Answer: D***

1 Pt(s) Unit 2 was operating at 100% power when a terrorist attack in the control room caused the operators to rapidly evacuate to the Auxiliary Shutdown Panel. The operators were not able to perform AP/17 (Loss of Control Room) actions prior to evacuation at 0200.

The terrorists tripped the turbine but did not operate any other controls. There are no other local operator actions taken. Given the following steam generator narrow range levels:

	<u>0200</u>	<u>0202</u>	<u>0204</u>	<u>0206</u>	<u>0208</u>
2A S/G NR	65%	37%	22%	15%	**25%**
2B S/G NR	64%	38%	23%	18%	26%
2C S/G NR	**63%**	39%	25%	16%	24%
2D S/G NR	65%	38%	***26%***	20%	27%

Which one o the following statements describes the comp :te **list** of running feedwater pumps when the operators first arrive at the **ASP** at 0210 to take local control of the plant?

A. **Both motor driven CA pumps**

→ **B.** **Both motor driven CA pumps and the turbine driven CA pump**

C. **Both motor driven CA pumps and both CF pumps (at minimum speed)**

D. **Both motor driven CA pumps, the turbine driven CA pump and both CF pumps (at minimum speed)**

Distracter Analysis: The lo-lo setpoint for SGWL **is** 17%. This causes:

- Reactor trip - on 1 of **4** S/Gs in 2 of **4** channels
- MD **CA** pumps auto-start - on 1 of 4 S/Gs in 2 of **4** channels
- TD CA pump auto-start – on 2 of 4 S/Gs in 2 of **4** channels

A. **Incorrect:** CF pumps will not trip – this is done by **a** local operator action in AP-17, TD **CA** pump auto-starts.
Plausible: MD CA pumps will start when S/G levels < 17% on 114 S/Gs

B. **Incorrect:** The **CF** pumps wili continue to run until tripped by **local** operator action in AP-17
Plausible: The MD and TD **CA** pumps auto start

C. **Incorrect:** The TD **CA** pump will auto start.

Plausible: The MD **CA** pumps auto start and the CF pumps remain running

D. **Correct answer:**

Level: RO&SRO

KA: APE 068 AA1.12 (4.4/4.4)

Lesson Plan Objective: CP-RSS Obj: **4**

Source: Bank

Level of Knowledge: Analysis

References:
1. OP-CN-CP-RSS page 9, 16-21
2. OP-CN-IC-IFE page 23
3. OP-CN-CF-CA page 9

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the following associated with the general design criteria for the Auxiliary Shutdown Complex. • Operational Modes required to Maintain and Achieve • Requirements for permanent and temporary instrumentation	X	X			
2	Describe the Auxiliary Shutdown complex design criteria including the definition of the Aux. S/D complex.			X	X	X
3	List the system control panels that are considered part of the Auxiliary Shutdown Complex.	X	X			
4	State the general plant functions that can be controlled at the Aux S/D panels and list the controls available to accomplish these functions.			X	X	X
5	Describe the sources of AC and DC power required to satisfy Auxiliary Shutdown Complex design criteria.	X	X			
6	State the capabilities lost and the alternatives available following a plant fire that affects B train components on the Auxiliaw Shutdown Complex.	X	X			
7	List the two Control Room conditions that result in an evacuation of the Control Room.	X	X			
8	List the remote storage locations for each of the following enclosures of AP/1/A/5500/17 (Loss of Control Room) and the general actions taken for each: Turbine Bldg Operator Actions • Auxiliary Bldg Operator Actions • HVAC Actions	X	X			
9	Describe all control manipulations performed from areas throughout the plant during a control room evacuation event, per AP/1/A/5500/17 • Describe what the operator must do upon arrival at the Auxiliary S/D panels A, B and the CAPT panel • List the automatic actions which occur when the Aux S/D Panels are taken to local State the control signals and partial controi signals that are blocked when the Aux S/D panels are taken to local			X	X	X

D. Additional controls on Auxiliary Shutdown Panels that provide the capability to go to Cold Shutdown. (Obj. #4)

1. Residual Heat Removal Pumps and Valves
2. Component Cooling Pumps and Valves
3. Nuclear Service Water Pumps

E. Additional controls of the Auxiliary Shutdown Complex (Obj. #4)

1. VCNC Local Panels - HVAC Control Panels 1A and 1B located behind control room Elv. 594 Auxiliary Building.
   a) Auxiliary Building Ventilation Controls (VA)
   b) Control Room Ventilation Controls (VC) YC also in general area.
2. D/G panels A & B and associated ventilation system (Controls for *DIG* to provide essential power).
3. VI local panels located in Service Building basement (Used to start and control instrument air compressors for vital valves).

2.4 Controls and Indications of the Aux Shutdown Complex (Obj. #4)

A. ASP A & B Controls and Indications available

1. CA controls and indications.
2. Boric Acid control and indications.
3. NV control
4. ND control
5. KC and RN control and indications.
6. Pzr indications.
7. CLA indication
8. Sequencer reset
9. Transfer switch
10. SR indication

B. CAPT Panel Controls and indications available

1. Each *SIG* indications - (W/R bevel, SM press, CA flow)
2. Each S/G CA manual loader.
3. RN valves to CA pump suctions
4. S/G. PORVs
5. CAPT speed and start/stop control

Auxiliary Shutdown Panel A
Instrumentation And Controls Available For Hot Shutdown

INDICATORS:

Steam Generator A bevel

Steam Generator B Level

Steam Generator A Pressure

Steam Generator B Pressure

Auxiliary Feedwater Flow to Steam Generator A

Auxiliary Feedwater Flow to Steam Generator B

Auxiliary Feedwater Condensate Storage Tank Level Low

Condenser Hotwell Level Low

Upper Surge Tank bevel Low

Auxiliary Feedwater Pumps Train A boss of Normal Suction

Nuclear Service Water System Flow

Component Cooling Water System Flow

Charging Line Flow

Letdown Flow

Pressurizer Level

Pressurizer Pressure

Reactor Coolant Cold Leg Temperature & Hot Leg Temperature

Seal Injection Flow

Volume Control Tank Level

Boric Acid Flow

Boric Acid Tank bevel

LOCA Sequencer Activated **Status** Light

B/O Sequencer Activated Status Light

Diesel Generator A Status bight

Auxiliary Shutdown Panel Relay Status

NCS WR Press (Loop B)

SR Count Rate

Low Press Mode

Cold Leg Accumulator Discharge Isolation Valves

CONTROLS:

Auxiliary Shutdown Panel A Transfer Switch

Auxiliary Feedwater Motor A Start/Stop

Auxiliary Feedwater Pump A Normal Suction Valve CA11A

Auxiliary Feedwater Pump A RN Suction Valve CAI5A

Nuclear Service Water Supply Valve RN250A

Auxiliary Feedwater Pump A Discharge to Steam Generator A Isolation Valve CA62A

Normal Charging Flow Isolation Valve NV-39A

Auxiliary Feedwater Pump A Discharge to Steam Generator B Isolation Valve CA58A

Auxiliary Feedwater Pump A Auxiliary Feedwater to SG A Valve Position Selector Station (CA60)

Auxiliary Feedwater Pump A Auxiliary Feedwater to SG B Valve Position Selector Station (CA56)

Nuclear Service Water Pump A

Component Cooling Water Pump A I

Component Cooling Water Pump *A2*

Boric Acid Transfer Pump A

Centrifugal Charging Pump A

Component Cooling System Valves - KC1A, KC3A, KC50A, KC230A, KCC37A, KC56A

Chemical & Volume Control System Valves - NV-1A, NV-2A, NV-13A, NV-378, NV-11A, NV-186A, NV-172A, NV-238A, NV-148, NV-309, NV-294

PZR PORV's - NC-33A, NC-34A

PZR Heaters

Sequencer Reset

Residual Heat Removal System Valves - ND-2A, ND-37A

Residual Heat Removal Pump A

Auxiliary Shutdown Panel B
Instrumentation And Controls Available For Hot Shutdown

INDICATORS:

Steam Generator C bevel
Steam Generator D bevel
Steam Generator C Pressure
Steam Generator D Pressure
Auxiliary Feedwater Flow to Steam Generator C
Auxiliary Feedwater Flow to Steam Generator D
Auxiliary Feedwater Condensate Storage Tank Level Low
Condenser Hotwell Level Low
Upper Surge Tank Level bow
Auxiliary Feedwater Pumps Train B Loss of Normal Suction
Pressurizer Level
Pressurizer Pressure
Reactor Coolant Cold beg Temperature & Hot Leg Temperature
Nuclear Service Water System Flow
Component Cooling Water System Flow
Charging Line Flow
Seal Injection Flow
Volume Control Tank bevel
Boric Acid Flow
Boric Acid Tank Level
LOCA Sequencer Activated Status bight
B/O Sequencer Activated Status Light
Diesel Generator B Status bight
Auxiliary Shutdown Panel Relay Status
NCS WR Press (Loop C)
SR Count Rate
Low Press Mode
Cold Leg Accumulator Discharge Isolation Valves

CONTROLS:

Auxiliary Shutdown Panel B Transfer Switch

Auxiliary Feedwater Motor B Start/Stop

Auxiliary Feedwater Pump B Normal Suction Valve CA9B

Auxiliary Feedwater Pump B RN Suction Valve CA18B

Nuclear Service Water Supply Valve RN310B

Auxiliary Feedwater Pump B Discharge to Steam Generator C Isolation Valve CA46B

Auxiliary Feedwater Pump B Discharge to Steam Generator D Isolation Valve CA42B

Auxiliary Charging Flow isolation valve NV-32B

Auxiliary Feedwater Pump B Auxiliary Feedwater to SG C Valve Position Selector Station (CA44)

Auxiliary Feedwater Pump B Auxiliary Feedwater to SG D Valve Position Selector Station (CA40)

CA Sys. VLV Ctl Trn B Reset

Nuclear Service Water Pump B

Component Cooling Water Pump B1

Component Cooling Water Pump 82

Boric Acid Transfer Pump B

Centrifugal Charging Pump B

Component Cooling System Valves - KC2B, KC18B, KC53B, KC228B, KCC40B, KC815

Chemical & Volume Control Systems Valves -NV122B, NV123B, NV124B,NV125B, NV236B, NV309

PORV's - NC31B, NC32B, NC35B, NC36B

Pressurizer Heaters

Sequencer Reset

Residual Heat Removal System Valves - NC-1B, ND-36B

Residual Heat Removal Pump B

AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL INSTRUMENTATIONAND CONTROLS AVAILABLE FOR HOT SHUTDOWN

Indicators:

Steam Generator A bevel
Steam Generator **B** Level
Steam Generator C Level
Steam Generator D bevel
Steam Generator A Pressure
Steam Generator **B** Pressure
Steam Generator C Pressure
Steam Generator D Pressure
Auxiliary Feedwater Flow to Steam Generator A
Auxiliary Feedwater Flow to Steam Generator B
Auxiliary Feedwater Flow to Steam Generator C
Auxiliary Feedwater Flow to Steam Generator D
Steam Supply Press to CA Pump Turbine
Auxiliary Feedwater Pump Turbine Speed

Indicatinq Lights:

Steam Supply Valve *SA2* Open-Close
Steam Supply Valve SA5 Open-Close
Condenser Hotwell bevel
Upper Surge Tank bevel
Auxiliary Feedwater Condensate Storage Tank level
Auxiliary Feedwater Pumps boss **of** Normal Suction

Controls:

Auxiliary Feedwater Turbine Driven Pump Steam Brain Isolation TE33A

Auxiliary Feedwater Turbine Driven Pump Discharge to SG A Isolation Valve CA66B

Auxiliary Feedwater Turbine Driven pump Discharge to SG B Isolation Valve CA54B

Auxiliary Feedwater Turbine Driven Pump Discharge to SG C Isolation Valve CA50A

Auxiliary Feedwater Turbine Driven Pump Discharge to SG D [solation Valve CA38A

Auxiliary Feedwater Turbine Driven Pump Normal Suction Valve CA7A

Nuclear Service Water Supply Valve CA1 16A

Nuclear Service Water Supply Valve CA85B

Auxiliary Feedwater Pump Turbine Start/Stop

Auxiliary Feedwater Pumps Suction From Hotwell Isolation Valve CA2

Auxiliary Feedwater Pumps Suction From Upper Surge Tank Isolation Valve CA4

Auxiliary Feedwater Pumps Suction From CA Condensate Storage Tank Isolation Valve CA6

Steam Generator A Power Operated Relief Valve SV19

Steam Generator B Power Operated Relief Valve SV13

Steam Generator C Power Operated Relief Valve SV7

Steam Generator D Power Operated Relief Valve SV1

Steam Generators Power Operated Relief Valves Transfer Switch (Unit 1 Only)

Train A Auxiliary Feedwater Pumps Discharge Valves Auto-Start Alignment Reset Switches

Train A Ctrl. Xfer SW

Train B Ctrl. Xfer SW

3) A setting less than 0% sets "B" CFPT to assume more load than "A".

2.16 CFPT Response to Reactor/CFPT Trip (Obj. #16)

A. Reactor Trip

1. Each CFPT that is in Auto will Runback to 50% (2975 RPM) and have each Slave M/A Station selected to Manual. Both Train A and Train B Reactor Trip signals (P-4A and P-45) are required to initiate this runback*.
2. If that CFPT was in Manual when the trip occurred it will still Runback to 2975 RPM.
3. The operator may operate the CFPT in the Decrease direction only. Speed may be increased, but no higher than 2975 RPM.
4. In order to regain control of the CF pumps, one of two things must be done.
   a) Close the Reactor Trip Breakers (to clear P4).
   b) Select BYPASS on the Reactor Trip Bypass key operated switch.
5. When the breakers are closed, the Runback is armed. If the CFPT Speed is very close to 2975 RPM at the time the Reactor Trip occurs, the Runback need not be accomplished for obvious reasons but the M/A Station will still be switched to Manual and operator control still lost.

B. CFPT Trip

1. When the CFPT trips, the following occur:
   a) Slave is forced to Manual.
   b) Speed Demand runs back to ZERO.
2. When the trip condition clears, the CFPT can be started only after the operator ensures slave demand is at zero prior to raising speed.
3. If speed still cannot be increased after reducing the slave demand to zero, transfer of CFPT speed control to the local panel may be required to reset SGWLC (Refer to OP/1(2)/A/6250/001, Enc. 4.3 - Feedwater Pump Startup).

2.17 Unit Differences Summary (Obj. #17)

A. Steam Generator Level Ramp Programs

B. Feedwater Pump Speed Control DP Programs

C. Unit 2 SGWLC Runback Circuit

D. Nozzle Swap Logic and Permissives

2.18 Technical Specifications (Obj. #18)

A. Technical Specification 3.3.1 (Reactor Trip System Instrumentation)

1. Steam Generator LO-LO bevel

* P-4A and P-4B are required to ensure on-line reactor trip breaker testing cannot potentially cause an inadvertant CFPT runback to 50% speed.

b) Each of the suction reliefs has a lift setpoint of 150 psig and a capacity of 30 gpm.

c) Discharge of each suction relief valve is to the associated pumps sump.

2.2 Operation

A. Automatic Operation **(Obj # 4)**

1. Start Signals: Motor Driven Pumps 1(2) A & B

   a) Safety Injection: Train Related; Sequencer Activated (Load Group 8)

   b) Blackout: Train Related; Sequencer Activated **(Load** Group 8)

   c) Two of four S/G narrow range level channels in one of four S/G *LO LO* LEVEL *(2* of **4** L.S./1 of **4** S/G) (Unit 1: 11%; Unit *2:* 37%): **starts** both CA Pumps.

   d) Loss ***of*** Both Feed Pumps (2/3 LOW FPT Control Oil Pressure (less than 75 psi): starts both CA Pumps.

   e) AMSAC: Starts both CA Pumps.

      1) Loss of CF feed path AMSAC: This system is functioning when Turbine Impulse Pressure is greater than 40% Turbine Load and remains active for TWO (2) minutes after Turbine Load decreases to less than 40%.

         (a) 3/4 CF Containment Isolation Valves closed **(UNIT 1 ONLY)**

         (b) 3/4 Main Feed Regulating Valves less than 25% open with associated Bypass less than 50% open. After 30 Seconds of this condition AMSAC causes Both Trains of CA to Start.

      2) **boss** of Both Feed Pumps.

2. Start Signals: Turbine Driven CA Pump **# 1 &** 2

   a) Blackout on either 4160 Essential Bus; Sequencer activated

      1) On a concurrent B/O and SI, the TDCAP will NOT start.

      2) If an SI is received within 8.5 sec of a B/O, the TDCAP will NOT start.

      3) If an SI signal is received and clears but the SI is not reset and then a B/O **is** received, the TDCAP will not Start.

      4) All B/O initiated TDCAP starts WILL be delayed by 8.5 sec for the Sequencer B/O logic to run.

      5) If a B/O occurs and a subsequent SI occurs greater than 8.5 secs after the B/O, the TDCAP will autostart on the B/O and wiil continue to run at the time of the SI whether the "on/off" switch is in the "on" or **"ow'** position until the CA Sys is Reset.

Bank Question: 489.1 ***Answer: A***

1 Pt(s) Unit 1 was operating at 100% power following a refueling shutdown. **Unit 2** was shutdown in mode 6. It was discovered khat a spent **fuel** element from the unit 1 refueling had been incorrectly stored in a filler location in the spent fuel pool. The element had exceeded the burnup (GWD/MTU) requirements to qualify for storage in a filler location.

Which one of the following statements describes the correct action(s) required by Tech Specs to preserve spent fuel pool shutdown margin?

A. Immediately initiate action to move the non-complying fuel assembly to an unrestricted storage location.

B. Immediately initiate actions to move the non-complying fuel assembly to a restricted storage location and to shutdown Unit 1 Within **1** hour.

C. Initiate action to move the non-complying fuel assembly to a restricted storage location within one hour.

D. Initiate actions to move the uon-complying fuel assembly to **an** unrestricted storage location and to shutdown Unit 1 within **1** hour.

Distracter Analysis: Restricted locations in the spent fuel pool will **store** spent fuel elements that have lower burnout. Elements that have higher burnout must be stored in unrestricted areas.

A. Correct answer:

B. Incorrect: - moving the spent fuel element to a restricted location would violate Tech Spec 3.7.16. Tech Spec 3.0.3 does not apply – no need **to** shutdown unit 1.
Plausible: - If the candidate does not know the difference between restricted and unrestricted locations and thinks that Tech Spec 3.0.3 applies to this condition.

C. Incorrect: - must initiate action immediately – not qualified for storage in a restricted location.
Plausible: - 1 hour LCQs for important Tech Specs are common – a "restricted" area may imply more reactive elements should he stored there.

D. Incorrect: - must initiate action immediately - Tech Spec 3.0.3 does not apply.

Plausible: - 1 hour LCQs for important Tech Specs ***are*** common Tech Spec 3.0.3 requires initiating action to shutdown the unit within 1 hour.

Level: RO&SRO

K A SYS 033 K2.01 (3.0/3.5)

Lesson Plan Objective: KF Qbj: 19, 22

Source: Mod McGuire NRC 1999

Level **of** knowledge: comprehension

References:
1. OP-CN-FH-KF page 13
2. Tech Spec 3.7.16

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
21	Describe the automatic actions associated with the Spent Fuel Pool Building Refueling Bridge Monitors (1EMF-15 and 2EMF-4)			X	X	X
22	State from memory all Technical Specification actions for the applicable systems, subsystems, and components which require remedial action to be taken in less than one hour			X	X	

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose(s) of the KF System	X	X	X	X	
2	Given a drawing of the KF System, designate the major components and trace the system flowpaths for different modes of operation	X	X	X	X	
3	Given appropriate plant conditions, apply the Limits and Precautions associated with OP/1/A/6200/005.	X	X	X	X	X
4	Describe the function and operation of KF local controls	X	X	X	X	
5	State the type of power supplies to the KF Pumps	X	X	X	X	
6	State normal cooling water supply and cooling and purification loop flow rates	X	X	X	X	
7	Describe methods used to adjust spent fuel cooling and purification flow rates	X	X	X	X	
8	Describe why it is important to control purification loop flow	X	X			
9	State the normal skimmer loop flow rate	X	X	X	X	
10	Describe methods used to control KF skimmer loop flow	X	X	X	X	
11	Describe KF System interconnections with other systems	X	X	X	X	X
12	Describe parallel cooling loop operation	X	X	X	X	
13	State KC pump flow limitations when shifting spent fuel cooling loops per operating procedures	X	X	X	X	
14	Describe typical parameter values during normal operations	X	X	X	X	X
15	Describe system/operator action during abnormal conditions per AP/1/A/5500/26 (boss of Refueling Canal or Spent Fuel Pool bevel)	X	X	X	X	X
16	List the trips and interlocks associated with the KF System	X	X	X	X	X
17	State the volume/level relationship of the spent fuel pool			X	X	X
18	Describe draining the spent fuel pool to the FWST or RHT per the operating procedure			X	X	X
19	Given a set of specific plant conditions and access to reference materials, determine the actions necessary to comply with Technical Specifications and Selected Licensee Commitments			X	X	X
20	State the system designator and nomenclature for major components	X				

2. Flow ~ 100 gprn
6. Cooling Loop
   1. Flow - 2300 gpm
D. Purification Loop
   1. Flow - throttled to less than or equal to 265 gpm
E. KC Flow - 3000 gprn

2.3 Limits and Precautions (Qbj. #3)

A. Review current Limits and Precautions per OP/1/A/6200/005 (Spent Fuel Cooling System)

2.4 Technical Specifications and Selected Licensee Commitments (Obj. #19 and 22)

A. 3.7.14 (Spent Fuel Pool Water Level) (Requires that remediai action be taken "IMMEDIATELY")

B. 3.7.15 (Spent Fuel Pool Boron Concentration) (Requires that remedial action be taken "IMMEDIATELY")

C. 3.7.16 (Spent Fuel Assembly Storage) (Requires that remedial action be taken "IMMEDIATELY")

D. SLC 16.7-9 (Standby Shutdown System)

E. SLC 16.7-10 (Radiation Monitoring for Plant Operations)

F. SLC 16.9-21 (Refueling Operations-Storage Pool Water Level)

2.5 Pump Power Supplies (Obj. #5)

A. Fuel pool cooling pump A Safety Related 4160V Essential Buss ETA

B. Fuel pool cooling pump B Safety Related 4160V Essential Buss ETB

C. Fuel pool skimmer pump Non- Safety related Unit 600V Motor Control Center MXK

5. Fuel Transfer Canal Air Driven Unwatering Pump (VI)

2.6 Setpoints

A. Alarms
   1. Temperature
      a) 145°F (KC) at the outlet of KF pump motor cooler.
      b) 125°F high temp spent fuel pool.
   2. Flow
      a) 2600/2100 gpm KF HX high/low flow (KF)
      b) 3150/500 gpm below setpoint of controller KF HX high/low flow (KC)

3.9 PLANT SYSTEMS

3.7.16 Spent Fuel Assembly Storage

LCO 3.7.16 The combination of initial enrichment and burnup of each new or spent fuel assembly stored in the spent fuel pool storage racks shall be within the following configurations:

a. Unrestricted storage of fuel meeting the criteria of Table 3.7.16-1; or

b. Restricted storage in accordance with Figure 3.7.16-1, of fuel which does not meet the criteria of Table 3.7.16-1.

APPLICABILITY: Whenever any fuel assembly is stored in the spent fuel pool.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirements of the LCO not met.	A.1 --------------NOTE------------- LCO 3.0.3 is not applicable. --------------------------------- initiate action to move the noncomplying fuel assembly to the correct location.	 Immediately

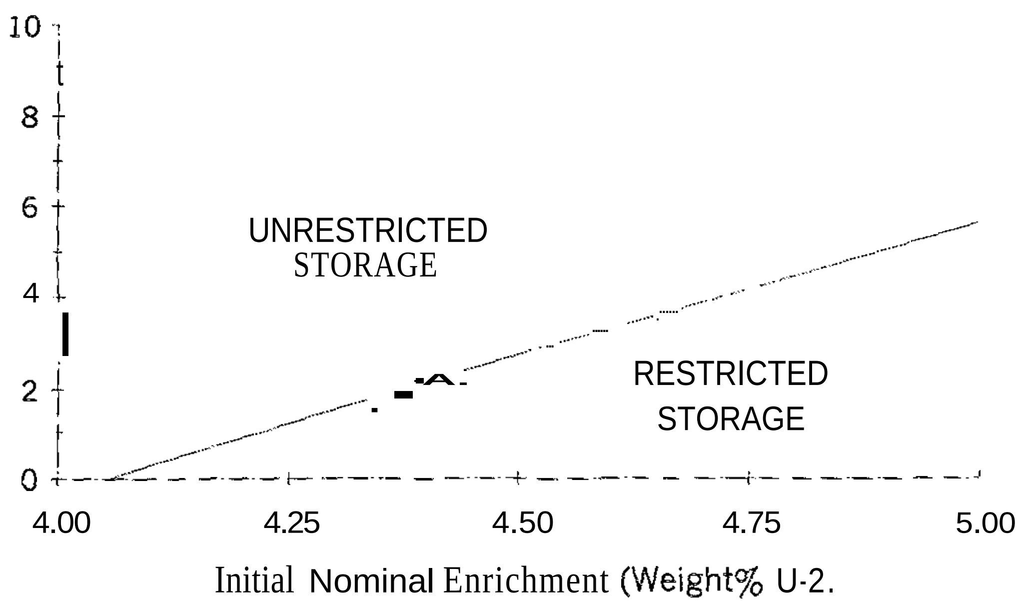
SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.7.16.1 Verify by administrative means the initial enrichment and burnup of the fuel assembly is in accordance with the specified configurations.	Prior to storing the fuel assembly in the spent fuel pool

Table 3.7.16-1

Minimum Qualifying Burnup **Versus** Initial Enrichment *for* Unrestricted Storage

Initial Nominal Enrichment (Weight% U-235)	Assembly Burnup (GWD/MTU)
4.05 (or less)	0
4.50	2.73
5.00	5.67



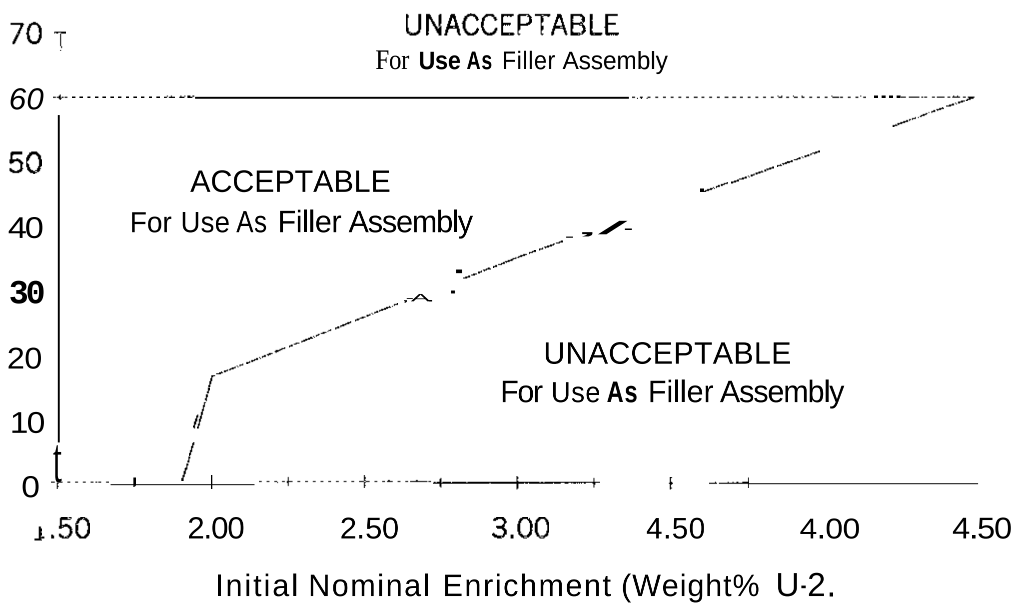
NOTES:

Fuel which differs from those designs used to determine the requirements of Table 3.7.16-1 may be qualified for Unrestricted storage by means *of* an analysis using NRC approved methodology to assure that k_{eff} is less than or equal to 0.95. Likewise, previously unanalyzed fuel up to a nominal 5.0 weight% U-235 may be qualified for Restricted storage by means of an analysis using NRC approved methodology to assure that k_{eff} is less than or equal to 0.95.

Table 3.7.16-2

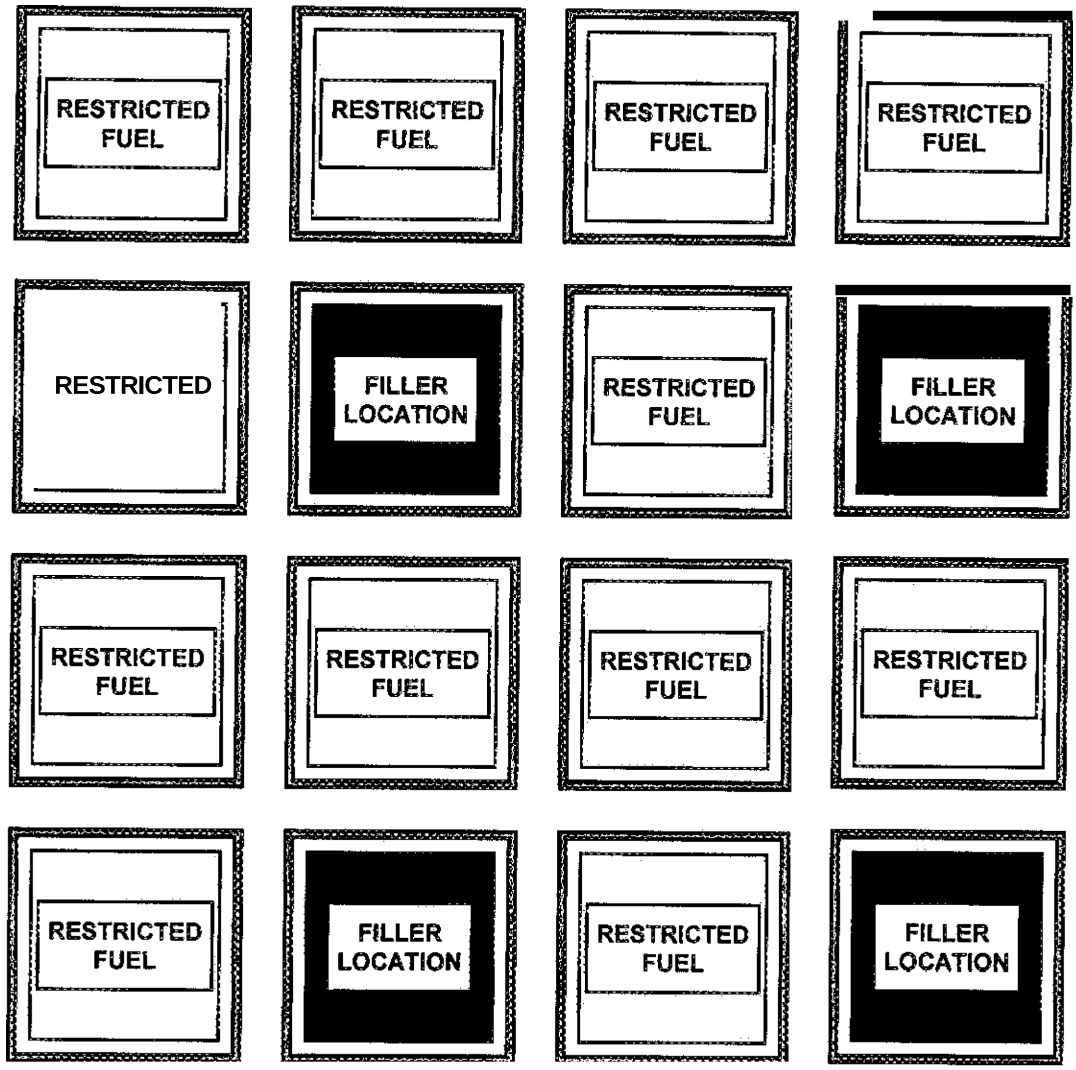
Minimum Qualifying Burnup Versus Initial Enrichment for Filler Assemblies

Initial Nominal Enrichment (Weight% U-235)	Assembly Burnup (GWD/MTU)
1.90 (or less)	0
2.00	16.83
2.50	26.05
3.00	35.11
3.50	43.4%
4.00	51.99
4.4%	6Q.00



NOTES:

Fuel which differs from those designs used to determine the requirements of Table 3.7.16-2 may be qualified for use as a Filler Assembly by means of an analysis using NRC approved methodology to assure that k_{eff} is less than or equal to 0.95.



Restricted Fuel:	Fuel defined for Restricted Storage in Table 3.7.16-1. (Fuel defined for Unrestricted Storage in Table 3.7.16-1, or non-fuel components, or an empty location may be placed in restricted fuel locations as needed)
Filler Location:	Either fuel which meets the minimum burnup requirements of Table 3.7.16-2, or an empty cell.
Boundary Condition:	Any row bounded by an Unrestricted Storage Area shall contain a combination of restricted fuel assemblies and filler locations arranged such that no restricted fuel assemblies are adjacent to each other. Example: In the figure above, row 1 or column 1 can not be adjacent to an Unrestricted Storage Area, but row 4 or column 4 can be.

Figure 3.7.16-1
Required 3 out of 4 Loading Pattern for Restricted Storage

MODIFIED: McGUIRE NRC 1999

Bank Question: 489 ***Answer: C***

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1 Pt(s) Unit 2 was **operating** at 100% power **following** a refueling shutdown. If it is discovered that a spent fuel element was incorrectly stored in the wrong region of the spent fuel pool, which one of the following statements describes the correct action(s) required **by** Tech Specs?

A. Initiate action **to** move the noncomplying fuel assembly **to** the correct location within one hour.

B. Initiate actions to move the noncomplying fuel assembly to the correct location and to shutdown Unit **2** within **1** hour.

C. Immediately initiate action to move the noncomplying fuel assembly to the correct location.

D. Immediately initiate actions to move the noncomplying fuel assembly to the correct location and **to** shutdown **Unit 2 within 1 hour.**

Distracter Analysis:

A. Incorrect: - must initiate action immediately
Plausible: - 1 hour LCOs for important Tech Specs are common and the fuel assembly has clearly decayed more than 16 days

B. Incorrect: - must initiate action immediately - Tech **Spec** 3.0.3 does not apply
Plausible: - 1 hour LCQs for important Tech Specs are common and the fuel assembly has clearly decayed more than 16 days; Tech Spec **3.0.3** requires initiating action to shutdown the unit w i t h **1** hour

C. Correct answer:

D. Incorrect: - Tech Spec 3.0.3 does not apply
Plausible: - If the candidate thinks that Tech Spec 3.0.3 applies

Bank Question: 482.1 **Answer: D**

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1 Pt(s) During **an** outage, air-operated valves 2NV-122B & 123B *(Loop C To Excess Ltdn HX Isol)* are being used to isolate valve *2NV* 124B *(Excess Ltdn Press Cont)* for maintenance.

Which one of the following statements correctly describes the requirements for using 2NV-122/123 as **an** isolation boundary?

A. Tag shut the air supply to the valves and tag open the air regulator petcocks. Tags should also be firmly fixed around the remote operating switch on **the** main control board.

B. Tag shut the air supply **to** the valves and tag closed the air regulator petcocks. Tags should also be firmly fured around the remote operating switch on the main control board.

C. Tag shut the air supply to the valves and tag closed the air regulator petcocks. A switch label should also be firmly fixed around the remote operating switch on the main control board.

D. Tag shut the air supply to the valves and tag open the air regulator petcocks. A switch labels should also be firmly fixed around the remote operating switch **on** the main control board.

Distracter Analysis:

A Incorrect: - switch labels are used on main control boards for tagging remote switches - not red tags.
Plausible: - the position of the components is correct -

B. Incorrect: - the air regulator petcocks must be tagged open not closed
Plausible: - if the candidate does not know the proper position for tagging the regulator petcock

C. Incorrect: - the air regulator petcock must be tagged open not closed - tags are not hung ***on*** main control board switches
Plausible: if the candidate does not know the proper tagging for the air operated valves

D. Correct answer - per NSD-500

Level: RO&SRO

KA: G 2.2.13 ***(3.6* / 3.8)**

Lesson Plan Objective: NSO2 Obj: 5

Source: Bank

Level of knowledge: memory

References:
1. OP-CN-ADM-NSO2 page 9
2. NSD-500 page 5, 1 I
3. OMP **2-33** page 14

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
5	Given a specific component, develop a tagout boundary for repair of that component using controlled references. • Isolate high energy before low energy • Tag open a vent or drain • Double isolate high energy boundaries or check valve used as isolations • Use Butterfly Isolation Reliability Guide • Access the equipment database	X	X	X	X	
6	Describe the responsibilities of the NLO for preparing, placing and clearing tagouts.	X	X	X	X	
7	Given a copy of a REDTAG/Configuration Control Tag, explain each entry made.	X	X	X	X	
8	Given a copy of a Tagout Record (R&R) Sheet, explain each entry made: • Initial entries • Removal entries • Restoration entries	X	X	X	X	
9	Explain how tags and tag stickers are properly placed on components and controls.	X	X	X	X	
10	Explain the process for voiding tags / R&R's.	X	X	X	X	
11	Explain the process for replacing lost or damaged tags/tag stubs.	X	X	X	X	
12	Explain the process for lifting tags for testing (TLFT).	X	X	X	X	

C. **Equipment Database (EDB)** – An Olympus computer program, which can be accessed individually or via use of the OPS REDTAG Program, which provides access to the data in the Equipment Database.

D. **Component Positions** - The REDTAG program uses many different removal positions when creating a tagout or adding tags. They are located on a Drop Down Screen in the OPS REDTAG Program.

E. Additional Items from OMP 2-18:

1. Tag outs are used to document a component being in an "out **of** normal" position and shall be used if the configuration will extend beyond the current shift.
2. Tag outs are not used in place of a procedure change.
3. Numbered tags shall be used for isolation purposes.
4. N/A tags may be used for nsn-isolation purposes such as vents or drains
5. If available, the operating procedure will be used to remove equipment from service.
6. Operating Experience Tagging Reference SHALL be used when making a tag out.
7. Tags are made for specific work and cannot be reused once signed.
8. If the tags are **for** a contaminated area, the stubs maybe removed and left in the WCC will removal ***is*** in progress.

F. Additional Items from NSD 500:

1. The R&R will give the correct sequence **for** components to be positioned and tagged. Normally this will be from high to low energy components. (Obj #5)
2. When possible a vent or drain shall be tagged open inside the tag boundary to prevent re-pressurization **of** the system. (Obj #5)
3. Double isolation will be considered **for** the following (Obj **#5**):
   a) High temp or pressure sources with suspected internal leakage
   b) Any check valve approved for use as a tag boundary.
4. The following must be approved by the QSM and documented via NSD 500 and attached to the tag out.
   a) use of any check valve as an isolation boundary
   b) the use of any air operated valve which is not gagged or have air isolated and vented
   c) Not hanging a tag due to safety or radiological reasons (WGS must approve in writing as well.)

500.7.1.2 White Tags

1. White Tags are used for the following:
   - Configuration control of equipment for procedure and regulation adherence
   - Equipment protection
   - Situations in which a component is functional, but some precaution or information is necessary prior to operation.
2. A White Tag shall not used:
   - If isolation of the component provides for personnel protection
   - When more appropriate administrative methods are available.
   - Used in place of Temporary Modification tag.
3. White Tag(s) will not be listed as part of the isolation boundary for a WO.
   - The Work Group will not be the Holder of any White Tags included in the Tagout that provides their protection during work.
4. Examples of White Tags generated by the Safety Tag Program are show in Appendix E - Operations/Chemistry Red/White Tag Instructions/Example Tags.
5. Examples of White Tags used by the Maintenance Department and Site Services Department are show in Appendix G - Maintenance Red/White Tags. The White Tag shown in Appendix G will only be hung OR equipment that Maintenance or Site Services are the OCG for.

500.7.1.3 Use of Control Board stickers

1 Tag stickers shall be used on control boards or control panels in the control room where use of a full sized tag could obscure other switches. indications, or control functions.

2 Tag stickers may be used on control boards and control panels in the piant.

3 A tag sticker shall be considered the same as the tag which it represents. with same requirements

4 When more than one tag is required on a control switch, a single control sticker may be used.

500.7.1.4 Use of Transmission Department Yellow Hold Tags

If Dispatcher requests Re-closer Devices to be tagged, use of Yellow Hold Tags prevents unwanted Re-closer actuation. Yellow Hold Tags are controlled by Dispatcher and are defined in Electrical Transmission Department Procedures.

500.7.2 TAGOUT RESPONSIBILITIES

500.7.2.1 OPERATIONS SUPERINTENDENT

I Will determine the Operational Control Group for equipment and systems.

2 Superintendent of Operations BEST is:

2.1 Owner of NSD 500 and responsible for the tagout standard.

2.2 Will approve the Removal and Restoration Process for all site groups that perform Tagout.

i

500.7.3.2 Tagout Development

1. The tagout deveiopment shall include the following:

   1.1. The work scope is sufficiently defined in the WO Task.

   1.2. Determination of tagout boundaries shall include a review of the Work Order for which the tagout is being developed.

   1.3. The identification of components to he tagged must be based on Controlled Plant Engineering Documents, whenever drawings exist that identifies all required Energy Isolation Devices.

   1.4. If no Controlled Plant Engineering Documents exist for identifying required Energy Isolation Devices, develop tagout as follows:

      1.4. I. Operational Control Group Supervisor/designee shall determine acceptable Energy Isolation Devices by referring to supplied drawings OR equipment or by performing a physical inspection.

      1.4.2. The OCG will request that the appropriate SME on the component/system provide adequate guidance in the WO Task for isolation.

   1.5. Boundaries, vent, and drain paths, will be based upon purpose and nature of potential hazards for each tagout request.

   1.6. Each operating mechanism for a device shall be tagged to ensure all motive force is removed.

      - Example: A valve that is manually or electrically operated shall be tagged electrically and on handwheel.

   1.7. Air operated valves are not a preferred tagout boundary.

      1.7.I. When air operated valves are used as tagout boundaries, motive force shall be removed by isolating and tagging air supply. Air shall be vented down stream of isolations.

      1.7.2. If air operated valve can not be vented, a determination must be made that trapped motive force is not adequate to move actuator.

      1.7.3. An air operated valve can only be used if it can be assured that the valve will remain in the required safe position.

      1.7.4. In lieu of this determination a mechanical type gag may be installed to prevent changing valve position.

      1.7.5. An Operations Manager shall approve use of air valves if requirements of steps 1.7.1 thru 1.7.4 are not met.

   1.8. The tagout will define the correct sequence in which components are to be positioned and tagged.

   1.9. In general, isolation sequence will be from high to low energy components.

   1.10. Where possible. a vent or drain path within the boundary shall be tagged open to prevent system re-pressurization.

   1.11. Safety related equipment tagout process shall include consideration of the following:

      - Technical Specification adherence for TS actions and Limiting Conditions for Operations (LCO).
      - Selected License Commitments (SLCs).
      - Technical Specification post maintenance testing requirements
      - Appropriate level of Pre-job and Post-job Brief.

2. The installation of a Red Tag may be considered hazardous or impractical in certain cases.

   - For example: Very high radiation levels or the only feasible isolation valve is inaccessible.
   - An exception to placing a red tag can be made for these situations.
   - This exception to red tag placement must be approved for use by an Operations Manager.

2. For pneumatic valves that fail into a certain position without additional valve positioning capabilities

   a. Ensure the desired position is the same as the failed position.

   b. Isolate the VI air supply to the positioner.

   c. Bleed air from the valve. The regulator drain valve may be used if the **VI** air supply is isolated upstream of the regulator.

NOTE: 1. The following returns the valve to normal operation.

2. Most pneumatic valves are controlled from a remote location. On a return **to** service, the controller should be verified or positioned for the desired position.

   d. **Close** the valve used to bleed air from the air operated vaive.

   e. Open the VI isolation to the positioner.

   f. Ensure air is available to the local controller, if applicable.

3. For pneumatic valves that fail into a certain position with handwheel positioned mechanical stops.

NOTE: If possible put valve in desired position using control switch, then engage handwheel and place the mechanical stop at that position before failing air. This reduces wear on the travel stop stem.

   a. Isolate VI air supply.

   b. Open the bypass valve if applicable.

   c. Bleed air from the valve. The regulator drain valve may be used if the VI air supply **is** isolated upstream of the regulator.

   d. If applicable, engage handwheel.

   e. Position valve by use of handwheel.

NOTE: The following returns the valve to normal operation.

Bank Question: 460.2 **Answer: D**

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1 Pt(s) If a large fire was reported in a vital area inside the RCA, which one of the following responses is correct by station procedures?

A. The Fire Brigade must suppress this fire without assistance because the Bethel Volunteer Fire Department is not allowed to access vital areas under the NRC's post-9/11 anti-terrorist orders.

B. The Fire Brigade must suppress this fire because Bethel Volunteer Fire Department is not qualified to fight fire in a radiologically controlled area.

C. The Fire Brigade is initially responsible for fire suppression activities at the scene. Upon arrival, the Bethel Volunteer Fire Department will take over control of the scene.

D. The Fire Brigade is primarily responsible for fire suppression activities at the scene. The Bethel Volunteer Fire Department will respond promptly to the scene and will function under the Site Incident Commander.

Distracter Analysis:

A. Incorrect: - Offside Fire Departments are allowed escorted access to vital areas of the plant. Provisions are in place to allow the offsite Fire Department to arrive at the scene promptly.
Plausible: - they have restrictions regarding leaving the site. The NRC's post-9/11 anti-terrorist orders place additional restrictions on vital area access by non-permanent employees.

B. Incorrect: -Offsite Fire Departments are trained to fight fires in radiologically controlled area.. of the plant. Provisions are in place to allow the offsite Fire Department to arrive at the scene promptly
Plausible: - If the candidate does not understand that offsite Fire Departments are trained in radiological fires.

C. Incorrect: The Site Incident Commander retains responsibility for the scene of the fire.
Plausible: The offsite Fire Departments are full-time professionals and the candidate may think that the Fire Brigade Leader should turn over the responsibilities to the offsite professionals.

D. Correct Incorrect: - The Fire Brigade is primarily responsible to fight fire inside the protected area.

Level: RO&SRO

KA: G 2.4.27 (3.0/3.5)

Lesson Pian Objective: SS-RFY SEQ **38**

Source: Mod Ques_460.1 McGuire NRC 2002

Level of knowledge: memory

References:
1. NSD 112 page 1

	Objective	I S	NLO	LPRO	LPSO	PTRQ
20	Explain the 3 methods of actuating the Mulsifyre Deluge Systems	X	X	X	X	X
21	State the purpose of the Turbine Bearing Deluge Systems	X	X	X	X	X
22	State what causes the Turbine Bearing Deluge Systems to alarm	X	X	X	X	X
23	State how the Turbine Bearing Deluge Systems is actuated	X	X	X	X	X
24	State how the Turbine Bearing Deluge Systems are pressurized	X	X	X	X	X
25	Describe how Deluge Systems for Carbon Filters are actuated	X	X	X	X	X
26	State the purpose of the D/G Low Pressure CO_2 (Cardox) Systems	X	X	X	X	X
27	State the capacity of the Cardox Systems	X	X	X	X	X
28	State the purpose of the Cardox Systems refrigeration unit	X	X	X	X	X
29	State the normal Cardox Systems pressure	X	X	X	X	X
30	State the Cardox Systems tank level requirements	X	X	X	X	X
31	Explain how the Cardox Systems are actuated, including: Automatic electric, Manual electric, & Manual	X	X	X	X	X
32	State the length of time delays for the Cardox Systems	X	X	X	X	X
33	State the purpose of the Auxiliary Feedwater Pump Pits High Pressure CO_2 (CA CO_2) Systems	X	X	X	X	
34	State the normal CA CO_2 Systems pressure	X	X	X	X	
35	Explain how the CA CO_2 Systems are actuated, including: Automatic electric, Manual electric, & Manual	X	X	X	X	X
36	State the length of time delays fer the CA CO_2 Systems	X	X	X	X	X
37	Given appropriate plant conditions, apply limits and precautions associated with related station procedures.	X	X	X	X	X
38	State your duties, per Nuclear System Directive: **112,** as a Fire Brigade member	X	X	X	X	X
39	Define "Fire Impairment" and state Operations primary responsibility concerning fire impairments	X	X	X	X	X

112. FIRE BRIGADE ORGANIZATION, TRAINING AND RESPONSIBILITIES

112.1 PURPOSE

The primary purpose of the Fire Brigade Organization is to minimize the consequences of postulated fires with or without the assistance of offsite fire agencies by rapid fire suppression. The site Fire Brigade Organization is trained to be self-sufficient and is expected to respond to a fire involving property inside the owner controlled area. The Fire Brigade may provide limited support during an onsite hazardous materials emergency, or a fire (including the Switchyard) as resources allow. Offsite fire agencies are normally responsible for fire suppression activities outside of the protected area, but may be used to assist with fire fighting activities inside the protected area; switchyard and other buildings outside the protected area. When offsite fire agencies are used inside the protected area, they will function under the direction of the Site Incident Commander.

112.2 REFERENCES

- Duke Power Company, Catawba Nuclear Station, Response to Appendix A to BTB-ASCB 9.5.1
- 10CFR50 Appendix R
- NFPA 27 Private Fire Brigades
- NFPA 600 Industrial Fire Brigades
- NRC Regulatory Guide 1.120 Fire Protection Guidelines for Nuclear Power Plants
- NRC Standard Review Plan, BTP CMEB 9.5-1 Position C3
- Nuclear Mutual Limited Property Loss Prevention Standards, Section 111A
- Fire Brigade Training & Qualifications Manual
- SLC 16.13-1 (Catawba, McGuire, and Oconee)
- PIP C-01-02617

112.3 SPECIFIC RESPONSIBILITIES

Site VP has overall authority and responsibility for all Hazards and Emergency Response Planning. The planning effort is delegated to the Manager, Emergency Planning.

Operations Shift Manager/Emergency Coordinator in the Control Room has final responsibility and authority in handling a fire emergency. The brigade leader will function under his cognizance and keep him informed of the status of the emergency. The Operations Shift Manager on duty is responsible for ensuring that Fire Brigade staffing requirements are met. In the event that a deviation in staffing levels occurs, the Operations Shift Manager shall ensure a PIP is initiated to document the deviation

Emergency Planning Manager has the responsibility for the administrative aspects of the Fire Brigade.

The Program Administration under the direction of the EP Manager is responsible for the following.

- Ensure that all offsite fire department training and drills are conducted.
- Provides technical and tactical advice to the Fire Brigade Leader in the attack and extinguishment of fires.
- Maintains the structure of the Fire Brigade's organization.

MODIFIED: MCGUIRE NRC EXAM 2002

Bank Question: 460.1 **Answer: B**

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1 Pt(s) If a fire was reported in the lunchroom of the Administrative Building, which one of the following responses is correct by station procedures?

A. Offsite fire departments are responsible for fire suppression activities at the scene. The Fire Brigade must be held in reserve for station fires inside the protected area.

B. Offsite fire departments are responsible for fire suppression activities at the scene. The Fire Brigade may provide limited support if resources allow.

C. The Fire Brigade is responsible for the initial response at the scene. They are required to turn over control of the scene as soon as an offsite fire department arrives and immediately return to the protected area.

D. The Fire Brigade is responsible for fire suppression activities at the scene. An offsite fire department may be called to provide support if additional resources are required.

CHANGED LOCATION TO INSIDE PA

Distracter Analysis:

A. Incorrect: - the Fire Brigade is allowed to leave the protected area.
Plausible: - they have restrictions regarding leaving the site.

B. Correct answer

C. Incorrect: - the Fire Brigade is not responsible for initial response and they are not required to return to the protected area.
Plausible: - if the candidate thinks that they cannot remain outside the protected area.

D. Incorrect: - The Fire Brigade is not primarily responsible to fight fire outside the protected area.
Plausible: - If the candidate does not understand fire brigade responsibilities.

Level: RO Only

KA: G 2.4.27 (3.0/3.5)

Lesson Plan Objective: SS-RFY SEQ 38

Source: Hank

Level of knowledge: memory

References:
1. NSD 112 page 1

Bank Question: 016.2 ***Answer: B***

1 Pt(s) Unit **2** is performing a plant **startup** when a problem occurs in the main feedwater system.

The following events and conditions occur:

- **2A** main feedwater pump is running
- 2B main feedwater pump turbine is not reset
- Reactor power is 25%
- The 2A main feedwater pump trips
- The operator manually trips the plant
- All steam generator levels decrease to **20%**

Assuming systems operate as designed, when did the turbine driven **CA** pump receive an auto-start signal (if at all)?

A. When the 2A main feedwater pump tripped.

B. When narrow range level decreased below 36%.

C. When the reactor trip occurred.

D. The turbine driven CA pump did not receive an auto start signal.

Distracter Analysis:

A. **Incorrect: AMSAC is** not in service
Plausible: The AMSAC signal to start **CA** on loss of both MFPs is not in service and only **starts** the motor driven pumps.

B. **Correct:** 36.8% is the unit **2** setpoint

C. **Incorrect** The **TDCA** pump started when SGWL reached 36.8%
Plausible: the **S/G** lo-lo level setpoint is 10.7% for unit 1

D. **Incorrect** The **TDCA** pump starts at 46.8% SGWL.
Plausible: this would be **true** for unit 1.

Level: RO&SRO

KA: SYS 059 K1.02 (3.4/3.4)

Lesson **Plan** Objective: CF Obj: 4

Source: **Bank**

Level of knowledge: analysis

References:
1. **OP-CN-CF-CApage** 10, 11
2. OP-CN-ADM-UD pages 12, 13

	Objective	ISS	NLO	LPRO	LPSO
1	State the purpose of the CF System.	X	X	X	X
2	State the purpose of the major components of the CF System.	X	X	X	X
3	List the controls and indications for the CF System located in the Control Room.			X	X
4	List the CF System interlocks.	X	X	X	X
5	List the CFPT trips and setpoints			X	X
6	Given appropriate plant conditions, apply Limits and Precautions associated with related station procedures.	X	X	X	X
7	Describe the Unit 1 CF flowpaths during the following normal plant evolutions. • Unit Startup to point where flow is transferred to the Main CF Nozzles. • Power escalation to Rated Power. • Power reduction to point where CF flow is transferred to the Auxiliary Nozzles.	X	X	X	X
8	Describe the Unit 2 CF flowpaths during the following Normal Plant Evolutions. • Unit Startup to point where Row is established to the Main CF Nozzles. • "Split Flow" during power escalation to rated power. • Power Reduction to point where CF flow is transferred to the Auxiliary Nozzles.	X	X	X	X
9	State the normal values during rated power operation for parameters indicated in the Control Room.			X	X

ADM-UD pages 12 and 13

1. At the top of these riser pipes is a metal fixture, which causes the steam-water mixture to take a swirling path, throwing the moisture to the outside into the pipe around the riser pipe. The moisture in this pipe then joins the rest of the separated out moisture above the top of the wrapper.
2. The steam which comes aut of the swirl vanes then enters the second-stage chevron moisture separators where any moisture left in the steam is taken out and then drains through pipes from this separator down above the top of the wrapper where it combines with the recirc flow from the swirl vanes.
3. All recirc flow above the wrapper flows down above the tube sheet by passing through the downcomer region. The downcomer region is the area between the wrapper and the *S/G* shell. This recirc water area is where the S/G level is measured.

B. Main Feedwater Nozzle

1. By procedure, the main nozzle will always be used above 15% flow going up in power and down to **15%** flow when decreasing power.
2. Feedwater first enters the reverse flew limiter, which contains **4** venturi-shaped holes. This reverse flow limiter limits the rate of reactivity addition on a feed line break.
3. To prevent excessive entering velocity on the tubes at the inlet two things have been done. One, the inlet region tubes are expanded to make them more rigid. Second, a flow orifice has been installed upstream of the containment isolations to limit the flow to the main nozzle to 87% of 100% flow with the CA nozzle unisolated. This is done to prevent excessive wear of the first row of tube due to high velocity feedwater entering the S/G.
4. After entering the CF nozzle the feedwater contacts the counter flow preheater section and flows up the T_C side of the tube bundle.

C. Steam Generator Level Program

I. Unit #1 Level Program

a) Unit 1 has Babcock & Wilcox Replacement Steam Generators. While this S/G design does not require S/G level to be ramped, a ramp is still provided to allow additional operational flexibility.

1) The ramp lower limit ensures that the main feed sing gooseneck remains covered and that plenty of mass margin exists to either S/G i o Lo Level reactor trip or S/G Hi Hi Level (P14) CF Isolation. This allows low power maneuverability.

2) The upper limit ensures that plenty of water exists in the S/G to ensure S/G Lo Lo Level reactor trip does not occur on a Loss of One Main Feedwater Pump (LOMFP) and that water level remains below the primary separators at all times.

b) Programmed level is determined by use of the Power Range Excore Detector Median Selected power.

1) Programmed Level Setpoint: 39%-65% Narrow Range level from 0-100% Excore power.

2) LEVEL DEVIATION ALARM: plus or equal to 5% of current Program value

3) LOW LEVEL ALERT: 5% above the Program LO LO Level Trip Setpoint

4) LO-LO LEVEL REACTOR TRIP: 11% (2/4 Levels on 1/4 S/G's)

5) HIGH-HIGH LEVEL (P-14); 83% (2/4 Levels an 1/4 S/G's) causes: Turbine Trip, Initiates CF Isolation and CF pump turbine Trip.

c) The S/G *Lo* Lo Level Trip and P14 functions independently from the S/G Level Control System. The Four level channels contain the circuitry necessary to monitor the fixed High and Low Level Trip setpoints.

2. Unit #2 Level Program (Qbj. #1)

a) Unit 2 S/G has Westinghouse D5 S/Gs. While this design does not require level to be ramped, level is programmed from 62% at 0% power to 67% at 100% power to ensure sufficient water mass is present in the S/G *to* avoid a S/G Lo Lo Levei reactor trip in the event of a LOMFP.

1) HI-HI LEVEL TURBINE TRIP: 77%

2) PRQGRAMMEB AT POWER LEVEL: 62% to 67%

3) LO-LO LEVEL REACTOR TRIP: 37%

b) The HI-HI LEVEL TURBINE TRIP and LO-LO LEVEL REACTOR TRIP setpoints are still 2/4 Level Bistables an 1/4 S/G coincidence. The Annunciators for LEVEL DEVIATION ± *5%* AND LO-LO LEVEL ALERT 5% above Reactor Trip remain the same.

c) The Level Trip Program for Unit 2 S/G's have Four (4) Channels of Trip instrumentation. The Four ievel channels contain the circuitry necessary to monitor the fixed High and Low Level Trip setpoints. The coincidence necessary to generate the Alert Annunciators and Trips work the same as Unit 1.

CF-CA **pages 10 and** 11

d) The most likely source of overpressure is leaking discharge check valves.

e) Each *of* the suction reliefs has a lift setpoint of **150** psig and a capacity *of* 30 gpm.

f) Discharge of each suction relief valve is to the associated pumps sump.

1.2 Operation

A. Automatic Operation (Obj # **4)**

1. Start Signals: Motor Driven Pumps 1(2) A & B

a) Safety Injection: Train Related; Sequencer Activated (Load Group 8)

b) Blackout: Train Related; Sequencer Activated (Load Group 8)

c) Two of four S/G narrow range level channels in one of four S/G LO LO LEVEL (2 of **4** L.S./1 of 4 S/G) (Unit 1: 11%; Unit 2: 37%): starts both CA Pumps.

d) Loss of Both Feed Pumps (2/3 LOW FPT Control Oil Pressure (less than 75 psi): **starts** both CA Pumps.

e) AMSAC: Starts both CA Pumps.

1) Loss of CF feed path AMSAC: This system is functioning when Turbine Impulse Pressure **is** greater than 40% Turbine Load and remains active for TWO (2) minutes after Turbine Load decreases to less than 40%.

(a) 3/4 **CF** Containment Isolation Valves closed **(UNIT 1 ONLY)**

(b) 3/4 Main Feed Regulating Valves less than 25% open with associated Bypass less than 50% open. After 30 Seconds of this condition AMSAC causes Both Trains of CA to Start.

2) Loss of Both Feed Pumps.

2. Start Signals: Turbine Driven CA Pump # 1 & 2

a) Blackout on either *4160* Essential Bus; Sequencer activated

1) On a concurrent B/O and SI, the TDCAP will NOT start.

2) If an SI is received within 8.5 sec of a B/O, the TDCAP will NOT start.

3) If an SI signal is received and clears but the SI is not reset and then a B/O is received, the TDCAQ will not start.

4) All B/O initiated TDCAP starts WILL be delayed by 8.5 sec for the Sequencer B/O logic to run.

5) If a B/O occurs and a subsequent SI occurs greater than 8.5 secs after the B/O, the TDCAP will autostart on the B/O and will continue to run at the time of the SI whether the "on/off" switch is in the "on" or "off' position until the CA Sys is Reset.

b) Two of four S/G narrow range level channels in two of four S/G LO LO LEVEL.

c) The following are NOT "CA AUTO STARTS" but merely cause the steam to be admitted to the Turbine, ("CA SYS VLV CTRL" resets remain lit):

1) Loss of Power or Instrument Air to **1(2)SA 2** or *5* causes these valves to fail open and admit Main Steam to the Turbine driven CA Pump.

2) 2/4 SSF Wide Range S/G bevels less than 45% cause SA-5 to fail open. **THIS FEATURE CAN NOT BE DEFEATED.** (A loss of SSF power will initiate this same failure).

3. Plant Response to the CA Auto Start.

a) BB flow control valves close.

b) BB Cont. Isolation and Bypasses Close; Train Related

c) NM Sample Cont. isolations Close; Train Related

d) CF Cont. Isolation Bypasses Close; either train

e) Individual Tempering Line Isolation Valves Close; either train

f) Flow Control Valves fail to "FULL OPEN".

g) If it was **a** Turbine Driven Start; SA 2 & 5 fail open, Governor positions to Max speed and TD Flow Control Valves fail to "FULL OPEN".

h) " A Train CA Signals causes TD governor to position to "MAX" speed and prevents manual closing of T&T Valve at MC-10. "B" Train DOES NOT provide these features.

i) RN Valves low suction pressure alignment circuits are enabled.

j) CS-47(Normal Hotwell M/U Control) fails closed on either train CA Auto start. This ensures the CA system is not affected by any UST inventory loss to the hotwell. Control board resets buttons for each train restores the valve to its normal makeup duties.

Bank Question: 039 ***Answer: B***

1 Pt(s) Unit 1 containment pressure is 4.0 psig. **All** equipment is operating as designed. Safety injection has been **RESET.**

What are the minimum actions necessary for the operator to reopen 1KC-425A (Reactor Building Non-Essential Supply Header Isolation)?

A. Press the OPEN pushbutton on **MC-11.**

B. Reset phase B train "A", then press the OPEN pushbutton on MC-11.

C. Wait **until** containment pressure is less than 3 psig, reset phase B train "A", then press the OPEN pushbutton on **MC-11.**

D. Reset phase B trains "A" and **"B"** (together), then press the OPEN pushbutton on MC-11.

Distracter Analysis:

A. Incorrect: must reset phase B.
Plausible: may not realize valve has closed due to phase B.

B. Correct: valve bas closed due to phase B. **KC-425** is a train **A** valve. Phase B can be reset at any time, therefore, to open KC-425, reset phase B train A, then open the valve.

C. Incorrect: Phase B can be reset **at** any time.
Plausible: candidate believes phase B cannot be reset until below the setpoint.

D. Incorrect: Only train **A** must be reset.
Plausible: candidate believes the train **A** and train B reset buttons must be depressed together in order to get phase B reset.

Level: RO & SRO

KA: **SYS** 103 K4.06 (3.1/3.7)

Lesson Plan Objective: CNT-CNT SEQ 17

Source: Bank

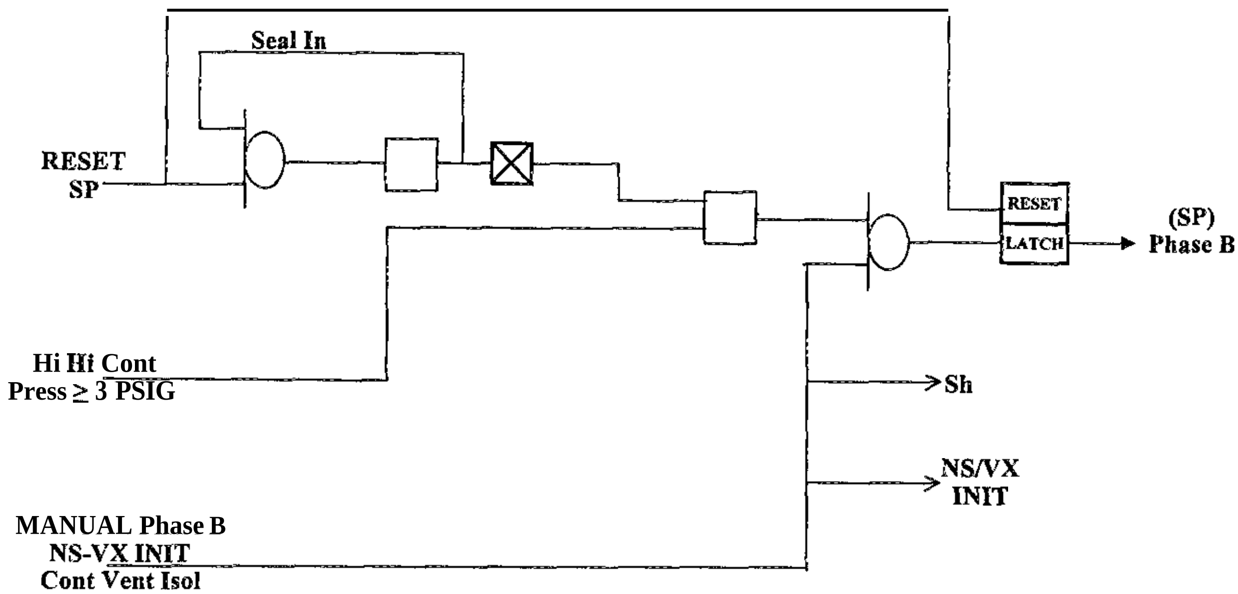
Level of knowledge: comprehension

References:
1. OP-CN-ECC-ISE pages 18-19
2. OP-CN-CNT-CNT pages 19-20

	CNT **Objective**	IS S	N L O	L P R O	L P S O	P T R Q
1	**STATE** the purpose of Containment.	X	X	X	X	
2	**LIST** the boundaries, which prevent the release of radioactivity to the environment.	X	X	X	X	X
3	**SUMMARIZE** the conditions that must exist for Containment to be considered OPERABLE.			X	X	X
4	**SUMMARIZE** the conditions that must exist for the Reactor Building to be considered OPERABLE.			X	X	X
5	**STATE** the normal operating range for containment pressure and temperature for all modes of operation.			X	X	X
6	**STATE** the design limits for containment pressure and temperature.			X	X	X
7	**DESCRIBE** the operation of Containment Atmosphere Radiation Monitors EMF-38 **(Particulate)**, 39 (Gas), and 40 (Iodine) including: • Operation of the sample **pump** and sample point selection valves. • Automatic actions initiated by **Trip 2** alarms • [illegible] to a Phase 'A' Containment Isolation			X	X	X
8	**DESCRIBE** the response of EMF-53A/B *to* a design **break** accident and how this response can be used to help determine containment conditions.			X	X	X
9	**DESCRIBE** alternate means of determining containment radiological conditions with EMF 53A/B out of service.			X	X	X
10	**STATE** the site administrative requirements for containment entry per SD 3.1.2 (Access to Containment or Annulus and Areas Having high Pressure Steam Relief Devices)	X	X			
1I	**STATE** the site administrative requirements for when. and in what areas the "Buddy System" is to be used per SD 3.1.2 (Access to Containment or Annulus and Areas Having High Pressure Steam Relief Devices).	X	X			
12	**EXPLAIN** the operation of the personnel airlock doors interlock and interlock bypass.	X	X	X	X	X
13	**EXPLAIN** the operation of the personnel airlock doors for normal entry and exit.	X	X	X	X	X
14	**EXPLAIN** the operation of the personnel airlock doors for emergency entry and exit.	X	X	X	X	X
15	Given appropriate plant conditions, **APPLY** limits and precautions associated with station procedures related to Personnel Air Lock Operations.	X	X			
16	**DESCRIBE** the operation **of** the Containment Isolation **ESF** systems **for** a Phase **'A'** Containment Isolation.			X	X	
17	**DESCRIBE** the operation **of** the Containment Isolation BSF **systems for a** [illegible]hase **'B'** [illegible]ontainment Isolation			X	X	
18	[illegible] the pur[illegible]se of the [illegible] valve injection [illegible]er (NW) system.	X	X	X	X	

ISE pages 18 and **19**

(Sp) Phase B Isolation



C. Phase B Isolation (S_p)

1. 2 signals can actuate an S_p

   a) Manual: One pushbutton per train under Plexiglas cover on MC11 (Phase B, NS-VX Initiate, Cont Vent Isol Button)

   b) Hi-Hi Containment Pressure: 2/4 Containment Pressure Channels greater than or equal to 3.0 psig. An annunciator (AD-13) signals Control Room on HI HI Containment Pressure on any one channel.

      1) The "Phase B, NS-VX Init and Cont Vent Isol" Button, when depressed, will initiate all three functions.

2. Reset (Phase B Reset Button)

   a) **Allows** manual control of S_p valves.

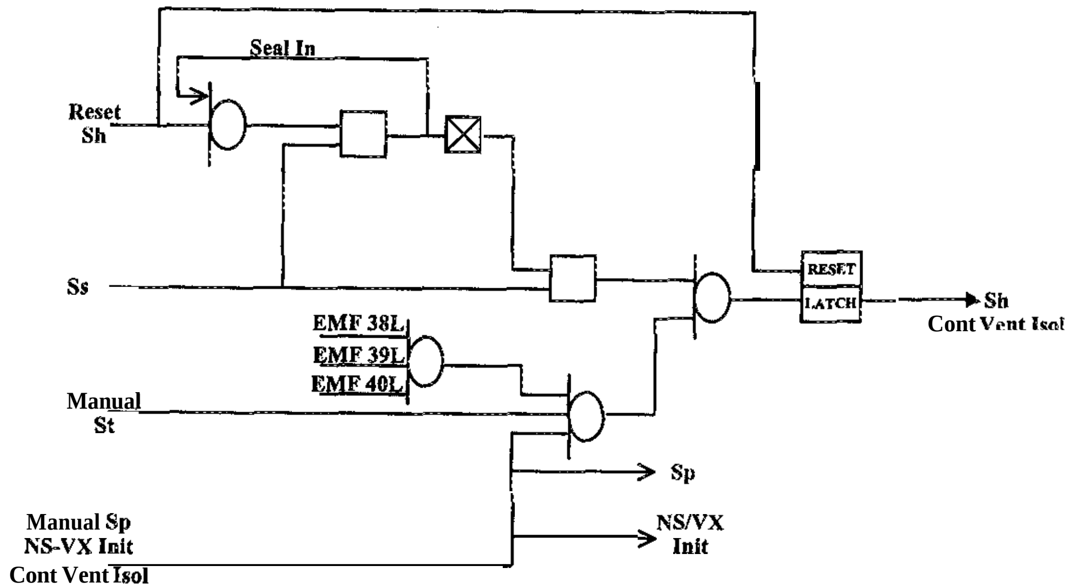
   b) One pushbutton **for** each train (NS board)

   c) Functional with any pressure in Containment.

3. Phase B Isolation indication: annunciator on AD13.

4. Phase B Isolation, completes the isolation of non-essential Containment penetrations including KC to the NCP's.

(Sh) Containment Ventilation Isolation

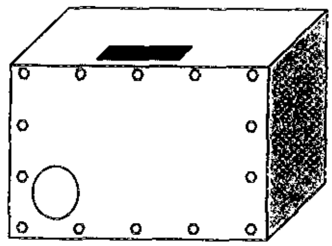


D. Containment Ventilation Isolation (S_H)

1. 4 Signals can actuate an S_H.
   a) Manual "Phase A" (S_T): Train A (B) S_T will actuate train A (B) S_H.
   b) Manual "Phase B, NS-VX Initiate, Cont Vent Isol": Train A (B) (Phase B, NS-VX Initiate, Cont Vent Isol) will actuate train A (B) S_H. This is a single pushbutton that actuates three functions.
   c) S_S Signal: Train A (B) S_S will actuate Train A (B) S_H.
   d) EMF 38 L, **39** L, 40 TRIP 2: High Containment Particulate, Gas, or Iodine will actuate BOTH Trains of S_H.
2. S_H will shutdown and will isolate VP and isolate VQ Containment [solation valves.
3. Reset (Cont Vent Isol Reset)
   a) One pushbutton per train (NS Board)
   b) Functional with S_S present **as** long as EMF Signals are not present.
4. Indication of the isolation is via the ESF Monitor lights.

CNT pages ***19*** and 20

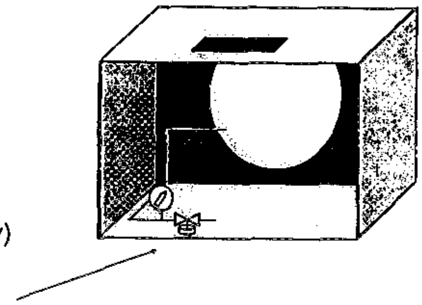
a) Typical Electrical Penetration -Annulus View



Typical E-Pen Enclosure

Cover portal allows viewing SF6 pressure gauge. Hand-held pyrometer used to measure penetration shell temperature. Calculation performed to obtain temperature adjusted pressure value

If pressure is low, remove cover and connect SF6 supply *to* test connection.
(Conductors net shown for clarity)

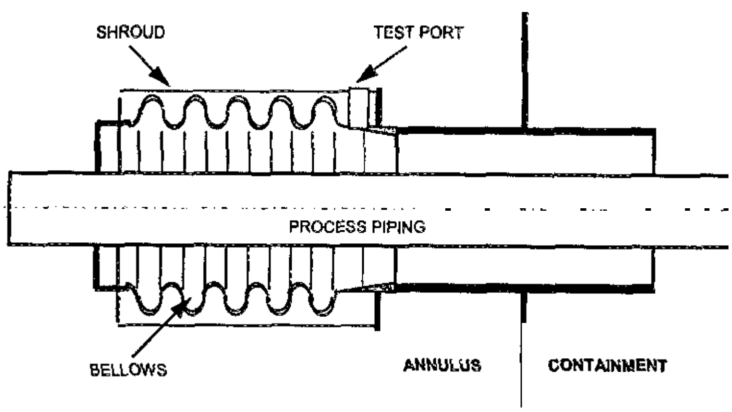


2. Mechanical Penetrations

   a) Where process piping penetrates containment, penetrations are designed to accommodate some piping movement and expansion while maintaining containment integrity.

   b) Dual Ply Mechanical Bellows assemblies are subject to leak rate testing.

   c) Mechanical Bellows - Typica Cold Penetration



Typical Mechanical Bellows Assembly

B. Containment Isolation Systems (Obj. #13 and 14)

1. The Containment Isolation System closes penetrations not required for engineered safety features operation on:

    a) Phase A (S_t) containment isolation signal that is derived from the safety injection signal.

    b) Phase B (S_p) containment isolation signal that is derived from the high-high containment pressure signal.

2. Valves on VPNQ purge line isolation close on:

    a) Phase **A** containment isolation signal.

    b) High containment activity (S_h) signal.

3. Post-Accident Valve Submergence

    a) A list of active valves in containment that are below maximum flood elevation is presented in UFSAR Table **6-96.**

    b) Some valve operators were not qualified ***for*** submergence. These valves close on Containment Isolation Phase A (S_t) signais. There is sufficient time for them to close before being flooded.

    c) To prevent possible repositioning after flooding, the vaives motor controls circuits have been modified. One relay per train will be energized by a S_t signal and mechanically latched in. Normally closed contacts from this relay will be wired between the limit switches and the open motor starter coils **of** vaives *of* the corresponding train. These contacts will open on S_t and prevent any spurious limit switch operation from repositioning the valves.

    d) These relays have manual reset capability in the control room.

4. Containment Isolation valves are identified in UFSAR Table 6-77 (Containment Isolation Valve Data).

    a) Lists all Containment Isolation Vaives and indicates the appropriate Tech. Spec. Condition for inoperable valves.

    b) Most are automatically operated valves. Some are manual valves that are normally locked closed.

    c) A few are manually operated and normally open. SA-I and **4** (S/G *to* CAPT Maintenance Isol) must be open for the CAPT to be OPERABLE, but are also manual containment isolation valves. The ability to close these valves ensures operability. These valves remain open because operability *of* the CAPT **is** more safety significant than the need for SA-1 and SA-4 to be closed.

    d) The S/G PORVs are dual function valves, required to perform a containment isolation function and to be available for cooldown. Refer to LCO 3.7.4 (Steam Generator Power Operated Relief Valves *(SG* PORVs).

    e) NW must be available *to* containment isolation valves (where applicable) being used *to* isolate a penetration to comply with any LCO 3.6.3 Required Action.

Bank Question: 060.1 **Answer: B**

1 Pt(s) Unit 2 was operating at 100% power when an electrical fire started inside the auxiliary building cable room corridor. What type of fire suppression system is installed in this area and what are the hazards to personnel if they enter this room?

A. A manual deluge (Mulsifyre) System is installed. An electrical shock hazard exists due to the use of water to combat an electrical fire.

B. An automatic sprinkler system is installed. An electrical shock hazard exists due to the use of water to combat an electrical fire.

C. An automatic Halon system is installed. An asphyxiation hazard exists due to the presence of Halon gas.

D. A manual Cardox system is installed. An asphyxiation hazard exists due to the presence of carbon dioxide gas.

Distracter Analysis:

A. Incorrect: An automatic sprinkler system is installed
Plausible: an electrical shock hazard exists
B. Correct Answer:
C. Incorrect: An automatic sprinkler system is installed
Plausible: Halon gas is generally used in areas in which electrical fires are the predominant risk because it does not create a shock hazard
D. Incorrect: An automatic sprinkler system is installed
Plausible: CARDOX is a common fire suppressant in the industry

Level: RO&SRO

KA: SYS 086K5.04 (2.9/3.5)

Lesson Plan Objective: SS-RFY Obj: 18

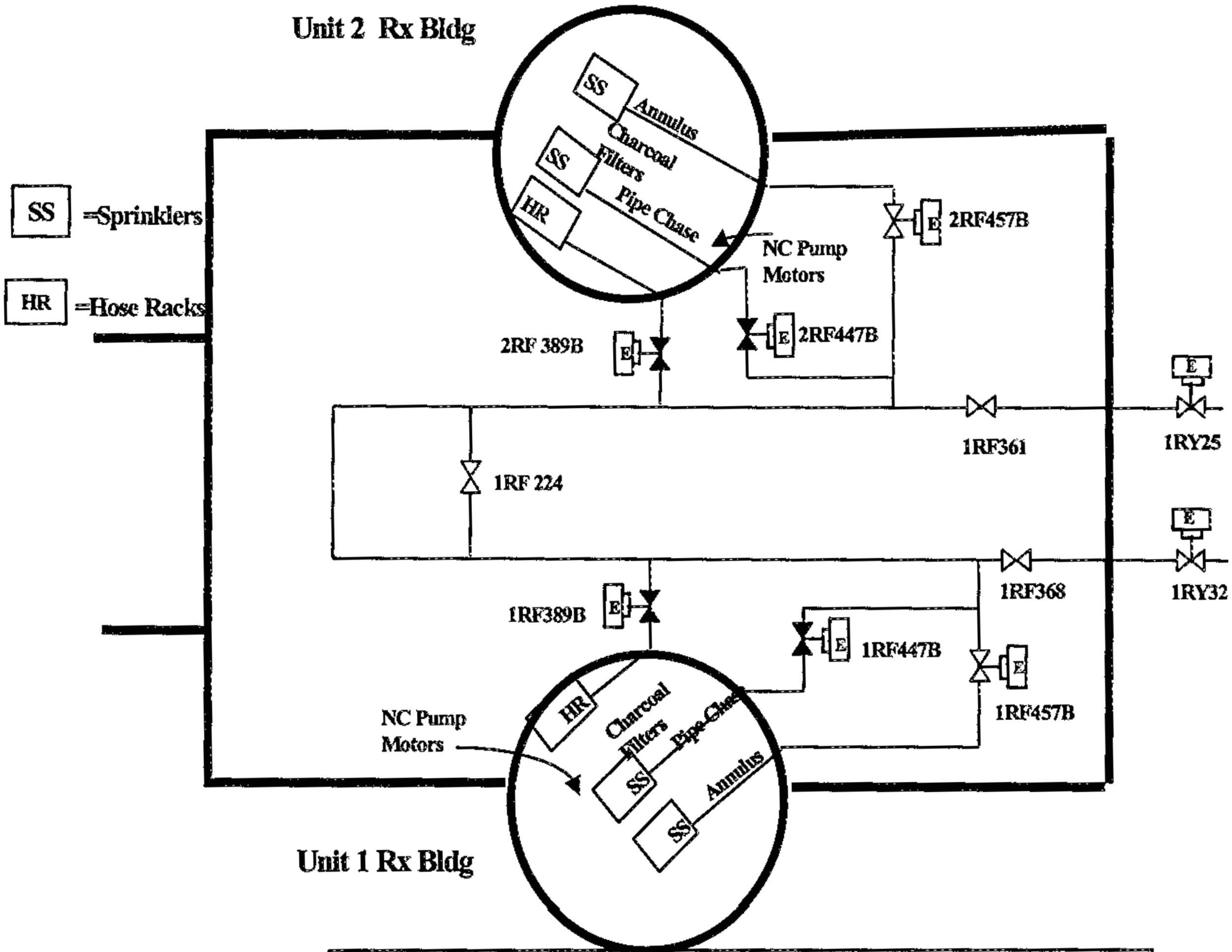
Source: Mod; Ques_060, McGuire NRC 99

Level of knowledge: memory

References:
1. OP-CN-SS-RFY page 15
2. SLC 16-9.2

OBJECTIVES

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Stale the purpose of the Fire Protection (RF & RY) Systems	X	X	X	X	
2	kist the power source for the Main Fire (RY) pumps	X	X	X	X	X
3	List the suction source for the Main Fire (RY) pumps	X	X	X	X	
4	Describe the basic RF & RY flow paths	X	X	X	X	
5	State the automatic start setpoint for the Main Fire (RY) pumps	X	X	X	X	X
6	State the location of Control Room RF & RY Controls			X	X	
7	List the 3 Headers that penetrate the Reactor Building wail and state which header isolations are normally closed	X	X	X	X	X
8	List the system that supplies the hose cabinets in the D/G rooms and state why this supply is used	X	X	X	X	X
9	State the automatic start setpoint for the Jockey (RF) pumps	X	X	X	X	X
10	State the normal Pressurizer Tank level	X	X	X	X	X
11	Explain how pressure is maintained on the RF & RY Systems	X	X	X	X	X
12	State the normal RF & RY header pressure	X	X	X	X	X
13	State the setpoint for the N_2 supply valve for the Pressurizes Tank	X	X	X	X	X
14	State the purpose of the Alarm Check Valves	X	X	X	X	X
15	State where Alarm Check Valves are used and how they are actuated	X	X	X	X	X
16	Describe how local Water Driven Bell Alarms oaerate	X	X	X	X	X
17	State the purpose of the Mulsifyre Deluge Systems	X	X	X	X	X
18	State where Mulsifyre Deluge Systems are used and give examples of plant locations	X	X	X	X	X
19	Explain how the clapper valve functions to control flow and provide alarms for Mulsifyre Deluge Systems	X	X	X	X	X



Auxiliary and Reactor Building Loops

L. Automatic Water Spray (Mulsifyre Deluge) Systems

1. Purpose: (Obj. #17, 21)

   a) Mulsifyre systems are designed to deliver large quantities of water to totally engulf equipment.

2. These systems are commonly referred to as "Mulsifyre" systems and normally consist of the following:

   a) Isolation (Controi) valve

   b) Mulsifyre clapper (deluge) valve

   c) Heat actuated fire detectors (thermal detectors)

   d) Alarm device (pressure switch)

16.9 AUXILIARY SYSTEMS - FIRE PROTECTION SYSTEMS

16.9-2 SPRINKLER SYSTEMS

COMMITMENT;

Sprinkler systems in Table 16.9-1 shall be OPERABLE:

APPLICABILITY:

Whenever equipment protected by the Sprinkler System is required to be OPERABLE.

REMEDIAL ACTION:

a. With one or more *of* the above required Sprinkler Systems inoperable, within 1 hour, in accordance with the "Fire Watch Code" given in Table 16.9-1, established a continuous fire watch or an hourly fire watch.

b. Verify backup fire suppression (fire extinguisher, nearby fire hose station) is available, and if not, establish backup fire suppression equipment for the affected area. This must be accomplished within the 1 hour given above.

TESTING REQUIREMENTS:

a. Each of the above required Sprinkier Systems shall be demonstrated OPERABLE:

i. By verifying that each valve (manual or power-operated) in the flow path, which is accessible during plant operations, is in the correct position. The frequency **of** the verification shall be determined by the performance based criteria stated in the Bases Section.

ii. At least once per 12 months by cycling each testable valve in the flow path through **at** least one complete cycle **of** full travel,

Exception: Valves that are cycled as part of the ASME Section XI, Subsection IWV (Inservice Testing of Valves in Nuclear Power Plants) program (RF389B, RF447B, RF457B) are exempt from this requirement.

iii. ***At*** least once pes 18 months by verifying that each valve (manual or power-operated) in the flow path which is inaccessible during plant operations is in its correct position and

TESTING REQUIREMENTS: (cont'd)

iv. At least once per 18 months:

1) By performing a system functional test which includes an inspector's test connection flow test and cycling each valve in the flow path that **is** not testable during plant operation through at least one complete cycle of full travel.

2) By **a** visual inspection of each Sprinkler System starting at the system isolation valve *to* verify the system's integrity; and

3) By a visual inspection of each nozzle's spray area to verify the spray pattern is not obstructed.

REFERENCES:

1) Catawba FSAR, Section 9.5.1
2) Catawba SER, Section 9.5.1
3) Catawba SER, Supplement 2, Section 9.5.1
4) Catawba SER, Supplement 3, Section 9.5.1
5) Catawba Fire Projection Review, as revised
6) Catawba Fire Protection Commitment index

BASES:

The OPERABILITY of the Fire Suppression Systems ensures that **adequate** fire suppression capability **is** available to confine and extinguish fires occurring in any portion of the facility where safety-related equipment *is* located. The Fire Suppression System consists of the water system, sprinklers, CO_2, and fire hose stations. The collective capability of the Fire Suppression Systems **is** adequate to minimize potential damage to safety -related equipment and is a major element in the facility Fire Protection Program.

The ability *to* demonstrate that the valves in the RF/RY flew path can be cycled is critical to maintaining the system properly. The containment isolation valves (RF389B and RF447B) and the annulus sprinkler system isolation valve (RF457B) are required *to* be cycled or stroked at least once every quarter as part of the Catawba IWV program. Therefore, credit can be taken for cycling these valves under the IWV program, and they do not need to be cycled annually to meet the SLC criteria.

The proper positioning of RF/RY valves is critical to delivering fire suppression water at the fire source as quickly **as** possible. The option of increasing **or** decreasing the frequency of valve position verification allows the ability to

BASES (cont'd)

optimize plant operational resources. Should an adverse trend develop with RF/RY valve positions, the frequency of verification shall be increased. Similarly if the RF/RY valve position trends are positive, the frequency of verification couid be decreased. Through programmed trending of RF/RY **as** found valve positions, the RF/RY System will be maintained at predetermined reliability standards. The RF/RY System Engineer is responsible for trending and determining verification frequencies based on the following:

Initially the frequency will be monthly.

Annually review the results of the completed valve position verification procedures.

- If the results demonstrate that the vaives are found in the correct position at least 99% of the time, the frequency of conducting the valve position verification may be decreased from - monthly to quarterly or - quarterly to semiannually or - semiannually to annually - **as** applicable. The frequency shall not be extended beyond annually (plus grace period).

- If the results demonstrate that the valves are not found in the correct position at (east 99% **of** the time, the frequency **of conducting** the valve position verification shall be increased from - annually to semiannuaily or - semiannuaily to quarterly or - quarterly *to* monthly - as applicable. The valve position verification need not be conducted more often that monthly.

In the event that portions of the Fire Suppression Systems **are** inoperable, alternate backup fire-fighting equipment **is** required to be made available in the affected areas until the inoperable equipment is restored to service. When the inoperable fire-fighting equipment **is** intended for use as a backup means of fire suppression, a longer period of time **is** allowed to provide an alternate means of fire fighting than if the inoperable equipment is the primary means of fire suppression.

This Selected Licensee Commitment is part of the Catawba Fire Protection Program and therefore subject to the provisions of Section 2.C. of the Catawba Facility Operating Licenses.

TABLE 16.9-1
SPRINKLER SYSTEMS

	Room No.	Equipment	Fire Watch Code
a.	Elevation 522+0 - Auxiliary Building		
	100,201,106 111,1f2	ND & NS Connecting Corridor	(2)
	104	ND Pump 1B	(3)
	105	ND Pump 1A	(3)
	109	ND Pump 2B	(3)
	110	ND Pump 2A	(3)
b.	Elevation 543+0 - Auxiliary Building		
	230	NV Pump 1A	(3)
	231	NV Pump 1B	(3)
	240	NV Pump 2A	(3)
	241	NV Pump 25	(3)
	250	Unit 1 CA Pump Roem	(1)
	260	Unit 2 CA Pump Room	(1)
c.	Elevation 554+0 - Auxiliary Buiiding		
	340	U2 Battery Room Corridor (DD-EE)	(2)
	350	U1 Battery Room Corridor (DD-EE)	(2)
d.	Eievation 560+0 - Auxiliary Building		
	300	KC Pumps 1A1, 1A2,	(3)
	300	KC Pumps 1B1,152	(3)
e.	Elevation 574+0 - Auxiliary Building		
	480	U2 Cable Room Corridor (DD-EE)	(2)
	490	U1 Cable Room Corridor (DD-EE)	(2)
f.	Elevation 577+0 - Auxiliary Building		
	400	KC Pumps 2A1, 2A2,	(3)
	400	KC Pumps 261,282	(3)
g.	Reactor Buildings		
		Annulus	(1)

TABLE 16.9-1
SPRINKLER SYSTEMS

Fire Watch Codes for Table 16.9-1 (Sprinkler Systems):

(1) Continuous.

(2) Hourly unless Standby Shutdown System (SSS) is inoperable. **if** SSS is inoperable - continuous watch is required.

(3) Hourly unless opposite train component **is** inoperable, OR sprinkler system for opposite train component is inoperable, OR Standby Shutdown System (SSS) is inoperable. If opposite train component, or sprinkler for opposite train component, or SSS is inoperable - continuous watch **is** required.

MODIFIED: McGuire NRC EXAM 1999

Bank Question: 60 ***Answer: A***

1 Pt(s) Unit 2 was operating at 100% power when an electrical fire started inside the auxiliary building cable spreading room. What type of fire suppression system is installed inside the cable spreading area and what are the hazards to personnel if they enter this room?

A. A manual deluge (Mulsifyre) System is installed. An electrical shock hazard exists due to the use of water to combat an electrical fire.

B. An automatic sprinkler system is installed. An electrical shock hazard exists due to the use of water to combat an electrical fire.

C. An automatic Halon system is installed. An asphyxiation hazard exists due to the presence of Halon gas.

D. A manual Cardox system is installed, An asphyxiation hazard exists due to the presence of carbon dioxide gas.

Distracter Analysis:

A. Correct Answer:

B. Incorrect: A manual deluge Mulsifyre system is installed
Plausible: an electrical shock hazard exists

C. Incorrect: A manual deluge Mulsifyre system is installed
Plausible: Halon gas is generally used in areas in which electrical fires are the predominant Rsk because it does not create a shock hazard

D. Incorrect: A manual deluge Mulsifyre system is installed
Plausible: Cardox gas is a personnel hazard – although all the CARDOX systems have been replaced with HALON, the pull switches still say CARDOX in some areas (like the diesel generators)

Bank Question: 260.2 **_Answer: D_**

1 Pt(s) Unit 2 is responding to a loss of main feedwater event from 100% power.

Given the following events and conditions:

- The reactor has tripped
- The 2A and 2B motor-driven CA pumps started in auto
- The turbine-driven CA pump (CAPT) started in auto
- Train "A" CA has been reset
- Train "B' CA has failed to reset
- The CA pumps are aligned to the CACST

Which one of the following automatic system responses will occur as storage tank and CA pump suction pressures decrease?

A. **2A CA pump trips.**
CAPT #2 pump trips.
2B CA pump shifts to the RN system.

B. **2A CA pump suction shifts to the RN system.**
CAPT #2 suction shifts to the RN system.
2B CA pump trips.

C. **2A CA pump suction shifts *to* the RN system.**
CAPT #2 pump trips.
2B CA pump trips.

D. **2A CA pump hips.**
***CAPT* #2 suction shifts to the RN system.**
2B CA pump suction shifts to the RN system.

Distracter Analysis:

A. **Incorrect:** because the CAPT pump swap to RN
Plausible: candidate believes **A** train **controls** CAPT pump

B. **Incorrect: 2A CA** pump trips and 2 5 **CA** pump shifts suction to RN
Plausible: if the candidate believes reset allows shift

C. **Incorrect:** Reverse **of** what actually happens
Plausible: if the candidate reverses the logic

D. **Correct:** because train B did not reset, it will shift when pressure decreases below ***6* psig.**

Level: RO&SRO

KA: *SYS* 061 K6.02 (2.6/2.7)

Lesson Plan Objective: **CA** Obj: 12

Source: **Mod** McGuire NRC 2002

Level of **knowledge: comprehension**

References:
1. OP-CN-CF-CA page **13,** 14

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Explain the purpose of the CA System.	X	X	X	X	
2	List all of the sources of water available to the CA pumps, and the order of preference of each.	X	X	X	X	X
3	Explain the normal and recirculation flew paths associated with the CA System.	X	X	X	X	X
4	List the automatic start signals (including setpoint) for the motor driven and turbine driven CA pumps	X	X	X	X	X
5	Explain the trip and reset procedures for the CAPT Trip/Throttle valve.	X	X			
6	Explain CAPT local operation.	X	X			
7	Given appropriate plant conditions apply Limits and Precautions associated with related station procedures.	X	X	X	X	X
8	Draw the CA system per the Simplified Flow Diagram.	X	X			
9	Describe the use of the Auto Start Defeat circuitry.			X	X	X
10	Describe the operation of CA System Valve Control reset circuitry.			X	X	X
11	Discuss how to regain control of CA pumps following CA auto start coincident with sequencer actuation.			X	X	X
12	Explain CA pump low suction pressure protection.			X	X	X
13	Given a set of plant conditions and access to reference materials, determine the actions necessary to comply with Tech Spec/SLC's.			X	X	X
14	State from memory all Technical Specification actions for the applicable systems, subsystems, and components which require remedial action *to* be taken in less than one hour.			X	X	
15	List the system designator and major component nomenclature.	X				

Time: 3 hours

2) Moving of these valve travel stops will place the CA system into an Action Statement and require rebalance **of** the system.

3) Positions are placed in the throttle valve program as number threads open, so anyone who wants to verify throttle position can count threads without moving the valves.

b) The vaive positioners are calibrated **so** that 0-100% demand corresponds to the actual (Full closed to Travel Stop) movement range.

1) The open Limit Switches are adjusted to provide open indication when the valve is at the travel stop.

2) The controllers on both units are 0% (Full Closed) to 100% (Full Open).

C. Loss of Normal Suction Pressure Protection (Obj # 12)

1. Provides a method to supply alternate suction sources to the CA pumps in the event that the Normal Sources, Condensate Grade Water, become inadequate. Annunciator alarms are provided for indications of Low inventory **in** these tanks. A low level alarm exists on the UST at 50% to allow the operator time to initiate make-up to preclude swapover to RN. If this action can not be performed, the operator must isolate the UST and break Condenser vacuum.

a) Each train of pressure switches share a common Impulse line. Should **that** line fail and pressure decrease, all three (3) pressure switches will sense a low pressure condition.

b) The Loss of Normal Suction Pressure Actions are on a **FIVE (5) Second Delay** for ALL three channels.

c) **if** both trains of "CA SYS VLV CTRL" are RESET following an automatic start of the CA system and "CA PUMPS LOSS OF NORMAL SUCT' (AD-5 E-I or 2) is received, the CA pumps will trip and if manually restarted will trip again in 5 seconds. To avoid this dilemma the operator must manually swap CA suction to the RN supply and then restart the CA pumps.

d) **If** any of the RN to CA valve's switches are selected to closed, the auto swap to RN for the associated pump is disabled, and therefore, the pump will be inoperable.

e) 'A' Train, 'B' Train and RC Low Suction Pressure Setpoints (10.5, 6, **and** 9.3 **psig** respectively) are different due to pressure tap locations (Elevations). They should all occur at same time on suction pressure decrease.

2. "A" Train **Loss of** Normal Suction Protection

a) Three (3) pressure switches monitor the suction pressure **to** " A MD and TD pump. Should 2/3 devices sense 10.5 PSIG decreasing, the following occurs:

1) For "A" pump, id Auto Start received AND CA NOT RESET AND Pump IS Running then 1(2)CA15A and 1(2)RN250A OPEN

2) For 1(2) TD pump, **if** AUTO START received AND CA NOT RESET then 1(2)CA116A and 1(2)RN250A OPEN.

3) 1(2)AD-5 E1:"CA PUMPS TRAIN A LOSS OF NORM SUCT' alarms on decreasing pressure and 1(2)AD-5 F1: "VLV RN250 RN WDR TO CA PMP SUCT ISOL OPEN" alarms when RN250A is intermediate or full opera.

3. "B" Train Loss of Normal Suction Protection

a) Three (3) pressure switches monitor the Suction Pressure **to** *"5"* MD and TD pump. Should 2/3 devices sense 6.0 PSIG decreasing, the following occurs:

1) For "B" pump, **if** Auto Start received AND CA NOT RESET AND Pump IS Running then 1(2)CA18B and 1(2)RN310B OPEN

2) For 1(2) TD pump, if AUTO START received AND CA NOT RESET then 1(2)CA85B and 1(2)RN310B OPEN.

3) 1(2)AD-5 E2:"CA PUMPS TRAIN B LOSS OF NORM SUCT" alarms on decreasing pressure **and** F2: "VLV RN310 RN HDR TO CA PMP SUCT ISOL OPEN" alarms when RN310B is intermediate or full open.

b) **RC** System **Loss *of*** Normal Suction Source

1) The RC piping buried within the Turbine Building provides a separate, redundant Sabotage **Proof** source *of* Feed Water **to** the S/G's. This Source **is *a*** part of the SSF Complex and can supply the S/G's with enough feed to maintain the plant at Hot Standby Conditions **fer** 3.5 days.

2) Three (3) pressure switches monitor suction pressure at the same location **as** the RN pressure switches. But these **Will** supply ONLY THE TD CA PUMP upon reaching setpoint.

3) At 9.3 PSIG decreasing (2/3 coincidence) 1(2)CA174 and 1(2)CA175 WILL OPEN.

4) 1(2)AD-5 G4:"SSF CA XFER TO RC" indicates when SSF source lined up to CA system.

5) RC swapover is independent **of** an auto start signal.

MODIFIED QUESTION

Bank Question: 260.1 ***Answer: D***

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1 Pt(s) Unit 2 is responding to a **loss** of main feedwater event **from** 100% power. Given the foilowing events and conditions:

- The reactor **has** tripped
- The 2A and 2B Motor-driven CA (MDCA) pumps started in auto
- The Turbine-driven CA pump (TDCA) started in auto
- CA suction pressure slowly drops to **4** psig

Which one of the following automatic system responses (*if* any) will occur at this time?

A. **2A CA** pump suction remains aligned to the **CA** storage tanks
The TDCA pump suction shifts to the RN system
2B CA pump suction shifts to the RN system

B. **2A CA** pump suction remains aligned **to** the CA storage tank
The TDCA pump suction remains aligned to the **CA** storage tank
2B CA pump suction remains aligned to the **CA** storage tank

C. 2A CA pump suction shifts to the RN system
The TDCA pump suction shifts to **the** RN system
2B CA pump suction shifts to the RN system

D. **2A CA** pump suction **shifts** to the RN system
The TDCA pump suction remains aligned to the **CA** storage tank
2B CA pump suction remains aligned to the CA storage tank

Distracter Analysis: Unit 2 A train valves RN-69A and CA-15A opens at **4.5** psig and B train valves including the TDCA A train supply opens at 3.5 psig.

A. Incorrect: 2A CA pump shifts suctions to the **RN** system and TDCA and 2B CA pumps do not shift
Plausible: *if* the candidate reverses the train relation of the unit difference.

B. Incorrect: 2A CA pump shifts suctions to the RN system.
Plausible: if the candidate does not know the auto-swap setpoints.
This is the correct answer for Unit 1

C. Incorrect: 2B CA and TDCA pumps do not shift suctions to the RN system.
Plausible: if the candidate does not know the swap over setpoints

D. Correct Answer:

Level: RO&SRO

KA: GEN G2.2.4 *(2.813.0)*

Lesson Plan Objective: CF-CA SEQ I0

Source: Mod; Ques_260, Catawba NRC **I997**

Level of knowledge: analysis

References:
1. OP-MC-CF-CA pages 21, 63

Bank Question: 263 **_Answer: A_**

1 Pt(s) Unit 1 is shutdown in mode *6* with fuel movement in progress. Given the following events and conditions:

- The new fuel elevator **fails** to operate **in** the **up** direction

Which one of the following statements describes the cause of this problem?

A. 1EMF-15 (*SPENT FUEL BLDG REFUEL BRIDGE)* has failed high.

B. 1EMF-20 (*NEW FUEL STOR 1A*) has failed high.

C. The load in the new fuel elevator weighs 1100 lbs.

D. The spent fuel bridge crane is NOT indexed over the new fuel elevator.

Distracter Analysis:

A. Correct answer
B. Incorrect: does not have **an** interlock with the new fuel elevator
Plausible: new **fuel** vault monitor sounds like it "fits" with new fuel monitor if candidate does not know answer
C. Incorrect: If load exceeds 1200 lbs., will prevent movement
Plausible: this is a valid interlock but the weight is insufficient **to** actuate it
D. Incorrect: there is no interlock to prevent moving the new fuel elevator
Plausible: there **is** an interlock ***to*** prevent moving **the** spent fuel pool crane

Level: RO&SRO

KA: *SYS* **034K6.02** (2.6/3.3)

Lesson Plan Objective: FH-FHS SEQ 8

Source: **Bank**

Level of knowledge: **memory**

References:
1. OP-CN-FH-FHS page 18

1	Explain the purpose and design features of the Fuel Handling System: 1. Fuel transfer canal 2. Spent fuel pool 3. Cask area 4. Transfer tube associated with fuel handling operations 5. New fuel storage vault			X	X	X
2	Describe in general terms the actions required per AP/1/A/5500/25 (Damage Spent Fuel), AP/1/A/5500/26 (Loss of Refueling Canal or Spent Fuel Pool Level), and AP/0/A/5500/33 (Damaged Tamper Seal on Special Nuclear Material Shipments).			X	X	X
3	Explain the purpose of each of the Fuel Handling Crane Bridges.			X	X	X
4	Describe the function and operation of the instrumentation and controls associated with the fuel handling bridges.			X	X	X
5	Describe the interlocks associated with the fuel handling bridges. • List the requirements for bypassing fuel handling interlocks			X	X	X
6	Given a set of specific plant conditions and access to reference materials, determine the actions necessary to comply with Tech Specs/SLCs.			X	X	X
7	Describe operations of the Reactor Building Fuel Mast.			X	X	X
8	Describe the design purposes and features of the Fuel Handling Auxiliaries. • New Fuel Elevator • Fuel Transfer Tube • Fuel Transfer Car • Upender • Fuel Handling Tools • Fuel Handling Accessories			X	X	X

A. Components Description

1. New Fuel Elevator (Obj. #8)

   a) Box shaped, with top open and able *to* hold one fuel assembly.

   b) Used to lower New Fuel assemblies into SFP. (Refer to OP/1-2/A/6550/006) (Transferring Fuel with the Spent Fuel Manipulator Crane).

   c) Control pendant on operating floor

      1) Up/Down light

      2) No-load light

         (a) less than or equal *to* 330 lbs. light

      3) Overload light

         (a) Normal greater than 1200 lbs. (Can be bypassed)

            (1) Prevents raising elevator with assembly in it unless key bypass switch is activated. (Prevents removing a Spent Assembly using this elevator).

         (b) Overload greater than 2400 lbs. (No Bypass on this)

      4) Up/Down pushbutton

   d) Will not go up with high radiation alarm on EMF-15 <u>or</u> loss of power to EMF-15 (Spent Fuel Pool Building Refueling Bridge Monitor).

   e) Will not go up with loss of power to SFP crane or crane over the elevator.

2. Transfer

   a) Fuel Transfer Tube (Obj. #8)

      l) Used for transferring fuel under water between containment and spent fuel pool.

      2) Blank flange closes transfer tube on containment side.

      3) Valve is used on spent fuel side.

   b) Transfer Car (Obj. #8)

      1) Runs on raised tracks through the transfer tube.

Normal drive system is two continuous roller chains running along the length of the tracks on the pit side. Ends of chains connected to a pusher a m .

1 Pt(s)

Which one of the following statements correctly describes the complete VI system response to a loss of VI header pressure?

A. 96 psig - the standby air compressor auto starts and loads
80 psig - VS-78 **(VS** supply to **VI)** opens

B. 96 psig - the standby air compressor auto starts and loads
80 psig - VS-78 **(VS** supply to VI) opens
76 psig - **VI-500 (VI** supply to VS) closes

C. 96 psig - the standby air compressor auto starts and loads
94 psig - the standby air compressor quick starts and loads
80 psig - **VI-500** (VI supply **to** VS) closes
76 psig - VS-78 **(VS** supply **to VI)** opens

D. 96 psig - the diesel air compressor quick starts and loads
94 psig - the standby air compressor auto starts and loads
80 psig - **VI-500** (VI supply to VS) closes
76 psig - VS-78 **(VS** supply to VI) opens

Distracter Analysis:

A. Incorrect: Missing the quick start ofthe standby air compressor and VS-78 opening
Plausible: partially correct - actions listed ***are*** correct

B. Incorrect: missing the quick start ofthe air compressor – valve operation setpoints are reversed
Plausible: partially correct - correct actions, wrong setpoints

C. Correct This is the correct sequence

D. Incorrect: the diesel air compressor does not auto-start – missing the quick start sequence for the standby air compressor.
Plausible: partially correct.

Level: RO&SRO

KA: SYS 079 **A4.01** (2.7/2.7)

Lesson **Plan** Objective: VI Ohj: 5, 8, 28, 30

Source: Bank

Level of knowledge: **memory**

References:

1. OP-CN-SS-VI **page** 19

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the system designator(s) and nomenclature for major components	X				
2	Explain the purpose of the Instrument Air system	X	X	X	X	
3	Describe the basic flow paths through the Instrument Air system • Airflow • Recirculated Cooling water flow • Nuclear Service Water flow	X	X			
4	Identify the normal Instrument Air system header pressure.	X	X			
5	Identify the major components served by the Instrument Air system and describe the effect on plant operations on a Boss of Instrument Air	X	X	X	X	
6	Describe the conditions which will cause an Instrument Air compressor to trip	X	X	X	X	X
7	Explain how the Instrument Air system will respond to a compressor trip	X	X	X	X	X
8	Describe how to cross-connect the Instrument Air and Station Air systems	X	X	X	X	X
	• Explain why the cross connection is made			X	X	X
	• Describe the flow path from VS to VI					
9	Describe the Instrument Air compressor automatic actions and their setpoints			X	X	X
10	Explain the purpose of the Instrument Air dryers			X	X	
11	Describe the automatic actions, alarms, and their setpoints associated with the Instrument Air Dryers			X	X	
12	Identify the type of power supplies to each compressor (Vi, VS and VB)	X	X	X	X	
13	Explain the purpose of the Station Air system	X	X	X	X	
14	Describe the basic flow paths through the Station Air system • Air flow • Recirculated Cooling Water flow • Low Pressure Service Water Row	X	X			
15	Identify the normal Station Air system header pressure	X	X			

2. Loss of VI to Primary PORV's

   Pressure regulating valves supply primary PORV's (1NC34A, and 328)

   a) Nitrogen pressure supplied from Cold Leg Accumulators A and B.

   b) The probabilistic risk assessment states the need to have two motive forces for Pzr PORV's in case NCS feed and bieed is needed, so the N_2 was added. If no N_2 and a major accident occurs in conjunction with a loss of VI to containment then there may be no means to control the heat buildup in the reactor and consequently core damage

3. **Loss of** VI (Obj. #5, 8, 28, 30)

   a) Automatic actions

      1) 96 psig **- Low** Pressure Alarm - Standby Compressor **starts** and loads

      2) 94 psig - Standby Compressor "Quick-Starts" and loads

         (a) NOTE: The "Quick-Start" feature refers **to a** timer that is set in the CEM computer program. This timer allows the standby compressor time to start and reach normal operating temperatures prior to loading. Phis also allows for small fluctuations in system pressure without loading the standby compressor.

         (b) Upon receipt of the **"Low** Pressure Emergency" alarm at **94** psig, this time **is** halved by the CEM computer to allow the standby compressor to load faster.

      3) 80 psig - VI 670 'VI Dryer Auto Bypass' opens

      4) 80 psig - VI500 'VI supply to VS' closes.

      5) 76 psig - VS78 'VS supply *to* VI' opens - **VS** provides instrument air via oil removal filters.

   b) AP/0/A/5500/22 *'Loss* **of** Instrument Air'

      1) Reference a current copy of this AP

      2) Major actions

         - Ensure proper compressor operations
         - Locate and isolate leaks
         - Maintain stable plant conditions
         - Monitor piant equipment for status changes.

Bank Question: 300.1 **_Answer: C_**

1 Pt(s) Unit 1 was responding to a steamline **break** inside containment on the 1C S/G per E-2 (Faulted Steam *Generator Isolation*). All equipment has operated as designed.

Which one ofthe following action statements correctly describes the expected method for isolating steam to the CAPT from the faulted S/G?

A. Manually close the CAPT trip and throttle valve (1SA-145).

B. Manually close the 1C MSN and MSIV bypass valve.

C. Manually close the maintenance isolation valve (1SA-4) in the doghouse.

D. Manually close the stop-check valve (1SA-6) in the mechanical penetration room.

Distracter Analysis:
The key to this question is for the candidate to realize that the manual isolation valve would be preferred to the stop check valve.

A. Incorrect: Will isolate steam from EB and 1C S/G
Plausible: partially correct -- will isolate wrong S/G

B. Incorrect:
Plausible: if candidate doesn't realize the tap for the CAPT is upstream of the MSIV

C. Correct: the manual isolation is the preferred choice in E-2
Plausible:

D. Incorrect:
Plausible: the stop check is closed if the isolation valve cannot be closed.

Level: RO&SRO

KA: APE 040 AK2.01 (2.6/2.5)

Lesson Plan Objective: CA Obj: 11

Source: Bank

Levei of knowledge: memory

References:
1. EP-E2 page 12

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Explain the purpose of the CA System.	X	X	X	X	
2	List all of the sources of water available to the CA pumps, and the order of preference of each.	X	X	X	X	X
3	Explain the normal and recirculation flow paths associated with the CA System.	X	X	X	X	X
4	List the automatic start signals (including setpoint) for the motor driven and turbine driven CA pumps	X	X	X	X	X
5	Explain the trip and reset procedures for the CAPT Trip/Throttle valve.	X	X			
6	Explain CAPT local operation.	X	X			
7	Given appropriate plant conditions apply Limits and Precautions associated with related station procedures.	X	X	X	X	X
8	Draw the CA system per the Simplified Flow Diagram.	X	X			
9	Describe the use of the Auto Start Defeat circuitry.			X	X	X
10	Describe the operation of CA System Valve Control reset circuitry.			X	X	X
11	Discuss how to regain control of CA pumps following CA auto start coincident with sequencer actuation.			X	X	X
12	Explain CA pump low suction pressure protection.			X	X	X
13	Given a set of plant conditions and access to reference materials, determine the actions necessary to comply with Tech Spec/SLC's.			X	X	X
14	State from memory all Technical Specification actions for the applicable systems, subsystems, and components which require remedial action to be taken in less than one hour.			X	X	
15	List the system designator and major component nomenclature.	X				

Time: 3 hours

A. Overview

1. Purpose: This procedure provides actions for transferring the safety injection system from the cold leg recirculation made to the hot leg recirculation mode.

2. ES-1.4 **is** entered from E-1 (Loss of Reactor or Secondary Coolant) where the plant specific time for transferring to hot leg recirculation is reached. In this case a break in the NC system has occurred which is large enough to reduce the NC pressure to less than the shutoff head of the ND pumps. After the transfer has been completed the operator should return to E-I..

B. Major Action Summary

1. Align SI Flowpath for Hot Leg Recirculation

a) Hot Leg recirculation *is* implemented to terminate boiling in the core and *to* prevent boron precipitation in the core.

C. Use the "Enhanced Background Document" for detailed step description.

2.6 EP/1/A/5000/ECA-1.1 (boss of Emergency Coolant Recirculation)

A. Overview

1. Purpose: This procedure provides actions when emergency coolant recirculation capability is lost. This is defined as the inability to inject from the sump lo the NC system using an **NB** pump.

2. ECA-1.1 can be entered from E-1, (Loss of Reactor or Secondary Coolant), when cold leg recirculation cannot be verified *to* be available. Entry *is* made from ES-1.3, (Transfer to Cold Leg Recirculation), when at least one flowpath from the sump cannot be established or maintained. ***Also*** entry can be made from ECA-I.2, (LOCA Outside Containment) when a LOCA outside containment cannot be isolated. If recirculation is restored at any time, the operator should return to the procedure and step in effect. If recirculation is not restored upon procedure completion the piant staff *is* consulted.

B. Major Action Summary

1. Continue attempts *to* Restore Emergency Coolant Recirculation.

a) The operator is to try to restore the equipment needed for recirculation in order to avoid performing any extreme recovery actions. These actions will be continued throughout the procedure.

2. Increase/Conserve FWST Level

a) Makeup is **added** to the FWST and FWST outflow is minimized by stopping any unnecessary containment spray pumps and decreasing SI pump flowrate.

3. Depressurize SGs to Cooldown and Depressurize the NC System

STEP 7: Isolate all faulted S/G(s) as follows:

PURPOSE:

To isolate all feedwater to and steam flow from the faulted S/G(s)

To prevent the operator from isolating steam to the CAPT if *it* is the only ≥
source of feed flow to the steam generators. ≥6

APPLICABLE ERG BASIS:

Isolation of the feedwater to the faulted S/G maximizes the cooldown capability of the nonfaulted loops following a feedline break and minimizes the NC System cooldown and mass and energy release following a steamline break. Isolation cf steam paths from the faulted S/G also minimizes the NC System cooldown and mass and energy release to containment. In addition. isolation of these steam paths could isolate the break.

If the CAPT is the only operable source of feed flow to the steam generators ≥
(i.e., CA Pump 1A and 1B ana other operable pumps are incapable. of providing ≥
feed flow to the SGs). then isolation of this steam supply line may degrade ≥
system conditions and result in a transtion to FR-H.1. Therefore. this ≥
isolation must not be performed. ≥6

PLANT SPECIFIC INFORMATION:

Corrective actions of PIP 90-0008 were implemented. The new guidance. should steam to CAPT require isolation. is to proceed first to the Maintenance isolations in the doghouse. to *be* consistent with Tech Specs and SAR. A contingent action is provided to direct the operator to the previously used stopcheck valves located in the mechanical penetration room.

KNOWLEDGE/ABILITY:

Bank ***Question:324*** **Answer:** ***D***

1 Pt(s) Unit 2 was operating at 100% power when a design basis LOCA into containment occurred. Given the following conditions:

- 2EMF-53A/B ***(Containment TRN A/B (HI Range))*** are both inoperable

Which one of the following indications would most accurately determine the dose rates inside containment for the offsite dose assessment calculations?

A. **2EMF-38, 39, 40 *(Containment PAR/GAS/IOD)* indications**

B. **2EMF-5 (*LIQ R/W CONT AREA*) indications**

C. **2EMF-54(HH) *(Unit Vent Gamma (HI-HI Range))* indications**

D. **Portable instruments readings taken on the containment wall and appropriately scaled for shielding factors**

Distracter Analysis:

A. **Incorrect:** 2EMF-38, 39, 40 are isolated by a phase **A** signal
Plausible: They accurately measure radiation levels **under** normal circumstances

B. **Incorrect** This would only measure activity inside the NC system piping
Plausible: This monitor **is** used to measure NC system activity during norma! operations

C. **Incorrect:** the unit vent path would be isolated during **an** accident
Plausible: If not isolated, this could be a good measurement of the activity in containment

D. **Correct:** In the event both Containment High Range Radiation Monitors become inoperable during **an** accident, alternate measurement of containment radiation may be performed per HP/0/B/1009/006 (Alternative Method for Determining Dose Rate Within the Reactor Building).

Level: RO&SRO

KA: SYS 073 A1.01 (3.2/3.5)

Lesson **Plan** Objective: CNT Obj: 9

Source: **Bank**

Level of **knowledge: memory**

References:
1. OP-CN-CNT-CNT **page 13**

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	**STATE** the purpose of Containment.	X	X	X	X	
2	**LIST** the boundaries, which prevent the release of radioactivity to the environment.	X	X	X	X	X
3	**SUMMARIZE** the conditions that must exist for Containment to be considered OPERABLE.			X	X	X
4	**SUMMARIZE** the conditions that must exist for the Reactor Building to be considered OPERABLE.			X	X	X
5	**STATE** the normal operating range for containment pressure and temperature for all modes of operation.			X	X	X
6	**STATE** the design limits for containment pressure and temperature.			X	X	X
7	**DESCRIBE** the operation of Containment Atmosphere Radiation Monitors EMF-38 (Particulate), 39 (Gas), and 40 (Iodine) including: • Operation of the sample pump and sample point selection vaives. • Automatic actions initiated by Trip 2 alarms • Package response to a Phase 'A' Containment Isolation			X	X	X
8	**DESCRIBE** the response of EMF-53A/B to a design break accident and how this response can be used to help determine containment conditions.			X	X	X
9	**DESCRIBE** alternate means of determining containment radiological conditions with EMF 53A/B out of service.			X	X	X
10	**STATE** the site administrative requirements for containment entry per SD 3.1.2 (Access to Containment or Annulus and Areas Having High Pressure Steam Relief Devices)	X	X			
11	**STATE** the site administrative requirements for when, and in what areas the "Buddy System" is to be used per SD 3.1.2 (Access to Containment or Annulus and Areas Having High Pressure Steam Relief Devices).	X	X			
12	**EXPLAIN** the operation of the personnel airlock doors interlock and interlock bypass.	X	X	X	X	X
13	**EXPLAIN** the operation of the personnel airlock doors for normal entry and exit.	X	X	X	X	X

2) Evaluation of Core Damage

(a) Operations SROs and Reactor Group will use RP/0/A/5000/015 (Core Damage Assessment) to determine the extent of clad/fuel failure.

(b) EMF53A and EMF53B may be used to calculate percent clad/fuel damage or to directly estimate fuel failure.

(c) Information is provided to the Emergency Dose Assessor to select the correct dose computer mode!.

3) Alternate Radiation Monitoring

(a) In the event both Containment High Range Radiation Monitors become inoperable during an accident, alternate measurement of containment radiation may be performed per HP/0/B/1009/006 (Alternative Method for Determining Dose Rate Within the Reactor Building).

(b) This procedure directs RP technicians to select a high range survey meter and obtain a contact dose rate at center of outside airlock door to the upper personnel airlock hatch.

(c) A calculation is performed to yield an estimated containment radiation level for use with emergency offsite dose assessment calculations.

4) EMF53A and EMF53B are required by TS 3.3.3 (Post Accident Monitoring Instrumentation)

B. Equipment Hatch (Penetration No. C400)

1. The Equipment Hatch Penetration and Cover are components of the steel Containment **Wall.**

2. Normally, the Equipment Hatch Cover is latched to the penetration sleeve.. When required for containment closure, the Equipment Hatch Cover is required to be held in place without gaps.

3. When access into Containment is required, the Equipment Hatch Cover is designed to be lifted out of the way by a hoist hung from the Containment wall. Maintenance Group is responsible for performing this evolution. The hatch must be capable of being replaced without AC power available (i.e. a backup portable generator to power the hoist) shouid it be required. The time required to do this is documented at the beginning of each outage. If containment closure is required, and exceptions are allowed, this time must be less than a calculated stay time to allow removal of the equipment hatch (the equipment hatch being removed would be considered a closure exception.)

4. The Equipment Hatch containment vessel seal is a double O-ring design subject to Type B Leak Rate Testing following final installation after an outage. (Refer to PT/1/A/4200/001H (Equipment Hatch Leak Rate Test))

Rank Question: 331.1 ***Answer: B***

1 Pt(s)

A technician is performing a calibration procedure, which requires a series **of** approximately 10 sequential steps to be conducted while standing in a contaminated **area.** He/she is in direct communications with **an** operator, the communicator, who holds the procedure and reads each step sequentially.

If the performer does not have the procedure in hand **as** he/she **performs** the steps, what are the requirements of NSD 704 ***(Technical Procedure Use and Adherence)*** regarding the sign off for each step?

A. Only the performer can sign off the steps upon completion of the task after leaving the contaminated area.

B. The communicator signs off each step as the step is completed using his/her own initials and the initials of the performer.

C. The communicator signs **off** each step as the step is completed using his/her own initials along with the time.

D. The communicator signs off each step as the step is completed using the performer's initials along with the time.

Distracter Analysis:

A. Incorrect: Both initials **must** be entered on each step.
Plausible: this is a logical albeit incorrect choice.
B. Correct:
C. Incorrect Bath initials must be entered **on** each **step.**
Plausible: this is a logical albeit incorrect choice.
D. Incorrect: Both initials must be entered on each **step.**
Plausible: this is a logical albeit incorrect choice.

Level: RO&SRO

KA: ADM G 2.1.20(4.3 / 4.2)

Lesson Plan Objective: ADM-OP SEQ 13

Source: Bank

Level of knowledge: memory

References:
1. OP-CN-ADM-OP page 8
2. NSD 704 pages 4, 7

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Describe the General philosophy and intent of procedures.	X	X	X	X	
2	Describe when a procedure is required.	X	X	X	X	
3	Describe how a procedure is revised for Permanent major changes with normal approval.	X	X	X	X	
4	Describe how a procedure is revised for Major changes with temporary approval.	X	X	X	X	
5	Describe how a procedure is revised for Restricted major changes.	X	X	X	X	
6	Describe how a procedure is revised for Minor procedure changes.	X	X	X	X	
7	Define the term - Qualified Individual.	X	X	X	X	X
8	Explain when IV is required.	X	X	X	X	X
9	Describe the responsibilities for use of procedures.	X	X	X	X	X
10	Describe "working copy", control copy (outside Control Room), and "control copy".	X	X	X	X	
11	List the actions to take prior to the use of a procedure.	X	X	X	X	
12	Describe when a procedure is required to be in the possession of the user.	X	X	X	X	
13	Explain when sign off/initials are required in a procedure.	X	X	X	X	
14	Describe the action taken for incomplete and completed procedures.	X	X	X	X	X
15	Describe the requirements necessary to depart from a procedure.	X	X	X	X	X
16	Describe the action necessary to resolve a given discrepancy.	X	X	X	X	
17	Describe how procedures are verified correct.	X	X	X	X	
18	Describe how control copy (outside the Control Room) procedures are maintained current.	X	X	X	X	
19	Describe the use and purpose of the "Revised Data Book".	X	X	X	X	
20	Explain the format used in the EP's and AP's.	X	X	X	X	
21	Describe the use of constrained language and the meaning of any word from the constrained language list.	X	X	X	X	X
22	Describe the difference between "A" and "B" procedures.	X	X	X	X	
23	Describe the transfer of initials in a procedure.	X	X	X	X	X

D. Information Used/Taken into Account

1. Tech Manuals
2. Manufacturer's Instruction Manuals
3. General technical information
4. Vendor technical bulletins
5. FSAR
6. Tech Specs
7. Relevant Operating Experiences (e.g. reportable occurrence).
8. Safety Precautions
9. Good Engineering/Operational Practices

2.2 Operations Management Procedure 1-4 (Use of Procedures) and NSD 704 outlines the specific requirements for using operations department procedures.

2.3 Use OMP 1-4, and NSD 704 cover with the student the following sections:

A. Responsibilities (Obj. #9)

1. Operations Shift Manager or Unit Supervisor
2. All personnel who use procedures

B. Qualifications (Obj. #7, 29)

C. Control of Approved Procedures (Obj. #10, 28)

1. Control Copy Procedures
   a) Control copies in the Control Room
   b) Control copies in locations other than Control Room
2. Working Copy Procedures

D. Use of Approved Procedures (Obj. #14, 15)

1. General Statements of Philosophy (Obj. #1)
2. Levels of Use (Obj. #12)
3. Use of Procedures (Obj. #11, 17)
4. Departure From Approved Procedures (Obj. #15)
5. Procedure Sign-off (Obj. #13, 23)
6. Procedure Conflicts (OP, PT's)
7. Independent Verification (IV) (Obj. #8)
8. Constrained Language (Obj. #21)
9. Component Operations
10. In Progress Procedures

an unexpected situation can make matters worse. Only when there is an immediate personnel hazard or risk of equipment damage should attempts be made to change the state of the system prior to involving supervision or the Control Room SRO.

2) Involving supervision or the Control Room SRO before taking any other actions to return system to normal or safe condition.

Note: Procedure problems do not relieve the performer of the responsibility for maintaining safe plant operation, while conducting the activity.

704.6 PROCEDURE USE (REFER TO APPENDIX B, 704.)

1. Procedures shall only be used for the intent and purpose for which they were written.
2. Procedures shall be adhered to during the course of activities
3. A Working Copy or a Control Copy of a procedure shall be used in the conduct of the specified activities.
4. Prior to use, Working Copies shall he vmified by comparison with the Control Copy of the procedure. This comparison shall be repeated every 14 calendar days while work is in progress. If work is stopped and later resumed more than 14 calendar days from last verification. comparison with the Control Copy shall be performed prior to restarting work.
5. At least one person performing the task described by the procedure shall be qualified to the procedure/task, or the task shall be directly supervised. Documentation of directly supervised tasks shall be included in the procedure or in the work order.
6. Procedure steps should normally be initialed/signed by the qualified (or directly supervised) person performing the step. When this is not practical, a separate qualified (or directly supervised) person may sign as the performer based on positive verification of correct step performance. The person signing as performer is accountable for correct step performance.
7. If the person signing a procedure step is not the performer. both doer and documenter initials (or names) shall be entered at each applicable step or group of steps.
8. Persons performing a procedure which contains sign-off steps should place their name and initials at the beginning of the procedure or on the first page of the procedure on whish their initials appear.
9. Transfer of sign-offs or data from contaminated procedures to a clean copy shall be step-by-step. Photocopy. facsimile, electronic message recorder. or direct communication to another individual are acceptable methods to accomplish this.
10. When transferring completed steps from an existing procedure to a new procedure:
    A. Transfer original initials of the person performing the procedure step
    B. The individual transferring the initials then signs or initials all applicable pages indicating that the initials have been transferred.
11. Direct supervision of a task includes. as a minimum, a pre-job briefing, a post-job review of results, and any job observations the supervisor deems necessary to ensure proper compliance and the desired results are obtained.
12. All procedures shall be considered as "Continuous Use" procedures unless otherwise designated within the procedure. Procedures should be classified in accordance with Appendix A. 704.
13. Continuous Use or Reference Use procedures shall be in the possession of the performer(s) at the job site.
14. For Continuous Use procedures. each step shall he read, understood. and performed as written. If sign-off is required. each step shall be signed off as the action is completed (step-by-step adherence).

3. If place keeping aides (hones, blanks, etc.) are not provided, the user may still check off steps as they are completed.

4. When the action or condition called for by a step is found to already exist, the step may be signed off as completed. Any unexpected actions or conditions shall be evaluated.

5. Procedure steps should normally be initialed/signed by the qualified (or directly supervised) person performing the step. When it is not practical for the person performing the step to sign the step. two other methods may be used.

   A. When a separate qualified (or directly supervised) person has positive verification of correct step performance. that individual may sign off as the performer.

      - The person signing off as performer is accountable for Correct step performance
      - Positive verification is direct visual observation of a step with an obvious and easy way to determine outcome.

   B. When another person signing a procedure step is not the performer AND does not have positive verification. both the performer's initials and the documenter's initials (or names) shall be entered at each applicable step or group of steps.

      - The performer is accountable for correct step performance
      - The documenter is accountable for correct step sequencing, proper place keeping, and correct documentation.

6. Initials may be transferred from an in-progress or completed Working Copy to another Working Copy.

   A. Circumstances which might require the transferring of initials are:

      - Transferring from a contaminated copy to a clean copy.
      - Consolidating signatures from several working copies to a single Working Copy.
      - Transferring from an in-progress procedure to a new revision of the procedure.

   B. Transfers of sign-offs or data is to be done step-by-step.

   C. Acceptable methods to accomplish transferring of initials are:

      - Photocopy
      - Facsimile
      - Direct communications to another individual

   D. Transfer initials from an in-progress Working Copy to another Working Copy as follows:

      - Transfer initials of the person performing the procedure step
      - The person transfemng the initials shall sign or initial all steps indicating the initials have been transferred.
      - For wholesale transfer of initials. the person transferring the initials may sign their initial on each page, with an explanation.

7. Repeating a series of steps:

   - Flexibility should be written into the procedure when steps may need to be repeated.
   - If steps have signoff blanks, sign off during the first or last pass through the block of steps.
   - Check boxes can be checked once during the last pass or once during each pass, whichever is best for the user to maintain place keeping.

Bank Question: 353.3 **Answer: A**

1 Pt(s) **A** male worker is repairing a valve **in a** contaminated area, which has the following radiological characteristics:

- The worker's present exposure **is** 1943 mrem for *the* year
- General **area** dose rate = 30 mrem/hr
- Airborne contamination concentration = 10.0 DAC

The job will take **2** hours if the worker wears ***a*** full-face respirator. It will only take 1 hour if the worker does NOT wear the respirator.

If the RP Manager grants all applicable dose extensions, which one of the following choices for completing **this** job would maintain the worker's exposure within **the** station administrative requirements?

A. The worker should **NOT** wear the respirator because the calculated **TEDE** dose received will be less than if he wears one.

B. The worker should NOT wear the respirator because the dose received without wearing a respirator **will** not exceed **site** annual personnel dose limits.

C. The worker should wear the respirator because the calculated **TEDE** dose received will be less than if he does not wear one.

D. The worker should wear the respirator otherwise fie could exceed **DAC limits.**

Distracter Analysis:

Radiation exposure comparison:
Without respirator
DDE = **30 mrem/hr X** I hr = 30 mrem
From airborne contamination:
CEDE = ***10* DAC 1** hr **X *2.5* mrcm/DAC-hr** = 25
TEDE = **30 +** 25 = ***55* mrem from job**
Total exposure for year = 1943 + 55 = 1998 mrem

With respirator
DDE = 30 mrem/hr x **2 hr** = 60 mrem
CEDE = 0
TEDE = 60 mrem
Total exposure for year = 1943 + 60 = 2003 mrem

(With respirator) (Without respirator)
TEDE = 60 mrem > 55 mrem = do not use a respirator

A. **Correct answer**

B. **Incorrect the** dose **will** exceed the 2000 mrem limit based on calculation.
Plausible: If the candidate miscalculates the dose.

C. **Incorrect:** The calculated exposure will be greater **if** you wear the respirator.
Plausible: If the candidate incorrectly computes the exposure - this **was** the correct answer on a previous exam

D. **Incorrect: DAC** limits are not direct ALARA controls.
Plausible: If the candidate does not understand the concept of derived airborne concentrations.

Level: RO&SRO

KA: ***G* 2.3.2 (2.5 / 2.9)**

Lesson Plan Objective: HP Obj: 2, 4

Source: **Bank**

Level **of** knowledge: analysis

References:
I. OP-CN-RAD-HP pages 14-15

	Objective	I S S	N L O	L P R O	L P S O	P T R Q
1	Define the following terms: Deep Dose Equivalent (DDE) Committed Dose Equivalent (CDE) Committed Effective Dose Equivalent (CEDE) Total Effective Dose Equivalent (TEDE) Shallow Dose Equivalent (SDE) Lens Dose Equivalent (LDE)			X	X	
2	List the 10CFR20 and Duke Power Administrative External and Internal Dose Limits for the following: TEDE Individual Organ or Tissue kens of the Eye Skin or any Extremity Declared Pregnant Woman Minors Public Planned Special Exposures (PSE)			X	X	
3	State the type of exposure each of the following terms relates *to:* Annual Limit on Intake (ALI) Derived Air Concentration (DAC)			X	X	
4	**List** the mathematical relationship between DAC-hours and ALI, and between ALI and TEDE.			X	X	
5	Describe how internal dose can occur.			X	X	

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
6	Define the following areas: Radiation Control Area (RCA) Radiation Control Zones (RCZ) Radiation Areas High Radiation Area (HRA) **Extra** High Radiation **Area** (EHRA) Very High Radiation Area (VHRA) Airborne Radioactivity Area Radioactive Materials Area Contaminated Area Hot Spots bow Exposure Waiting Area (LEWA) Significant Dose Contributor			X	X	
7	List the requirements for wearing dosimetry devices inside and outside the RCA.			X	X	
8	State the correct action *to* take when an Electronic Alarming Dosimeter (EAD) alarms.			X	X	
9	Correctly interpret the information on the Daily Dose Report and (S) RWP's. A. Summarize the purpose and use of Radiation Work Permits and Standing Radiation Work Permits per Radiation Protection Policy III-1 and NSD-507.			X	X	

2.4 Emergency Exposure (Obj. #18)

A. Personnel chosen for emergency exposure will be selected based on the following.

1. Personnel must be Duke Power Emergency Response Organization Member or Off-site Agency Emergency Worker.
2. Should be a volunteer, but if expected to receive greater than 25 rem the person must be a volunteer.
3. Personnel shall be advised of the risks, including the effects of different levels of dosage, both short and long term effects.
4. Should be non pregnant adult.
5. All factors equal the older workers should be considered first.

B. Exposure Limits

1. To protect valuable property a person may receive up to 10 rem TEDE, 30 rem to the Lens of the eye, and 100 rem to the skin and extremities.
2. To save a life or protect a large population a person may receive 25 rem TEDE, 75 rem to the Lens of the eye, and 250 rem to the skin and extremities.
3. To save a life or protect a large population on volunteer basis only, a person may receive greater than 25 rem TEDE, greater than 75 rem to the Lens of the eye, and greater than 250 rem to the skin and extremities.

2.5 Internal Exposure

A. Annual Limit on Intake (ALI) (Obj. #3)

The amount of airbarne radioactive material necessary to receive a CEDE of 5 rem effective dose equivalent or 50 rem to any organ. Each individual is limited to one ALI per year.

B. Derived Air Concentration (DAC) (Obj. #3)

The concentration of radioactive material in air that would result in an intake of one ALI if breathed for 2,000 hours (40 hours/week, 50 weeks/year).

2000 DAC-hours = 1 ALI = 5 rem internal exposure (CEDE) Obj. #4)

1 DAC hr = 2.5 mrem

C. Relating DAC, CEDE, ALI, and TEDE

TEDE is equal to the external dose plus the internal dose (CEDE). Since 5 rem is equivalent to 1 ALI, which is also equivalent to 2,000 DAC hours, 1 DAC hour is equal to 2.5 mrem of external dose for most radionuclides (5,000 mrem/2,000 hours = 2.5 mrem per DAC hour). For nonstochastically limited radionuclides, the hazard is somewhat less than that of 2.5 mrem external dose.

At 25% of DAC or greater, area is posted with sign "Airborne Radioactivity Area". Personnel entering the area are assigned DAC-hrs based on time in the area.

Example of a Simplified TEDE/ALARA Evaluation

Review the following problems:

An individual **is** assigned the ***task*** of repairing a *door* in a radiological area. The area has a dose rate of **24 mrem/hr** and also has some airborne radioactivity. From experience with this door, the individual knows it will take 2 hours and 20 minutes to make the repair with a respirator or 2 hours without a respirator. If the job **is** done without a respirator, the individual will receive 2 DAC hours' internal exposure.

If the individual wears a respirator what **will** the total dose be?

Answer: The total dose will be 56 mrem.

(24 mrem/hr)(2.33 hrs) = 56 mrem

If the individual does not wear a respirator, what will the total exposure be?

Answer: The total dose will be 53 mrem.

(24 mrem/hr)(2 hour) + (2 DAC hours)(2.5 mrem/DAC hour) = 53 mrem

Which individual received **less** dose?

Answer: The individual not wearing the respirator.

D. Methods of internal Deposition **(Obj. #5)**

1. Radioactive Material enters the body through:
   a) Inhalation- breathing.
   b) Ingestion-eating, drinking, or chewing.
   c) Absorption - absorbing it through the skin.
   d) Injection/Open wounds - through an open wound, sore, or puncture wound. Notify RP if you have open cuts or sores ***BEFORE*** entering radiologically controlled areas.

3. Radiological Areas (Obj. #6)

3.2 Plant Condition Changes

Bank Question: 592.1 Answer: C

I Pt(s)

Unit 1 is in mode 3. NC pressure is 1940 psig. CA auto start defeat "Defeated" lights are lit

The following sequence of events occur on unit 1 while in mode 3:

1. CF isolation and the running CFPT trips on S/G Hi-Hi level
2. The S/G Hi-Hi level clears
3. CF isolation is reset
4. T-avc increases and NC pressure increases to 1960 psig

Which of the following correctly explains when, if at all, the CA pumps should have automatically started'?

A. Following the CF isolation reset.

B. When the S/G Hi-Hi level cleared.

C. When pressure increased above P-11.

D. The CA pumps have remained off for these events.

Distracter Analysis:
Tests the candidates' knowledge of the low suction pressure protection circuitry when the CA has been reset.

A. Incorrect: defeated by CA auto start defeat
Plausible: could result in a CA pump start

B. Incorrect: defeated by CA auto start defeat
Plausible: normally true

C. Correct answer The auto start defeat will Auto RESET when above P-11 and can be manually RESET at any time.

D. Incorrect: auto **resets**
Plausible: candidate does not recall the signal auto resets above P-11

Level: RO&SRO

KA: SYS 061 A2.05 (3.1*/3.4*)

Lesson Plan Objective: CA Obj: 9

Source: Mod Ques_592 McGuire NRC 2000

Level of knowledge: analysis

References:
1. **OP-CN-CF-CA pages 10** and **11**

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Explain the purpose of the CA System.	X	X	X	X	
2	List all of the sources of water available to the CA pumps, and the order of preference of each.	X	X	X	X	X
3	Explain the normal and recirculation flow paths associated with the CA System.	X	X	X	X	X
4	List the automatic start signals (induding setpoint) for the motor driven and turbine driven CA pumps	X	X	X	X	X
5	Explain the trip and reset procedures for the CAPT Trip/Throttle valve.	X	X			
6	Explain CAPT local operation.	X	X			
7	Given appropriate plant conditions apply Limits and Precautions associated with related station procedures.	X	X	X	X	X
8	Draw the CA system per the Simplified Flow Diagram.	X	X			
9	Describe the use of the Auto Start Defeat circuitry.			X	X	X
10	Describe the operation of CA System Valve Control reset circuitry.			X	X	X
11	Discuss how to regain control of CA pumps following CA auto start coincident with sequencer actuation.			X	X	X
12	Explain CA pump low suction pressure protection.			X	X	X
13	Given a set of plant conditions and access to reference materials, determine the actions necessary to comply with Tech Spec/SLC's.			X	X	X
14	State from memory all Technical Specification actions for the applicable systems, subsystems, and components which require remedial action to be taken in less than one hour.			X	X	
15	List the system designator and major component nomenclature.	X				

Time: 3 hours

b) Two **of** four S/G narrow range level channels in *two* of four S/G LO LO LEVEL.

c) The following are NOT "CA AUTO STARTS" but merely cause the steam to **be** admitted to the Turbine, ("CA ***SYS*** VLV CTRL" resets remain lit):

   1) Loss of Power or Instrument Air to **1(2)SA 2** or 5 causes these valves to fail open and admit Main Steam to the Turbine driven CA Pump.

   2) **2/4 SSF** Wide Range **S/G Levels less** than 45% cause **SA-5** to fail open. **THIS FEATURE CAN NOT BE DEFEATED.** (A loss **of** SSF power will initiate this same failure).

3. Plant **Response** to the CA **Auto** Start.

   a) BB Row control valves close.

   b) BB Cont. Isolation and Bypasses Close; Train Related

   c) NM Sample Cont. Isolations Close; Train Related

   d) CF Cont. Isolation Bypasses Close; either train

   e) Individual Tempering bine isolation Valves Close; either train

   f) Flow Control Valves fail to "FULL OPEN".

   g) If it was a Turbine Driven Start; SA 2 & *5* fail open, Governor positions to Max speed and TD Flow Control Valves fail to "FULL OPEN".

   h) "A" Train CA Signals causes TD governor to position to "MAX" speed and prevents manual closing of T&T Valve at MC-I0. "B" Train DOES NOT provide these features.

   i) RN Valves low suction pressure alignment circuits are enabled.

   j) CS-47(Normal Hotwell M/U Control) fails <u>closed</u> on either train CA Auto start. This ensures the CA system is not affected by any UST inventory loss to the hotwell. Control board resets buttons **for** each train restores the valve to its normal makeup duties.

4. AUTO-START-DEFEAT: (M/D PUMPS ONLY **Obj** # 9) Each train of CA contains a defeat button that allows the **operators** to prevent certain start signals for normal unit shutdown.

   a) Defeated Start Signals: (NOTE: These are the 3 MID CA auto-starts that are **<u>NOT</u>** sequencer actuated.)

      1) 1/4 S/G 214 LO LO LEVEL

      2) Loss of Both Feed Pumps

      3) AMSAC (already defeated if less than **40%** for greater than 2 min.)

b) To operate this circuit, you must be in the P-11 state: 2/3 Pressurizer Pressures less than 1955 PSIG.

c) This feature will Auto RESET when above P-11 and can be manually RESET at any time.

5. CA SYSTEM VALVE CONTROL RESETS (Obj # 10)

a) Any CA Auto Start automatically starts and positions the CA system to supply feed to the S/G's. During this period, the operator can neither affect CA valve control nor shutdown the pumps. In order to regain control of CA, the operator must RESET each Train of CA. These switches are labeled "CA SYS VLV CTRL". These "RESETS" must be held depressed for greater than 2 seconds to ensure reset.

b) If the motor driven CA pumps were in "Auto-Start Defeat" when an auto-start signal is generated,

1) The pumps will start if the "auto-start defeat" should clear (either manually or automatically if above P-11).

2) The operator can know an Auto-Start signal is present prior to going above P-11 by observing CA valves RESET light "lit" for both trains. If an auto-start signal is present, then the RESET lights will be dark.

3) If CA starts due to Ss or Blackout, the motor driven pumps are still controlled by the Sequencer until the sequencer is reset. (Obj # 11)

c) "A" Train RESET gives operator control to the following

1) CA PUMP "A" (If Sequencer is Reset)

2) 1(2)CA 60 & 56; S/G A and B Flow Control Valves

3) 1(2)CA 48 & 36; TD Flow Control Valves for C & D S/G's.

4) "A" Train Air Solenoids energize for 1(2)SA 2 & 5

5) Allows closing T&T valve at MC-10

6) Allows Train Related BB, NM and CF valve control

d) "B" Train RESET gives operator control of the following

1) CA PUMP "B" (If Sequencer Reset)

2) 1(2)CA 44 & 40; S/G C and D Flow Control Valves

3) 1(2)CA 64 & 52; TD Flow Control Valves for A & B S/G's.

4) "B" Train Air Solenoids energize for 1(2)SA 2 & 5

5) Allows Train Related BB, NM and CF valve control.

MODIFIED – McGUIRE NRC 2000

Bank Question: 592 ***Answer: 6***

1 Pt(s) Unit 1 was cooling down in Mode **4** when the 1A1 KC pump trips. Given the following conditions:

- Both trains of KC were initially in operation
- 1A2 KC pump was secured due to high KC flow
- Both trains of **ND** were aligned for RHR shutdown cooling
- NCS temperature was 205 **°F**

If train **A** KC pumps cannot be restarted, which one of the following list of actions is the <u>complete **list**</u> of actions that must be taken to prevent damage to equipment?

A. Stop ND pump 1A

B. Stop ND pump 1A
Isolate ND flow through the 1A ND heat exchanger

C. Cross-connect KC flow to the 1A **ND** heat exchanger
Cross-connect KC flow through the 1A ND Pump mechanical seal heat exchanger

D. **Stop** ND **pump** 1A
Isolate KC flow through the letdown heat exchanger

Distracter Analysis: Upon a loss of KC to **an** operating ND train, AP/21 requires two actions (per Foldout page):

- Stop the associated ND pump
- Isolate flow to the associated **ND** HX

A. Incorrect: Must also stop flow to the ND HX per **AP/21**
Plausible: action to stop the 1A **ND** pump is correct. There is a separate operating precaution to maintain flow through the **ND** HX > 2000 gpm to prevent water hammer – but it does not apply to this case.

B. Correct answer

C. Incorrect: cannot cross-connect B train KC flow to the **A** train **ND** HX under these conditions – AP/21 specifies that flow must be stopped to the **ND** HX.
Plausible: There is a precaution to ensure that KC flow is maintained to ND mechanical seal HX for all operating ND pumps

D. Incorrect: no need to secure flow the letdown HX

Plausible: this **would be required if KC was lost when the plant was** at **power and** NCS **temp was higher** to **prevent flashing** in **the letdown line.**

Bank Question: 594.3 **Answer: C**

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1 Pt(s) Unit 1 was operating at **45%** power when a loss of condenser vacuum occurred. Given the following events and conditions:

- The s t e m dump system **was** in **a** normal alignment
- All automatic protective actions occur as designed
- Condenser **vacuum** slowly decreases **to** 16 inches
- The operators implement AP/23 *(Loss of Condenser Vacuum)*.

Which one of the following statements correctly describes **how** T_{ave} is controlled after the transient is over and the plant has stabilized?

REFERENCES PROVIDED – Steam Tables

A. **Controlled on the condenser steam dumps around 553 °F**

B. **Controlled on the atmospheric steam dumps around 557 °F**

C. **Controlled on the condenser steam dumps around 561 °F**

D. **Controlled on the PORVs around 561 °F**

Distracter Analysis: the turbine will trip at approximately *22* inches of vacuum, C-9, condenser available, is **not lost** because vacuum does not drop below 15 inches and the condenser steam dumps will control Tave. The reactor does **not trip** because power *is* below P8. Rods drive in automatic.

The operators would enter **AP-2** (Turbine Trip) and stabilize Rx power at 6-10%. The **plant** would stabilize on the load rejection controller at Tref *of* 577°F +3°F (deadband) + *1°F* (6-10%) = 561°F

A. **Incorrect:** Tave will stabilize at –561°F on the condenser steam dumps.
Plausible: if the candidate thinks that the plant will stabilize on the P-12 setpoint when the dumps activate in load reject mode. This occurs under certain instrument failures that cause Tref **to** fail low.

B. **Incorrect:** Tave will stabilize at –561°F on the condenser steam dumps.
Plausible: If the candidate does not recognize that **C-9** is not lost. This was the answer in a prior version of this question.

C. **Correct:** Tave will stabilize at ~561°F **on** the condenser steam dumps.

D. **Incorrect:** Tave will stabilize at **~561°F** on the condenser steam dumps.
Plausible: if the plant stabilizes on the PORVs – if the candidate thinks that both the condenser and atmospheric steam dumps do not actuate, then Tave would be controlled on the S/G PORV's (1125#+14.7 converts to ~561 °F). This occurs under certain instrument failures where Tref failed high.

Level: RO&SRO

KA: G 2.4.2 **(3.9 / 4.1)**

Lesson Plan Objective: STM-IDE SEQ 7

Source: Mod Ques_594, Catawba NRC **1999**

Level of knowledge: comprehension

References:
1. OP-CN-STM-IDE pages 7-10, 21, 24, 25
2. OP-CN-STM-SM page 8
3. Steam Tables - PROVIDED

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Describe the purpose of the IDE System.			X	X	
2	List the banks of steam dumps and the number of valves in each bank.			X	X	
3	Describe the capacity of the Steam Dump System.			X	X	X
4	Describe the controllers in the Steam Dump System. • Describe the inputs to each controller • Discuss the plant conditions required to "enable" the controller			X	X	X
5	Discuss the conditions required to "arm" each bank of dump valves. • Discuss the plant conditions that would cause Steam Dump "actuation"			X	X	X
6	State the number of steam dumps that can be isolated with the unit at 400% power.			X	X	X
7	Discuss the purpose and state the setpoint of each of the following: • P-12 Lo-Lo T_{avg} Interlock • C-7A • c7E3 • c-9			X	X	X
8	Describe the controls associated with the ID€ System.			X	X	X
9	Describe the system response to a failure of each input to IDE.			X	X	X
10	Describe haw to transfer modes of operation of the IDE System.			X	X	X
11	Discuss how a cooldown Is accomplished using the IDE System.			X	X	X

4. Condenser steam dumps are provided with inlet and outlet manual isolation valves.
5. Atmospheric steam dumps can be isolated from CR by electrically operated isolation valves.

G. Steam Pressure Controller (Obj. # *4)*

1. Used during S/U and S/D less than 15% power. Can be used if Load Rejection or Plant Trip Controllers are not properly operating.
2. Enabled by **"STEAM DUMP SELECT** switch on Control Board being selected **to "STM PRESS".**
3. This controller compares steam header pressure to a setgoint put in by the operator on the "STM PRESS CTRL" Man/Auto Station on MC2.
4. Sends a signal **to** modulate condenser dumps if the arming signals are satisfied and no blocks exist.
   - **a)** Arming signals (Obj. # 5)
     - 1) Press Mode Selected
     - *2)* C-9
       - (a) 2/2 condenser vacuum greater than 15" Hg on condensers A&B.
       - (b) 1/4 RC pump bkrs closed.
   - b) Blocking signal
     - **1)** P-12 TRN A
     - 2) P-12 TRN B.

H. Load Rejection Controller (Obj. # 4)

1. Used during a load rejection to prevent a large T_{avg} increase on a loss of load.
2. Enabled by Steam Dump Select switch being in "T_{avg}" and no Keactor **trip** (P-4 Train B).
3. Compares auctioneered high T_{avg} to T_{ref} and sends **a** signal to modulate all banks **as** necessary. A lead/lag circuit conditions the auctioneered Hi Tavg signal. This circuit initially boosts the magnitude of any change in auctioneered Hi Tavg by a factor of 2. This is to make the steam dumps respond in **an** anticipatory manner and to prevent overshoot.
4. A 3°F dead band exists on the controller to allow rod control to actuate to decrease T_{avg}.
5. Sends signal to modulate dumps open one bank **at** a time.
   - a) Bank one open fully, then Bank 2 starts opening, etc.

6. Arming Signais (Obj. # 5)
   a) "T_{avg}" mode selected
   b) C-7A or C-7B actuated.
      1) C-7A arms condenser dumps.
      2) C-7B arms atmospheric dumps.
   c) NO Reactor Trip (P-4 Train A) - atmospheric dumps.
   d) C-9 - Condenser Dumps
7. Load Rejection Signals
   a) Load detected by turbine impulse pressure channel II.
      1) Different channel than reactor control uses for T_{ref} calculation.
   b) Load signal goes thru Isol amp to derivative circuit.
   c) Derivative circuit generates output signal proportional to rate of change of impulse pressure.
      1) Output zero fer nonchanging pressure signal.
   d) Load Reduction Bistables
      1) C7A Loss of Load Interlock (Obj. # 7)
         (a) 10% Step load decrease or a ramped load decrease over a given period of time.
         (b) Energizes latching relay.
         (c) Activates C-7A loss of load interlock status light
            (1) LOSS OF LOAD INTLK COND DMP VLVS.
         (d) With C-9 activated, will arm banks 1, 2, 3.
            (1) Energizes arming solenoid valves.
            (2) C-9 not activated will block arming signals (Banks 1, 2, 3)
         (e) C-7A Reset-take "STM DUMP SELECT SWITCH" to "RESET"
      2) C7B boss of Load Interlock (Obj. # 7)
         (a) 30% step load decrease or a ramped load decrease over a period of time.

(b) Energizes latching relay

(c) Activates C-7B interlock status light

(1) LOSS OF LOAD INTLK ATMQS BUMP

(d) Arms Banks 4 and 5 with:

(1) NO (Train A - P-4) Reactor Trip

(2) STM DUMP SEL. SWITCH IN "Tavg"

(3) (Train A P-4) Reactor Trip blocks arming signal for Bank 4 and 5.

(e) C-7B Reset - Take STM DUMP SELECT SW. to RESET

I. Plant Trip Controller (Obj. # **4)**

1. Used to reduce T_{avg} to $T_{no\text{-}Load}$ following a Reactor trip.
2. Enabled by select switch in "T_{avg}" with a Reactor Trip (**P-4** Train B).
3. Compares T_{avg} to $T_{no\text{-}Load}$ and modulates Banks 1, 2 and 3 (Condenser Dumps). A lead/lag circuit conditions the auctioneered Hi Tavg signal. This circuit initially boosts the magnitude of any change in auctioneered Hi Tavg by a factor of 2. This is to make the steam dumps respond in an anticipatory manner and **to** prevent overshoot.
4. Arming Signals (Obj. # 5)
   a) Reactor **Trip (P-4** Train **A)**
   b) C-9
5. Trip signal **is** similar **to** Load Rejection.
6. Output limited to **49%** steam dump demand, which is not enough of a control signal **to** open the atmospheric steam clumps.

J. P-12 Lo-Lo T_{avg} Interlock (Obj. # 7)

1. Blocks dump actuation to prevent excessive cooldown below minimum temperature for criticality.
2. Set at 553°F on 2/4 NC loops.
3. Solenoid valves that shut off control air for each steam dump valve.
4. Steam Dump INTLK Byp TRN (A) B
   a) Either Switch in OFF
      1) Steam dumps blocked
   b) Both switches in ON
      1) Normal plant operation
      2) Steam dump actuation permitted.

c) 1&4 switches to BYP INTLK momentarily. (Spring return to "ON")

1) Bypasses P-12 block signal for Bank 1 dump valves.

2) Allows Bank 1 to be used for plant cooldown below P-12 setpoint.

3) Activates Status light STM DUMP INTLK TRAIN A (B) BYPASSED.

4) If P-12 clears (3/4 NC loops greater than 553°) - bypass automatically reset.

d) Both switches to OFF/RESET

1) Resets bypass signal

2) Blocks All steam dumps

K. Status Lights (SI-5) (Obj. # 8)

1. ATMOS/COND STM DUMP MODULATION - Lit when any arming signal is present.

2. ATMOS/COND STM DUMP TRIP OPEN - Lit when Steam dump demand is greater than 16.2% and Tave Mode is selected on the STM BUMP SELECT Switch.

4. PROCEDURES

4.1 Normal Startup (Qbj. # 10)

A. Select STM PRESS control mode

B. Set steam header pressure controller for no-load operating pressure (●90 psig at 557°F).

C. Steam dump is used as an artificial load until sufficient steam is available to roll the turbine at 10% power.

4.2 Normal Operation

A. When the load increases to approx. 15% and all dump vaive close, select T_{avg} control mode.

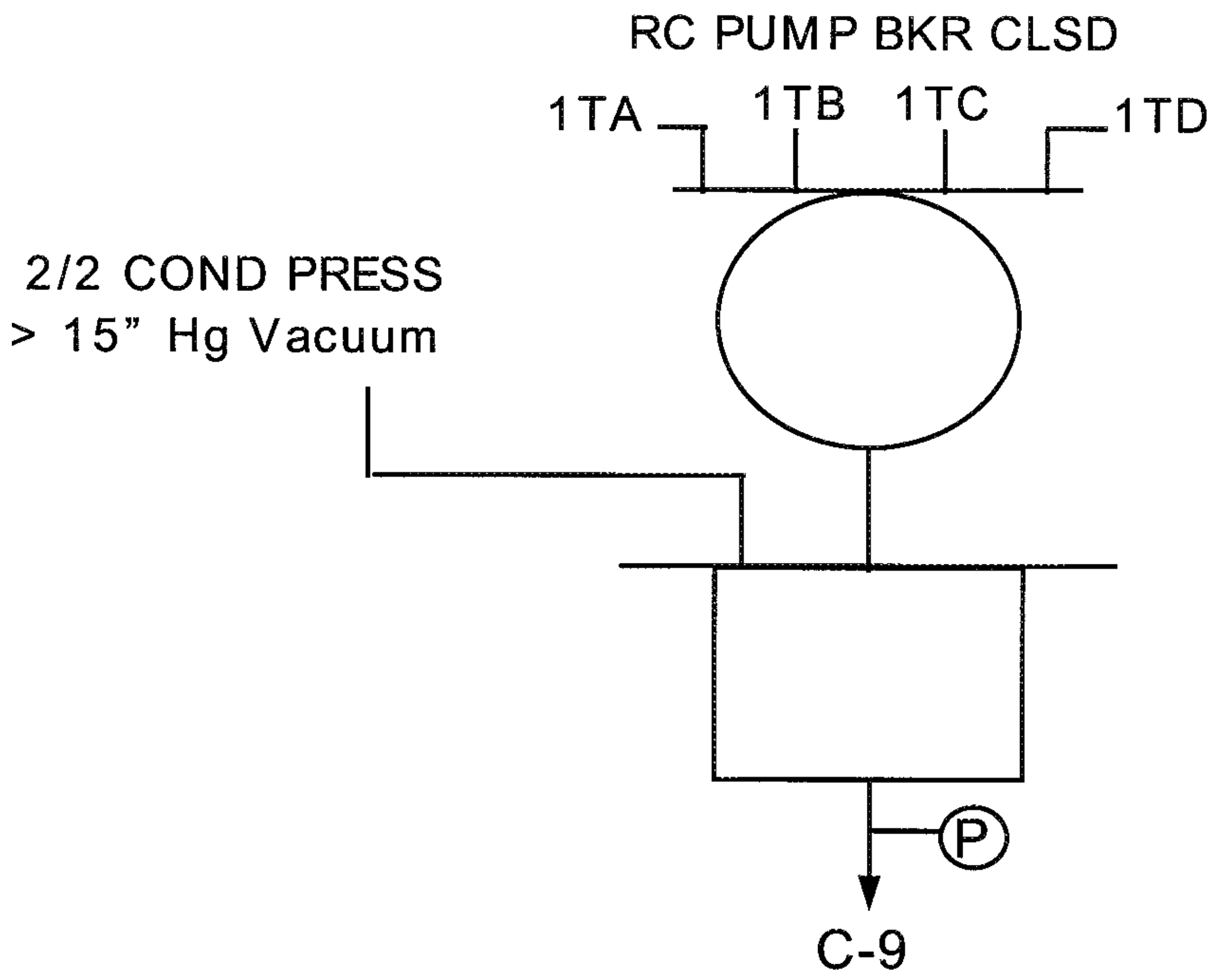
B. Steam dump valves will remain closed during normal operation.

C. Steam Dump Isolation (Ref. Site Directive 3.0.8 Scheduling Philosophy for Priority Work) (Obj. #6)

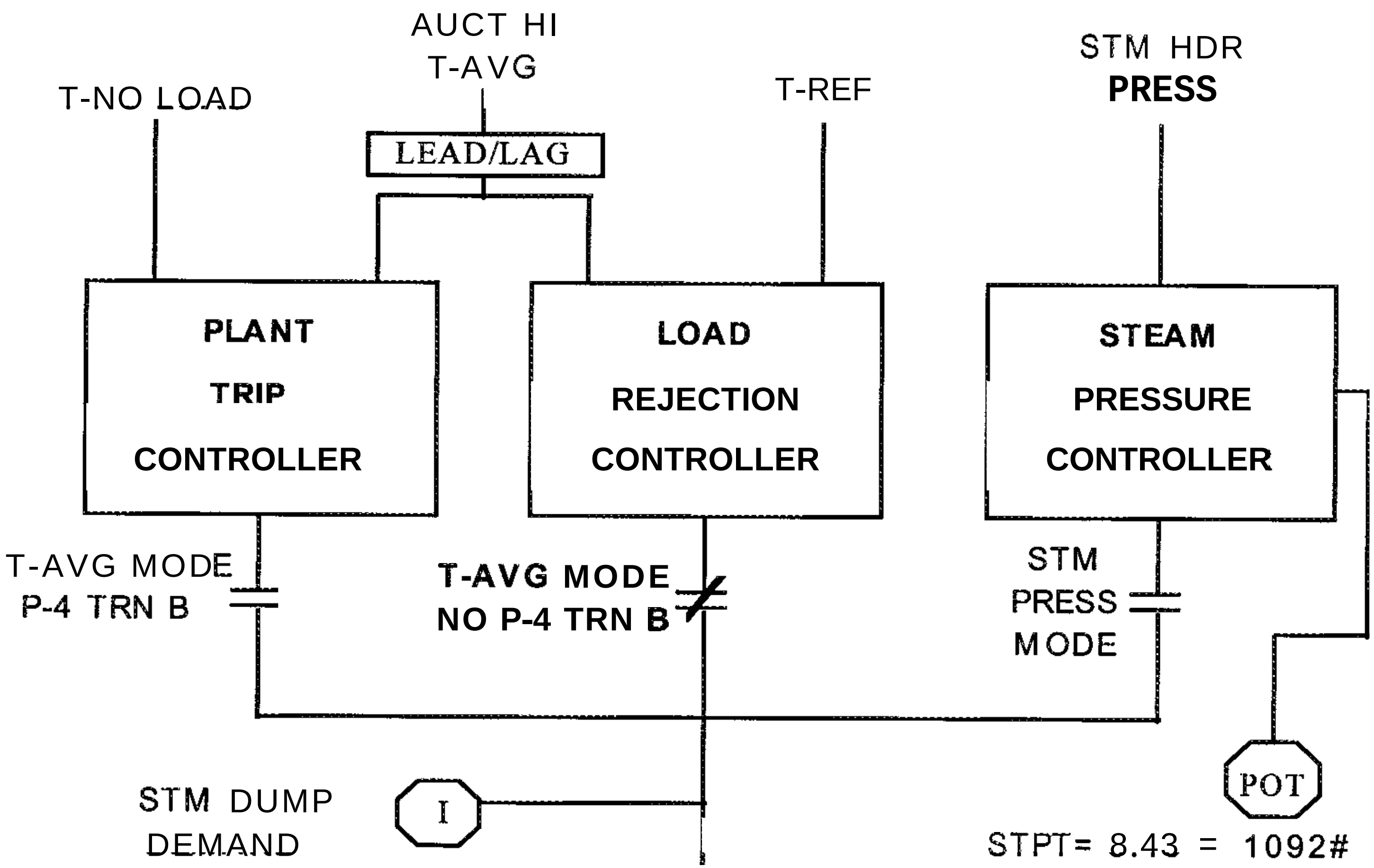
The maximum number of steam dumps and S/G PORV's which can be isolated at 100% power is 2. The two can be made up of any atmospheric dump, one condenser dump, or one S/G PORV. However, the 2 should never be 2 atmospheric, 2 condenser or 2 S/G PORV's. This is lo prevent lifting steam line safety valves in the event of a full and instantaneous load rejection.

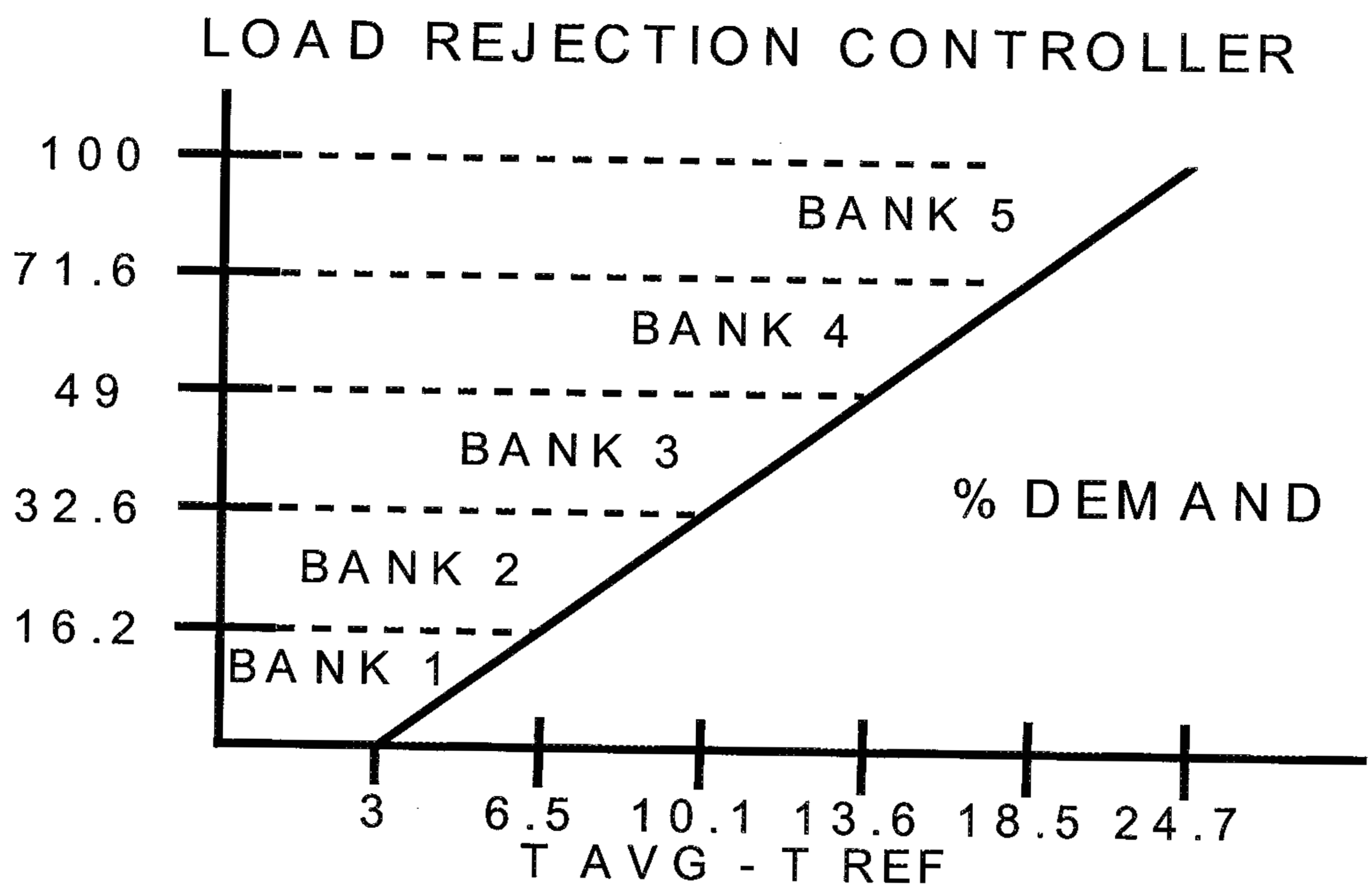
4.3 Loss of Load

A. If a 10% step load reduction occurs, steam wilt be dumped to the condenser automatically.


RC PUMP BKR CLSD
1TA
1TB
1TC
1TD
2/2 COND PRESS
> 15" Hg Vacuum
P
C-9

T-AVE MODE@ 15% LOAD




LOAD REJECTION CONTROLLER
100
71.6
49
32.6
16.2
BANK 5
BANK 4
BANK 3
BANK 2
BANK 1
% DEMAND
3
6.5
10.1
13.6
18.5
24.7
T AVG - T REF

2. S/G PORV's can be controlled from:

a) Control Room (Panel MC-2)

1) "AUTO" - PORV's open at **1125** psig increasing
PORV's close at 1092 psig decreasing

2) "MANUAL" - S/G PORV is opened or closed by the operator using a "0" to "10" position pot, with "0" being closed and "10" being fully open

(a) Prior to selecting "MANUAL", the pot should be set on "0" to prevent inadvertent PORV opening.

3) In "AUTO", only VI (Instrument Air) is available to operate the S/G PORV.

4) In "MANUAL", solenoid valves align such that either VI or N2 can supply the PORV. The source with the higher pressure **will** supply control air and positioning air.

(a) Two (2) breakers are located behind panel MC-6 in the Control Room. These breakers should remain energized ('ON') at all times. They provide the capability to take the POKV to "MANUAL" Control. When these breakers are de-energized indication of "AUTO" or "MANUAL" control is lost and the control for the PORV fails to the "AUTO" position.

b) CAPT Panel in "LOCAL" Control

1) Two (2) breakers are provided in the CAPT panel room to transfer control for the S/G PORV's from Control Room Control to CAPT LOCAL CONTROL.

2) Breakers are located in the CAPT Room.

3) Breakers are normally 'OFF' and should only be turned 'ON' when Control transfer is desired.

4) Prior to transfer, the "Manual Loaders" associated with each PORV should be verified 'closed' to prevent inadvertent PORV opening.

5) When breakers have been selected to 'ON', all control functions are taken away from the Control Room and the operator controls PORV position using local "Manual Loaders" for each PORV.

6) When operating the PORV's from the CAPT panel, VI is the <u>only</u> source available for positioning the PORV's. If VI **is** lost while at the CAPT panel in "LOCAL" control, the S/G PORV cannot be opened.

MODIFIED: McGUIRE AUDIT ~~NRC~~ 2002

Bank Question: 594.2 ***Answer: C***

1 Pt(s) Unit 1 was operating at 40% power when a **loss** of condenser vacuum occurred. Given the following events and conditions:

- Condenser vacuum decreases to 19 inches
- The steam dump system was in a normal alignment
- All automatic protective actions occur as designed
- The operators implement AP/23, *Loss of **Condenser Vacuum.***

What should be the value of T-ave after the transient is over and the plant has stabilized?

A. **553 °F**

B. **557 °F**

C. **561 °F**

D. **566 °F**

Distracter Analysis: the turbine will trip at approximately 20 inches of vacuum, C-9, condenser available, is lost below 20 inches.

A. **Incorrect:** will stabilize at 559 °F.
Plausible: if the candidate **thinks** that the C-7 load reject controllers will activate the dumps, the lack of C-9 lets only the atmospheric dumps operate in steam pressure mode until shut by P-12 at 553 **°F**. This is the right answer if the candidate does not know that the reactor is tripped for loss **of** vacuum at any power.

B. **Incorrect:** Tave will stabilize at 559 **°F**
Plausible: If the candidate misunderstands that the **Tavg/plant trip** mode is blocked by 6-9. This was the answer in a **prior** version.

C. **Correct:** plant will stabilize on the S/G PORVs – the atmospheric dumps do not function.

D. **Incorrect:** will stabilize at 559 °F.
Plausible: if the plant stabilizes on the steam generator code safeties – if the candidate thinks that both the condenser dumps **and** the atmospheric dumps do not actuate, and forgets about the S/G PORVs.

Level: RO&SRO

KA: APE 051AK3.01 (**2.8** / 3.1)

Lesson Plan **Objective:** STM-IDE **SEQ** 5/6

Source: Mod; Ques_594.1, Catawba **Audit 2001**

Level of knowledge: comprehension

References:
1. OP-MC-STM-IDE **pages 21-31**

MODIFIED: CATAWBA AUDIT 2000

***Bank Question:* 594.1** ***Answer:* B**

1 Pt(s) Unit 1 was operating at 100% power when a **loss** of condenser vacuum occurred. Given the following events **and** conditions:

- Condenser vacuum decreases to 16 inches
- The steam dump system was in ***a* normal** alignment
- All automatic protective actions occur **as** designed
- No operator action

What should be **the** value of T-ave after the transient is over and **the** plant has stabilized?

A. **553 °F**

B. **557 °F**

C. **561 °F**

D. **564 °F**

Dfstracter Analysis: the turbine will trip at approximately 22 inches of vacuum, C-9, condenser available, is lost below 15 inches.

A. **Incorrect:** Tave will stabilize at **557 °F**
Plausible: If the misunderstands **the** P-12 interlock

B. **Correct:** will stabilize at **557 °F**
P-4 occurs and enables the plant **trip** controller to return NC temperaure to no-load Tave.

C. **Incorrect:** will stabilize at 557 °F.
Plausible: if the candidate thinks that the plant will stabilize on the atmospheric steam dumps – the condenser dumps do not function

D. **Incorrect:** will stabilize at **557 °F**
Plausible: if the plant stabilizes on the steam generator code safeties – if the candidate thinks that both the condenser dumps and the atmospheric **dumps do** not actuate.

Level: RO&SRO

KA: APE 051AK3.01 (2.8 / **3.1)**

Lesson Plan Objective: IC-IDE SEQ **5,7**

Source: Mod; Ques_594, McGuire Exam 2000

Level **of** knowledge: comprehension

References:
1. OP-CN-IC-IDE pages 5-11

MODIFIED: McGUIRE NRC 1999

Bank Question: 594 **Answer: C**

1 Pt(s) Unit 1 was operating at 100% power when a loss of condenser vacuum occurred. Given the following events and conditions:

- Condenser vacuum dropped to 10 inches
- The steam dump system was in a normal alignment
- **All** automatic protective actions occurred as designed

Which one ***of*** the following statements correctly describes the operation **of** the condenser dump valves?

A. Condenser steam dump valves do not open because the C-7A arming signal is blocked.

B. Condenser steam dump valves **do** not open because the load rejection controller is active.

C. Condenser steam dump valves isolate when condenser pressure drops below 20 inches of vacuum.

D. Condenser steam dump valves isolate when the P-12 block solenoid valves close.

Distracter Analysis:

A. Incorrect: C-7A will arm on a 10% step change in load
Plausible: If the **C-7A** interlock did not pick **up** and arm the condenser **dump** valve, they would not open

B. Incorrect: The piant trip controller is active when P-4 occurs and the steam **dump** select switch is in T-ave position.
Plausible: The load rejection controller is active when **P-4** does not occur.

C. Correct answer

D. Incorrect: The condenser dump valves would close on loss of c-9. The **P-12** block solenoids do not actuate unless T-ave is below **554** °F.
Plausible: The P-12 block solenoids act to protect the NCS against ***an*** uncontrolled cooldown

Bank Question: 600 ***Answer: C***

1 Pt(s) Unit 1 is at 4% power, conducting a plant startup. Given the following events and conditions:

- **A** control bank "A" rod drops
- NCS temperature decreases to **550°F**

Which one of the following statements correctly describes the required actions (if any)?

A. **No** technical specification action is required, however, the plant must be shutdown to mode 3 **to** recover the rod.

B. Within 30 minutes, adjust power range N/Is to increase reactor power so that reactor power and thermal power best estimate are equal.

C. Within 30 minutes be in mode **2** with K_{eff} less than **1.0.**

D. Immediately trip the reactor and enter **E-0** (Reactor Trip or Safety Injection).

Distracter Analysis:

A. Incorrect: Tech Spec 3.4.2 is applicable in mode 2 when critical. Plausible: The change from mode 2 to mode 1 occurs when power exceeds 5%. If the candidate thinks that ITS 3.4.2 only applies in mode 1, this would be a plausible mistake.

B. Incorrect: Thermal power would indicate lower, not higher **than** reactor power due to increased thermalization of the neutrons. While NI adjustment is **a** problem, this action docs not comply with tech spec 3.4.2.
Plausible: This was a recent event (July 1, 1998) at McGuire – but the temperature remained under 551°F for only 4 minutes. The concern expressed in the lessons learned report was for the NI power to thermal power mismatch.

C. Correct answer

D. Incorrect: ***An*** immediate reactor hip is NOT required. AP/14 requires a controlled shutdown to mode 3 - but with temp only 1 °F below minimum required for criticality, the best choice is C. Shutting down to mode 3 is not a distracter.
Plausible: Seems like an appropriate response to finding yourself below the minimum temperature **for** criticality – an overly conservative response.

Level: RO&SRO

KA: **G2.1.11** (3.0/3.8)

Lesson Plan Objective: NC SEQ 10

source: Bank

Level of knowledge: comprehension

References:
1. OP-CN-PS-NC page 33
2. Tech Spec **3.4.2** page 1

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
9	Examine **NC** system operations.					
	• Explain NC System leak testing			X	X	X
	• Given appropriate plant conditions, apply limits and precautions associated with related station procedures.			X	X	X
	• Explain controlling NC level in a drained condition.			X	X	X
	• List the symptoms for entry into AP/1/A/5500/10 (Reactor Coolant Leak)			X	X	
10	Given a set **of** specific plant conditions and access ***to*** reference materials, determine the actions necessary to comply with Tech Specs/SLC's.			X	X	X
11	State the system designator and nomenclature for major components.	X				
12	Describe "Critical Valves" as specified in OP/1(2)/A/6100/001 (Controlling Procedure For Unit Startup). Include in discussion which valves are designated as critical valves, how they may be identified locally, and actions taken to ensure these valves are closed prior ***to*** commencing normal power operations.	X	X			
13	Describe the EMF's associated with NC and be able ***to*** describe the automatic actions that occur when they reach the Trip 2 setpoint.			X	X	X

TIME: 2.0 HOURS

2) A I minute transport time delay (via extra length of pipe) allows for decay of N-16.

3) No automatic actions associated with this EMF.

4) Symptom for entry to AP/18 (High Activity in Reactor Coolant).

2.3 Technical Specifications (Obj. #10)

A. Refer to the latest revision of the following Technical Specifications:

1. T.S. 2.0 Safety Limits
2. T.S. 3.4.1 RCS Pressure, Temperature, and Flow DNB Limits
3. T.S. 3.4.2 RCS Minimum Temperature for criticality
4. T.S. 3.4.3 RCS Pressure and Temperature (P/T) Limits
5. T.S. 3.4.4 RCS Loops - Mode 1 and 2
6. T.S. 3.4.5 RCS Loops - Mode 3
7. T.S. 3.4.6 RCS Loops - Mode 4
8. T.S. 3.4.7 RCS Loops - Mode 5, Loops Filled
9. T.S. 3.4.8 RCS Loops - Mode 5, Loops not Filled
10. T.S. 3.4.9 Pressurizer
11. T.S. 3.4.10 Pressurizer Safety Valves
12. T.S. 3.4.11 Pressurizer PORVs
13. T.S. 3.4.12 LTOP System
14. T.S. 3.4.13 RCS Operational Leakage
15. T.S. 3.4.14 RCS Pressure Isolation Valve (PIV) Leakage
16. T.S. 3.4.15 RCS Leakage Detection Instrumentation
17. T.S. 3.4.76 RCS Specific Activity

B. Refer to the latest revision of the following Selected Licensee Commitments

1. SLC 16.5-1 Mid-Loop Operation with Irradiated Fuel in the Core.
2. SLC 16.5-2 Safety Valves - Shutdown
3. SLC 16.5-3 Chemistry
4. SLC 16.5-4 Pressurizer
5. SLC 16.5-5 Structural Integrity
6. SLC 16.5-6 Reactor Coolant System Vents
7. SLC 16.5-7 S/G Pressure/Temperature Limitation

2.4 Power Supplies

A. Pressurizer Heaters (Obj. #3)

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.2 RCS Minimum Temperature for Criticality

LCO 3.4.2 Each RCS loop average temperature (T_{avg}) shall be ≥ 551°F.

APPLICABILITY: MODE 1,
MODE 2 with k_{eff} ≥ 1.0.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. T_{avg} in one or more RCS loops not within limit.	A.1 Be in MODE 2 with K_{eff} < 1.0.	30 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.4.2.1 Verify RCS T_{avg} in **each** loop ≥ 551°F.	--------NOTE-------- Only required if T_{avg} - T_{ref} deviation alarm not reset and any RCS loop T_{avg} < 562°F ------------------------ 30 minutes

1 Pt(s) Unit 2 is responding to a LQCA. The crew has entered ES-1.2. Post LQCA Cooldown and Depressurization.

Given the following events and conditions:

- NCPs tripped
- Pressurizer level is steady
- Only one train of ECCS is injecting
- Loop **A** temperatures are representative of all **4** loops
- MSIVs and steam dumps are open

Which **one** of the following sets of plant parameters is indicative of fully established natural circulation as outlined in Enclosure **3,** Natural Circulation Monitoring Parameters?

References Provided: ~~steam tables~~

		0200	0205	0210	0215
A.	**Steam Header Pressure (psig)**	742	715	676	645
	NC System Pressure (psig)	968	964	960	958
	Loop A T-hot (°F)	544	536	535	521
	Loop A T-cold (OF)	512	510	502	497
B.	**Steam Header Pressure (psig)**	142	709	676	645
	NC System Pressure (psig)	968	972	975	981
	Loop A T-hot (OF)	547	552	555	563
	Loop A T-cold (OF)	548	544	540	536
C.	**Steam Header Pressure (psig)**	142	747	750	762
	NC System Pressure (psig)	968	964	960	958
	LOOP A T-hot (OF)	544	536	535	527
	Loop A T-cold (°F)	512	514	515	517
D.	**Steam Header Pressure (psig)**	742	737	140	732
	NC System Pressure (psig)	938	942	945	941
	Loop A T-hot (OF)	539	542	545	545
	Loop A T-cold (OF)	513	510	510	506

Distracter Analysis: The following conditions support natural circulation:

S/G pressure stable of decreasing

- **T-hot** stable or decreasing
- T-cold stable or decreasing
- NC subcooling > 0 - NC pressure may trend up or down.

A. **Correct:** This shows indication of natural circulation flow occurring - decreasing S/G pressure, T-cold at S/G saturation conditions and decreasing, T-hot decreasing.

B. **Incorrect:** T-hot is increasing while steam pressure is decreasing
Plausible: Steam pressure and T-cold *are* both decreasing

C. **Incorrect:** **Steam** pressure **is** increasing and T-cold is tracking along with this trend. Temperature difference is decreasing indicating that heat removal rate is decreasing. This is a classic case of gas binding
Plausible: T-hot is decreasing.

D. **Incorrect:** No subcooling.
Plausible: T-cold is decreasing

Level: RO&SRO

KA: EPE 011 EA2.09 (4.3/4.5)

Lesson Plan Objective: HT Obj: 15

Source: **Bank**

Level of knowledge: analysis

1. EP/1/A/5000/ES-1.2 enclosure 3
2. stem tables
3. OP-CN-THF-HT page 8-10

	Objective	I S S	N L O	L P R O	L P S O	P T R Q
1	Define 'Heat Transfer'.			X	X	X
2	State the three ways heat *is* transferred in a nuclear power piant.			X	X	X
3	Define 'Conduction' heat transfer.			X	X	X
4	Explain the variables that effect the rate of conduction.			X	X	X
5	List the formulas used for conduction.			X	X	X
6	Give an example of where conduction heat transfer occurs in the power plant.			X	X	X
7	Given a set of parameters, **be** able to work conduction problems.			X	X	X
8	Define 'Convection' heat transfer.			X	X	X
9	Explain the variables that effect the rate of convection.			X	X	X
10	List the formulas used for convection.			X	X	X
11	Give an example **of** convection heat transfer in the power plant.			X	X	X
12	Given a set of parameters, be able to work convection problems.			X	X	X
13	Define 'Natural Circulation'.			X	X	X
14	List the characteristics of a power plant that are required for natural circulation.			X	X	X
15	Describe the parameters used to determine if natural Circulation exists.			X	X	X
16	Explain what plant conditions the operator maintains to enhance natural circulation.			X	X	X
17	Describe what plant conditions can impede natural circulation.			X	X	X
18	Define 'Radiation' heat transfer.			X	X	X
19	Explain the variables that effect the rate of radiation heat transfer.			X	X	X
20	Give an example *of* radiation heal transfer in the power plant.			X	X	X
21	Define 'Departure From Nucleate Boiling'.			X	X	X
22	Explain how DNB occurs in a nuclear reactor.			X	X	X
23	Describe the undesirable effects of DNB.			X	X	X
24	List the parameters that effect DNB.			X	X	X

B. (Obj. #10) The formulas used for connective heat transfer are:

1. Q = MC Delta T and,
2. Q = M Delta h

C. Uses

1. Q = M C Delta T
    a) Used for heat transfer in medium with **no** phase changes end **no** boundary is crossed.

       Example:

       1) NC Delta T across the Rx core
       2) NC Delta T across the S/G
2. Q = M Delta h
    a) Used for heat transfer where there **is** a phase change, but **no** boundary is crossed. (Obj. #11)

       Example:

       1) Feedwater to steam in the S/G
       2) Steam to condensate in the condenser

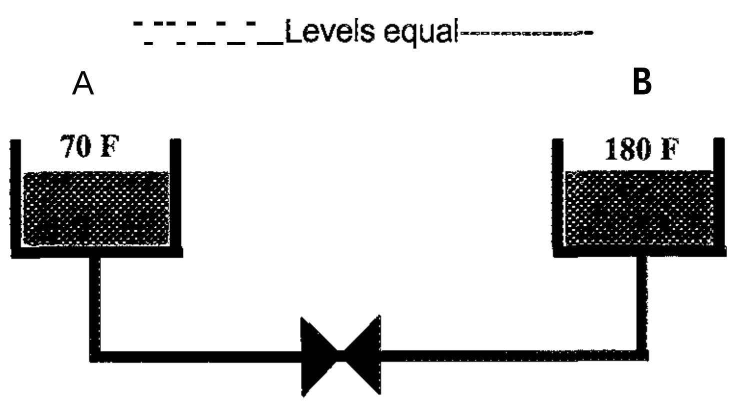
D. Example Problem (Obj. #12)

1. A reactor is producing 3411 Mw with a core Tavg 591°F. If core Tc is 561, what is NC flow rate?

2.4 Natural Circulation

A. Mechanism (Obj. #13)

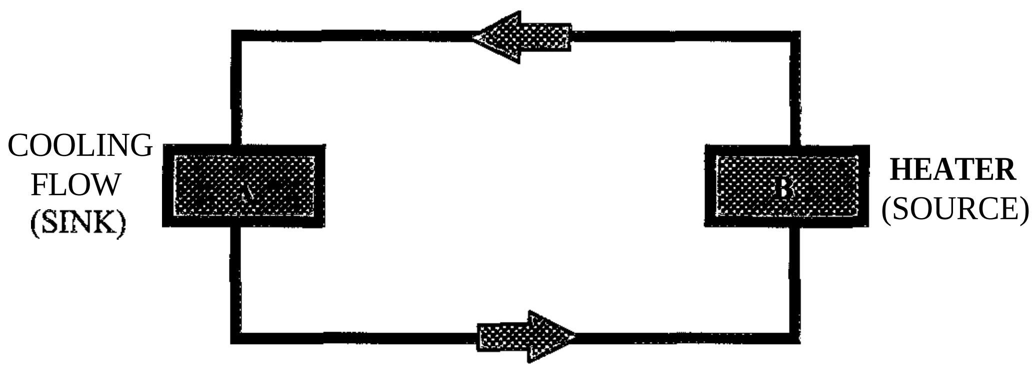
1. Natural Circulation occurs due to density difference between fluids or two points in the same fluid system. As a fluid is heated up its density decreases. Fluids of higher temperature, lower density have a natural tendency to rise to a higher elevation. Conversely, fluids with lower temperature, higher density have a tendency to fall to a lower elevation.
    a) Example



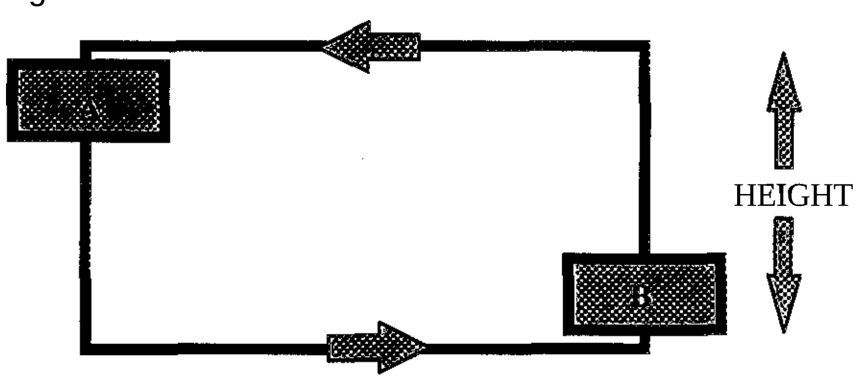
Tank 'A' water has a higher density than tank 'B' because of the lower temp. Static pressure felt on either side of the valve will be due to the difference in density between the tanks since there is no height difference.

If the valve is opened flow will occur from tank 'A to Tank '€3' **until** levels change sufficiently *to* cause the Delta P = 0.

b) In the above example we could place a heater in tank 'B' and a heat exchanger in tank 'A' to remove heat and we would still only get flow until the levels changed to make Delta P = 0. To have continuous flew between the tanks, a complete path from tank 'B' to tank 'A' and a completely filled loop **is** needed. With the heat source (heater), heat sink (heat exchanger), and return flow path, we can establish a small natural circulation flow.



2. The amount of flow we can get from the above system can be aided further by elevating the heat sink (tank 'A') above the source (tank 'B'). The difference in height will cause a greater Delta P across the valve, increasing flow.



B. Plant Application (Obj. #14)

1. In the NC system we have all the <u>design</u> <u>characteristics</u> for natural circulation. They are:

   a) Heat source - the core

   b) Heat sink - the S/G

c) A complete flow path - NC piping

d) Difference in height with sink above source - S/G *is* higher than core.

1) The centerline of the core (source) to the centerline of S/G (sink).

(a) The sink is considered to be the centerline of the heat xfer area.

(b) In a QTSG this can be varied significantly by varying the S/G water level. In a U-tube S/G, however, the centerline will stay constant as long as water level is kept in the NR, which is above the tubes.

C. Verification of Natural Circulation (Obj. #15)

1. In the NC system, when we lose forced convection cooling, natural circulation will be established "naturally" if ali of our systems respond correctly.

2. When the NCPs trip, the Reactor will trip or will be tripped. The decay heat in the core will have to be removed and will be the heat source. We will still be drawing steam either thru the auxiliaries or steam dumps or both. The S/G leveis will be maintained either by CF or CA. Heat added in the core will cause the NC fluid to rise to the S/G where heat is removed. The cooler water will then fall to the core to be reheated.

3. An operator must be able to verify that this occurs by looking at his plant instrumentation.

   Indicators of natural circulation are: (Per Emergency Procedures)

   a) NC Subcooling: > 0°F

   b) Th steady or decreasing

   c) Core exit thermocouple: stable or decreasing

   d) ***S/6*** pressure constant (or decreasing with Yh).

   e) NC T-cold (Wide Range): near saturation temperature for S/G pressures.

4. If any of the above indications are outside the expected indication, natural circulation may not exist and there may be a blockage in the NC system.

5. Adequate time must be allowed to verify actions (steam dumping) have been effective. NC Loop Transit time wiil be increased to approximately 2 to 6 minutes. It may also take 15 to 30 minutes before Natural Circulation flow is fully established. This will be seen as a 'sluggish' NC system response to changes in steam demand.

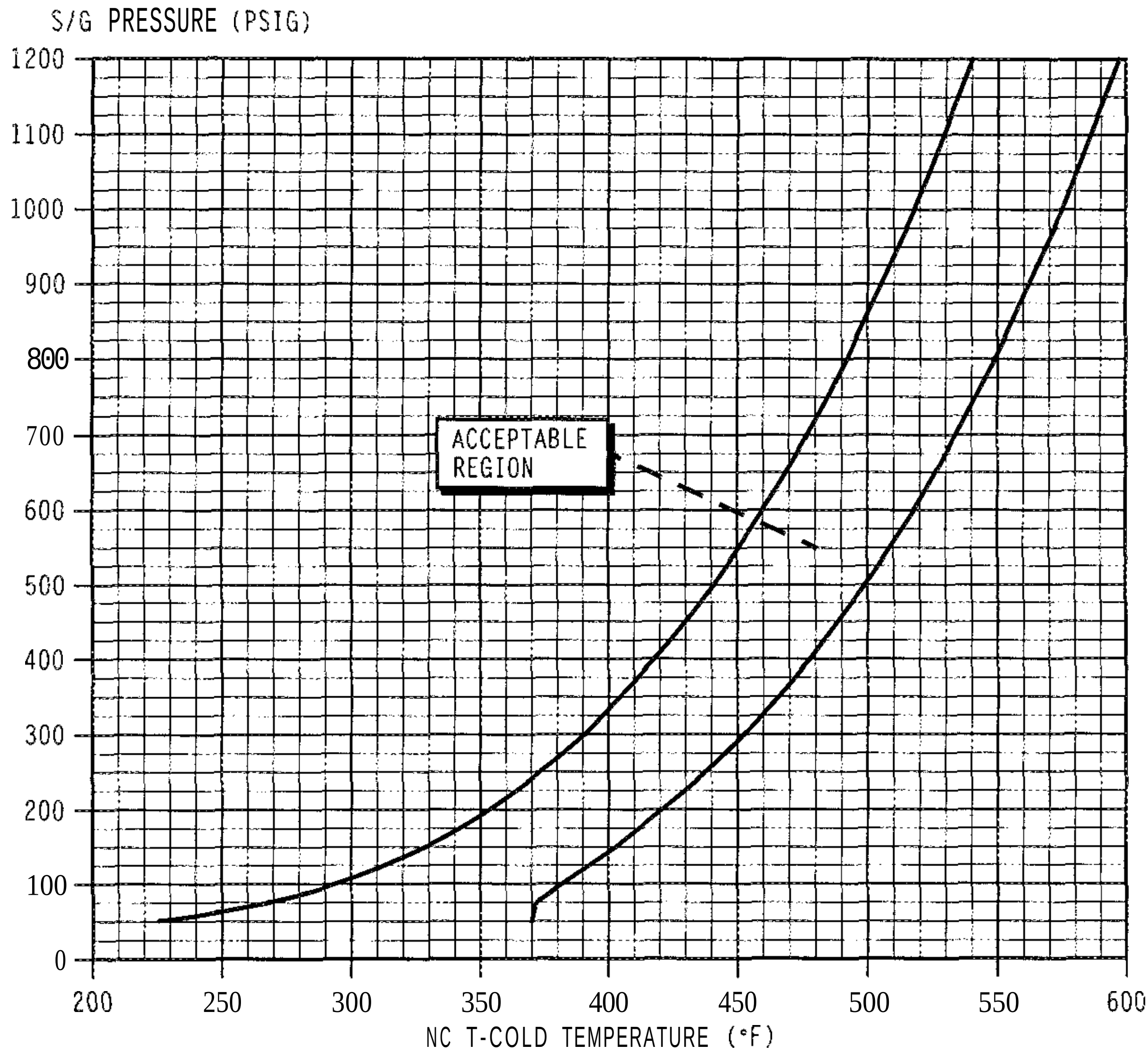
D. Detriments to Natural Circulation (Obj. #16)

1. Loss of heat sink

   a) Loss of S/G feed

1. The following conditions support or indicate natural circulation flow:

   - o NC subcooling - GREATER THAN 0°F
   - o S/G pressures - STABLE OR DECREASING
   - o NC T-Hots - STABLE OR DECREASING
   - o Core exit T/Cs - STABLE OR DECREASING
   - o NC T-Colds - AT SATURATION TEMPERATURE FOR S/G PRESSURE (WITHIN THE LIMITS OF THE GRAPH BELOW).



2. IF Natural Circulation flow is not established. THEN increase dumping steam to establish Natural Circulation flow.

Bank Question: 605.1 ***Answer: A***

---

1 Pt(s) Unit 1 trips from 100% power due to an electrical fault.

5 minutes later, 1EMF-33 (Condenser Air Ejector Exhaust) alarms in trip 2.

Which one of the following indications will provide the best indication (most sensitive and timely) to confirm that a S/G tube leak has just occurred?

A. **Observing 1EMF-26, 27, 28 and 29 (*Steamline 1A – 1D*)**

B. **Comparing S/G feed flow to steam flow mismatch**

C. **Observing 1EMF-34(L) (*S/G sample (lo range)*)**

D. **Observing 1EMF-71, 72, 73, 74 (*S/G A-D leakage*)**

Distracter Analysis:

A. **Correct answer:** normally, **EMF-71-74** are the most sensitive monitors. But these monitors detect N^{16} γ radiation that has a high energy (7 MeV) γ that only is generated when the reactor is operating at power (requires a neutron **flux).**

B. **Incorrect:** Not a sensitive method of comparison – requires large gpm leak rates before this is noticeable.
Plausible: This method will show gross SGTRs

C. **Incorrect:** S/G sample line will isolate at EMF-33 trip **2** – the sample line can only be lined up to 1 S/G **at** a time. If the leak is not ***in*** that S/G, there will be no indication of anything after isolation. **Prior** to isolation, it may show **an** increasing trend due to a general build up of activity in the fcedwater.
Plausible: This would be a good answer if the automatic isolation did not occur

D. **Incorrect:** most sensitive method as it detects N^{16} y radiation
Plausible: This was the correct answer for the 1997 NRC exam – when the premise of the question had the reactor **was** operating at 100% power. In this question, the reactor has tripped and neutron **flux** has decreased – causing the N^{16} y to decay off (T½ is 7 seconds) so that by the time that the steam Iine monitors see the contents of the S/G, the N^{16} γ has decayed away.

Level: RO&SRO

KA: **SYS** 039 A2.03 (3.4/3.7)

Lesson **Plan** Objective: SM Obj: 28

Source: **Bank**

Level of knowledge: comprehension

References:
1. OP-CN-STM-SM page 12, 13

	SM System Objective	ISS	NLO	LPRO	LPSO	PTRQ
24	Discuss S/G overfill including: • The conditions that couid result in S/G overfill • The potential consequences of S/G overfill • Automatic actions that could preclude overfill			X	X	X
25	Given a set of specific plant conditions and access to reference materials, determine the actions necessary to comply with Tech Specs/SLC's			X	X	X
26	Discuss the symptoms and subsequent actions of AP/1/A/5500/28 Secondary Steam Leak			X	X	X
27	State system designator and nomenclature for major components	X				
28	Describe the operation of the following radiation monitors associated with the SM (Main Steam): • Unit 1 Steam Line EMF26, 27, 28, 29 • Unit2 Steam Line EMF10, 11, 12, 13 • Unit 1 Steam kine N16 Monitors 1EMF71, 72, 73, 74 • Unit 2 Steam Line N16 Monitors 2EMF71, 72, 73, 74			X	X	X

Time: 2 hours

b) For a gradual loss of VI, the valve will not close until pressure goes below about 35 - 40 psig. We should be able to take credit for the MSIVs down to and even below 40 psig.

c) When performing operator actions per Loss of VI (AP/022), the AQ cautions the operator to depress the "close" pushbutton on the MSIV's, if they have failed closed. This prevents them from opening inadvertently when Vi is restored.

3. Manually controlled from MC-2 with a momentary PB.

   a) indication of open/closed and 90% position on MC-2.

4. Auto close on main steam isolation and must be reset to open.

5. Auto close when ASP is placed in "LOCAL"; will automatically reopen when the ASP is transferred back to the control room, unless "CLOSE" pushbutton is depressed.

6. Located in the doghouse.

F. Main Steam Isolation Valve Bypass Valves

1. Provide bypass for MSIV's for warming SM lines.

2. Manually controlled from MC-2 with air loader.

3. Auto close on "Main Steam Isolation" and must be reset to open.

4. Auto close when ASP is placed in local; will automatically return to selected position when ASP controi is transferred back to the C/R.

5. Located in doghouse.

G. Radiation Monitors (Obj#28)

1. 1EMF26, 27, 28, 29 and 2EMF11, 12, 13, 14 (Steam Line Radiation Monitors)

   a) Area monitors located upstream of the MSIV's *in* the doghouses.

   b) Monitors potential S/G relief paths to atmosphere.

   c) No automatic functions.

   d) Symptom for entry to AP/1/A/5500/10 (Reactor Coolant Leak)

2. EMF-71, 72, 73, 74 (N-16 Steam Line Monitors)

   a) These EMF's provide accurate real-time monitoring of the Main Steam lines at the point just before they reach the equalization header. The detectors monitor energy levels associated with N-16 gammas present in the NC (Reactor Coolant System). The presence of the N-16 isotope in the SM headers *is* indication that a primary to secondary leak exists.

b) The N-16 isotope emits such energetic gammas that it is probable that during a S/G tube rupture that the count rate on the adjacent monitor (B&C or A&D) will also increase, though not as much as for the actual leaking generator.

c) The readings on the N-16 monitors are calculated based on a complex mathematic calculation. Because of the way the calculation is done internaily (programming) and the way they are set up, these EMFs became increasingly inaccurate at power levels below 40% and may spuriously alarm.

d) No control functions are associated with these EMF's.

e) Symptom for entry to AP/1/A/5500/10 (Reactor Coolant Leak).

f) SLC 16.7-10 (Radiation Monitoring Instrumentation for Plant Operations)

H. Equalization Header

1. Located in Turbine Building 594 level.
2. Most of the auxiliary loads tap off here.
3. Supplies main turbine stop valves.
4. Ensures equal pressures on all S/G's.

I. Loads (Obj. # 13)

1. Main turbine stop valves
   a) Provide steam shut off for normal and emergency conditions.
   b) Below seat chambers interconnected.
   c) Pressure equalized around valves by #2 stop valve internal bypass.
2. CAPT steam supply
   a) Comes off upstream of S/G's ‘B’ and ‘C’ MSIV's.
   b) Supplied thru air valves SA2, 5.
3. Steam seals
   a) Seals turbine shaft.
   b) SM supply used during operation.
4. CSAE
   a) Maintain vacuum on main condenses
   b) SM reduced to 150 psig for use in CSAE
   c) SM supply used during operation
5. Auxiliary Steam
   a) Qne supply to aux steam

Bank Question; 731 ***Answer: A***

A bocA Ho.S

1 Pt(s) Federal Regulations require the emergency core cooling system to be designed to maintain peak cladding temperature below 2200 °F.

Which one of the following statements correctly describes the basis for this design criterion?

A. To prevent acceleration of the zircalloy-water reaction.

B. To prevent exceeding the zircalloy clad melting point.

C. To prevent exceeding the fuel melting point.

D. To prevent the onset of full film boiling and DNB.

Change Stem

Distracter Analysis:

A. **Correct:** The zirconium-water reaction **is** described by the following chemical equation: $Zr + 2H_2O \dashrightarrow ZrO_2 + 2H_2 + HEAT$. The rate of this reaction is highly dependent upon clad temperature, such that above approximately 1800°F the reaction becomes significant. **It** becomes accelerated at 2200°F **and** auto-catalytic (self-sustaining) at 4800°F.

B. **Incorrect:** Zircalloy will melt at approximately 3316 °F.
Plausible: its approximately 900 degrees below the melting point.

C. **incorrect:** fuel melt is **a** much higher temperature, 5100°F.
Plausible: a logical answer if the candidate doesn't know the answer

D. **Incorrect:** these are event specific mechanisms rather analysis criteria.
Plausible: If the candidate confuses heat transfer mechanisms with ECCS criteria.

Level: RO&SRO

KA: ***SYS*** 006 K3.02 (4.3/4.4)

Lesson Plan Objective: TA-AM SEQ 10

Source: Bank

Level of knowledge: memory

References:
1. OP-CN-IC-ISE page ***5***

2. OP-CN-TA-AM **pages 7-9**
3. 10CFR50.46

OBJECTIVES

	Objective	ISS	NLO	LPRO	LPS-	PTRQ	STA
1	Describe available heat sinks and the mechanics of core cooling.			X	X	X	X
2	State alternate methods of core cooling for specific plant conditions.			X	X	X	X
3	List the sources of gas/steam during accident conditions.			X	X	X	X
4	Describe situations that may result in gas accumulation in the NCS.			X	X	X	X
5	Explain how gas accumulation in the NCS could block reflux cooling.			X	X	X	X
6	Describe how the use of NC pumps minimizes the effect of gas accumulation.			X	X	X	X
7	State the symptoms and effects of gas/steam binding.			X	X	X	X
8	Explain how boron precipitation affects core cooling.			X	X	X	X
9	Explain the effect of boron precipitation due to boiling in the core.			X	X	X	X
10	State limits for clad and fuel melt temperatures.			X	X	X	X
11	Describe alternate success paths when normal components or systems are not available for core cooling			X	X	X	X
12	Describe the instrumentation that is required to be qualified for operation in a hostile environment. (Adverse Containment Conditions)			X	X	X	X
13	Explain the possible failure modes of Post Accident Monitor (PAM) instrumentation			X	X	X	X
14	Describe alternate means of determining critical parameter values assuming failure of the primary means			X	X	X	X
15	Discuss the plant computer capabilities for data acquisition for recognizing core damage			X	X	X	X
16	Describe the use of radiation monitors to detect a degraded core condition			X	X	X	X
17	Discuss the administrative procedures used to address the unexaected conditions for which no emergency procedures exist			X	X	X	X
18	Explain why all incore Thermocouples are not expected to read the same following an accident			X	X	X	X

1. introduction

1.1 Overview

A. Safeguards are used to control the plant during all operating conditions designed into their operating features.

B. Included in the design are safeguards to:

1. Control anticipated abnormal transients
2. Sense accident situations and to initiate operation of equipment to control the plant during the accident. This presentation will focus on these safeguards which are called the Engineered Safety Features Actuation System.

1.2 System Purpose: (Obj #1)

The purpose of the Engineered Safeguard Actuation System **is** to initiate action to protect the core and Reactor Coolant System components, and ensure containment integrity in the event of an accident.

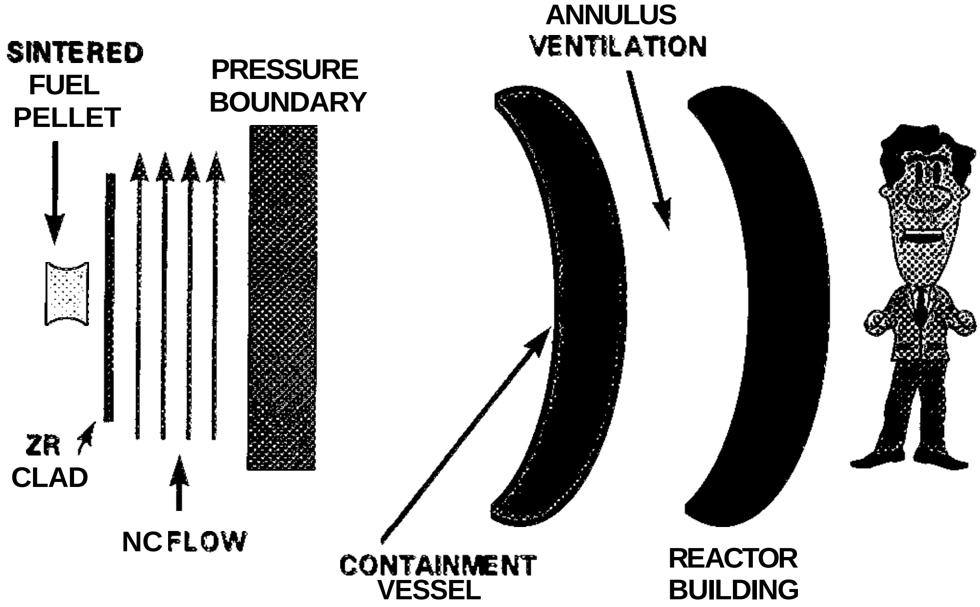
1.3 ECCS Acceptance Criteria

A. Emergency Core Cooling Systems shall be designed such that its calculated cooling performance following postulated **loss** of coolant accidents conforms to the criteria of 10CFR 50.46

1. Peak Cladding Temperature: The calculated maximum fuel element cladding temperature shall not exceed 2200°F.
2. Maximum cladding oxidation: The calculated total oxidation of the cladding shall no where exceed 0.17 times the total cladding thickness before oxidation.
3. Maximum Hydrogen Generation: The calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam shall not exceed 0.01 times the hypothetical amount that would be generated if all **of** the metals in the cladding cylinders surrounding the fuel, excluding the cladding surrounding the plenum volume, were **to** react.
4. Coolable Geometry: Calculated changes in core geometry shall be such that the core remains amenable to cooling.
5. Long Term Cooling: After any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long lived radioactivity remaining in the core.

1.4 Objectives

5 BARRIERS



The boundaries are the permanent structures which surround the core/fuel.

E. Acceptance criteria for ECCS per 10CFR 50.46

1. The calculated maximum fuel element cladding temperature shall not exceed <u>2200</u>°F.
2. The calculated total oxidation of the cladding shall nowhere exceed .17 times the total cladding thickness before oxidation.
3. The calculated total amount of H_2 generated shall not exceed .01 times the amount that would be generated if all the cladding were to react.
4. Calculated changes in core geometry shall be such that the core remains amenable to cooling.
5. The calculated core temperature shall be maintained at an acceptable low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core.

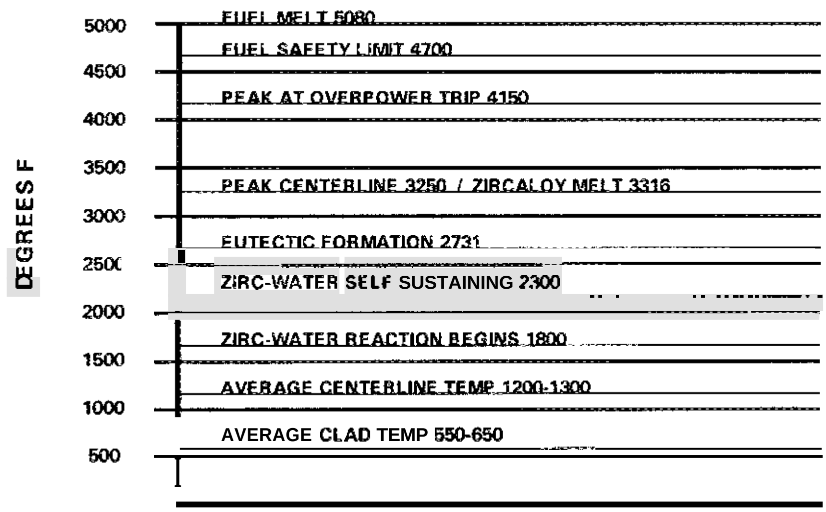
2. PRESENTATION

2.1 Core Cooling Maintenance

A. Fuel Temperature Limits **(Obj. #10)**

1. With inadequate flow for core cooling, core temperatures will rise. Once steam is contacting the clad the heat transfer coefficient diminishes greatly which requires a much higher clad temperature and therefore centerline fuel temperature will increase.

SUMMARY OF CLAD AND FUEL TEMPERATURES



2. During normal operation of a PWR core, the reactor coolant temperature reaches a maximum of about 620°F, and the maximum average fuel centerline temperature around 3250°F. These values are well below any level where significant material damage occurs. The normal average fuel temperature is about 1300°F.

3. On core uncovery the heat transfer out of the fuel rods is dominated by the drastic lowering of the heat transfer coefficient at the outer cladding surface which destroys the capability of the fuel element to dissipate the decay heat of the core at a rate fast enough to avoid temperatures high enough to damage the fuel element materials. As the temperature excursion continues to clad temperatures above 1831°F, additional heat can be generated within the system by metal (primarily zirconium/steam exothermic chemical) reactions.

   At elevated temperature during a LOCA that involves core uncovering, zirconium may react with steam to form zirconium oxide and hydrogen by the following chemical reaction

   $$Zr + 2H_2O \rightarrow ZrO_2 + 2H_2 + \text{Heat}$$

   a) Although zircaloy oxidizes much more rapidly than stainless steel at temperatures below about 1000°C (1831°F), the rate of stainless steel oxidation per unit weight at about 1250°C (2281°F) is equal lo that of zirconium.

b) As the zirconium oxide layer on the cladding grows, the oxygen generated at the zirconium oxide surface must diffuse through an increasingly resistant diffusion barrier to get to the base metal. In this way, the zirconium oxide layer itself could serve to shield the unoxidized metal from further oxidation.

4. The melting point of uranium dioxide is approximately 5100°F, for zirconium oxide 4891°F, and for zircaloy 3316°F. The melting point of zircaloy is also variable as a function of the amount of oxygen dissolved in the metal. (Increasing from 3316°F for 0% dissolved oxygen to 3586°F for about 20 % dissolved oxygen.) The equilibrium ternary system uranium-zirconium-oxygen, however, has combinations of these elements that form a liquid phase at temperatures as low as 2731°F. This is known as the uranium/zirconium eutectic.

a) No liquid phase exists at 1000°C (1831°F). At 2000°C (3630°F), eutectic liquid can form given an equilibrium contact condition between uranium dioxide and any zircaloy metal, irrespective of the level of dissolved oxygen in the metal. No liquid can form, however, between UO_2 and oxidized zircaloy or ZrO_2.

b) The cladding is likely to burst due to internal pressure effects before it reaches eutectic formation temperature (≈1500°C, 2731°F). This would allow steam into the fuel/cladding gap, oxidizing the interior cladding surface and thus effectively shielding the UO_2 from the Zircaloy metal and preventing eutectic liquid formation.

Poor contact between the fuel pellet and inside cladding surface would inhibit eutectic formation below the melting point of the cladding. Once the cladding becomes melted, the potential for eutectic formation would increase.

A fast temperature ramp would increase the probability for eutectic formation by raising the temperature faster than oxygen can diffuse into the zircaloy.

B. Methods of Core Cooling

1. Normal operation **(Obj. #1, 2, & 11)**

a) Forced convection cooling is provided by the NC pumps with the heat sink provided by the steam generators. (preferred method of cooling)

1) The main feedwater pumps normally provide water to the S/G's above ~700 psig. Below this pressure, the condensate booster pumps provide the feed requirements.

2) The CA pumps will auto start to provide feed if the CF pumps are unavailable or trip.

Bank Question: 736.1 **_Answer: D_**

1 Pt(s) Unit 2 is in the process of conducting a plant startup.

Power range channels indicate the following:

- PR N41 = 8%
- PR N42 = 8%
- PR N43 = 10%
- PR N44 = 8%

Which of the following conditions would result in an automatic reactor trip?

A. All four RCPs trip.

B. One turbine impulse pressure channel fails high.

C. NCS controlling pressurizer level channel fails Low.

D. NCS controlling pressurizer pressure channel fails high.

Distracter Analysis:

A. Incorrect: all loop flow trips are automatically blocked below P-'7
Plausible: if the candidate does not recall that the NCP trip is blocked by P-7

B. Incorrect: P-'7 would be enabled, but this does not cause a trip
Plausible: if the candidate is confused over the effect of turbine impulse on main generator trip

C. Incorrect: Pressurizer High Level, Pressurizer Low Pressure, blocked by P-7
Plausible: an old horse is that if Pzr level fails low, eventually the reactor will trip on high Pzr level.

D. Correct: As pressure decreases to 1845 psig, SI is actuated. The SI signal generates a Reactor Trip Signal

Level: RO&SRO
KA: SYS 010 K3.03 (4.0/4.2)

Lesson Plan Objective: ISE Obj: 4

Source: Mod Catawba NRC 2000

Level of knowledge: comprehension

References:
1. OP-CN-ECCS-ISE page 14

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the Engineered Safeguards Actuation System.			X	X	
2	Describe the sequence of events that occur if an Engineered Safeguards Actuation System setpoint is reached.			X	X	X
3	Explain the purpose of each of the Engineered Safeguards System Components.			X	X	
4	List all the Engineered Safeguards Signals with their setpoints, logic and interlocks.			X	X	X
5	Describe how each ESF Signal is reset.			X	X	X
6	Given a set of specific plant conditions and access to reference materials, determine the actions necessary to comply with Tech Specs / SLC's.			X	X	X
7	State from memory all Tech Spec actions for the applicable systems, subsystems and components which require remedial action to be taken in less than 1 hour.			X	X	

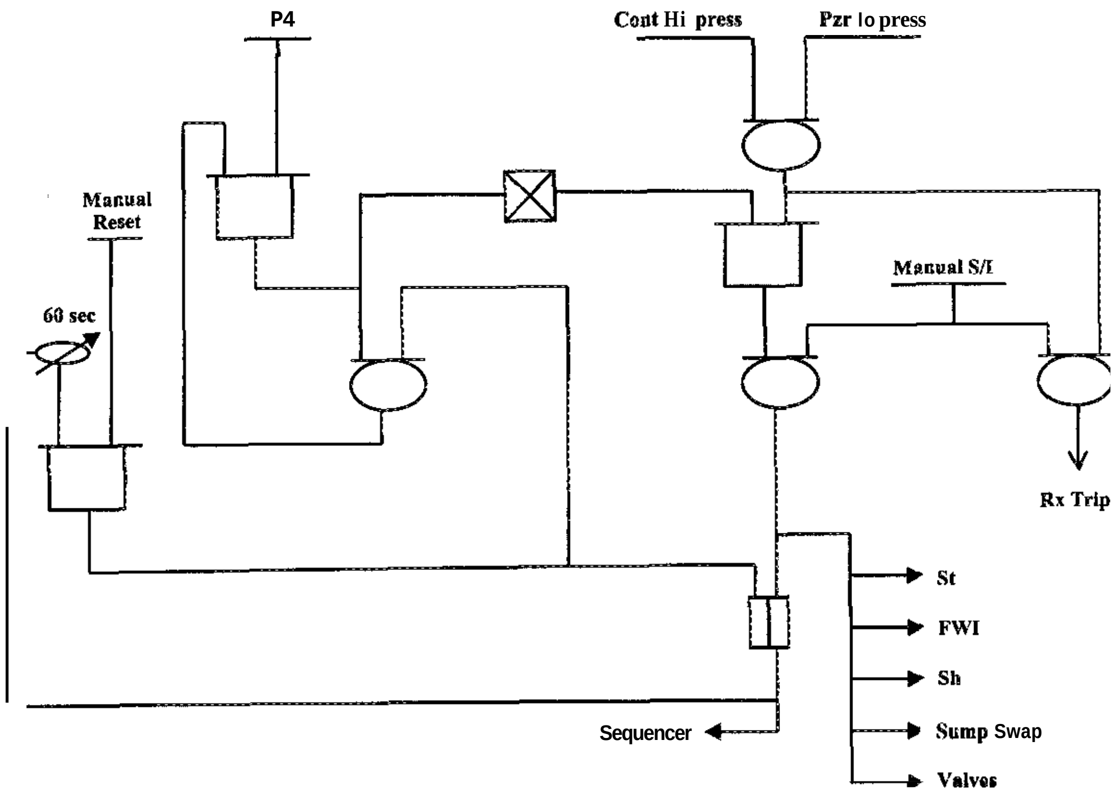
D. The Auxiliary Safeguards Cabinet is a single bay cabinet containing relays and electronic components. This cabinet was added due to changes and modifications (not enough room in the output bay).

1. The purpose of the Auxiliary Safeguards Cabinet is to provide input for various process and protection interlocks.

2. Contains extra relays for actuation of interlocks for Process Control and SSPS. (I.e. VCT LO LEVEL interlock swap to FWST, P-12 interlock, orifice isolation auto close at 17% pressurizer level.)

2.4 ESF Signals (OBJ #4 & 5)

Safety Injection



A. Safety injection (Ss)

1. Three signals actuate S_S.

a) Manual

1) One button for Train A and One button for Train B under Plexiglas on MC11.

2) Each button ONLY ACTUATES its respective train. (See drawing above)

MODIFIED: CATAWBA NRC 2000

Bank Question: 736 ***Answer: C***

1 Pt(s) Unit 2 is in the process **of** conducting a plant startup. Given the following events and conditions:

- Power range channels indicate the following:
  - PR N41 = 8%
  - PR N42 = 8%
  - PR N43 = 10%
  - PR N44 = 8%

Which of the following conditions would result in **an** Automatic Reactor Trip?

A. All four RCPs trip.

B. Pressurizer level increases to 94%.

C. RCS pressure decreases to 1840 psig.

D. One turbine impulse pressure channel fails high.

Distracter Analysis:

A. **Incorrect:** all loop flow trips are automatically blocked below P-7
Plausible: if the candidate does not recall that the NCP trip is blocked by P-7

B. **Incorrect:** Pressurizer High Level, Pressurizer Low Pressure, blocked by P-7
Plausible:

C. **Correct:** As pressure decreases to 1845 psig, SI is actuated. The SI signal generates **a** Reactor Trip Signal

D. **Incorrect** P-4 would be enabled, but this does not cause a trip
Plausible: if the candidate is confused over the effect of turbine impulse on main generator trip

Levei: RO&SRO
KA: SYS 010K1.02(3.9/4.1)

Lesson Plan Objective: ISE SEQ **4**
Source: New

Level of knowledge: comprehension

References:
1. OP-CN-ECCS-ISE page 14

Bank Question: 757 ***Answer: B***

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1 Pt(s) Units 1 and 2 are operating at 100% power with a normal service water line-up and RN pump 2A running. Given the following conditions and indications:

- **RN pumps 1A,** 1B and **2B** start.
- 1 and 2 RN-48B (*RN SUPPLY X-OVER ISQL)* close
- 1 and 2 RN-47A (*RN SUPPLY X-OVER ISOL*) remain open
- RN suction and discharge valves swap to the SNSWP.

Which one of the following conditions correctly describes the cause of this condition?

A. **The** Lake Wylie dam failed.

B. **RN pump** intake **pit "A"** screens **are clogged.**

C. **RN pump** intake **pit "A"** level indicator ***(RN INTAKE PIT LVL "A")*** failed low.

D. There was **a** spurious containment **phase "B"** actuation on Unit **1.**

Distracter Analysis:

A. Incorrect: low lake level would cause a low level in both RN pump pits **A** and B, which would close valves 1/2RN-47A
Plausible: Partially correct – all other actuations would occur

B. Correct

C. Incorrect: requires 2 of 3 level *instruments to* fail to get the actions.
Plausible: if the candidate does not know the coincidence logic.

D. Incorrect: would not cause RN suction valves to swap to the SNSWP – would cause 1RN-47A to close and would not cause 2RN-48B to close
Plausible: partially correct – would cause all other conditions

Level: RO&SRO

KA: APE 062 AA1.02 (3.2/3.3)

Lesson Plan Objective: PSS-RN Obj: 12

Source: Bank

Level of knowledge: comprehension

References:

1. OP-CN-PSS-RN pages 14, 15, 32-33
2. AP-29 Encl 14 **page** 110

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
12	Explain the action which takes place on:					
	• A Blackout	X	X	X	X	X
	• An Emergency Low Pit Level	X	X	X	X	X
	• A Safety Injection signal	X	X	X	X	X
	• An Sp signal	X	X	X	X	X
	• ASP to local			X	X	X
13	Describe the reason for not isolating the Auxiliary Building non-essential header **supply** valve on a blackout signal.	X	X	X	X	X
14	Draw *a* block diagram of the RN System per the ISS REQUIRED training drawing.	X				
15	Explain the purpose of the YV system and basic operation of the system. • Purpose • Normal Alignment • Flow Path • Control switch alignments & parameters required for auto swap. • Parameters required for YV operable status.	X	X	X	X	X
16	Explain the purpose of the VZ system and basic operation of the system. • Purpose • Normal Alignment • Describe how temperature is controlled.	X	X	X	X	
17	Given appropriate plant conditions, apply limits and precautions associated with related station procedures.	X	X	X	X	X

c) Flow

1) RN Strainer Outlet Flow

(a) This instrumentation provides flow indication in the Control Room and on the Auxiliary Shutdown Panel.

It also provides high and low flow alarms and a signal to the RN minimum flow selector. High flow 24,000 gpm, Low flow 8,600 gpm.

2) RN Pump Cooling Flow

Locai indication is provided for the following process flows:

(a) RN Pump Motor Cooler Outlet Flow

(b) RN Pump Motor Upper Bearing Oil Cooler Outlet Flow

d) bevel

1) Lake Wylie Water Level provides Control Room indication of the level of Lake Wylie. No alarms are provided.

2) Standby Nuclear Service Water Pond Level provides Control Room indication of the level of the SNSWP. An annunciator and computer alarm is initiated at low level *(572 ft)* and an annunciator alarm is initiated at low-low level (571.5 *ft).* bevel marks visible from shore are painted on the SNSWP instrumentation pier.

3) RN Pumphouse Screen Relative Level Differential provides Control Room indication of the relative differential levels across the RN Pumphouse screens. An alarm is provided on high (15" water column) differential level to alert personnel of partially blocked screen.

4) RN Pump Intake Pit A and Pit B Levels

There are three (3) level instruments **per** pumphouse, one Unit 1 designated is powered from Unit 1, one Unit *2* designated **is** powered from Unit **2,** and one Shared is powered from Unit **1**.Alarms are provided on low (559) and emergency low (557.5) levels. In addition, the following actions are automatically initiated upon two out of three emergency low level in <u>either</u> RN Pumphouse pit: (Obj. #12)

(a) Pit A <u>OR</u> Pit B Emergency Low Level will start RN Pumps 1A, 1B, 2A, 2B.

(b) Pit A Emergency bow Level will close:

(1) 1 and 2 RN48B

(c) Pit B Emergency Low Level will close:

(1) 1 and 2 RN47A

(d) Pit A OR Pit B Emergency Low Level will swap to the SNSWP

(1) Open valves 1RN3A, 1RN4B, 1RN58B, 1RN63A 1 & 2 RN846A, 1 & 2 RN848B.

(2) Close valves 1RN1A, 1RN2B, 1RN5A, 1RN6B, 1RN53B, 1RN54A, 1RN57A, 1RN843B, 1 & 2 RN847A, 1 & 2RN849B.

(3) There is a **2** minute time delay before the valves can be swapped back to their normal position.

4. RN Pumphouse Miscellaneous

a) Fire hose racks in the RN Pumphouse are supplied from the general use headers.

1) The general use header is normally isolated by locked ciosed manual isolations below the ground level (i.e. must be accessed by ladder); therefore the pumphouse is provided with a tire hydrant, outside, near the pumphouse.

b) Temperatures inside the KN Pumphouse will be maintained by the VZ System, **so** freeze protection **is** not necessary.

c) VZ System (RN pumphouse ventilation System) (Obj. #6)

1) Purpose (Obj. #16)

(a) The purpose of the VZ system is to provide normal and emergency Ventilation of the Nuclear Service Water Pump compartments during all operating conditions.

2) General Description

(a) The VZ System consists of two, 100% capacity safety related, fans for each pump compartment. One fan in each compartment is designated Unit 1 and the other Unit 2. Fans 1A and 2A will service RN pumps 1A and 2A while fans IB and *28* will serve RN pumps IB and **2B.**

(b) In addition to the above safety Ban, one non-safety fan is provided to ventilate the pumphouse area below the operating level when local maintenance is performed.

(c) The VZ fans are powered from the motor control centers in the RN pumphouse.

(d) Local thermostatically controlled heaters (non-safety related) are provided to maintain ambient temperatures during winter months in the pump compartments.

(a) OPEN: 2RN287A (KC 2A Hx Inlet Isol)

e) 2ASP B to LOCAL

1) CLOSE: 2RN849B (D/G 2B Hx Ret To Lake)

2) OPEN: 2RN69B (2B RN Header Supply Isol), 8488 (*BIG* 2B Hx Rtn To SNSWP), 2RN351 (KC 2B Hx Outlet Throttle)

3) *If* a unit *2* "B" train KC pump is running then

(a) OPEN: 2RN347B (KC 2B Hx Inlet Isol)

E. Action on emergency low pit level (clogged intake or loss of lake Wylie due to a seismic event) (Obj. #12)

1. Pit A <u>OR</u> Pit B actuates <u>Pit A AND Pit B Emeraencv bow Level Annunciators.</u>

2. Pit A <u>OR</u> Pit B Emergency Low bevel starts all 4 RN Pumps

a) Pumpstart

1) **opens** its discharge valve

2) opens its motor cooler inlet

3. Pit A <u>OR</u> Pit B Emergency Low Level swap RN suction and discharge to SNSWP

a) CLOSE: 1RN1A (RN P/H Pit A Isol From Lake), 2B (RN P/H Pit A **Isol** From Lake), 5A (RN P/H Pit B **Isol** From Lake), 6B (RN P/H Pit B Isol From Lake), 57A (Station RN Disch To RL System), 843B (Station RN Disch To RL System).

b) OPEN: 1RN3A (RN P/H Pit A Isol From SNSWP), 4B (RN P/H Pit B Isol From SNSWP), 63A (RN Header A Return To SNSWP), 58B (RN Header B Return To SNSWP).

4. Swap diesel discharge to SNSWP

a) CLOSE: 1RN847A, 1RN849B, 2RN847A, 2RN849B

b) OPEN: 1RN846A, 1RN848B, 2RN846A, 2RN848B

5. Pit A <u>OR</u> Pit B Emergency tow Level split A/B train discharges

a) CLOSE: 1RN53B (B Train Disch Crossover **Isol),** 1RN54A (A Train ***Disch*** Crossover **Isol)**

6. Pit A Emergency Low Level closes supply header crossover valves.

a) CLOSE 1 and 2 RN48B (RN Supply X-Over Isol)

7. Pit B Emergency Low Level closes supply header crossover valves.

a) CLOSE 1 and 2 RN47A (RN Supply X-Over **Isol)**

8. There is a two minute time delay before the operator may realign the suction valves to the lake. This allows system restoration to normal if the signal was erroneous. Two minutes is sufficient time for all components to respond and allows the operator to verify the error prior to attempting to return to the normal lineup.

F. Actions on Safety Injection "S_s" (Obj. #12)

1. ANY unit S_s will:

   a) Start all RN pumps

      1) Pumpstart

         (a) opens its discharge

         (b) opens its motor cooler inlet

   b) Close lube injection strainer crossover valves

      1) CLOSE: 1RN36A AND 1RN37B

2. LOCA unit specific action on S_s

   a) Full KC Hx Flow on LOCA unit

      1) Throttle valve fully opens

         (a) Unit 1 S_s open: 1RN291 (KC Hx 1A Outlet Throttle), 351 (KC Hx 1B Outlet Throttle)

         (b) Unit 2 S_s open: 2RN291 (KC Hx 2A Outlet Throttle), 351 (KC Hx 2B Outlet Throttle)

   b) Isolate LOCA unit Aux Bldg vent header

      1) Unit 1 S_s - CLOSE: 1RN839A (Unit 1 AB Fuel Hdlg Rad Area Sup Hdr), 841B (Unit 1 AB Fuel Hdlg Rad Area Ret Hdr)

      2) Unit 2 S_s - CLOSE: 2RN839A (Unit 2 AB Fuel Hdlg Rad Area Sup Hdr), 841B (Unit 2 AB Fuel Hdlg Rad Area Ret Hdr)

3. If control has been switched to the ASP's, the only equipment automatically positioned on an S_s (which will occur during NC cooldown) will be the lube injection strainer crossover valves (1RN36A, 37B), and the Aux Bldg vent header (1 and 2 RN839A, 841B)

G. Actions on containment high-high pressure "S_p" (Obj. #12)

1. Assure discharge flow path

   a) Any S_p - OPEN 1RN63A (RN Header A Return To SNSWP), 58B (RN Header B Return To SNSWP)

2. Split LOCA unit essential header supplies

   a) Unit 1 S_p - Close 1RN47A (RN Supply X-Over Isol), 48B (RN Supply X-Over Isol)

17. NV **System:**

- The foilowing valves fail closed if selected to "AUTO":
  - ___ • 2NV-181A (B/A Blender Otlt To VCT)
  - ___ • 2NV-186A (B/A Blender Otlt To VCT Otlt)
  - ___ • 2NV-242A (RMWST To BIA Blender Ctrl)
  - ___ • 2NV-238A (BIA To Blendr Ctrl Vlv).
- ___ • BAT Pumps 2A and 2B will not operate if in "AUTO"
- ___ • Reactor Makeup Pumps 2A and 28 will not operate
- e Train A SMM Boron Dilution Interlock will be disabled with switch in "Enable"
- ___ • "2NV-37A Vlv Position" receiver gauge fails lo.

18. **RN System:**

- ___ • RN Pit A Emergency Low bevel swap to SNSWP logic is reduced from 2/3 to 1/2
- ___ • 2RNP7400 (RN Intake PIP Level A) fails low.

19. SM System:

- 2SMP5210 (Turb Imp Press)
- ___ • Chart Recorder 2SMCR5080 (S/G 2A Stm Press, S/G 2A Lvl (%), S/G 2B Press) is deenergized.

20. **SV System:**

- ___ • 2SV-13 (S/G 2B PORV Manual Ctrl) fails closed if in manual. Unaffected if in AUTO
- ___ • 2SV-19 (S/G 2A PORV Manual Ctrl) fails closed if in manual. Unaffected if in AUTO.

21. **VA System:**

- ___ • Tornado isolation Train A will not stop Aux Bldg Filter Exh Fan 2A.

1 Pt(s) Unit 1 is recovering from a loss of secondary coolant accident. Safety injection initiated properly. A total loss of feedwater has caused the operators to implement FR-H.1, *(Loss of **Secondary Heat Sink**)*. Given the following plant conditions:

• NCS Pressure	2335 psig
• NCS Temperature	565°F
• S/G 1A, 1B, 1C Pressure	1180 psig
• S/G 1A, 1B, 1C Level (WR)	12%
• S/G 1D Pressure	100 psig
• S/G 1D Level (WR)	35%
• VI system pressure	10 psig
• Containment pressure	3.4 psig

Which one of the following actions is initially required to assure the maintenance **of** adequate core cooling?

A. Depressurize S/G 1A, 1B, and 1C to allow feeding the S/G using the condensate system.

B. Reset the CAPT and align it to feed S/G's 1A, 1B and 1C.

C. Open 1NC-32B *(PZR PORV)* and 1NC-34A *(PZR PORV)* using nitrogen pressure.

D. Reset safety injection and containment phase "A" isolation signals to re-establish instrument air pressure to open 1NC-32B and 1NC-34A.

Distracter Analysis: The FR-H.1 values for *dry* S/G level is < 12% (ACC < 21%). Because containment pressure *is* **3.4** psig, ACC values are in effect.

A. **Incorrect:** Can't feed *dry* S/G's
Plausible: if the candidate does not recognize dry S/G criteria met, this is one FR-Z.1 recovery method.

B. **Incorrect:** Can't feed dry S/G's
Plausible: if the candidate does not recognize dry S/G criteria met, *this* is one FR-Z.1 recovery method.

C. **Correct:**

D. **Incorrect:** Must reset S_p to reopen VI valves.
Plausible: if the candidate thinks that VI is a phase "A" isolated system.

Level: RO&SRO

KA: WE05 G2.1.32 (3.4i3.8)

Lesson Plan Objective: FRH Obj: 2

Source: **Bank**

Level **of** knowledge: analysis

References:
I. OP-CN-EP-FRH page *6*
2. FR-H.**1** background document **step** 17, page 18

OBJECTIVES

	Objective	ISS	NLO	LPRO	LPSO	STA	PTRQ
1	State the purpose of Function Restoration procedures EP/1/A/5000/FR-H Series - Heat Sink			X	X	X	X
2	State the Bases for all NOTES and CAUTIONS in Function Restoration procedures EP/1/A/5000/FR-H Series - Heal Sink			X	X	X	X
3	Explain the Bases for the Major Actions of Function Restoration procedures: EP/1/A/5000/FR-H Series - Heat Sink			X	X	X	X
4	Explain the Bases for all steps in each of Function Restoration procedures EP/1/A/5000/FR-H Series - Heat Sink			X	X	X	X
5	Given a set of specific plant conditions and required procedures, apply the rules of usage and outstanding PPRBs to identify the correct procedure flowpath and necessary actions			X	X	X	X

D. Loss of Normal Steam Release Capabilities

1. This event assumes that a reactor trip has occurred and the SG PORVs and steam dump systems fail to respond, and SG safeties lift to limit the SG pressure transient.

2. Operation on the safeties does not allow operator control of SG pressure, and the steam release path of the safeties is unisolable.

E. Steam Generator Low Level

1. A SG low level condition is expected following a reactor trip from power; however, with the actuation of auxiliary feedwater SG level should be gradually restored under normal conditions.

2. If SG level is not restored, then the cause could be due to an auxiliary feedwater system problem or the SG may be faulted.

2.2 Response To Loss of Secondary Heat Sink (EP/FR-H.1)

A. Cover the purpose of FR-H.1 as stated on the cover of the H.1 procedure. (OBJ. #1)

B. Red Path

1. NR Level in all S/G less than 11% **(29%** ACC) and

2. Total feedwater flow to intact S/G's less than 450 gpm.

C. Major action step summary (OBJ. #3)

1. Attempt Restoration of Feed Flow to Steam Generators: The operator attempts to restore **or** establish auxiliary feedwater flow, main feedwater flow, and condensate flow while checking symptoms for a **loss** of secondary heat sink. Auxiliary feedwater flow restoration is attempted first and, if unsuccessful, NC pumps are tripped to extend the available time to establish feed flew from the main feedwater and condensate systems.

2. Initiation of NC Bleed and Feed Heat Removal: If symptoms for **loss** of secondary heat sink are reached, NCS bleed and feed heat removal is initiated through SI actuation (feed path) and opening the Pzr PORVs (bleed path). Bleed and feed heat removal is maintained until the secondary heat sink is reestablished and verified.

3. Restore and Verify Secondary Heat Sink: After NCS bleed and feed heal removal is established, the operator continues attempts to restore narrow range level in at least one SG. After level is established, the effectiveness of the secondary heat sink is verified by decreasing NC temperatures.

STEP 17: Verify bleed and feed should bo initiated as follows:

PURPOSE:

To check if the secondary heat sink conditions require initiatian of bleed and feed.

APPLICABLE ERG BASIS:

The operator should continue attempts to estabiish flow to the steam generators until 3 S/G WR levels are less than 12% (21% ACC) is exceeded which indicates the need for initiation of bleed and feed. If the operator gets to Step 17. initial attempts to establish CA flow. main feedwater flow or condensate flow have been unsuccessful. Step 17 checks 3 S/G WR leveis greater than 12% (21% ACC) to determine if the secondary heat sink is still effective. If it is not effective. the cperator continues to Step 18 to establish NC System bleed and feed heat removal. If the seccndary heat removal is still effective. the operator returns to Step 1 to continue attempts to restore feed flow to the S/Gs. If at any time the bleed and feed criterion is exceeded. bleed and feed should be immediately initiated.

PLANT SPECIFIC INFORMATION:

KNOWLEDGE/ABILITY:

Two additional purposes are served by this step. IF feed and bleed has already been succesfully initiated. the crew is transitioned to the appropriate procedure sections tc continue attempts to restore secondary cooling. If feed and bleed has been previously attempted and failed, then the step assumes more than eight minutes have passed since event initiation. and further atteapts to initiate bleed and feed are bypassed.

Bank Question: 793.1 ***Answer: A***

1 Pt(s) Unit 2 is operating at 100% power with all rods out.

An operator notices that one core exit thermocouple for quadrant II on the plasma display indicates >1300°F.

Which of the following correctly describes a reason for this thermocouple to be much higher than the other thermocouples?

A. The thermocouple measuring junction has shorted.

B. The thermocouple measuring junction has an open circuit.

C. The thermocouple reference junction temperature has increased.

D. The thermocouple reference junction temperature has decreased.

Distracter Analysis: The voltage across a thermocouple junction increases as the temperature of that junction increases. A shorted measuring junction will cause the temperature to fail high.

A. Correct: a shorted thermocouple causes the removal of the difference in **EMF,** the TC will read high.

B. Incorrect: an open measuring junction causes the temperature indication to fail LOW not high.
Plausible: if candidate believes that like an RTD and open causes a high reading

C. Incorrect: the temperature measured is based on the difference on voltage between the reference junction (at 165 °F) and the T/C. If the reference junction is heated above 165 "F, then the voltage difference will decrease and the temperature signal will decrease.
Plausible: if the candidate reverses the effects

D. Incorrect: the temperature measured is based on the difference on voltage between the reference junction (at 165°F) and the TIC. If the reference junction is cooled below 165°F, then the voltage difference will increase and the temperature signal will increase. However, the increase of >600 °F is not possible because the reference junction temperature cannot be cooled enough.
Plausible: the effect of a decrease in reference junction temperature will be to make the measured temperature increase.

Level: RO&SRO

KA: SYS 017 **K6.01** (2.7/3.0)

Lesson Plan Objective: IG Obj: 2

Source: Mod Catawba NRC 2000

Level of knowledge: comprehension

References:
1. OP-CN-SS-IG page 10
2. OP-CN-PS-CCM page 15

LPRO TRAINING OBJECTIVES

1. Describe the difference between setpoint and control point.
2. Describe how the thermocouple fails (high or low) with an open circuit, with a short circuit.
3. Describe how the RTD fails (high or low) with an open circuit, with a short circuit.
4. State how elastic deformation pressure instruments operate.
5. State the principle of operation of flow detectors.
6. Using the Pressurizer as an example, state indication failures (high or low) for:
   - 6.1 Break in the reference leg.
   - 6.2 High containment temperature.
   - 6.3 Break in the impulse leg.
   - 6.4 Rupture of the diaphragm.
   - 6.5 An open equalization line.
7. List the ESF signals and their setpoints.
8. Recognize the logic gate symbols and correctly interpret a logic diagram.

B. Temp. Instrumentation and Control

1. The simplest temp. detector used is the thermocouple.

   a) Used for a wide range of temperature detection where —— accuracy is not required.

   b) Consists of a pair of dissimilar metal wires.

      1) Jined at the ends forming 2 Junctions, Measuring and Reference.

      2) Heating the Measuring Junction produces a voltage greater than the voltage across the Reference Junction.

      3) You can read the difference between the 2 voltages on a Voltmeter.

   c) Thermocouple failures: (LPRO/LPSO #2/PTRQ #1)

      1) Open - fails low

      2) Short - fails high

2. Resistance Temperature Detectors (RTD's)

   a) Operate OR the principie that the resistance of certain metals changes as the temp. changes - (temp. increases => resistance increases)

   b) RTD's act as electrical Transducers, converting temp. changes to voltage signals by measuring resistance.

   c) The metals most suitable for RTD's are platinum, copper and nickel.

      1) Platinum is the best and most often used.

      2) The metal wire is formed and shaped around an insulating material.

   d) RTD's are highly accurate, give fast response and are small in size.

   e) They can be used in a well (wide range in NCS). A well is a piping penetration with an insert to contain the RTD (slower response)

   9 They can be used in a manifold type arrangement (narrow range in NCS). A manifold arrangement is a bypass with the RTD inserted directly into the fluid (Faster response)

   g) RTD Instrument Failures (LPRO/LPSO #3/PTRQ #2)

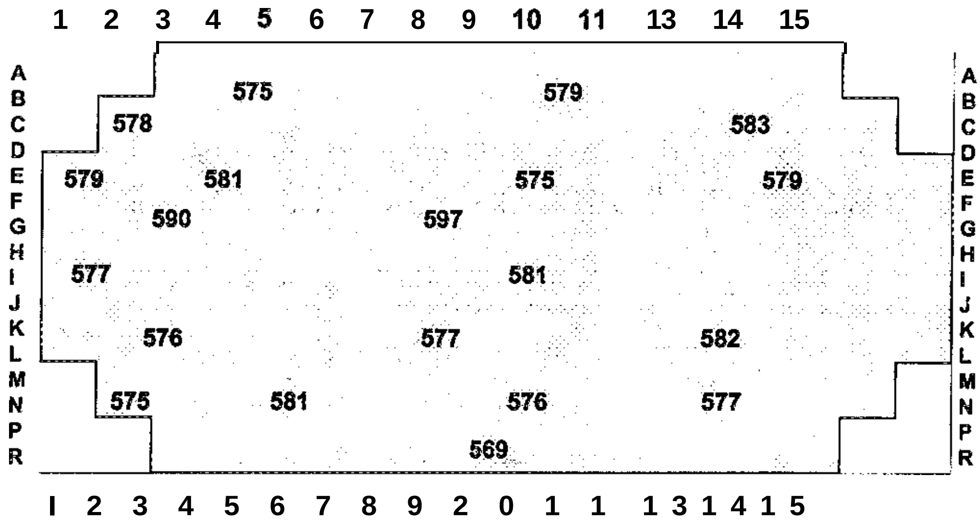
      1) If the RTD opens it will fail high because of no current flow, therefore infinite resistance (Most common). This would give a failed high temp. indication.

      2) If the RTD shorts it will fail low because of zero resistance. This would give failed low temp. indication.

   h) Bridge Circuit

6. Thermocouple Core Map Displav Pase - An outline of the core with a train-oriented view of the incore T/C layout. The values are located on the map as they appear in the core.

TIC CORE MAP |



7. Thermocouple Quadrant Displav Pase - Divided into four (4) sections, one for each quadrant. The appropriate thermocouples are shown by their location and the temp is displayed in degrees F.

T/C QUAD I/II/III/IV

QUAD I		QUAD II		QUAD III		QUAD IV	
LOC	°F	LOC	°F	LOC	°F	LOC	°F
A06	575	A10	579	J10	581	J02	577
B03	578	B13	583	L14	582	L04	576
E02	579	E14	579	N10	576	L08	577
E06	581	E09	575	N14	577	N02	575
G04	590	G08	597	R08	509	N06	581

MODIFIED: CATAWBA NRC 2000

Bank Questdon: 793 ***Answer: D***

1 Pt(s) Unit 2 is operating at 100% power with all rods out.

An operator notices that one core exit thermocouple for quadrant II on the plasma display indicates 2200°F.

Which of the following correctly describes a reason for this thermocouple to be much higher than the other thermocouples?

A. The thermocouple reference junction temperature has increased.

B. The thermocouple reference junction temperature has decreased.

C. The thermocouple measuring junction has an open circuit.

D. The thermocouple measuring junction has shorted.

Distraeter Analysis: The voltage across **a** thermocouple junction increases as the temperature of that junction increases. **A** shorted measuring junction will cause the temperature to fail high.

A. **Incorrect:** the temperature measured is based on the difference on voltage between the reference junction (at 165 **°F)** and the TIC. If the reference junction is heated above 165 °F, then the voltage difference will decrease and the temperature signal **will** decrease.
Plausible: if the candidate reverses the effects

B. **Incorrect:** the temperature measured is based on the difference on voltage between the reference junction **(at** 165 °F) and the T/C. If the reference junction is cooled below 165 °F, then the voltage difference will increase and the temperature signal **will** increase. However, the increase of 1600 **°F is** not possible because the reference junction temperature cannot be cooled enough.
Plausible: the effect of **a** decrease in reference junction temperature will be to make the measured temperature increase.

C. **Incorrect:** an open measuring junction causes the temperature indication to fail LOW not high.
Plausible: if candidate believes that like **an** RTD and open causes a high reading

D. **Correct:** **a** shorted thermocouple causes the removal of the difference in **EMF,** the TC will read high.

Level: RO&SRO

KA: **017** A2.01 (3.1/3.5)

Lesson Pian **Objective:** IG SEQ **2**

Source: **New**

Level of **knowledge: comprehension**

References:
1. OP-CN-SS-IG **page 10**
2. **OP-CN-TA-AM page 26**
3. OP-CN-PS-CCM **page 15**

Bank Question: 796 **Answer: C**

1 Pt(s) Unit 1 was operating at 100% power. Given the following events **and** conditions:

- 1-AD-6 F/10, (*PRT HI TEMP*) in alarm
- 1 **AD-6** F/11 (*PRT HI PRESS*) in alarm
- Lower **containment** temperature = 124 °F
- The NC system is at normal operating temperature
- Letdown is in service

Which one of the following statements correctly describes a condition that could cause these alarms?

A. The PRT has heated up due **to** ambient containment temperature.

B. **1** ND-3 or **1ND-38,** ***(ND SUCTIONRELIEF VALVEs)*** have lifted.

C. **1 NV-15B** ***(LETDN CONT ISOL)*** has spuriously closed.

D. The reactor vessel inner O-ring has leaked.

Distraeter Analysis:

A. Incorrect: Containment temperature is less than PRT temperature. Plausible: Heat up from containment ambient conditions can cause this to occur if containment temperature is high enough.

B. Incorrect: the ND system is too low in temperature and isolated from the NC system, to cause this to occur even if the ND suction relief were to lift.
Plausible: the ND suction relief line goes to the PRT.

C. Correct: if 1NV-15B closes. the letdown relief valve 1NV-14 will lift and relieve to the PRT.

D. Incorrect: the reactor vessel inner O-ring leaks to the NCDT. Plausible: if the candidate thinks that this leaks to the PRT

Level: RO&SRO

KA: SYS 007 G2.4.4 (4.0/4.3)

Lesson Plan Objective: NC Obj: 3

Source: **Bank**

Level of knowledge: comprehension

References:
1. OP-CN-PS-NC **pages** 12, 21-22, 25-26, 31
2. OP-CN-PS-NV **pages** 11-13
3. OP/1/B/6100/010G F/10, Fill

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Explain the purpose of the NC system.	X	X	X	X	
2	Describe the NC System normal operating parameters.	X	X	X	X	X
3	Be able to describe and understand the NC System interfaces with Pzr, PRT, NV, NI, and ND.	X	X	X	X	X
	• Explain how normal system parameters are maintained in the NC System.	X	X	X	X	
	• Describe the purpose and operation of the Pzr.	X	X	X	X	
	• identify the purpose of the Pzr relief valves and safety valves.			X	X	
	• Identify the power supply to the Pzr heaters.	X	X	X	X	
	• List the system parameters and setpoints associated with NC System relief valves and safety valves.					
4	Be able to draw the Reactor Coolant system per training drawing PS-NC-12.	X	X			
	• Show flow paths through major components.					
5	Identify the three major parts of the vessel internals and list their components.					
	• Identify the various internal components on a drawing of the reactor vessel.			X	X	X
	• Explain the purpose of the internal components.			X	X	
	• Explain the methods of support (radial and axial) of reactor vessel internals.			X	X	X
6	Describe the reactor vessel construction.			X	X	
	• Identify the vessel head penetrations and their purpose.					
	• Identify the vessel bottom penetrations and their purpose.					
	• Explain how the vessel is supported vertically.					
7	Analyze the normal coolant flowpath through the core.			X	X	X
	• Explain the core bypass flow paths, the amount bypassed, and the purpose or cause of the flow.					
	• Explain the appropriate pressure drop across the core.					
8	Identify all NC System penetrations and the relative locations of the penetrations.			X	X	X

f) Primary Boundaries

1) leading edge of thimble is sealed.

2) Thimbles are sealed *to* conduits with mechanical seals at the seal table.

E. Surveillance specimen Baskets

1. Six core locations.

2. Attached *to* the four neutron shield pads at the core axial centerline.

F. O-Ring Leak Detection

1. Two Leakoff Line Connections with isolation valve in each line

a) One between the O-rings (Inner) with isolation valve normally open.

b) One after both O-rings (Outer) with isolation valve normally closed.

1) Inner and outer leakoff isolation valves are manual valves on Unit 1 and remotely operated valves (from control room) on Unit 2.

c) Pie into common line to NCDT

1) Common line contains RTD and isolation valve operated from control room

2. If inner o-ring fails, leakage will flow through inner leakoff line past RTD into NCDT. The RTD will initiate annunciator in control room to alert operators of o-ring failure.

G. Flow Path (Obj. #7)

1. Core barrel separates inlet and outlet core water.

a) Flow comes into the vessel.

b) Flows down the annulus formed by reactor vessel and core barrel.

c) Flows up thru core.

d) flows out thru the TH outlet nozzle.

2. Core Bypass Flow **(7.5% of** total flow) (Obj. #7)

a) Flow up thru columns undesirable.

b) Head cooling flow (4%) maintains flow down thru columns.

3. Upper Internal Flowpaths

a) Head cooling bypass flow **(4%)**

1) Head Cooling Nozzles.

2) Nozzles penetrate upper support structure flange and core barrel.

18. Code Safeties
    a) Provide NC Integrity protection (Obj. #3)
    b) 3 totally enclosed pop type valves (NC-1, 2, 3)
    c) Relieve at 2485 psig (**Obj.** #3)
    d) RTD to indicate valve leakage
        I) 1 per valve
        2) Temperature indicated on MCB
        3) Alarm in control room on high temperature
    e) Acoustic Monitoring System to indirectly detect safety valve position
        1) 2 accelerometers on each safety valve discharge Bine detect acoustical vibrations mused by steam flowing through the valve discharge piping.
            (a) Both sensors are wired but only one is selected for processing with the other utilized as a spare
        2) Signal from accelerometer is converted to **a** voltage which is processed in a cabinet located in the 560' Electrical Penetration Room to provide an output that represents relative valve position and initiate signals to control room.
            (a) Output **is** displayed on local panel as 10 LEDs corresponding to relative valve position.
            (b) Preset alarm setpoint causes annunciator on MC14 and illuminates a Group **2** monitor light panel status light.
            (c) A "Flow/No Flow" light on MCIO will also indicate "Flow" when the alarm setpoint is reached.
19. Pressurizer Relief Tank (PRT) (Obj. #3)
    a) Designed to condense and cool Pzr discharge steam equal to 100% of the volume above the full-power pressurizer water level setpoint. Not designed for continuous discharge.
    b) Normally –75% level with 3-5 psig N_2 over pressure.
    c) Steam discharges to tank through sparger and drained to NCDT.
    d) Can be cooled by
        1) Spray from RMWST; cool from 200°F to 110°F in one hour.
        2) NCDTHX
    e) Rupture disc: Relieves at 100 **psig**
        1) Relief capacity equal to the combined capacity **of** the three-pressurizer safety valves.

2) The PRT design pressure (and the rupture disc settings) is twice the calculated pressure resulting from the maximum safety valve discharge described above.

f) Vent sight glass has been upgraded to **2500** psia and 300°F.

g) Inputs:

1) Pzr PORV's

2) Pzr Safety Valves

3) Reactor Vessel Head Vent

4) ND Suction Relief Valves

5) NV Letdown Relief Valves

6) NV NCP Seal Return Relief

7) Pzr Vent

B. Instrumentation and Control

1. Temperature

a) Narrow range Th and Tc

1) indication for all four loops

2) 510°F - 630°F range for Tc

3) 530°F - **650°F** range for **Th**

4) indication on computer

b) Narrow Range RTD's

1) Provide AT and Tavg signals

NOTE: **AT** = Th - Tc

$$Tavg = \frac{Th + Tc}{2}$$

(a) Reactor Control System

(b) Reactor Protection System

(c) MCB indication (each loop)

(d) Recorder inputs for readout display (AT, OPAT, OTAT)

(e) MCB deviation alarm on excessive single loop variation from other loops on **AT** and Pavg.

2) Reactor trip on 2/4 **AT** signals exceeding OP or OTΔT setpoints.

3) Rod stop/turbine runbacks on **2/4** AT signals exceeding OP/OTΔT rod stop setpoints. Turbine runback to continue until the AT rod stop signal disappears.

2) Temperature indicated on MCB (50-350°F)

3) High alarm indicates at 130°F tank cooling *is* required.

j) RV Flange Leakoff RTD

1) NCRD 5890

2) Temperature indicated on MCB

3) High alarm on MCB at 140°F

4) High alarm indicated 0-ring seal leakoff.

2. Pressure

a) Pzr Pressure (four (4) transmitters)

1) Covered in detail in Pressurizer Pressure Control Lesson Plan.

b) Reactor Loop Pressure (WR)

1) NCPT 5120 (Loop B) (0-3000 psig)

(a) Interlocked with ND2A and ND37A

385 psig OPEN permissive

(b) Supplies indication on MCB indicator and recorder.

(c) WR pressure indication in used during startup and shutdown in conjunction with manual control Pzr heaters and sprays for accurate pressure indication.

2) NCPT 5141 (Loop C)

(a) Provides WR indications on MCB

(b) Interlocked with ND1B and ND36B

385 psig OPEN permissive (Obj. #3)

3) NCPT 5142 (Loop C Low Range Press. Indication 0-800 psig

c) Low Range NC Pressure on C/R SMCR5080, 5810

1) 0-600 psig

2) At 550 pisg decreasing, C/R will set **to** Hi speed to aid monitoring LTOP ops.

d) Pressurizer Relief Tank Pressure

1) NCPT 5130 (0-100 psig)

2) Pressure indicator on MCB

3) Hi alarm at 8 psig

3. bevel

a) Pressurizer bevel

1) (Four (4) channels indicated on MCB)

(a) Three (3) hot calibrated provides signals

(1) Reactor Protection System

(2) NV System

(3) Pzr heater cutout circuit

(4) Input to LEVEL PROGRAM/ACTUAL level summer

(5) Input to OAC for channel indication and input to computed value for "Actual Level"

(i) "Actual Level"' is hot calibrated average corrected for deviation from 653°F pressurizer temperature

(b) One (1) cold calibrated used during startup, shutdown and refueling for indication.

2) Three (3) channels provide remote indication

(a) Hot Shutdown Panels A and B – one channel each

(b) Safe Shutdown Facility (SSF) – one channel

b) Pressurizer Relief Tank

1) NCLT 5130

2) Level indication on MCB (0-100%)

3) High/Low level alarm on MCB at 89%/67%

4. Flow

a) Loop Flow Measurement

1) Measured by three detectors

2) Tap at piping elbow between S/G and NC pump suction. Delta P proportional to velocity squared

3) Provides low flow signal for reactor trip 2/3 coincidence.

4) Provides Control Board Indication (0-100%)

b) Bypass Panel (1.47) Automatic Inputs. Any motor-operated containment isolation in the NC System.

- FWST through NB33 to Hot Legs via NI183B

Makeup flowpath status will be displayed on a control room whiteboard.

Required makeup flow rates are specified in AP/1(2)/A/5500/19 'Loss of ND'.

Makeup Rowpath status will be displayed on a control room whiteboard.

e) AP/1(2)/A/5500/19 'boss of Residual Heat Removal' - This procedure addresses remedial action for a loss of ND including containment closure, makeup flow, and restoration of ND. This procedure is discussed further in the ND lesson.

4. NC System Leak Testing

   Limits and Precautions - reference PT/1(2)/A/4150/001A

5. Pressurizer Relief Tank Qperation Limits and Precautions - reference OP/1(2)/A/6150/004

6. NC System Leakage Calculation - reference PT/1/A/4150/001D (Qbj. #9)

   Basic Procedure:

   a) Ensure unit temperature and pressure are stable

   b) Isolate any NC unmeasured input/output sources

   c) Run KCSLEAK program on the OAC. This program performs NC system mass calculations in various locations in the NC and NV systems. Receives input from:

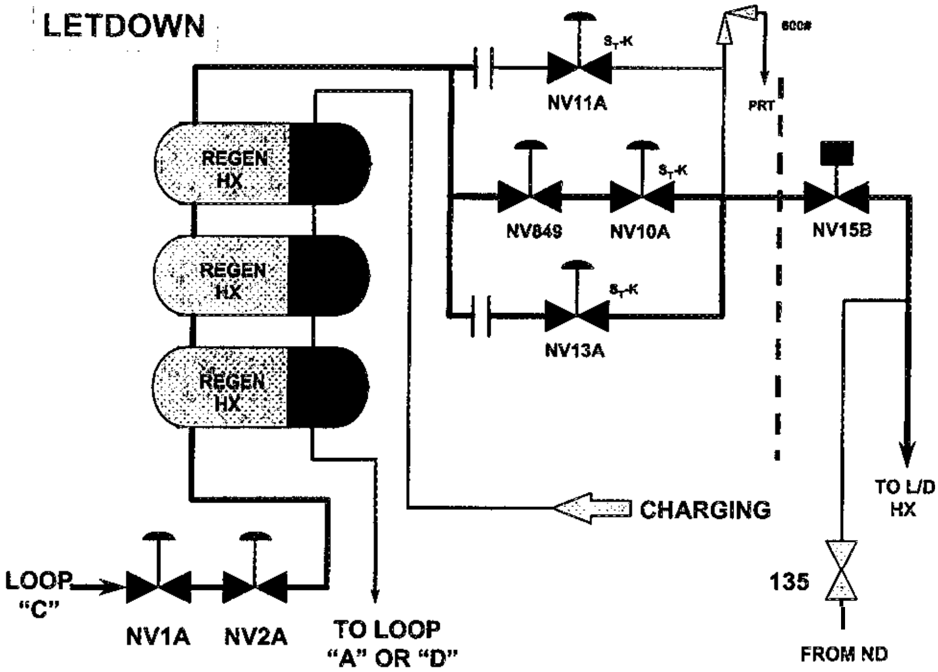
      - All loops T-HOT, T-COLD, and T-AVE. Uses only those loops with an NC pump running to calculate average values for each.
      - Pressurizer Average Level
      - PRT average level
      - VCT average level
      - NCDT average level
      - Pressurizer Surge line temperature
      - Pressurizer Water temperature
      - NC system pressure
      - Various valve positions that would indicate unmeasured mass being added/removed from the NCS.

        The program must be allowed to run long enough to ensure a high confidence in the result but in all cases will run for 30 minutes or more.

3) **Loss** of air.

c) Cannot open unless NVIOA, 1 1A and 13A are closed.

d) Cannot close if either NVIOA, 11A or 43A is open, except on PZR low level when both valves will auto close.



2. Regenerative Heat Exchanger

   a) Recovers heat **loss** from L/D flow by reheating charging flow.

   b) Nominal **Hx** outlet temp - 300°F.

   c) Limit and Precaution limits charging flow through heat exchanger to 180 gpm.

   d) UD flow on shell side; charging flow on tube side.

   e) First temperature reduction for demineralizer protection

   9 Letdown Temperature

      1) Indicates temperature exiting the regenerative heat exchanger.

      2) Indication and high alarm on MCB.

3. Orifice Isolation Stop Valves NV11A, 10A, 13A (OBJ. #22 & 23)

   a) Air operated globe valves, fail closed, operated from MCB or Aux S.D. panel (NV-11A & NV-13A only from ASP-A).

   b) Cannot be opened unless UD ISOL valves are open

   c) Auto close signals

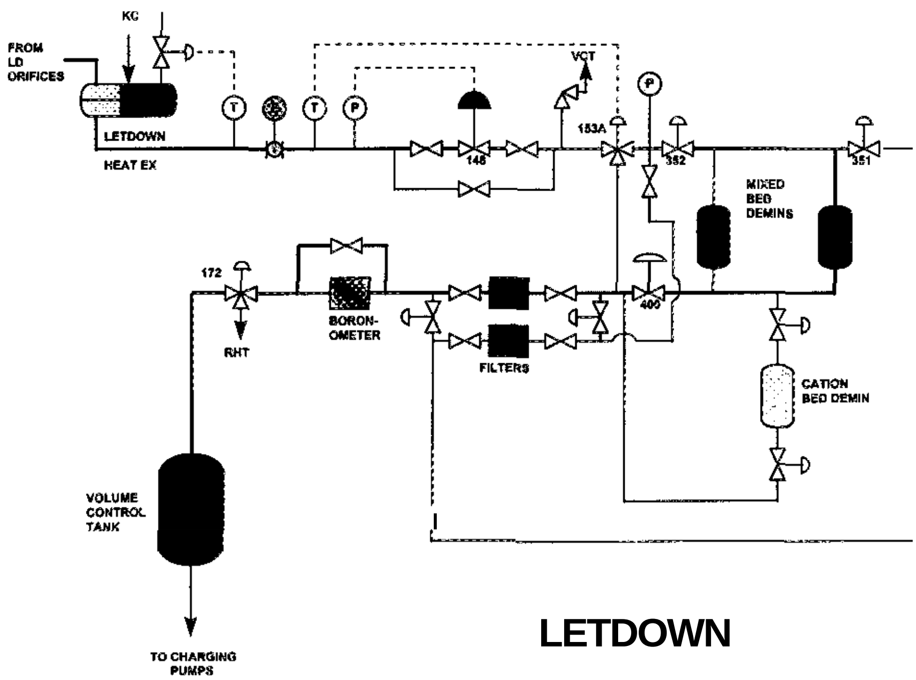
1) Low PZR level (17%).
2) Containment Isolation (S_T).
3) Closure of NV1A or NV2A (cannot open NVIOA, 1I A or 13A unless NV1 and 2 are open).
4) Both centrifugal charging pumps tripped.

4. L/D Orifices (2) Isolation Valves NV-11 & 13
   a) Reduce coolant press - 1900 psig at design flow rate.
   b) One 75 gpm orifice. This is the normal flowpath for letdown on Unit 2 (NV-13 Block Valve).
   c) One 45 gprn orifice (NV-11 Block Valve). Used to obtain greater L/D flow in conjunction with 75 gprn orifice or reduce letdown flow as required by procedures.
   d) Max L/D flow of 120 gpm at normal operating pressure.

5. L/D Manual Flow Control Valve (NV849) (NV10 Block Valve)
   a) Used to warm up downstream piping on Unit 2. On Unit 1 this is the normal letdown flowpath and is set at 75 gpm per the NV operating procedure.
   b) Flow rate of 5 to 110 gpm (when NCS pressure is less than or equal to 385 psig).
   c) Controlled from MCB via manual loader.
   d) The power source for the control circuit of this valve (NV 849) is now a non-safety related, non-interruptible power source (1KXPB). During a LOOP event, control of this valve is still available as long as the battery source for 1KXPB and VI are available.
   e) The response of NV-849 to the controller shows that the flow response is not linear throughout the scale and is as follows:
      1) NV-849 does not respond until –35% demand on the controller.
      2) OAC indicates the valve is full closed at 26% demand.
      3) Demand is off scale high when flow is 110 gpm.
      4) NV-849 travel stops are set for 110 gpm.
      5) NV-849 flow rate is very sensitive in the 95-110+ % demand range.
      6) NV-849 controls for a very steady flow rate once set.

6. If Letdown flow is to be increased to greater than normal flow (greater than 80 gpm) a new Dose Equivalent Iodine limit is instated per AP/18, High Activity in Keactor Coolant.

7. Letdown Line Relief Valve (1NV14)
   a) Overpressure protection *for* low press. piping and tube side of L/D heat exchanger.
   b) Relief setpoint 600 psig.
   c) Kelieves to Pressurizer Relief Tank (PRT).
   d) Capacity - max flow rate through all orifices.
8. NV15B - L/D Containment Isolation Valve
   a) Operated from MCB.
   b) AUTO-CLOSE on S_t signal.
   c) AUTO-OPENS on ASP " B to local.
9. ND Letdown Control Valve (NV135) (OBJ. #5)
   a) Opera when ND system is in RHR Mode and NCS cleanup desired.
   b) Control and indication on C/B.
   c) Fails closed on loss of instrument air. (OBJ. #23)
10. Letdown heat exchanger



LETDOWN

   a) Single shell-multi pass.

F/10

PKT HI TEMP

SETPOINT: 130°F

ORIGIN: 1NCRD5350

PROBABLE CAUSE:

1. PZR PORV lifting or leaking.
2. PZR safety lifting or leaking.

THE RESPONSES FOR THIS ALARM ARE LISTED IN AP/1/A/5500/11 (PRESSURIZER PRESSURE ANOMALIES)

F/11

PRT HI PRESS

SETPOINT: > **8** psig

ORIGIN: 1NCPT5130

PROBABLE CAUSE:
1. Pressurizer relief or safety valve discharging into tank.
2. N_2 overpressure.

AUTOMATIC ACTIONS: 1WG-225 (Unit 1 PRT to WG Comp Isol) closes.

NOTE:
- PRT rupture disk relieves at a "NOMINAL" pressure of 100 psig.
- Computer point C1A0885 (PRT Press) alarms at 6 psig.

IMMEDIATE ACTIONS: Monitor PRT temperature, pressure, and level on main control board and PORV downstream and safety downstream temperatures to determine cause of alarm.

SUPPLEMENTARY ACTIONS:
1. Ensure source of pressure is identified and action taken.
2. Since the normal depressurization **flow** path to WG has isolated. perform the following per OP/1/A/6150/004 (Pressurizer Relief Tank):
   - 2.1 Reduce level until the auto close signal to 1WG-225 clears.
   - 2.2 Perform pressure reduction.
   - 2.3 Re-establish normal PRT level.
3. Refer to TS 3.4.13 , for operational Reactor Coolant leakage criteria.

REFERENCES:
1. CNEE-0173-03.03
2. Westinghouse Precautions, Limitations and Setpoints CNM-1201.00-39
3. NC System Description - PRT rupture disc relief pressure

Bank Question: 828 ***Answer: B***

1 Pt(s) Unit 1was operating at 7% power when an electrical problem causes the loss of 1T1B. Given the following events and conditions in chronological sequence:

- Voltage **on** short buses 1TB and 1TD drops to 75%
- Frequency on short buses 1T5 and 1TD decreases to **55** hertz.
- The 1TB-to-1TD fast bus transfer fails to occur
- All equipment operates as designed.
- No operator action

What is the current status **of** the unit?

A. The reactor does not trip, B and D NCPs trip.

B. The reactor does not trip, all NCPs trip.

C. The reactor trips, B and D NCPs trip.

D. The reactor trips, all NCPs trip.

Distracter Analysis:

A. **Incorrect:** all NCPs are tripped
Plausible: partially correct - power is below P-7, candidate may not know UF will trip all NCPs.

B. **Correct: UF (**56 hertz) will trip all NCP breakers, because power is less than P-7, the reactor will not trip.

C. **Incorrect:** the reactor does not trip if below P7 **–** all NCPs are tripped
Plausible: partially correct – B& D NCPs do trip - candidate may think UF trips only B and D NCPs and because it is always in effect, may trip the reactor.

D. **Incorrect:** the reactor does not trip if below P7
Plausible: candidate may **think** UF trips all NCPs and because **it** is always in effect, may trip the reactor.

Level: RO&SRO

KA: SYS 062 **K4.03** (2.8/3.1)

Lesson Plan Objective: NCP Obj: **8** EP Obj: 12

Source: **Bank**

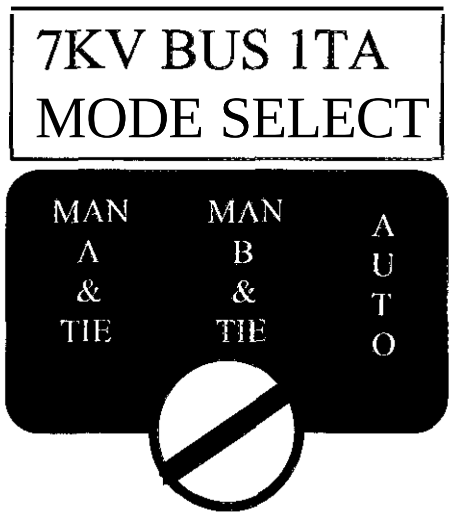
Level **of** knowledge: comprehension

References:
I. OP-CN-PS-NCP **page** 20, 21, 22, 23
2. OP-CN-EL-EP **page** 29, 30

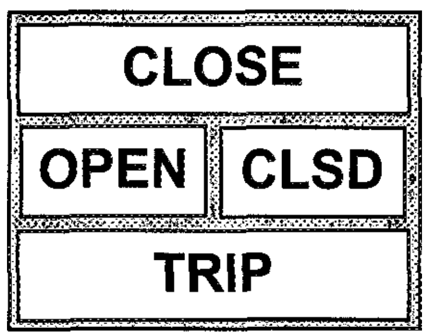
	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the NC pumps.	X	X	X	X	
2	Explain the design, operation, and function of major NC pump and motor components. • Stator and Stator Cooler • Vibration Monitors • Flywheel • Anti-reverse Rotation Device • Motor Thrust and Guide Bearings • Pump Impeller • Pump turning Vane-Diffuser • Pump Diffuser Adapter • Thermal Barrier Heat Exchanger • Pump Radial Bearing	X	X	X	X	
3	Explain the operation of the NC pump seals including injection flow paths, flow rates, discharge flow paths, and pressure drops.	X	X	X	X	X
4	Explain which coaling water supplies cool the NCP components.	X	X	X	X	X
5	Explain the operation and purpose of the oil lift system.	X	X	X	X	X
6	Explain the sources of water, lineups and flowpaths needed to till the NCP stand pipe.			X	X	
7	Identify the power supplies to the NC pumps.			X	X	
8	Explain the function and operation of the NCP Pump Monitor System.			X	X	X
9	Given appropriate plant conditions, apply limits and precautions associated with related station procedures.			X	X	X
10	Outline the procedures fer starting/stopping NC pumps. • Explain the use of redundant breakers between the 7KV switchgear and the NC pumps. • Explain the interlocks associated with the pump breakers and the oil lift system.			X	X	X

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	E:ꞎ the purpose of the Electrical Distribution əm	X		X	X	
2	List from where the switchyard **PCB's** can be operated.	X	X	X	X	
3	Describe how to remove and return a switchyard PCB from/to service.	X	X	X	X	
4	Describe how to operate switchyard disconnects, **also** list what protective equipment **is** required to operate a switchyard or transformer disconnect.	X	X	X	X	
5	Describe how to operate a main transformer ground disconnect.	X	X	X	X	X
6	Describe how to operate the Generator **PCB's** and MOD's; also list from where they are operated.	X	X	X	X	X
7	Describe how to operate the generator neutral ground disconnect.	X	X	X	X	X
8	Explain the purpose of the Isolated Phase Bus System (IPB).	X	X	X	X	
9	Describe the procedure for grounding the IPB.	X	X	X	X	
10	Describe the 6.9 KV power system.	X	X	X	X	X
11	List the loads Dowered from 6.9 KV toad centers.	X	X	X	X	X
12	Describe how a transfer of power on the 6.9 KV load center can be accomplished.	X	X	X	X	X
13	Describe how to operate a 600 V breaker.	X	X	X	X	
14	Explain how to shift 600 V unit and shared load enters to the alternate source.	X	X	X	X	
15	Explain how to shift 600 V unit and shared and blackout MCC's to the alternate source.	X	X	X	X	
16	Describe the term "Hot Bus" Transfer and how it apples to Unit, Shared and Blackout MCC's.	X	X			
17	Describe the term "Dead Bus" Transfer and how it applies to Unit, Shared and Blackout MCC's.	X	X			
18	Describe the 4460 V power essential system.	X	X	X	X	X
19	Explain how the **4160** V load center is assured a Dower source.	X	X	X	X	X

6. 6.9KV incoming and tie breakers are controlled from control room - MC-11
   a) 3 position transfer switch (See one below typical **of** eight)
      1) Auto - allows auto swap
      2) Man "A and Pie - allows operating the "A incoming breaker and the t i breaker.
      3) Man "B" and Tie - allows operating the "B" incoming breaker and the tie breaker.



   b) Open - Close Pushbutton operates the breaker (See below)



7. To supply a 6900V load center completely from one auxiliary transformer, the tie breaker can be closed and one incoming breaker opened.
8. Transfer can occur automatically or manually. (OBJ. #12)
   a) **Auto** Transfer
      1) Mode select switch in "Auto"
      2) Auto transfer initiated by a Zone Lockout or 75% UV **on** the incoming line (No fault on affected bus)
      3) If in synch - **fast** transfer **with** no loss of load. This will only occur with the Main Generator on line.

4) If **NOT** in sync then the transfer **is** delayed to allow voltage to decay to a point that syncronization is not a concern. (slow transfer). **Loss of** load will occur.

5) A new switch was added that controls this transfer. With the Main Generator off line , this switch is placed in the defeat position and then only slow transfers will occur. This switch controls the tie breaker.

6) The defeat removes the sync check relays (25s) from the circuit and provides for only a slow transfer. See **4** above for description.

7) The AUTOMATIC FAST TRANSFER ENABLE, DEFEAT switch is located in the 6.9KV load center rooms on the control panels with the under voltage transfer relays.

b) Manual Transfer (Example: Transfer I T A to 1T2B)

1) Select "Man A and T I € - these are the breakers to be operated.

2) Close the Tie breaker, the "A" feeder will open.

3) The transfer switch should always be selected to the position for the breakers **to** be operated.

2. NC Pump Monitor System (OBJ #8)

a) Purpose: To initiate a reactor protective action whenever a significant **loss** of reactor coolant flow ***is*** imminent due to a sustained reduction in voltage or frequency on the power cables to the NC pump motors.

b) Monitor System Description

1) Solid State

(a) ONE Undervoltage and ONE Undefrequency detector monitors each NCP power supply.

(b) If the voltage or frequency drops below an acceptabie pre-set level for a pre-set time, the associated monitor channel provides a trip signai to SSPS.

2) Status lights

(a) Indicates channel trip

(b) Located on NCP monitor panel

(c) Recorded by event recorder

3) SSPS

(a) Activates annunciator alarm in Control Room

(b) Control Woom status lights in Control Room

(c) Utilizes 2/4 logic scheme to evaluate the signal

c) Reactor Trip greater than P-7

1) Undervoltage on 2/4 **NCPs** trips the Reactor **if** power level greater than or equal to 10% **(P-7).** UV detectors are located between the Safety Breaker and the NCP motor.

2) Underfrequency on 2/4 NCPs trips the Reactor if power level greater than 10% (P-7). UF detectors are located between the 6.9 KV Supply Breaker and the Safety Breaker.

NOTE: The P-7 interlock is used in the circuit as the NC pumps are not required during reactor operation below 10%.

3) Underfrequency also trips all four (4) **NC** pump motor safety breakers - Not dependent on **P-7,** alwavs enabled.

4) Component Location
   (a) NCP monitor panel (1RCP)
      (1) Contains all components of system.
      (2) Located in control room.
   (b) Contents (channel)
      (1) Voltage module
      (2) Frequency Module
      (3) Test Switch
      (4) Asst. Aux. Relays
      (5) Status bights
   (c) Voltage/frequency Monitor Modules
      (1) Major components of system.
      (2) Variable sensing circuits.
      (3) Adjustable trip.
      (4) Adjustable timer.
5) Trip Setpoint Ranges
   (a) Voltage - 5082 VAC (77% of RCP motor nominal operating voltage.)
   (b) Frequency - 56 hertz

d) Monitor operation
   1) Trips adjustable trip components
      (a) Triggers adjustable timing ckt.
      (b) After pre-set timer, contacts open to de-energize aux. relay.
      (c) Aux. relay contacts
         (1) De-energize status light on monitor panel
         (2) Activate event recorder
         (3) Sends channel voltage + trip signal to **SSPS**

e) Test Feature
   1) Individual channel test
      (a) installed
      (b) Key-operated
      (c) 3-position

(d) Spring-return-to-center

2) Energizes test delay

(a) VMT (Volt)

(b) FMT (Freq)

3) Relay contacts provide test signal

(a) Computer

(b) Annunciator

NOTE: Contacts also interrupt input ckt. to volt/freq monitor. The 2/4 channel logic scheme in the SSPS allows one channel to be tested during reactor operation without reactor/NC motor bkr. trip.

B. Trips and Interlocks

1. NCP Interlocks (OBJ #10)

a) The 6.9 KV Supply Breaker (located in the 6.9 KV switch gear) trips are:

1) ground fault

2) overcurrent

3) overfrequency

4) phase balance

5) motor differential

This breaker has NO UV or UF trips.

b) The Safety Breaker (located in the **Aux** Bldg) trips are:

1) ground fault

2) overcurrent

3) associated 6.9 KV Supply Breaker trip

4) underfrequency on any two NCP Power supplies

c) If Supply (Non-safety) breaker fur an individual pump opens, the safety breaker fer that pump opens

d) Oil lift pressure must be greater than 500 psi (2/3 switch logic) to close safety breaker.

e) 3/4 supply breakers closed to **dose** a Safety breakers (to clear UF trip of all Safety Breakers)

2. Oil Lift Trips

a) Flasher wired to starter if overload condition.

3. Oil Lift interlocks
   a) Only one oil lift pump can operate at any give time per NCP.
   b) Prevents NC motor start until oil lift press is greater than 500 psi.

C. Instrumentation
   1. Indication
      a) NC Pump Supply AMP Meter (1 for each safety breaker)
      b) NCP A Sea! Outlet Temp * (50-250° F)
      c) NCP A Seal Water Flow* (0-20 GPM)
      d) NCF A No. 1 Seal Delta P * (0-400 PSID)
         NCP A Radial Bearing Temp*
      e) *Same for B, C, and D Pumps
      f) NC PMP MON PNL (1RCPM)
         1) Bus Voltage Normal (Light)
         2) Control Power Available (Light)
         3) Bus Frequency Normal (Light)
         4) Voltage Monitor Test (Light)
         5) Frequency Monitor Test (Light)
      g) NCP Vibration on Shaft and Frame
   2. Chart Recorders
      a) NCP A and B Hi-Leak-Off Flow (C and D on another recorder)
      b) NCP A and B Lo-Leak-OFF Flow (C and D on another recorder)
   3. Computer Inputs
      a) Analog (applicable to all four pumps)
         1) NC Pump A MTR LWR THR BRG TEMP
         2) NC Pump A MTR UPR THR BRG TEMP
         3) NC Pump A MTR LWW BRG TEMP
         4) NC Pump A MTR STATQR WINDING TEMP.
         5) NC Pump A MTR AMPS
         6) NC Pump A MOTOR UPR BRG TEMP.
         7) NC Pump A VIBRATION CHANNELS.
      b) Digital
         1) NC Pump Oil Fill Otsd Cont Isol.

Bank Question: 829 **Answer: A**

1 Pt(s) Unit 1 was operating at **100%** power when the crew detects indications of a loss of NC inventory. Given the following events and conditions:

- **All** systems are **In** automatic
- Indicated letdown flow is 62 gpm
- **1NV-13A** (LTDN ***ORIF 1A*** OTLT *CONT ISOL*) is open
- Letdown pressure is 350 psig
- Seal return – 3.5 gpm per NCP
- Indicated charging flow – 90 gpm
- Indicated seal injection flow – 35 gpm
- VCT level is decreasing
- Pressurizer pressure and level are constant
- Containment humidity is increasing

Which one of the following statements correctly describes the location of the leak?

A. Letdown line, between the letdown orifice and the containment Isolation valve.

B. Charging line between **1NV-309 (*Seal Water Injection Flow*) and 1NV-294 (*NV Pumps A&B Disch Flow CTRL*).**

C. Charging line inside containment.

D. One of the RCS loops.

Distracter Analysis:

A. Correct: if the leak is on the letdown line, VCT level will drop, charging and letdown will be matched and pressurizer level will remain constant.

B. Incorrect:
Plausible: operator misses that these valves are outside containment.

C. Incorrect: charging leak would be indicated by increased charging.
Plausible: candidate misinterprets indications.

D. Incorrect: Charging flow would have to increase.
Plausible: candidate assumes it's a small leak and misinterprets the indications.

Level: RO&SRO

KA: SYS 004 A1.11 (3.0/3.0)

Lesson Plan Objective: none

Source: *Bank*

Level of knowledge: analysis

References:
1. OP-CN-PS-NV page 20-25
2. K/A EPE **009** EA2.02 (3.5/3.8)

i) Failure of NV5761 variable leg

1) Isolation of this variable leg downstream of the bellows would cause the control board VCT level indication to fail low and one of the OAC indications of VCP level would fail as is.

2) A leak in this variable leg downstream of the bellows would give erroneously lower than actual indication determined by the size of the leak, affecting the control board indication and one of the two VCT level indication on the OAC.

3) Discrepancy between this channel and NV5760 should cause the operator to check the trend of the two and then determine he has a failure on NV5761.

4) When the channel fails to less than 23%, a VCT low level alarm will occur, alerting the operator of a problem.

5) If the channel fails to less than 35%, auto makeup will start requiring the operator to take action to stop the auto makeup, and check the QAC for indication of level on channel 2.

j) Failure of NV5760 reference leg

1) A leak in this reference leg or a failure of the DIP instrument will cause the local indication and one of the two OAC indications of VCT level to indicate higher than actual level.

2) if level fails to greater than 83.5% (UNIT 1) or 78 % (UNIT 2), a VCT high level alarm will occur alerting the operator to a problem which the operator should be able to detect by looking at trends and his other channel.

3) If level fails to greater than 91.4% (UNIT 1) or 85.3% (UNIT 2), NV172A will fully divert to the RHT, requiring the operator to select VCT on the control switch. This failure also affects the auto swap to the FWST on bo-Lo VCT level. The operator would be required to manually swap.

k) Failure of NVLT5761 reference leg

1) A leak in this reference leg or a failure of the D/P instrument will cause the control board indication and one of the two OAC indications of VCT level to indicate higher than actual level.

2) If level fails to greater than 83.5% (UNIT 1) or 78% (UNIT 2), a VCT high level alarm will occur alerting the operator to a problem which the operator should be able to detect by looking at trends and his other channel.

3) If the above VCT level transmitter fails high or as is, VCT auto makeup will not occur causing VCT level to decrease over time.

(a) Operator monitoring of VCT level will notice no change in VCT level if failed as is, or wiil be alerted by the VCT Hi Lvl alarm if failed high.

(b) NVLT5760 indicates on the OAC, and will show actual VCT level in this situation.

(c) The operator will be required to perform manual makeup to insure VCT level is maintained.

(d) If NVLT5761 has failed high, the operator will have to select manual on the MAN/AUTO station for NV172A, and position the controller to 100% to direct all letdown flow to the VCT or select the VCT position on the control switch for NV172A.

l) A leak in the common reference tap will not affect indication unless the leak is big enough. If the common tap ruptures then all 4 VCT level indications will fail high momentarily, but then as the VCT depressurizes quickly, the level wilt return to indicating accurately.

1) PIP 0-M98-0747 pointed out that a leak dowstream of the common root valve could cause a deviation between indicated and actual level of significant amount that is well within the manufacturer's rated capacity of the hydrogen gas makeup valve to the VCT.

(a) This makes a single failure of the common reference tap capable of indicating level on all 4 channels higher than actual.

(b) Ne modifications to the CNS VCT level instrumentation were deemed necessary. (PIP C98-965)

m) VCT Outlet Temperature

1) Measures VCT discharge temperature.

2) Indication and high alarm on MCB.

n) VCT Pressure

1) Indicates VCT pressure.

2) Auto-closes WG3 in Waste Gas System on low pressure.

3) Indication and high-low alarms on MCB.

19. VCT Gas Space Control

a) H_2 blanket

1) 15 to 50 psig H_2 overpressure on VCT - as pressure in the VCT increases more hydrogen is put into solution. Pressure changes occur due to Bevel changes as well as hydrogen control valve adjustments. Operation with VCT pressure greater than normal (35 psig) for extended periods will cause hydrogen concentration in the NCS to increase to greater than Tech Spec allowable values.

2) Two functions (OBJ. #14)

(a) Maintains H_2 in Rx coolant 25-50 cc/kg H_2.

(b) Sufficient back press for seal return flow.

3) NV224 H_2 supply valve

(a) Self regulating, normally open.

(b) Maintains 15 to 50 psig over pressure in VCT

b) VCT to Waste Gas Purge

1) Purges H_2 and fission gases to waste gas system.

2) Limits radioactive gas leakage to buildings from leakage of Rx coolant.

3) WG3- Auto closes on low VCT pressure.

c) Degassing

1) NV466 - VCT Vent to Waste Gas Header

(a) Controlled from MCB.

(b) Used when degassing the VCT.

2) NV467 - VCT Vent to WG System

(a) Self regulating valve.

(b) Used during degassing to maintain 15 psig in the VCT

d) N_2 Purge

1) Used to purge gases (H2 and fission gases) prior to opening reactor coolant system.

2) NV226 - N_2 Supply to VCT

(a) Self regulating normally closed.

(b) Used during purging operation of VCT to purge gases (H_2 and fission gases) prior to opening reactor coolant system.

20. Potential gas sources into the Charging pump suction (OBJ. #30)

   a) Nitrogen supply 1NV226

      1) Not normally used. Chemistry will align when needed during a shutdown.

   b) Hydrogen supply NV224

      1) Aligned to supply hydrogen to the VCT during normal operation. Set to maintain 30 psig in the VCT.

      2) Isolated when entering mode 5 during a shutdown, and then realigned when mode 4 **is** entered during startup.

   c) Nitrogen from WG (WG163)

      1) Supplies nitrogen to the VCT during shutdown when Mode 3 is entered from B Shutdown Decay Tank. Set **to** maintain 20 psig.

      2) isolated during a startup when Mode 4 is entered. Isolated by three valves in series.

   d) Gas desorption

      1) As water flows from the VCT to the charging pumps' suction some of the gas in solution is stripped out and accumulates in the high points ***of*** the suction header.

         (a) This header is vented monthly per Tech Spec surveillance 3.5.2.3, which requires venting of ECCS pump casings and discharge lines. CNS has also inciuded venting the suction header as well resulting in small quantities of gas being removed from the suction header, but preventing a large amount from accumulating over time and eventually causing trouble in the charging pumps.

         (b) Prior to implementing this venting requirement several NV pump damage incidents occurred at CNS. One occurred **7/88,** and resulted in NV Pump 2A impeller cracking from various causes including entrainment of hydrogen gas. Another occurred in **11/89** and also involved entrainment **of** hydrogen gas musing damage to NV Pump 1B rotor.

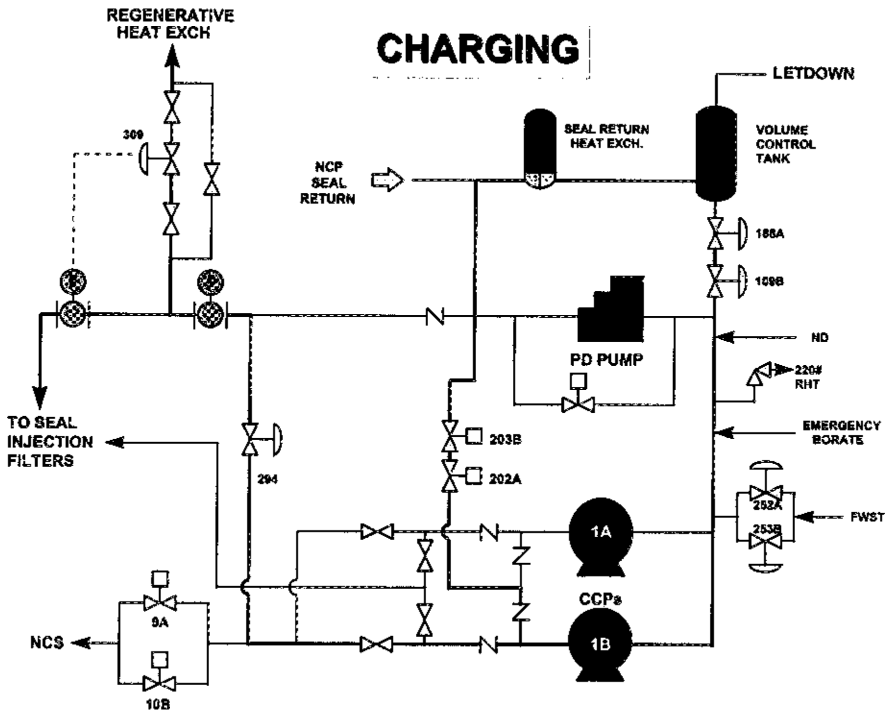
      2) The charging pumps miniflow line returns to the seal return line through two mini flow orifices which tend to strip some gases out **of** solution. These gases return with the rest **of** the flow into the auxiliary nozzle into the VCT putting the gas back into the VCT gas space.

e) Makeup system isolations

1) During a shutdown *to* account for NC system shrinkage, considerable makeup will be necessary. NV186A, makeup isolation to the VCT outlet will be opened to supply makeup, and must be reclosed when not in use.

2) If the normal letdown flowpath becomes unavailable and excess letdown is placed in service, the line coming into the top of the VCT will fill with gas and if the valves providing makeup are open or leaking, gas could flow from the VCT to the charging pump suction.

B. Charging (OBJ. #6)



1. NV188A, 189B - VCT Outlet Isolation

a) Operated from MCB.

b) AUTO-CLOSE (OBJ. #22 & 23)

1) Low-Low level in VCT *(212* and associated FWST suction valve is not 'Closed'; NV252A for NV188A and NV253B for NV189B).

2) S_S signal - associated FWST suction valve not 'Closed'.

3) Alarm on BDMS - associated FWST suction valve not 'Closed'.

c) AUTO-OPEN on ASP *to* local (Train related). (OBJ. #24)

2. NV252A, 253B - Supply from FWST
   a) Operated from MCB.
   b) AUTO-OPEN (OBJ. #22)
      1) Low-Low level in VCT (2/2).
      2) S_S signal.
      3) Alarm on BDMS.
3. Positive Displacement Pump (PDP) abandoned in place
4. Centrifugal Charging Pumps (2) (OBJ. #6)
   a) Provides normal means of charging.
   b) Suctions
      1) VCT
      2) **FWST**
      3) ND System during recirculation (Hot or Cold) Phase of an accident.
   c) Backup cooling water supply from the YD system for 1A and 2A NV pumps.
   d) Discharge
      1) Miniflow recirc valves NV203 and 202
         (a) Open to protect CCP's during low Chg flow conditions.
         (b) 60 gpm/pump
         (c) Closed by operator when NC pressure less than 1500 following a LQCA and NV SI flow is indicated.
         (d) Auto OPEN on ASPs to local. (OBJ. #24)
      2) NV 294 flow control valve
         (a) Manual or auto control
            (1) Auto controlled by PZR level error and feedback from total charging flow.
            (2) Manual control by operator.

Bank Question: 834 ***Answer: B***

1 Pt(s) Unit 1 was operating at 100% when a design basis LOCA occurred. Radiation monitoring teams at the site boundary report that projected Iodine 131 dose is 25 rem.

Which one of the following statements correctly describes the cause of this problem on the **VE** filter trains?

A. The HEPA fdters are saturated

B. The charcoal filters are saturated

C. The prefilter/demisters are saturated

D. The VE filter unit preheaters are energized

Distracter Analysis:

A. **Incorrect:** HEPA filters do not remove radioactive Iodine
Plausible: HEPA filter remove small particulates
B. **Correct:**
C. **Incorrect:** Prefilter/demister do not remove Iodine.
Plausible: If the candidate does not know the prefilter function.
D. **Incorrect:** Heaters are supposed to be energized.
Plausible: If the candidate does not know the heater function.

Level: RO&SRO

K A *SYS* 027K5.01 (3.1/3.4)

Lessen Plan Objective: CNT-VE SEQ 2/3

Source: **Bank**

Level of knowledge: memory

References:
1. OP-CN-CNT-VE pages ***5-6***

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Describe the purpose *of* the VE system	X	X	X	X	
2	Describe why it is necessary to maintain a vacuum in the annulus following a LQCA	X	X	X	X	X
3	Explain how the release **of** fission products from containment is limited	X	X	X	X	X
4	Describe how fires can start in the VE carbon filter	X	X	X	X	X
5	Describe how a fire in the carbon filter **is** extinguished	X	X	X	X	X
6	Given appropriate plant conditions, apply **Limits** and Precautions associated with related station procedures	X	X	X	X	
7	Describe the Standby alignment for VE per OP/1/A/6450/002			X	X	
8	Describe the conditions necessary ***to*** auto start the VE fans	X	X	X	X	X
9	Describe how the VE System operates to maintain a vacuum in the annulus	X	X	X	X	X
10	Explain how **to** secure VE following an auto start per OP/1/A/6450/002			X	X	X
11	Describe how lo manually **start** and stop the VE Bans per OP/1/A/6450/002	X	X	X	X	X
12	Explain the Annulus Ventilation Operability Test PT/1/A/4450/003A			X	X	
13	Discuss the relationship between VE and VY systems			X	X	X
14	Given a set **of** specific plant conditions and access to reference materials, determine the actions necessary to comply with Tech Specs/SLCs			X	X	X
15	Trace the VE stem flow path given a dra ving of t e VE	X	X			

TIME: 1.0 Hour

1 INTRODUCTION

1.1 Overview

A. This lesson will describe the operation of the Annulus Ventilation System (VE) including a description of each major component.

1.2 Format

A. The system will be discussed in the following order:

1. Objectives
2. Basic Description and Operation
3. Tech Specs
4. Summary

1.3 Student Learning Objectives

A. Cover Objectives

2. PRESENTATION

2.1 Purpose (Obj. #1)

A. Produce and maintain a negative pressure in the annulus during LOCA conditions.

B. Reduce the concentration of radioactivity in the air within and discharged from the annulus through recirculation and filtration of annulus air.

C. Provide long term fission product removal within the annulus through filtration.

2.2 Basic Description

A. The VE System consists of two redundant trains per Unit, each train having:

4. Full capacity fan

2. Filter Train.

3. Dampers and associated duct work

4. Controls

B. The VE System will produce a 1.5" water vacuum in the annulus within 60 seconds following an S_S signal. Maintaining a negative pressure in the annulus allows leakage from the primary containment to enter the annulus for collection and filtration prior to release to the Unit Vent. This filtration reduces potential offsite and onsite dose. (Obj. #2)

C. The VE fans take suction high in the annulus, and the VE fans discharge low in the annulus. This provides for good mixing and filtration of the annulus air.

D. Fission product release is prevented by two methods: (Obj. #3)

1. Containment isolation valves Mock potential leak paths from containment
2. Limiting containment pressure and temperature following an accident to prevent exceeding design parameters of the containment structure.

2.3 Components

A. Fans (2 per Unit)

1. Auto started by the train related D/G sequencer following the S_s signal,
2. On/Off controls so fans can be operated manually from the control room for performance testing
3. Each fan is 100% capacity at approximately 9000 cfm
4. Powered from EMXI, EMXB

B. Filter train (2 per Unit)

1. Prefilter/Demister - Prefilter removes larger particles entrained in the air and the demister removes at least 99% of entrained moisture.
2. Heater
   a) Reduces relative humidity of air too less than or equal to 70%.
   b) Energized when the fan is started with proper differential pressure across the filter unit.
3. HEPA filter (2 per filter train)
   a) One before carbon filter - removes finer particles from the air
   b) One after carbon filter - used to remove carbon filter bed particles
4. Carbon filter
   a) Removes radioiodines from the annulus air
   b) Fire detection alarms indicate increasing temperatures in the carbon bed
   c) Fire Alarm Procedure (Obj. #5)
      1) Ensure that affected train is secured; place fan select switch in "OFF"
      2) Manually close the sprinkler drain valve
      3) Manually open the sprinkler deluge valve
   d) Fires can be started by (Obj. #4)
      1) Decay of fission products in the filter bed
      2) Heavy local deposition of radioiodines which generate decay heat.

C. Miniflow dampers D4 and D9 (1 per filter)

Bank Question: 843.1 ***Answer: A***

---

1 Pt(s) Unit 1 is operating at 75% power and Unit 2 is at 100% power. Given the following events and conditions:

- Switchyard breakers PCB 20 and 21 open.

Which one of the following statements correctly describes the effect on units 1 and 2?

A. Unit 1 will remain at 75% power and unit 2 will runback to approximately 56%.

B. Unit 1 will runback to approximately 3$% and unit 2 will remain at 100%.

C. Unit I will runback to approximately 56% and unit 2 will remain at 100%.

D. Both units 1 and 2 will runback to approximately *56%.*

Distracter Analysis:

A. Correct: Unit 2 is affected, unit 1 is not.
B. Incorrect: Unit 1 will not runback
Plausible: answer transposed – If candidate believes unit I affected and will runback for 3 minutes at 15%/minute.
C. Incorrect: Unit 1 will not runback
Plausible: previous correct answer on earlier test.
D. Incorrect: Unit 1 will not runback
Plausible: partially correct – if candidate believes both units affected.

Level: RO&SRO

K A SYS 062 A4.01 (3.3/3.1)

Lesson Plan Objective: EP Obj: 39

Source: Mod Catawba Audit Exam 2000

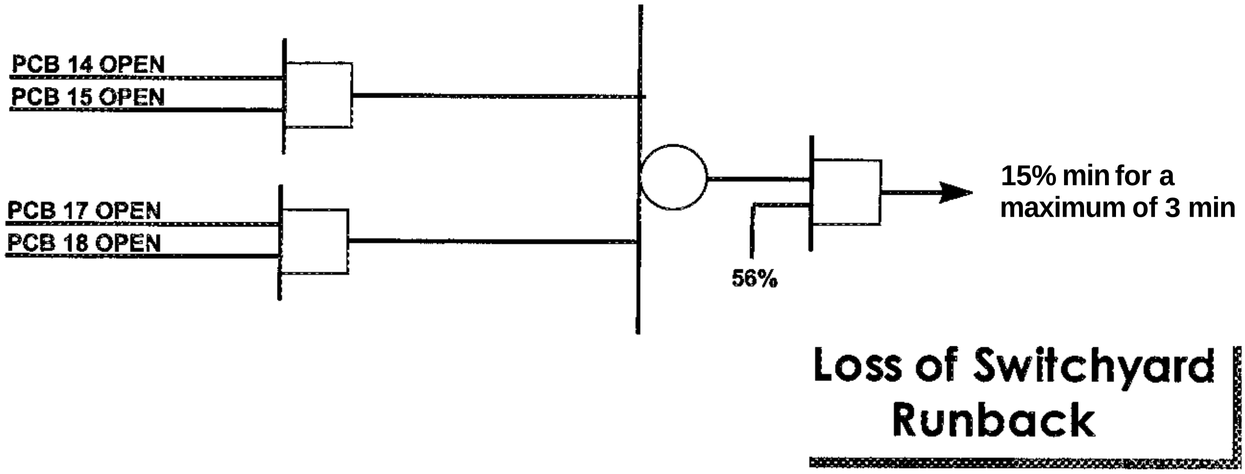
Level of knowledge: comprehension

References:
1. OP-CN-EP-EP pages 11 and 12

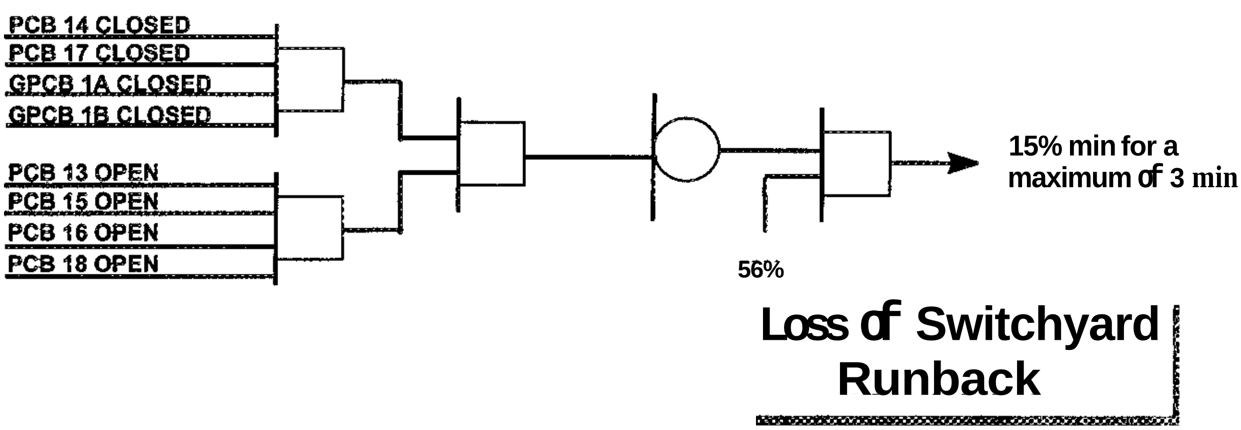
	Objective	ISS	NLO	LPRO	LPSO	PTRQ
37	Given a set of specific plant conditions and access to reference materials, determine the actions necessary to comply with Tech Specs/SLCs.			X	X	X
38	Describe the requirements for reporting relay or breaker operation to the dispatcher, and explain how to fill out and route a **CATAWBA NUC** SW STA EVENT LOG.				X	X
39	Describe the initiating signals fer a Main Turbine Runback associated with Main Power System.			X	X	X
40	State **from** memory the Immediate Actions of AP/1,2/5500/03 (Load Rejection)			X	X	X
41	State the system designator and nomenclature for major components	X				

TIME: **3.0** HOURS

b) until less than 56%



12. If PCB 14 (23) is closed and PCB 17 (20) is closed with their associated bay ties open PCB's 13 and 15 (22 and 24) and PCB's 16 and 18 (19 and 21) and unit at 100% power a Main Turbine Runback will be initiated. (OBJ. #40).
    a) 15% per minute for a max of 3 min.
    b) Unit 1 less than 56%
    e) Potential in this configuration to overload the remaining tie line to Allison Creek and Roddey.



B. Motor Operated Disconnects
1. A set of disconnects is located between the Main transformers and the switchyard to allow isolating the unit feeders.
2. These disconnects are motor operated and can be controlled from:
    a) Control Room
    b) Relay House
    c) Local

3. The MOD's are interlocked such that:
   a) An MOD will not operate if either of its associated PCB's are closed.
   b) Cannot close the MOD's if the busline ground disconnects are closed (and vice versa). There is a mechanical and electrical interlock to prevent this.

C. Ground Disconnects (OBJ. #%)

1. Each unit tie line is provided with a set of ground disconnects to ground the line when the unit is separated from the grid.
2. Interlocked with the MOD's so both can't be closed at the same time.
3. Refer to OP/0/A/6350/010 (Operation of Station Disconnects and Breakers) for operation guidance.

D. Main Transformers

1. Two 230KV/22KV stepup/stepdown transformers, each 50% capacity connect the onsite and offsite power systems.
2. The transformers are oil cooled
   a) Oil is pumped thru the transformer and then cooled by oil/air heat exchangers.
   b) Fans are provided for forced cooling.
   c) The pumps and fans power comes from 1(2)LXC, 1(2)LXD and are divided into banks.
   d) LXC (LXD) is the normal supply for one bank and emergency supply for another bank.
   e) Shifting main transformer auxiliaries (OP/1(2)/A/6350/005, Enclosures 4.21 and 4.22)
      1) Allows power to be supplied to all of the cooling groups on each main transformer from either LXC or LXD.
      2) If done in a timely manner (within 12 minutes), may prevent a turbine runback on a loss of one supply.

Bank Question: 857.2 ***Answer: C***

1 Pt(s) Unit 2 is operating at 100% power. Pressurizer level is on program, and normal charging is in service and letdown flow is through a 75 gpm orifice.

Given the following events and conditions:

- **2NV-3 14E** *(CHARGING LINE CONT OUTSIDE ZSOL)* **spuriously** closes due a relay failure
- Flashing in the letdown line reduces letdown flow to ***5*** gpm

Without operator action, approximately how long before a pressurizer level deviation alarm actuates?

Assume I35 gallons = I %pressurizer level

A. A low-level deviation alarm will occur in less than one hour.

B. A low-level deviation alarm will occur in greater than one hour.

C. A high-level deviation alarm will occur in less than one **hour.**

D. A high-level deviation alarm will Occur in greater than one hour.

Distracter Analysis:
Charging flow is reduced to the minimum value – goes to **32** gprn to the NCP seals. 12 gpm seal **flow** goes to the VCT.
PZR level **starts** on program **(55%)** and must change by **5%** to actuate **a** deviation alarm. **5% x 135** gallons is **665** gallons.
The reduction in charging flow into the NCS causes charging flow to reduce to minimum **(32** gpm) **as** the PZR fills up. NCP Seal flow continues (12 gpm). Letdown flow drops to **5** gpm because of high regen HX outlet temperature (flashing at the orifices). Net charging flow drops to 1-15 gpm **(32 – 12 - 5)**
665 gallons/15 gpm = **44.3** minutes.

A. **Incorrect:** level will increase not decrease
Plausible: If candidate miscalculates and believes level will decrease because NC is supplying sed injection.

B. **Incorrect:** level will increase not decrease
Plausible: If the candidate believes only the **5 gpm** letdown is causing level to decrease.

C. **Correct: Alarm** should occur in 44 – **45** minutes

D. **Incorrect:** Alarm should occur in 44 **– 45** minutes
Plausible: If the candidate miscalculates or does not know the deviation is **5%,** or neglects the 12 gpm **ioss** due to the seal leakoff.

Level: RO&SRO

KA: APE 022 **AA2.04** (2.9/3.8)

Lesson Plan Objective: NV Obj: 2,3,4

Source: Mod Ques_857.1 McGuire NRC 2002

Level of **knowledge: analysis**

References:
1. OP-CN-PS-NV **pages** 12
2. OP-CN-PS-ILE page 19

OBJECTIVES

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the Chemical and Volume Control (NV) system.	X	X	X	X	
2	State the purpose of the makeup portion of the Reactor Makeup (NB) system.	X	X	X	X	
3	Discuss the importance of maintaining a flow balance in the NV system and state nominal flow values.	X	X	X	X	X
4	Describe the operation and flowpath of NV normal letdown purification including functions of the different ion exchangers and filters.	X	X	X	X	
5	Describe the operation and flowpath of NV letdown from ND.	X	X	X	X	
6	Describe the operation and flowpath of normal charging.	X	X	X	X	
7	Describe the operation and flowpath of NV seal injection.	X	X	X	X	
8	Describe the operation and flowpath of NV excess letdown.	X	X	X	X	
9	Describe the operation and flowpath of NV auxiliary spray.			X	X	
10	Describe the ECCS alignment of the NV system.	X	X	X	X	X
11	List the source(s) of cooling water to components requiring cooling in NV.	X	X	X	X	
12	Discuss the basic operation of the NC system makeup portion of the NB system for boration, dilution and emergency boration.	X	X			
13	Given a copy of the system flow diagram or a one line symbolic diagram, label the major components and show the flow path through the major components.	X	X			
14	State the function of the cover gases used on the VCT including minimum pressure requirements and how pressure is maintained.			X	X	X
15	Discuss how fission gases are removed from the VCT.			X	X	X
16	List the control features of VCT level, including channel, setpoint and coincidence.			X	X	X

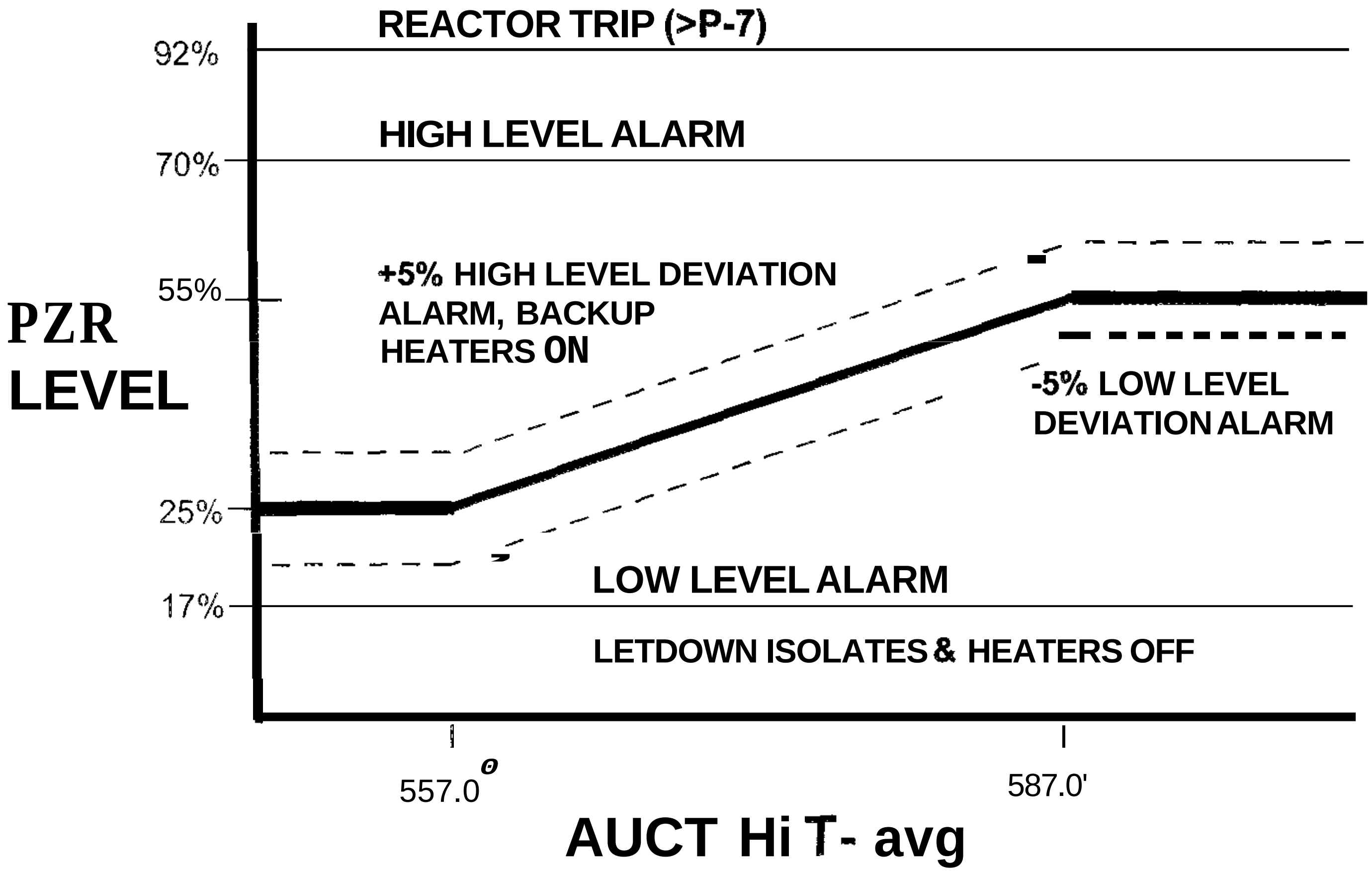
1) Low PZR level (17%).
2) Containment Isolation (S_T).
3) Closure of NVIA or NV2A (cannot open NV10A, 11A or 13A unless NVI and 2 are open).
4) Both centrifugal charging pumps tripped.

4. L/D Orifices (2) Isolation Valves NV-11 & 13
   a) Reduce coolant press - 1900 psig at design flow rate.
   b) One 75 gprn orifice. This is the normal flowpath for letdown OR Unit 2 (NV-13 Block Valve).
   c) One 45 gpm orifice (NV-11 Block Valve). Used to obtain greater L/D flow in conjunction with 75 gpm orifice or reduce letdown flow as required by procedures.
   d) **Max L/D flow** of 120 gpm at normal operating pressure.

5. L/D Manual Flow Control Valve (NV849) (NV10 Block Valve)
   a) Used to warm up downstream piping on Unit 2. On Unit 1 this is the normal letdown flowpath and is set at 75 gpm per the NV operating procedure.
   b) Flow rate of 5 to 110 gprn (when NCS pressure is less than or equal to 385 psig).
   c) Controlled from MCB via manual loader.
   d) The power source for the control circuit of this valve (NV 849) is now a non-safety related, non-interruptible power source (1KXPB). During a LOOP event, control of this valve is still available as long as the battery source for 1KXPB and VI are available.
   e) The response of NV-849 to the controller shows that the flow response is not linear throughout the scale and is as foliows:
      1) NV-849 does not respond until –35% demand on the controller.
      2) OAC indicates the valve is full closed at 26% demand.
      3) Demand is *off* scale high when flow is 110 gpm.
      4) NV-849 travel stops are set fer 110 gpm.
      5) NV-849 flow rate is very sensitive in the 95-110+ % demand range.
      6) NV-849 controls for a very steady flow rate once set.

6. If Letdown flow is to be increased to greater than normal flow (greater than 80 gpm) a new Dose Equivalent Iodine limit is instated per AP/18, High Activity in Reactor Coolant.

PZR LEVEL PROGRAM AND SETPOINTS (U2)



MODIFIED: McGuire NRC 2002

Bank Question: 857 **Answer: D**

1 Pt(s)

Unit I is operating at 65% power with pressurizer level on program, and normal charging and letdown flow through a 75 gpm orifice. Given the following events and conditions:

- 1NV-245B *(CHARGINGLINE CONT OUTSIDE ISOL)* spuriously closes
- Flashing in the letdown line reduces letdown flow to 5 gpm
- The operators take no actions

How long before the pressurizer high level alarm actuates?

REFERENCES PROVIDED: Unit 1 Databook Curve 7.38

A. Less than 2 hours

B. 2 to 2.5 hours

C. Greater than **2.5** hours to **3.5** hours

D. Greater than **3.5** hours

Distracter Analysis:
Charging flow is reduced to the minimum value – goes to 32 gpm to the NCP seals. 12 gpm seal flow goes to the VCT.
PZR level starts at **44.5%** (.65 * (55%-25%) +25% = ***44.5%).***
PZR level increases to the high level alarm at 70%.
The reduction in charging flow into the NCS causes charging flow to reduce to minimum (32 gpm) as the PZR fills up. NCP Seal flow continues (12 gpm). Letdown flow drops to **5** gpm because of high regen HX outlet temperature (flashing at the orifices). Net charging flow drops to +15 **gpm** **(32 – 12 - 59**
Per tank curve: 70%=9800 gal, 44.5%=6500 gal, 17%=2800 gal.
3300gal (9800-6500) / (15gpm) = 220 minutes = **3.67** hours

A. Incorrect: There are more than 3.5 hours.
Plausible: If candidate neglects to subtract seal flow and letdown flow 3300 gal / 32 gpm = 103 minutes = 1.7 hours – or misreads tank curves / miscalculates pressurizer level

B. Incorrect: There are more than 3.5 hours.
Plausible: If the candidate includes the loss of letdown but neglects seal return flow: 3300 gal/(32-5) gpm = 122 min = 2.03 hours. – or misreads tank curves / miscalculates pressurizer level

C. Incorrect: There are more than 3.5 hours.

Plausible: Assuming loss **of** letdown, if the candidate does **not** include seal return flow: 3300gal / (32 – 12) gpm = 165 min ≈ 2.75 hours – or misreads tank curves / miscalculates pressurizer ievel

D. **Correct answer:** 3.67 hours

Level: RO&SRO

KA: APE 022AA2.04(2.9/3.8)

Lesson Plan Objective: PS-NV SEQ *6*

Source: New

Level *of* knowledge: analysis

References:
1. OP-MC-PS-NV pages 17, 39
2. OP-MC-PS-ILE page 35
3. Unit I **Databook** Curve 7.38 - PROVIDED

Bank Question: 865.2 ***Answer: A***

1 Pt(s) Unit 2 is at full power when the following events occur:

- Reactor power is approximately 98%
- NCS T_{ave} is increasing
- Main turbine load is 1150 MWe
- Feedwater flow continues to operate as designed
- The RO is manually inserting rods

Which one of the following statements correctly describes the EOP basis in FR-S.1 ***(Response to Nuclear Power Generation / ATWS)*** for immediately tripping the turbine?

A. Prevent an uncontrolled cooldown and positive reactivity addition.

B. Maintain or extend steam generator inventory.

C. Prevent turbine overspeed when the main generator trips.

D. Minimize the peak pressure transient for the event.

Distracter Analysis:

A. **Correct:** The basis **in** the EOPs is to prevent an uncontrolled cooldown and causing a positive reactivity addition

B. **Incorrect:** if the main feedwater pumps continue to operate, the S/G inventory will not be a problem
Plausible: This is the EOP basis for an **ATWS** with a loss of feedwater

C. **Incorrect:** The basis in the EOPs is to prevent **an** uncontrolled cooldown and causing a positive reactivity addition
Plausible: concern €or the operation **of** the turbine

D. **Incorrect:** The basis in the EOPs is to prevent **an** uncontrolled cooldown and causing a positive reactivity addition. The peak pressure will actually be greater if the turbine is tripped early in the transient.
Plausible: minimizing the peak pressure is always a good thing for an accident.

Level: RO&SRO

KA: EPE 029 EK1.02 (2.6/2.8)

Lesson Plan Objective: FRS Obj: 5

Source: Mod McGuire NRC 2002

Level of **knowledge:** memory

References:
1. OP-CN-EP-FRS **pages 5-7**
2. FR-S.1 **page 2**
3. FR-S.1 Background Step **2 page** 2

OBJECTIVES

	Objective	ISS	NLO	LPRO	LPSO	STA	PTRQ
1	State the purpose of Function Restoration procedures: EP/1/A/5000/FR-S Series - Subcriticality			X	X	X	X
2	State the Immediate Actions of EP/1/A/5000/FR-S.1 (Response to Nuclear Power Generation/ATWS).			X	X	X	X
3	Explain the difference between an ATWS event and a failure of the Reactor Protection System to initiate a Reactor Trip			X	X	X	X
4	State the Bases for all NOTES and CAUTIONS in Function Restoration procedures EP/1/A/5000/FR-S Series - Subcriticality			X	X	X	X
5	Explain the Bases for the Major Actions of Function Restoration procedures EP/1/A/5000/FR-S Series - Subcriticality			X	X	X	X
6	Explain the Bases for all steps in Function Restoration procedures EP/1/A/5000/FR-S Series - Subcriticality			X	X	X	X
7	Given a set of specific plant conditions and required procedures, apply the rules of usage and outstanding PPRBs to identify the correct procedure flowpath and necessary actions			X	X	X	X

1. INTRODUCTION

1.1 Objectives

1.2 inputs to Subcriticality CSF tree

A. Source Range Startup Rate

B. Intermediate Range Startup Rate

C. Power Range Indication

D. Keactor Protection System (Reactor trip required)

E. Control Rod on bottom indication

F. Reactor trip breaker position

2. FR-S Series - **Subcriticality** CSF

2.1 Overview **of** plant conditions covered by FR-S series

A. ATWS - Anticipated Transients without Scram.

1. **ATWS** is any mechanical **or** electrical failure that keeps the control rods from dropping into the core during anticipated transients (Condition II events) which require a reactor trip.

   - **Loss** of Load/Turbine Trip
   - **Loss** of Normal Feedwater
   - Loss **of Offsite** Power
   - Uncontrolled Rod Withdrawal
   - Accidental NC Depressurization
   - Partial **Loss** of Forced NC Flow

2. The common characteristic of ATWS events is a power generation-power removal mismatch leading **to** temperature excursions of the NC system. The increased NC system temperatures could lead **to** a severe reduction in the Departure from Nucleate Boiling Ratio (DNBR) and lead to fuel damage.

3. The **loss** of load ATWS and loss **of** normal feedwater ATWS have the greatest potential for creating a NC system over pressure condition which could lead to a **loss** of NC system integrity. Fuel damage combined with a loss of NC integrity could lead to a radioactive release into containment and/or the environment.

4. instrumentation failures that generate a reactor trip signal and the reactor does not trip, and a plant transient is not initiated due to the failure, are not considered ATWS events.(OBJ.#3)

B. **boss** of Subcriticality

1. The normal expectation for core flux after a reactor trip is to promptly drop out of the power range and level off in the source range.

2. Core heat production after several minutes should be limited to that from radioactive decay of fission products, rather than from the fission process itself.

3. Several scenarios could occur that could lead to positive reactivity insertion and subsequent neutron flux increase:

   - Control rods drop but do not fully insert
   - Inadvertent dilution of the NC system
   - Excessive cooldown from secondary depressurization or excessive feedwater addition

2.2 Nuclear Power Generations/ATWS (EP/FR-S.1)

A. Cover the purpose of FR-S.1 as stated on the cover **of** the S.1 procedure. (OBJ.#1)

B. RED Path.

1. Rx Trip required and
2. PR >5%

C. ORANGE Path.

1. Rx trip required and
2. PR <5% and
3. I/R SUR >0

D. Immediate Actions (OBJ.#2)

E. Major action step summary (OBJ.#5)

1. Verifv Automatic Actions or Perform Manual Actions to Reduce Core Power: A Bul reactor trip is the preferred way to shut down the reactor. If automatic functions have still not been effective, any manual trips from the control room are to be actuated. If these are still not effective, the rods should be inserted using the Rod Control System.

2. Emerqencv Borate: Several methods of emergency borating are available in the control room. This action is taken prior to initiating more time-consuming local actions to trip the reactor and/or turbine.

3. Check for Possible Sources **of** Positive Reactivitv and Eliminate Them: Possible sources of positive reactivity are checked and eliminated at this time. Actions include isolation **of all** dilution paths and identification/isolation of faulted SG(s) causing an uncontrolled NC system cooldown. These actions address the return-to-power condition and will probably not be required for an ATWS.

4. Verifv Subcriticality: This final action checks on the effectiveness of previous steps in mitigating the transient prior to departing the guideline. Departure is not allowed until subcriticality is verified.

F. Use the "Enhanced Background Document", maintained by the Catawba Procedures Group, for a detailed discussion of the bases of steps, notes and cautions and immediate actions. (OBJ.#2, 4 and 6)

2.3 Response to Loss of Core Shutdown (EP/FR-S.2)

A. Cover the purpose of FR-S.2 as stated on the cover of the S.2 procedure (OBJ.#1)

B. Yellow Path

1. IR SUR less negative than -.2dpm or
2. SR SUR positive

C. Major action step summary (OBJ.#5)

1. Check if Loss of Core Shutdown is from Core Reactivity or Instrumentation Problems: A check is made of the behavior of the I/R flux traces and the source range channels startup rate. If the I/R flux is decreasing, source range detectors are energized either automatically or manually when the flux is less than the P-6 setpoint. If the intermediate range channels are undercompensated, source range detectors are manually energized. Undercompensation is recognized by a flux trace leveling off above the P-6 setpoint, and preventing automatic source range re-energination. Any reactivity problem is addressed by boration.

2. Borate NCS as Necessary: If the intermediate range flux is not decreasing and the intermediate range channels are not undercompensated, the NCS is borated until the flux is less than the P-6 setpoint. If the source range channels indicate a positive startup rate, then the NCS is borated until the source range startup rate is negative or zero.

3. Check for Subcriticality: This action checks for the desired indications of an adequately shutdown core, i.e., source range channels indicating zero or negative startup rate. If this is not the case, boration intended only to ensure subcriticality is performed. However, a CAUTION following this action informs the operator that boration should continue to obtain adequate shutdown margin.

D. Use the "Enhanced Background Document", maintained by the Catawba Procedures Group, for a detailed discussion of the bases of steps, notes, cautions and immediate actions. (OBJ.#2, 4 and 6)

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
C. Operator Actions	
1. Verify Reactor Trip: __ • All rod bottom lights - LIT __ • All reactor trip and bypass breakers - OPEN __ • I/R amps - DECREASING	**Perform** the **following:** __ a. Manually trip the reactor. __ b. **IF** reactor will not trip, **THEN** manually insert rods.
2. Verify Turbine Trip: __ • All turbine stop valves - CLOSED **OW** • Both of the following: __ • All MSIVs - CLOSED __ • All MSIV bypass valves - CLOSED.	**Perform the following:** __ a. Manually trip the turbine. b. **IF** turbine will not trip, **THEN**: __ 1) Depress the "MANUAL" pushbutton on the turbine control panel. __ 2) Rapidly unload turbine by simultaneously depressing the "CONTROL VALVE LOWER and "FAST RATE" pushbuttons 3) **IF** turbine will not runback, **THEN** **close:** __ • All MSIVs __ • All MSIV bypass valves.
3. Verify CA pumps are sunning as follows:	
__ a. Motor driven CA pumps - ON.	__ a. Manually start motor driven CA pump(s).
__ b. 3 S/G N/R levels - GREATER THAN 11%.	__ b. Ensure CA Pump #1 - RUNNING.
4. Initiate emergency boration of NC System as follows:	
__ a. Ensure at least one NV pump - **ON**	

STEP 2: Verify Turbine Trip:

PURPOSE:

To ensure that the turbine is tripped

APPLICABLE ERG BASIS:

The turbine is tripped to prevent an uncontrolled cooldown of the NC System due to steam flow that the turbine would require. For an ATWS event where a loss of normal feedwater has occurred, analyses have shown that a turbine trip is necessary (within 30 seconds) to maintain S/G inventory.

If the turbine will not trip, a turbine runback (manual decrease in load: at maximum rate will also reduce steam flow in a delayed manner. If the turbine stop valves cannot be closed by either trip or runback, the MSIVs should be closed.

A turbine trip is required for an ATWS event where a loss of main feedwater has occurred. For other ATWS events, with the exception of when a turbine trip is the initiating event, manual tripping of the turbine may yield a somewhat higher system pressure, depending on the initiating event and time in core life, than what would otherwise be expected. However, this action has been determined to be necessary due to the analytical results obtained. Since these are many initiating ATWS events and some that require immediate mitigating actions, diagnosis of the initiating event would not be feasible and separate guidance for different ATWS events would complicate training and could delay timely performance of necessary operator actions.

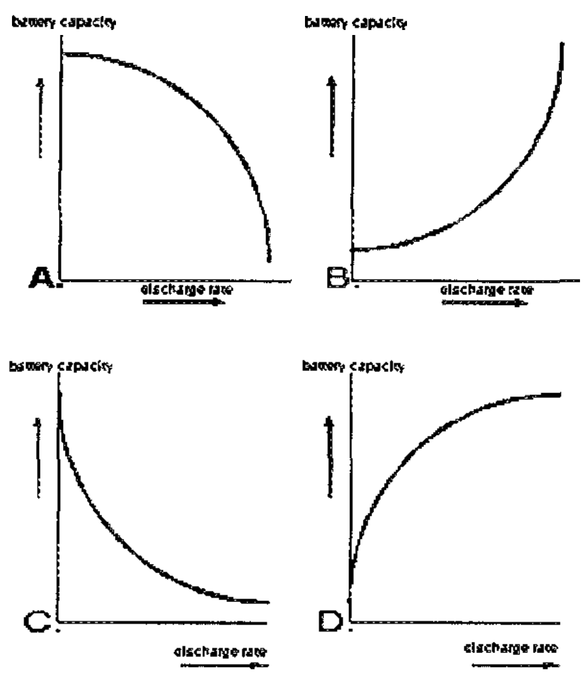
PLANT SPECIFIC INFORMATION:

KNOWLEDGE/ABILITY:

Bank Question: 906.1 Answer: A

1 Pt(s) **A** station emergency battery is supplying DC bus loads without **a** battery charger on line.

If the equipment load on the DC bus does **not** change, whish one of the following battery discharge curves describes the battery capacity **as** a function **of** the battery discharge rate?



Distracter Analysis:

A. **Correct: As** battery voltage drops, discharge current will increase to maintain power to the same load

B. **Incorrect:** Battery capacity decreases **as** discharge rate increases
Plausible: If the candidate does not apply E=IR and P=IE correctly

C. **Incorrect:** Battery voltage decreases slowly initiatally
Plausible: If the candidate does not apply E=IR and P=IE correctly

D. **Incorrect:** Battery capacity decreases **as** discharge rate increases
Plausible: If the candidate does not apply E=IR and P=IE correctly

Level: RO&SRO

KA:SYS *063* **A1.O1** (2.5/3.3)

Lesson Plan Objective: EPL Obj: 4, 21

Source: Mod Ques_906 McGuire NRC 2002

Level of **knowledge:** comprehension

References:
1. OP-CN-EP-EPL page 7,8

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the Vital Instrumentation and Control System	X	X	X	X	
2	Describe the operation of Kirk-Key Interlocks	X	X	X	X	
3	Describe the operation of Battery Chargers	X	X	X	X	
4	Describe the operation of Batteries	X	X	X	X	
5	Describe the operation of Static Inverters	X	X	X	X	
6	Describe the operation of Manual Bypass Switches	X	X	X	X	
7	Describe the operation of Auctioneering Diode Assemblies	X	X	X	X	
8	Describe the basic actions required of an NLO for a loss of Vital or Auxiliary Control Power per AP/1/A/5500/29 (Loss of Vital or Auxiliary Control Power)	X	X			
9	Describe operation of the Vital I & C system when configured for normal alignment	X	X	X	X	X
10	Describe operation of the Vital I & C system when configured for a battery charger being removed from service	X	X	X	X	X
11	Describe operation of the Vital I & C system when configured for a battery being removed from service	X	X	X	X	X
12	Describe operation of the Vital I & C system when configured for an equalizing charge on a battery	X	X	X	X	X
13	Describe operation of the Vital I & C system when configured for an Inverter being removed from service	X	X	X	X	X
14	Sketch channel A of the Vital I & C system per training drawing CN-SYS-EL-EPL-11	X	X	X	X	
15	Evaluate the impact a failure of any Vital I & C component will have on unit operation	X	X	X	X	X
16	Describe the Ground Detection controls and indications used at Catawba Nuclear Station	X	X	X	X	X
17	Describe how a ground is indicated on the ground detection devices used at Catawba Nuclear Station	X	X	X	X	X
18	Given appropriate plant conditions, apply the Limits and Precautions associated with OP/1/A/6350/008 (125 VDC/125 VAC Vital Instrument and Control Power System	X	X	X	X	X

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
19	Using the Annunciator Alarm Response Procedure for 1AD-11, correctly describe the annunciator alarms associated with the Vital I & C system			X	X	X
20	Given a set of specific plant conditions and access to reference material, determine the actions necessary to comply with Tech Specs/SLC's.			X	X	X
21	Summarize DC battery operation under loaded conditions • State where to obtain accurate indication of a battery's condition • State actions to be taken to minimize the drain on a battery • Describe the operational characteristics when subjected to heavy loads for long periods of time	X	X	X	X	X
22	State from memory all Technical Specification actions for the applicable systems, subsystems and components which require remedial action to be taken in less than 1 hour.			X	X	

3. Each battery is also capable of supplying the anticipated momentary loads during this two-hour period.

4. DC battery operation under loaded conditions (Obj. # 21) (SER 3-99, PIP c-00-1223)

   a) When batteries consisting of more than one cell are discharged for an extended period of time, the potential exists for individual ceils to drop below the voltage of the battery bank. Under loaded conditions the most accurate indication of a battery's condition (voltage) is taken at each individual cell and not at the distribution center or any meter which measures voltage across the entire bank of batteries.

   b) When a battery is under a heavily loaded condition for a long period of time a phenomena known *as* cell reversal may occur-. Cell reversal is a condition where an individual battery cell reverses polarity. The positive lead becomes the negative lead and the negative lead becomes the positive lead. When this happens, the cell becomes a load on the battery and causes the battery's voltage to decrease rapidly. This phenomena occurs at approximately 80-85% *of* normal battery voltage. Once a cell has undergone cell reversal, it cannot be recovered.

   c) bow battery voltage can cause damage to the remaining cells in a battery bank and damage the equipment being supplied from the battery.

   d) To prevent cell reversal and damage to equipment being supplied by a battery we have to minimize the drain on the battery. Actions taken to minimize the drain on a battery include removing non-vital loads from the DC bus, placing AC portions of these systems **on** alternate power sources, and consulting station management for recommended loads to remove from a DC bus.

   e) Anytime battery voltage drops below 105 VDC, the battery *is* removed from the **bus.**

5. Plant Response due to 125VDC Battery Failure (Obj. #15)

   a) During normal operation there should be no effect on the Plant since the Battery Charger will be supplying the 125VDC Distribution Center.

   b) Receive Annunciator 1(2) AD-1 1; H(1-4) 125 VDC ESS PWR Channel **(A-8)** trouble for the applicable Battery.

   c) If the Vital Battery is the only source of power then the channel will become completely de-energized which will be indicated by some of the following:

      1) Multiple Control Room Alarms/Annunciators

      2) One row of lights on the Status Indicator Panels will be lit.

3) All instruments which receive power will fail to the bottom of their indicated scale.

4) Loads affected:

(a) Channel B & Channel C will have little effect **on** plant operations since virtually no loads come off of these.

(b) ***See*** Section F2 for Loads affected by a Channel A Battery Failure.

(c) See Section F3 **for** Loads affected by a Channel D Battery Failure.

6. Kirk-Key Interlocks (Obj. #2)

1. inputs to A 6 Power Panel **EMS** are interlocked such that only one breaker can be closed at a time. This prevents tying two trains of Vital Power together thereby, preventing **a** single failure from rendering two or more channels of Vital Instrumentation and Control Power inoperable.

2. EDS output breakers are interlocked to prevent closing more than one breaker at a time.

3. Any combination of breaker alignment which results in one train supplying the other train through the standby charger results in a control room annunciator which serves to warn the operator of this condition.

4. The feeder breakers to AC Power Panel EMS on 1EMXA and 1EMXJ are interlocked such that only one breaker may be closed at a time.

D. 425 VDC Distribution Centers

1. Four per unit, designates as follows:

a) EDA - Channel A

b) EDB - Channel B

c) EDC - Channel C

d) EDD - Channel **D**

2. Each Distribution Center receives power from the associated channel battery charger (normal) or battery (emergency).

3. Each Distribution Center supplies the associated channel static inverter and one 125 VDC panel boards.

a) EDA supplies auctioneering diode assembly EADA, which feeds **125** VDC Panelboard EDE.

b) EDD supplies auctioneering diode assembly EADB, which feeds 125 VDC Panelboard EDF.

4. A 125VDC Distribution Center Failure will cause the Plant to respond like **a** Battery Failure when the Battery is the only source of power to the Distribution Center.

MODIFIED: McGUIRE NRC 2002

Bank Question: 906 ***Answer: C***

1 Pt(s) **A** station emergency battery **is** supplying DC bus loads without a battery charger online. **If** the load on the DC **bus** does not change, which one of the following statements correctly describes a vital battery's discharge rate (amps) as the battery is expended?

A. The discharge rate **will** be fairly constant **until** the design battery capacity (amp-hours) is exhausted and then **will** rapidly decrease.

B. The discharge rate **will** decrease steadily until the design battery capacity is exhausted.

C. The discharge rate will increase steadily until the design battery capacity is exhausted.

D. The discharge rate **will** initially decrease until approximately **50%** design capacity had been expended and then increase until the battery has been exhausted.

Distracter Analysis:

A. Incorrect: The discharge rate increases.
Plausible: **This is** a typical response for many design systems - **If** the candidate does not recall that V= IxR.

B. Incorrect The discharge rate increases.
Plausible: If the candidate reverses the effect of decreasing voltage on discharge rate.

C. Correct:

D. Incorrect: The discharge rate increases.
Plausible: If the candidate does not understand battery theory.

Level: RO&SRO

KA: EPE ***055*** EK1.01 (3.3/3.7)

Lesson Plan Objective: EL-EPL SEQ 12/20

Source: New

Level **of** knowledge: memory

References:
I. OP-MC-EP-EPL pages 65-67

Bank Question: 907.1 **Answer: D**

1Pt(s) Unit 1 is responding to a S/G tube rupture in E-3 ***(Steam Generator*** Tube ***Rupture).*** Given the following events and conditions:

- The target temperature has been determined.
- P-11 has been reached and the operators have blocked main steam isolation signal.
- Operators are preparing to open the steam dumps to cooldown to the target temperature.

What is the applicable limit for the operator opening the steam dumps?

A. The steam dumps should be opened to limit the main steam header depressurization rate to < 100 psig/sec.

B. Steam dumps should be opened to limit the cooldown rate to less than 100 degrees/hour to prevent exceeding Tech Spec limits.

C. Steam dumps should be opened to limit the cooldown rate to less than 25 degrees/hour to prevent pressurized thermal shock concerns.

D. All steam dumps should be fully opened to depressurize the S/Gs as quickly as possible.

Distracter Analysis:

A. Incorrect: E-3 requires depressurizing at the maximum rate while avoiding a main steam isolation signal at 100 psig/sec when above P-11.
Plausible: if the operator does not recognize that blocking P-11 prevents the main steam isolation signal actuation

B. Incorrect: E-3 requires depressurizing at the maximum rate while avoiding a main stem isolation signal at 100 psig/sec
Plausible: While TS limits apply, the dumps will be isolated long before that limit is approached. This is the TS cooldown limit.

C. Incorrect: E-3 requires depressurizing at the maximum rate while avoiding a main stem isolation signal at 100 psig/sec
Plausible: PTS and limiting cooldown are reasonable concerns for other events.

D. Correct: E-3 requires depressurizing at the maximum rate while avoiding a main steam isolation signal at 100 psig/sec – but P11 has been blocked so this is not a problem.

Level: RO&SRO

KA: EPE 038 A1.05 (4.1/4.3)

Lesson Plan Objective: **EP4** Obj: 19

Source: Mod McGuire NRC 2002

Level of knowledge: memory

References:
1. OP-CN-EP-EP4 page 8
2. E-3 page 20
3. E-3 Background Document step 19 pages 23-28

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
16	Explain Enclosure 1 (Foldout Page) actions of EP/1/A/5000/ES-3.3 (Post-SGTR Cooldown Using Steam Dump)			X	X	X
17	Explain Enclosure 1 (Foldout Page) actions of EP/1/A/5000/ECA-3.1 (SGTR With Loss of Reactor Coolant-Subcooled Recovery Desired)			X	X	X
18	Explain Enclosure 1 (Foldout Page) actions of EP/1/A/5000/ECA-3.2 (SGTR With Loss of Reactor Coolant-Saturated Recovery Desired)			X	X	X
19	Explain the Bases, including any identified knowledges/abilities, for all of the steps, notes, and cautions in EP/1/A/5000/E-3 (Steam Generator Tube Rupture)			X	X	X
20	Explain the Bases, including any identified knowledges/abilities, for all of the steps, notes, and cautions in EP/1/A/5000/ES-3.1 (Post-SGTR Cooldown Using Backfill)			X	X	X
21	Explain the Bases, including any identified knowledges/abilities, for all of the steps, notes, and cautions in EP/1/A/5000/ES-3.2 (Post-SGTR Cooldown Using Blowdown)			X	X	X
22	Explain the Bases, including any identified knowledges/abilities, for all of the steps, notes, and cautions in EP/1/A/5000/ES-3.3 (Post-SGTR Cooldown Using Steam Dump)			X	X	X
23	Explain the Bases, including any identified knowledges/abilities, for all of the steps, notes, and cautions in EP/1/A/5000/ECA-3.1 (SGTR With Loss of Reactor Coolant-Subcooled Recovery Desired)			X	X	X
24	Explain the Bases, including any identified knowledges/abilities, for all of the steps, notes, and cautions in EP/1/A/5000/ECA-3.2 (SGTR With Loss of Reactor Coolant-Saturated Recovery Desired)			X	X	X
25	Given a set of specific plant conditions and all required procedures, use the rules of usage and outstanding PPRBs to identify the correct procedure flowpath			X	X	X

1. INTRODUCTION

1.1 Objectives

3.1 is made if either condition is not satisfied. NC System depressurization to ruptured S/G pressure is accomplished using either PZR sprays or PZR PORVs. Depressurization will be terminated prior to stoppage of the P-S leak and recovery of PZR level, if PZR level indicates abnormally high (head void formation - loss of PZR press control) or loss of subcooling (steam formation in the active NC System region).

4. Terminate S/I to Stop Primary to Secondary Leakage with the successful stoppage of P-S leakage there is no need for S/I flow to maintain NC inventory. S/I pumps are stopped and normal inventory control is established. NC pressure and charging flow are controlled to prevent leakage through ruptured S/G tubes.

5. Prepare for Cooldown to Cold Shutdown. With all safety concerns addressed the operators will align the plant systems for a cooldown from near hot shutdown conditions to a cold shutdown condition. Transition will be made to a post-SGTR cooldown method procedure (ES-3.1, 3.2, 3.3). Subsequent cooldown will be accomplished by backfilling, S/G blowdown or steam dumps.

C. Use the "Enhanced Background Document" for Enclosure Explanation, basis for NOTES/CAUTIONS and All Steps.

2.2 EP/1(2)/A/5000/ES-3.1 (Post-SGTR Cooldown Using Backfill) (Obj. #1,2,3,4,5)

A. Overview

1. Purpose: To provide guidance for attaining cold shutdown conditions while controlling primary pressure at secondary press (no P-S leakage) end cooling the ruptured S/G by repeatedly transferring the heated secondary water through the rupture to the primary and refilling *the* S/G with feedwater.

2. ES-3.1 *is* entered from E-3 based on the availability of intact S/Gs for cooldown and other piant systems to support normal cooldown functions.

3. ES-3.1 is exited to E-3, if a rupture of another S/G occurs. Exit to ECA-3.1 is made, if NC subcooling is lost or steam release capability from all non-ruptured S/G(s) is lost. ES-3.1 is a terminal procedure that places the plant in a cold shutdown condition with further actions being determined by station management.

B. Major Action Summary

1. Prepare for cooldown to cold shutdown. Normal NC System inventory and pressure control is established or verified. CLAs are isolated to prevent injection that could re-establish P-S leakage and would delay NC depressurization. Shutdown margin is controlled to ensure adequacy during backfill operation that wiil dilute the NC System.

2. Cooldown and Depressurize NC System for RHR Operations.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

19. (Continued)

__ f. Bump steam to condenser from intact S/G(s) at maximum rate while attempting to avoid a Main Steam Isolation.

f. Perform the following:

__ 1) Dump steam from all intact S/G(s) with S/G PORV(s) at maximum rate while attempting to avoid a Main Steam Isolation.

__ 2) IF any intact S/G PORV cannot be opened from the control room, **THEN** dispatch operator(s) to dump steam at maximum rate from intact S/G(s) PORV. **REFER TO** Enclosure 3 (Local Operation of S/G PORVs).

3) **IF** operator(s) were dispatched to S/G PORV(s), **THEN**:

__ a) Obtain sound powered phone from storage box on rear wall of control room.

__ b) Connect sound powered phone to jack on 1MC-11.

__ c) Monitor sound powered phone for communication from the Doghouse(s).

4) **IF** no intact S/G is available for NC System cooldown, **THEN** contact station management to determine which of the following to perform:

__ • **Use** faulted S/G

OR

__ • ~~GO TO~~ EP/1/A/5000/ECA-3.1 (SGTR With Loss Of Reactor Coolant - Subcooled Recovery Desired).

__ 5) **GO TO** Step 19.g

STEP 19 NOTE 2 : After the loa steamline pressure main steam isolation signal is blocked Main Steam Isolation will occur if the high steam pressure rate setpoint is exceeded

PURPOSE:

Tc alert the operator to the potential for inadvertent steamline isolation during the subsequent steam generator depressurization.

APPLICABLE ERG BASIS:

An automatic protection feature is provided to close the main steamline isolation valves when the steam pressure rate signal is exceeded. In the following step. the operator is instructed to dump steam from the intact steam generators which may result in exceeding the rate setpoint. Therefore. this note is intended to alert the operator of this possibility.

The rapid cooldown should be continued using the atmospheric steam dumps if MSIV closure occurs.

PLANT SPECIFIC INFORMATION:

KNOWLEDGE/ABILITY:

STEP 19 Initiate NC System cooldown as follows,

PURPOSE:

To establish sufficient subcooling in the NC System so that. the primary system will remain subcooled after pressure is decreased to stop primary-to-secondary leakage.

- Discussion of Substep a.: ≥18
  - To identify a secondary side break in the ruptured steam generator and transfer the operator to the appropriate contingency procedure. ≥ ≥18
  - To minimize possible pressurized thermal shock of the reactor vessel due to rapid cooldown below 350°F in subsequent steps. ≥ ≥18

APPLICABLE ERG BASIS:

The principal goal of the E-3 procedure is to stop primary-to-secondary leakage and to establish and maintain sufficient indications of adequate coolant inventory. These indications include a pressurizer level indication to trend coolant inventory and HC System subcooling to ensure that the indicated pressurizer level is reliable. This step is designed to establish sufficient subcooling in the NC System so that the primary system will remain subcooled after NC System pressure is decreased in subsequent steps to stop primary-to-secondary leakage,

Since. in order to stop this leakage. the NC System pressure must be decreased to a value equal to the ruptured steam generator pressure. the temperature at which this cooldown is terminated is dependent upon the ruptured steam generator pressure. A table is provided for various ruptured steam generator pressures showing the fluid temperature corresponding to 20°F subcooling at each of these pressures, including allowances for subcooling uncertainties with normal or adverse containment conditions. The cooldown is based on the core exit T/Cs since these also provide the icput for S/I termination and reinitiation. The 20°F subcooling is provided as operating margin to accommodate fluctuations in NC System temperature. perturbations in ruptured steam generator pressure, interpolation between listed ruptured steam generator pressures, and overshoot during NC System depressurization.

As previously demonstrated. the pressure of the intact steam generators must be maintained less than the pressure of the ruptured steam generators in order to maintain NC System subcooling. Since flow from the ruptured steam generator should be isolated. this pressure differential is established by dumping steam only from the intact steam generators. Steam dump to the condenser is preferred to minimize radiological releases and conserve feedwater supply. However, the PORVs on the intact steam generators provide an alternative steam release path. If no intact steam generator is available. NC System temperature should be controlled by adjusting feed flow to a faulted steam generator or by releasing steam from a ruptured steam generator. This latter method will result in continued primary-to-secondary leakage and is best handled in ECA-3.1 (SGTR With Loss Of Reactor Coolant - Subcooled Recovery desired).

It is not intended for the operator to re-evaluate the required core exit temperature or precisely interpolate between values listed in the table.

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For small tube failures. Pzr pressure may reaain above the P-11 permissive. Although pressure will decrease as the NC System is cooled. it may still remain greater than the P-11 permissive. In that case the operator can reduce Dzr pressure using Pzr spray or a PORV. so that the S/I signal can be blocked.

When the required core exit temperature is reached. the intact steam generator pressure (or feed flow to a faulted steam generator) should be controlled to maintain that temperature.

Cooldown of the NC System should be completed before continuing in the procedure.

Natural circulation flow in the ruptured loops may stagnate during this cooldown. The hot leg temperature in that loop may remain significantly greater than the intact loops. In addition. safety injection flow into the cold leg may cause the cold leg fluid temperature to decrease rapidly in that same loop. Steps to depressurize the NC System and terminate S/I should be performed as quickly as possible after the cooldown has been completed to minimize possible pressurized-thermal shock of the reactor vessel.

NC System cooldown should proceed as quickly as possible and should not be limited by the 100°F/hr Technical Specification limit. Integrity limits should not be exceeded since the final temperature will remain above 350°F

Considerations when selecting a faulted or ruptured S/G for NC System cooldown:

- In the unlikely event that no intact steam generator is available. one must select either a faulted steam generator. i.e., one with a secondary side break. or a ruptured steam gererator for cooling the NC System to NO System operating conditions. This decision should be based upon consideration of the concerns created by each method and an evaluation of the parameters that effect them. A secondary side break leads to uncontrolled steaming of the affected steam generator and possible avercooling of the NC System. Continued feed flow to this steam generator will increase the amount of steam discharged and can increase the uncontrolled cooldown of the WC System. The potential consequences of continuing to feed a faulted steam generator depend on the size and location of the secondary side break. For breaks inside containment. feed flow to the affected stem generator will result in additional discharge to containment and potentially higher containment pressures and temperatures. This may adversely affect the reliability and accuracy of instrumentation inside containment. Therefore. if containment pressure is adverse, a faulted steam generator should not be used for NC System cooldown. Although containment conditions will not be affected if the break is located outside containment. the area surrounding the break will be uninhabitable until after steam flow subsides. Since continued feed flow will prevent access to this area. personnel requirements in the vicinity should be considered before feeding a faulted steam generator.

- As previously mentioced. a steam break may also result in an overcooling event. The cold leg temperature response depends on the size of the break and the inventory in the affected steam generator. For larger breaks. continued feed flow can reduce the cold leg temperature and may cause a challenge to reactor vessel integrity. Consequently. feed flow should not be initiated to a faulted steam generator if any cold leg temperature may violate the Integrity Status Tree ORANGE or RED path priority limits.

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- Thermal stresses on the steam generator tubes should also be considered before feeding a faulted steam generator. If the steam generator is dry, cold feed flow may stress the hot tubes causing tube failures. further discussion on feeding a hot, dry steam generator is provided in the background document for FR-H.5 (Response To Steam Generator Low Level).

- As an alternative cooldown method. one could steam a ruptured steam generator. In add'ition to increasing radiological releases. this will result in continued primary-to-secondary leakage. If the tube failure is large, the reactor coolant makeup supply could be depleted before RHR system cooling can be established. This may also result in a steam generator overfill condition. Hence. before steaming a ruptured steam generator. one must consider potential radiological consequences. including availability of the condenser, reactor coolant activity. and meteoroiogical conditions. and also the rate of accumulation of water in the ruptured steam generator and reactor coolant makeup supply.

If more than one steam generator is ruptured. the lowest ruptured S/G pressure should be used to determine the required core exit temperature. If cooldown to a target core exit temperature is already in progress when a subsequent. SGTR is diagnosed. the operator should stop the cooldown (as directed by enclosure 1) until the subsequent ruptured S/G is isolated since continuing the cooldown would lower the pressure in the newest ruptured S/G and would result in unnecessary releases prior to its isolation from the intact S/Gs. The target core exit temperature should be re-examined to determine if the temperature should be reduced based on the subsequent ruptured S/G pressure (DW-92-070).

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Discussion of Substep a. (320 PSIG): ≥18

- Subsequent steps direct the operator to dump steam from the intact steam generators to cool the NC System as rapidly as possible in crder to establish adequate subcooling margin. The temperature at which this cooldown is terminated depends on the pressure in the ruptured steam generators. If this pressure is less than the saturation presstire corresponding to 350°F plus 20°F and inaccuracies. this cooldown could result in an ORANGE prtority on the Integrity Status Tree. To avoid this condition the operator is transferred to ECA-3.1 (SGTR With Loss Of Reactor Coolant - Subcooled Recovery Desired). which limits the cooldown rate to less than 100°F/hr. 218

- A ruptured steam generator pressure less than the saturation pressure corresponding to 350°F plus 20°F and inaccuracies is also a possible indication of a steam break associated with the affected steam generator. For such an event. the ECA-3.1 procedure is more appropriate since primary-to-secondary leakage cannot be terminated until cold shutdown. 218

- A pressure based on 350°F was chosen to prevent unnecessary transitions from E-3 at higher pressures when it is still desirable to continue with E-3 and to minimize possible pressurized thermal shock of the reactor vessel. Since there is no check on the reactivity condition, there is no guarantee that return to criticality will not occur during NC System cooldown. ≥18

- Under the unlikely case that recriticality occurs. the NC System cooldown would result in a challenge to the Critical Safety Functions. i.e., a criticality condition on the Subcriticality Status Tree. The operator will be directed to the procedure FR-S.! (Response To Nuclear Power Generation/ATWS), or the procedure FR-S.2 (Response To Loss Of Core Shutdown). to initiate emergency boration of the NC System and obtain adequate shutdown margin. After the adequate shutdown margin is assured. the operator will be directed to go back to E-3 procedure to continue the recovery actions. 218

PLANT SPECIFIC INFORMTION:

Operating crews have asked if they could base their target temperature on the S/G PORV setpoint if pressure is befng maintained by the S/G PORV. The PPRB response states that in order to avoid adding complexity to this procedure. the crew should use the pressure that is observed at the time the step is read. Even though using the lower pressure and resulting lower target temperature results in a longer cooldown and subsequent higher ruptured S/G level, the Pzr PORVs can be used if S/G overfill becomes a concern. Also. using the lower target temperature results in a more conservative subcooling margin after depressurization (PPRB EP/1/A/5000/1E, 4/16/93).

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MODIFIED: McGUIRE NRC 2002

Bank Question: 907 ***Answer: D***

1 Pt(s) Unit 1 is implementing FR-C.1 ***(Response to Inadequate Core Cooling).*** Given the following events and conditions:

- P-11 has been blocked.
- Operators are preparing **to** open the steam dumps **to** depressurize intact steam generators to 110 psig.

What guidance should be given to the operator opening the *s t e m* dumps?

A. The steam dumps should be fully opened to depressurize the S/Gs as quickly **as** possible.

B. A cooldown rate of less than **100** degrees/hour should be established to prevent exceeding Tech Spec limits.

C. A cooldown rate of less than **25** degrees/hour should be established to prevent pressurized thermal shock concerns.

D. The steam dumps should be very slowly opened **(**$<$**2** psig / sec) **to** prevent MSIV closure.

Distracter Analysis:

A. Incorrect: The steam dumps should be opened slowly.
Plausible: If the candidate confuses the **FR-C** guidance with tube rupture guidance.

B. Incorrect: While TS limits apply, the dumps will be isolated long before that limit is approached.
Plausible: This is the TS cooldown limit.

C. Incorrect: PTS is not the immediate concern with CETs $>$1200 degrees.
Plausible: PTS and limiting cooldown are reasonable concerns for other events.

D. Correct: note in C.1 informs the operator that a depressurization rate of less than 2 psig/second will maintain the MSIVs open.

Level: RO&SRO

KA: EPE 074 EK2.06 (3.5/3.6)

Lesson Plan Objective: EP-FRC SEQ **4**

Source: New

Level of **knowledge:** memory

References:
1. OP-MC-EP-FRC page *37*
2. EP/1/A/5000/FR-C.1 **page** 9

K\A

Bank Question: 977.1 **Answer: B**

1 Pt(s) Unit 1 was operating at 100% power when a **loss** of offsite power caused a reactor trip. The crew has verified natural circulation in ES-0.1 ***(Reactor Trip Response)***. Ten minutes later, the operator notes that the themiocouple input to both plasma displays is malfunctioning.

Which one **of** the following correctly describes a valid indication that natural circulation is continuing?

A. **S/G saturation temperatures are decreasing and *REACTOR VESSEL UR LEVEL* indication is greater than 100 %.**

B. **S/G pressures are decreasing and T_{cold} is at S/G saturation temperature.**

C. **S/G pressures are decreasing and *REACTOR VESSEL D/P* indication is greater than 100%.**

D. **S/G pressure is at saturation pressure for T_{cold} and *REACTOR VESSEL D/P* indication is greater than 100 %.**

Distracter Analysis:

A. **Incorrect:** There ***is* no** indication of coupling between primary and secondary.
Plausible: These are important indications during natural circulation.

B. **Correct:**

C. **Incorrect:** RVLIS is unavailable during natural circulation.
Plausible: S/G pressure decreases during natural circulation and RVLIS **is** one of the other plasma display indications.

D. **Incorrect:** RVLIS **is** unavailable during natural circulation.
Plausible: S/G pressure will remain close to saturation for Tcold during natural circulation and RVLIS is one of the other plasma display indications.

Level: RO&SRO

KA: APE 056 AK1.04 (3.1*/3.2*)

Lesson Plan Objective: HT Obj: **15**

Source: Bank

Level of knowledge: memory

References:

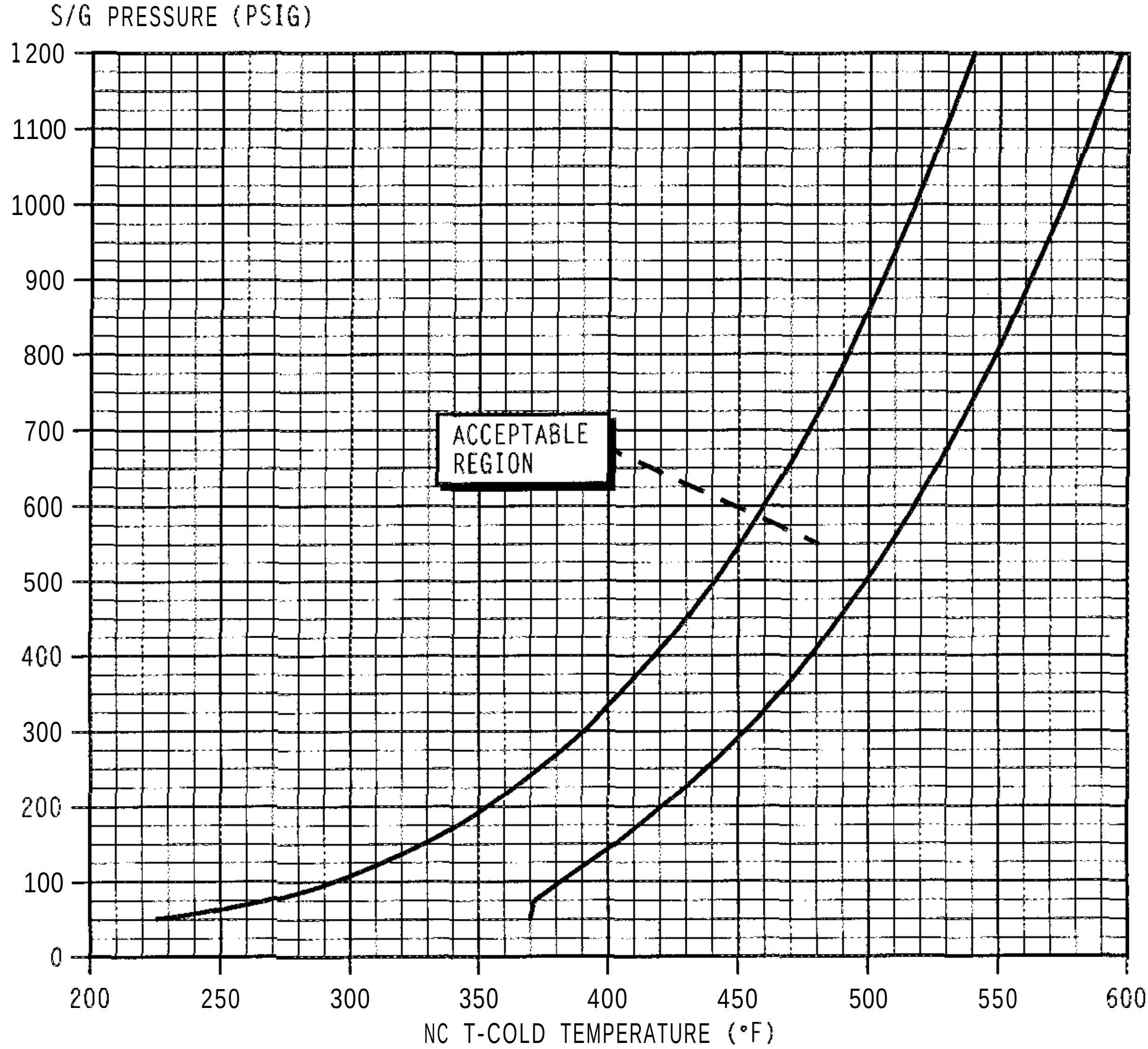
1. ES-0.1 page 12
2. ES-0.1 Enclosure 2 page 21

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Define 'Heat Transfer'			X	X	X
2	State the three ways heat is transferred in a nuclear power plant.			X	X	X
3	Define 'Conduction' heat transfer.			X	X	X
4	Explain the variables that effect the rate of conduction.			X	X	X
5	List the formulas used for conduction.			X	X	X
6	Give an example of where conduction heat transfer occurs in the power plant.			X	X	X
7	Given a set of parameters, be able to work conduction problems.			X	X	X
8	Define 'Convection' heat transfer.			X	X	X
9	Explain the variables that effect the rate of convection.			X	X	X
10	List the formulas used for convection.			X	X	X
11	Give an example of convection heat transfer in the power plant.			X	X	X
12	Given a set of parameters, be able to work convection problems.			X	X	X
13	Define 'Natural Circulation'.			X	X	X
14	List the characteristics of a power plant that are required for natural circulation.			X	X	X
15	Describe the parameters used to determine if natural circulation exists.			X	X	X
16	Explain what plant conditions the operator maintains to enhance natural circulation.			X	X	X
17	Describe what plant conditions can impede natural circulation.			X	X	X
18	Define 'Radiation' heat transfer.			X	X	X
19	Explain the variables that effect the rate of radiation heat transfer.			X	X	X
20	Give an example of radiation heat transfer in the power plant.			X	X	X
21	Define 'Departure From Nucleate Boiling'.			X	X	X
22	Explain how DNB occurs in a nuclear reactor.			X	X	X
23	Describe the undesirable effects of DNB.			X	X	X
24	List the parameters that effect DNB.			X	X	X

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
___ 13. Verify at least one **NC pump - ON.**	Perform the following: **NOTE** Preference should be given to running NC Pump 1B and then NC Pump 1A to provide Pzr spray capability. ___ a. Start one NC pump. **REFER TO** OP/1/A/6150/002A (Reactor Coolant Pump Operation). ___ b. Verify Natural Circulation until an NC pump can be started. **REFER TO** Enclosure 3 (Natural Circulation Monitoring Parameters).
14. Determine status of N/Is as follows:	
___ a. Verify I/R channels - LESS THAN 10^{-10} AMPS.	a. Perform the following: ___ 1) **WHEN** I/R channels are less than 10^{-10} Amps, **THEN** perform Steps 14.b and 14.c. ___ 2) **GO TO** Step 15.
___ b. Verify S/R channels - ENERGIZED.	___ b. Place S/R select switches in "RESET".
___ c. Transfer one channel of the "NIS RECORDER" to S/R instrumentation.	

1. The following conditions support or indicate natural circulation flow:

o NC subcooling - GREATER THAN 0°F
o S/G pressures - STABLE OR DECREASING
o NC T-Hots - STABLE OR DECREASING
o Core exit T/Cs - STABLE OR DECREASING
o NC T-Colds - A1 SATURATION TEMPERATURE FOR S/G FRESSURE (WITHIN THE LIMITS OF THE GRAPH BELOW).



2. IF Natural Circulation flow is not established. THEN increase dumping steam to establish Natural Circulation flow.

Bank Question: 957.I   Answer: D

1 Pt(s)

Unit 1 is operating at full power. Given the foliowing containment ventilation lineup:

- 3 Lower Containment Ventilation Units (LCVUs)
- **1** Pipe Tunnel Booster Fan (PTBF)
- **3** Control Rod Drive Mechanism (CRDM) Vent Fans
- 1 Incore Instrument Room Air Handling **Units** (IIRAHUs)
- 3 Upper Containment Ventilation Units (UCVUs)
- Both Containment Auxiliary Charcoal Filter Units (CACFUs) are shutdown

A loss of offsite power occurs on Unit 1. Both diesel generators **start** and energize ETA and ETB. Sequencing is complete. No operator action **has** been taken regarding the electric plant.

What is the expected Containment Ventilation lineup?

A. None of the previously running equipment will he running,.

B. All equipment running prior to the loss of offsite power will be running.

C. All equipment running prior to the loss of offsite power running, except the CACFUs, which remain shutdown.

D. All the LCVU, PTBF, CRDM vent, UCVU fans, and both IIRAHUs, will be running. The CACFUs will remain shutdown.

Distracter Analysis:

A. **Incorrect:** Each train starts their respective fans, even those not running previously, except for **the** CACFUs.
Plausible: may believe no equipment **starts** until the sequencers are reset.

B. **Incorrect:** Each train starts their respective fans, even those not running previously, except for the CACFUs.
Plausible: partially correct - true except for the CACFUs

C. **Incorrect:** Each train starts their respective fans, even those not running previously, except for the CACFUs.
Plausible: partially correct - neglects the start of the other equipment.

D. **Correct:** Each train starts their respective fans, even those not running previously, except for the CACFUs.

Level: RO&SRO

KA: ***SYS*** 022 A3.01 (4.1/4.3)

Lesson Plan Objective: **W** Obj: 12

Source: **Bank**

Level of knowledge: comprehension

References:

1. OP-CN-W pages 12 **and** 13

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
11	Describe the Containment Ventilation (VV) System configuration for the following operating modes: • Normal Cooling • Lower Containment Additional Cooling • Upper Containment Additional Cooling	X	X	X	X	X
12	Describe the automatic actions that occur in the VV System on a Blackout Load Sequencer actuation.			X	X	X
13	Describe the effects on the Containment Chilled Water (VV)system and associated piping when the Containment Ventilation (VV) System is not configured properly during periods of low containment heat load.			X	X	X
14	Given appropriate plant conditions, apply Limits and Precautions associated with related station procedures.			X	X	X
15	Given a copy of Tech Specs, associated Bases, and a set of plant conditions, determine compliance with the LCO and apply any Required Actions or Surveillance Requirements.			X	X	X

4. The CACFUs contain paper HEPA filters and prefilters. These are installed upon unit entry into Mode 5 and removed prior to entry into Mode 4. This eliminates the possibility of filter material coming loose in lower containment during an accident and clogging the ND pump suction screens.
5. CACFUs are controlled by individual ON/OFF E30 pushbuttons on the Main Control Board.

2.7 System Alignments (Modes 1 - 4) (Obj #11)

A. Normal Cooling Alignment

1. 3 LCVUs in LOW speed and NORM.
2. 1 PTBF in LOW speed.
3. 3 CRDM vent fans ON.
4. 1 IIRAHU in NORM.
5. 1 or 2 UCVUs in NORM and associated RAFs in AUTO.

B. If Lower Containment additional cooling is required:

1. First, start the fourth LCVU in LOW speed and NORM
2. If additional cooling is required, place two LCVUs in HIGH speed and place the PTBF in HIGH speed.
3. A third LCVU can be placed in HIGH speed if necessary.

C. If Upper Containment additional cooling is required, start additional UCVUs in NORM.

2.8 System Response to a Blackout Load Sequencer actuation (Obj #12)

A. A blackout, as far as containment ventilation is concerned, can be defined as a loss of normal power to either 4160v Essential Bus ETA or ETB with subsequent Blackout Load Sequencer actuation. Containment ventilation system components are designed to respond to a "train related blackout" (e.g. A and C LCVUs will respond only to a blackout on ETA).

5. All VV System components except the CACFUs are powered from Blackout MCCs.

C. VV System Component Response

1. LCVUs start in LOW speed. If LCVUs were in HIGH speed they will start in LOW speed to protect the Diesel Generator.
2. PTBFs start in LOW speed.
3. CRDM vent fans start.
4. IIRAHUs start
5. UCVUs start

D. All VV units operate as indicated regardless of switch position.

E. All VV units will return to their pre-blackout status when the load sequencer is reset.

F. If the loss of power to ETA and/or ETB was caused by a loss of offsite or unit power, The YV system may automatically align RN to the VV cooling coils. VV will automatically swap to RN on a loss of power to 600v Unit Motor Control Centers MXE or MXI

2.9 Limits and Precautions (Obj #14) - Provide students with Limits and Precautions from OP/1/A/6450/001 (Containment Ventilation (VV) Systems).

2.10 Technical Specifications (Obj #14)

A. Provide the students with copies of latest revisions of the LCO and Bases far T.S. 3.6.5 (Air Temperature).

B. Note that Containment Air Temperature is determined by calculating the average of the temperature indications at the inlet of the operating ventilation units (separately for lower and upper compartments)

3. SUMMARY

3.1 System Operation Alignment

A. Normal

1. 3 CRDM Fans
2. 1 Incore Instrument Room Cooling Unit
3. 3 bower Containment Cooling Units/Fans
4. 1 Pipe Tunnel Booster Fan
5. l or 2 Upper Containment Cooling Units and Return Air Fans

B. Blackout (Train related).

1. Lower Containment Fans start in LOW speed.
2. Pipe Tunnel Booster Fans Start in LOW speed
3. CRDM Fans Start
4. Incore Instrument Fans Start
5. Upper Containment Fans Start
6. Cooling water Auto Swaps from YV to RN unless VV is in local then a manual swap to RN is required.

3.2 Review Objectives

Bank Question: 963 **Answer: C**

1 Pt(s) Which one of the following statements correctly describes how a severe axial flux imbalance that is outside of the normal limits (as defined in the ROD **Book** section **3.9** (*OAC Manual Input* ***Data)***) could affect automatic and manual rod withdrawal at 100% power?

A. **AFD** inputs to OTDT cause the QTDT setpoint to increase, which could actuate a C3 rod stop to prevent automatic rod withdrawal. Operator would manually insert rods to restore AFD within the target band and clear the rod stop.

B. AFD inputs to OPDT cause the OPDT setpoint to decrease, which could actuate a C3 rod stop to prevent automatic or manual rod withdrawal. Operator would manually insert rods to restore AFD within the target band and clear the rod stop.

C. AFD inputs to OPDT and QTDT cause both setpoints to decrease, which could actuate a C3 or C4 rod stop to prevent automatic or manual rod withdrawal. A turbine runback would automatically reduce NC temperature below the QPDT or OTDT setpoints to clear the rod stop.

D. AFD inputs to OPDT and OTDT cause both setpoints to increase, which would actuate a C3 or **C4** rod stop to prevent automatic rod withdrawal. Manual rod withdrawal would still operate and a turbine runback would not occur. Operators would manually insert or withdraw rods to restore AFD within the target band and clear the rod stop.

Distracter Analysis: **AFD** being outside the penalty box causes OTDT and OPDT setpoints to decrease which will cause the C3 and **C4** rod stops to actuate at 100% power

A. Incorrect: ***An*** automatic turbine runback will reduce delta-t below 63 setpoint.
Plausible: answer is partially correct – auto rod withdrawal will be inhibited

B. Incorrect: OPDT causes a **C4** rod stop – not C3. An automatic turbine runback will reduce delta-t below C4 setpoint.
Plausible: confuses with OTDT – answer is partially correct

C. Correct:

D. Incorrect: Manual rod withdrawal is inhibited and an automatic turbine runback will reduce delta-t below C3 or C4 setpoint.
Plausible: answer is partially correct – moving rods to restore AFD directly counters the **AFD** problem.

Level: RO&SRO

KA: ***SYS*** **001 A3.03** (3.6/3.8)

Lesson Plan **Objective: IPX SEQ 9**

Source: New

Level of **knowledge: comprehension**

References:
I. OP-CN-IC-IPX **page 14, 15**
2. Tech Spec 3.3.1 gages 18-20

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the Reactor Protection System (IPX) System.	X	X	X	X	
2	List the reactor trips.	X	X	X	X	X
3	List the setpoint for each reactor trip.		X	X	X	X
4	List the logic and interlocks associated with each reactor trip.			X	X	X
5	[illegible] function of the Solid State Protection System (SSPS).	X	X			
6	Describe the operation of the following breakers and associated interlocks: • Reactor trip breakers • Reactor trip bypass breakers	X	X	X	X	X
7	Explain the derivation of the reactor trip setpoints.			X	X	
8	Define the following: • Safety Limit • Limiting Safety System Setting • Nominal Setpoint			X	X	
9	List all permissive and control "P" and "C" interlocks and their function, setpoint and logic.			X	X	X
10	Describe the function of the "First Out" annunciator panel.			X	X	X
11	Describe the function of all instrumentation and controls associated with the Reactor Protection System (IPX).			X	X	X
12	Given a set of specific plant conditions and access to reference materials, determine the actions necessary to comply with Tech Specs.			X	X	X
13	State from memory all Tech Spec actions for the system, subsystem or components which require remedial action to be taken in less than one hour.			X	X	

TIME: 2.0 HOURS

6) OT Delta T Rod Stop **(C-3)**
   (a) Delta T = Delta T setpoint -3%
   (b) Blocks automatic and manual rod withdrawal
   (e) QT Delta T Turbine Runback **(C-3) .**Turbine runback @ 10% pes minute until Delta T is below the setpoint.

b) Over power Delta T (OP Delta T)
   1) Protects against excessive fuel centerline temperature, (KW/ft)
   2) Provides a backup to the Power Range High Flux- High Setpoint Trip.
   3) Delta T setpoint varies as a function of T_{ave}, the Rate of Change of Tave and AFD.
      (a) T_{ave} decreases setpoint as Tave rises above full load T_{ave} to correct for changes in coolant density and specific heat capacity with changes in coolant temperature,
      (b) The rate of change of Tave decreases the setpoint if Tave is increasing.
      (c) AFD decreases setpoint if AFD is outside the range given *in* ROD Book Section 3.9.
      (d) OP Delta T *is* calculated for each loop.
      (e) At full power steady state conditions, OPAT setpoint should be the value of K4 in the COLR times 100%.
   4) If the Delta T in 2/4 loops is greater than the OP Delta T setpoint, the reactor will trip.
   5) Turbine Runback & Rod Stop (C-4)
      (a) Delta T = Delta T sp -1%
      (b) Blocks automatic and manual rod withdrawal.
      (c) Turbine Runback @ 10% per minute until Delta T is below the setpoint.

4. Pressurizer Trips

a) Low Pressurizer Pressure Rx Trip
   1) Protects NC System against Departure from Nucleate Boiling (DNB).
   2) 214 Pressurizer pressure channels less than or equal to 1945 psig.
   3) Trip Signal auto unblocked greater than P-7, and automatically blocked less than P-7.

b) Hi Pressurizer Water Level Rx Trip

1) Prevents release of water through the reliefs and collapsing of the Pzr steam bubble.

2) 2/3 level indication greater than or equal to 92% level.

3) Trip signal auto unblocked greater than P -7 and automatically blocked less than P-7.

c) Hi Pressurizer Pressure

1) Prevents overstressing pressure vessel and piping. (NCS integrity)

2) 2/4 pressure sensors greeter than or equal to 2385 **psig.**

5. Reactor Coolant Flow Trips

a) Lo NC flow trip

1) Protects against DNB

2) 2/3 channel less than or equal to **91%** full flow in **1/4** loops when greater than P-8.

3) 2/3 channel less than or equal to **91% of** full flow in 2/4 loops when greater than P-7.

b) Undervoltage NC Pump Busses

1) **2/4** NCP busses less than or equal to **5082** volts.

2) Trip signal auto unblocked greater than P-7 and automatically blocked less than P-7.

c) Under frequency on NC Pump Busses

1) **2/4** NCP busses less than or equal to 56.4 **Hz.**

2) Trip signal auto unblocked greater than P-7 and automatically blocked less than P-7.

3) NCPs are tripped regardless of the state ***of*** P-7

B. Heat Sink Protection

1. Steam Generator Trips (Obj. #2)

a) Low-Low Water Level Reactor Trip

1) 2/4 channel on **1/4** S/G less than or equal to 10.7% (Unit 1), 36.8% (Unit 2)

2) Low low level in 1/4 S/G starts motor driven aux feed pumps.

3) Low-low level in 2/4 S/G auto start turbine aux feed pump.

4) Protects against sudden **loss** of heat sink.

Table 3.3.1-1 (page 5 of 7)
Reactor Trip System Instrumentation

Note **1:** Overtemperature ΔT

The Overtemperature AT Function Allowable Value shall not exceed the following NOMINAL TRIP SETPOINT by more than 4.3% (Unit 1) and 4.5% (Unit 2) of RTP.

$$AT \frac{(1+\tau_1 s)}{(1+\tau_2 s} \left(\frac{1}{1+\tau_3 s} \right) \le \Delta T_0 \left\{ K_1 - K_2 \frac{(1+\tau_4 s)}{(1+\tau_5 s)} \left[T \frac{1}{(1+\tau_6 s)} - T' \right] + K_3 (P - P') - f_1(\Delta I) \right\}$$

Where: AT is the measured RCS AT by loop narrow range RTDs, °F.
ΔT_0 is the indicated AT at RTP, °F.
s is the Laplace transform operator, sec^{-1}.
T is the measured RCS average temperature, °F.
T' is the nominal T_{avg} at RTP (allowed by Safety Analysis), ≤ 585.1°F (Unit 1)
≤ 590.8°F (Unit 2).
P is the measured pressurizer pressure, psig
P' is the nominal RCS operating pressure, = 2235 psig

K_1	=	Overtemperature AT reactor NOMINAL TRIP SETPOINT, **as** presented in the COLR,
K_2	=	Overtemperature AT reactor trip heatup setpoint penalty coefficient, as presented in the COLR,
K_3	=	Overtemperature AT reactor trip depressurization setpoint penalty coefficient, as presented in the COLR,
τ_1, τ_2	=	Time constants utilized in the lead-lag compensator for AT, as presented in the COLR,
τ_3	=	Time constant utilized in the lag compensator for AT, as presented in the COLR,
τ_4, τ_5	=	Time constants utilized in the lead-lag compensator for T_{avg}, as presented in the COLR,
τ_6	=	Time constant utilized in the measured T_{avg} lag compensator, as presented in the COLR, and
$f_1(\Delta I)$	=	a function of the indicated difference between top and bottom detectors of the power-range neutron ion chambers; with gains to **be** selected based on measured instrument response during plant startup tests such that:

(i) for $q_t - q_b$ between the "positive" and "negative" $f_1(\Delta I)$ breakpoints as presented in **the** COLR; $f_1(\Delta I) = 0$, where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is total THERMAL POWER in percent of RATED THERMAL POWER;

(ii) for each percent ΔI that the magnitude of $q_t - q_b$ is more negative than the $f_1(\Delta I)$ "negative" breakpoint presented in the COLR, the AT Trip Setpoint shall be automatically reduced by the $f_1(\Delta I)$ "negative" slope presented in the COLR; and

(continued)

Table 3.3.1-1 (page 6 of 7)
Reactor Trip System Instrumentation

(iii) for each percent Ai that the magnitude of $q_t - q_b$ is more positive than the $f_1(\Delta I)$ "positive" breakpoint presented in the COLR, the AT Trip Setpoint shall be automatically reduced by the $f_1(\Delta I)$ "positive" slope presented in the COLR.

Note 2: Overpower AT

The Overpower AT Function Allowable Value shall not exceed the following NOMINAL TRIP SETPOINT by more than 2.6% (Unit 1) and 3.1% (Unit 2) of RTP.

$$\Delta T \frac{(1+\tau_1 s)}{(1+\tau_2 s)} \left(\frac{1}{1+\tau_3 s}\right) \le \Delta T_0 \left\{K_4 - K_5 \frac{\tau_7 s}{1+\tau_7 S} \left(\frac{1}{1+\tau_6 s}\right) T - K_6 \left[T \frac{1}{1+\tau_6 s} - T''\right] - f_2(\Delta I)\right\}$$

Where: AT is the measured RCS AT by loop narrow range RTDs, "F.
ΔT_0 *is* the indicated AT at RTP, "F.
s is the Laplace transform operator, sec^{-1}.
T is the measured RCS average temperature, °F.
T'' is the nominal T_{avg} at RTP (calibration temperature for AT instrumentation), ≤ 585.1°F (Unit 1) ≤ 590.8°F (Unit 2).

K_4 = Overpower AT reactor NOMINAL TRIP SETPOINT as presented in the COLR,

K_5 = 0.02/°F for increasing average temperature and 0 for decreasing average temperature,

K_6 = Overpower AT reactor trip heatup setpoint penalty coefficient as presented in the COLR for $T > T''$ and $K_6 = 0$ for $T \le T''$,

τ_1, τ_2 = Time constants utilized in the lead-lag compensator for AT, as presented in the COLR,

τ_3 = Time constant utilized in the lag compensator for AT, as presented in the COLR,

τ_6 = Time constant utilized in the measured T_{avg} lag compensator, as presented in the COLR,

τ_7 = Time constant utilized in the rate-lag controller for T_{avg}, as presented in the COLR, and

$f_2(\Delta I)$ = a function of the indicated difference between top and bottom detectors of the power-range neutron ion chambers; with gains to be selected based on measured instrument response during plant startup tests such that:

(i) for $q_t - q_b$ between the "positive" and "negative" $f_2(\Delta I)$ breakpoints as presented in the COLR; $f_2(\Delta I) = 0$, where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is total THERMAL POWER in percent of RATED THERMAL POWER;

(continued)

Table 3.3.1-1 (page 7 of 7)
Reactor Trip System instrumentation

(ii) for each percent AI that the magnitude of $q_t - q_b$ **is** more negative than the $f_2(\Delta I)$ "negative" breakpoint presented in the COLR, the **AT** Trip Setpoint **shall** be automatically reduced by the $f_2(\Delta I)$ "negative" slope presented in the COLR; and

(iii) for each percent AI that the magnitude of $q_t - q_b$ is more positive than the $f_2(\Delta I)$ "positive" breakpoint presented in the COLR, the AT Trip Setpoint shall be automatically reduced by the $f_2(\Delta I)$ "positive" slope presented in the COLR.

Bank Question: 964 ***Answer: D***

1 Pt(s) Unit 1 is operating at 100% power. Given the following events and conditions:

- Train "A" equipment is in service.
- 1ETA is deenergized due to a bus fault and power cannot he restored
- **All** plant safety equipment operates automatically as designed.
- No operator action **has** been taken.

What would be the immediate impact (if **any)** of the loss of 1ETA on the NCP pump bearings?

A. **All NCPs would continue to be cooled.**

B. **A and D NCPs would lose cooling.**

C. **B and C NCPs would lose cooling.**

D. **All NCPs would lose cooling.**

Distracter Analysis:

A. **Incorrect:** all NCPs **are** affected -- the bus fault precludes reenergizing 1ETA and prevents restarting "A" train KC pumps from the D/G.
Plausible: candidate believes the B train KC pumps would auto-start.

B. **Incorrect:** all NCPs **are** affected – the bus fault precludes reenergizing 1ETA and prevents restarting "A" train KC pumps from the DIG.
Plausible: One header supplies **A** and D NCPs

C. **Incorrect:** all NCPs are affected – the bus fault precludes reenergizing **1ETA** and prevents restarting **"A"** train KC pumps from the DIG.
Plausible: one header supplies B and C NCPs

D. **Correct** all NCPs are affected.

Level: RO&SRO

KA: **SYS** 003 K2.02 (2.5*/2.6*)

Lesson Plan Objective: KC **Obj: 4**

Source: New

Level of knowledge: memory

References:
1. OP-CN-PSS-KC page 4

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of the KC System.	X	X	X	X	
2	Describe how the KC System is cooled.	X	X	X	X	
3	Describe the normal flowpath of the KC System, including each header and the type of loads serviced by each.	X	X	X	X	X
4	Explain what happens in the KC System during: - Safety Injection (Ss) - Phase A Containment Isolation (St) - Phase B Containment Isolation (Sp) - Blackout - Low Low KC Surge Tank Level	X	X	X	X	X
5	Given appropriate plant conditions, apply limits and precautions associated with OP/1(2)/A/6400/005 (Component Cooling Water System)	X	X	X	X	X
6	State the typical values of the KC pump discharge pressure, KC Hx outlet temperature and KC pump flow.	X	X	X	X	X
7	State the basic actions required of an NLO for a loss of Component Cooling Water and why.	X	X			
8	Describe KC system makeup.	X	X			
9	Draw a block diagram of the KC system per the KC System Simplified Drawing.	X	X			
10	Explain when the Chemistry group is to be notified concerning the KC system.	X	X	X	X	X
11	Describe the purpose of the EMF's associated with the KC System and what is indicated by a high level radiation alarm.	X	X	X	X	X
12	List the instrumentation available in the control room for the KC System.			X	X	
13	When given a set of plant conditions and access to reference materials, determine the actions necessary to comply with Tech Spec/SLC's.			X	X	X
14	Discuss the supplementary actions for the loss of KC AP.			X	X	X

d) Precautions for chemicals used in the KC system:

(a) Sodium nitrite is a suspected carcinogen, so avoid/limit exposure.

(b) Wash off any KC water thoroughly. It may cause an irritation to the skin and it will burn the eyes.

11. bevel Indication in CR. (OBJ. #4 and #12)

a) bow level in Surge tank (computer point) 37.3%

b) Low low level

(a) 34% (1/1 instrument per tank causes valve closure. A separate instrument is used for indication and alarms.)

(b) Closes the train related Auxiliary and Reactor Building non-essential header isolation valves.

(c) Ensures at least one train will provide adequate NPSH if a leak develops with the trains cross-connected.

B. KC Pumps (Obj. #18)

1. Two per train - one pump normally running.

2. Power Supply - 1(2) ETA/B

3. Normal Parameters (OBJ. #6, 12)

a) Pressure

1) Normally approximately 100 psig.

2) Indication available in Control Room and at each pump.

b) Flow (OBJ. # 6, #12)

1) CR indication

2) Aux. S/D Panel indication

3) Flow will depend on the components in service

(a) NB **Hx** ~ 5000 gpm

(b) KF Hx **as** required (1000-3000 gpm)

(c) other components normally in service supply 3500 gpm

4. Runout Flow (OBJ. #17,)

a) Annunciators

1) 5700 gpm increasing with either KC Pump running (Train A(B) single pump runout)

2) 10,800 gpm increasing with 2 KC Pumps running (Train A(B) two pump runout)

Bank Question: 965 ***Answer: B***

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1 Pt(s) Unit 2 was operating at 100% when a large-break LOCA occurred inside containment at 0200. Given the following events and conditions:

- 0201 – containment pressure = 1.0 psig
- 0205 – Containment pressure = *3.0* psig
- 0210 – containment pressure = 0.5 psig
- 0215 – containment pressure = 0.1 psig

What should be the **status** of the Containment Air Return dampers and fans at time 0210?

A. **Dampers open; fans** running.

B. **Dampers open; the fans never started.**

C. **Dampers opened but have closed, fans started but have stopped.**

D. **Dampers opened but have closed; the fans never started.**

Distracter Analysis: from the VX lesson plan:

Dampers are automatically opened if the following conditions are met: (Obj. #4, 5)

- 10 seconds **have** elapsed from receipt of Sp signal.
- Greater than or equal to 0.4 psig signal from Containment Pressure Control System (CPCS).
- Less **than** or equal to *0.5* psid across the damper.
- Load Group #1 from D/G sequencer has permission to start

Air return fans (ARF) automatically start if the following conditions are met: (Obj. #4,5)

- 9 minutes have elapsed from receipt of Sp (phase B) signal.
- Greater than **or** equal to **0.4** psig **signal** from **CPCS.**
- Load Group #11 from D/G sequencer has permission to start.

A. **Incorrect:** fans are not running until 0210 - because 9 minutes have not elapsed since reaching Sp setpoint **(3.0 psig).**
Plausible: Candidate believes the ARF **starts** 9 minutes after phase "A" (St) signal

B. **Correct** dampers open 10 seconds after the Sp signal. Fans start nine minutes later <u>if CPCS present</u>. CPCS is **not** present until 0215.

C. **Incorrect:** dampers remain open; fans start nine minutes after the **Sp** signal and would shutdown, however, they never started.
Plausible: candidate does not know time delay – fans stop on CPCS interlock at *0.3* psig.

D. **Incorrect:** dampers remain open

Plausible: **candidate believes the dampers** close – **partially correct.**

Level: RO&SRO

KA: SYS 025 A4.02 (2.7*/2.5*)

Lesson Plan **Objective:** VX Obj: **4, 5**

Source: New

Level of knowledge: analysis

References:
1. **OP-CN-CNT-VX pages 7 and 8**

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	State the purpose of each of the following Containment Hydrogen Control Systems: • Containment Air Return and Hydrogen Skimmer System • Hydrogen Recombiners • Hydrogen Ignition System • Hydrogen Purge System • Containment Hydrogen Monitors	x	x	x	x	
2	Describe the sources of hydrogen in containment during a LOCA and the limit on hydrogen concentration in containment.	x	x	x	x	x
3	Describe the various flow paths during operation of these systems.	x	x			
4	Describe the automatic and manual operations performed to control the hydrogen concentration in containment.			x	x	x
5	Describe the conditions necessary for automatic operation of the Containment Air Return and Hydrogen Skimmer System.			x	x	x
6	Given appropriate plant conditions, apply Limits and Precautions associated with related station procedures.	x	x	x	x	x
7	Given a set of plant conditions and access to reference materials, determine the actions necessary to comply with Tech Specs/SLCs. • 3.3.3 Hydrogen Monitors • 3.6.7 Hydrogen Recombiners • 3.6.8 Hydrogen Skimmer System • 3.6.9 Hydrogen Ignition System • 3.6.11 Air Return System			x	x	x

c) 40,000 CFM capacity

3. Back draft dampers, normally closed, act as check valves to prevent ice condenser bypass. Prevent backflow from lower to upper CNT through the Air Return Fans. (Obj. #3)

4. Electrically operated dampers are located on discharge of fans. Delta P interlock is to prevent overloading the damper motor.

5. Inadvertent operation of the Containment Air Return Fan System may result in excessive depressurization of the containment atmosphere. The Containment Pressure Control System (CPCS) prevents the occurrence of such an event. Each CPCS loop transmits a start permissive on containment pressure in excess of the permissive setpoint. The CPCS loop will initiate termination signals when pressure falls below the termination setpoint. A single CPCS transmitter provides an open permissive to the Containment Air Return Fan Isolation Damper. This same transmitter along with a redundant CPCS transmitter provides the start/enable or the stop signal to the Containment Air Return Fans. Two redundant interlocks prevent a single failure from resulting in a failure of the Containment Air Return Fan to stop.

6. Dampers are automatically opened if the following conditions are met: (Obj. #4, 5)
   a) 10 seconds have elapsed from receipt of Sp signal.
   b) Greater than or equal to 0.4 psig signal from Containment Pressure Control System (CPCS).
   c) Less than or equal to 0.5 psid across the damper.
   d) Load Group #4 from D/G sequencer has permission to start.

7. CPCS and less than or equal to .5 psid permissive is no longer an input once the damper is OPEN.

8. ARF automatically start if the following conditions are met: (Obj. #4,5)
   a) 9 minutes have elapsed from receipt of Sp signal.
   b) Greater than or equal to 0.4 psig signal from CPCS.
   c) Load Group #11 from D/G sequencer has permission to start.

9. If containment pressure reaches less than or equal to 0.3 psig, the ARF will stop, to prevent inadvertent Containment depressurization, but the dampers will not close. (Obj. #4,5)

10. Carbon Steel angle dams has been installed around the VX Fans to prevent flooding and subsequent inoperability during Containment Spray actuation.

11. To manually start the ARF, requires CPCS signal and "ON" selected. Manual starts of fan will bypass the time delay. (Obj. #4)

12. To manually open the damper requires the following: (Obj. #4)
    a) Sp or ARF Manually " O N
    b) CPCS signal
    c) "OPEN" selected
    d) Time delay is bypassed
43. CPCS function is performed by "POWER LOCKOUT" MCC's. Each contactor has an associated breaker in series. The breaker serves no useful function but had to be bought as a package to obtain a safety related seismic qualified contactor. If this "POWER LOCKOUT" breaker is opened, control room indication is unaffected.

B. Hydrogen Skimmer System
1. Safety related system.
2. Two fans (4260-CFM capacity) located in upper containment.
3. Fans take suction from the following dead-ended spaces in lower containment. (Obj. #3)
    a) All 4 S/G compartments
    b) Pressurizer compartment
    c) Reactor compartment
    d) All 4 cold leg accumulators
    e) North and South fan rooms
    f) Incore instrumentation room
4. Fans discharge in upper containment in the vicinity of hydrogen recombiners. (Obj. #3)
5. Electrically operated isolation valves located in each fan suction line.
6. Isolation valves VX-1A and VX-2B will automatically open 9 minutes after the receipt of Sp signal. (Obj. #4, 5)
7. Hydrogen skimmer fans will automatically start if the following conditions are met: (Obj. #4, 5)
    a) 9 minutes have elapsed from receipt of Sp signal.
    b) Load Group #11 from the D/G sequencer has permission to start.
    c) The suction isolation valves are open.
8. To manually start the fan just requires manually " O N on the key switch. This will bypass any time delays. (Obj. #4)
9. Po manually OPEN the isolation valve requires (Obj. #4)
    a) Sp or VX fan manually on

Bank Question: 966 **Answer: A**

1 Pt(s) During a reactor start-up, the following conditions are noted:

- The reactor is at normal operating pressure and temperature.
- Four NCPs are running.
- NCS temperature is being controlled using the steam dumps.
- The reactor power is *5%.*

Which of the following describes the change in actual plant parameters if the controlling steam header pressure transmitter fails high?

A. Steam dump demand increases. Steam header pressure decreases, and NCS temperature decreases.

B. Steam dump demand decreases. Steam header pressure increases, and **NCS** temperature increases.

C. Steam dump demand increases, Steam header pressure increases, and **NCS** temperature decreases.

D. Steam dump demand decreases. Steam header pressure decreases, and **NCS** temperature decreases.

Distracter Analysis:

A. Correct:
B. Incorrect: Steam dump demand increases.
Plausible: Parameter changes are consistent with error in steam dump change.
C. Incorrect: Steam pressure change is not consistent with increased demand.
Plausible: reflects indicated rather **than** actual pressure.
D. Incorrect: Steam dump demand does not go down.
Plausible: psychometrically balanced.

Level: RO&SRO

KA: SYS 041K3.02 (3.8/3.9)

Lesson **Plan** Objective: STM-IDE SEQ 9

Source: **New**

Level of knowledge: comprehension

References:

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
1	Describe the purpose of the IDE System.			X	X	
2	List the banks of steam dumps and the number of valves in each bank.			X	X	
3	Describe the capacity of the Steam Bump System.			X	X	X
4	Describe the controllers in the Steam Dump System. • Describe the inputs to each controller • Discuss the plant conditions required to "enable" the controller			X	X	X
5	Discuss the conditions required to "arm" each bank of dump valves. • Discuss the plant conditions that would cause Steam Bump "actuation"			X	X	X
6	State the number of steam dumps that can be isolated with the unit at a00% power.			X	X	X
7	Discuss the purpose and state the setpoint of each of the following: • P-12 Lo-Lo T_{avg} Interlock • C-7A • C-7B • c-9			X	X	X
8	Describe the controls associated with the IDE System.			X	X	X
9	Describe the system response to a failure of each input to IDE.			X	X	X
10	Describe how to transfer modes of operation of the IDE System.			X	X	X
11	Discuss how a cooldown is accomplished using the IDE System.			X	X	X

A. Fails High - would affect Load Rejection Controller

1. The Load Rejection Controller would not generate an output since T_{ref} would in most cases, always be higher than Auctioneered Hi T_{avg}.

2. This situation would require manual operation of the steam dump system to reduce T_{avg} unless T_{avg} increased above the failed T_{ref} value by more than 3 degrees.

B. Fails Low - would affect Load Rejection Controller

1. Generates a T_{avg} - T_{ref} mismatch causing an output signal to be generated from the Load Rejection Controller when indicated T_{avg} exceeds T_{ref} by 3° F.

2. Steam Dump Valves will not open until C-78 or C-75 arming signals are generated by a subsequent failure or actual load rejection/reduction.

5.5 Turbine impulse Pressure Channel II

A. Affects C-7A and C7-B loss of load interlock arming signals

1. A high failure would prevent the C-78 and C-75 loss of load interlocks from actuating.

2. If Channel II impulse pressure fails low, loss of load interlocks C-7A and C-7B will actuate to arm the steam dumps.

5.6 Reactor Trip Breaker Failures

A. Breaker "A" fails to open on a reactor trip

1. The Plant Trip controller is enabled due to P-4 Train B.

2. P-4 Train A arming signal to the condenser dumps is not available.

3. Condenser dumps could still be armed if C7A or C7B are actuated on the reactor trip.

4. Atmospheric dumps will be armed if C7B is actuated on the reactor trip, but the Plant Trip controller output is limited to 49% demand. This demand is insufficient to open the atmospheric dumps.

B. Breaker "B" fails to open on a reactor trip

1. Plant Trip controller is not enabled due to no P-4 Train B.

2. Load Rejection controller is enabled due to no P-4 Train B. Demand based on Auct H. T_{avg} - T_{ref} signal is sent to the steam dumps.

3. Condenser dumps are armed due to P-4 Train A and will open.

4. Atmospheric dumps are **not** armed because of P-4 Train A *is* present.

6. POWER SUPPLY

Bank Question: 967 ***Answer: C***

1 Pt(s) Which one of the following practices is required **of** control room personnel in order to assure accurate; concise verbal communications when communicating with non-licensed operators (NLOs)?

A. NLOs shall use sound-powered phone systems as the priority communications method.

B. NLOs shall use ***a*** two-way radio for communications from the cable spreading room, since there is no telephone readily available.

C. **NLOs** shall repeat-back instructions for actions directed by the control room.

D. Change NLOs shall report the completion of ordered actions upon their return **to** the kitchen, if there is no telephone readily available.

Distracter Analysis:

A. Incorrect: The telephone is the priority communication method.
Plausible: Sound powered phones **are** often used when **a** direct and constant communication link is required.

B. Incorrect: Two-way radios are not allowed in the cable spreading area.
Plausible: Two-way radios are used for fire brigade **and** when telephones are not available.

C. Correct:

D. Incorrect: Reporting completion of actions is required immediately from the nearest phone.
Plausible: OMP 2.2**1** requires immediate reporting of actions completed to the control room.

Level: RO&SRO

KA: G 2.1.17 (3.5/3.6)

Lesson Plan Objective: ADM-NSOI Obj: 14

Source: New

Level **of** knowledge: memory

References:
1. **OMP** 2-16 page 6
2. **NSD** 509 pages 2 and 7

	Objective	ISS	NLO	LPRO	LPSO	PTRQ
i	Describe each step of the **S.T.A.R.** Self Checking process	X	X	X	X	X
2	State the purpose for performing "Independent Verification'.	X	X	X	X	X
3	Describe the qualifications of the "Verifier".	X	X	X	X	X
4	Describe the process of Separate Verification and state when it is used.	X	X	X	X	X
5	Describe the process of Double verification and state when it is used.	X	X	X	X	X
6	Describe the process of Independent Verification of locked components.	X	X	X	X	X
7	State the conditions that may allow IV to be waived.	X	X	X	X	X
8	Describe the action required when a component is found out of the required position.	X	X	X	X	X
9	Describe the process of performing a Verbal Pre-Job Briefing and state when it is used.	X	X	X		
10	Assess when a Verbal Pre-Job Briefing should be conducted per CNS S.D. 3.0.21.				X	X
11	Explain what items must always be addressed in Verbal $re-Job Briefing per CNS S.D. 3.0.21.				X	X
12	Evaluate the need for a Written Pre-Job Briefing in accordance with S.D. 3.0.21 (SRQ Only).				X	X
13	State how and when an operations Written Pre-Job Briefing is documented.				X	X
14	Explain and apply the "Standard Practices" and "Rules of Conduct" for the Operations Communications Standards as stated in NSD 509 and OMP 2-21.	X	X	X	X	X
15	Illustrate the application of: • Use of Names • Repeat Back (Three Way Communications) • Providing specific Information, for the Operations Communications Standards as stated in NSD *509* and OMP 2-21	X	X	X	X	X

OMP 2-16

I. Only authorized IAE personnel shall adjust the sound level of annunciators in the Control Room.

6. Communications

6.1. To ensure effective communications. the following shall be strictly adhered to by ail Operations personnel.

- Non-Iicensed Operators shall be instructed, with the assignment of each Control Room initiated task, to report their actions back to the Controi Room immediately upon completion.

6.2. Telephones are the primary source of communications in the Control Room. All operators shall ensure the following standard practices are implemented.

A. When answering the telephone, Control Room personnel shall answer: "Unit (#) Control Room, (Name)".

B. When giving instructions *to* other employees, Control Room personnel shall have the person repeat the instructions back to ensure thev understand.

C. When incoming calls request action of Control Room personnel, the Control Room personnel shall repeat the instructions back to the person requesting the action. This will ensure both persons understand the request.

509.2.2.3 Performance Criteria

1. Control Room Access: Access to the control room shall be strictly controlled during normal and emergency conditions. The control room and control room area boundaries shall be clearly defined in Operations administrative procedures. All personnel who are not normally assigned to the control room, but have a specific need for access, shall request authorization to enter. Exceptions shall be specifically addressed. For exaniple. the on duty Operations shift personnel are not required to request authorization tu enter the control ronm due to the nature of their responsibilities. Responsibility for controlling access to the control room in normal and emergency conditions shall be clearly defined in Operations administrative procedures.

2. Control Room Appearance: High housekeeping standards and cleaning routines shall be implemented and strictly followed. Responsibilities and routines for the Control Room and Control Room area housekeeping shall be specifically defined.

3. Control Room and Control Room Area Material Condition: Material condition standards shall be implemented and strictly followed. Control boards. cabinets, chairs, desks, ceilings. floors. walls, lighting, etc. shall be routinely inspected, repaired, repainted or replaced to maintain a like-new appearance. Tape shall not be used on control boards, cabinets or desks. Responsibility for the Control Ruom and Control Room area material conditions shall be clearly defined.

4. Control Room Personnel Dress Code: Control Room licensed personnel shall have standard dress to aid in proper identification and to present a neat and professional appearance. Reactor Operators shall be distinguished from Senior Reactor Operators. Licensed operators normally assigned on shift shall wear the standard dress when on the simulator or standing license duties.

6. Control Room Environment: The Control Room environment shall be quiet and conducive to a professional approach to the job. Unnecessary distractions that could cause operator attention to be diverted shall be eliminated.

7. Control Room Communication Practices: The standard communication practices described in Appendix A of this directive shall be implemented and strictly followed.

   Communications is one of the most important functions related to Control Room operations. Directions are given and taken via several means of communication.

   Control Room personnel shall verify their communications are clear. precise and acknowledged. Care should be taken to ensure all parties are speaking the same technical language. Instructions provided from the Control Room or requests received by the Control Room personnel shall be repeated using three way communication to ensure accuracy and understanding. Instructions that are unusual or complex shall be written down to eliminate confusion.

   Radio communications shall strictly adhere to the Federal Communications Commission regulations as addressed in the Duke Power Company Radio Operators Manual.

8. Control Hoom Surveillance: Operators shall be alert and attentive to control board indications and alarms.

   Control board indications shall be monitored frequently to detect problem situations early. Operator response to alarms shall be timely and actions shall be taken to address and correct the alarm causes. The number **of** work activities affecting control board indications that are performed concurrently shall be limited so that the operator's ability to detect and respond to abnormal conditions will not be compromised.

9. Control Room Annunciators and Instrumentation:

   Defective Control Room Annunciators and Instrumentation shall be identified and repaired promptly. If an annunciator is determined to be defective, the Control Operator shall ensure that alternate monitoring means are available to monitor parameters of importance.

10. Control Room Equipment: Cahinets, chairs. desks. tables, etc. shall be professional in appearance and limited to what is authorized by designated Operations Supervision. Workstations shall be arranged in the Control Room and Control Room area to prevent unnecessary distraction of Control Room Personnel.

APPENDIX A.509. NUCLEAR SITE COMMUNICATION STANDARDS

Three Way Communication & Use of the Phonetic Alphabet

- These communication standards describe acceptable practices to be used at the three sites
- They apply to **ALL** site personnel whenever:
  1. An individual is directed to take an action affecting **installed** plant equipment and/or
  2. Information is given to an individual about limits, precautions or plant status.

Communication Standards:	**Phonetic Alphabet:**
Three Way Communication **(repeatbacks):**	A - ALPHA
This tool is our primary defense against miscommunication.	B - BRAVO
-Repeatbacks and acknowledgments shall be used whether talking face-to-face or using radios/telephones.	C - CHARLIE
-Action/Information is clearly directed by using the receiver's name.	D - DELTA
-Requested action will not take place until repeatbacks and acknowledgments are complete. for example.	E - ECHO
Sender-"Fred. **open** valve 1HP-26."	F - FOXTROT
Receiver- "Open valve 1HP-26."	G - GOLF
Sender-"That's correct."	H - HOTEL.
Sender (calling work control from next to an operating feedpump)- "Jack. alignment complete on Main Feedwater **Pump** 1- Alpha"	I - INDIA
Receiver- "Alignment **complete** an Main Feedwater Pump 1- Alpha"	J - JULIETT
Sender- "That's correct."	K - KILO
Use of the Phonetic Alphabet:	L - LIMA
Phonetics shall **always** he used for train **and** channel designations For example.	M - MIKE
1A Steam Generator would be "1 Alpha **Steam** Generator"	N - NOVEMBER
CCW pump IC **would** be "CCW Pump 1 Charlie.'.	O - OSCAR
1CF-126B **would** be "1CF-126 Bravo"	P - PAPA
Unit. main and channel designation shall always he used. For **example.**	Q - QUEBEC
For **valve** 1CF-126B saying "1CF -126 Bravo" is correct.	R - ROMEO
Saying "CF-126 Bravo"	S - SIERRA
or "1CF-126",	T - TANGO
or "1CF-126B" is not correct."	U -UNIFORM
Phonetics or noun names should hc used for system or component designators where the sender or receiver feels there is a reasonable chance of miscommunication such **as. sound** alike systems. high noise **areas.** radio/telephone communication where reception is poor. etc. For example:	V - VICTOR
At MNS/CNS: NV system **may** he referred to **as** N-Victor.	W - WHISKEY
41 ONS. "High Pressure Extraction" could he **used** instead of HPE to prevent confusion **with** HPC - "High Pressure Injection" **system**	X - X-RAY
The standard phonetic **alphabet** listed on this attachment shall he used.	Y -YANKEE
	Z - ZULU

2) Ask any questions at any time

3) Stop at any point if a question occurs

4) Ensure quality before all else

e) For certain activities, the turnover process or a pre-shift briefing can take the place of a pre-job brief.

d) Some activities may be performed without **a** Pre-Job Brief, as specified by the group manager or his designee.

3. Canned Pre-Job Briefs – This is a ready made Briefing Form specifically designed for a task known to require **a** written Pse-Job Brief. It can be edited by user to fit current conditions. It SHALL be used if a "canned" brief exists.

2.5 Operations Communications Standards, and Practices (Obj. **14,** 15, 16, 17)

A. Review the communications standards and expectations as presented in NSD 509.

1. Use of Names - use students to demonstrate this application
2. Use of Repeat Backs - have students demonstrate
3. Use of Specific Information - have students demonstrate
4. Use of Names/Work areas when using phones/radios
5. Use of Phonetics (Obj. #17)

a) Demonstrate cases of likely confusion when the phonetic alphabet shall be used.

b) Review the three cases in which the phonetic alphabet must be used.

1) NV, **NC** & ND Systems

2) When Referring to a valve number and train

3) When referring to a loop or train

c) Misuse of phonetics

B. Review the Rules of Conduct as presented in OMP 2-21 Section 6.0 and the key considerations when Reporting Abnormal conditions as explained in Section 7.11A. (Qbj. #14)

C. Review proper use of Two-way Radios using latest copy of OMP 2-21, Section 7. (Obj. #16)

2.5 Control Room Conduct

A. Using S.D. 3.1.10 (Control Room Access and Control) and OMP 2-16 (Control Room Conduct), review the procedures that govern Control Room access. (Obj. #23)

1. The CRSRO is responsible for controlling access to the Control Room horseshoe area.
2. During emergencies the OSM or designee is responsible for controlling access to the Control Room horseshoe area.
3. Review the list of personnel who may access the Control Room without permission.
4. Control Room access is restricted during designated turnover times.

B. Using OMP 2-16 (Control Room Conduct), review control room conduct and professionalism expectations (Obj. #24). Specifically:

1. The CRSRO is responsible for providing the leadership necessary to enhance the professionalism of Control Room personnel.
2. Access to the "Red Zone" (the carpeted area in front of the main control boards) is controlled by the Nuclear Control Operators (NCOs).
3. All Control Room personnel shall behave in a courteous: tactful, and businesslike manner. Distractions are to be minimized. Review telephone protocol.
4. Only personnel authorized by the OSM may eat in the Control Room.
5. Only Licensed Operators or HLC License Candidates performing ETQS tasks may manipulate the reactor controls.
6. If the Control Room Operators request NLOs to perform actions in the station, the NLOs shall be instructed to report back to the Control Room when actions are completed.
7. Annunciator Response:
   a) Control Operators shall ensure other Control Room personnel are notified when an alarm is received.
   b) Procedures for replacement of burned out annunciator lamps.

C. Using NSD 509, (Site standards in Support of Operational Focus), review the expectations for Control Room personnel response to Control Room alarms with respect to (Obj. #22);

1. Unexpected alarms,
2. Individual expected alarms
3. Multiple expected alarms.
4. Nuisance alarms.