Draft Submittal

MCGUIRE JUNE 2003 EXAM
50-369/2003-301 AND
50-370/2003-301

JUNE 16 - 30, 2003

1. Reactor Operator Operator Written Exam

1 Pt

After a loss of all AC power (station blackout), ES 0.2 (*Natural Circulation Cooldown*) is implemented after AC power has been restored.

Given the following conditions:

1) NC pumps cannot be restarted.
2) Power has been restored to all station AC busses.
3) A natural circulation cooldown is in progress.

Step 18 of ES 0.2 requires that the operators maintain subcooling greater than 50 degrees if all CRD fans are running and greater than 100 degrees if less than all CRD fans are running using core exit thermocouples.

What is the EOP basis for these limits?

A. To prevent degradation of reactor coolant pump seals due to steam.

B. To prevent possible void formation in the upper head.

C. To collapse any voids that are already present in the core.

D. To ensure adequate subcooling due to possible degradation of core exit T/Cs accuracy.

Bank Question: 47.1 ***Answer: B***

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LEVEL: RO

SOURCE: BANK

LEVEL OF KNOWLEDGE: Comprehension

REFERENCES: EP/1/A/5000/ES0.2 step 18
OP-MC-EP-E0 6.4.18 page 147

LESSON: OP-MC-EP-E0

OBJECTIVE: OP-MC-EP-E0 Obj. 6

K/A: W/E09 EK2.1 (3.2/3.4)

E09 Natural Circulation Operations

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Natural Circulation Operations)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.0 SRO 3.4

EK1.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation Operations).
IMPORTANCE RO 3.3 SRO 3.7

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Natural Circulation Operations).
IMPORTANCE RO 3.3 SRO 3.6

EK2. Knowledge of the interrelations between the (Natural Circulation Operations) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.2 SRO 3.4

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.6 SRO 3.9

EK3. Knowledge of the reasons for the following responses as they apply to the (Natural Circulation Operations)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.3 SRO 3.6

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	2.0	2.0	1.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Describe the accidents that are diagnosed in E-0 and the diagnostic sequence. EPE0001			X	X	X
2	Explain the purpose for each procedure in the E-0 series. EPE0002			X	X	
3	Discuss the entry and exit guidance for each procedure in the E-0 series. EPE0003			X	X	
4	Discuss the symptoms of a reactor trip and/or safety injection. EPE0004			X	X	
5	Discuss the mitigating strategy (major actions) of each procedure in the E-0 series. EPE0005			X	X	X
6	Discuss the basis for any note, caution or step for each procedure in the E-0 series. EPE0006			X	X	X
7	Describe the immediate actions and include the RNO when appropriate. EPE0007			X	X	X
8	Describe the actions included on the E-0 Foldout page and the basis for these actions. EPE0008			X	X	X
9	Given the Foldout page, other than E-0, discuss the actions included and the basis for these actions. EPE0009			X	X	X

STEP 17 <u>IF</u> <u>AT</u> <u>ANY</u> <u>TIME</u> cooldown rate must be raised to greater than 50°F in an hour, <u>THEN</u> <u>GO</u> <u>TO</u> EP/1/A/5000/ES-0.3 (Natural Circulation Cooldown with Steam Void in Vessel). (Continuous Action Step)

<u>PURPOSE:</u> To make the operator aware that, if a rapid cooldown is required, another procedure exists which allows for void formation and a continued cooldown/depressurization.

<u>BASIS:</u> From this point onward in ES-0.2, the operator has the option of changing procedures if and when he determines a need to cooldown and depressurize more quickly than at the present rate.

Procedure ES-0.3, Natural Circulation Cooldown With Steam Void In Vessel, should be used in this case.

The major factors which could require a more rapid cooldown and depressurization than ES-0.2 allows are:

1. Limited condensate storage, or
2. No CRDM fans operating.

STEP 18 Initiate NC System depressurization:

<u>PURPOSE</u>: To initiate depressurization of the NC system while maintaining required subcooling.

<u>BASIS:</u> The pressurizer pressure should periodically be lowered to maintain the NC and pressurizer pressure-temperature relationship in accordance with the Technical Specifications. The depressurization should be accomplished using pressurizer auxiliary spray or pressurizer PORVs, depending upon whether letdown is in service.

To prevent possible void formation in the upper head, the minimum NC subcooling based on core exit T/Cs should be maintained.

The depressurization limit is repeated prior to the actual depressurization attempt. This will reinforce the limit to the operator performing the evolution.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

15. **Maintain following plant conditions:**

__ • NC pressure - AT 1905 PSIG

__ • Pzr level - AT 25%

__ • *Cooldown rate based on NC T-Colds -* LESS THAN 50 ° F IN AN HOUR

__ • NC temperature and pressure - WITHIN LIMITS OF DATA BOOK CURVE 1.6.a.

16. **Monitor NC cooldown:**

__ • Core exit T/Cs - GOING DOWN

__ • NC T-Hots - GOING DOWN

__ • NC subcooling based on core exit T/Cs - GOING UP.

__ 17. **<u>IF AT ANY TIME</u> cooldown rate must be raised to greater than 50° F in an hour, <u>THEN GO TO</u> EP/1/A/5000/ES-0.3 (Natural Circulation Cooldown With Steam Void In Vessel).**

18. **Initiate NC System depressurization:**

<u>NOTE</u> Steps 18.a through 18.c will require maintaining 2 different subcooling limits. One will be based on core exit T/Cs, and the other based on upper head T/Cs.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ a. Check all CRDM fans - ON.	a. Perform the following: __ 1) Maintain NC subcooling based on core exit T/Cs greater than 100° F. __ 2) <u>GO TO</u> Step 18.c.
__ b. *Maintain NC subcooling based on core* exit T/Cs - GREATER THAN 50° F.	

1 Pt. Which one of the following selections correctly matches the reactor trip signals to their limiting accident?

	Reactor Trip Signal	Limiting Accident/Protection
A.	OPΔT	DNB
	OTΔT	Excessive fuel centerline temperature
	Pzr High Level	DNB
	Pzr Low Pressure	NC system integrity
B.	OPΔT	Excessive fuel centerline temperature
	OTΔT	DNB
	Pzr High Level	DNB
	Pzr Low Pressure	NC system integrity
C.	OPΔT	DNB
	OTΔT	Excessive fuel centerline temperature
	Pzr High Level	NC system integrity
	Pzr Low Pressure	DNB
D.	OPΔT	Excessive fuel centerline temperature
	OTΔT	DNB
	Pzr High Level	NC system integrity
	Pzr Low Pressure	DNB

Bank Question: 048.1 ***Answer: D***

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	Reactor Trip Signal	Limiting Accident/Protection
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	OTΔT	**Excessive fuel centerline temperature**
	Pzr High Level	**DNB**
	Pzr Low Pressure	**NC system integrity**
B.	**OPΔT**	**Excessive fuel centerline temperature**
	OTΔT	**DNB**
	Pzr High Level	**DNB**
	Pzr Low Pressure	**NC system integrity**
C.	**OPΔT**	**DNB**
	OTΔT	**Excessive fuel centerline temperature**
	Pzr High Level	**NC system integrity**
	Pzr Low Pressure	**DNB**
D.	**OPΔT**	**Excessive fuel centerline temperature**
	OTΔT	**DNB**
	Pzr High Level	**NC system integrity**
	Pzr Low Pressure	**DNB**

Distracter Analysis:

A. **Incorrect**: OPΔT and OTΔT are reversed.
Plausible: PZR low pressure and high level are correct.

B. **Incorrect**: All are incorrect.
Plausible: Provided for psychometric balance.

C. **Incorrect**: OPΔT and OTΔT are reversed.
Plausible: PZR low pressure and high level are correct.

D. **Correct**:

Level: RO

KA: SYS 012 K5.01(3.3/3.8)

Lesson Plan Objective: OP-MC-IC-IPE Obj. 2

Source: Bank

Level of knowledge: Memory

References:
1. OP-MC-IC-IPE pages 19, 45 & 81

SYSTEM:	012 Reactor Protection System (RPS)		
K5	**Knowledge of the operational implications of the following concepts as the apply to the RPS:** (CFR: 41.5 / 45.7)		
K5.01	DNB	[illegible]	[illegible]
K5.02	Power density	3.1*	3.3*
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the RPS:** (CFR: 41.7 / 45/7)		
K6.01	Bistables and bistable test equipment	2.8	3.3
K6.02	Redundant channels	2.9	3.1
K6.03	Trip logic circuits	3.1	3.5
K6.04	Bypass-block circuits	3.3	3.6
K6.05	Test circuits	2.4	2.8
K6.06	Sensors and detectors	2.7*	2.8
K6.07	Core protection calculator	2.9*	3.2*
K6.08	COLSS	3.6*	3.7*
K6.09	CEAC	3.6*	3.7*
K6.10	Permissive circuits	3.3	3.5
K6.11	Trip setpoint calculators	2.9*	2.9
	<u>ABILITY</u>		
A1	**Ability to predict and/or monitor Changes in parameters (to prevent exceeding design limits) associated with operating the RPS controls including:** (CFR: 41.5 / 45.5)		
A1.01	Trip setpoint adjustment	2.9*	3.4*
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the RPS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)		
A2.01	Faulty bistable operation	3.1	3.6
A2.02	Loss of instrument power	3.6	3.9
A2.03	Incorrect channel bypassing	3.4	3.7
A2.04	Erratic power supply operation	3.1	3.2
A2.05	Faulty or erratic operation of detectors and function generators	3.1*	3.2*
A2.06	Failure of RPS signal to trip the reactor	4.4	4.7
A2.07	Loss of dc control power	3.2*	3.7

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
	2.0	3.0	3.0	3.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Reactor Protection System. ICIPE001		X	X	X	
2	Describe the reactor core parameters and values the system is designed to prevent exceeding. ICIPE002		X	X	X	X
3	Explain how the following Reactor Trip signals will cause the Reactor Trip Breakers and Bypass Breakers to Open (include coils affected): • Automatic signal from SSPS. • Manual Reactor Trip signal. • Manual Safety Injection signal. ICIPE003		X	X	X	X
4	Explain the significance of the SSPS General Warning Alarm and the conditions which will initiate it. ICIPE004		X	X	X	X
5	State the power source(s) to each Reactor Protection Channel and Train. ICIPE005		X	X	X	
6	Describe the effect on the RPS due to loss of a power source including bistable status, trip logic and any alarms which would indicate the loss of power. ICIPE006		X	X	X	X
7	Describe how the operator knows when more than one Protection Cabinet Door is Open. ICIPE007		X	X	X	X

What if the input instrumentation is also used for control systems? It is assumed that a controlling channel failure produces a transient requiring protective action and at the same time prevents this channel from initiating protective action. Further, it is assumed that the single failure criteria must be met for a fault in a non-controlling channel to generate a protective signal. This then requires two other non-faulted channels to initiate the protective action, or a total of four channels for instrumentation used for both protection and control systems. Therefore a two-out-of-four (2/4) logic circuit is used.

Due to the redundancy requirements, there are two separate trains of protection, two reactor trip breakers in series, and physical separation between the process and nuclear channels (I, II, III, and IV).

1.2.2 System Design Basis

Objective # 2

The Reactor Protection System provides Reactor Trip signals and other protective actions to: prevent core damage and protect system integrity. This is accomplished by preventing the DNBR from dropping below the design limit of 1.3, preventing the maximum NC System pressure from exceeding 2735 psig, and preventing the fuel rod maximum linear power from exceeding 18 kW/FT to prevent fuel centerline melt (C/L fuel temperature < 4700 °F).

In addition to reactor trips, the system actuates alarms, provides rod withdrawal stops, initiates turbine runbacks, and allows for testing and bypass of trip signals. The Reactor Protection System consists of several subsystems including the Process Instrumentation, Nuclear Instrumentation, Solid State Protection, Reactor Trip Switchgear, and Reactor Coolant Pump Monitor Panel.

2.0 COMPONENT DESCRIPTION

2.1 Process Instrumentation and Control Cabinets

There are four redundant protection cabinets or channels. Each receives and processes signals from dedicated detectors. Each cabinet contains the following: primary and backup power supplies, signal processing circuits, protection bistables and test circuitry. Cabinet outputs go to the SSPS cabinets.

2.2 Nuclear Instrumentation System (NIS)

A four bay cabinet in the control room contains the NIS drawers. Eight independent channels cover the Nuclear Instrumentation operating range. The system consists of two Source Ranges, two Intermediate Ranges, and four Power Ranges. The detectors are located around the periphery of the reactor vessel, adjacent to the reactor vessel wall. The Nuclear Instruments monitor neutron flux to provide indication and generate trips signals if needed. When a channel trips, the output goes to the SSPS cabinets.

Objective # 10

Power Range NIS Low Setpoint (2/4 channels = 25%) - Protects against startup accidents. The trip can be manually blocked when 2/4 PR channels > 10% (P-10) by using the two control board switches, one per train. The control board provides indication of the bistable block. This trip is auto-reinstated when 3/4 PR channels < 10% (P-10).

Power Range NIS High setpoint (2/4 channels = 109%) - protects against an overpower condition which could lead to a DNB concern. This circuit also provides a rod withdrawal stop when 1/4 channels > 103% power (C-2).

Power Range Positive (+) Rate (2/4 channels + 5% in 2 sec) - protects against an ejected rod accident for DNB concerns.

Pressurizer High Pressure (2/4 channels = 2385 psig) - Protects against losing NC system integrity.

Pressurizer Low Pressure (2/4 channels = 1945 psig) - protects against DNB due depressurization. This "at-power" trip protection is auto-blocked < 10% power (P-7) and is automatically reinstated > P-7.

Pressurizer High Level (2/3 channels = 92%) - protects system integrity by preventing the passage of water through the safeties. This "at-power" trip protection is auto-blocked < 10% power (P-7) and is automatically reinstated > P-7.

OTΔT (2/4 channels = variable) - provides DNB protection. DNB causes a large decrease in the heat transfer coefficient between the fuel surface and the coolant, resulting in high fuel clad temperature. The setpoint is a function of the 120% full power ΔT, Tavg, Pressurizer Pressure, and Δ Flux. Pressures below 2235 psig cause the setpoint to decrease while pressures above 2235 psig cause an increase in the setpoint. Tavg above 585 °F causes the setpoint to decrease while Tavg below 585 °F causes an increase in the setpoint. A Δ Flux more positive than the limit in the COLR (positive breakpoint) causes the setpoint to decrease. This circuit also provides a rod withdrawal stop and Turbine Runback 2% (C-3) below the trip setpoint.

OPΔT (2/4 channels = variable) - protects against excessive fuel centerline temperature due to high fuel rod power density (kW/ft). The setpoint is a function of the 109% full power ΔT, Tavg, Rate of Tavg increase, and Δ Flux. Tavg above 585 °F cause the setpoint to decrease with no credit for Tavg below 585 °F. A Δ Flux more positive than the limit in the COLR (positive breakpoint) or more negative than the limit in the COLR (negative breakpoint) causes the setpoint to decrease. This circuit also provides a rod withdrawal stop and Turbine Runback 2% (C-4) below the trip setpoint.

NC Pump Bus Low Voltage (2/4 busses = 74%) - this anticipatory loss of coolant flow trip protects against DNB. This "at-power" trip protection is auto-blocked < 10% power (P-7) and is automatically reinstated > P-7.

7.5 Reactor Trips (3/27/01)

REACTOR TRIP	SETPOINT	LOGIC	PERMISSIVES	BASES
MANUAL	Sw. turned 45°	1/2 sw.		operator judgment
S.R. NI HIGH	10^5 CPS	1/2 ch.	P6, P10	uncontrolled rod withdrawal/ startup accidents
I.R. NI HIGH	amps-25% power	1/2 ch.	P10	uncontrolled rod withdrawal/ startup accidents
P.R. NI LOW	25% power	2/4 ch.	P10	reactivity excursion from low powers
P.R. NI HIGH	109% power	2/4 ch.		reactivity excursion from all powers DNB
P.R. POS RATE	+5%/2 sec	2/4 ch.		DNB (rod ejection)
PZR HIGH PRESS	2385 psig	2/4 ch.		coolant system integrity
PZR LOW PRESS	1945 psig	2/4 ch.	P7	DNB
PZR HIGH LEVEL	92%	2/3 ch.	P7	water through safeties (system integrity)
OTΔT	$\Delta T \geq$ OTΔTsp	2/4/ ch.		DNB
OPΔT	$\Delta T \geq$ OPΔTsp	2/4 ch.		KW/FT
NCP BUS LOW VOLT	74% of normal	2/4 ch.	P7	DNB (anticipatory loss of flow)
NCP BUS LOW FREQ	56 Hz	2/4 ch.	P7	DNB (anticipatory loss of flow)
S/G LO-LO LVL	17%	2/4 in 1/4 s/g		loss of heat sink
1 LOOP LOSS OF FLOW	88%	2/3 in 1/4 loops	P8	DNB
2 LOOP LOSS OF FLOW	88%	2/3 in 2/4 loops	P7	DNB
SAFETY INJECTION	any S/I signal actuated	1/2 S/I trains		trip reactor if trip not generated by trip instrumentation
GENERAL WARNING ALARM	loose card, loss of voltage, train in test, by-pass bkr connected/closed, logic ground return fuse blown	2/2 alarms		loss of protection
TURBINE TRIP	low Auto-stop oil press <45 psig or all 4 stop valves closed	2/3 ASO Press switches 4/4 valves	P8	trip reactor on turbine trip

1 Pt Given the following conditions:

- Unit 1 has experienced a large break LOCA
- 30 minutes have elapsed since the LOCA
- FWST Lo Lo level annunciator has just alarmed

Which one (1) of the following describes the operator actions for the alignment of the containment spray system after a LOCA?

A. **Reset Containment Spray and Phase 'B' and stop NS pumps within 45 seconds and manually swap the pump alignment to take suction on the containment sump.**

B. **Reset Containment Spray and the NS pumps will automatically swap over to take a suction on the containment sump when FWST level reaches 33".**

C. **Reset Containment Spray and Phase 'B" and stop the NS pumps within 45 seconds when FWST level reaches 33" and initiate containment spray flow from the ND system.**

D. **Reset Containment Spray and stop the NS pumps within 45 seconds when FWST level reaches 33" and manually swap the pump alignment to take suction on the containment sump.**

Bank Question: 50.1 ***Answer: D***

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- 30 minutes have elapsed since the LOCA
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D. **Reset Containment Spray and stop the NS pumps within 45 seconds when FWST level reaches 33" and manually swap the pump alignment to take suction on the containment sump.**

MISCINFO: RO

SOURCE: BANK

LEVEL OF KNOWLDEGE: Memory

REFERENCES: OP-MC-ECC-NS 3.2 page 31
EP1/A/5000/FR-Z.1 4,d,2 page 5
EP/1/A/5000/ES-1.3

LESSON: OP-MC-ECC-NS

OBJECTIVE: 6, 8

K/A: 026000 K401 (3.1/3.6)

2.4.44 **Knowledge of emergency plan protective action recommendations.**
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.1 SRO 4.0

2.4.45 **Ability to prioritize and interpret the significance of each annunciator or alarm.**
(CFR: 43.5 / 45.3 / 45.12)
IMPORTANCE RO 3.3 SRO 3.6

2.4.46 **Ability to verify that the alarms are consistent with the plant conditions.**
(CFR: 43.5 / 45.3 / 45.12)
IMPORTANCE RO 3.5 SRO 3.6

2.4.47 **Ability to diagnose and recognize trends in an accurate and timely manner utilizing the appropriate control room reference material.**
(CFR: 41.10,43.5 / 45.12)
IMPORTANCE RO 3.4 SRO 3.7

2.4.48 **Ability to interpret control room indications to verify the status and operation of system, and understand how operator actions and directives affect plant and system conditions.**
(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.5 SRO 3.8

2.4.49 **Ability to perform without reference to procedures those actions that require immediate operation of system components and controls.**
(CFR: 41.10 / 43.2 / 45.6)
IMPORTANCE RO 4.0 SRO 4.0

2.4.50 **Ability to verify system alarm setpoints and operate controls identified in the alarm response manual.**
(CFR: 45.3)
IMPORTANCE RO 3.3 SRO 3.3

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.0	1.0	1.0	1.0

OBJECTIVES

	Objective	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Containment Spray (NS) System.	X	X	X	X	
2	Draw the NS System per Drawing 7.1 Containment Spray System, valve numbers and instrumentation not required.	X	X	X	X	
3	Describe the local indications and controls associated with the NS System.	X				
4	Describe the controls and indications associated with the NS System.		X	X	X	X
5	Describe the signals and permissives required to initiate the NS System.	X				
6	Describe the signals, setpoints, permissives, and logic required to initiate and reset NS System.		X	X	X	X
7	Describe the operation of the NS Pump room Air Handling Unit	X	X	X	X	X
8	Describe the NS System Operation (including automatic alignments).		X	X	X	X
9	Evaluate local plant parameters to determine any abnormal system conditions that may exist.	X				
10	Evaluate plant parameters and status indicators to determine any abnormal system conditions that may exist.		X	X	X	X
11	Given a limit and/or precaution associated with the NS System, discuss it's basis and applicability.	X	X	X	X	X
12	List the power supplies of the NS Pumps.	X	X	X	X	

3.2. Abnormal and Emergency Operation

Objective #5, 6, 8

The Containment Spray System will be initiated either manually from the Control Room or on coincidence of two out of four High-High Containment Pressure signal. For either initiating signal, Containment Pressure must be at least 0.35 psig (CPCS Signal). An "Sp" signal will start the Containment Spray Pumps and open the discharge valves to the spray headers. If after an "Sp" signal, the containment pressure decreases to < .35 psig the containment spray pumps are automatically turned off and the discharge valves are automatically closed. If the pressure increases after the pumps have stopped, the Containment Pressure Control System will automatically open the discharge valves at ≥ .35 psig and if pressure continues to increase CPCS will restart the pumps at > 0.8 psig. This provides a deadband and prevents frequent cycling of the pumps. The pumps and valves will continue cycling, at these setpoints until the spray signal is reset.

If an "Sp" signal exists (containment spray has not been reset) and containment pressure decreases below .35 psig, the NS Pumps will stop and the pump discharge valves will close. If containment pressure increases above .35 psig (opening the valves), the pumps may be manually started from the control room.

The Residual Heat Removal System shifts from the injection phase to the recirculation phase automatically when the Refueling Water Storage Tank level reaches the low level alarm point (180"). If the automatic switchover fails, the operator is instructed to manually switch to the recirculation.

The NS pumps are manually aligned to the containment sump by the operator when the FWST reaches the low-low level alarm point (33"). When the FWST low-low level alarm is received, the operator has about 45 seconds to stop the NS Pumps before pump vortexing (air entrainment) begins. This 45 seconds assumes that both NS Pumps are running and some conservative assumptions on vortexing phenomena.

The spray flow from the Residual Heat Removal Pumps is initiated to assure adequate spray to counteract any rise in Containment pressure that might occur after all the ice has melted. FSAR Figure 6-12 shows the ice melt transient lasting about one hour.

NS System CPCS Failures (EP/1/A/5000/FR-Z.1, Enclosure 2)

Objective #3

In the event of a CPCS malfunction, some local operator actions may be required. A malfunction may require the operator to locally place valves in the desired position. Other malfunctions may require obtaining keys from the key locker, and proceeding to the CPCS Cabinet (Auxiliary Building, 750 - Train A, 733 - Train B, Electrical Penetration Room). Here the key would be used to place the appropriate control switch for the malfunctioning component in the "TEST" position. The test potentiometer would then be adjusted until the component responded as desired.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
8. **Check if NS should be aligned for recirc as follows:**	
__ a. Check "FWST LEVEL LO-LO" alarm - LIT.	a. Perform the following: **CAUTION** • **Steps to reset Containment Spray and stop NS pumps must be completed within 45 seconds of receiving "FWST Level LO-LO" alarm.** • **This step applies even after leaving this EP.** 1) <u>WHEN</u> "FWST LEVEL LO-LO" alarm setpoint (33 inches) is reached, <u>THEN</u> immediately perform the following: __ a) Reset Containment Spray. __ b) Stop 1A NS Pump. __ c) Stop 1B NS Pump. __ d) Perform Steps 8.e through 8.h. __ 2) Ensure this step is flagged and crew prepared to perform it immediately upon receiving alarm. __ 3) <u>GO TO</u> Step 9.
__ b. Reset Containment Spray.	
__ c. Stop 1A NS Pump.	
__ d. Stop 1B NS Pump.	

1 Pt. A large break LOCA is in progress and the operators are responding in FR-Z.1 (*Response to High Containment Pressure*). Given the following conditions:

- ND pump 1A is tagged out of service for maintenance.
- Containment pressure is 14 psig.
- FWST level reaches the swap-over setpoint.

When shifting to cold leg recirc using ES-1.3 (Transfer to Cold Leg Recirc), valve 1NI-184B (RB Sump to Train 1B ND & NS) fails to open. The operators implement ECA-1.1 (Loss of Emergency Coolant Recirculation).

FR-Z.1 (Response to High Containment Pressure) requires both NS pumps to be in operation. ECA-1.1 limits the operators to only one NS pump in step 6. Which of these two procedures takes priority under these conditions and what is the basis for this requirement?

A. FR-Z.1 takes priority because a total loss of ND causes the NS system to become relatively more important to reduce containment pressure.

B. FR-Z.1 takes priority because it was implemented in response to a red path and FRPs always have priority over ECA procedures.

C. ECA-1.1 takes priority because it conserves FWST water level as long as possible for injection while providing sufficient NS flow to mitigate containment pressure.

D. ECA-1.1 takes priority because ECA procedures always have priority over FRPs.

Bank Question: 51.1 ***Answer: C***

1 Pt. A large break LOCA is in progress and the operators are responding in FR-Z.1 (*Response to High Containment Pressure*). Given the following conditions:

- ND pump 1A is tagged out of service for maintenance.
- Containment pressure is 14 psig.
- FWST level reaches the swap-over setpoint.

When shifting to cold leg recirc using ES-1.3 (Transfer to Cold Leg Recirc), valve 1NI-184B (RB Sump to Train 1B ND & NS) fails to open. The operators implement ECA-1.1 (Loss of Emergency Coolant Recirculation).

FR-Z.1 (Response to High Containment Pressure) requires both NS pumps to be in operation. ECA-1.1 limits the operators to only one NS pump in step 6. Which of these two procedures takes priority under these conditions and what is the basis for this requirement?

A. FR-Z.1 takes priority because a total loss of ND causes the NS system to become relatively more important to reduce containment pressure.

B. FR-Z.1 takes priority because it was implemented in response to a red path and FRPs always have priority over ECA procedures.

C. ECA-1.1 takes priority because it conserves FWST water level as long as possible for injection while providing sufficient NS flow to mitigate containment pressure.

D. ECA-1.1 takes priority because ECA procedures always have priority over FRPs.

Distracter Analysis:

A. **Incorrect**: ECA-1.1 takes priority over FR-Z.1
Plausible: Although a loss of ND and containment sump recirc causes a loss of the containment heat sink, the supply for NS comes from the FWST which will be drawn down until containment sump recirculation can be established.

B. **Incorrect**: ECA-1.1 takes priority over FR-Z.1
Plausible: FRPs normally take priority over most EOPs

C. **Correct answer**

D. **Incorrect**: ECAs do not always have priority over FRPs.
Plausible: Some ECAs take priority e.g. ECA-0.0 has priority over FRPs in that F-0 is not applicable until transition out of ECA-0.0.

Level: RO

KA: G2.4.23 (2.8/3.8)

Source: Bank

Lesson Plan Objective: EP-FRZ Obj. 4

Level of Knowledge: Memory

Reference:
1. OP-MC-EP-FRZ pages 21 & 25

2.4 Emergency Procedures /Plan (Continued)

2.4.18 Knowledge of the specific bases for EOPs.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.7 SRO 3.6

2.4.19 Knowledge of EOP layout, symbols, and icons.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.7 SRO 3.7

2.4.20 Knowledge of operational implications of EOP warnings, cautions, and notes.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.3 SRO 4.0

2.4.21 Knowledge of the parameters and logic used to assess the status of safety functions including:
1. Reactivity control
2. Core cooling and heat removal
3. Reactor coolant system integrity
4. Containment conditions
5. Radioactivity release control.

(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.7 SRO 4.3

2.4.22 Knowledge of the bases for prioritizing safety functions during abnormal/emergency operations.
(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.0 SRO 4.0

2.4.23 Knowledge of the bases for prioritizing emergency procedure implementation during emergency operations.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.8 SRO 3.8

2.4.24 Knowledge of loss of cooling water procedures.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.3 SRO 3.7

2.4.25 Knowledge of fire protection procedures.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.9 SRO 3.4

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		0.5	0.5	0.5

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose of each procedure in the FR-Z series. EPFRZ001			X	X	
2	Discuss the entry and exit guidance for each procedure in the FR-Z series. EPFRZ002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the FR-Z series. EPFRZ003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the FR-Z series. EPFRZ004			X	X	X
5	Given the Foldout page, discuss the actions included and the basis for these actions. EPFRZ005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPFRZ006			X	X	X
7	Discuss the time critical task(s) associated with the FR-Z series procedures including the time requirements and the basis for these requirements. EPFRZ007			X	X	X

3.4. Detailed Description of Procedural Steps

STEP 1 <u>IF</u> loss of emergency coolant recirc has occurred, <u>THEN</u> this procedure may be completed as time allows. (Continuous Action)

<u>PURPOSE:</u> To allow completing this procedure as time allows if a loss of emergency coolant recirc event is occurring.

<u>BASIS:</u> Delays caused by implementing FR-Z.1 during a scenario involving a large LOCA and failure to transfer to Cold Leg Recirc (CLR), greatly diminish operators capability to successfully mitigate this event. To maintain core cooling during this beyond design base event, flexibility is given to perform actions in ECA-1.1 as a higher priority than FR-Z.1.

STEP 4 Check containment isolation:

PURPOSE: To ensure non-essential containment penetrations are isolated.

BASIS: This step instructs the operator to check the Phase A and Phase B containment isolation valves closed. This prevents the release of radioactive materials from containment. It should be noted that operator actions in other procedures may have resulted in deliberate actions to defeat containment isolation of specific fluid lines.

STEP 5 Check NS System in operation as follows:

PURPOSE: To ensure NS pumps are operated as directed in ECA-1.1 instead of this procedure if ECA-1.1 is in effect.

BASIS: This steps instructs the operator to operate NS as indicated in ECA-1.1 if appropriate. This procedure specifies maximum available heat removal in order to reduce containment pressure. ECA-1.1 permits reduced spray pump operation depending on FWST level and containment pressure. The criteria for containment spray operation is used in ECA-1.1 since recirculation flow to the NC is not available and it is very important to conserve FWST water, if possible, by stopping the NS pumps.

1 Pt. 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.

Bank Question: 60.1 ***Answer: A***

1 Pt. 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 risk 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)

LEVEL: RO

LEVEL OF KNOWLEDGE: Memory

SOURCE: BANK

KA: 000067 AK3.02 (2.5/3.3)

Lesson Plan: OP-MC-SS-RFY

OBJECTIVE: OP-MC-SS-RFY Obj. 11

REFERENCE: OP-MC-SS-RFY pages 37, 49, 51, 53

APE 067: Plant fire on site

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Plant Fire on Site: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Fire classifications, by type	2.9	3.9
AK1.02	Fire fighting	3.1	3.9
AK2.	**Knowledge of the interrelations between the Plant Fire on Site and the following: (CFR 41.7 / 45.7)**		
AK2.01	Sensors, detectors and valves	2.3	2.5*
AK2.02	Controllers and positioners	2.0	2.3
AK2.03	Motors	1.9	2.1
AK2.04	Breakers, relays, and disconnects	1.9	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Plant Fire on Site: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Installation of fire detectors	2.3	2.8
AK3.02	**Steps called out in the site fire protection plan, FPS manual, and fire zone manual**	**2.5**	**3.3**
AK3.03	Fire detector surveillance test	2.0*	2.5*
AK3.04	Actions contained in EOP for plant fire on site	3.3	4.1
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Plant Fire on Site: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Respirator air pack	3.6	3.6
AA1.02	Re-installation of a fire detector	2.4*	2.5*
AA1.03	Bypass of a fire zone detector	2.5*	2.8*
AA1.04	Bypass of a heat detector	2.5*	2.7*
AA1.05	Plant and control room ventilation systems	3.0	3.1
AA1.06	Fire alarm	3.5	3.7
AA1.07	Fire alarm reset panel	2.9	3.0
AA1.08	Fire fighting equipment used on each class of fire	3.4	3.7
AA1.09	Plant fire zone panel (including detector location)	3.0	3.3

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	*Discuss the function of the following components on the Fire* Pump Room thermostat panels: • Temperature setting control knob • Hi/Lo speed indication • AUTO/OFF Switch • Room heaters	X	X	X	X	
9	Discuss the following supply headers tapping off the Main Fire Pump discharge header: • *Low Level Intake Pump bearing* • Condenser Circulating Water Pump bearing • CCW Intake Screen Backwash	X	X	X	X	
10	Describe the operational differences between a mulsifyre system and a sprinkler system.	X	X	X	X	
11	Describe the major areas that are protected by the following fire protection systems: • Mulsifyre System • Sprinkler system	X	X	X	X	
12	Explain the basic principle of mulsifyre operation including how holding pressure is relieved.	X	X	X	X	
13	Discuss the three basic devices used to trip a mulsifyre.	X	X	X	X	
14	Discuss how alarms are generated on the Fire Protection System annunciator alarm panels (AD-1,2,3,4 and 5).	X	X	X	X	
15	Discuss operator response to alarms on the Fire Protection System Annunciator Alarm Panels including how to acknowledge and silence alarms.	X	X	X	X	

2.9 Components/Areas Protected by Mulsifyre System

Objective #11

The Automatic deluge (Mulsifyre) systems, which provide fixed spray patterns of water similar to a sprinkler system, are provided for:

- **Main and station oil filled power transformers (1A, 1B, 2A & 2B)**
- **Auxiliary transformers(1ATA, 1ATB, 2ATA, & 2ATB)**
- **Auxiliary Electric Boiler oil filled transformers (1ATE, 2ATE)**
- ***Spare oil filled transformers***
- **Turbine oil reservoirs, oil piping, and bearings in Unit 1 & 2 as follows:**
  - **Main Turbine piping and bearings**
  - **MTOT**
  - **FWPT lube oil reservoir**
  - **Hydrogen seal oil unit**
  - **D/G lube oil transfer storage tanks(clean and dirty)**
  - **Main Turbine lube oil transfer tanks**
  - **Oil Purifier areas**
  - **Lube Oil house in service building**
- **Acetylene and oxygen storage in the yard**

Manually operated mulsifyre systems are provided for the unit 1 & 2 cable rooms. These systems consist of a number of open spray nozzles with locked closed manual isolation valves. When the valve is opened, water discharges from all the nozzles in the system.

The following HVAC filters contain built in deluge systems:

- **VE filters (1A, 1B, 2A, 2B)**
- **Fuel Pool area filters Unit 1 & 2**
- **Auxiliary Building exhaust filters (1A, 1B, 2A, 2B)**
- **Reactor Building Purge Exhaust filters (1A, 1B, 2A, 2B)**
- **Control Room *Ventilation Unit* 1 & 2**
- **Counting Room supply unit**
- **Incore Instrumentation room purge exhaust filter Unit 1 & 2**
- **Onsite TSC filter unit**

2.12.2 Diesel Generator Halon Fire Suppression System

The two Diesel Generators provided for each unit are protected by one Halon 1301 fire suppression system (refer to Drawing 7.8). This system has a main and reserve bank of cylinders. **It is designed so that a bank of cylinders will discharge into either of the Diesel Generator rooms if needed. Each Diesel Generator room is equipped with thermostats, pushbutton discharge stations, an abort switch, a selector valve and alarms. If there is a fire in a Diesel Generator room, the thermostats in this area automatically cause each of the following:**

- **An alarm and blue light**
- **Shutdown of air intake and discharge ports for the Diesel Generator**
- **Discharge of halon**
- **Opening of the selector valve for this room**
- **Trip the diesel**
- **Trip all lube and fuel oil pumps**

Actuation of the halon system can also be done manually by the manual discharge switches located on two panels in each room or by a manual lever located on the cylinder assembly. If the manual lever is used, the pilot valve which controls the opening of the selector valve must be manually opened.

This halon system is also equipped with a time delay device which will delay the discharge of halon for 20 seconds after an automatic actuation. This allows the operator time to abort the discharge. The time delay operates only on automatic actuation of the system.

Objective #21

Each Diesel Generator Halon Fire Suppression System is equipped with the following controls and indication:

- **A "Transfer Switch" (main/reserve positions) located at the halon cylinders.**
- **A manual actuator lever and pull key for each main and reserve halon bottle.**
- **Two Fire Protection Control Panels in each Diesel room (one at the front and rear of the room) each of which contain: (refer to Drawing 7.9)**
  - **Main Actuator pushbutton**
  - **Reserve Actuator pushbutton**
  - **An ABORT/OFF pushbutton**
- **A halon supply control valve (pilot valve) and pull key on one of the two halon actuation panels in each diesel room. (these panels are located near the door connecting the Diesel generator rooms)**
- **A CARDOX pressure switch plunger (push to reset) on the halon actuator panels in each diesel room.**

The <u>"Transfer Switch"</u> **(main/reserve positions) located at the halon cylinders is used to select the bank of halon cylinders that will automatically dump into a selected diesel room during a fire.** Two solenoids automatically open to allow actuation to occur. One solenoid, mounted on a nitrogen bottle pressurized to ≅ 1000 psig, opens to admit nitrogen up to the first main or reserve cylinder (refer to Drawing 7.10). This nitrogen then forces open a valve that permits halon to exit the bottle onto the header. Then the room select pilot solenoid located under one of the Fire Protection Control Panel permits a pilot halon pressure signal to be sent back to the room select valve for the room in question. This pilot pressure signal opens the appropriate room select valve permitting halon to enter the room. Both solenoids will close when the fire detection signal has cleared (temperature below thermostat setting).

Objective #23

The **manual actuator lever and pull key** are used in conjunction with **the halon supply control valve (pilot valve)** and **pull key** to manually actuate halon. **First the pull key is removed and the pilot valve is opened. This allows a pilot pressure to be sent to the room select valve when halon is released to the header. Then the pull key for the manual lever is removed and the lever pulled downward. This releases halon to the header. Once the pilot pressure signal has returned to the room select valve, the valve opens. Halon is then dumped to suppress the fire.** Once all the halon has dumped the pilot valve should be closed. This will allow the remaining bank of halon bottles to be used to suppress fires in the other diesel room or same room if another fire occurs.

Objective #22

The <u>MAIN</u> and <u>RESERVE</u> actuator pushbuttons, located on each of the actuation panels, in each diesel room are used to electrically actuate either bank of halon cylinders regardless of MAIN/RESERVE switch positions (refer to Drawing 7.11). By depressing the MAIN or RESERVE pushbuttons (and holding for five seconds) the appropriate solenoid valve is opened at the nitrogen bottle. The solenoid valve, located on the actuator panel in the diesel room, is also opened. This allows halon to be sent to whichever room the MAIN or RESERVE actuator pushbutton is located in. **For proper discharge, the button must be held for no less than five seconds. The <u>ABORT/OFF</u> switch, located on each of the actuation panels, in each diesel room is used to stop any automatic halon actuation**. This button locks into place and an ABORTED light will illuminate. Abort will de-energize the two solenoid valves that open on automatic actuation only. A manual electric actuation cannot be aborted.

Objective #24

The <u>CARDOX pressure switch plunger</u> (push to reset), located under the actuation panel near the door in each diesel room, is used to TRIP and RESET the diesel room Emergency Ventilation Fans. When the pilot pressure signal is sent to the room select valve, this pressure also exerts enough force on the CARDOX pressure switch to trip it. With this switch tripped, the control power to the Emergency Ventilation Fans is de-energized causing them to trip. A plunger, located on the bottom of the CARDOX pressure switch, is used to reset it. Once halon has dumped and all other

signals reset, the operator pushes upward on the plunger. This reinstates control power to the Emergency Ventilation Fans.

2.12.3 **Turbine Driven Auxiliary Feedwater Pump Halon Fire Suppression System**

There is one Auxiliary Feedwater Pump Turbine Halon 1301 Fire Suppression system per unit. It has one main and one reserve halon cylinder located in the Turb Bldg basement on the north wall between col. 1L34 and 1M34 for unit #1 and 2L34 and 2M34 for unit #2. The operation of the system is basically the same as that of the Diesel Generator. The exception is that there are no room selector valves because each system is dedicated to one area. **Each Auxiliary Feedwater Pump Turbine Halon Fire Suppression system is equipped with the following controls and indication:**

- **A CARDOX pressure switch plunger (push to reset)**
- **A manual actuation lever and pull key for both the main and reserve cylinders**
- ***A discharge station main ON/OFF switch***
- **A discharge station reserve ON/OFF switch**
- **A system ABORT ON/OFF switch**
- **A "CA Halon Bank Select Switch"**

Objective #24

The CARDOX pressure switch plunger (push to reset), located on the discharge manifold near the Halon cylinders, is used to generate a signal. This signal is used to close fire dampers on ventilation duct work entering the Auxiliary Feedwater Pump Turbine Room. It also energizes alarm bells located near the Turbine Room to alert the plant that a halon discharge has occurred. An annunciator alarm is also generated from this pressure switch.

Objective #25

Each halon cylinder has a pull key and manual actuator lever **associated with it to allow manual pneumatic operation (refer to Drawing 7.12). These devices work in conjunction with each other to allow an operator to manually dump halon into the CA Turbine Room.** The operator removes the pull key from the halon bottle. The operator then pulls downward on the manual actuation lever allowing halon to escape from the bottle. This escaped halon is used as a pilot pressure to open the bottles main valve to the manifold. This allows halon to be dumped into the room.

Objective #26

MAIN and RESERVE ON/OFF switches are located on the CA Turbine Halon *discharge station to allow manual electric operation* (refer to Drawing 7.13). The ON/OFF switch is used to activate that cylinder. If the MAIN or RESERVE ON/OFF switch is selected to ON, a signal is sent to the fire dampers in the CA Turbine room to close. A signal is also sent to the solenoid valve mounted on the appropriate MAIN/RESERVE cylinder. When energized this solenoid valve allows halon from the bottle to be admitted to the manifold and into the turbine room. Once halon enters the

1 Pt Unit 1 is at 12% power with 4 NCPs running during a plant startup when an electrical transient occurs on the 6.9KV busses.

Given the following transient conditions:

	Electrical Bus			
Parameter	TA	TB	TC	TD
Frequency (Hz)	55	60	55	60
Voltage (Volts AC)	6800	6900	6800	6900

Offsite bus-line 1A is supplying TA and TC
Offsite bus-line 1B is supplying TB and TD

Which one of the following describes the immediate plant response to this transient?

A. **No NCP pumps trip and the reactor does NOT trip**

B. **The 1' A 'and 1 'C' NCPs trip and the reactor trips**

C. **All four NCPs trip but the reactor does NOT trip**

D. **All four NCPs trip and the reactor trips**

Bank Question: 63.1 ***Answer: D***

1 Pt Unit 1 is at 12% power with 4 NCPs running during a plant startup when an electrical transient occurs on the 6.9KV busses.

Given the following transient conditions:

	Electrical Bus			
Parameter	TA	TB	TC	TD
Frequency (Hz)	55	60	55	60
Voltage (Volts AC)	6800	6900	6800	6900

Offsite bus-line 1A is supplying TA and TC
Offsite bus-line 1B is supplying TB and TD

Which one of the following describes the immediate plant response to this transient?

A. No NCP pumps trip and the reactor does NOT trip

B. The 1' A 'and 1 'C' NCPs trip and the reactor trips

C. All four NCPs trip but the reactor does NOT trip

D. All four NCPs trip and the reactor trips

Level: RO

SOURCE: BANK

Level of Knowledge: Analysis

REFERENCES: OP-MC-PS-NCP pages 29 & 31
OP-MC-IC-IPE pages 47 & 81
OP-MC-EL-EP pages 41 & 43

LESSON: OP-MC-PS-NCP
OP-MC-IC-IPE
OP-MC-EL-EP

OBJECTIVE: OP-MC-PS-NCP Obj. 15
OP-MC-IC-IPE Obj. 10
OP-MC-EL-EP Objs. 23 & 24

K/A: EPE 007 EA1.04 (4.2/4.1)

Ques_63.1.doc

EPE: 007 Reactor Trip

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the reactor trip:** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Principles of neutron detection	2.4	2.9
EK1.02	Shutdown margin	3.4	3.8
EK1.03	Reasons for closing the main turbine governor valve and the main turbine stop valve after a reactor trip	3.7	4.0
EK1.04	Decrease in reactor power following reactor trip (prompt drop and subsequent decay)	3.6	3.9
EK1.05	Decay power as a function of time	3.3	3.8
EK1.06	Relationship of emergency feedwater flow to S/G and decay heat removal following reactor trip	3.7	4.1
EK2	**Knowledge of the interrelations between a reactor trip and the following:** (CFR 41.7 / 45.7)		
EK2.01	Sensors and detectors	2.3	2.3
EK2.02	Breakers, relays and disconnects	2.6	2.8
EK2.03	Reactor trip status panel	3.5	3.6
EK2.04	Controllers and positioners	2.3	2.4
EK3	**Knowledge of the reasons for the following as the apply to a reactor trip:** (CFR 41.5 /41.10 / 45.6 / 45.13)		
EK3.01	Actions contained in EOP for reactor trip	4.0	4.6
	ABILITY		
EA1	**Ability to operate and monitor the following as they apply to a reactor trip:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	T/G controls	3.7	3.4
EA1.02	MFW System	3.8	3.7
EA1.03	RCS pressure and temperature	4.2	4.1
EA1.04	RCP operation and flow rates	3.6	3.7
EA1.05	Nuclear instrumentation	4.0	4.1
EA1.06	Reactor trip (scram): verification that the control and safety rods are in after the trip	4.4	4.5
EA1.07	MT/G trip; verification that the MT/G has been tripped	4.3	4.3
EA1.08	AFW System	4.4	4.3
EA1.09	CVCS	3.2	3.3
EA1.10	S/G pressure	3.7	3.7
EA2	**Ability to determine or interpret the following as they apply to a reactor trip:** (CFR 41.7 / 45.5 / 45.6)		
EA2.01	Decreasing power level, from available indications	4.1	4.3
EA2.02	Proper actions to be taken if the automatic safety functions have not taken place	4.3	4.6
EA2.03	Reactor trip breaker position	4.2	4.4

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Describe the controls and any interlocks associated with the Reactor Coolant Pump and Motor.	X	X	X	X	X
9	Given a parameter associated with the Reactor Coolant Pumps or Motors describe the indications for that parameter.			X	X	X
10	Given a limit and/or precaution associated with an operating procedure, discuss its basis and applicability.			X	X	X
11	Explain the reason for closing the NC Pump Seal Return valves when NCS pressure is below 100 psi.		X	X	X	X
12	Concerning the NC Pump seals: • Describe the general design of the NC Pump Seals. • Discuss the purpose of seal injection. • Discuss the flowpaths, flowrates and differential pressures associated with each seal. • Discuss the purpose of the seal injection throttle valves. • Discuss the purpose of the standpipes and the operation of the standpipe (draining and filling).	X	X	X	X	X
13	Describe the operation for adjusting NC Pump seal controlled leakage.		X	X	X	X
14	Concerning NC Pump Vibration Monitoring System:					
	• State the purpose of the system.			X	X	
	• Discuss the operation of the system.			X	X	X
15	State the parameters and setpoints which would require an NC Pump to be stopped.			X	X	X

Approximately 100 cc/hr from the No. 2 seal is directed to the No. 3 seal. The pressure drops from 3 psig to atmospheric across this seal. After passing through the seal the leakoff is directed to the NCDT.

The minimum and maximum flow rates and temperatures for seal injection water are 6 gpm and 50° F and 12 gpm and 150° F, respectively.

Objective #9

No.1 seal temperature, injection flow, and ΔP indications are provided on the Main Control Board. Recorders are provided for No. 1 seal leakoff flow indicating low range (0-2 gpm) and high range (0-6 gpm) flow. Other indications are provided on the OAC.

2.4 NC Pump Monitor System

Objective #15

The purpose of the EME system is to monitor the voltage and frequency of the 6900V power source for the reactor coolant pump motors. Following a drop in either parameter below its setpoint, the monitoring system will provide a signal to the Solid State Protection System (SSPS) to indicate the condition. If an under-frequency condition exists on 2/4 monitored channels, all NC Pump circuit breakers will trip and if reactor power is greater than P-7 (10%), the reactor will also trip.

Due to the direct impact of the EME system on the performance of the Reactor Protection System (through the SSPS reactor trip circuit), it is classified as nuclear safety related. By definition, the Reactor Protection System is designed to shut down the reactor to protect against fuel cladding damage or loss of system integrity, which may result in the release of radioactive fission products into Containment.

The under-voltage and under-frequency monitors are voltage and frequency sensing devices, respectively. Each monitor's output sends a signal to its corresponding auxiliary relay which in turn sends a signal to the SSPS to indicate the condition. If 2 out of the 4 channels monitored indicate an under-voltage (or under-frequency) condition, the SSPS will initiate a reactor trip (1/4 causes an NC Pump Bus Alert alarm in the Control Room). As listed in Technical Specification Table 3.3.1-1 #11 and # 12, the under-voltage monitor shall indicate an under-voltage condition if the voltage drops to 5016V on the 6900V bus. Likewise, the under-frequency monitor shall indicate an under-frequency condition if the frequency drops to 55.9 Hz on the 6900V bus.

For an under-frequency condition, the reactor coolant pump circuit breakers will be tripped as well. Note that at a power level less than the P-7 interlock the SSPS Reactor Trip Function on under-voltage and/or under-frequency will be blocked. However, the P-7 interlock will **NOT** block the trip of the Reactor Coolant Pump Safety Breakers. If an under-frequency condition exists on 2 or more pumps, the Reactor Coolant Pump Safety breakers will be tripped, regardless of the power level.

The actual setpoint of the under-voltage monitor is 5082V to ensure that the monitor and its auxiliary relay do not violate the Technical Specification requirement. Potential transformers with ratios of 60/1 translate the 5016V and 5082V to monitor sensing values of 83.6V and 84.7V, respectively.

The actual setpoint of the under-frequency monitor is 56.4Hz to ensure that the monitor and its auxiliary relay do not violate the Technical Specification requirement.

The under-frequency monitor has a low voltage threshold sensing which, for an input voltage less than 25V, will send an under-frequency condition signal.

The basis for both the under-voltage and under-frequency setpoints is taken from the Westinghouse RPS/ESFAS Setpoint Methodology Document. It lists the following under-voltage setpoints:

Tech Spec trip setpoint	77% of bus voltage
Tech Spec allowable value	76% of bus voltage
Safety analysis limit (setpoint)	68% of bus voltage

6600 V is the standard nameplate motor voltage upon which the under-voltage setpoints were based.

The document lists the following under-frequency setpoints:

Tech Spec trip setpoint	56.4 Hertz
Tech Spec allowable value	55.9 Hertz
Safety analysis limit (setpoint)	55.8 Hertz

Reactor trip based on either under-voltage or under-frequency to the reactor coolant pumps shall occur during a Complete Loss of Reactor Coolant Flow. Loss of coolant flow may occur as a result of a Loss of Offsite Power (LOOP) event or a major power disturbance on the grid. The 25V input sensing threshold voltage is employed on the under-frequency monitor to prevent the relay from toggling between the trip/not trip states. Without any voltage input, and therefore no frequency, the monitor does not know whether or not to initiate a trip; it must have some voltage, however minimal, to make the decision. The threshold voltage ensures that the monitor will send a trip signal to the auxiliary relay for zero input voltage conditions (during outages, for example, when the RCP's aren't running).

The trip setpoints protect the core and reactor coolant system by initiating a reactor trip prior to the Low Flow Trip Setpoint being reached.

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Describe the function of the First-Out annunciator panel. ICIPE008		X	X	X	
9	Given a Limit and/or Precaution associated with an operating procedure, discuss its basis and applicability. ICIPE009		X	X	X	X
10	List all the Reactor Trip Signals including the setpoints, logic permissives and bases/protection afforded by each. ICIPE010		X	X	X	X
11	List all the protective system permissive ("P" signal) interlocks to include input parameter(s), logic and function. For interlocks which provide Trip block, state the Trips affected and whether Auto or Manual block. ICIPE011		X	X	X	X
12	List all the protection system control ("C" signal) interlocks including logic and functions. ICIPE012		X	X	X	X
13	Briefly describe the incident that occurred at Salem Nuclear Plant and how this event affected McGuire Reactor Trip Breaker operation. ICIPE013		X	X	X	X

Objective # 10

NC Pump Bus Under Frequency (2/4 busses = 56 Hz) - this anticipatory loss of coolant flow trip protects against DNB. The trip also trips open all four NC pump breakers to prevent electrical braking of the pump motors during frequency decay. A reduction in pump speed would reduce fly wheel inertia and pump coast down flow capability. This "at-power" trip protection is auto-blocked < 10% power (P-7) and is automatically reinstated > P-7.

SG Lo-Lo Level (2/4 channels on 1/4 SGs = 17%) - protects against a loss of heat sink. This protection also causes an auto-start of the CA motor driven pumps (2/4 channels on 1/4 SGs) and the CA turbine driven Pump (2/4 channels on 2/4 SGs).

Single Loop Loss of Flow (2/3 channels in 1/4 loops = 88%) - protects against DNB. This protection is auto-blocked < 48% (P-8) and automatically reinstated > P-8.

Two Loop Loss of Flow (2/3 channels in 2/4 loops = 88%) - protects against DNB. This protection is auto-blocked < 10% (P-7) and automatically reinstated > P-7.

Safety Injection (any SI signal 1/2 Trains) - initiates a reactor trip during LOCA events.

Turbine Trip (2/3 channels ASO < 45psig, 4/4 stop valves closed) - protects against loss of integrity by preventing Pressurizer PORVs from opening on turbine trip at high power.

Objective # 4, 10

General Warning (2/2 Trains) - protects against a loss of both protection trains. Anytime a General Warning is present on both SSPS trains a reactor trip will occur. General Warning is caused by: loose circuit board card; loss of voltage (AC or DC); SSPS train in "Test"; a Reactor Trip By-pass breaker in the Connected position and Closed; a Logic Ground Return fuse blown.

3.1.3 Protection Permissive Interlocks

Objective # 11

P-4 (Reactor Trip Breaker and Bypass Breaker Open for a given train) - initiates: Turbine Trip; Feedwater Isolation (coincident with low Tavg of 553 °F); Allows reset of SI signal after one minute time-out; Inputs to Steam Dump Control System for plant trip mode.

P-6 (1/2 IR instruments > 10^{-10} amps) - allows Manual Block of SR reactor trip. On a power reduction, provides automatic reinstatement of SR high voltage and SR reactor trip when 2/2 IR channels < 10^{-10} amps.

P-7 (2/4 PR instruments > 10% or 1/2 Turbine Impulse Pressures > 10%) - Enables (unblocks) the "at power" reactor trips: Pzr Hi-Level, Pzr Lo-Pressure, 2 Loop Loss of Flow, NCP UV, and NCP UF. The above trips are automatically blocked when below P-7, 3/4 PR < 10% and 2/2 Impulse Pressure < 10%.

7.5 Reactor Trips (3/27/01)

REACTOR TRIP	SETPOINT	LOGIC	PERMISSIVES	BASES
MANUAL	Sw. turned 45°	1/2 sw.		operator judgment
S.R. NI HIGH	10^5 CPS	1/2 ch.	P6, P10	uncontrolled rod withdrawal/ startup accidents
I.R. NI HIGH	amps-25% power	1/2 ch.	P10	uncontrolled rod withdrawal/ startup accidents
P.R. NI LOW	25% power	2/4 ch.	P10	reactivity excursion from low powers
P.R. NI HIGH	109% power	2/4 ch.		reactivity excursion from all powers DNB
P.R. POS RATE	+5%/2 sec	2/4 ch.		DNB (rod ejection)
PZR HIGH PRESS	2385 psig	2/4 ch.		coolant system integrity
PZR LOW PRESS	1945 psig	2/4 ch.	P7	DNB
PZR HIGH LEVEL	92%	2/3 ch.	P7	water through safeties (system integrity)
OTΔT	$\Delta T \geq OT\Delta Tsp$	2/4/ ch.		DNB
OPΔT	$\Delta T \geq OP\Delta Tsp$	2/4 ch.		KW/FT
NCP BUS LOW VOLT	74% of normal	2/4 ch.	P7	DNB (anticipatory loss of flow)
NCP BUS LOW FREQ	56 Hz	2/4 ch.	P7	DNB (anticipatory loss of flow)
S/G LO-LO LVL	17%	2/4 in 1/4 s/g		loss of heat sink
1 LOOP LOSS OF FLOW	88%	2/3 in 1/4 loops	P8	DNB
2 LOOP LOSS OF FLOW	88%	2/3 in 2/4 loops	P7	DNB
SAFETY INJECTION	any S/I signal actuated	1/2 S/I trains		trip reactor if trip not generated by trip instrumentation
GENERAL WARNING ALARM	loose card, loss of voltage, train in test, by-pass bkr connected/closed, logic ground return fuse blown	2/2 alarms		loss of protection
TURBINE TRIP	low Auto-stop oil press <45 psig or all 4 stop valves closed	2/3 ASO Press switches 4/4 valves	P8	trip reactor on turbine trip

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
12	*List the normal operating voltages at both the low and high* side of the Main Step-Up Transformers (Unit 1 and 2).	X	X	X	X	X
13	Describe the "primary" and the "secondary" use for the Main Step-Up Transformers.	X	X	X	X	X
14	List the Auxiliary Transformers, for each unit, and their normal operating voltages at both the low and high sides.	X	X	X	X	X
15	Describe the design loads each Auxiliary Transformer is sized to carry.	X	X	X	X	X
16	List the three components that make up the Main Generator Circuit.	X	X	X	X	X
17	Explain the advantage(s) of using Generator Breakers.	X	X	X	X	X
18	Describe the six steps of electricity production from the PMG to the Generator Output.	X	X	X	X	X
19	State the purpose for both the 6900 V and 13.8 KV power systems.	X	X	X	X	X
20	List the normal and alternate power supplies to the 6900 V buses.	X	X	X	X	X
21	Describe the Kirk-Key Interlock associated with the 6900 V feeder breakers to SATA (SATB) and state the purpose of this Kirk-Key arrangement.	X	X	X	X	X
22	List the normal and alternate power supplies to Auxiliary Transformers SATA and SATB.	X	X	X	X	X
23	State the two reasons for providing Safety Breakers on the Reactor Coolant Pumps.	X	X	X	X	X
24	Describe the Automatic Fast Transfer feature associated with the 6900 V switchgear.	X	X	X	X	X
25	Describe the Automatic Slow Transfer feature associated with the 6900 V switchgear	X	X	X	X	X

Objective # 20

Auxiliary Transformers 1ATA and (2ATA) normally feed power to 1TA and 1TC (2TA and 2TC) through normal source breakers and can alternately feed power to (1TB and 1TD (2TB and 2TD) through alternate source breakers.

Auxiliary Transformers 1ATB and (2ATB) normally feed power to 1TB and 1TD (2TB and 2TD) through normal source breakers and can alternately feed power to 1TA and 1TC (2TA and 2TC) through alternate source breakers.

Objective # 21 & 22

Kirk-Key Interlock arrangements are used to prevent tying two separate power sources together; such as Unit 1 and Unit 2 in the case of SATA (SATB).

Transformers SATA (SATB) have a one-key Kirk Key Interlock arrangement *associated with their 6900 V supplies from 1TC & 2TC (1TB & 2TB).* This interlock will only allow one of the associated 6900 V feeder breakers to be inserted into an operating position at a time (either 1TC or 2TC for SATA and either 1TB or 2TB for SATB). (Referencing training drawing 7.1, Main Power Distribution Unit 1 *Interconnections, may help in understanding the explanation above.)*

Currently both SATA and SATB are powered from Unit 2 whenever Unit 2 is in Mode 1 - 4. (There is an FSAR Commitment that at least one of SATA or SATB be normally powered from its Unit 2 supply when Unit 2 is in modes 1 - 4.) Hence, SATA will normally be powered from Unit 2 through 2TC with its alternate power supplied from Unit 1 through 1TC; and SATB will normally be powered from Unit 2 through 2TB with its alternate power supplied from Unit 1 through 1TB. During outage conditions we typically align both SATA and SATB to the non-outage unit due to anticipated busline work during the outage.

__NOTE__: **Control power fuses must be installed in 1TC cubicle 4 (SATA) and 1TB cubicle 4 (SATB) regardless of whether SATA or SATB are being supplied 6900 V power from Unit 1 or Unit 2. Power for operation of the differential relaying, associated with these transformers, is provided through these fuses.**

Objective # 23

Each reactor coolant pump has two supply breakers, a 6900V breaker and a Safety Breaker located in the Auxiliary Building.

The initial 6900 V power sources for the reactor coolant pumps 1(2) TA , 1(2) TB, 1(2) TC, and 1(2) TD feed the **Reactor Coolant Pump Safety Breakers** located within the Auxiliary Building. **These Safety Breakers are utilized to provide:**

1. **Redundant fault and overload protection for the feeders entering containment.**
2. **A QA Condition 1 disconnecting device for each NC pump. The Safety Breaker starts/stops the Reactor Coolant Pump.**

The 6900 KV switchgear constitutes a part of each units preferred power source to the 4160 V switchgear.

A fault condition within Relay Protection Zones A or B will require total clearing of the faulted zone.

This will include the normal supply breaker for the two switchgear assemblies.

Each 6900 V switchgear assembly has an automatic transfer scheme that will automatically transfer power from the normal source to the alternate source, provided the alternate source is available.

This automatic transfer will occur whenever the normal incoming breaker is tripped by a generator-switchyard protective lockout (86A/1A, 86A/1B, 86B/1A, 86B/1B, 86TTA/1A, 86TTA/1B, 86TTB/1A, or 86TTB/1B).

Automatic fast transfer circuitry will permit a rapid transfer, within eight cycles dead time. The reactor coolant pumps, which are energized from the 6900 V switchgear assemblies, are designed to withstand the over-voltage, which may be generated during such an automatic transfer. The possible overvoltage incurred will not cause a seizure of the NCP motor, which would result in a rapid loss of reactor coolant flow. If the transformer power supplies are initially out of synchronism, or if both affected buses NCP's are off, the automatic transfer initiated will be of the time-delayed type to allow the residual bus voltage to decay to an acceptable level.

Objective # 24

An Automatic Fast Transfer will operate in 8 cycles if the following conditions are met:

1. **The (AUTO/MANUAL) Mode select switches on the main control board in the control must be in AUTO**
2. **The Normal and Standby sources are in synchronization. (Synchronism is determined automatically in the transfer circuit by the position of breaker's auxiliary contacts. These contacts reflect the position of the unit generator/switchyard circuit breakers.)**
2. **The Reactor Coolant Pumps on the two affected switchgear are both operating.**

An Automatic Fast Transfer of power will then take place transferring power from one electrical zone to the other (ex., zone 1A to zone 1B)

<u>NOTE</u>: If a fast bus transfer is to be performed on TA and/or TC (Zone A) then NCP's A and C must be running. Similarly, for a fast bus transfer on TB and/or TD (Zone B), NCP's B and D must be running.

1 Pt

Unit 1 has experienced an ATWS and the operators are performing the immediate action steps of FR-S.1 (Response to Nuclear Power Generation/ATWS).

Given the following malfunctions:

1) The reactor is manually tripped
2) The turbine fails to trip automatically and manually.

Which one of the following describes the operator's response in FR-S.1 to respond to failure of the turbine to trip?

A. **Place turbine in emergency manual and close governor valves in fast action and close all MSIVs**

B. **Place turbine in manual and close governor valves in fast action and close all MSIVs**

C. **Place turbine in manual and close governor valves in fast action and if turbine will not runback then close all MSIVs and MSIV bypass valves**

D. **Place turbine in emergency manual and close governor valves in fast action and if turbine will not runback then close all MSIVs and MSIV bypass valves**

Bank Question: 107.1 ***Answer: C***

1 Pt

Unit 1 has experienced an ATWS and the operators are performing the immediate action steps of FR-S.1 (Response to Nuclear Power Generation/ATWS).

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MISCINFO: RO

SOURCE: BANK - Modified

REFERENCES: EP/1/A/5000/FR-S.1 page 2
OP-MC-EP-FRS page 25

OBJECTIVE: 1) OP-MC-EO-FRS.Obj 4

K/A: 00012 K3.02 (3.2*/3.3)

LEVEL OF KNOWLEDGE:: COMPRHENSION

012 Reactor Protection System

TASK: Place an RPS channel in the tripped condition
Bypass a trip condition on a reactor protection panel
Monitor the RPS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause effect relationships between the RPS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	120V vital/instrument power system	3.4	3.7
K1.02	125V dc system	3.4	3.7
K1.03	CRDS	3.7	3.8
K1.04	RPIS	3.2*	3.3*
K1.05	ESFAS	3.8*	3.9
K1.06	T/G	3.1*	3.1
K1.07	SDS	3.2*	3.2*
K1.08	MFW	2.9*	3.1
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	RPS channels, components, and interconnections	3.3	3.7
K3	**Knowledge of the effect that a loss or malfunction of the RPS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	CRDS	3.9	4.0
K3.02	T/G	3.2*	3.3
K3.03	SDS	3.1*	3.3
K3.04	ESFAS	3.8*	4.1*
K4	**Knowledge of RPS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Trip logic when one channel OOC or in test	3.7	4.0
K4.02	Automatic reactor trip when RPS setpoints are exceeded for each RPS function; basis for each	3.9	4.3
K4.03	Function generator processing and combining of detector signals in RPS channels	2.3	2.7*
K4.04	Redundancy	3.1	3.3
K4 05	Spurious trip protection	2.7	2.9
K4 06	Automatic or manual enable/disable of RPS trips	3.2	3.5
K4.07	First-out indication	3.0	3.2*
K4.08	Logic matrix testing	2.8*	3.3*
K4.09	Separation of control and protection circuits	2.8	3.1

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		.75	.75	.75

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the FR-S series. EPFRS001			X	X	
2	Discuss the entry and exit guidance for each procedure in the FR-S series. EPFRS002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the FR-S series. EPFRS003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the FR-S series. EPFRS004			X	X	X
5	Given the Foldout page, discuss the actions included and the basis for these actions. EPFRS005			X	X	X
6	Describe the immediate actions and include the RNO when appropriate. EPFRS006			X	X	X
7	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPFRS007			X	X	X
8	Discuss the time critical task(s) associated with the FR-S series procedures including the time requirements and the basis for these requirements. EPFRS008			X	X	X

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
C. Operator Actions	
1. Check Reactor Trip:	**Perform the following:**
__ • All rod bottom lights - LIT	__ a. Trip the reactor.
__ • Reactor trip and bypass breakers - OPEN	__ b. IF reactor will not trip, THEN manually insert rods.
__ • I/R amps - GOING DOWN.	
2. Check Turbine Trip:	**Perform the following:**
__ • All throttle valves - CLOSED.	__ a. Trip turbine. b. IF turbine will not trip, THEN: __ 1) Place turbine in manual. __ 2) Close governor valves in fast action. 3) IF turbine will not run back, THEN close: __ • All MSIVs __ • All MSIV bypass valves.
__ 3. **Monitor foldout page.**	
4. **Check proper CA pump status:**	
__ a. MD CA pumps - ON.	__ a. Start pumps.
__ b. Check N/R Level in at least 3 S/Gs - GREATER THAN 17%.	__ b. Ensure TD CA Pump is running.

STEP 2 Check Turbine Trip: (IMMEDIATE ACTION)

PURPOSE: To ensure that the turbine is tripped.

BASIS: 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. For other ATWS events, manual tripping of the turbine may yield a higher system pressure than would otherwise occur. However, this action has been determined to be necessary due to the analytical results discussed earlier. Since there 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.

If the turbine will not trip, a turbine runback (manual lowering of 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 and MSIV bypass valves should be closed.

STEP 3 Monitor foldout page.

PURPOSE: Remind the operators to monitor the Foldout Page.

BASIS: The Foldout Page contains three items:

1. Transfer to Cold Leg Recirculation if FWST low level is reached. This operator action is required no matter what EP is in effect to ensure the transfer is accomplished without delay.
2. CA Suction Source Monitoring.
3. Criteria for isolating and unisolating the NV Pump Recirculation Isolation Valves (NV-150 and NV-151).

1 Pt Given the following plant conditions:

- Unit 1 in Mode 6.
- Reactor Missile Shield removed.
- "Norm-Refuel" Selector Switch in the REFUEL position.
- Fan Mode Selector Switch in the 100% position.
- 1EMF-38 trip 2 alarm.

Which one of the following selections describes the COMPLETE system response by the Containment Purge System?

A. Supply Fan (1B) will STOP.
Supply Damper will CLOSE.
Exhaust Fan (1B) will STOP.
Exhaust Damper will CLOSE.
Upper Containment Inside Isolation Valves will CLOSE.
Upper Containment Outside Isolation Valves will CLOSE.
Lower Containment Inside Isolation Valves will CLOSE.
Lower Containment Outside Isolation Valves will CLOSE.

B. Supply Fans (1A & 1B) will STOP.
Exhaust Fan (1A & 1B) will STOP.
Upper Containment Inside Isolation Valves will CLOSE.
Upper Containment Outside Isolation Valves will CLOSE.

C. Supply Fan (1B) will STOP.
Exhaust Fan (1B) will STOP.
Lower Containment Inside Isolation Valves will CLOSE.
Lower Containment Outside Isolation Valves will CLOSE.

D. Supply Fans (1A & 1B) will STOP.
Supply Damper will CLOSE.
Exhaust Fan (1A & 1B) will STOP.
Exhaust Damper will CLOSE.
Upper Containment Inside Isolation Valves will CLOSE.
Upper Containment Outside Isolation Valves will CLOSE.
Lower Containment Inside Isolation Valves will CLOSE.
Lower Containment Outside Isolation Valves will CLOSE.

Bank Question: 131.1 ***Answer: D***

1 Pt Given the following plant conditions:

- Unit 1 in Mode 6.
- Reactor Missile Shield removed.
- "Norm-Refuel" Selector Switch in the REFUEL position.
- Fan Mode Selector Switch in the 100% position.
- 1EMF-38 trip 2 alarm.

Which one of the following selections describes the COMPLETE system response by the Containment Purge System?

A. Supply Fan (1B) will STOP.
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Exhaust Damper will CLOSE.
Upper Containment Inside Isolation Valves will CLOSE.
Upper Containment Outside Isolation Valves will CLOSE.
Lower Containment Inside Isolation Valves will CLOSE.
Lower Containment Outside Isolation Valves will CLOSE.

B. Supply Fans (1A & 1B) will STOP.
Exhaust Fan (1A & 1B) will STOP.
Upper Containment Inside Isolation Valves will CLOSE.
Upper Containment Outside Isolation Valves will CLOSE.

C. Supply Fan (1B) will STOP.
Exhaust Fan (1B) will STOP.
Lower Containment Inside Isolation Valves will CLOSE.
Lower Containment Outside Isolation Valves will CLOSE.

D. Supply Fans (1A & 1B) will STOP.
Supply Damper will CLOSE.
Exhaust Fan (1A & 1B) will STOP.
Exhaust Damper will CLOSE.
Upper Containment Inside Isolation Valves will CLOSE.
Upper Containment Outside Isolation Valves will CLOSE.
Lower Containment Inside Isolation Valves will CLOSE.
Lower Containment Outside Isolation Valves will CLOSE.

Distracter Analysis:

A. **Incorrect:**
Plausible:
B. **Incorrect:**
Plausible:
C. **Incorrect:**

Plausible:

D. **Correct answer**
Plausible:

Level: RO

Source: BANK

Level of Knowledge: Memory

Lesson: OP-MC-CNT-VP

Objective: OP-MC-CNT VP Obj. 3

KA: 029 K4.03 (3.2/3.5)

029 Containment Purge System (CPS)

TASK:
Perform lineups of the CPS
Start up the CPS
Shut down the CPS
Vent the containment building
Initiate a containment radiation signal

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the Containment Purge System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Gaseous radiation release monitors	3.4	3.7
K1.02	Containment radiation monitor	3.3	3.6
K1.03	Engineered safeguards	3.6	3.8
K1.04	Purge system	3.0?	3.1?
K1.05	Containment air cleanup and recirculation system	2.9*	3.1*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Purge fans	2.1	2.3*
K2.02	Recirculation fans	2.0	2.4*
K2.03	Purge exhaust radiation monitors	2.3*	2.7*
K2.04	Purge valves	2.1	2.3
K2.05	Supply air heaters	1.7	1.9
K3	**Knowledge of the effect that a loss or malfunction of the Containment Purge System will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment parameters	2.9	3.1
K3.02	Containment entry	2.9*	3.5*
K4	**Knowledge of design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Use of filters for purging to the atmosphere	2.4	2.9
K4.02	Negative pressure in containment	2.9	3.1
K4.03	Automatic purge isolation	3.2*	[illegible]
K4 04	Prevention of damage to fans from lack of flow rate	2.4	2.6
K4.05	Temperature limits on dampers	2.0*	2.1*

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.5	1.5	1.5	1.5	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Containment Purge System. CNTVP001	X	X	X	X	
2	Describe the air flow path during a normal and refueling purging operation and explain the importance of supply and exhaust air flow balance during a purging operation. CNTVP002	X	X	X	X	
3	**Explain what occurs automatically on a Phase "A" or Containment Ventilation (S_h) isolation signal if a purging operation is in progress.** CNTVP003	X	X	X	X	X
4	Describe the controls and indications, on Local Panel RB-CP-1, associated with the Containment Purge System. CNTVP004	X	X	X	X	
5	Describe the controls and indications, in the Control Room, associated with the Containment Purge System. CNTVP005		X	X	X	X
6	Given a Limit and/or Precaution associated with an operating procedure, discuss it's basis and applicability. CNTVP006		X	X	X	X

3.2. Abnormal and Emergency Operation

Objective #3

This system is not safety related and will not operate during a LOCA/Blackout. The VP and VT System supply/exhaust fans will automatically stop and the containment isolation valves and supply and exhaust dampers will close in the event of a Containment Ventilation Isolation (S_H) signal:

These close on a 'Train' related S_H signal

- VP-1B, 2A, 3B, 4A (VP Supply Isolation Valves to Upper Containment)
- VP-6B, 7A, 8B, 9A (VP Supply Isolation Valves to Lower Containment)
- VP-10A, 11B, 12A, 13B (VP Exhaust Isolation Valves From Upper Containment
- VP-15A, 16B (VP Exhaust Isolation Valves From Lower Containment)
- VP-17A, 18B (Incore Instrument Room Purge Supply Isolation Valves)
- VP-19A, 20B (Incore Instrument Room Purge Exhaust Isolation Valves)
- Containment Purge Supply "Supply Damper"
- Containment Purge Exhaust "Exhaust Damper"
- Incore Instrument Room "Supply Damper"
- Incore Instrument Room "Exhaust Damper"

These will shutdown on a "Train" related S_H signal

- VP Supply Fans A & B
- VP Exhaust Fans A & B
- VT Supply Fan (either train)
- VT Exhaust Fan (either train)

1 Pt Which ONE (1) of the following Containment Radiation Monitors will initiate *containment ventilation isolation* as indicated by the corresponding sequence of actions?

A. **EMF-38(H) trip-1 will secure VP and VQ, and shutoff containment sump pumps and incore sump pumps.**

B. **EMF-39(L) trip-1 will sound the containment evacuation alarm, and secures VP and VQ.**

C. **EMF-40 trip-2 will secure VP and VQ, and shutoff containment sump pumps and incore sump pumps.**

D. **EMF-41 trip-2 will secure VP and VQ, and shutoff containment sump pumps and incore sump pumps.**

Bank Question: 162.1 ***Answer: C***

1 Pt Which ONE (1) of the following Containment Radiation Monitors will initiate containment ventilation isolation as indicated by the corresponding sequence of actions?

A. **EMF-38(H) trip-1 will secure VP and VQ, and shutoff containment sump pumps and incore sump pumps.**

B. **EMF-39(L) trip-1 will sound the containment evacuation alarm, and secures VP and VQ.**

C. **EMF-40 trip-2 will secure VP and VQ, and shutoff containment sump pumps and incore sump pumps.**

D. **EMF-41 trip-2 will secure VP and VQ, and shutoff containment sump pumps and incore sump pumps.**

LEVEL: RO

SOURCE: BANK

REFERENCES: OP-MC-WE-EMF page 25

LESSON: OP-MC-WE-EMF

OBJECTIVE: OP-MC-WE-EMF Obj. 3

KA: SYS 103 A301 (3.9/4.2)

SYSTEM:	**103 Containment System**		
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the containment system:** (CFR: 41.7 / 45.7)		
K6.01	Valves	2.1*	2.3
K6.02	Controllers and positioners	1.9	2.1*
K6.03	Pumps	1.5	1.6
K6.04	Heat exchangers and condensers	1.5	1.7
K6.05	Breakers, relays, and disconnects	1.5	1.7
K6.06	Sensors and detectors	1.9	2.1
	<u>ABILITY</u>		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the containment system controls including:** (CFR: 41.5 / 45.5)		
A1.01	Containment pressure, temperature, and humidity	3.7	4.1
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the containment system and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations** (CFR: 41.5 / 43.5 / 45.3 / 45.13)		
A2.01	Integrated leak rate test	2.0*	2.6*
A2.02	Necessary plant conditions for work in containment	2.2	3.2*
A2 03	Phase A and B isolation	3.5*	3.8*
A2 04	Containment evacuation (including recognition of the alarm)	3.5*	3.6*
A2.05	Emergency containment entry	2.9	3.9
A3	**Ability to monitor automatic operation of the containment system, including:** (CFR: 41.7 / 45.5)		
A3.01	**Containment isolation**	**3.9**	**4.2**
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Flow control, pressure control, and temperature control valves, including pneumatic valve controller	3.2*	3.3
A4.02	Excess letdown divert valves to reactor coolant drain tank	2.1*	2.2*
A4.03	ESF slave relays	2.7*	2.7*
A4 04	Phase A and phase B resets	3.5*	3.5*

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
3	3	3	3	2

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Process and Area Radiation Monitoring System. WEEMF001	X	X	X	X	
2	List the process monitored by each EMF and why it is monitored. WEEMF002	X	X	X	X	X
3	Describe the automatic actions that occur as a result of a Trip alarm for each of the following EMFs • 1(2) EMF 31 Unit 1(2) Conv. Waste Treatment System • 1(2) EMF 34(L) Unit 1(2) Steam Generator Sample • 1(2) EMF 35(L) Unit 1(2) Unit Vent Part. (low range) • 1(2) EMF 36(L) Unit 1(2) Unit Vent Gas (low range) • 1(2) EMF 37 Unit 1(2) Unit Vent Iodine Monitor • 1(2) EMF 38(L) Unit 1(2) Cont. Part. (low range) • 1(2) EMF 39(L) Unit 1(2) Cont. Gas (low range) • 1(2) EMF 40 Unit 1(2) Cont. Iodine • EMF 41 Aux. Bldg Vent. • 1(2) EMF 42 Unit 1(2) Spent Fuel Bldg. Vent. • 1(2) EMF 44(L) Unit 1(2) Cont. Vent. Drain Tank • 1(2) EMF 46A/B Unit 1(2) Component Cooling • EMF 47 Boron Recycle Evap. Distillate (cont.)	X	X	X	X	X

(SEQ is the order in which the objective is first covered in the lesson plan)

The three sample points are monitored by a single Particulate-Iodine-Gas detector assembly. Selection of the point to be sampled is made using the toggle switches on the sample flow select module on the control cabinet (refer to Drawing 7.1). To prevent damage to the sample pump, at least one flow path must be opened. The sample air is returned to the containment.

Objective # 3

A Trip 2 high radiation alarm on particulate (EMF-38(L)), EMF-40(L) iodine, or gaseous (EMF-39(L)) channels will stop the CFAES pumps and the Incore Sump pump. Also, trip 2 will initiate a containment ventilation isolation signal through the Solid State Protection System. This SH signal will:

- **Secure VQ**
- **Secure VP**
- **Shut off containment sump pumps 1A1, 1A2, 1B1, 1B2, and incore sump pump.**

A high alarm on the gaseous (EMF-39(L)) channel will also sound the Containment Evacuation Alarm unless both source range high flux trips are blocked.

The purpose of the auto actions are to:

- **terminate a release originating in containment which is discharging to the Unit Vent if the release limits are exceeded.**
- **Stop the containment sump pumps to prevent pumping potentially highly contaminated water into the Aux. Building (i.e., FDT or WEFT).**
- **Sound the containment evacuation alarm to inform personnel to leave the containment due to the potential for high airborne concentration existing in containment.**

The Gas channel has a high and low range. The low range uses a plastic Scint detector while the high range uses a GM detector. The iodine portion uses a NaI Scint.

2.1.6 Auxiliary Building Ventilation Monitor

The Auxiliary Building is monitored by EMF 41 - Aux Building Ventilation.

Objective # 2, 5

EMF-41 uses a scanner capable of monitoring 12 points within the Auxiliary Building ventilation ducts. These points are located to provide maximum coverage of Auxiliary Building rooms. (refer to Drawing 7.2 and 7.3)

1 Pt Unit 1 was operating at 100% when a pipe break occurred on the 1D S/G steam header. The operators are responding in E-2 *(Faulted Steam Generator Isolation)*. The following sequence of events occurred:

- Isolation of the 1D S/G
- PZR level dropped to 0% and was restored to 20%
- NCS pressure is 1900 psig
- Safety Injection has not been reset

What are the correct panel actions for the restoration of power to pressurizer back-up heater bank D?

A. **Reset safety injection on 1MC-6.**
Ensure AUTO is selected on the heater mode switch on 1MC-10
Select CLOSED on the heater breaker switch on 1MC-5 (vertical board)

B. **Ensure AUTO is selected on the heater mode switch on 1MC-5**
Select CLOSED on the heater breaker switch on 1MC-10
Select ON for the heater control switch on 1MC-5

C. **Select MANUAL on the heater mode switch on 1MC-10**
Select CLOSED on the heater breaker switch on 1MC-5
Select ON for the heater control switch on 1MC-10

D. **Reset safety injection on 1MC-6**
Select MANUAL on the heater mode switch on 1MC-5
Select CLOSED on the heater breaker switch on 1MC-10
Select ON for the heater control switch on 1MC-5

Bank Question: 164.2 ***Answer: C***

1 Pt Unit 1 was operating at 100% when a pipe break occurred on the 1D S/G steam header. The operators are responding in E-2 *(Faulted Steam Generator Isolation)*. The following sequence of events occurred:

- Isolation of the 1D S/G
- PZR level dropped to 0% and was restored to 20%
- NCS pressure is 1900 psig
- Safety Injection has not been reset

What are the correct panel actions for the restoration of power to pressurizer back-up heater bank D?

A. **Reset safety injection on 1MC-6.**
Ensure AUTO is selected on the heater mode switch on 1MC-10
Select CLOSED on the heater breaker switch on 1MC-5 (vertical board)

B. **Ensure AUTO is selected on the heater mode switch on 1MC-5**
Select CLOSED on the heater breaker switch on 1MC-10
Select ON for the heater control switch on 1MC-5

C. **Select MANUAL on the heater mode switch on 1MC-10**
Select CLOSED on the heater breaker switch on 1MC-5
Select ON for the heater control switch on 1MC-10

D. **Reset safety injection on 1MC-6**
Select MANUAL on the heater mode switch on 1MC-5
Select CLOSED on the heater breaker switch on 1MC-10
Select ON for the heater control switch on 1MC-5

Distracter Analysis: The B/U heater breakers will not close unless the mode selector switch is in MANUAL.

A. **Incorrect**: insufficient action, SI reset is unnecessary, and mode switch to MANUAL.
Plausible: if the candidate is not familiar with the interlocks on the PZR heater circuit, the locations are correct.

B. **Incorrect**: must turn the heater mode switch to MANUAL, and the locations are incorrect.
Plausible: if the candidate reverses the panel locations and knows that SI reset is unnecessary, it would appear that this is the best answer.

C. **Correct answer**: Bank D does not require SI reset

D. **Incorrect**: Not necessary to reset safety injection and wrong locations for SI reset and heater controls.

Plausible: If the candidate does not know the panel locations, this is the right method for Banks A&B (and would work for D) and was correct in the prior version of the question.

Level: RO

KA: SYS 010 G2.1.31 (4.2/3.9)

Lesson Plan Objective: OP-MC-PS-ILE Obj. 11

Source: BANK

Level of knowledge: comprehension

References:
1. OP-MC-PS-IPE page 19

2.1 Conduct of Operations (continued)

2.1.27 Knowledge of system purpose and or function.
(CFR: 41.7)
IMPORTANCE RO 2.8 SRO 2.9

2.1.28 Knowledge of the purpose and function of major system components and controls.
(CFR: 41.7)
IMPORTANCE RO 3.2 SRO 3.3

2.1.29 Knowledge of how to conduct and verify valve lineups.
(CFR: 41.10 / 45.1 / 45.12)
IMPORTANCE RO 3.4 SRO 3.3

2.1.30 Ability to locate and operate components, including local controls.
(CFR: 41.7 / 45.7)
IMPORTANCE RO 3.9 SRO 3.4

2.1.31 Ability to locate control room switches, controls and indications and to determine that they are correctly reflecting the desired plant lineup.
(CFR: 45.12)
IMPORTANCE RO 4.2 SRO 3.9

2.1.32 Ability to explain and apply all system limits and precautions.
(CFR: 41.10 / 43.2 / 45.12)
IMPORTANCE RO 3.4 SRO 3.8

2.1.33 Ability to recognize indications for system operating parameters which are entry-level conditions for technical specifications.
(CFR: 43.2 / 43.3 / 45.3)
IMPORTANCE RO 3.4 SRO 4.0

2.1.34 Ability to maintain primary and secondary plant chemistry within allowable limits.
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.3 SRO 2.9

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
10	Describe the protection (signals, setpoints, permissives) associated with Pressurizer level (logic not required).		X	X	X	X
11	~~Describe the actions the operator must take to restore Pressurizer heater operation following a low level heater cutoff.~~			X	X	X
12	For any Pressurizer Level Control System input signal failure, determine the effect and evaluate operator action to be taken.			X	X	X
13	Determine program Pressurizer level for interim power levels between 0% and 100%.		X	X	X	X
14	Concerning the Technical Specifications related to the Pressurizer Level Control System:					
	• Given the LCO title, state the LCO (including any COLR values) and applicability.			X	X	X
	• For any LCO's that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any Tech Spec LCO's is (are) not met and any action(s) required within one hour.			X	X	X
	• Given a set of parameters or system conditions and the appropriate Tech Specs, determine required action(s).			X	X	X
	• Discuss the bases for a given Tech Spec LCO or Safety Limit				X	
	* SRO ONLY					

2.5. Control Functions

2.5.1. PZR Low Level

Objective #9

In the event PZR Level decreases to 17%, valves NV1, NV2, NV457, NV458 and NV35 are automatically closed. This isolates letdown to prevent further loss of inventory and minimize the possibility of uncovering the heaters. At the same time all PZR Heater groups are de-energized to protect them from overheating should they become uncovered. An Annunciator Alarm, PZR LO LEVEL HTRS OFF & LETDN SECURED, alerts the operator of the low level condition.

Objective #11

Once level has increased to greater than 17%, all heater groups must be manually re-energized and letdown can be re-established. This is accomplished by selecting "MAN" on "A", "B", and "D" Heater MAN/AUTO Selector Switch. This allows closing the 600V supply breaker from their control switches on 1MC-5. "C" Heater supply breaker is closed via the switch on 1MC-10. There is no "MAN/AUTO" switch for "C" Heater.

NOTE: **If a Safety Injection has occurred, the Safety Injection signal and the sequencers must be reset in order to close the A & B heater breakers.**

2.5.2. High Level Deviation

Objective #9

If level should increase to greater than 5% above program level an Annunciator alarm, PZR HI LEVEL DEV CONTROL, is generated and the back-up heaters come on. This is done so that the subcooled water which has just surged into the PZR can be heated to saturation temperature. This will allow the water to flash to steam and avoid a pressure decrease as the level decreases to normal.

2.5.3. Low Level Deviation

If level should decrease to less than 5% below program level an Annunciator alarm, PZR LO LEVEL DEVIATION, alerts the operator of the low level condition.

2.5.4. Hi Level Alarm

If level should increase to 70% an annunciator alarm, PZR HI LEVEL, alerts the operator of the high level condition

1 Pt

Unit 1 was operating at 100% power when a total loss of feedwater occurred. The operators reached Step 7 of FR-H.1 *(Response to Loss of Secondary Heat Sink)*, which attempts to establish CA flow to at least one S/G. Sub-step 7.k states:

> ***Maintain feed flow rate less than or equal to 100 GPM until S/G WR level is greater than 12% (17% ACC).***

Given the following conditions:

	Loop A	Loop B	Loop C	Loop D
S/G (WR) [%]	0	15	9	10
NC T_{Hot} [°F]	150	555	530	545

- Containment pressure is 3.4 psig
- The TD CA pump is available to feed the S/Gs

Which one of the following statements correctly describes the bases for the restrictions for restoring feedwater flow following feed and bleed in FR-H.1?

A. **Restore flow to the 'A' S/G because loop 'A' T-hot is the lowest of the loops and this will reduce the chance of thermal shocking the S/G. Flow should not be restored to the 'B' and 'C' S/Gs because they will be reserved for use later to provide a steam supply for the TD CA pump.**

B. **Restore flow to the 'B' S/G because 'B' S/G level is the highest and this will reduce the chance of thermal shocking the S/G. Flow should be preferentially restored to the 'B' or 'C' S/G to maintain the TD CA pump steam supply.**

C. **Restore flow to the 'C' S/G because loop 'C' T-hot is less than loop 'B' T-hot and this will reduce the chance of thermal shocking the S/G. Flow should be preferentially restored to the 'B' or 'C' S/G to maintain the TD CA pump steam supply.**

D. **Restore flow to the 'D' S/G because the 'D'S/G is higher than 'A' S/G level, which will reduce the risk of thermal shock. Flow should not be restored to the 'B' and 'C' S/Gs because they will be reserved for use later to provide a steam supply for the TD CA pump.**

Bank Question: 191.3 ***Answer: B***

1 Pt Unit 1 *was operating at* 100% power when a total loss of feedwater occurred. The operators reached Step 7 of FR-H.1 *(Response to Loss of Secondary Heat Sink)*, which attempts to establish CA flow to at least one S/G. Sub-step 7.k states:

> ***Maintain feed flow rate less than or equal to 100 GPM until S/G WR level is greater than 12% (17% ACC).***

Given the following conditions:

	Loop A	Loop B	Loop C	Loop D
S/G (WR) [%]	0	15	9	10
NC T_{Hot} [°F]	150	555	530	545

- Containment pressure is 3.4 psig
- The TD CA pump is available to feed the S/Gs

Which one of the following statements correctly describes the bases for the restrictions for restoring feedwater flow following feed and bleed in FR-H.1?

A. **Restore flow to the 'A' S/G because loop 'A' T-hot is the lowest of the loops and this will reduce the chance of thermal shocking the S/G. Flow should not be restored to the 'B' and 'C' S/Gs because they will be reserved for use later to provide a steam supply for the TD CA pump.**

B. **Restore flow to the 'B' S/G because 'B' S/G level is the highest and this will reduce the chance of thermal shocking the S/G. Flow should be preferentially restored to the 'B' or 'C' S/G to maintain the TD CA pump steam supply.**

C. **Restore flow to the 'C' S/G because loop 'C' T-hot is less than loop 'B' T-hot and this will reduce the chance of thermal shocking the S/G. Flow should be preferentially restored to the 'B' or 'C' S/G to maintain the TD CA pump steam supply.**

D. **Restore flow to the 'D' S/G because the 'D'S/G is higher than 'A' S/G level, which will reduce the risk of thermal shock. Flow should not be restored to the 'B' and 'C' S/Gs because they will be reserved for use later to provide a steam supply for the TD CA pump.**

Distracter Analysis: The guidance is to select the S/G that has the highest apparent level and to preferentially select the B or C S/G.

A. **Incorrect**: T-hot should not be used to determine which S/G should receive flow. It is not a reliable means of determining S/G shell temp in a dry stagnant loop.
Plausible: The apparent temp of the A loop is the lowest and it may appear that the chance of thermal shock is lessened.

B. **Correct answer**: feed the S/G that has the highest level and preferentially feed B & C S/Gs to maintain steam supply to the TD CA pump.

C. **Incorrect**: C S/G has a lower S/G level than B S/G
Plausible: C S/G has a lower T-hot than B S/G

D. **Incorrect:** No basis for reserving the B & C S/Gs for restoring flow
Plausible: There is a high probability that restoring feed to a dry S/G could rupture the tube sheet due to thermal stress. It makes sense to select a S/G that is NOT used to supply steam to the TD CA pump for the initial restoration of the heat sink.

Level: RO

KA: W/E05 2.4.18 (2.7/3.6)

Level of Knowledge: Analysis

Lesson Plan Objective: OP-MC-EP-FRH, Obj.4

Source: BANK

References:
1. EP/FR-H.1, Step 7.k (NOTE prior)

2.4 Emergency Procedures /Plan (Continued)

2.4.18 Knowledge of the specific bases for EOPs.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.7 SRO 3.6

2.4.19 Knowledge of EOP layout, symbols, and icons.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.7 SRO 3.7

2.4.20 Knowledge of operational implications of EOP warnings, cautions, and notes.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.3 SRO 4.0

2.4.21 Knowledge of the parameters and logic used to assess the status of safety functions including:
1. Reactivity control
2. Core cooling and heat removal
3. Reactor coolant system integrity
4. Containment conditions
5. Radioactivity release control.

(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.7 SRO 4.3

2.4.22 Knowledge of the bases for prioritizing safety functions during abnormal/emergency operations.
(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.0 SRO 4.0

2.4.23 Knowledge of the bases for prioritizing emergency procedure implementation during emergency operations.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.8 SRO 3.8

2.4.24 Knowledge of loss of cooling water procedures.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.3 SRO 3.7

2.4.25 Knowledge of fire protection procedures.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.9 SRO 3.4

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		3	3	2.5

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose of each procedure in the FR-H series. EPFRH001			X	X	
2	Discuss the entry and exit guidance for each procedure in the FR-H series. EPFRH002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the FR-H series. EPFRH003			X	X	X
4	**Discuss the basis for any note, caution or step for each procedure in the FR-H series.** EPFRH004			X	X	X
5	Given the Foldout page, discuss the actions included and the basis for these actions. EPFRH005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPFRH006			X	X	X
7	Discuss the time critical task(s) associated with the FR-H series procedures including the time requirements and the basis for these requirements. EPFRH007			X	X	X

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

7. (Continued)

NOTE
- It may be preferrable to feed 1B or 1C S/G first, to maintain steam supply for TD CA Pump
- Selecting S/G with highest level will reduce risk of thermal shock to S/G when reestablishing feed flow.

__ i. Check core exit T/Cs - STABLE OR GOING DOWN.

i. Perform the following:

__ 1) Throttle open CA control valve to one S/G to establish flow rate required to lower core exit T/Cs.

__ 2) IF core exit T/Cs continue to go up, THEN throttle open CA control valve to feed another S/G as required to lower core exit T/Cs.

__ 3) GO TO Step 7.m.

__ j. Slowly throttle open CA control valve to one S/G to establish feed flow less than or equal to 100 GPM.

__ k. Maintain feed flow rate less than or equal to 100 GPM until S/G WR level is greater than 12% (17% ACC).

__ l. WHEN S/G W/R level is greater than 12% (17% ACC), THEN feed flow may be raised greater than 100 GPM.

__ m. Check S/G W/R levels on intact S/Gs with feed flow isolated - ANY GREATER THAN 12% (17% ACC).

__ m. GO TO Step 7.o.

__ n. Slowly establish flow to any available intact S/G with level greater than 12% (17% ACC).

o. Do not continue until the following are met:

- __ NC T-Hot associated with a S/G being fed - GOING DOWN
- __ Core Exit T/Cs - GOING DOWN.

1 Pt Unit 1 was conducting a plant start up. At 1% power, an instrument malfunction caused an inadvertent reactor trip. Given the following indications:

- Two rod bottom lights are NOT lit
- Reactor trip and bypass breakers are open
- IR amps = $2x10^{-8}$
- IR SUR = -0.3 DPM

Which one of the following response actions is required?

A. Implement AP/14, (*Control Rod Misalignment*) and respond to the stuck rods.

B. Implement E-0, (*Reactor Trip or Safety Injection*), and immediately transition to FR-S.2, (*Response to Loss of Core Shutdown*).

C. Implement E-0, (*Reactor Trip or Safety Injection*) and immediately transition to FR-S.1, (*Response to Nuclear Power Generation/ATWS*).

D. Implement E-0, (*Reactor Trip or Safety Injection*), and then transition to ES-0.1, (*Reactor Trip Response*).

Bank Question: 195.5 **Answer: D**

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1 Pt

Unit 1 was conducting a plant start up. At 1% power, an instrument malfunction caused an inadvertent reactor trip. Given the following indications:

- Two rod bottom lights are NOT lit
- Reactor trip and bypass breakers are open
- IR amps = $2x10^{-8}$
- IR SUR = -0.3 DPM

Which one of the following response actions is required?

A. **Implement AP/14, (*Control Rod Misalignment*) and respond to the stuck rods.**

B. **Implement E-0, (*Reactor Trip or Safety Injection*), and immediately transition to FR-S.2, (*Response to Loss of Core Shutdown*).**

C. **Implement E-0, (*Reactor Trip or Safety Injection*) and immediately transition to FR-S.1, (*Response to Nuclear Power Generation/ATWS*).**

D. **Implement E-0, (*Reactor Trip or Safety Injection*), and then transition to ES-0.1, (*Reactor Trip Response*).**

Distracter Analysis: The RNO will evaluate the need to transition to FR-S.1 based on indications of reactor criticality. Transition is not appropriate unless reactor power is > 5% and not decreasing.

A. **Incorrect**: If above P-11 (1955 psig) must use E-0.
Plausible: This would be the correct answer for a reactor trip below P-11.

B. **Incorrect**: There is no yellow path because SUR < -0.2dpm. In addition, F-0 is not in effect at this point in the procedure
Plausible: This would be the correct response if SUR > -0.2 dpm.

C. **Incorrect**: inappropriate to enter FR-S.1 because the reactor is subcritical and F-0 is not in effect
Plausible: If the candidate makes a literal reading of E-0 without knowledge of the ERG background positions on what constitutes a tripped reactor. Some plants enter FR-S.1 for two rods stuck out.

D. **Correct**:

Level: RO

KA: W/E 01 EK1.2 (3.4/4.0)

Lesson Plan Objective: EP-EO Obj. 10

Source: BANK

Level of knowledge: Memory

References:
1. OP-MC-IC-IRE page 35
2. OP-MC-EP-FRS page 15, 17
3. OP-MC-EP-E0 pages 19, 27
4. F-0 page 1
5. E-0 page 3
6. AP-14 page 2

4.5 Westinghouse EPEs / APEs

Westinghouse
E01 Rediagnosis

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Reactor Trip or Safety Injection/Rediagnosis)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.1 SRO 3.5

~~EK1.2 Normal, abnormal and emergency operating procedures associated with (Reactor Trip or Safety Injection / Rediagnosis).~~
IMPORTANCE RO 3.4 SRO 4.0

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Reactor Trip or Safety Injection/Rediagnosis).
IMPORTANCE RO 3.1 SRO 3.5

EK2. Knowledge of the interrelations between the (Reactor Trip or Safety Injection/Rediagnosis) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.3 SRO 3.5

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 3.8

EK3. Knowledge of the reasons for the following responses as they apply to the (Reactor Trip or Safety Injection/Rediagnosis)
(CFR: 41.5, 41.10, 45.6, 45.13)

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
10	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPE0010			X	X	X
11	Discuss the time critical task(s) associated with the E-0 series procedures including the time requirements and the basis for these requirements. EPE0011			X	X	X

- When Control Rods are being moved, observe the demand position and actual (digital) position to verify proper operation of the Rod Control System. (Basis: self-explanatory)

Commitment #1

- When Turbine Generator paralleled to grid, the following apply:
  a) Maximum Tavg deviation from Tref is + or – 4 deg. F. (Basis: UFSAR limit to maintain plant within analyzed operating envelope.)
  b) When CRD Select in "Manual", Tavg deviation from Tref is + or – 2 deg F.
- When pushing or pulling rods, hold the "Rod Control" lever "In" or "Out" until rod(s) are in the desired position. After releasing the "Rod Control" lever, wait at least 2 seconds prior to attempting to move rods again. (Ba *ip2982Xossibility of inadvertently dropping a rod exists.)

3.1.2. Operating Procedures

OP/1/A/6150/08, Rod Control

The purpose of this procedure to explain the proper operation of the Rod Control system during various evolutions. Enclosures cover M/G set startup/parallel operation/shutdown, shutdown bank withdrawal/insertion, removal/replacement of reactor trip breakers and rod control system evaluation.

3.2. Abnormal and Emergency Operation

3.2.1. AP/1/A/5500/14, Rod Control Malfunction.

The purpose of this procedure is to ensure proper response in the event of a Rod Control System Malfunction and to assess plant conditions and identify appropriate steps for the following conditions.

- Failure of a Control Rod Bank to Move on Demand.
- Continuous Insertion/Withdrawal of a Control Rod Bank.
- Dropped Control Rod.
- Control Rod Misalignment.

This procedure will be further discussed in the lesson plan for AP/1or2/A/5500/14, Rod Control Malfunction.

2.2. FR-S.2, Response to Loss of Core Shutdown

Following a reactor trip or safeguards actuation, nuclear flux is expected to drop promptly to the bottom end of the power range, and shortly thereafter establish a fixed rate of decrease at -0.3 DPM until it stabilizes at some level on the source range scale. FR-S.2 allows the operator to judge whether the behavior is consistent with expectations, and to act (or not act) accordingly. The startup rate above -0.2 DPM in the intermediate range could indicate either a near-critical core or possible instrument abnormalities (under compensation), both unacceptable conditions which are addressed. The positive source range startup rate indicates a supercritical core, which is indeed an unacceptable condition. However, since the ultimate concern is fuel damage from excessive heat generation, and the core is still far from significant power production, the need for action is not considered urgent. A substantial rise in flux level will be detected when the Subcriticality Status Tree is reevaluated and a RED or ORANGE priority is obtained.

It is possible for some unusual core conditions to produce the initiating symptoms without the core actually being supercritical. Removal of shielding (water) or addition of extraneous sources could seriously disturb source range indications. However, the low level of priority (YELLOW) assigned to FR-S.2 allows the operator a great deal of latitude in initiating action.

3.0 FR-S.1, RESPONSE TO NUCLEAR POWER GENERATION / ATWS

3.1. Purpose

The purpose of FR-S.1 is to provide actions to add negative reactivity to a core which is observed to be critical when expected to be shut down.

This procedure is used in the event of an unexpected nuclear flux condition following a reactor trip as indicated by the RED or ORANGE priority on the Subcriticality Status Tree, or if an Anticipated Transient Without Scram (ATWS) has occurred. The operator is provided with instructions to restore the core to a subcritical state; restoration of shutdown margin is desired, but is not a necessity to exit from this FRP.

The procedure is entered if a reactor trip is required and power is either greater than 5% (RED) or I/R SUR is positive (ORANGE). Entry can also come from E-0 Step 2 when a reactor trip can not be verified and a manual trip is not effective (ATWS event).

If entry is due to an ATWS, then power production and support systems more resemble an at-power configuration than a shutdown configuration. The urgency in this case is based on violation of the design basis protection of the core.

FR-S.1 is exited when all actions have been completed and the reactor is subcritical. At this time the operator is instructed to return to the procedure and step that was in effect at the time FR-S.1 was entered. If Core Exit Temperature exceeds 1200°F and is increasing, the operator is directed to leave the EPs and implement the Severe Accident Management Guideline SACRG-1. In this situation core damage has occurred and SAMGs are required.

3.2. Symptoms/Entry Conditions

FR-S.1 is to be entered from:

1. EP/1/A/5000/E-0 (Reactor Trip Or Safety Injection), Step 2, when reactor trip is not verified and manual trip is not effective.
2. EP/1/A/5000/F-0 (Critical Safety Function Status Trees) (Subcriticality), on either a red or orange condition.

3.0 E-0, REACTOR TRIP OR SAFETY INJECTION

3.1. Purpose

The purpose of E-0 is to check proper response of the automatic protection systems following manual or automatic actuation of a reactor trip or safety injection (S/I), assess plant conditions and identify the appropriate Optimal Recovery Procedure.

3.2. Symptoms/Conditions

E-0 is to be entered (from initial conditions >P-11) whenever a reactor trip or safety injection is required or has occurred as follows:

- A reactor trip is required as determined by plant specific setpoints or requirements being exceeded.
- A reactor trip has occurred as determined by the plant annunciators, neutron flux instrumentation, and control rod position indicators.
- A safety injection is required as determined by plant specific setpoints or requirements being exceeded.
- A safety injection has occurred as determined by the plant annunciators or S/I pump status.

Symptoms of a reactor trip are,

- Any reactor trip annunciator - LIT
- Rod bottom lights - LIT
- Neutron Flux - RAPIDLY GOING DOWN

The following are symptoms of a reactor trip and safety injection.

- Any S/I annunciator - LIT
- NV, ND, NI pumps - ON
- "SAFETY INJECTION ACTUATED" status light (1SI-18) - LIT
- "LOCA SEQ ACTUATED TRAIN A (B)" status lights (1SI-14) - LIT

Once E-0 is entered, it is not exited until there is a direct transition to an ORP or a FRP as directed by the symptoms being monitored in E-0, or a direct transition to a FRP as directed by the CSF Status Trees.

STEP 2 & 3 Check Reactor and Turbine Trip: (IMMEDIATE ACTIONS)

PURPOSE: To ensure the reactor and turbine are tripped.

BASIS: Reactor trip must be checked to ensure the only heat being added to the NC system is from decay heat and NC pump heat. The safeguards systems protecting the plant during accidents are designed assuming only decay heat and pump heat are being added to the NC.

If the reactor is not tripped, the RNO directs us to trip it manually. If the reactor cannot be tripped F-0, CSF Status Trees, is implemented and a transition is made to FR-S.1, Response to Nuclear Power Generation/ATWS, to deal with the ATWS conditions.

The turbine is tripped to prevent an uncontrolled cooldown of the NC due to steam flow that the turbine would require.

If the turbine is not tripped, the RNO directs us to trip it manually. If the turbine will not trip, steam is isolated to it by first attempting to close the turbine governor valves. If the turbine will not runback, steam is isolated to it by closing the MSIVs and bypass valves.

STEP 4 Check 1ETA and 1ETB - ENERGIZED. (IMMEDIATE ACTION)

PURPOSE: To ensure electrical power to at least one emergency bus.

BASIS: AC power must be checked from either offsite sources or the diesel generators to ensure adequate power sources to operate safeguards equipment. At least one train of safeguards equipment is required to deal with emergency conditions.

If both AC emergency busses are deenergized, the RNO directs a transition to ECA-0.0, Loss of All AC Power.

A. Purpose

This procedure provides guidance on monitoring the Critical Safety Functions.

B. Symptoms or Entry Conditions

This procedure is entered from:

- EP/1/A/5000/E-0 (Reactor Trip Or Safety Injection), Step 26, when S/I cannot be terminated and cause has not been determined.
- On any transition out of EP/1/A/5000/E-0 (Reactor Trip Or Safety Injection).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
C. Operator Actions	
__ 1. **Monitor foldout page.**	
(2.) **Check Reactor Trip:** __ • All rod bottom lights - LIT __ • Reactor trip and bypass breakers - OPEN __ • I/R amps - GOING DOWN.	**Perform the following:** __ a. Trip reactor. b. IF reactor will not trip, THEN: __ • Implement EP/1/A/5000/F-0 (Critical Safety Function Status Trees). __ • GO TO EP/1/A/5000/FR-S.1 (Response To Nuclear Power Generation/ATWS).
(3.) **Check Turbine Trip:** __ • All throttle valves - CLOSED	**Perform the following:** __ a. Trip turbine. b. IF turbine will not trip, THEN: __ 1) Place turbine in manual. __ 2) Close governor valves in fast action. 3) IF turbine will not runback, THEN close: __ • All MSIVs __ • All MSIV bypass valves.
__ (4.) Check 1ETA and 1ETB - ENERGIZED.	Perform the following: __ a. IF both busses de-energized, THEN GO TO EP/1/A/5000/ECA-0.0 (Loss Of All AC Power). __ b. WHEN time allows, THEN try to restore power to de-energized bus PER AP/1/A/5500/07 (Loss Of Electrical Power) while continuing with this procedure.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

B. Symptoms

1. Dropped Rod

- "RPI AT BOTTOM ROD DROP" alarm (1AD-2, D-9)
- "RPI AT BOTTOM > 1 ROD DROPPED" alarm (1AD-2, E-9)
- Individual rod "RB" indication on DRPI monitor (yellow or green rod with orange background)
- "P/R CHANNEL DEVIATION" alarm (1AD-2, B-3)
- Unanticipated rod withdrawal
- Sudden drop in T-Ave
- "T-REF/T-AUCT ABNORMAL" alarm (1AD-6, B-10)
- Turbine load deceasing
- "PZR LO PRESS CONTROL" alarm (1AD-6, C-6)
- Nuclear Instrument indication of flux tilt

2. Rod Misalignment

- "P/R LOWER DET HI FLUX DEV OR AUTO DEFEAT" alarm (1AD-2, B-1)
- "P/R UPPER DET HI FLUX DEV OR AUTO DEFEAT" alarm (1AD-2, B-2)
- "DEVIATION > 12 STEPS" DRPI monitor alarm
- Nuclear Instrument indication of flux tilt
- Demand step counters indicate misaligned group of rods
- DRPI indicates misaligned rod(s)

3. Failure of Rods to Move on Demand

- No automatic rod motion occurring when expected
- No manual rod motion occurring when expected
- "ROD CONTROL URGENT FAILURE" alarm (1AD-2, A-10)
- "T-REF/T-AUCT ABNORMAL" alarm (1AD-6, B-10)

4. Continuous Rod Movement

- Unwarranted rod insertion or withdrawal
- "T-REF/T-AUCT ABNORMAL" alarm (1AD-6, B-10)

1 Pt Unit 1 is in mode 6 and in the process of unlatching control rods. Which ONE (1) of the following limiting conditions requires immediately suspending all CORE ALTERATIONS in the Reactor Building?

A. **Loss of one channel of SR NIs with both Gamma Metric SDMs in operation.**

B. **Loss of direct communications between the control room and the refueling bridge (refueling station).**

C. **Loss of the Fuel Handling Ventilation System.**

D. **Time since entering mode 2 is 102 hours.**

Bank Question: 228.1 ***Answer: B***

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A. **Loss of one channel of SR NIs with both Gamma Metric SDMs in operation.**

B. **Loss of direct communications between the control room and the refueling bridge (refueling station).**

C. **Loss of the Fuel Handling Ventilation System.**

D. **Time since entering mode 2 is 102 hours.**

LEVEL: RO

SOURCE: BANK

LEVEL OF KNOWLEDGE: Memory

REFERENCES: SLC 16.9.18
OP-MC-FH-FC pages 11, 27, 33
Tech Spec 3.9.3

LESSON: OP-MC-FH-FC

OBJECTIVE: OP-MC-FH-FC Objs. 1 & 7

KA: G 2.2.27 (2.6/3.5)

2.2 Equipment Control (Continued)

2.2.18 Knowledge of the process for managing maintenance activities during shutdown operations.
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.3 SRO 3.6

2.2.19 Knowledge of maintenance work order requirements.
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.1 SRO 3.1

2.2.20 Knowledge of the process for managing troubleshooting activities.
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.2 SRO 3.3

2.2.21 Knowledge of pre- and post-maintenance operability requirements.
(CFR: 43.2)
IMPORTANCE RO 2.3 SRO 3.5

2.2.22 Knowledge of limiting conditions for operations and safety limits.
(CFR: 43.2 / 45.2)
IMPORTANCE RO 3.4 SRO 4.1

2.2.23 Ability to track limiting conditions for operations.
(CFR: 43.2 / 45.13)
IMPORTANCE RO 2.6 SRO 3.8

2.2.24 Ability to analyze the affect of maintenance activities on LCO status.
(CFR: 43.2 / 45.13)
IMPORTANCE RO 2.6 SRO 3.8

2.2.25 Knowledge of bases in technical specifications for limiting conditions for operations and safety limits.
(CFR: 43.2)
IMPORTANCE RO 2.5 SRO 3.7

2.2.26 Knowledge of refueling administrative requirements.
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.5 SRO 3.7

2.2.27 Knowledge of the refueling process.
(CFR: 43.6 / 45.13)
IMPORTANCE RO 2.6 SRO 3.5

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		1.5	1.5	1.5

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Describe the roles and responsibilities of Control Room Operators during Fuel Handling operations.			X	X	X
2	Describe the roles and responsibilities of Fuel Handling SRO's during Fuel Handling operations.				X	X
3	Describe how monitoring of core reactivity is accomplished during Fuel Handling.			X	X	X
4	Deleted					
5	Describe the requirements that must be met before **bypassing** a Fuel Handling Interlock.			X	X	X
6	Concerning AP-25, Spent Fuel Damage; AP-40, Loss of Refueling Canal; and AP-41, Loss of Spent Fuel Cooling or Level: • State the purpose of the AP • Given symptoms, state the AP and Case (if applicable)			X	X	X
7	**Concerning the Technical Specifications related to the FC System;**					
	• Given the LCO title, state the LCO (including any COLR values) and applicability.			X	X	X
	• For any LCO's that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any Tech. Spec. is (are) not met and any action(s) required within one hour.			X	X	X
	• Given a set of plant parameters values or system conditions and the appropriate Tech Specs, determine required action(s).				X	*
	• Discuss the basis for a given Tech. Spec. LCO or Safety Limit. * **SRO only**					

The following is a specific list of Fuel Handling SRO responsibilities:

1. Ensure all fuel handling activities are performed in a safe and efficient manner.
2. Securing fuel handling operations as required by Tech Specs, Plant conditions, Safety concerns, or during times of uncertainty.
3. Should monitor refueling cavity to insure FME is being maintained.
4. Maintain constant communications with the control room during core alterations.
5. Assist the control room in monitoring refueling canal level, audible count rate and EMF or containment evacuation alarms.
6. Assist fuel handling crew in visually verifying fuel assemblies are lowered and raised safely. Gives hoist operator clearance to engage or disengage on fuel assemblies. Verifies assemblies are aligned properly and down on core plate prior to giving concurrence to disengage gripper.
7. Gives verbal clearance prior to pulling control rods during control rod latching, unlatching, and drag testing activities.
8. During core alterations, approve use of fuel handling bypass interlocks as necessary when not specified by an approved procedure (NSD 414).

Objective #1

Control Room Operators

Direct monitoring and manipulation of plant and reactor controls. Including monitoring of subcritical multiplication from nuclear instruments during core alterations. Responsible for implementing any necessary responses required by Abnormal Procedures. Logging and verifying technical specifications for MODE 6 and for core alterations. The Reactor Operator on the headset in the back of the control room communicates with the refueling crew. The Reactor Operator on the headset will get permission from the "Operator At The Controls" prior to unloading each fuel assembly. **The Operator at the Controls may stop fuel handling operations if, in his/her judgement, control room indication or communications show warranting conditions.**

Nuclear/Reactor Engineering

One responsibility is coordination of fuel movements during core loading operation by use of controlling procedure. Another is monitoring nuclear instrumentation to verify appropriate subcritical behavior and shutdown margin.

Fuel Handlers

One responsibility is operation of Fuel Handling Equipment in a safe manner moving fuel to locations recommended by reactor engineers by procedure. Another is the ability to recognize and properly respond to abnormal conditions.

4.0 TECHNICAL SPECIFICATIONS

Objective #7

4.1. Tech. Spec. 3.9.1 Page 3.9.1-1

LCO Boron in RCS, Refueling Canal, Refueling Cavity > COLR value (*Unit 1 currently 2675 ppm).*

APPLICABILITY Mode 6

ACTION Immediately suspend CORE ALTERATIONS **AND** positive reactivity changes **AND** initiate action to restore boron concentration to within limits.

BASIS (1) Ensure the reactor will remain subcritical during CORE ALTERATIONS, and (2) uniform boron for reactivity control. The accident assumed that requires these limitations as initial conditions is the boron dilution accident. Normally, Reactor Makeup Water is isolated during refueling to prevent diluting the boron. Isolation is normally accomplished via NV-250.

4.2. Tech. Spec. 3.9.2 Page 3.9.2-1

LCO Each valve used to isolate unborated water sources shall be secured in the closed position.

APPLICABILITY Mode 6

ACTION Immediately suspend CORE ALTERATIONS **AND** immediately initiate action to secure valve in closed position **AND** perform SR 3.9.1.1. (*verifying boron conc.)* within 4 hours.

BASIS Prevent unplanned boron dilution during MODE 6 and thus avoid a reduction in shutdown margin.

4.3. Tech. Spec. 3.9.3 Page 3.9.3-1

LCO Two SR Monitors OPERABLE.

APPLICABILITY Mode 6

ACTION With one monitor inoperable immediately suspend CORE ALTERATIONS **AND** positive reactivity changes. With both inoperable immediately initiate action to restore one **AND** determine boron once/12 hrs.

BASIS Ensures redundant monitoring capability to detect reactivity changes. The WR Neutron Flux Detectors (ENC) can be used. All of the LCO, ACTION, and SURVEILLANCE REQUIREMENTS must be met for the two monitors in use at any time and the monitors have alarm set at 0.5 decades above steady state background.

4.8. SLC. 16.9.17

LCO Reactor subcritical for 100 hrs

APPLICABILITY During movement of irradiated fuel in the reactor vessel

ACTION With less 100hrs, suspend all operations involving movement of irradiated fuel in the reactor vessel.

BASIS Sufficient time for decay of short lived fission products, consistent with assumptions used in accident analysis.

4.9. SLC. 16.9.18

LCO Direct Communications shall be maintained between the control room and the personnel at the refueling station.

APPLICABILITY During CORE ALTERATIONS

ACTION suspend all CORE ALTERATIONS

BASIS Ensures Refueling Station Personnel can be promptly informed of significant changes in the facility status or core reactivity conditions during CORE ALTERATIONS.

4.10. SLC. 16.9.19

LCO The manipulator crane and auxiliary hoist shall be used for movement of drive rods <u>or</u> fuel assemblies and shall be OPERABLE with:

a. The manipulator crane used for movement of fuel assemblies having:
   1) A minimum capacity of 3250 pounds, and
   2) An overload cutoff limit $\leq$ 2900 pounds
b. The Auxiliary Hoist used for latching and unlatching drive rods having:
   1) A minimum capacity of 1000 pounds, and
   2) A load indicator which shall be used to prevent a lifting force in excess of 600 pounds on the core internals.

APPLICABILITY During movement of control rods or fuel assemblies within the reactor vessel

ACTION Suspend use of any inoperable hoist or crane from operations involving movement of drive rods or fuel assemblies within the reactor vessel.

BASIS Ensures (1) manipulator crane will be used for movement of drive rods and fuel assemblies, (2) each crane has sufficient load capacity to lift a drive rod or fuel assembly, and (3) the core internals and reactor vessel are protected from excessive lifting force in the event they are inadvertently engaged during lifting operations.

3.9 REFUELING OPERATIONS

3.9.3 Nuclear Instrumentation

LCO 3.9.3 Two source range neutron flux monitors shall be OPERABLE.

APPLICABILITY: MODE 6.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required source range neutron flux monitor inoperable.	A.1 Suspend CORE ALTERATIONS.	Immediately
	<u>AND</u>	
	A.2 Suspend positive reactivity additions.	Immediately
B. Two required source range neutron flux monitors inoperable.	B.1 Initiate action to restore one source range neutron flux monitor to OPERABLE status.	Immediately
	<u>AND</u>	
	B.2 Perform SR 3.9.1.1.	Once per 12 hours

16.9 AUXILIARY SYSTEMS

16.9.18 Refueling Operations - Communications

COMMITMENT Direct communications shall be maintained between the control room and personnel at the refueling station.

APPLICABILITY During CORE ALTERATIONS.

REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Direct communications between control room and refueling station personnel cannot be maintained.	A.1 Suspend CORE ALTERATIONS.	Immediately

TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.9.18.1 Demonstrate direct communications between control room and personnel at refueling station.	Within 1 hour prior to start of CORE ALTERATIONS AND Once per 12 hours thereafter

1 Pt Unit 1 is operating at 50% power. Given the following conditions:

- Pressurizer pressure is 2235 psig
- Pressurizer Relief Tank (PRT) pressure is 20 psig
- PRT temperature is 125 °F
- PRT level is 81%
- The PRT is being cooled by spraying from the RMWST
- A pressurizer code safety valve is suspected of leaking by its seat

What temperature would be indicated on the associated safety valve discharge RTD if the code safety were leaking by?

REFERENCES PROVIDED

A. **258-262 °F**

B. **227-231 °F**

C. **161-165 °F**

D. **123 -127°F**

Ques_311.2.doc

Bank Question: 311.2 ***Answer: A***

1 Pt Unit 1 is operating at 50% power. Given the following conditions:

- Pressurizer pressure is 2235 psig
- Pressurizer Relief Tank (PRT) pressure is 20 psig
- PRT temperature is 125 °F
- PRT level is 81%
- The PRT is being cooled by spraying from the RMWST
- A pressurizer code safety valve is suspected of leaking by its seat

What temperature would be indicated on the associated safety valve discharge RTD if the code safety were leaking by?

REFERENCES PROVIDED: Steam Tables

A. **258-262 °F**

B. **227-231 °F**

C. **161-165 °F**

D. **123 -127°F**

Distracter Analysis:

A. **Correct answer**

B. **Incorrect**: Temp is too low - the correct temp is 260 °F
Plausible: If the candidate makes the mistake of not correcting for atmospheric pressure by failing to adding 14.6 psi to the PRT pressure and uses 20 psia.

C. **Incorrect**: Temp is too low - the correct temp is 260 °F
Plausible: If the candidate reverses the correction for atmospheric pressure by subtracting 14.6 psi from PRT pressure of 20 psig to get 5 psia.

D. **Incorrect:** Temp is too low - the correct temp is 260 °F
Plausible: If the candidate thinks that the discharge temperature will be at the same temperature as the PRT fluid.

Level: RO

KA: SYS 010 K5.01 (3.5/4.0)

Source: BANK

Level of Knowledge: Analysis
Objective: OP-MC-THF-EB Obj. 8

Reference: OP-MC-THF-EB pages 23-26

SYSTEM: 010 Pressurizer Pressure Control System (PZR PCS)

K4 **Knowledge of PZR PCS design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	Spray valve warm-up	2.7	2.9
K4.02	Prevention of uncovering PZR heaters	3.0	3.4
K4.03	Over pressure control	3.8	4.1

K5 **Knowledge of the operational implications of the following concepts as the apply to the PZR PCS:**
(CFR: 41.5 / 45.7)

K5.01	Determination of condition of fluid in PZR, using steam tables	3.5	4.0
K5.02	Constant enthalpy expansion through a valve	2.6	3.0*

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the PZR PCS:**
(CFR: 41.7 / 45.7)

K6.01	Pressure detection systems	2.7	3.1
K6.02	PZR	3.2	3.5
K6.03	PZR sprays and heaters	3.2	3.6
K6.04	PRT	2.9	3.2
K6.05	Valves	2.3	2.4
K6.06	Sensors and detectors	2.3	2.4
K6.07	Controllers and positioners	2.3	2.5

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the PZR PCS controls including:**
(CFR: 41.5 / 45.5)

A1.01	PZR and RCS boron concentrations	2.8	2.9*
A1.02	Spray and surge line flow rates	2.4	2.6*
A1.03	PRT pressure and temperature	2.9	3.2
A1.04	Effects of temperature change during solid operation	3.6	3.8
A1.05	Pressure effect on level	2.8	2.9
A1.06	RCS heatup and cooldown effect on pressure	3.1	3.2
A1.07	RCS pressure	3.7	3.7
A1.08	Spray nozzle DT	3.2	3.3
A1.09	Tail pipe temperature and acoustic monitors	3.4	3.7

LPRO OBJECTIVES:

TIME: 4 Hours

1. Define and give examples of open and closed systems.

2. State the First Law of Thermodynamics and discuss the relationship of the Steady Flow Energy Equation.

3. List and define the six energy forms considered in the study of Thermodynamics.

4. Identify the variable(s) which indicate a change in each of the six energy forms.

5. Define power and relate it to energy in the Thermodynamic system.

6. State the Continuity Equation and apply it in determining mass flow rate, volume flow rate and velocity changes in power plant components.

7. Describe the energy conversions which occur and relate them to changes in observable parameters and fluid properties for:

   A. Constant diameter pipe

   B. Nozzle and venturi

   C. Throttling device

   D. Pump

   E. Turbine

8. Plot the throttling process on a Mollier Diagram and determine fluid properties upstream and downstream, given appropriate information.

9. Define pump efficiency.

10. Plot a real and ideal turbine on a Mollier Diagram and T/S Diagram and determine fluid properties at the inlet and outlet, given sufficient information.

11. Determine turbine work and power given appropriate information.

12. Define turbine efficiency.

3. Effect of friction will result in some pressure drop across the device

   a. This effect is minimized by the smooth transition

   b. The orifice is not smooth and significant pressure drop will occur.

4. Application

   a. Inc. NPSH on pump suction

   b. Steam Jet

   c. Pump Volute

   d. Accommodate expansion

5.3 Energy Balance on Throttling Device

A. Assumptions:

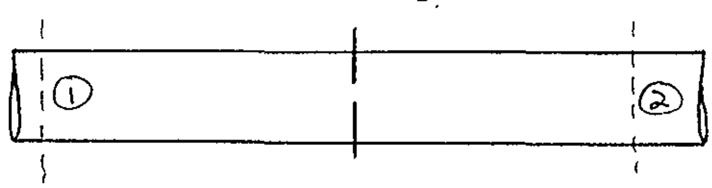
1. $\dot{Q}_{in}$ and $\dot{Q}_{out} = 0$

2. $\dot{M}_{in} = \dot{M}_{out}$

3. Area at 1 = Area at 2

4. Any ΔKE is negligible when comparing KE at point 2 as compared to 1

5. Point 2 is far enough away to be unaffected by turbulence caused by orifice



B. $KE_1 + PE_1 + Pv_1 + U_1 + Q_{in} + W_{on} =$

$KE_2 + PE_2 + Pv_2 + U_2 + Q_{out} + W_{by}$

1. Q_{in} and $Q_{out} = 0$
2. W_{on} and $W_{by} = 0$
3. $KE_1 = KE_2$
4. $PE_1 = PE_2$

C. $U_1 + Pv_1 = U_2 + Pv_2$ and since

$$h = \frac{Pv}{J} + U$$

then $h_1 = h_2$

D. A throttling process is a constant enthalpy process

E. Example: Plot on Mollier Diagram

Given: Pzr. pressure of 2200 psi
PRT pressure of 15 psi

1. If relief valve opens, find:
   a. Δh
   b. ΔS
   c. Temperature downstream of relief valve
   d. Phase of steam downstream of relief valve
   e. ~~ΔU~~ Δv

2. Δh - h at 2200 psia = 1120 BTU/lbm and since this is a throttling process $\Delta h = 0$

3. ΔS

   a. S @ 2200 => 1.27 BTU/lbm°F

   b. S @ 15 psia => 1.76 BTU/lbm°F

   c. ΔS = .49 BTU/lbm°F

4. Temperature = ~~214~~ 213°F (saturation for 15 psia)

5. 97% steam quality => wet vapor(from Mollier chart)

6. For Δv

   $\Delta v = v_{final} - v_{initial}$

   $v_{wv} = v_f + (x \cdot v_{fg})$

   $v_{wv} = .016726 \frac{ft^3}{lbm} + (.975 \times 26.274)$ (Using Stm tables)

   $v_{wv} = 25.63 \frac{ft^3}{lbm}$

   $\Delta v = (25.129 - .16272) \frac{ft^3}{lbm}$

   $\Delta v = 25.5 \frac{ft^3}{lbm}$ (increase)

7. If u is evaluated we will find that it decreases

8. U↓, T↓, P↓, v↑, S↑

F. The major point on Pressurizer Relief

Example:

1. Can't necessarily expect to see a temperature increase to pzr. temp. down stream

2. Entropy increases indicating some energy is unavailable. This will be important in studying the turbine.

G. Do another example on Mollier Chart using Main Steam Header Conditions Pressure = 950 psia.

5.3 Energy Balance on a Pump

NOTE: Sketch pump on board with suction as Point 1 and Discharge Point 2.

A. Assumptions:

1. No heat transferred in or out

2. No friction

3. Steady flow conditions => $\mathring{M}_{in} = \mathring{M}_{out}$

4. The fluid is water => $\rho_{in} = \rho_{out}$

5. Suction diameter = Discharge diameter

1 Pt In E-3 *(Steam Generator Tube Rupture)* Enclosure 5 *(NC Pressure and Makeup Control to Minimize Leakage)* the operators are directed to energize pressurizer heaters if the ruptured S/G level is decreasing and pressurizer level is greater than 25%.

What is the purpose for this action?

A. **Maintain pressurizer saturation temperature corresponding to ruptured S/G pressure to minimize S/G leakage into the NC system.**

B. **Maintain pressurizer saturation temperature corresponding to intact S/G pressure to minimize primary leakage into the S/G.**

C. **Maintain pressurizer saturation temperature above the corresponding ruptured S/G pressure to ensure S/G water does not flow into the NC system.**

D. **Maintain pressurizer saturation temperature corresponding to intact S/G pressure to minimize NC pressure transients.**

Bank Question: 321.1 ***Answer: A***

1 Pt In E-3 *(Steam Generator Tube Rupture)* Enclosure 5 *(NC Pressure and Makeup Control to Minimize Leakage)* the operators are directed to energize pressurizer heaters if the ruptured S/G level is decreasing and pressurizer level is greater than 25%.

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C. **Maintain pressurizer saturation temperature above the corresponding ruptured S/G pressure to ensure S/G water does not flow into the NC system.**

D. **Maintain pressurizer saturation temperature corresponding to intact S/G pressure to minimize NC pressure transients.**

Distracter Analysis: The purpose of this question is to determine if the candidate understands that thermal hydraulic equilibrium (temp/press/leak rate) needs to be established between the NCS and the ruptured S/G. No references are provided because the candidate should be able to answer the question by simply comprehending the pressures and reasons for this equilibrium.

A. **Correct Answer**:

B. **Incorrect**: required to maintain NCS pressure equal to ruptured S/G pressure, not the intact S/G - Intact S/G pressure < ruptured S/G pressure would not reduce NCS to S/G leakage
Plausible: if the candidate is confused over the thermal hydraulics

C. **Incorrect**: required to maintain NCS pressure equal to ruptured S/G pressure
Plausible: *partially correct – do not want leakage from S/G to NCS or NCS to S/G*

D. **Incorrect**: required to maintain NCS pressure equal to ruptured S/G pressure, not the intact S/G
Plausible: this would be a *reasonable basis for monitoring intact* S/G pressure if that were the correct answer.

Level: RO

KA: EPE 038 EK1.02(3.2/3.5)

Lesson Plan Objective: OP-MC-EP-EP3 Obj 4

Source: Bank

Level of knowledge: comprehension

References:
1. OP-MC-EP-EP3 pages 19, 101, 119
2. EP/1/A/5000/E-3 pages 56, 57

EPE: 038 Steam Generator Tube Rupture (SGTR)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the SGTR:** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Use of steam tables	3.1	3.4
EK1.02	Leak rate vs. pressure drop	3.2	3.5
EK1.03	Natural circulation	3.9	4.2
EK1.04	Reflux boiling	3.1*	3.3
EK2	**Knowledge of the interrelations between the and the following a SGTR:** (CFR 41.7 / 45.7)		
EK2.01	Valves	2.2*	2.2
EK2.02	Sensors and detectors	2.4	2.5
EK2.03	Controllers and positioners	2.1	2.2
EK2.04	Pumps	2.3*	2.4
EK2.05	Motors	2.1	2.2
EK2.06	Heat exchangers and condensers	2.1	2.4
EK2.07	Breakers, relays, and disconnects	2.1*	2.3
EK3	**Knowledge of the reasons for the following responses as the apply to the SGTR:** (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	Equalizing pressure on primary and secondary sides of ruptured S/G	4.1	4.3
EK3.02	Prevention of secondary PORV cycling	4.4	4.5
EK3.03	Automatic actions associated with high radioactivity in S/G sample lines	3.6*	4.0*
EK3.04	Automatic actions provided by each PRM	3.9	4.1
EK3.05	Normal operating precautions to preclude or minimize SGTR	4.0	4.3
EK3.06	Actions contained in EOP for RCS water inventory balance, S/G tube rupture, and plant shutdown procedures	4.2	4.5
EK3.07	RCS loop isolation values	3.4*	3.8
EK3.08	Criteria for securing RCP	4.1	4.2
EK3.09	Criteria for securing/throttling ECCS	4.1	4.5
	ABILITY		
EA1	**Ability to operate and monitor the following as they apply to a SGTR:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	S/G levels, for abnormal increase in any S/G	4.5	4.4
EA1.02	Steam and feedwater flow, for mismatched condition	4.2	4.1
EA1.03	SWS to the turbine building	1.9*	2.0
EA1.04	PZR spray, to reduce coolant system pressure	4.3	4.1
EA1.05	Maximum controlled depressurization rate for affected S/G	4.1	4.3
EA1.06	Cleanup of a contaminated S/G	2.1*	2.5*
EA1.07	PRT tank temperature, pressure, and setpoints	2.5*	2.6*
EA1.08	Core cooling monitor	3.7*	3.8*
EA1.09	PZR tank level/pressure indicators, gauges, and recorder.	3.2	3.3
EA1.10	Control room radiation monitoring indicators and alarms	3.7*	3.7
EA1.11	S/G level indicators	3.8	3.9
EA1.12	S/G blowdown line radiation monitors	4.3	4.3
EA1.13	Steam flow indicators	3.7*	3.6

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		4.0	4.0	3.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the E-3 series. EPE3001			X	X	
2	Discuss the entry and exit guidance for each procedure in the E-3 series. EPE3002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the E-3 series. EPE3003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the E-3 series. EPE3004			X	X	X
5	Given the Foldout page, discuss the actions included and the basis for these actions. EPE3005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPE3006			X	X	X
7	Discuss the time critical task(s) associated with the E-3 series procedures including the time requirements and the basis for these requirements. EPE3007			X	X	X

NC pressure goes down more rapidly as energy transfer to the secondary shrinks the reactor coolant and tube rupture flow continues to deplete primary inventory. This results in a low-low Pzr pressure S/I signal soon after reactor trip. Normal feedwater flow is automatically isolated on the S/I signal and CA flow is started to all steam generators.

Once a tube failure has been identified, recovery actions begin by isolating steam flow from and stopping feedwater flow to the affected S/Gs. In addition to minimizing radiological releases, this also reduces the possibility of filling the affected S/G with water by minimizing the accumulation of feedwater flow and by enabling the operator to establish a pressure differential between the ruptured and intact steam generators as a necessary step toward terminating primary-to-secondary leakage.

If steam flow from the affected S/G can be isolated, then recovery actions are directed by the ES-3.x series procedures. If steam flow from the affected S/G cannot be stopped, then pressure in that steam generator may remain less than NC pressure. In that case, the operator is directed to ECA-3.1 on low pressure in the ruptured S/G.

STEP 36 Control NC pressure and charging flow to minimize Primary-to-Secondary leakage PER Enclosure 5 (NC pressure and charging flow control to minimize leakage)

PURPOSE:

1. To control NC pressure and reactor coolant makeup flow to maintain an indicated Pzr level while minimizing primary-to-secondary leakage.
2. To maintain NC pressure less than the S/G PORV setpoint to prevent lifting the PORV or code safety valve.

BASIS: The operator must continuously adjust NC pressure and makeup flow to control Pzr and ruptured S/G inventories. This step provides guidance for performing these actions in the form of a table contained in Enclosure 5.

Enclosure 5 is in effect throughout this event unless directed otherwise in ES-3.1, Post - SGTR Cooldown Using Backfill. ES-3.2 and ES-3.3 utilize the same steps to control ruptured S/G and NC pressure as described in Enclosure 5.

If NC pressure is greater than the S/G PORV setpoint, primary-to-secondary leakage will compress the steam bubble in the ruptured S/G and raise pressure until the PORV eventually lifts.

Normal Pzr spray is the preferred means of controlling NC pressure. If it is not available and letdown is in service, auxiliary spray should be used. If letdown is not in service, a Pzr PORV should be used instead of auxiliary spray.

Enclosure 5 table does not specify what actions are required if the ruptured S/G N/R level is stable. This is because no additional actions are required if the level is on scale and stable.

Enclosure 4 - Natural Circulation Parameters

1. *The following conditions support or indicate natural circulation flow:*
   - NC Subcooling - GREATER THAN 0°F
   - S/G pressures - STABLE OR GOING DOWN
   - NC T-hots - STABLE OR GOING DOWN
   - Core Exit T/Cs - STABLE OR GOING DOWN
   - NC T-colds - AT SATURATION TEMPERATURE FOR S/G PRESSURE (WITHIN THE LIMITS OF THE GRAPH PROVIDED)

BASIS: These parameters are indicative of natural circulation flow.

2. **IF** natural circulation flow is not established, **THEN** raise dumping steam to establish Natural Circulation flow.

BASIS: By increasing steam demand, more steam is drawn from the S/Gs. This results in decreased temperature (increased density) in the cold legs. This denser/colder water flows down the cold leg to the core while the warmer (less dense) water in the hot leg flows up to the S/Gs. This density difference is the driving force for natural circulation.

The graph plots S/G pressure versus cold leg temperature. The cold legs should be at saturation temperature for S/G pressure. Two curves are plotted. One curve is saturation plus instrument inaccuracies and the other curve is saturation minus instrument inaccuracies. The acceptable operating region is between the curves, or in other words, saturation ± instrument inaccuracies.

Enclosure 5 - NC Pressure and Charging Control to Minimize Leakage

This enclosure provides actions for maintaining NC and ruptured S/G pressures less than the S/G PORV setpoint (1125 PSIG) to minimize primary to secondary leakage and to reduce the likelihood of release to the environment. A table is provided that provides actions to be taken based on Pzr level and the level trend of the highest ruptured S/G. A variety of actions may be performed dependent on these parameters and trends.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 1. **Check normal Pzr spray flow - AVAILABLE.**	**Perform the following:** __ a. IF letdown in service, THEN use NV aux spray PER EP/1/A/5000/G-1 (Generic Enclosures), Enclosure 3 (Establishing NV Aux Spray). __ b. IF letdown isolated OR NV aux spray not effective, THEN control pressure using one Pzr PORV.
2. **Maintain NC and ruptured S/G pressures less than S/G PORV setpoint as follows:** a. Depressurize NC System until either of the following is met: __ • NC pressure - LESS THAN 1125 PSIG OR __ • IF ruptured S/G N/R level is on scale, THEN check ruptured S/G N/R level - STABLE OR GOING DOWN. __ b. Maintain NC pressure to ensure ruptured S/G pressure remains less than 1125 PSIG.	

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

__ 3. **Perform action(s) from table to minimize primary to secondary leakage:**

PZR LEVEL	HIGHEST RUPTURED S/G N/R LEVEL		
	GOING UP	GOING DOWN	OFFSCALE HIGH
LESS THAN 25% (50% ACC)	• Raise charging flow. • Depressurize NC System.	Raise charging flow.	• Raise charging flow. • Maintain NC and ruptured S/G(s) pressures equal.
BETWEEN 25% (50% ACC) AND 50%	Depressurize NC System.	Turn on Pzr heaters.	Maintain NC and ruptured S/G(s) pressures equal.
BETWEEN 50% AND 76% (58% ACC)	• Depressurize NC System. • Lower charging flow.	Turn on Pzr heaters.	Maintain NC and ruptured S/G(s) pressures equal.
GREATER THAN 76% (58% ACC)	Lower charging flow.	Turn on Pzr heaters.	Maintain NC and ruptured S/G(s) pressures equal.

__ 4. **Perform required actions of this enclosure throughout event, unless directed otherwise in EP/1/A/5000/ES-3.1 (Post SGTR Cooldown Using Backfill).**

1 Pt During a cold startup, the NCPs are limited to 3 consecutive starts in any 2-hour period. There is an additional requirement of a minimum idle period of 60 minutes between restarts. What is the reason for these limitations?

A. **This restriction assures that the oil temperature will decrease to design specifications between restart attempts.**

B. **This restriction prevents overheating the motor windings due to high starting currents.**

C. **This restriction allows the NCP seals to fully reseat between NCP oil lift pump cycles.**

D. **This restriction ensures that natural circulation is reestablished between starts to prevent a cold-water addition accident.**

Bank Question: 330.1 *Answer: B*

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C. **This restriction allows the NCP seals to fully reseat between NCP oil lift pump cycles.**

D. **This restriction ensures that natural circulation is reestablished between starts to prevent a cold-water addition accident.**

Distracter Analysis:

A. **Incorrect**: The reason is stator-winding temperatures
Plausible: if the candidate remembers this as a high temperature concern - *another adverse consequence of multiple starts on* motors

B. **Correct Answer**:

C. **Incorrect**: The reason is stator-winding temperatures
Plausible: NCP seal seating is the basis for a different cold start precaution – seal leakoff limit after seal replacement

D. **Incorrect**: The reason is stator-winding temperatures
Plausible: if the candidate is confused regarding the basis for the precaution.

Level: RO

Source: BANK

Level of Knowledge: Memory

KA: G2.1.32 (3.4/3.8)

References:
1. OP-MC-PS-NCP *page 35*

2.1 Conduct of Operations (continued)

2.1.27 Knowledge of system purpose and or function.
(CFR: 41.7)
IMPORTANCE RO 2.8 SRO 2.9

2.1.28 Knowledge of the purpose and function of major system components and controls.
(CFR: 41.7)
IMPORTANCE RO 3.2 SRO 3.3

2.1.29 Knowledge of how to conduct and verify valve lineups.
(CFR: 41.10 / 45.1 / 45.12)
IMPORTANCE RO 3.4 SRO 3.3

2.1.30 Ability to locate and operate components, including local controls.
(CFR: 41.7 / 45.7)
IMPORTANCE RO 3.9 SRO 3.4

2.1.31 Ability to locate control room switches, controls and indications and to determine that they are correctly reflecting the desired plant lineup.
(CFR: 45.12)
IMPORTANCE RO 4.2 SRO 3.9

2.1.32 Ability to explain and apply all system limits and precautions.
(CFR: 41.10 / 43.2 / 45.12)
IMPORTANCE RO 3.4 SRO 3.8

2.1.33 Ability to recognize indications for system operating parameters which are entry-level conditions for technical specifications.
(CFR: 43.2 / 43.3 / 45.3)
IMPORTANCE RO 3.4 SRO 4.0

2.1.34 Ability to maintain primary and secondary plant chemistry within allowable limits.
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.3 SRO 2.9

BASIS: This is sufficient flow to ensure adequate lubrication (seal separation) and cooling of the #1 seal. If the leakoff flow is less than 0.2 gpm it is probable that minor foreign matter is restricting the flow at the seal face inlet. The seal faces tend to act like a filter. Increasing the seal ΔP may clean the seal but if not decrease seal ΔP and rotate shaft by hand.

NOTE:	**The following precaution is not applicable during NC System filling and venting operations.**

IF all NC Pumps have been idle for more than 5 minutes and NC System temperature is greater than charging and seal injection water temperature, NC Pumps are unable to be started until a bubble has been formed in the pressurizer. This is NOT applicable during NC System filling and venting operations.

BASIS: **With no bubble in the pressurizer there is no pressure dampening available and a NCP start may result in a pressure spike. The cooler water in the NC loops (due to seal injection) will heat up following a pump start and this thermal expansion will result in a pressure increase. This may result in lifting the PORV's.**

NC Pumps shall be started one at a time.

BASIS: **The NCP's are large motors and draw significant starting current. When one pump is started system, bus voltage and frequency decreases until the pump reaches rated speed. Starting more than one pump at the same time would result in lower bus voltage which would result in higher starting current for a longer period of time to reach rated speed. This may result in motor damage. Also, the pump(s) may trip prior to reaching speed due to under-voltage or under-frequency.**

Prior to restarting an NC Pump, it must cool by standing idle for 30 minutes unless the following conditions are met:

- NC Pump running normally for 2 hrs. or more
- Stator Temperature on affected pump below 248°F
- Stator Temperature stable or decreasing

Maximum number of NC Pump starts within a 2 hr. period is 3.
IF three NC Pump starts or attempted starts made within a two-hour period, the NC Pump Motor must be allowed to cool by standing idle for at least one hour prior to restart.

BASIS: **These limitations ensure the motor windings and rotor core have cooled sufficiently prior to attempting another start. Frequent starting of the NCP may result in damage to the NCP motor windings due to excessive heat generated during starting.**

1 Pt

Unit 1 is responding to a small break LOCA using E-1 *(Loss of Reactor or Secondary Coolant).* Given the following events and conditions:

- FWST Level = 340 inches
- Containment pressure = 1.5 psig
- Containment Sump Level = 1.05 ft
- EMF-41 (*AUX BLDG VENTILATION*) = trip 2
- Aux Building area radiation monitors are in alarm
- EMF-51A and B (*CONTAINMENT TRN A & B*) = 25 R/Hr
- Hydrogen Analyzer = 0.7% in containment
- NLO's report significant leakage at the seals of the 1A ND pump

Which one of the following procedures should the operator transition into from E-1?

A. FR-Z.3 (*Response to High Containment Radiation Level*)

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

C. FR-Z.4 (*Response to High Containment Hydrogen*)

D. ECA-1.2 (*LOCA Outside Containment*)

Bank Question: 359.3 ***Answer: D***

1 Pt

Unit 1 is responding to a small break LOCA using E-1 (Loss of Reactor or Secondary Coolant). Given the following events and conditions:

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A. FR-Z.3 (*Response to High Containment Radiation Level*)

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

C. FR-Z.4 (*Response to High Containment Hydrogen*)

D. ECA-1.2 (*LOCA Outside Containment*)

Distracter Analysis: The initial conditions provide a LOCA into containment and a leakage path outside of containment. The question is which of the problems take priority? The purpose is not to memorize procedure steps but to answer this from a broader perspective.

A. **Incorrect**: Cont RAD levels < 35 R/hr and this would be a YELLOW path that does NOT require priority action.
Plausible: If the candidate thinks that the abnormal radiation level requires priority action.

B. **Incorrect**: Still in injection phase of SI – have failed to isolate leak outside containment.
Plausible: if candidate is not familiar with the entry conditions for ECA 1.1 (after failure to isolate leak outside containment).

C. **Incorrect**: Cont H2 > 0.5 %, but this is a YELLOW path not requiring priority action.
Plausible: If the candidate fails to recognize the leak in the auxiliary bldg and/or the fact that E-1 takes care of the cont H2 problem.

D. **Correct**:

Level: RO

KA: WE 04EK3.2 (3.4 /4.0)

Lesson Plan Objective: OP-MC-EP-E1 Obj 2

Source: BANK

Level of knowledge: comprehension

References:
1. OP-MC-EP-E1 page 45
2. EP/1/A/5000/E-1 pages 12-14
3. EP/1/A/5000/F-0 page 9

EPE: LOCA Outside Containment (Continued)

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (LOCA Outside Containment)
IMPORTANCE RO 3.4 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.8 SRO 3.8

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.6 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (LOCA Outside Containment)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 4.0

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.8

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.8 SRO 4.0

EA2. Ability to determine and interpret the following as they apply to the (LOCA Outside Containment)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.4 SRO 4.3

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	5.0	5.0	4.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the E-1 series. EPE1001			X	X	
2	Discuss the entry and exit guidance for each procedure in the E-1 series. EPE1002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the E-1 series. EPE1003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the E-1 series. EPE1004			X	X	X
5	Given the Foldout page discuss the actions included and the basis for these actions. EPE1005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPE1006			X	X	X
7	Discuss the time critical task(s) associated with the E-1 series procedures including the time requirements and the basis for these requirements. EPE1007			X	X	X

STEP 13 Initiate evaluation of plant status:

PURPOSE: To initiate an evaluation of the plant status with respect to radiation leakage and availability of equipment needed for long-term plant recovery.

BASIS: Since an evaluation of plant status may require some time to complete and may affect subsequent actions, it is initiated prior to performing a post-LOCA cooldown/depressurization or transferring to cold leg recirculation.

The capability to use cold leg recirculation is verified in this step. The intent is to only verify the availability of required equipment and not its proper alignment. For example, it should be verified that a required valve is available-not that the valve is correctly aligned for cold leg recirculation. The valve would be correctly aligned in ES-1.3, Transfer to Cold Leg Recirculation. Also, availability of a ND pump is checked, not just whether power is available to the pump to cover cases where the pump may not be available for reasons other than loss of power.

If for some reason cold leg recirculation capability cannot be verified, the operator should transfer immediately to ECA-1.1, Loss of Emergency Coolant Recirculation.

A check is also made for radioactive leaks into the auxiliary building. If leakage is identified, and is determined to be the result of an NC leak into the auxiliary building, the operator is directed to ECA-1.2, LOCA Outside Containment.

Samples are obtained to assess NC reactivity, fuel damage, hydrogen concentration, etc. In the case of a large LOCA plus multiple S/G tube failures, significant back-leakage could occur. The recirculation sump is sampled (via the PALS Panel since the sample comes off ND, which should be in service) to verify that excessive dilution of the NC boron concentration has not occurred. If it has, then the operator would have to provide additional boron to the coolant.

An evaluation of plant equipment available following a LOCA is necessary in determining long-term recovery actions. Hence, this evaluation is initiated at this time and any additional equipment that would assist in the plant recovery is started.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
13. **Initiate evaluation of plant status:**	
a. Check Cold Leg Recirc capability:	
__ 1) Any ND pump - AVAILABLE.	__ 1) GO TO EP/1/A/5000/ECA-1.1 (Loss Of Emergency Coolant Recirc).
2) Power to following valves - AVAILABLE: __ • 1ND-19A (A ND Pump Suct From FWST or NC) __ • 1NI-185A (RB Sump To Train A ND & NS) __ • 1ND-58A (Train A ND To NV & NI Pumps) __ • 1ND-4B (B ND Pump Suct From FWST or NC) __ • 1NI-184B (RB Sump To Train B ND & NS) __ • 1NI-136B (B NI Pump Suction From ND) __ • 1NI-332A (NV & NI Pumps Suction X-Over) __ • 1NI-333B (NV & NI Pumps Suction X-over) __ • 1NI-334B (NV & NI Pumps Suct X-Over Blk) __ • 1NI-147A (NI Pumps Miniflow Hdr Isol) __ • 1NI-115B (A NI Pump Miniflow) __ • 1NI-144B (B NI Pump Miniflow).	__ 2) IF power not available to minimum number of valves to establish Cold Leg Recirc, THEN GO TO EP/1/A/5000/ECA-1.1 (Loss Of Emergency Coolant Recirc).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
13. (Continued)	
3) "S LATCHED" on following switches - LIT: __ • 1NI-184B control permisive for recirc mode __ • 1NI-185A control permissive for recirc mode.	3) <u>WHEN</u> FWST low level alarm actuates, <u>THEN</u>: __ a) Depress "BYPASS" on control permissive for recirc mode switch(s). __ b) Open valve(s).
b. Check aux bldg radiation: __ • All area monitor EMFs - NORMAL __ • EMF-41 (Aux Bldg Ventilation) - NORMAL.	b. Evaluate cause of abnormal conditions as follows: __ 1) Monitor area EMFs to determine location of activity. __ 2) Using the OAC, determine which EMF-41 sample points (turn on code "EMF-41") are reading the highest. __ 3) Determine plant locations for points that are reading the highest. __ 4) Dispatch operator to locate potential leak. __ 5) <u>IF</u> cause of alarm is LOCA outside containment, <u>THEN</u> <u>GO TO</u> EP/1/A/5000/ECA-1.2 (LOCA Outside Containment).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

13. (Continued)

c. **WHEN** the TSC is staffed, **THEN** request TSC to evaluate obtaining samples as follows:

1) Ensure cooling of sample HXs is considered in evaluation as follows:

__ • KC will remain isolated to normal sample HXs for 10 hours, until KC is realigned to normal sample HXs and KF per AP/1/A/5500/41 (Loss Of Spent Fuel Cooling or Level).

__ • **IF** sample is desired prior to aligning KC to KC aux bldg non-essential header, **AND** fuel damage is not expected, **THEN** evaluate obtaining sample **PER** OP/1/A/6200/011 (Unit 1 NM Sampling), Enclosure 4.6 (1NC Hot Leg with KC Non-essential Header Isolated).

2) Evaluate obtaining NC System sample for:

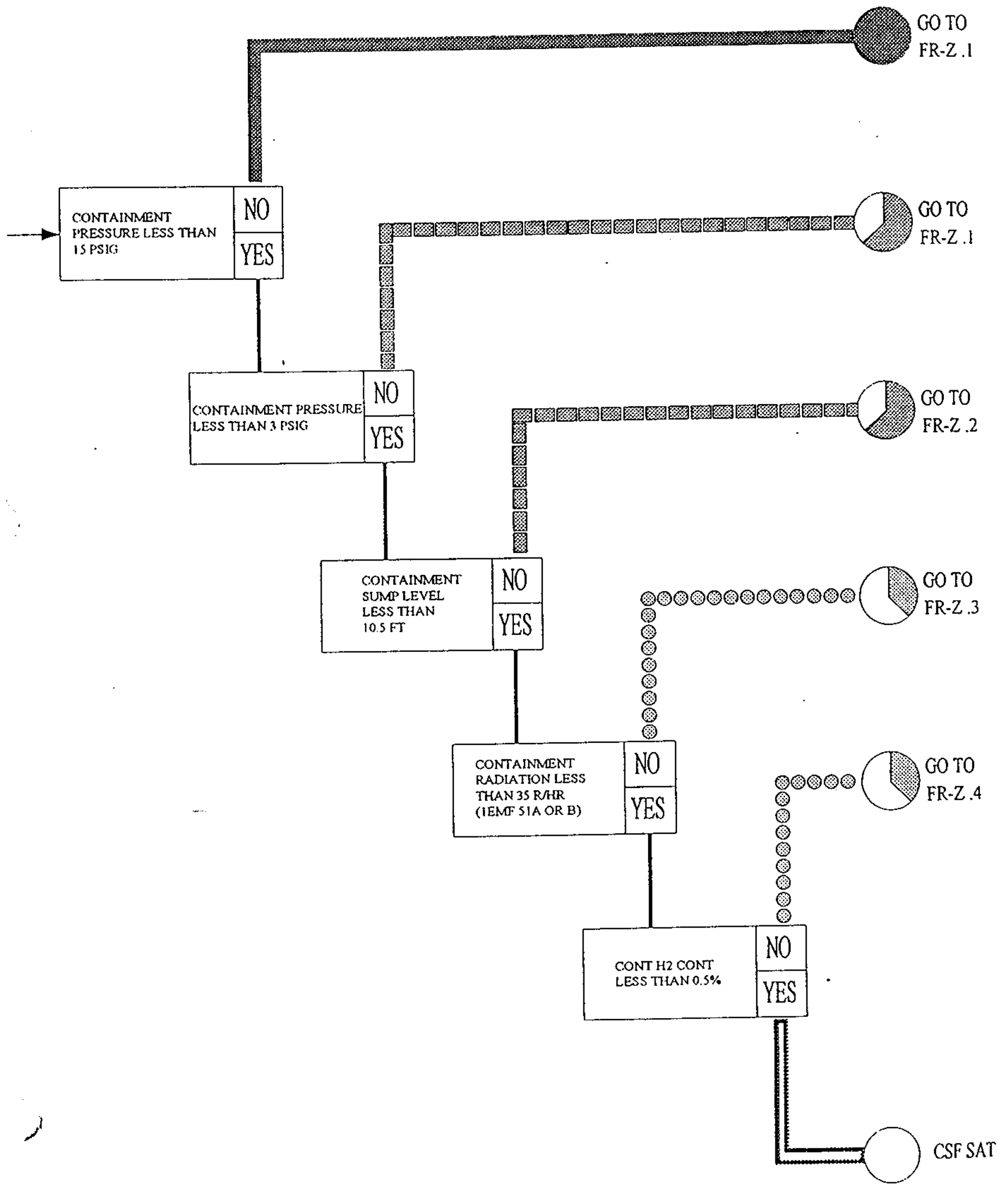
__ • Boron Concentration
__ • Radionuclides.

3) **WHEN** ND is aligned for Cold Leg Recirc, **THEN** evaluate obtaining containment sump sample (by sampling ND) for:

__ • Boron Concentration
__ • Radionuclides
__ • PH.

__ 4) Evaluate obtaining containment air sample.

__ d. Consult station management to start additional plant equipment to assist in recovery as necessary.


CONTAINMENT PRESSURE LESS THAN 15 PSIG
NO
YES
GO TO FR-Z .1
CONTAINMENT PRESSURE LESS THAN 3 PSIG
NO
YES
GO TO FR-Z .1
CONTAINMENT SUMP LEVEL LESS THAN 10.5 FT
NO
YES
GO TO FR-Z .2
CONTAINMENT RADIATION LESS THAN 35 R/HR (1EMF 51A OR B)
NO
YES
GO TO FR-Z .3
CONT H2 CONT LESS THAN 0.5%
NO
YES
GO TO FR-Z .4
CSF SAT

1 Pt

Unit 2 was at 10% during a plant startup when a loss of condenser vacuum occurred. Given the following conditions:

- The reactor was tripped
- The steam dump select switch was in steam pressure mode
- Condenser vacuum dropped to 18 inches
- No component or instrument failures occurred
- No operator action taken

Which one of the following sequences best describes the actuation of the steam dumps to this event assuming?

	Condenser dump valves	Atmospheric dump valves
A.	open	open
B.	open	shut
C.	shut	open
D.	shut	shut

Bank Question: 373.1 ***Answer: D***

1 Pt

Unit 2 was at 10% during a plant startup when a loss of condenser vacuum occurred. Given the following conditions:

- The reactor was tripped
- The steam dump select switch was in steam pressure mode
- Condenser vacuum dropped to 18 inches
- No component or instrument failures occurred
- No operator action taken

Which one of the following sequences best describes the actuation of the steam dumps to this event assuming?

	Condenser dump valves	Atmospheric dump valves
A.	**open**	**open**
B.	**open**	**shut**
C.	**shut**	**open**
D.	**shut**	**shut**

Distracter Analysis:

A. **Incorrect**: - the condenser dumps will not open due to the C9 arming signal not present caused by a low vacuum condition (20 in) The atmospheric dumps will not open because they do not actuate when the steam dump selector switch is in steam pressure mode
Plausible: - this would occur if the transition had not yet been made to steam pressure mode and C9 had actuated - a normal *plant response during a startup < 10% power.*

B. **Incorrect**: - the condenser dumps will not open due to the C9 arming signal not present caused by a low vacuum condition
Plausible: - this sequence would occur if there was not a loss of condenser vacuum or if the candidate does not recognize the interaction between condenser pressure and the C9 arming signal.

C. **Incorrect**: - the atmospheric dumps will not open because they do not actuate when the steam dump selector switch is in steam pressure mode
Plausible: - this sequence would occur if the plant was in Tave mode above ~55% - the transition from Tave to steam pressure mode occurs by procedure at 10% power

D. **Correct answer**

Level: RO

KA: APE 051 AK.3.01 (2.8*/3.1*)

Lesson Plan Objective: STM-IDE LPSO 5, 6, 9

Source: Bank

Level of Knowledge: comprehension

References:
1.OP-MC-STM-IDE pages 17-35 (odd only)

APE: 051 Loss of Condenser Vacuum

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Condenser Vacuum: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Relationship of condenser vacuum to circulating water, flow rate, and temperature	2.4*	2.4*
AK2.	**Knowledge of the interrelations between the Loss of Condenser Vacuum and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	1.6	1.6
AK2.02	Controllers and positioners	1.6	1.6
AK2.03	Pumps	1.6	1.5
AK2.04	Motors	1.6	1.5
AK2.05	Heat exchangers and condensers	1.7*	1.6
AK2.06	Sensors and detectors	1.6	1.5
AK2.07	Steam jet air ejectors and vacuum pumps	1.9*	1.7
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Condenser Vacuum: (CFR 41.5,41.10 /.45.6 / 45.13)**		
[redacted]	[redacted]		*

ABILITY

K/A NO.	ABILITY	IMPORTANCE RO	IMPORTANCE SRO
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Condenser Vacuum: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Condenser vacuum pump	1.9*	1.9
AA1.02	Condenser vacuum	2.3*	2.2*
AA1.03	Gland steam header pressure	2.0*	1.9
AA1.04	Rod position	2.5*	2.5*
AA1.05	Turbine header pressure	1.8*	1.7
AA1.06	Turbine throttle and governor valves position	2.0*	2.0
AA1.07	Feedwater flow	2.2*	2.2*
AA1.08	Air ejector steam supply	2.3*	2.1
AA1.09	Circulating water system	2.1*	2.0

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
NA	2	3	3	2

OBJECTIVES

No.	Objective	NLO	NLOR	LPRO	LPSO	LOR
1.	State the purpose of the Steam Dump Control System		X	X	X	
2.	List the banks of steam dumps and the number of valves in each bank.		X	X	X	
3.	Sketch the valve arrangement per Drawing 7.3, Steam Dump Valve Pneumatic Control.		X	X	X	
4.	Describe the effect of a failed or stuck open steam dump valve on primary plant parameters, and determine any compensatory Operator action			X	X	X
5.	Explain the operation of the system in steam pressure, plant trip and load rejection mode. Include the fast response "trip open bistables". Include the input signals for each control.		X	X	X	X
6.	Describe all control and permissive interlocks (C9, C7A, C7B, P4, P12) required for various modes of operation.		X	X	X	X
7.	DELETE					
8.	Describe all selector switches and their functions for various modes of operation		X	X	X	X
9.	Describe the effect on the system resulting from a failure of each input to the system.		X	X	X	X
10.	Explain what occurs in the IDE System during start-up, power operation, shutdown and cooldown of the plant. Include all manual functions required to be performed by the operator during these modes.			X	X	X
11.	Relate % steam dump demand indication to corresponding steam dump valve operation			X	X	X

2.2. Pneumatic Dump Valve Control - Atmospheric Dump Valves (Unit 2)

Objective #3

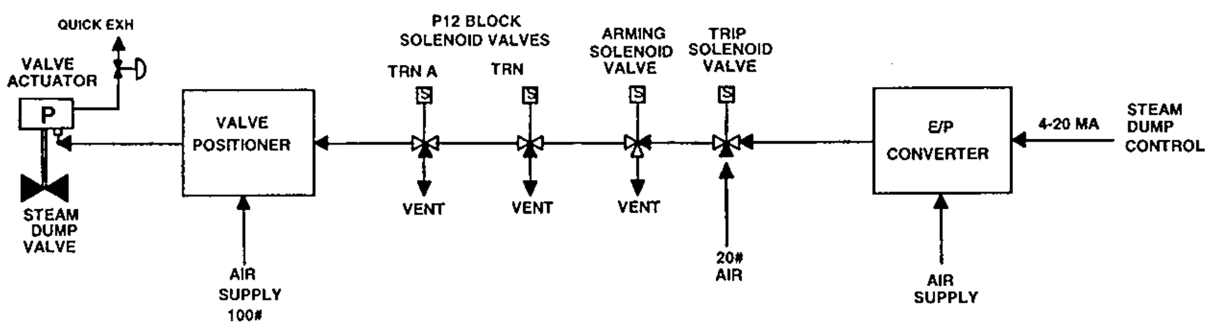


Figure 3, ATMOSPHERIC DUMP VALVE PNEUMATIC CONTROL 3/15/95

The Atmospheric Dump Valves use pneumatic valve actuators. On loss of air supply, the dump valves will close. The Steam dump control system supplies a 4-20ma electrical signal, which is converted to a 3-15 psig pneumatic control signal by an E/P converter (4ma = 3 psig = dump valve closed). The valve positioner provides the valve actuating air pressure and volume to position and maintain the valve position proportional to control signal.

NOTE: The valve positioner is between the P-12 solenoid valves and the actuator on the Atmospheric Dump Valves. This difference from the setup on the Condenser Dump Valves is required because the valve actuators are piston operated rather than diaphragm actuators used on the condenser dumps.

The three solenoid valves, P-12 Block (Train A&B) and the Arming solenoid, must be energized to allow the E/P to input the valve positioner to open steam dump valve. A trip solenoid valve, when energized, aids in faster valve response time to reach the full open position. When de-energized, control air is supplied to the positioner to modulate the required amount of air to open the valve. When energized, 20 psig air is sent directly to the valve positioner. 15 psig control air equates to a full open demand signal. The E/P converter is bypassed. Also, a Quick Exhaust Valve on the actuator opens. This results in the dump valve reaching the full open position faster. The trip solenoid valves for a particular bank of valves are energized by trip bistables when the error signal used to modulate the valves exceeds the value corresponding to a full open demand.

Limit switches provide control room indications when individual dump valves are fully open or closed. Both lights will be lit when valve is modulating.

2.3. Steam Dump Demand Signal

Refer to Figure 4 below.

2.3.1. The dump valve 'modulate open' (demand) signal is developed from one of three controllers:

- Load Rejection Controller

  Output proportional to T_{avg} - T_{ref}

- Plant Trip Controller

  Output proportional to $T_{avg} - T_{no\ load}$

- Steam Header Pressure Controller

  Output proportional to (Steam Header Pressure – M/A Setpoint) in Auto M/A station output in manual

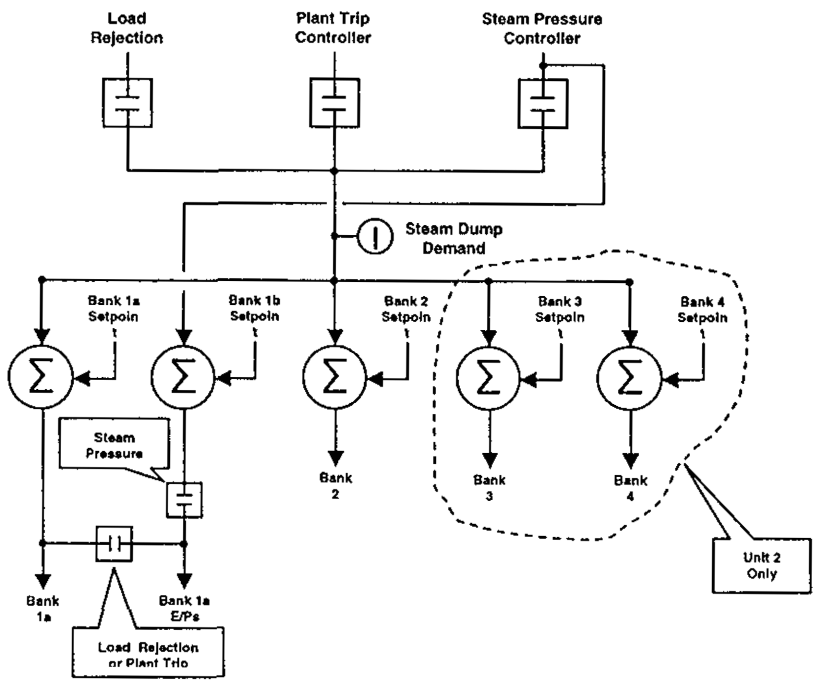


Figure 4, STEAM DUMP CONTROLLER MODES 1/27/03

Objective #11

2.3.2. The control (demand) signal used is selected according to the controller (load rejection, etc.) in use. These controllers will be covered in later sections. A control board indicator displays 0 - 100% Steam Dump Demand. For Unit 1, 100% Steam Dump Demand is equivalent to 40% of design full steam load. (At 45% demand, Banks 1 & 2 will be full open.) For Unit 2, 100% Steam Dump Demand is equivalent to 85% of design full load steam flow which is the total

(100%) capacity of the four steam dump banks. (40% for the condenser Banks 1 & 2 and 45% for the atmosphere Banks 3 & 4).

2.3.3. The steam dump demand signal is sent to summing amplifiers, one per bank, which compare it to a setpoint. The setpoint for each bank is the value of steam dump demand at which the associated Bank of valves will start to open. The output of the summer is the difference between the Steam dump demand and the setpoint, multiplied by the gain. The gain of the summing amplifier is set to provide a 20 ma output to the E/P converter when the steam dump demand reaches the value where the associated bank should be fully open.

Refer to the table below and Fig. 5 which depict the Steam dump bank response to steam dump demand.

Notice that Bank 1 will modulate from closed to full open between 0% to 25% steam dump demand. Bank 2 will begin to open when steam dump demand exceeds 25% and will be open at 45%. Bank 3 will begin to open when bank 2 is open and so forth until all are open at 100% at which time the total steam flow would be 85% of the Steam flow at 100% power. (Banks 3 & 4 only available on Unit 2.)

The effect is for the banks to modulate open in sequence proportional to the steam dump demand.

Notice also that Bank 1 valves are sequenced differently depending on the controller in effect. With the Load Rejection or Plant Trip controller in effect, the one summer with the 0 set point drives all 5 Bank 1 Valves. When the steam pressure controller is in effect, Bank 1a is driven by one summer while bank 1b is driven by second which begins opening at a steam dump demand of 5.5%. In either case all bank 1 valves will be open at 25% steam dump demand.

Bank	% Steam Dump Demand	% Full Load Steam Flow
1+	0-25	0-21
1a*	0-25	0-21
1b*	5.5-25	
2	25-45	21-40
3	45-72	40-64
4	72-100	64-85

NOTE: Setpoints shown above are approximate values.
+ Bank 1 for Load Rejection & Plant Trip modes
* Bank 1 split for Steam Pressure mode

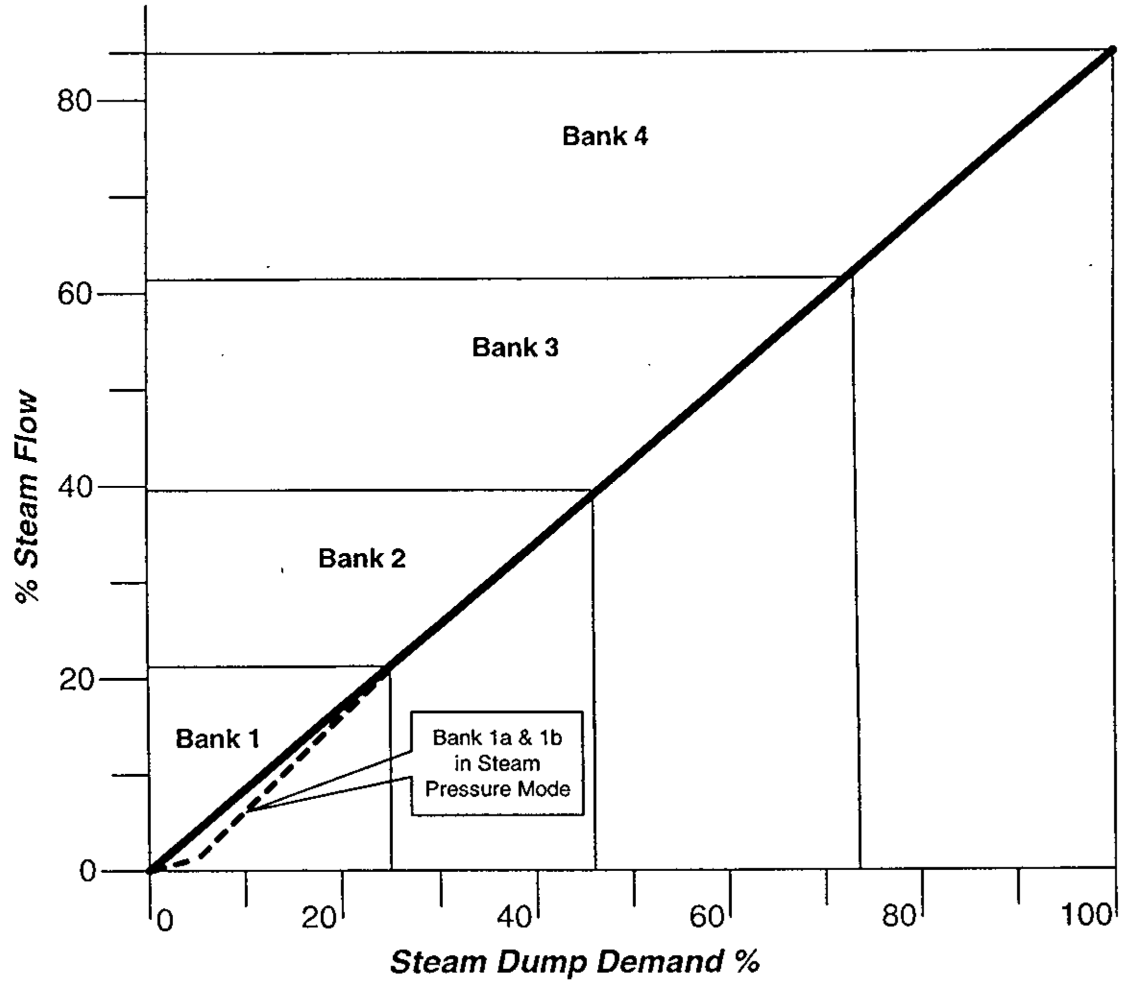


Figure 5, Bank Sequencing with Steam Dump Demand 3/19/02

2.3.4. For steam dump to occur in any of the three control modes, three conditions must be satisfied.

- There Must be a Steam Dump Demand
- The Dumps must be Armed (Arming Solenoids energized)
- The P-12 interlock must be reset or defeated

In the following sections we will discuss each of the three controllers to understand:

- The conditions required for the controller to be in effect
- How the steam dump demand signal is developed
- Which banks are armed and the conditions required to arm them.

2.4. Load Rejection Steam Dump Controller

2.4.1. The purpose of the controller is to prevent a large increase in reactor coolant temperature following a large, sudden load reduction.

2.4.2. The load rejection mode of control is "in effect" when both of the following conditions exist: (refer to Fig. 7.2 or 7.2a)

Objective #6,8

- Steam Dump Select Switch is in the 'T AVG' position
- The reactor is not tripped (no P-4 signal from Train B SSPS)

If the logic above is satisfied the output of the load rejection controller will be the "Steam Dump Demand" signal which is sent to the summers. Bank 1a & 1b will receive the same demand signal and will move together as one bank. This controller will be in effect during normal steady state power operation, however the dumps will not be "Armed" and no steam dump will occur even If there is an output from the controller.

Objective #5

2.4.3. The demand signal (output) from the load rejection controller is generated from a comparison of auctioneered Hi T_{avg} and T_{ref}.

The auctioneered Hi T_{avg} signal comes from the Reactor Control System. In the Reactor Control System, the hot and cold leg narrow range RTD temperature measurements are averaged for each loop. The highest loop T_{avg} is selected (auctioneered Hi) and is sent to the Steam Dump Control System. A compensation circuit compensates for lags in the plant thermal response and in valve positioning.

The T_{ref} signal also comes from the Reactor Control System where it is derived from the turbine first stage impulse chamber pressure (CH-1) which is proportional to turbine load. T_{ref} represents the T_{avg} setpoint for a given turbine load. Refer to Figure 6 below.

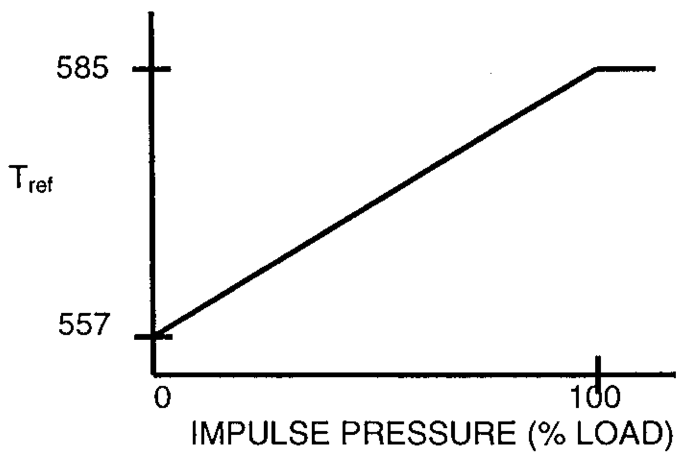


Figure 6, T_{ref} Signal Generation Based on Turbine Load 5/5/98

The load rejection controller output signal (Steam Dump Demand) is derived from T_{avg} - T_{ref}. Refer to Figure 7 below. Notice that the controller does not develop an output until the T_{avg} - T_{ref} reaches 3 °F. The 3 °F deadband allows the Reactor Control System to restore T_{avg} to T_{ref} following small transients without Steam Dump operation. At (T_{avg} - T_{ref}) of 8.8 °F the Steam Dump Demand will be 25% which is the value required to modulate Bank 1 fully open, 14.3 will demand Bank 2 to open fully and so forth.

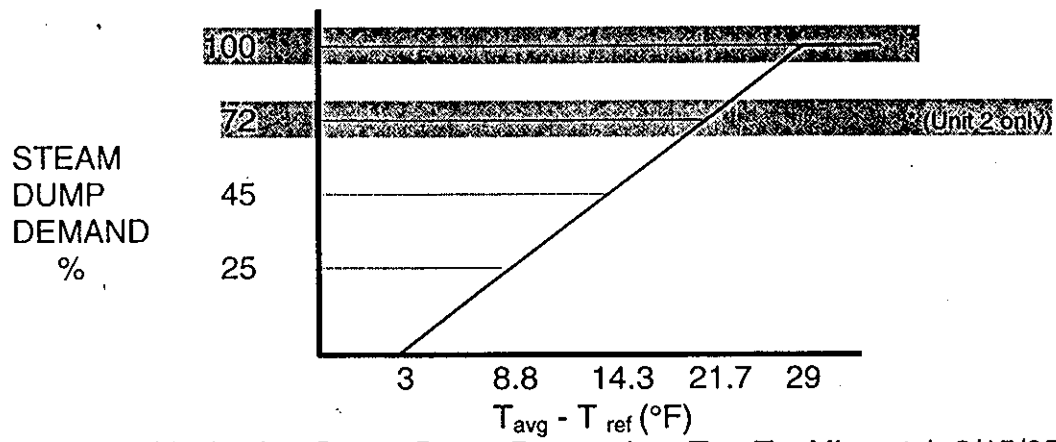


Figure 7, Load Rejection Steam Dump Demand on T_{avg}-T_{ref} Mismatch 3/15/95

2.4.4 The load rejection trip bistables are used to provide a separate dump valve trip open signal by energizing the trip solenoid valves for its associated bank when the (Tavg-Tref) signal reaches the value where the bank should be fully open. This provides faster response on rapidly increasing demand signals. The setpoints are:

Bank	T_{avg} - T_{ref} (°F)	
1	8.8	
2	14.3	
3	21.7	Unit 2
4	29	only

Trip bistables and valves are energized to actuate; thus, a signal failure will prevent tripping (modulation may still be available).

2.4.5 Arming the steam dumps in the load rejection mode.

Objective #6

To arm the Condenser Dump Valves in the load rejection mode, T-Avg mode must be selected on the Steam Dump select switch, the condenser available interlock (C-9) must be satisfied, and the loss of load interlock (C-7A) must be satisfied. When all are satisfied, control board status light COND STM DUMP (Unit 1) MODULATION and ATMOS/COND STM DUMP MODULATION (Unit 2) will illuminate.

2.5. Plant Trip Controller

2.5.1. The purpose of the Plant Trip Controller is to reduce T_{avg} to the no-load value of 557 °F following a reactor trip.

2.5.2. The Plant Trip Controller will be in effect when both of the following conditions exist:

Objective #6,8

- STEAM DUMP SELECT switch is in the 'T AVG' position
- The reactor has tripped (P-4 signal from Train B SSPS)

Objective #5

2.5.3. The Plant Trip Controller output signal (Steam Dump Demand) is derived from a comparison of Auctioneered Hi T_{avg} to $T_{no\text{-}load}$. Auctioneered Hi T_{avg} was discussed in section 2.4.3.

$T_{no\text{-}load}$ is a fixed setpoint which is set for the no load reactor coolant temperature (557 °F).

The plant trip steam dump demand signal is equivalent to T_{avg} - $T_{no\text{-}load}$. There is no deadband. Refer to Figure 8 below.

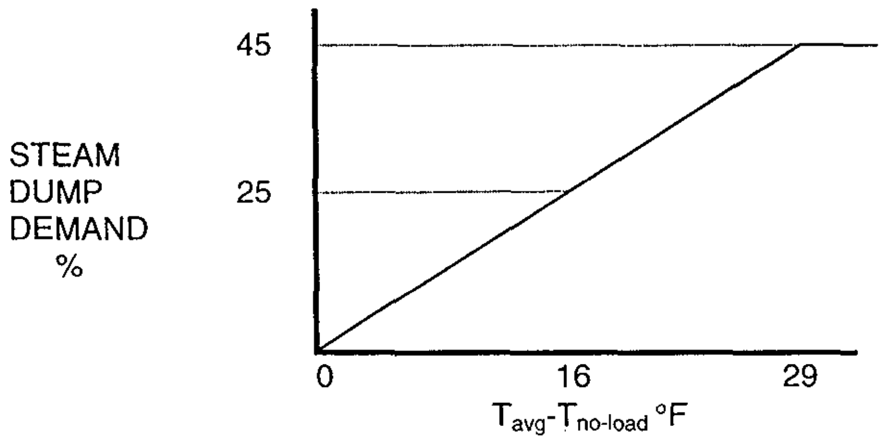


Figure 8, Plant Trip Steam Dump Demand on T_{avg} -$T_{no\text{-}load}$ Mismatch 3/15/95

NOTE: Figure 7 and 8 are available on the OAC (SB graphic)

Following a reactor (plant) trip, steam dump capacity requirement is only that necessary to maintain steam pressure below the steam generator safety valve setpoint. This is met by the 40% condenser dump capacity. Atmospheric dump valves are not armed since they are not required in this mode (Unit 2).

2.5.4. Arming the steam dumps in the plant trip mode.

Following a reactor trip Auctioneered Hi T_{avg} will be greater than $T_{no\text{-}load}$ and a steam dump demand signal proportional to the error will be generated. The electrical demand signal will be converted to a control air signal in the E/P converter which will drive the valve positioner. The resultant air supply will reach the valve actuator provided the valve is 'armed' (arming solenoid valve energized).

Only the two condenser dump banks are armed in the plant trip mode. To do this, the condenser available interlock (C-9) has to be satisfied, and Train 'A' P-4 reactor trip signal needs to be present. Any time a Train 'A' P-4 signal is present, the atmospheric steam dump valves will **NOT** be armed (Unit 2).

2.5.5 Valve trip bistables.

The trip bistables are used to provide a separate dump valve trip open signal by energizing the trip solenoid valves for its associated bank when the (T_{avg}-$T_{No\ Load}$) signal reaches the value where the bank should be fully open. This provides faster response on rapidly increasing demand signals. The setpoints are:

Bank	T_{AVG} - T_{NoLoad}
1	16°
2	29°

Only Banks 1&2 are required since the plant trip controller only operates the two banks of condenser dumps, unlike the load rejection controller that potentially operates all four banks (Unit 2). Any of the bank trip signals are indicated by the single status panel window, 'ATMOS/COND STM DUMP TRIP OPEN' (Unit 2). COND STM DUMP TRIP OPEN (Unit 1).

2.6. Steam Header Pressure Controller

2.6.1. The Steam Header Pressure Mode is used to control reactor coolant temperature when the unit is below 15% power, during plant startup and shutdown and to cooldown the reactor coolant system to cold shutdown..

The condenser dump valves, Banks 1&2, are modulated in response to the steam dump demand output from the steam pressure controller. The steam dump demand is a function of Pressure Error between Steam Header Pressure and an operator determined setpoint or manual operator input. The atmospheric dump valves are not required and are therefore blocked by their arming solenoid valves being deenergized.

1 Pt

Unit 1 has initiated a liquid radioactive waste release from the Ventilation Unit Condensate Drain Tank (VUCDT) through the RC system. All lineups and authorizations have been properly made in accordance with OP/1/A/6500/001 A using the normal path. Two RC pumps are the minimum required under the LWR document.

Given the following initial conditions:

- 3 RC pumps are running
- 1EMF-44 *(CONT VENT DRN TANK OUT)* correctly set for trip 1 and trip 2 activity limits
- No other releases are in progress

If the release automatically terminates 40 seconds after initiation, which one of the following conditions could have terminated the release?

A. **1WM-46 *(LIQUID WASTE DISCH VALVE)* closing automatically if 1 RC pump tripped**

B. **1WM-46 closing automatically if 1EMF-44 reached the trip 2 setpoint**

C. **1WP-35 *(WMT & VUCDT TO RC CNTRL)* closing automatically if 1 RC pump tripped**

D. **1WP-35 closing automatically if 1EMF-44 reached the trip 2 setpoint**

Bank Question: 407.1 ***Answer: D***

1 Pt

Unit 1 has initiated a liquid radioactive waste release from the Ventilation Unit Condensate Drain Tank (VUCDT) through the RC system. All lineups and authorizations have been properly made in accordance with OP/1/A/6500/001 A using the normal path. Two RC pumps are the minimum required under the LWR document.

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A. 1WM-46 *(LIQUID WASTE DISCH VALVE)* closing automatically if 1 RC pump tripped

B. 1WM-46 closing automatically if 1EMF-44 reached the trip 2 setpoint

C. 1WP-35 *(WMT & VUCDT TO RC CNTRL)* closing automatically if 1 RC pump tripped

D. 1WP-35 closing automatically if 1EMF-44 reached the trip 2 setpoint

---

Distracter Analysis:

A. **Incorrect**: - RC pump interlock will not actuate - set at 2 pumps (minimum required on LWR document). WM-46 is isolated and not used anymore as a release path.
Plausible: - this was formerly the normal release path

B. **Incorrect**: - WM-46 receives a closing signal from EMF-44 but this is not the normal path for a release. WM-46 is isolated and not used anymore.
Plausible: - this was formerly the normal release path

C. **Incorrect**: - RC pump interlock will not actuate - set at 2 pumps (minimum required on LWR document).
Plausible: - if the candidate misunderstands the RC pump interlock--this was the correct answer on a prior NRC exam -

D. **Correct answer**

Level: RO

KA: G 2.3.11 (2.7/3.2)

Lesson Plan Objective: OP-MC-WE-WL Obj. 3

Source: Bank

Level of knowledge: Comprehension

References:
1. OP-MC-WE-WL pages 21, 23, 27, 59
2. OP-MC-WE-EMF page 31
3. OP-MC-WE-RLR page 11 and 13

2.3 Radiation Control (Continued)

2.3.10 Ability to perform procedures to reduce excessive levels of radiation and guard against personnel exposure.

(CFR: 43.4 / 45.10)

IMPORTANCE RO 2.9 SRO 3.3

2.3.11 Ability to control radiation releases.

(CFR: 45.9 / 45.10)

IMPORTANCE RO 2.7 SRO 3.2

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1	1	1.5	1.5	1

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Liquid Waste (WL) System. WEWL001	X	X	X	X	
2	Discuss the purpose/operation of the following: • VUCDT • VUCDT Pump • VUCDT Pump Discharge Pressure Gage • WL-320 (VUCDT EMF Outlet) • WL-324 (VUCDT EMF Bypass) • WL-359 (VUCDT Pump Recirc.) WEWL002	X	X	X	X	
3	Describe the two possible VUCDT discharge flow paths. WEWL003	X	X	X	X	
4	List the control room indication available to indicate a high level in the VUCDT. WEWL004			X	X	X
5	Describe the Containment Floor and Equipment Sump operations. WEWL005	X	X	X	X	X
6	Describe the purpose/operation of the NCDT WEWL006	X	X	X	X	
7	Given a Limit and/or Precaution associated with an operating procedure , that Operations personnel are responsible for; discuss its basis and applicability. WEWL007			X	X	X
8	Evaluate plant parameters to determine any abnormal system conditions that may exist. WEWL008			X	X	X
9	Describe the purpose and contents of the NPDES Permit. WEWL009				X	X

2.2 Releasing a WMT

Refer to Drawing 7.2, WMT Subsystem. Radwaste initiates the procedure. They select the tank to be discharged, recirculate it for mixing, and obtain a sample. Next, the sample is analyzed. Radwaste delivers the sample to RP for isotopic analysis.

RP then generates a Release Discharge Document using the Radwaste Computer Program. RP assigns the next sequential LWR number. Based on the isotopic analysis report, RP calculates instantaneous release rates.

Objective #2

The **Recommended Release Rate** is the lesser of:

- Maximum System Release Rate (MSRR) for WMT = 120 gpm, or
- Allowable Release Rate.

The "Allowable Release Rate" is determined by the amount of activity present in the tank.

RP indicates the "EMF Utilized", which is EMF49L for WMT releases. RP next indicates the EMF background cpm, expected cpm, , trip 1, and trip 2 setpoints.

Objective #3

RP then takes the release procedure and the discharge document to the control room. The SRO authorizes the release by signing the release document. The SRO authorizing the release ensures the following:

- EMF 49 and 1WP-35 & 37 (Liquid Radwaste to RC control valves) are operable (WM-46, the old release path, is not used).
  - If any of these are inoperable, then the appropriate documentation / procedure enclosure must be in the release package
- A source check has been performed on EMF-49.
- Select EMF 49 to record on the chart recorder if desired.

NOTE: **The above checks are required by procedure prior to release.**

Prior to signing the LWR document, the SRO should review the following:

- Any special instructions
- Ensures the LWR document agrees with the Radwaste OP (i.e., same tank)
- The required number of RC pumps are in operation

NOTE: **The RC minimum flow interlock is set to the minimum # of pumps required for the release. If the total # RC pumps running is less than the selected number, 1WP-35 and 1WP-37 will close.**

- The "Recommended Release Rate" is less than the "Allowable Release Rate".

Objective #4

- The proper EMF is utilized (for a WMT release, this is EMF 49)
- The "Expected CPM of the EMF" and the "EMF Trip I Setpoint" are less than the "EMF Trip II Setpoint"

The RO logs the LWR number in autolog. The purpose of the log is to maintain an account, in the control room, of all LWR/GWR releases. The information contained in the log is:

- Release #
- Start Time & Date
- Stop Time & Date
- Volume Released
- Any unusual events encountered during the release

Now the release is ready to be started. Radwaste notifies the Shift Supervisor the discharge is initiated. The Radwaste technician aligns the WMT to be discharged to RC and commences the release. When the release is terminated, the Shift Supervisor is notified. Autolog is updated, and the Release document is closed out, with the Shift Supervisor signing the Release document acknowledging the completion.

2.3 Releasing a VUCDT

Refer to Drawing 7.3, VUCDT Release Flowpath. A lot of the elements in the release process for a VUCDT are similar to the release of a WMT. The following are the highlights of a VUCDT release.

2.1.9 Containment Ventilation Unit Condensate Drain Tank Monitor

Objective # 2

The following channels:

- **1(2) EMF 44 (L) - Containment Vent Drains (Low Range)**
- **1(2) EMF 44 (H) - Containment Vent Drains (High Range)**

are used to monitor the discharge from the containment unit condensate drain tank.

Objective # 2, 3

On a Trip 2 high radiation alarm on 1EMF 44(L), valves 1WL320 WP35 and 1WM46 (which is normally isolated) will be closed automatically, thus terminating discharge from the drain tank.

The purpose of the auto. Actions are to prevent exceeding the release rate limits to the RC discharge for releases originating in the VUCDT.

This channel uses a dual range gamma liquid:

- Low Range (Nal Scint.)
- High Range (GM)

2.1.10 Nuclear Service Water Monitor

The following channels monitor the Nuclear service Water System:

- 1(2) EMF 45A (L) - Unit 1(2) Nuclear Service Water A (Low Range)
- 1(2) EMF 45A (H) - Unit 1(2) Nuclear Service Water A (High Range)
- 1(2) EMF 45B (L) - Unit 1(2) Nuclear Service Water B (Low Range)
- 1(2) EMF 45B (H) - Nuclear Service Water B (High Range)

Objective # 2

These channels monitor the nuclear service water at the outlet of the containment spray heat exchanger. 1 EMF 45A monitors heat exchanger 1A while 1 EMF 45B monitors heat exchanger 1B. 2 EMF 45A monitors heat exchanger 2A while 2 EMF 45B monitors heat exchanger 2B. These monitors are exposed to potentially radio-active fluids only during the post LOCA operation of the containment spray. A radiation reading indicates a heat exchanger tube failure.

No control action is performed on high alarm.

The FDT liquids are analyzed for chemical content and radioactivity. The tank contents are processed through filters and demineralizers, and sent to the WMT for discharge. If processing is not immediately desired, the contents can be sent to either the AFDT or the AWEFT.

2.6 Laundry and Hot Shower Tank Subsystem

Refer to Drawing 7.6, Laundry and Hot Shower Subsystem. The LHST collects soapy liquids that are potentially radioactive and are not recyclable. The sources of input to the LHST are:

- Decontamination Showers
- Decontamination Sink
- Some Auxiliary Building service sinks above the 716' level
- Laundry effluent (LHST Sump - 1202 Bldg)
- Laundry Sump (U2 Equipment Staging Bldg)

The LHST contents' radioactivity should be below the level required for processing to reduce radioactivity. To reduce the environmental effects of discharging the fluid, it is processed through the LHST Post Strainer (40 mesh) and the LHST Primary Filters (25 micron). The LHST is normally pumped to WMT 'A' or 'B'.

2.7 Ventilation Unit Condensate Drain Tank Subsystem

Objective #2, 3

Refer to Drawing 7.7, VUCDT Subsystem. The VUCDT collects non-recyclable condensation from various ventilation units. **The sources of input to the VUCDT include:**

- **Upper CONT. Ventilation Units**
- **Lower CONT. Ventilation Units**
- **Incore Instrument Air Handling Units**
- **Auxiliary Building Air Handling Units ****
- **Melted Ice (a possible input during outages)**

** **Condensation from the VA AHUs is normally routed to WZ Groundwater Sump "A". It can be routed to the Unit 1 VUCDT if needed.**

Contents of VUCDT are released to RC Discharge periodically utilizing the following process:

- **VUCDT is placed in Recirc by starting pump and throttling WL-359 (VUCDT Pump Recirc) to obtain 25-30 psig on Discharge Pressure Gage.**

  NOTE: 31 psig is Shutoff Head of VUCDT Pumps.

- Radwaste samples contents of VUCDT.
- 1WL-1312 (VUCDT Pump Disch Isol.) is opened.
  (Unit 1 only - valve does not exist on Unit 2)

  NOTE: For Unit 2 the air supply is opened to 2WL-320 (VUCDT EMF Isol.) to align the discharge flowpath. **In both cases (U1 and U2), EMF-44 Trip 2 will cause WL-320 to isolate, terminating the release.**

- To begin release, Operators open:
  - 1WP-35 (WMT/VUCDT to RC)
  - 1WP-37 (Liquid Waste to RC)
  - **WL-324 (VUCDT EMF Bypass) to obtain 2-6 GPM through EMF-44 while throttling WL-359 to obtain 30 psig on pump discharge.**

- **EMF-44 Trip 2 will cause WL-320, WP-35, and WM-46 to isolate, terminating the release.** (Refer to Drawing # 7.7)

2.8 Waste Monitor Tank Subsystem

Refer to Drawing 7.8, WMT Subsystem. The Waste Monitor Tanks collect liquid to provide for final holdup for monitoring prior to release to the environment. The sources of input to the WMT are:

- FDT
- LHST
- AFDT
- AWEFT

The WMT contents are pumped through EMF-49, and then to the RC Discharge. A high radiation on EMF-49 will terminate the discharge by closing WP-35 and WM-46 (normally isolated).

2.9 Recycle Holdup Tank Subsystem

Refer to Drawing 7.9, RHT Subsystem. The RHTs collect fluid to provide for holdup prior to being recycled. The sources of input to the RHTs are :

- NCDT
- WDT
- VCT Divert

2.14 ND and NS Sump

The ND and NS Sump is located on the 695 ft.elev. of the Auxiliary Bldg. It can receive input from draining or leaking ND System and NS System. It can also receive input from the KCDT (not normally). The sump can be pumped to the WEFT or FDT (normal).

ND and NS Sump level is indicated in the Control Room on the vertical panel behind the Waste Systems panel. On the MCB Waste Systems panel on 1MC-11 are the sump pump controls, one for the 1A Pump and one for the 1B Pump. The control switch is an AUTO/MAN START/STP type control. Unit 2 has similar controls for the 2A and 2B pumps. The sump is common for both units. Pumps will start (and alarms received) as follows:

44" 1A pump start
48" 1B pump start and annunciator 1AD13-C1 (ND & NS room sump Hi-Hi level)
52" 2A pump start
56" 2B pump start and annunciator 2AD13-C1 (ND & NS room sump Hi-Hi level)

Each pump has 100gpm capacity.

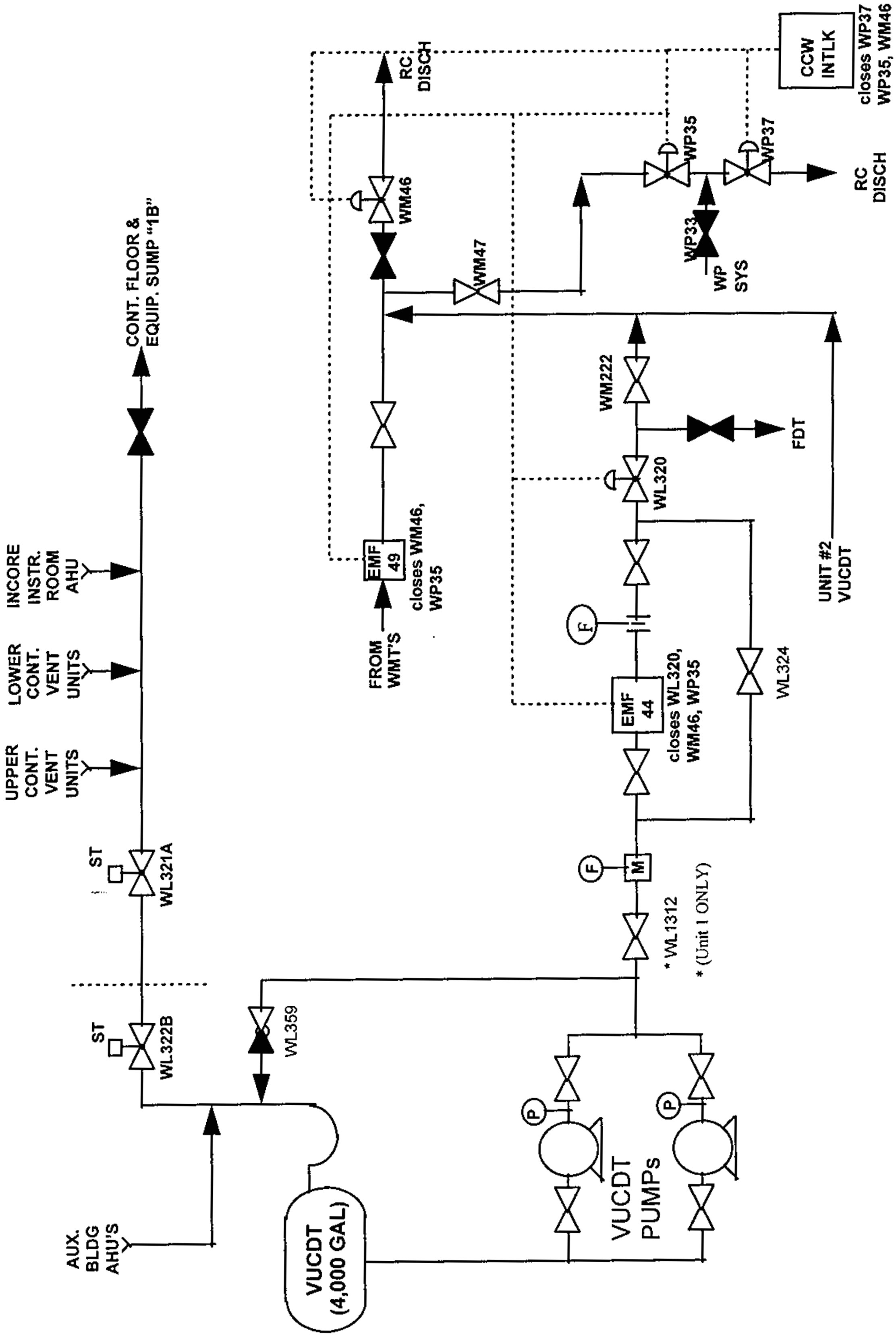
2.15 WM-46/WP-35&37 RC Pump Interlock

WM-46/WP-35&37 is/are the isolation valve(s) the WMT or VUCDT contents pass through on their way from the liquid waste system to the RC discharge for release. Normally WM-46 is isolated and WP-35&37 are used for the discharge path. There are two switches associated with the pump interlock.

One switch can be selected to the NORMAL or BYPASS position. In NORMAL the interlock is in service. In the BYPASS position, the interlock is not in service and the INTERLOCK BYPASSED status light is lit. There is also a NORMAL/BYPASS switch at the WL Panel. Placing either switch (at C/R or WL Panel) in BYPASS will cause the interlock to be overridden. Only the status light at that switch will be lit.

The second switch can be selected to OFF or any one of the positions numbered 1 - 8. In the OFF position, the interlock is disabled (DISABLED status light is lit) and WM-46/WP-35&37 will close if the NORMAL/BYPASS switch is in the NORMAL position. In the 1 - 8 position, the interlock is enabled (ENABLED light lit) and is monitoring the number of RC Pumps running. If the actual number of RC Pumps running is less than the switch setting, WM-46/WP-35&37 will automatically close. WM-46/WP-35&37 can be stroked with its' OPEN/CLOSED pushbutton regardless of the number of RC Pumps running. When intending to open these valves, the OPEN position must be maintained until the valve is full open for it to remain open.

7.7 VUCDT Subsystem (09/10/97)



2.2 Releasing a WMT

Refer to Drawing 7.2, WMT Subsystem. Radwaste initiates the procedure. They select the tank to be discharged, recirculate it for mixing, and obtain a sample. Next, the sample is analyzed. Radwaste delivers the sample to RP for isotopic analysis.

RP then generates a Release Discharge Document using the Radwaste Computer Program. RP assigns the next sequential LWR number. Based on the isotopic analysis report, RP calculates instantaneous release rates.

Objective #2

The **Recommended Release Rate** is the lesser of:

- Maximum System Release Rate (MSRR) for WMT = 120 gpm, or
- Allowable Release Rate.

The "Allowable Release Rate" is determined by the amount of activity present in the tank.

RP indicates the "EMF Utilized", which is EMF49L for WMT releases. RP next indicates the EMF background cpm, expected cpm, , trip 1, and trip 2 setpoints.

Objective #3

RP then takes the release procedure and the discharge document to the control room. The SRO authorizes the release by signing the release document. The SRO authorizing the release ensures the following:

- EMF 49 and 1WP-35 & 37 (Liquid Radwaste to RC control valves) are operable (WM-46, the old release path, is not used).
  - If any of these are inoperable, then the appropriate documentation / procedure enclosure must be in the release package
- A source check has been performed on EMF-49.
- Select EMF 49 to record on the chart recorder if desired.

NOTE: **The above checks are required by procedure prior to release.**

Prior to signing the LWR document, the SRO should review the following:

- Any special instructions
- Ensures the LWR document agrees with the Radwaste OP (i.e., same tank)
- The required number of RC pumps are in operation

NOTE: **The RC minimum flow interlock is set to the minimum # of pumps required for the release. If the total # RC pumps running is less than the selected number, 1WP-35 and 1WP-37 will close.**

- The "Recommended Release Rate" is less than the "Allowable Release Rate".

Objective #4

- The proper EMF is utilized (for a WMT release, this is EMF 49)
- The "Expected CPM of the EMF" and the "EMF Trip I Setpoint" are less than the "EMF Trip II Setpoint"

The RO logs the LWR number in autolog. The purpose of the log is to maintain an account, in the control room, of all LWR/GWR releases. The information contained in the log is:

- Release #
- Start Time & Date
- Stop Time & Date
- Volume Released
- Any unusual events encountered during the release

Now the release is ready to be started. Radwaste notifies the Shift Supervisor the discharge is initiated. The Radwaste technician aligns the WMT to be discharged to RC and commences the release. When the release is terminated, the Shift Supervisor is notified. Autolog is updated, and the Release document is closed out, with the Shift Supervisor signing the Release document acknowledging the completion.

2.3 Releasing a VUCDT

Refer to Drawing 7.3, VUCDT Release Flowpath. A lot of the elements in the release process for a VUCDT are similar to the release of a WMT. The following are the highlights of a VUCDT release.

Operations initiates the procedure. The VUCDT is placed in recirculation (OPS), and a sample is taken and analyzed (Radwaste). If activity is too high, then processing is desirable (pump to FDT) over release to RC. Assuming the activity isn't too high, RP generates a LWR Release Document. For VUCDT releases, the "Recommended Release Rate" is the lesser of the following:

- Maximum System Release Rate of 60 gpm
- "Allowable Release Rate" indicated on the release document
- Flow restriction calculated due to high background on EMF-44 (this information would be listed under "Special Instructions" on the discharge document.

Prior to the release, the Shift Supervisor notes any special instructions, reviews the release document, ensures no WMT releases in progress and the required number of RC pumps are in operation. The Shift Supervisor then authorizes the release by signing the release document. Operations then initiates the release by:

- Verifying with Radwaste that 1WM-222 (VUCDT to RC Discharge Header) is unlocked and open.
- Open 1WL-1312 (VUCDT Pmps Disch. Isol)
- Open 1WP-35 (WMT/VUCDT To RC CNTRL)
- Open 1WP-37 (Liquid Waste To RC CTRL)

Objective #4

- Throttle 1WL-324 (VUCDT EMF Bypass) to obtain 2-6 gpm thru EMF-44 while throttling 1WL-359 (VUCDT Pump Recirc) to obtain 30 psig pump discharge pressure.
- Request Radwaste to verify less than 60 gpm

NOTE: IF the flow integrator is not counting, Chemistry will request a flow rate estimate using pump performance curves from the McGuire Data Book.

When the tank level reaches desired level or ≤ 15%, secure the release by stopping the pump, realigning to normal, and logging total volume released in autolog.

If pumping the VUCDT to the FDT, this is not a release, so no recirc / sampling or release paper work is necessary. Operations has Radwaste open 1WM-221 (VUCDT to FDT). Ops bypasses EMF-44, opens the pump discharge, and starts the pump(s). At 15%, Ops stops the pump(s), returns the pump recirc to its' throttled position, closes the pump discharge, and has Radwaste close 1WM-221.

If the VUCDT level is increasing at a rate such that RP Shift agrees that changing to a "Continuous VUCDT Release Documentation" is justified, then a "Pumping VUCDT to the RC Discharge Using Continuous Release Method" is used. This release is similar to the normal release to RC, except that the release paper work is kept open, and 1WP-35 & 37 and 1WM-222 are kept open, and the release is stopped and started as needed based on VUCDT level.

1 Pt Unit 1 has just entered Mode 5 in preparation for refueling. Given the following conditions and events:

- A lower containment entry is planned for the next shift.
- The SRO directs the RO to purge the containment in preparation for the containment entry.
- Currently the VP system is secured with all fans off and containment purge and exhaust valves closed

Which one of the following describes the proper alignment of the containment purge system?

A. **The *NORMAL-REFUEL SELECTOR* switch is placed in the "*NORM*" position and ratio of supply air is 2/1 (Upper/Lower Containment).**

B. **The *NORMAL-REFUEL SELECTOR* switch is placed in the "*NORM*" position and ratio of supply air is 4/1 (Upper/Lower Containment).**

C. **The *NORMAL-REFUEL SELECTOR* switch is placed in the "*REFUEL*" position and ratio of supply air is 2/1 (Upper/Lower Containment).**

D. **The *NORMAL-REFUEL SELECTOR* switch is placed in the "*REFUEL*" position and ratio of supply air is 4/1 (Upper/Lower Containment).**

Bank Question: 432.3 ***Answer: A***

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1 Pt

Unit 1 has just entered Mode 5 in preparation for refueling. Given the following conditions and events:

- A lower containment entry is planned for the next shift.
- The SRO directs the RO to purge the containment in preparation for the containment entry.
- Currently the VP system is secured with all fans off and containment purge and exhaust valves closed

Which one of the following describes the proper alignment of the containment purge system?

A. The *NORMAL-REFUEL SELECTOR* switch is placed in the "*NORM*" position and ratio of supply air is 2/1 (Upper/Lower Containment).

B. The *NORMAL-REFUEL SELECTOR* switch is placed in the "*NORM*" position and ratio of supply air is 4/1 (Upper/Lower Containment).

C. The *NORMAL-REFUEL SELECTOR* switch is placed in the "*REFUEL*" position and ratio of supply air is 2/1 (Upper/Lower Containment).

D. The *NORMAL-REFUEL SELECTOR* switch is placed in the "*REFUEL*" position and ratio of supply air is 4/1 (Upper/Lower Containment).

Distracter Analysis:

A. ***Correct***: - this is the proper position for this operation.
B. **Incorrect**: Air ratio is 2/1 not 4/1
Plausible: -
C. **Incorrect** : - this will over-pressurize the upper containment
D. **Incorrect:** - this will over-pressurize the upper containment.
Plausible: .

Level: RO

KA: G 2.3.9 (2.5/3.4)

Lesson Plan Objective: CNT-VP Obj. 2

Source: BANK

Level of knowledge: Comprehension

References:
1. OP-MC-CNT-VP pages 19, 21, 23

2.3 Radiation Control

2.3.1 **Knowledge of 10 CFR: 20 and related facility radiation control requirements.**
(CFR: 41.12 / 43.4. 45.9 / 45.10)
IMPORTANCE RO 2.6 SRO 3.0

2.3.2 **Knowledge of facility ALARA program.**
(CFR: 41.12 / 43.4 / 45.9 / 45.10)
IMPORTANCE RO 2.5 SRO 2.9

2.3.3 **Knowledge of SRO responsibilities for auxiliary systems that are outside the control room (e.g., waste disposal and handling systems).**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 1.8 SRO 2.9

2.3.4 **Knowledge of radiation exposure limits and contamination control, including permissible levels in excess of those authorized.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.5 SRO 3.1

2.3.5 **Knowledge of use and function of personnel monitoring equipment.**
(CFR: 41.11 / 45.9)
IMPORTANCE RO 2.3 SRO 2.5

2.3.6 **Knowledge of the requirements for reviewing and approving release permits.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.1 SRO 3.1

2.3.7 **Knowledge of the process for preparing a radiation work permit.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 2.0 SRO 3.3

2.3.8 **Knowledge of the process for performing a planned gaseous radioactive release.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.3 SRO 3.2

2.3.9 **Knowledge of the process for performing a containment purge.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.5 SRO 3.4

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.5	1.5	1.5	1.5	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Containment Purge System. CNTVP001	X	X	X	X	
2	Describe the air flow path during a normal and refueling purging operation and explain the importance of supply and exhaust air flow balance during a purging operation. CNTVP002	X	X	X	X	
3	Explain what occurs automatically on a Phase "A" or Containment Ventilation (S_h) isolation signal if a purging operation is in progress. CNTVP003	X	X	X	X	X
4	Describe the controls and indications, on Local Panel RB-CP-1, associated with the Containment Purge System. CNTVP004	X	X	X	X	
5	Describe the controls and indications, in the Control Room, associated with the Containment Purge System. CNTVP005		X	X	X	X
6	Given a Limit and/or Precaution associated with an operating procedure, discuss it's basis and applicability. CNTVP006		X	X	X	X

3.0 SYSTEM OPERATION

3.1. Normal Operation

The Containment Purge System consists of two 50% capacity supply fans with matching exhaust fans and one 100% incore instrumentation room supply fan with a matching exhaust fan. Each supply fan is interlocked with its corresponding exhaust fan so that they will energize as a pair. Controls in the Control Room consist of a three position switch (OFF - 50% - 100%), which selects the number of fans to be used, a two position switch (FAN 1A - FAN 1B), which selects which fan is used in the 50% mode; push-button (START-STOP), for the incore instrumentation purge fans.

The normal mode of operation would be to have all fans operating. Fan status is indicated in the Control Room and on local panel RB-CP-1. Fans may be de-energized manually, by fire protection contacts, by motor overload or by the SSPS (S_t).

The lower Containment and Incore Purge Supply and Exhaust valves are required to be locked closed in modes 1, 2, 3 and 4. Two position (OPEN - CLOSED) key switches are provided to perform this function. When placed in the closed position, power to the valve solenoid is blocked so that air cannot be admitted to open the valves. The A Train switch blocks the operation of valves VP7A, 9A, 15A, 17A and 19A. The B Train switch blocks the operation of valves VP6B, 8B, 16B, 18B and 20B. When a switch is placed in the open position the dampers are allowed to operate as this system demands.

This system contains Reactor Building Auxiliary Carbon Filter Fans A and B.

Dampers in the supply and exhaust ducts are provided with limit switches to indicate their status (Open or Closed) in the Control Room. These indicators are provided to indicate blockage of air flow or as redundant indication of fan motor failure.

As soon as the motor starter is energized auxiliary contacts energize interposing relays which activate the Electro/Pneumatic solenoids controlling the Containment Isolation Valve for Train A and Train B. The pneumatic operated isolation valves open, thus purging the Reactor Building. Each isolation valve is supplied with a limit switch package which will energize an indicator lamp in the Control Room to provide the operator with valve status indication. (i.e., Upper Containment Purge Isolation Valves Open - Lights lit, valves Closed - Lights extinguished).

Objective #6

3.1.1. Limits and Precautions

Do not purge lower Containment in modes 1-4. (Tech Specs require lower Containment purge valves to be closed in these modes.)

"Normal - Refuel Selector Switch" should be in "NORM" except during refueling. (This is done to prevent overpressurizing the upper Containment.)

In Modes 5 and 6, EMF-39(L) shall be operable during VP releases. (Required by SLC 16.11.7.)

Do not purge the Incore Instrument Room if Containment Integrity is required. (The exhaust package in unqualified.)

Airlock doors must be secured during VP System Startup. (To prevent accidental door movement.)

Maximum VP exhaust rate shall be below the release rate of the VP Gaseous Waste Release Document {PIP 0-M97-2033}. (This is to ensure Tech Spec flowrate limits through the exhaust filter package are not exceeded.)

3.1.2. Operating procedures

The Containment Purge System is normally de-energized. It is used to purge Containment and the Incore Instrument Room when testing and maintenance are to be performed on equipment inside these areas. Manual actuation is provided from the HVAC Controls in the Main Control Room. Should the system be active at the time of a LOCA or detection of radiation leakage, the units are automatically de-energized and the associated isolation valves are closed upon receipt of Containment Isolation Phase A (S_t) signal from the SSPS or a Containment Ventilation Signal (S_h).

To start the Purge Supply and Exhaust Fans select 100% capacity (normal operation) or 50% capacity on Purge and Supply Mode Switch. If for some reason it is necessary to operate the purge system at 50% capacity select Train "A" or Train "B" position.

Objective #2 & 4

Place the Purge Mode Selector Switch, on local panel RB-CP-1, to the desired position "NORMAL" or "REFUEL". In the NORMAL position dampers RBPS-D-8 and 9 in the supply air lines position to provide a flow split of 2/1 ratio of supply air (Upper verses Lower Containment). Upper and lower supply flows are indicated on RB-CP-1. In the REFUEL position these dampers position to provide a flow split of 4/1. To operate the system in the Refuel mode, the missile shield must be removed (procedure requirement).

Operation of the supply and exhaust fans should be such that the total air flow rate entering the containment equals that exhausting containment to avoid placing the Containment vessel under a positive or negative pressure. Air flow rates into and out of containment are controlled by throttling a set of pneumatic dampers, one on the discharge and one on the recirculation line, for the supply (RBPS-D-5 and 6) and exhaust (RBPE-D-4 and 5). As one of the dampers throttles closed the other will open to maintain the desired flow rate.

For the supply air VPMPS-5 on RB-CP-1 controls dampers RBPS-D-5 and 6 in the supply duct system. When this control is rotated in the clockwise position the discharge damper, RBPS-D-6 closes. As D-6 closes, supply air flow rate to the Containment decreases and D-5 opens to maintain flowrate for the operating supply fan(s). An air monitor mounted in the supply duct to the Containment furnishes air flow rate (cfm) read-out on RB-CP-1 indicating the rate (cfm) air is being supplied to the Containment.

For the exhaust air VPMPS-6 on RB-CP-1 control dampers RBPE-D-4 and 5 in the exhaust duct system. When this control is rotated in the clockwise position the discharge damper, RBPE-D-4 closes. As D-4 closes, exhaust air flow rate from the Containment decreases and D-5 opens to maintain flowrate for the operating exhaust fan(s). An air monitor mounted in the exhaust duct from the Containment furnishes air flow rate (cfm) read-out on RB-CP-1 indicating the rate (cfm) air is being exhausted from the Containment.

At times during refueling with no core alterations or movement of irradiated fuel, when the equipment hatch is opened, the containment is kept ~~at~~ a slightly negative pressure to ensure no unfiltered release paths from containment exist.

To startup the Incore Instrument Purge System open the isolation valves on control board and depress the "START" pushbutton and monitor the flow meters to insure proper operation of the fans.

To operate the Auxiliary Carbon Filters depress the fans "ON" pushbutton and monitor the filter DP until Containment activity is reduced to acceptable levels.

1 Pt Unit 1 is shutdown in a refueling outage. Given the following events and conditions:

- The VI system was in a normal lineup.
- The VS system was in a normal lineup.
- A VI header rupture occurs.
- The VI system completely depressurizes.

What effect does a total loss of the VI system have on the VS system?

A. **VI-820 will auto-close as VI header pressure decreases below 82 psig and the VS air compressor will start automatically to maintain VS header pressure.**

B. **VI-820 will auto-close as VI header pressure decreases below 90 psig and the VS air compressor must be manually started to maintain VS header pressure.**

C. **Check valves in the VI - VS cross-connect line will close to isolate VS system pressure before it drops below 90 psig.**

D. **VS pressure in the Fire Protection Pressurizer Tank will be lost until a VS air compressor can be started.**

Bank Question: 451.1 ***Answer: B***

1 Pt Unit 1 is shutdown in a refueling outage. Given the following events and conditions:

- The VI system was in a normal lineup.
- The VS system was in a normal lineup.
- A VI header rupture occurs.
- The VI system completely depressurizes.

What effect does a total loss of the VI system have on the VS system?

A. **VI-820 will auto-close as VI header pressure decreases below 82 psig and the VS air compressor will start automatically to maintain VS header pressure.**

B. **VI-820 will auto-close as VI header pressure decreases below 90 psig and the VS air compressor must be manually started to maintain VS header pressure.**

C. **Check valves in the VI - VS cross-connect line will close to isolate VS system pressure before it drops below 90 psig.**

D. **VS pressure in the Fire Protection Pressurizer Tank will be lost until a VS air compressor can be started.**

Distracter Analysis:

A. **Incorrect**: - the VS air compressor does not automatically start to maintain pressure
Plausible: - The VI system is safety significant, VI-820 used to close 82 psig but the setpoint was recently changed from 82 psig to 90 psig. There is a separate VS air compressor, which has an automatic startup feature – but is normally in "off" and requires operator action to start.

B. **Correct answer**

C. **Incorrect**: - there are no check valves in this line
Plausible: - this is another possible method to prevent depressurizing the VS header at some plants.

D. **Incorrect**: - the RF system tank is pressurized with VS air - but is maintained isolated from the VI header
Plausible: - if the candidate does not know that the RF system air tank is isolated from the VS header.

Level: RO

KA: SYS 078 K4.01 (2.7/2.9)

Lesson Plan Objective: SS-MC-SS-VI Obj. 7

Source: Bank

Level of Knowledge: comprehension

References:
1. OP-MC-SS-VI page 115

078 Instrument Air System (IAS)

TASK:

- Perform lineups of the IAS
- Start up the IAS
- Monitor IAS
- Shift instrument air compressors
- Operate system air dryers
- Perform testing of automatic operation of IAS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the IAS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Sensor air	2.8*	2.7*
K1.02	Service air	2.7*	2.8
K1.03	Containment air	3.3*	3.4*
K1.04	Cooling water to compressor	2.6	2.9
K1.05	MSIV air	3.4*	3.5*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Instrument air compressor	2.7	2.9
K2.02	Emergency air compressor	3.3*	3.5*
K3	**Knowledge of the effect that a loss or malfunction of the IAS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment air system	3.1*	3.4*
K3.02	Systems having pneumatic valves and controls	3.4	3.6
K3.03	Cross-tied units	3.0	3.4
K4	**Knowledge of IAS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Manual/automatic transfers of control	2.7	2.9
K4.02	Cross-over to other air systems	3.2	3.5
K4.03	Securing of SAS upon loss of cooling water	3.1*	3.3*
K5	**Knowledge of the operational implications of following concepts as they apply to the IAS:** (CFR: 41.5 / 45.7)		
K5.01	Gas laws	1.5	1.7
K5.02	Diesel effect	1.7	1.8

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
6	Explain the control function associated with each of the following VI Air Compressor (A, B, and C) pushbuttons: • Start/Stop pushbutton • Reset pushbutton	X	X	X	X	
7	List the interlocks / trips associated with operation of the following plant air system components: • VI Air Compressors • VI-820 (VI to VS Supply Valve) • VS Low Pressure Air Compressor • VB Air Compressor	X	X	X	X	X
8	Describe the following controls and/or indications associated with operation of VI Air Compressors D, E, and F: • On/Off switch and indication • Start/Stop pushbuttons • Pre-lube pump status • Acknowledge/Reset pushbutton	X	X	X	X	
9	Describe how the following VI System components function to provide a continuous supply of clean dry air: • Service Building Air Receiver Tanks (and drains) • Air Dryers • Auxiliary Building Instrument Air Tanks	X	X	X	X	
10	Explain each one of the following controls and /or indications, associated with the Breathing Air Compressors: • Start/Stop Pushbutton • "Power ON" Light • "RUN" Light • Discharge Air Over-Temperature Light • Rotor Oil Filter Service Light • Bearing Oil Filter Service Light • Air/Oil Separator Service Light • Service Air Filter ΔP Gauge • Purification Filter ΔP Gauge • Rotor Coolant Temperature Gauge • Discharge Air Pressure Gauge • Discharge Air Temperature Gauge	X	X	X	X	
11	Describe normal operation of the Breathing Air Compressor(s).	X	X	X	X	X

2.12 1VI-820 VI to VS Control Valve

The VI System normally supplies the Low Pressure Station Air System through control valve 1VI-820.

Controls and indication for 1VI-820 are located at the VI Sequencer Control Panel. The valve control switch is a three position switch:

- Close
- Auto
- Open

Objective # 7

Indication provided at the VI Sequencer Control Panel consist of the following:

- 1VI-820 Close (green light)
- 1VI-820 Open (red light)

This valve is normally positioned to the AUTO position and will automatically close should VI System Pressure decrease to <90 psig. Upon valve closure 1VI-820 can be reopened once VI System Pressure has increased >90 psig by placing the valve to the OPEN position. After opening the valve 1VI-820, the switch should be returned to the AUTO position. If not, the valve will reopen without operator action, after closure, as soon as pressure has increased above 90 psig.

2.13 VI System Air Dryers A, B, and C

Instrument Air Dryers A, B, and C (AMLOC-CHA Dryers) are fully automatic, desiccant-type air dryers specifically designed to remove vaporous moisture from the Instrument Air System.

Objective # 9

Generally, two of these three desiccant air dryers (A, B, and C) are in-service while one remains in standby, ready and available for service when needed. Each in-service dryer will alternately cycle air through one of the two desiccant chambers for moisture removal, while the other chamber is regenerated (removal of previously adsorbed moisture) and re-pressurized.

General Information on the CHA Dryer

This fully automatic, heaterless-type dryer alternately cycles the compressed, processed gas flow through tow desiccant-filled, vertical chambers where the gas's entrained, vaporous moisture content is adsorbed. One desiccant chamber is always on-stream in a timed drying cycle throughout normal dryer operation. The opposite, off-stream chamber is in a pressurized condition, or a timed regeneration cycle for removal of the desiccant's previously adsorbed moisture content. The dryer's **fail safe** design feature provides continued process gas through one desiccant chamber if the control system's power supply is ever lost or interrupted.

1 Pt Unit 2 is operating at 75% power when a load rejection occurs. Which one of the following statements correctly describes the response of 2CM-420 (Load Rej Byp) to this transient?

A. **2CM-420 closes to prevent condensate water from being diverted to the suction of the hotwell pumps from the condensate booster pumps to assure minimum flow to the CF pumps.**

B. **2CM-420 closes to prevent diversion of water from the "C" heater drain tank back to the UST thereby ensuring sufficient CF pump suction pressure.**

C. **2CM-420 opens to divert condensate flow directly to the condensate booster pump suction to ensure that CF pumps have sufficient suction pressure.**

D. **2CM-420 opens to divert condensate flow, bypassing around the condensate booster pumps, directly to the CF pumps to assure minimum flow requirements.**

Bank Question: 531.1 ***Answer: C***

1 Pt Unit 2 is operating at 75% power when a load rejection occurs. Which one of the following statements correctly describes the response of 2CM-420 (Load Rej Byp) to this transient?

A. **2CM-420 closes to prevent condensate water from being diverted to the suction of the hotwell pumps from the condensate booster pumps *to assure minimum flow to the CF* pumps.**

B. **2CM-420 closes to prevent diversion of water from the "C" heater drain tank back to the UST thereby ensuring sufficient CF pump suction pressure.**

C. **2CM-420 opens to divert condensate flow directly to the condensate booster pump suction to ensure that CF pumps have sufficient suction pressure.**

D. **2CM-420 opens to divert *condensate flow, bypassing around* the condensate booster pumps, directly to the CF pumps to assure *inimum flow requirements.***

Distracter Analysis:

A. **Incorrect**: CM-420 opens - does not close. Does not prevent water from being recirculated around the hotwell pumps.
Plausible: this function is performed by CM-407 – which opens to assure minimum flow around the hotwell pumps to prevent water hammer on the CM system during startup.

B. **Incorrect**: CM-420 *opens - does not close*. Does not prevent a loss of water to the condensate booster pump suction.
Plausible: CM-227 opens to recirc condensate from the C feedwater heater to the USTs to assure minimum recirc flow on the CBPs

C. **Correct answer**

D. **Incorrect**: CM-420 does not provide a flow path around the condensate booster pumps directly to the CF pumps to meet minimum flow requirements
Plausible: *CM-420 opens to provide bypass flow* – but directly to the CBPs – not the CF pumps

Level: RO

Level of Knowledge: Memory

Source: BANK

K&A: 056 A2.04 (2.6/2.8*)

Lesson Plan: OP-MC-CF-CM Obj. 11

References: OP-MC-CF-CM page 33 & 67

SYSTEM: 056 Condensate System

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the Condensate System controls including:**
(CFR: 41.5 / 45.5)

A1.01	Pressure, flow and amps for condensate, booster, and main feed pumps	2.1*	2.4*
A1.02	Deleted		
A1.03	Normal sequence of alarms on startup of condensate pumps, including low suction pressure alarm	1.6	1.6
A1.04	Hotwell level alarms and flow indicators	1.6	1.7
A1.05	Differential pressure indicators (Across pumps, demineralizers	1.6	1.7
A1.06	Heater parameters (temperature, pressure, flow level) and their effect on condensate flow	1.7	1.8
A1.07	S/G level under transient induced by feed rate change (pumps on and off)	2.1	2.3*
A1.08	MFW pump suction pressure	2.3	2.6*

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the Condensate System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Loss of condenser pressure	1.8	2.0
A2.02	Bad chemistry	1.8	2.3*
A2.03	Demineralizer D/P	1.8	2.0*
A2.04	Loss of condensate pumps	2.6	2.8*
A2.05	Condenser tube leakage	2.1	2.5*
A2.06	Abnormal hotwell pump discharge pressure	1.6	1.7
A2.07	Removal of condensate demineralizer from service	1.7	1.9
A2.08	Feedwater heater tube leak	1.6	1.8
A2.09	Feedwater level high or low	1.6	1.7
A2.10	Decreased effectiveness of condensate demineralizer due to increased flow through it	1.5	1.7
A2.11	Approximate time necessary to regenerate one condensate demineralizer resin bed	1.6	1.8*
A2.12	Opening of the heater string bypass valve	1.8	2.1*
A2.13	Opening of the condensate recirculation valve	1.7	1.8
A2.14	Opening of the condensate spill valve	2.0	2.2

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
9	Describe the operation, including controls and indications, of the Polishing Demineralizers Bypass valves (CM-422 and 423) to cut in or cut out flow to the Polishing Demineralizers CFCM009		X	X	X	X
10	Explain how flow is controlled through the following components: • Condensate Coolers • Stator Coolers • Generator Hydrogen Coolers • Gland Steam Condenser CFCM010	X	X	X	X	X
11	Concerning the load rejection bypass line: • Explain the operation of the load rejection bypass line. (CM-420 Load Rejection Controller)	X	X	X	X	X
	• Explain how to "RESET" the Load Rejection Bypass Controller CM-420 after a Load Rejection. CFCM011		X	X	X	X
12	Describe the operation, including controls and indications, of Condensate Booster Pumps including the CBP Auxiliary Oil Pump Subsystem. CFCM012	X	X	X	X	
13	State the purpose of the Main Feedwater Pump Seal Injection (CL) System. CFCM013	X	X			
14	Describe the operation of the Main Feedwater Pump Seal Injection (CL) System. CFCM014	X	X	X	X	X
15	Discuss the purpose of the Condensate Storage System. CFCM015	X	X	X	X	
16	Describe the operation of the Condensate Storage System to maintain inventory for the Condensate System. CFCM016	X	X	X	X	

The C heaters increase the condensate temperature from approximately 299^{0}F to 364^{0}F **(about 65^{0}F)** with a terminal difference of 8^{0}F. Pressure drop across the tube side at design flow rate is approximately 11 psi.

During unit startup/heat up the "C" Heaters can be used to heat the condensate by aligning Auxiliary Steam (AS) to them.

2.10.5 C Heat Drain Tanks and Drain Pumps

There are three 50% capacity "C" HDPs (refer to Drawing 7.11 and 7.12). **At 100% power their combined output provides 30% of the total condensate flow. They return flow to the CM System after the "C" heaters. The "C" HDPs are normally placed inservice at approximately 35% power. At this power level there is sufficient drain flow to allow the "C" Heater Drain Tank level control system to control tank level to prevent tripping the drain pump.**

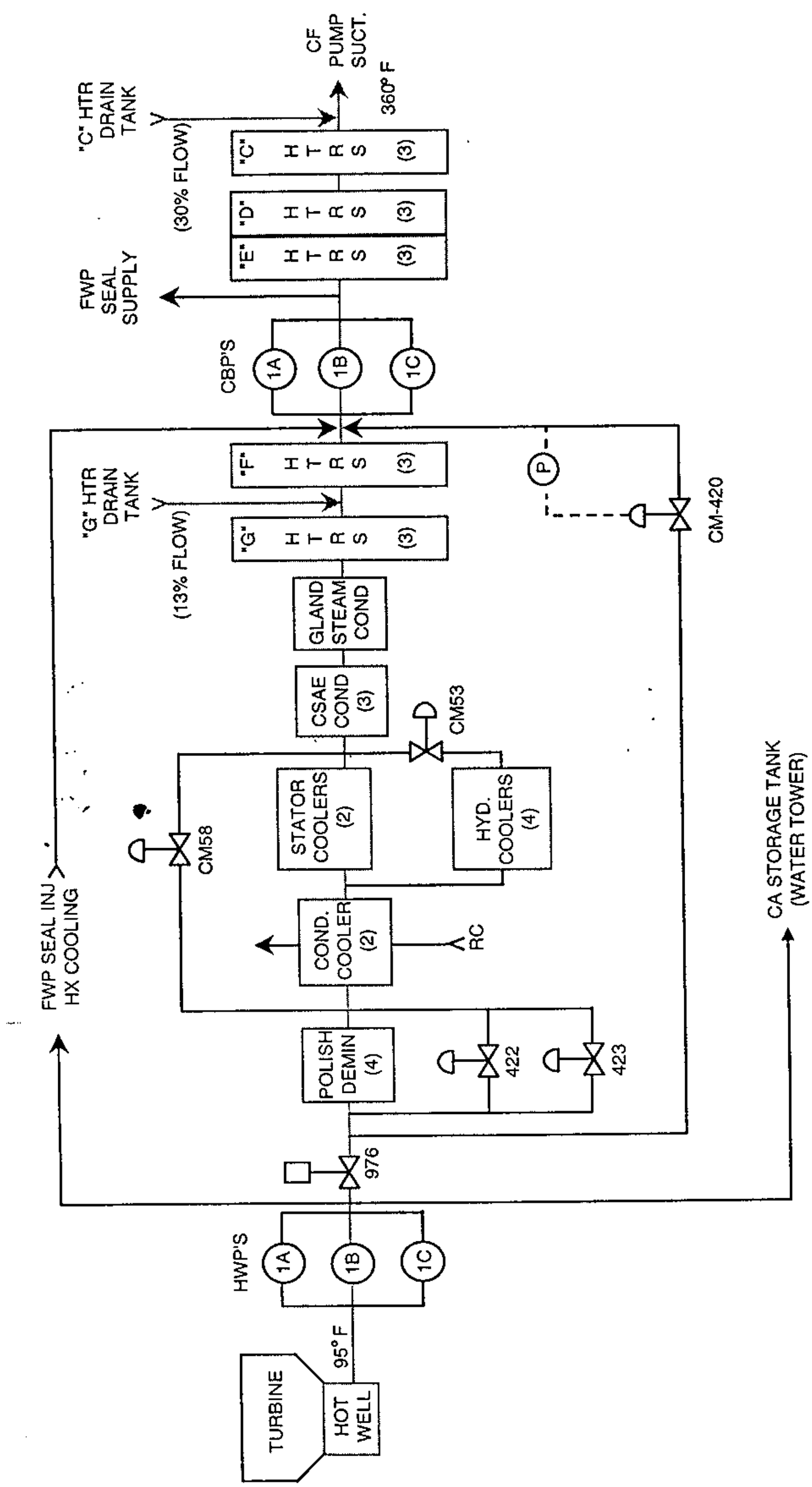
2.11 CM-420 Load Rejection Valve

Objective #11

CM-420 is designed to ensure that the Main Feedwater Pumps (CFPs) have sufficient suction pressure (by ensuring that the CBP have sufficient suction pressure (refer to Drawing 7.1. **This is accomplished by allowing the Hotwell Pump discharge pressure to be diverted directly to the CBP suction. CM-420 has a manual loader located in the Control Room on MC-13. During normal operation the manual loader for CM-420 is positioned for 100% by procedure. During normal operation, the manual loader is not in the control circuit** (refer to Drawing 7.13). **CM420 is controlled by the pressure signal from the CBP suction header through a controller set to modulate the valve open if CBP suction pressure decreases to 100 psig. The CBP low suction pressure trip (45 psig) has a 30 second time delay to allow CM-420 time to respond.**

During a Load Rejection, the runback signal will cause the three way solenoid valve to direct air from the manual loader to the valve positioner. (refer to Drawing 7.13). **By procedure, the manual loader is normally set for 100%. However, if the manual loader was not at 100%, CM420 would only open to the manual loader setting, (i.e., if the loader was set for 50%, the valve would only open 50%). After the transient is over, the operator throttles CM-420 closed by lowering the manual loader to 0%. Status lights on 1SI-17 on MC13 provide open and closed indication for CM-420. When CM420 is closed, the operator will then check if the load rejection signal is reset (OAC point M1S0331). When the load rejection signal is reset the solenoid valve will reposition to allow CM420 to control CBP suction pressure at 100 psig. The manual loader (which will now be out of the control circuit) is slowly positioned to 100%.**

7.1 Condensate System Block Diagram (05/30/01)



1 Pt

Unit 1 was operating at 100% power when main condenser vacuum dropped suddenly from 25 inches vacuum to 23 inches vacuum. Given the following events and conditions:

- All 3 condenser steam air ejectors (CSAEs) are in service
- Both primary and secondary jets are operating
- The system lineup is in the normal configuration

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

A. Loss of YM supply to the condenser boot seals

B. Loss of Main Steam to the CSAEs

C. CM flow to all CSAE inter-coolers has been obstructed

D. A CSAE drain was left open

Bank Question: 547.2 ***Answer: C***

1 Pt

Unit 1 was operating at 100% power when main condenser vacuum dropped suddenly from 25 inches vacuum to 23 inches vacuum. Given the following events and conditions:

- All 3 condenser steam air ejectors (CSAEs) are in service
- Both primary and secondary jets are operating
- The system lineup is in the normal configuration

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

A. Loss of YM supply to the condenser boot seals

B. Loss of Main Steam to the CSAEs

C. CM flow to all CSAE inter-coolers has been obstructed

D. A CSAE drain was left open

Distracter Analysis:

A. **Incorrect**: A recent change no longer runs seals water to the condenser boot seals.
Plausible: Seal water to the boot seals was originally designed to prevent condenser leakage

B. **Incorrect**: Main steam does not supply the CSAEs
Plausible: There are physical connections for main steam to be the back up supply for aux steam – but these connections are not used.

C. **Correct answer** - reduces effectiveness of steam jets and causes vacuum to decrease.

D. **Incorrect**: CSAE drains are normally open to allow condensate to drain out of the air ejectors.
Plausible: If the drain is left closed, the condensate will build up and flood out the CSAE, which could cause a loss of vacuum. This is the reverse of the distracter.

Level: RO

KA: SYS 055K3.01 (2.5 / 2.7)

Lesson Plan Objective: MT-ZM SEQ 4, 5, 9

Source: Bank

Level of knowledge: comprehension

References:
1. OP-MC-MT-ZM pages 11, 13, 15, 23, 27

055 Condenser Air Removal System (CARS)

TASK:
Perform lineups of the CARS
Conduct condenser air leakage check
Monitor the CARS operation
Operate the mechanical vacuum pump
Operate steam jet air ejectors

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CARS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Main turbine generator	1.6	1.7
K1.02	Main condenser	2.0	2.1
K1.03	Condensate	1.9	2.1
K1.04	S/G	1.9	2.0
K1.05	Polishing demineralizers	1.5	1.5
K1.06	PRM system	2.6	2.6
K1.07	WGDS	1.9	1.9
K1.08	Containment	1.7	1.6
K1.09	Auxiliary steam	1.6	1.6
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Vacuum pump(s)	1.6	1.7
K2.02	Exhaust fan(s)	1.5	1.5
K3	**Knowledge of the effect that a loss or malfunction of the CARS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Main condenser	2.5	2.7
K3.02	T/G	1.7	1.9
K3.03	MT/G	1.6	1.9
K3.04	MFW pumps (steam driven)	1.7	2.0*
K3.05	SDS	2.3	2.6

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.0	N/A	N/A	N/A

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Main Vacuum System. MTZM001	X	X			
2	Discuss how the Main Condenser is used in conjunction with the Steam Jet Air Ejectors and Main Vacuum pumps in maintaining condenser vacuum. MTZM002	X	X			
3	State the purpose of the rubber belt expansion joint (boot seal) on the Main Condenser. MTZM003	X	X			
4	Describe the operation of the Steam Jet Air Ejectors. MTZM004	X	X			
5	List the steam supplies to the Steam Jet Air Ejectors. MTZM005	X	X			
6	Describe the operation of the Main Vacuum Pumps. MTZM006	X	X			
7	Given a Limit and/or Precaution associated with an operating procedure, discuss its bases and when it applies. MTZM007	X	X			
8	Describe how de-aeration of the Upper Surge Tank (UST) is accomplished. MTZM008	X	X			
9	List three (3) causes of a low vacuum condition. MTZM009	X	X			

Objective # 2

Steam exhausting from the LP Turbines is channeled down around tube bundles from all directions. Non-condensable gasses enter the air cooling section. The CSAE's and Main Vacuum Pumps take a suction on this section to remove these gasses. The major portion of the vacuum is created by steam condensing to water around the tube bundles.

2.0 COMPONENT DESCRIPTION

2.1. Rubber Belt Expansion Joint (Boot Seal) (See Drawing 7.3)

Objective # 3

The boot seals allow for expansion and contraction of the turbine during load changes. They are located between each low pressure turbine and its associated condenser. They are physically attached to the condenser neck and low pressure turbine. There is a seal trough that runs around the perimeter of the boot seals. Water can be supplied to the seal troughs from the YM or the CM System. It was once believed that this practice would help mitigate the consequences of any small leaks that may develop in the seal.

Engineering began researching the merit of this practice in 1997. They discovered that the boot seal material actually degrades faster when it is covered in water. The vendor said the seal was designed to run dry and recommended that we discontinue our current practice. It is postulated that a pinhole leak in the seal would propagate quickly due to the differential pressures involved. Therefore, it was determined that the water would probably not be very effective in slowing down a seal leak. Also, we were using roughly 50,000 gallons of water per day to provide seal trough water to both units. After all of these factors were considered, the decision was made in 1998 to isolate the boot seal water supplies.

The procedures, valves and piping necessary to supply the seal troughs still exist however, in case such an alignment is desired in the future. The YM System (≈100 psig) would be the preferred source of water. The CM System (≈200 psig) is the backup supply and comes from the discharge of the Hotwell Pumps. Swapping between YM and CM is manually performed by procedure whenever necessary. Due to the large pressure differential between supply sources, manual valves must be adjusted when changing supply sources. This is done to ensure adequate overflow from the seals. When in this alignment, water overflows to a floor drain via seal trough overflow lines.

2.2. Condenser Steam Air Ejector (CSAE) (See Drawing 7.2)

Objective # 4

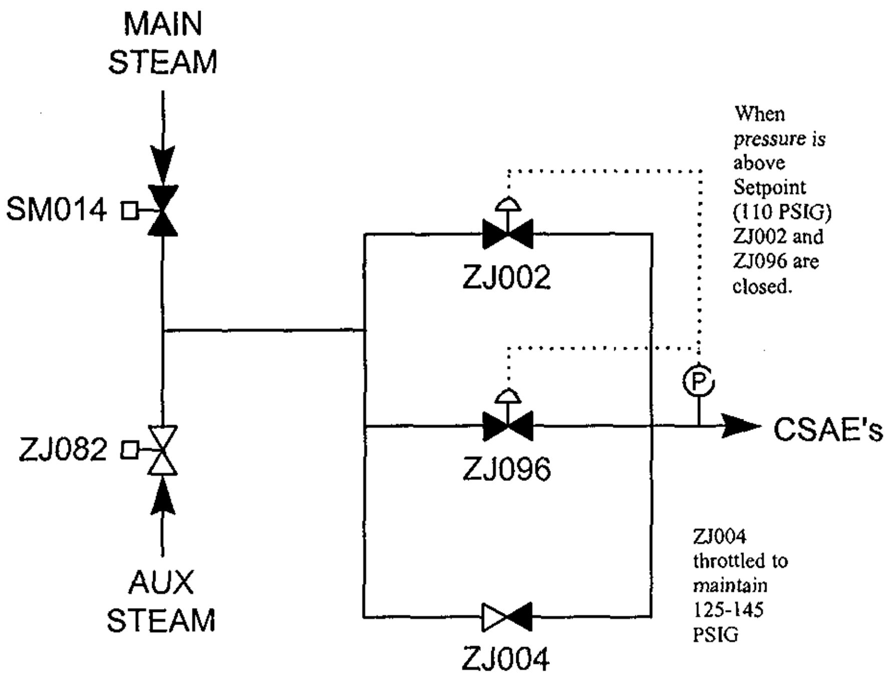
Each CSAE draws the non-condensable gases and water vapor mixture from a condenser shell to the first air ejector stage. The mixture then flows to the inter-condenser where it is cooled to condense and remove the water vapor and motive steam. The second air ejector stage draws the uncondensed portion of the cooled mixture from the inter-condenser and compresses it further. The compressed mixture then passes through the after-condenser where it is cooled

and more water vapor and motive steam are condensed. The condensed water vapor and motive steam from the first stage drain to the main "C" condenser. The second stage drains are normally aligned to the Turbine Building ditch in order to aid in removal of residual ammonia from the water system. The remaining non-condensable gases and water vapor are released to the atmosphere through the unit vent.

There are three CSAE's per unit, each one connected to a header that is normally aligned to all three of the main condenser shells and the CF pump condensers. Each CSAE has two sets of primary and secondary jets. The vendor design recommends having one set in service with the spare set in standby. However, in order to maintain maximum unit reliability, Operations management has decided to typically operate with both sets of jets in service. Each CSAE is designed to remove 288 lbm/hr (total air-vapor mixture) at 1.0" Hg absolute when supplied with 1300 lbm/hr of steam at 110 psig, 345°F.

Objective # 5

Steam to the air ejector jets is supplied from the AS (aux steam) header. There is a connection from Main steam to supply the air ejectors, but it's not used. There is no procedural guidance to allow Main steam to be aligned to the CSAE's.



Recent events (see PIP-99-5243 in the Industry Events section for more details) have driven **a change in the method used to control steam pressure to the CSAE's. Steam pressure is now maintained at 125 - 145 psig by throttling the manual bypass valve (ZJ004) around the control valves. Both control valves will be normally closed. A dual acting controller which controls both ZJ002 and ZJ096 will attempt to restore pressure if it decreases below the setpoint of 110 PSIG. As pressure decreases, ZJ002 opens in an attempt to maintain pressure. If ZJ002 reaches the full open position and pressure remains below setpoint, ZJ096 will begin opening and continue opening as long as pressure is below setpoint.**

Stage steam admission is via manual valves. There are two sets of first and second stage valves per CSAE. The second stage is placed in service before first stage.

Each first stage jet has a supply connection from each main and FWPT condenser. These manually operated isolation valves are used to separate all supply headers from the associated first stage jet.

Air discharge flow monitors (one high flow 0-50 SCFM and one low flow 0-15 SCFM), on the discharge of each CSAE, can be valved in to check off gas flow rate. Typically we run with both sets of primary and secondary jets in service on all three CSAE's.

The air stream to the unit vent is monitored by EMF-33 (CSAE Discharge). An EMF Trip II alarm, signals the Control Room of a high off gas activity level.

The gland steam condenser air discharge combines with the condenser off-gas discharge and flows to the unit vent. This connection is located downstream of the EMF-33 sample connection. The gland seal discharge is not monitored for activity.

Cooling water is supplied to the CSAE inter and after-condensers from the Condensate (CM) System. CM flow must be established prior to ejector startup.

CSAE main header and FWPT condenser vacuum gauges are located on a panel on the main turbine floor. These gauges indicate vacuum at the inlet of the jets.

3.0 SYSTEM OPERATION

3.1. Normal Operation

Objective # 7

3.1.1. Limits and Precautions

OP/1/B/6300/006, Main Vacuum and Vacuum Priming.

- Condenser vacuum must be broken prior to securing steam seals.

  Basis: **This ensures that foreign material (trash/dirt) will not be drawn in through the turbine shaft seals when steam seal pressure goes away. It also prevents drawing relatively cool air across the hot turbine shaft.**

- Minimum CM flow for steam jets on each CSAE is 1000 gpm.

  Basis: **This ensures sufficient cooling water to condense the steam discharge from the CSAE's. Insufficient cooling would result in increased backpressure (decreased efficiency) on the CSAE.**

- ZM pump operation during a S/G Tube Leak is an unmonitored radioactive release and may contaminate Service Building and Turbine Buildings.

  Basis **The discharge of the ZM pumps is unmonitored and goes directly into the Service Building ditch. The consequences of operating the ZM pumps under these conditions should be carefully evaluated before starting them up.**

3.1.2. Operating Procedures

OP/1/B/6300/006, Main Vacuum and Vacuum Priming

This procedure addresses Startup and Shutdown of the ZM and ZP systems. It also gives guidance on CSAE operation, blowdown of CSAE "Y" strainers, and establishing Main and CFPT condenser vacuum.

During the 1998/1999 timeframe, all CSAE steam nozzles were replaced on both units. Testing of the new nozzles showed that adequate off-gas removal could be achieved by using only one set of nozzles (one 1st stage and one 2nd stage) per CSAE. Operating with a single set of jets in service would conserve condensate grade water by sending less aftercondenser drainage to the ditch. By operating in this alignment, we could save about 6 to 10 gpm of CM water, per unit. This equates to a significant saving of 8,000 to 14,000 gallons per day, per unit. Initially after replacement, it was believed that either set of nozzles (#1 set or #2 set) could be placed in service with the same results. Engineering discovered subsequently **that operation with only the #1 set of nozzles in service could lead to increased CFPT condenser pressure due to inadequate removal of off-gas** (See PIP-99-3428). The #2 set of nozzles ties directly into the CFPT condenser off-gas piping. The #1 set of nozzles does not, thus is less effective.

3.2. Abnormal and Emergency Operation

Objective # 9

A low vacuum condition can be caused by any of the following:

- **Insufficient steam flow or pressure to CSAE's or too few CSAE's in service.**
- **Excessive air in leakage.**
- **Poor Heat Transfer caused by high RC temperature, low RC flow, or fouled condenser tubes.**
- **Faulty Air Removal caused by high CM temperature to CSAE, low steam pressure to CSAE's, high backpressure on CSAE, air ejector "flooding", or loss of loop seal.**

AP/1/A/5500/23, Loss of Condenser Vacuum

If a Turbine/Reactor trip is not required, the following actions are taken to assist in maintaining vacuum:

- Reduce turbine load.
- Start additional RC Pumps.
- Start both main vacuum pumps.
- Ensure adequate AS header pressure is available.
- Ensure at least one ZP pump is running.
- Ensure turbine exhaust hood sprays are open as required.

If the reason for the loss of vacuum is unknown, an operator is dispatched to run **Enclosure 1 (Air Ejector Local Actions)**. This new enclosure was added in May, 2000. It gives detailed guidance on how to check the CSAE's for proper operation and lists several possible sources of vacuum leaks. Actions include:

- Starting additional CSAE's (per the OP).
- Placing the Second Set of Air Ejector Nozzles in Service (per the OP).
- Using a pyrometer to check for air ejector "flooding" that could occur due to a clogged or closed drain.
- Ensuring CM isolation valves are open for each CSAE.
- Blowdown of air ejector "Y"-strainers (per the OP).
- Check Gland Steam System operation and consider raising steam seal pressure.
- Check main condenser penetrations.
- Have Chemistry ensure 1BB-194 (Blowdown Blowoff Tank to HR Flash Tank Control) in manual and closed.
- Check valve packing leaks.
- <u>IF</u> turbine has tripped, <u>THEN</u> check MSR Reliefs.

4.0 TECH SPECS / SELECTED LICENSEE COMMITMENTS

4.1 SLC 16.11.7, Radioactive Gaseous Effluent Monitoring Instrumentation (EMF-33)

1 Pt

Unit 1 was operating in mode 3 during a plant shut down for a refueling outage. If a safety injection signal is received, which one of the following events will occur to protect the vital AC busses from overload?

A. **Only non-LOCA loads will be shed. The accelerated sequence will sequence remaining loads on after checking for adequate bus voltage.**

B. **A complete load shed will occur. The accelerated sequence will sequence LOCA loads on after checking for adequate bus voltage and DG speed.**

C. **A complete load shed will occur. The accelerated sequence will sequence LOCA loads on after checking for adequate bus voltage.**

D. **Only non-LOCA loads will be shed. The accelerated sequence will sequence remaining loads on after checking for adequate bus voltage and DG speed.**

Bank Question: 548.1 ***Answer: A***

1 Pt

Unit 1 was operating in mode 3 during a plant shut down for a refueling outage. If a safety injection signal is received, which one of the following events will occur to protect the vital AC busses from overload?

A. Only non-LOCA loads will be shed. The accelerated sequence will sequence remaining loads on after checking for adequate bus voltage.

B. A complete load shed will occur. The accelerated sequence will sequence LOCA loads on after checking for adequate bus voltage and DG speed.

C. A complete load shed will occur. The accelerated sequence will sequence LOCA loads on after checking for adequate bus voltage.

D. Only non-LOCA loads will be shed. The accelerated sequence will sequence remaining loads on after checking for adequate bus voltage and DG speed.

Distracter Analysis:

A. **Correct answer**
B. **Incorrect**: only non-LOCA loads are shed, the accelerated sequence does not check for DG speed during a LOCA
Plausible: DG speed is checked when the sequencer is actuated during a blackout signal
C. **Incorrect**: only non-LOCA loads are shed
Plausible: the remaining part of the answer is correct
D. **Incorrect**: the accelerated sequence does not check for DG speed during a LOCA
Plausible: DG speed is checked when the sequencer is actuated during a blackout signal

Level: RO

KA: SYS 013 K4.11(3.2/3.8)

Lesson Plan Objective: DG-EQB Obj 6

Source: Bank;

Level of knowledge: Memory

References:

1. OP-MC-DG-EQB page 25

SYSTEM 013 Engineered Safety Features Actuation System (ESFAS)

K3 **Knowledge of the effect that a loss or malfunction of the ESFAS will have on the following:**
(CFR: 41.7 / 45.6)

K3.01	Fuel	4.4	4.7
K3.02	RCS	4.3	4.5
K3.03	Containment	4.3	4.7

K4 **Knowledge of ESFAS design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	SIS reset	3.9	4.3
K4.02	Containment integrity system reset	3.9	4.2
K4.03	Main Steam Isolation System	3.9	4.4
K4.04	Auxiliary feed actuation signal	4.3*	4.5*
K4.05	Core spray actuation signal reset	4.0*	4.2*
K4.06	Recirculation actuation system reset	4.0*	4.3*
K4.07	Power supply loss	3.7	4.1
K4.08	Redundancy	3.1	3.4
K4.09	Spurious trip protection	2.7	3.1*
K4.10	Safeguards equipment control reset	3.3	3.7
K4.11	Vital power load control	3.2	3.8
K4.12	Safety injection block	3.7	3.9
K4.13	MFW isolation/reset	3.7	3.9
K4.14	Upper head injection accumulator isolation	3.7*	4.0*
K4.15	Continuous testing	2.6	3.2
K4.16	Avoidance of PTS	3.8	4.2
K4.17	Reason for stopping air coolers on train being tested	2.9*	2.9*
K4.18	Reason for jumping containment high-high-pressure signal to containment spray pump on train being tested	3.3*	3.5*
K4.19	Reason for opening breaker on high-head injection pump	3.0*	3.4*
K4.20	Reason for stopping CCW pump on train being tested	3.1*	3.3*
K4.21	Reason for starting an additional service water booster pump for train not being tested and stopping the pump on train under test	3.1*	3.3*
K4.22	Reason for shut safety injection pump discharge valve of train to be tested	2.9*	3.1*
K4.23	Reason for disabling of ED/G during ESF sequencer test	2.6*	2.9*
K4.24	Reason for disabling of BIT so it will not function during ESF sequencer test	3.0*	3.1*

K5 **Knowledge of the operational implications of the following concepts as they apply to the ESFAS:**
(CFR: 41.5 / 45.7)

K5.01	Definitions of safety train and ESF channel	2.8	3.2
K5.02	Safety system logic and reliability	2.9	3.3

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.5	1.5	1.5	1.5

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Diesel Generator Load Sequencing System.	X	X	X	X	
2	List the Sequencer Automatic Actuation Signals.	X	X	X	X	X
3	List the two Sequencer Modes of Operation and give a brief explanation of each mode.	X	X	X	X	X
4	State which of the Sequencer Modes has priority.		X	X	X	X
5	Describe the sequence of events which occur during the Blackout Mode of Sequencer Operation.		X	X	X	X
6	Describe the sequence of events which occur during the Safety Injection Mode of Sequencer Operation.		X	X	X	X
7	Describe the sequence of events which occur during a Blackout followed by a Safety Injection.		X	X	X	X
8	Describe the sequence of events which occur during a Safety Injection Actuation followed by a Blackout. (NOTE: with S_s reset and with S_s not reset).		X	X	X	X
9	Describe the sequence of events required to be done in order to return the 4.16 KV bus back to normal following a: • Safety Injection • Blackout • Safety Injection followed by a Blackout • Blackout followed by a Safety Injection		X	X	X	X
10	Given a Limit and/or Precaution associated with an operating procedure, discuss its bases and when the it applies.	X	X	X	X	X

3.4 Sequencer Operation during Safety Injection

Sequencer Operation during a Safety Injection actuation with no blackout signal.

Objective # 6

Upon receiving an SI signal, the SSPS energizes sequencer relays to:

1. Start the diesel generator.
2. Lock out the blackout relay, trips blackout only loads.
3. Align logic relays to lockout non-SI loads and to load SI loads.

Loading Criteria:

1. If bus voltage is greater than 92.5%, the accelerated sequence logic immediately loads group #1. Bus frequency is no longer a permissive, since the diesel is not tied to the bus.
2. If bus voltage is between 76% and 92.5% the accelerated sequence will delay and wait for voltage to recover before loading the next group. However, under these conditions, the "early committed sequence" will load the first group after a 1 second time delay.
3. Loading is similar to that described for a blackout except that:
   - Only loads necessary during an SI are allowed to operate or be started in sequence.
   - SI loads previously in operation remain unchanged.
   - Additional timers for load groups 3 and 4 (ND & NS) are in the committed time circuit.

To recover control after a Safety Injection actuation

1. The actuating signal must be no longer present.
2. Reset SI using pushbuttons on MCB.
3. Reset Diesel Generator Sequencer using MCB or local reset pushbutton.

<u>NOTE 1</u> **Since normal power is available to the 4160V bus during an SI only event, a check for 4160V bus frequency is unnecessary. Prior to and during the accelerated sequence, if 4160V bus voltage drops below the 92.5% setpoint, the accelerated sequence is halted and remains halted until bus voltage is again above the setpoint.**

<u>NOTE 2</u> **The committed sequence looks at neither voltage nor frequency. When the time delay relay associated with a given load group's sequence timer has timed out, the committed sequence applies that load group regardless of voltage or frequency.**

1 Pt

Unit 2 was operating at 99% power when a steamline break occurred. Given the following events and conditions:

0200 The operators enter AP/01 (*Steam Leak*)
0200 The operators start reducing turbine load to match T_{ave} and T_{ref}
0201 The operators start a second NV pump and isolate letdown
0202 NLOs start investigating for the location of the steam leak
0203 *P/R OVER POWER ROD STOP* alarms – the RO reports that power is now going down.
0204 STA reports pressurizer level is decreasing and cannot be maintained
0205 The turbine building operator reports that the line to the atmospheric dump valves has a steam leak and cannot be isolated

If no safety injection has occurred and pressurizer pressure is maintained, which one of the following operator responses is correct?

A. Manually trip the reactor at 0203

B. Manually trip the reactor at 0204

C. Manually trip the reactor at 0205

D. Commence a rapid down power using AP/04 *(Rapid Downpower)* at 0205

Bank Question: 593.1 **_Answer: B_**

1 Pt

Unit 2 was operating at 99% power when a steamline break occurred. Given the following events and conditions:

0200 The operators enter AP/01 (*Steam Leak*)
0200 The operators start reducing turbine load to match T_{ave} and T_{ref}
0201 The operators start a second NV pump and isolate letdown
0202 NLOs start investigating for the location of the steam leak
0203 *P/R OVER POWER ROD STOP* alarms – the RO reports that power is now going down.
0204 STA reports pressurizer level is decreasing and cannot be maintained
0205 The turbine building operator reports that the line to the atmospheric dump valves has a steam leak and cannot be isolated

If no safety injection has occurred and pressurizer pressure is maintained, which one of the following operator responses is correct?

A. Manually trip the reactor at 0203

B. Manually trip the reactor at 0204

C. Manually trip the reactor at 0205

D. Commence a rapid down power using AP/04 *(Rapid Downpower)* at 0205

Distracter Analysis:

A. **Incorrect**: no requirement to trip the reactor because reactor power has turned and is decreasing. Not approaching the overpower automatic reactor trip at 109% in 2 of 4 channels.
Plausible: shows a power mismatch – reactor power reaches 103% on 1 of 4 PR channels to cause C-2. OMP 4-3 (*Use of Abnormal and Emergency Procedures)* requires the operator to trip when an automatic safeguards action setpoint is approached to avoid challenging the automatic safeguards function.

B. **Correct answer** required to trip under AP/01 (and many other procedures) if you cannot maintain pressurizer level with 2 NV pumps

C. **Incorrect**: required to trip when PZR level cannot be maintained
Plausible: if the candidate thinks that a reactor trip is required because the steam leak was not isolated.

D. **Incorrect**: required to trip when PZR level cannot be maintained
Plausible: this would be the correct answer if not required to trip at 0204.

Level: RO

KA: W/E12 EA1.03(3.4/3.9)

Lesson Plan Objective: AP-1 Obj. 4

Source: Bank;

Level of knowledge: comprehension

References:
1. AP/1/A/5500/01 page 3
2. OP-MC-IC-IPE page 45
3. OMP 4-3, page 8

EPE: Uncontrolled Depressurization of all Steam Generators (Continued)

K/A NO. KNOWLEDGE

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.5 SRO 3.9

EK3.2 Normal, abnormal and emergency operating procedures associated with (Uncontrolled Depressurization of all Steam Generators).
IMPORTANCE RO 3.3 SRO 3.9

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.5 SRO 3.7

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Uncontrolled Depressurization of all Steam Generators)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 3.8

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.7

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.4 SRO 3.9

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		1.0	1.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for AP/01 (Steam Leak). AP01001			X	X	X
2	Analyze the mitigating strategy (major actions) contained in the procedure. AP01002			X	X	X
3	Given scenarios describing accident events and plant conditions, evaluate the basis for any caution, note, or step. AP01003			X	X	X
4	Given scenarios describing accident events and plant conditions, evaluate conditions which require application of continuous action steps. AP01004			X	X	X

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 3. **Check Pzr level - STABLE OR GOING UP.**	**Perform the following as required to maintain level:** __ a. Maintain charging flow less than 175 GPM at all times in subsequent steps. __ b. Ensure 1NV-238 (Charging Line Flow Control) opening. __ c. Open 1NV-241 (Seal Inj Flow Control) while maintaining NC pump seal flow greater than 6 GPM. __ d. Reduce or isolate letdown. __ e. Start additional NV pump. f. **IF** Pzr level going down with maximum charging flow, **THEN**: __ 1) Trip reactor. __ 2) Close all MSIVs using individual valve pushbuttons. __ 3) **IF** reactor tripped in previous step, **THEN GO TO** EP/1/A/5000/E-0 (Reactor Trip or Safety Injection). 4) **IF** Pzr level goes below 4% **AND** cannot be restored using normal charging, **THEN**: __ a) Ensure reactor tripped. __ b) **WHEN** reactor tripped **OR** auto S/I setpoint reached, **THEN** ensure S/I initiated. __ c) **GO TO** EP/1/A/5000/E-0 (Reactor Trip or Safety Injection).
__ 4 IF AT ANY TIME while in this procedure Pzr level cannot be maintained stable, THEN perform Step 3.	
__ 5. Announce occurrence on paging system.	

Objective # 10

Power Range NIS Low Setpoint (2/4 channels = 25%) - Protects against startup accidents. The trip can be manually blocked when 2/4 PR channels > 10% (P-10) by using the two control board switches, one per train. The control board provides indication of the bistable block. This trip is auto-reinstated when 3/4 PR channels < 10% (P-10).

Power Range NIS High setpoint (2/4 channels = 109%) - protects against an overpower condition which could lead to a DNB concern. This circuit also provides a rod withdrawal stop when 1/4 channels > 103% power (C-2).

Power Range Positive (+) Rate (2/4 channels + 5% in 2 sec) - protects against an ejected rod accident for DNB concerns.

Pressurizer High Pressure (2/4 channels = 2385 psig) - Protects against losing NC system integrity.

Pressurizer Low Pressure (2/4 channels = 1945 psig) - protects against DNB due depressurization. This "at-power" trip protection is auto-blocked < 10% power (P-7) and is automatically reinstated > P-7.

Pressurizer High Level (2/3 channels = 92%) - protects system integrity by preventing the passage of water through the safeties. This "at-power" trip protection is auto-blocked < 10% power (P-7) and is automatically reinstated > P-7.

OTΔT (2/4 channels = variable) - provides DNB protection. DNB causes a large decrease in the heat transfer coefficient between the fuel surface and the coolant, resulting in high fuel clad temperature. The setpoint is a function of the 120% full power ΔT, Tavg, Pressurizer Pressure, and Δ Flux. Pressures below 2235 psig cause the setpoint to decrease while pressures above 2235 psig cause an increase in the setpoint. Tavg above 585 °F causes the setpoint to decrease while Tavg below 585 °F causes an increase in the setpoint. A Δ Flux more positive than the limit in the COLR (positive breakpoint) causes the setpoint to decrease. This circuit also provides a rod withdrawal stop and Turbine Runback 2% (C-3) below the trip setpoint.

OPΔT (2/4 channels = variable) - protects against excessive fuel centerline temperature due to high fuel rod power density (kW/ft). The setpoint is a function of the 109% full power ΔT, Tavg, Rate of Tavg increase, and Δ Flux. Tavg above 585 °F cause the setpoint to decrease with no credit for Tavg below 585 °F. A Δ Flux more positive than the limit in the COLR (positive breakpoint) or more negative than the limit in the COLR (negative breakpoint) causes the setpoint to decrease. This circuit also provides a rod withdrawal stop and Turbine Runback 2% (C-4) below the trip setpoint.

NC Pump Bus Low Voltage (2/4 busses = 74%) - this anticipatory loss of coolant flow trip protects against DNB. This "at-power" trip protection is auto-blocked < 10% power (P-7) and is automatically reinstated > P-7.

7.5 Manual Initiation of Safeguards Actions

ROs and SROs are expected to manually initiate safeguards actions if an automatic action setpoint is being approached, to avoid challenging the automatic safeguards function. An example of this is to manually initiate safety injection if pressure is decreasing in an uncontrolled manner to 1845 psig.

However, during an ATWS, it is undesirable to initiate S/I in "anticipation" of an S/I signal if the reactor will not trip, since this will cause a loss of CF flow to the S/Gs. This exception is stated in the APs that manually initiate S/I in "anticipation" of an S/I signal.

The operator is expected to manually initiate any action which should have automatically occurred if the automatic function fails, such as the Safety Injection fails to initiate during an uncontrolled Reactor Coolant depressurization at 1845 psig (even during an ATWS) or an ECCS pump fails to start on a Safety Injection signal.

IF directed to initiate a signal, initiate both trains unless otherwise specified.

7.6 Resetting Safety Systems

IF directed to reset a signal, reset both trains unless otherwise specified.

IF a procedure directs resetting a signal that has not been received or that has been previously reset, the reset pushbuttons do not have to be depressed since the intent of the step has bee met. Likewise, if a procedure directs the operator to stop, start or reposition a component which is already in the desired position; the component's control switch does not have to be depressed.

7.7 Blocking of Automatic Safety Actuations

It is the policy of Operations to not block any automatic safety actuation from performing its intended function. The RO or SRO has the option to violate this policy if, in his/her judgment, plant conditions require it to be done. Blocking an automatic safety actuation should only be done to better protect the health and safety of the public or to protect the lives of plant personnel. Non-procedural blocking of automatic safety actuations must be approved prior to taking the action by two licensed personnel, one of whom is a supervisor who holds an SRO license.

WHEN an automatic safety actuation is blocked outside of procedure, the action must be reported to the NRC under the provisions of 10CFR50.54x.

In the event that an RO/SRO blocks an automatic actuation of a safety system, it is his/her responsibility to be fully aware of all associated plant parameters, and to manually actuate safety equipment as necessary to assure safe plant conditions.

1 Pt Unit 2 was operating at 90% power after a start-up from a refueling outage. A pressurizer PORV is found to be leaking and the associated PORV block valve was shut. The PRT was cooled down to the following PRT conditions:

- PRT Level – 65%
- PRT Pressure – 9 psig
- PRT Temperature – 100°F
- Lower Containment Temperature - 118 °F

What actions are required to restore and maintain normal operating conditions to the PRT for the long term?

A. Vent the PRT to the waste gas system.

B. Vent the PRT to containment.

C. Cool the PRT by pressurizing with nitrogen and initiating spray flow from the NCDT.

D. Cool the PRT by initiating spray flow through the sparger line from the RWST

Bank Question: 617.2 ***Answer: A***

1 Pt Unit 2 was operating at 90% power after a start-up from a refueling outage. A pressurizer PORV is found to be leaking and the associated PORV block valve was shut. The PRT was cooled down to the following PRT conditions:

- PRT Level – 65%
- PRT Pressure – 9 psig
- PRT Temperature – 100°F
- Lower Containment Temperature - 118 °F

What actions are required to restore and maintain normal operating conditions to the PRT for the long term?

A. Vent the PRT to the waste gas system.

B. Vent the PRT to containment.

C. Cool the PRT by pressurizing with nitrogen and initiating spray flow from the NCDT.

D. Cool the PRT by initiating spray flow through the sparger line from the RWST

Distracter Analysis: With PRT pressure > 8 psig and temperature < containment temp, cooling the PRT will only result in the PRT heating back up again.

A. ***Correct***:

B. **Incorrect**: cannot be performed at power as the vent valve is inside containment and is inaccessible at power
Plausible: *venting to containment* would accomplish the required action

C. **Incorrect**: Lower Containment temp is 118 °F. Cooling the tank further would only delay the time when *it would heat back up again* and require further cooling. The PRT can be cooled by pressurizing the PRT with nitrogen - but then spray flow must be initiated from the RMWST not the NCDT.
Plausible: Cooling will reduce pressure temporarily but will not allow the PRT to reheat to its normal limit of 114°F without getting a high-pressure condition (containment temp is 118°F). In addition, recirculating through the NCDT using the NCDT pumps cools the PRT and pressure would be reduced – temporarily.

D. **Incorrect:** Cannot cool the PRT through the sparger line
Plausible: can cool the PRT by recircing through the RWST – must pressurize with N2 and recirculate RWST water through the spray and drain connections.

Level: RO

KA: SYS 007 A2.02 (2.6/3.2)

Lesson Plan Objective: PS-NC Obj. 20

Source: BANK

Level of knowledge: memory

References:
1. OP-MC-PS-NC pages 41, 43

SYSTEM: 007 Pressurizer Relief Tank/Quench Tank System (PRTS)

K5 **Knowledge of the operational implications of the following concepts as the apply to PRTS:**
(CFR: 41.5 / 45.7)

K5.01	Principles of steam quenching	2.2	2.6
K5.02	Method of forming a steam bubble in the PZR	3.1	3.4
K5.03	Characteristics of convection heat transfer	1.8	2.1
K5.04	Properties of noncondensable gases in contact with water	1.9	2.2
K5.05	Characteristics of conduction heat transfer	1.8	2.1
K5.06	Properties of condensable gases in contact with water	1.9	2.2

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the PRTS:**
(CFR: 41.7 / 45.7)

K6.01	Valves	1.9	2.0
K6.02	Sensors and detectors	1.8	1.9
K6.03	Pumps	1.4*	1.7*
K6.04	Motors	1.3*	1.6*
K6.05	Breakers, relays, and disconnects	1.6	1.8

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the PRTS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Maintaining quench tank water level within limits	2.9	3.1
A1.02	Maintaining quench tank pressure	2.7	2.9
A1.03	Monitoring quench tank temperature	2.6	2.7

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the P S; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Stuck-open PORV or code safety	3.9	4.2
A2.02	**Abnormal pressure in the PRT**	**2.6**	**3.2**
A2.03	Overpressurization of the PZR	3.6	3.9
A2.04	Overpressurization of the waste gas vent header	2.5	2.9
A2.05	Exceeding PRT high-pressure limits	3.2	3.6
A2.06	Bubble formation in PZR	2.6	2.8
A2.07	Recirculating quench tank	2.3*	2.6*

A3 **Ability to monitor automatic operation of the PRTS, including:**
(CFR: 41.7 / 45.5)

A3.01	Components which discharge to the PRT	2.7*	2.9

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
20	Concerning operation of the PRT: • Describe how the PRT can be vented to containment. • Describe how the PRT is purged with and without the Shutdown Tanks Available	X	X	X	X	
21	Describe how NCS temperature, pressure, flow and Pzr level are measured and indicated.		X	X	X	
22	Describe the operation and indication readout of the following NCS level instrumentation: • Ultrasonic level detection • WR level • NR level • Sightglass		X	X	X	X
23	State the nominal values for NC System pressure, Th, Tc, Tave, Pzr temperature for Hot Zero Power and Hot Full Power.	X	X	X	X	
24	Given a Limit and/or Precaution associated with the following procedures, discuss its basis and when it applies: • OP/1or2/A/6100/001 • OP/1or2/A/6100/SU1, 2, 3, 5, 6, 7, 8, 9, 10, 13, 15, 19, 20 • OP/1or2/A/6100/SO1, 2, 3 • OP/1or2/A/6100/002 • OP/1or2/A/6100/SD1, 2, 4, 7, 8, 11, 12, 14, 16, 20, 21, 22 • OP/1or2/A/6150/004		X	X	X	X

The discharge line from each safety also has a temperature element which provides meter indication on 1(2)MC10 and an alarm on **1(2)AD6 "PZR Safety Discharge Hi Temp " (setpoint 20^0 F above ambient on one out of three).** This indication alerts the operator of leaking/lifting safety valve(s). The discharge line also has an acoustic monitor which "listens" for sounds of a safety valve discharge. This monitor provides input to an alarm on **1(2)AD6 "NC1, 2, or 3 FLO DETECTED"** and also to a control board light **"FLOW/NO FLOW".** Each pressurizer safety valve is equipped with an accelerometer to detect leakage. The accelerometers provide a signal for each pressurizer safety valve at panel ALDM-1 (733 electrical penetration room). Operations can direct an NLO and an IAE technician to this panel when flow has been detected by the control room alarm. This local panel can give a bar graph readout "relative" to leakage indication with IAE assistance This is not a GPM read out but rather a 1 to 10 scale of 0% to 100% flow anticipated from a pressurizer safety at full temperature and pressure.

2.9 Pressurizer Relief Tank (PRT)

Objective # 19

The purpose of the pressurizer relief tank is to condense and cool discharge water from the PORVs and safeties. The tank normally contains water and a N_2 cover gas. The N_2 gas overpressure is used to prevent the O_2 from entering the tank and forming an explosive mixture with the H_2 gas present. The N_2 gas is supplied from bulk N_2 (GN system) or from Waste Gas Decay Tank B. When the relief valves lift, the steam is discharged into the PRT through a sparger pipe (under water). The PRT design is based on the requirement to:

- be able absorb the pressurizer discharge during a step load decrease of 10% (equivalent to 110% continuous discharge from the pressurizer).
- the spray rate is designed to cool the tank from 200^0 F to 120^0 F in approximately one hour following the design discharge.
- the volume of the N_2 gas in the PRT is selected to limit the maximum pressure following a design discharge to 50 psig.

The PRT is not designed for relief valve continuous discharge, therefore, it has two rupture discs designed to prevent it from exceeding its design pressure of 100psig. The rupture disc setting is also 100 psig which is twice the calculated pressure resulting from the maximum design safety valve discharge. The tank and rupture discs are also designed for full vacuum to prevent tank collapse if the contents cool following a discharge without nitrogen being added.

Objective # 20

The PRT can be vented to containment atmosphere through a manual vent valve at the tank (NC51). This line has a capped connection designed to accept a filter assembly to reduce radioactivity released from the tank to containment. The PRT can also be aligned to the waste gas system for venting.

The PRT is equipped with internal spray and drain system to cool the tank. The PRT is cooled by recirculating its contents with the Reactor Coolant Drain Tank (NCDT/) Pump through the NCDT heat exchanger. If the NCDT pumps are unavailable, the PRT can be cooled by increasing PRT N_2 pressure, initiating PRT spray flow from the RMWST while cycling NC107 maintain level. The PRT has a temperature indication on 1(2)MC10 and an alarm on **1(2)AD6 "PRT Hi Temp" (setpoint 114^0 F)** to inform the operator that the tank needs cooling. The PRT has level and pressure indication on 1(2)MC10 and alarms on **1(2)AD6 "PRT Hi Press" (setpoint 8 psig)** and **"PRT Abnormal Level" (setpoints hi 88% and low 64%).**

Venting of the PRT is done primarily to reduce the pressure in the PRT. Purging of the PRT is done because the PRT gas space does not meet the Radwaste Chemistry specifications. Purging is initiated following the Radwaste Chemistry group notifying the control room that a purge of the PRT is needed. Venting of the PRT is initiated when the operator notices the PRT pressure is greater than 5 psig or following an alarm on 1(2)AD6 "PRT Hi Press" (setpoint 8 psig) is received in the control room.

The basic steps to **vent the PRT to the WG System** (OP/1/A/6150/04 Enclosure 4.4), require Radwaste Chemistry to isolate the N_2 supply to the PRT and open the PRT to the WG compressor suction. NC48 (sample tank bypass) is slowly opened (coordinating with Radwaste Chemistry to ensure the WG compressor does not trip). until PRT pressure is less than 8 psig. Radwaste Chemistry closes the PRT suction to the waste gas compressor. NC48 is closed and Radwaste Chemistry will align N_2 supply to the PRT.

The basic steps to **purge the PRT with the Shutdown Tank Available** (OP/1/A/6150/04 Enclosure 4.5). require Radwaste Chemistry to isolate the shutdown tank from the PRT and open the PRT to WG compressor suction. NC48 (sample tank bypass) is slowly opened to purge the PRT (coordinating with Radwaste Chemistry to ensure the WG compressor does not trip) until PRT pressure decreases to WG vent header pressure. When PRT pressure is at WG header pressure NC48 is closed and Radwaste Chemistry aligns the PRT to the shutdown tank. Radwaste Chemistry will sample the PRT to ensure the tank gas space is within specification. If not, the process will be repeated.

The basic steps to **purge the PRT with WG Shutdown Tank not available** (OP/1/A/6150/04, Enclosure 4.6) require the applicable R&Rs to be evaluated for impact on this operation. Radwaste Chemistry isolates the PRT N2 supply and opens the PRT to WG compressor suction. NC48 (sample tank bypass) is slowly opened to vent the PRT while coordinating with Radwaste Chemistry to ensure the WG compressor does not trip. PRT is purged until pressure decreases to WG Vent header pressure. When PRT pressure decreases to WG header pressure, NC48 is closed. Radwaste Chemistry will open the N_2 supply to the PRT and ensure PRT pressure is from 3 to 5 psig. The N2 supply will be isolated for Radwaste Chemistry to sample the PRT to ensure the tank gas space is within specification. If not, the process will be repeated. After the PRT is within specification, PRT to WG compressor suction will be closed and the PRT N2 supply will be opened.

Bank Question: 1074 **Answer: D**

1 Pt(s) Unit 1 is in the process of releasing the Ventilation Unit Condensate Drain Tank (VUCDT) using approved station procedures. Just after the release was initiated, the 1EMF-44 (Ventilation Unit Condensate Drain Tank) power supply fails.

Which one of the following statements correctly describes the effect on this Liquid Waste Release (LWR)?

REFERENCE PROVIDED
SLC 16.11.2

A. **1EMF-44 fails in the conservative direction and both Trip 1 and Trip 2 alarm, terminating the release. The high radiation alarms can not be reset and the release can not be continued.**

B. **Nothing, there is no effect on this LWR. There is no alarm which informs the Control Room operators that there has been a loss of power to 1EMF-44. The release is allowed to continue.**

C. **1EMF-44 will alarm Trip 1 and Trip 2 terminating the release. The Trip 2 alarm may be reset only one time, if no further alarms are received. The LWR may proceed provided that station RP performs an analysis of grab samples for radioactivity at a lower limit of detection.**

D. **1RAD2-F/2, "1EMF-44 LOSS OF CONT VENT DRN TNK SAMPLE FLOW" alarms and the release must be terminated. The LWR may proceed provided that station RP performs an analysis of grab samples for radioactivity at a lower limit of detection.**

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Distracter Analysis:

A. **Incorrect**: The hi rad alarms will not be received upon loss of power supply.
Plausible: Some bistables and alarms 'fail on' when power is lost or detectors fail.

B. **Incorrect**: The LOSS OF SAMPLE FLOW will alarm.
Plausible: There is an alarm for loss of sample flow, but there is not an alarm for loss of power.

C. **Incorrect:** The hi rad alarms will not be received.
Plausible: Some hi rad alarms may be reset one time to reinitiate the LWR without additional sampling or LWR paperwork.

D. **Correct:**

Level: RO

KA: SYS 073 A2.02 (2.7/3.2)

Lesson Plan Objective:

Source: New

Level of knowledge: comprehension

References:
1. 1RAD2-F/2 Annunciator Response Procedure
2. SLC 16.11.2

1 Pt(s) Unit 1 is in the process of releasing the Ventilation Unit Condensate Drain Tank (VUCDT) using approved station procedures. Just after the release was initiated, the 1EMF-44 (Ventilation Unit Condensate Drain Tank) power supply fails.

Which one of the following statements correctly describes the effect on this Liquid Waste Release (LWR)?

REFERENCE PROVIDED

A. **When the power supply to 1EMF-44 fails, both Trip 1 and Trip 2 alarm. 1EMF-44 Trip 2 will close WL-320, WP-35, and WM46 to isolate, terminating the release. The alarms can not be reset and the release can not be continued.**

B. **Nothing. There is no alarm which informs the Control Room operators that there has been a loss of power to 1MF-44. The release would continue until secured by the operator.**

C. **1EMF-44 will alarm (Trip 2). 1EMF-44 Trip 2 will close WL-320, WP-35, and WM46 to isolate, terminating the release. The Trip 2 alarm may be reset only one time and the release may continue if no further alarms are received.**

D. **1RAD2-F/2, "1EMF-44 LOSS OF CONT VENT DRN TNK SAMPLE FLOW" alarms and the release must be terminated. The LWR my proceed provided that station RP performs an analysis of grab samples for radioactivity at a lower limit of detection.**

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Bank Question: 1074 **Answer: D**

1 Pt(s) Unit 1 is in the process of releasing the Ventilation Unit Condensate Drain Tank (VUCDT) using approved station procedures. Just after the release was initiated, the 1EMF-44 (Ventilation Unit Condensate Drain Tank) power supply fails.

Which one of the following statements correctly describes the effect on this Liquid Waste Release (LWR)?

REFERENCE PROVIDED
SLC 16.11.2

A. **When the power supply to 1EMF-44 fails both Trip 1 and Trip 2 alarm. 1EMF-44 Trip 2 will close WL-320, WP-35, and WM46 to isolate, terminating the release. The alarms can not be reset and the release can not be continued.**

B. **Nothing. There is no alarm which informs the Control Room operators that there has been a loss of power to 1MF-44. The release would continue until secured by the operator.**

C. **1EMF-44 will alarm (Trip 2). 1EMF-44 Trip 2 will close WL-320, WP-35, and WM46 to isolate, terminating the release. The Trip 2 alarm may be reset only one time and the release may continue if no further alarms are received.**

D. **1RAD2-F/2, "1EMF-44 LOSS OF CONT VENT DRN TNK SAMPLE FLOW" alarms and the release must be terminated. The LWR my proceed provided that station RP performs an analysis of grab samples for radioactivity at a lower limit of detection.**

Distracter Analysis:

A. **Incorrect:** The hi rad alarms will not be received upon loss of power supply.
Plausible: Some bistables and alarms 'fail on' when power is lost or detectors fail.

B. **Incorrect:** The LOSS OF SAMPLE FLOW will alarm.
Plausible: There is an alarm for loss of sample flow, but there is not an alarm for loss of power.

C. **Incorrect:** The hi rad alarms will not be received.
Plausible: Some hi rad alarms may be reset one time to reinitiate the LWR without additional sampling or LWR paperwork.

D. **Correct:**

Level: RO

KA: SYS 073 A2.02 (2.7/3.2)

Lesson Plan Objective:

Source: New

Level of knowledge: comprehension

References:
1. 1RAD2-F/2 Annunciator Response Procedure
2. SLC 16.11.2

Nomenclature: **1EMF 44 LOSS OF CONT VENT DRN TNK SAMPLE FLOW**

Window: **F2**

Setpoint: Switch activated

Origin: 1EMF-44 loss of sample flow switch

Probable Cause:

- Line blockage
- Pipe leak
- Inlet AND outlet valves NOT open
- 1WL-324 (Vent Unit Cond Drn Tank Rad Monitor Bypass) improperly throttled

Automatic Action: None

Immediate Action: None

Supplementary Action:

1. Check for pipe leak.
2. Check inlet AND outlet valves.
3. Adjust 1WL-324 (VUCDT Rad Mon Byp) for proper flow (until alarm clears).
4. IF alarm does NOT clear, terminate VUCDT release.
5. Notify RP.

References: MC-1565-7.0

End Of Response

Unit 1

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.2 Radioactive Liquid Effluent Monitoring Instrumentation

COMMITMENT The radioactive liquid effluent monitoring instrumentation channels shown in Table 16.11.2-1 shall be OPERABLE with their Alarm/Trip Setpoints set to ensure that the limits of SLC 16.11.1 are not exceeded.

AND

The Alarm/Trip Setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY At all times.

REMEDIAL ACTIONS

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

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more radioactive liquid effluent monitoring channels Alarm/Trip setpoint less conservative than required.	A.1 Suspend the release of radioactive liquid effluents monitored by the affected channel.	Immediately
	OR	
	A.2 Declare the channel inoperable.	Immediately
	OR	
	A.3 Adjust setpoint to within limit.	Immediately
B. One or more radioactive liquid effluent monitoring instrument channels inoperable.	B.1 Enter the Remedial Action specified in Table 16.11.2-1 for the channel(s).	Immediately

(continued)

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One channel inoperable.	C.1.1 Analyze two independent samples per TR 16.11.1.1.	Prior to initiating a release
	<u>AND</u>	
	C.1.2 Perform independent verification of the discharge line valving.	Prior to initiating a release
	<u>AND</u>	
	C.1.3.1 Perform independent verification of manual portion of the computer input for the release rate calculations performed by computer.	Prior to initiating a release
	<u>OR</u>	
	C.1.3.2 Perform independent verification of entire release rate calculations for calculations performed manually.	Prior to initiating a release
	<u>AND</u>	
	C.1.4 Restore channel to OPERABLE status.	14 days
	<u>OR</u>	
	C.2 Suspend the release of radioactive effluents via this pathway.	Immediately

(continued)

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. One channel inoperable.	D.1 Perform an analysis of grab samples for radioactivity at a lower limit of detection per Table 16.11.1-1.	Once per 12 hours during releases when secondary specific activity is > 0.01 µCi/gm DOSE EQUIVALENT I-131 AND Once per 24 hours during releases when secondary specific activity is ≤ 0.01 µCi/gm DOSE EQUIVALENT I-131
	AND	
	D.2 Restore the channel to OPERABLE status.	30 days
E. One or more channels inoperable.	E.1 Perform an analysis of grab samples for radioactivity at a lower limit of detection per Table 16.11.1-1.	Once per 12 hours during releases
	AND	
	E.2 Restore the channel to OPERABLE status.	30 days

(continued)

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. One or more flow rate measurement channels inoperable.	F.1 ------------NOTE------------ Pump performance curves generated in place may be used to estimate flow. ------------------------ Estimate the flow rate of the release.	Once per 4 hours during releases
	AND	
	F.2 Restore the channel to OPERABLE status.	30 days
G. RC minimum flow interlock inoperable.	G.1 Verify that the number of pumps providing dilution is greater than or equal to the number of pumps required.	Once per 4 hours during releases
	AND	
	G.2 Restore the channel to OPERABLE status.	30 days
H. Required Action and associated Completion Time of Condition C, D, E, F, or G not met.	H.1 Explain why the inoperability was not corrected within the specified Completion Time in the Annual Radioactive Effluent Release Report.	In the next scheduled Annual Radioactive Effluent Release Report

TESTING REQUIREMENTS

---NOTE---
Refer to Table 16.11.2-1 to determine which TRs apply for each Radioactive Liquid Effluent Monitoring channel.

TEST	FREQUENCY
TR 16.11.2.1 Perform CHANNEL CHECK.	24 hours
TR 16.11.2.2 ---NOTE--- The CHANNEL CHECK shall consist of verifying indication of flow. --- Perform CHANNEL CHECK.	Every 24 hours during periods of release
TR 16.11.2.3 Perform SOURCE CHECK.	Prior to each release
TR 16.11.2.4 Perform SOURCE CHECK.	31 days
TR 16.11.2.5 ---NOTES--- 1. For Instrument 1, the COT shall also demonstrate that automatic isolation of the pathway occurs if the instrument indicates measured levels above the Alarm/Trip Setpoint. 2. For Instruments 1 and 2, the COT shall also demonstrate that control room alarm annunciation occurs if the instrument indicates measured levels above the Alarm/Trip Setpoint; circuit failure and, a downscale failure. --- Perform CHANNEL OPERATIONAL TEST.	92 days
TR 16.11.2.6 Perform a CHANNEL CALIBRATION.	18 months

(continued)

TESTING REQUIREMENTS (continued)

TEST		FREQUENCY
TR 16.11.2.7	---------------------------NOTE--------------------------- The initial CHANNEL CALIBRATION shall be performed using standards certified by the National Institute of Standards and Technology (NIST) or using standards obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used. --- Perform a CHANNEL CALIBRATION.	24 months

TABLE 16.11.2-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	REMEDIAL ACTION	TESTING REQUIREMENTS
1. Radioactivity Monitors Providing Alarm And Automatic Termination of Release			
a. Waste Liquid Effluent Line (EMF-49)	1 per station	A, C, H	TR 16.11.2.1 TR 16.11.2.3 TR 16.11.2.5 TR 16.11.2.7
b. EMF-49 Minimum Flow Device	1 per station	C, H	TR 16.11.2.5 TR 16.11.2.7
c. Containment Ventilation Unit Condensate Line (EMF-44)	1	A, E, H	TR 16.11.2.1 TR 16.11.2.4 TR 16.11.2.5 TR 16.11.2.7
d. EMF-44 Minimum Flow Device	1	E, H	TR 16.11.2.5 TR 16.11.2.7
2. Radioactivity Monitors Providing Alarm But Not Automatic Termination of Release			
a. Conventional Waste Water Treatment Line or Turbine Building Sump to RC (EMF-31)	1	A, D, H	TR 16.11.2.1 TR 16.11.2.4 TR 16.11.2.5 TR 16.11.2.7
b. EMF-31 Minimum Flow Device	1	D, H	TR 16.11.2.5 TR 16.11.2.7
3. Continuous Composite Samplers			
a. Containment Ventilation Unit Condensate Line	1	E, H	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
b. Conventional Waste Water Treatment Line	1 per station	E, H	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
c. Turbine Building Sump to RC	1	E, H	TR 16.11.2.2 TR 16.11.2.6

(Continued)

4. Flow Rate Measurement Devices			
a. Waste Liquid Effluent Line	1 per station	F, H	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
b. Containment Ventilation Unit Condensate Line	1	F, H	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
c. Conventional Waste Water Treatment Line	1 per station	F, H	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
d. Turbine Building Sump to RC	1	F, H	TR 16.11.2.2 TR 16.11.2.6
5. RC Minimum Flow Interlock (1)	1 per station	G, H	TR 16.11.2.5

NOTES:

1. Minimum flow dilution is assured by an interlock which terminates waste liquid release if the number of RC pumps running falls below the number of pumps required for dilution. The required number of RC pumps for dilution is determined per station procedures.

BASES

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The Alarm/Trip Setpoints of these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the Alarm/Trip will occur prior to exceeding the limits stated in SLC 16.11.1. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50. The Turbine Building Sump to RC Discharge Flow Measurement and Sampler Devices are for monitoring only and do not alarm or have any controls that require a quarterly COT.

REFERENCES

1. McGuire Nuclear Station Offsite Dose Calculation Manual (ODCM)

2. 10 CFR Part 50, Appendix A

1 Pt

Unit 1 was releasing the contents of a waste gas decay tank in accordance with an approved release permit. If the detector power supply for 1EMF-36(L) *(UNIT VENT GAS)* failed during the release, which one of the following actions must be taken?

A. **Stop the release and complete repairs on 1EMF-36(L) before *restarting.***

B. **Recalculate the trip set points using 1EMF-36(H) as the release path monitor.**

C. **Restart the release using 1EMF-50(L) *(WASTE GAS DISCH)* as the release path monitor.**

D. **Continue the release using 1EMF-50(L) as the release path monitor.**

Bank Question: 671.3 ***Answer: D***

1 Pt *Unit 1 was releasing the contents of a waste gas decay tank in accordance with an approved release permit.* If the detector power supply for 1EMF-36(L) *(UNIT VENT GAS)* failed during the release, which one of the following *actions must be taken?*

A. **Stop the release and complete repairs on 1EMF-36(L) before restarting.**

B. **Recalculate the trip set points using 1EMF-36(H) as the release path monitor.**

C. **Restart the release using 1EMF-50(L) *(WASTE GAS DISCH)* as the release path monitor.**

D. **Continue the release using 1EMF-50(L) as the release path monitor.**

Distracter Analysis:

A. **Incorrect**: not required to use 1EMF-36(L) as the release path monitor.
Plausible: if the candidate does not recognize that 1EMF-50(L) is normally used to monitor the release path.

B. **Incorrect**: 1EMF-36(H) does not automatically trip 1WG-160, and cannot be used as a waste gas release path monitor
Plausible: if the candidate thinks that substituting the high range of 1EMF-50(L) is necessary and provides the same automatic protection.

C. **Incorrect**: the release would NOT be terminated when 1EMF-36(L) failed low due to detector failure.
Plausible: if the candidate did not recognize that 1EMF-36(L) fails low on detector failure and would not trip 1WG-160.

D. **Correct answer**

Level: RO

KA: SYS 073 A2.02(2.7/3.2)

Lesson Plan Objective: OP-MC-WE-RGR Obj 4
OP-MC-WE-WG Obj 2,5 and 6

Source: BANK

Level of knowledge: Analysis

References:
1. OP-MC-WE-RGR page 15
2. OP-MC-WE-EMF pages 21, 23, 37
3. OP-MC-WE-WG pages 27 and 41

SYSTEM: 073 Process Radiation Monitoring (PRM) System

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the PRM system:**
(CFR: 41.7 / 45.7)

K6.01	Sensors and detectors	2.2	2.4
K6.02	Moving filters	2.0	2.1
K6.03	Sample blowers	1.9	2.0

<u>ABILITY</u>

A1 **Ability to predict and/or monitor changes in parameters *(to prevent exceeding design limits)* associated with operating the PRM system controls including:**
(CFR: 41.5 / 45.7)

A1.01	Radiation levels	3.2	3.5

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the PRM system; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Erratic or failed power supply	2.5	2.9*
[redacted]			
A2.03	Calibration drift	2.4	2.9*

A3 **Ability to monitor automatic operation of the PRM system, including:**
(CFR: 41.7 / 45.5)

None

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Effluent release	3.9	3.9
A4.02	Radiation monitoring system control panel	3.7	3.7
A4.03	Check source for operability demonstration	3.1	3.2

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	2.0	2.0	2.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Radiological Gaseous Releases.			X	X	X
2	Given a completed GWR, state the recommended release rate.			X	X	X
3	State what responsibility the Control Room SRO is accepting when he signs to authorize a release.			X	X	X
4	Given a completed GWR, state the proper EMF to be used for the release.			X	X	X
5	Evaluate plant parameters to determine any abnormal system conditions that may exist			X	X	X
6	Concerning the Selected Licensee Commitments (SLC) related to Gaseous Waste Releases;					
	• Given the SLC Manual, discuss any commitments and their applicability.			X	X	X
	• For any commitments that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any commitment is (are) not met and any action(s) required within one hour.			X	X	X
	• Given the SLC Manual, discuss the basis for a given commitment.				X	*
	* SRO only					

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2.0	2.0	2.0	2.0	2.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Waste Gas (WG) System. WEWG001	X	X	X	X	X
2	Describe the system flowpath during normal operation, shutdown operation and waste gas discharge. WEWG002	X	X	X	X	X
3	List four components that discharge waste gas into the WG Header. WEWG003	X	X	X	X	X
4	List two types of non-radioactive waste gas discharged into the WG Header. WEWG004	X	X	X	X	X
5	List the WG Discharge Flow Controller (WG-160) trips. WEWG005	X	X	X	X	X
6	Concerning the Selected Licensee Commitments (SLC) related to the WG System:					
	• Discuss any commitments and their applicability.			X	X	X
	• For any commitments that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any commitment is (are) not met and any action(s) required within one hour.			X	X	X
	• Discuss the basis for a given commitment.				X	*
	* SRO only WEWG007					

The discharge flow piping will be purged prior to releasing a tank. This ensures the release flowpath is clear of gas from a previously released tank and the normal flowpath for S/D B has been flushed if it has been in service frequently.

WGDT release rates shall be < 40 SCFM. Maximum range of the release rate recorder is 40 SCFM.

3.1.2 Procedure

Tank to be released is sampled prior to release by Chemistry. The sample is analyzed by RP and the Discharge Document is generated based on the sample analysis.

Objective #2, 3, 4

The Discharge Document is then delivered to the Control Room where the Control Room SRO ensures all paperwork is complete prior to authorizing the release. This authorization serves as an acknowledgment by the Control Room SRO that a release is about to take place. He should review the following prior to authorization.

- Expected range of EMF, Trip 1, and Trip 2 setpoints.
- Special Instructions.
- GWR document agrees with release procedure.
- Recommended Release Rate vs calculated release rates.

  The "Allowable Release Rate" will be the most restrictive release rate based on sample activity or the maximum observed system release rate (40 CFM for WGDT releases), whichever is less.

  The SRO reviewing the release paperwork should ensure the Recommended Release Rate is less than or equal to the Most Restrictive Release Rate.
- EMF utilized (50 or 36) and any necessary inoperable actions. It is preferable not to make a release with either 36 or 50 inoperable.

NOTE: With 50 and 36 both operable three attempts to release are allowed. With 50 operable and 36 inoperable, only one attempt is allowed.

The purpose of the auto actions:

- **EMF34 effluent is directed to ground water drainage sump "A", therefore isolating this flowpath prevents contaminating this sump.**
- **S/G blowdown blowoff tank effluent may be directed to either the condensate system or the turbine building sump, isolating blowdown will prevent contaminating these systems via the blowdown pathway.**
- **Conventional sampling effluent may be directed to the CST or turbine building sump, isolating conventional sampling will prevent contaminating these systems via this pathway.**

These channels use dual range gamma liquid assembly. The low range uses a gamma liquid (NaI Scint) while the high range uses a GM detector.

2.1.4 Unit Vent Airborne Monitor

The following channels are used to monitor the unit vent:

- 1(2) EMF 35 (L) Unit 1(2) Unit Vent Particulate (Low Range)
- 1(2) EMF 36 (L) Unit 1(2) Unit Vent Gas (Low Range)
- 1(2) EMF 36 (H) Unit 1(2) Unit Vent Gas (High Range)
- 1(2) EMF 37 Unit 1(2) Unit Vent Iodine

Objective # 2

These EMFs, utilizing a sample probe located within the Unit Vent to, monitor, record, and alarm the gaseous, iodine and air particulate activity levels released to the atmosphere from the combined ventilation systems within the station.

Atmosphere from the Containment Purge, Containment Annulus Ventilation, Auxiliary Building Ventilation, Condenser Air Ejector, Fuel Pool Ventilation and other potentially radioactive systems are discharged through the Unit Vent.

Objective # 2, 3

The automatic actions for these EMFs are as follows:

- **A Trip 2 high radiation alarm on 1 EMF 35 (L), 1 EMF 37, 2 EMF 35 (L), or 2 EMF 37 will stop Auxiliary Building Unfiltered Exhaust Fans 1ABFXF-1A, 1ABFXF-1B, 2ABFXF-1A, and 2ABFXF-2B.**
- **A Trip 2 high radiation alarm on 1 EMF 36 (L) will close 1WG160 to terminate waste gas discharge.**
- **1 EMF 36 (L) will also alarm and indicate at the Waste Gas Processing Panel.**

The purpose of auto actions are:

Activity being released via the Unit Vent could have several sources, (i.e., VP, VE, VQ, VF, WG, VA, CSAE) most of these are monitored by other EMF's or are filtered.

Stopping the unfiltered exhaust fans should terminate a release originating from the unfiltered exhaust.

WG discharges are normally monitored and if release rate limits are exceeded, terminated by EMF50. EMF36 will duplicate EMF50 actions.

EMF35,36,37 use a particulate-iodine-gas assembly. The Gas channel has a high and low range. The low range uses a plastic Scint detector while the high range uses a GM detector. The iodine portion uses a NaI Scint.

There are Loss of Sample Flow annunciators associated with both the EMF vacuum pump and the RP Composite Sampler. However, the actions required by SLC 16.11-7 are different for each. Loss of the Unit Vent Composite Sampler requires RP to estimate flow once per four hours. (Ref. PIP 1-M96-2953)

2.1.5 <u>Containment Airborne Monitor</u>

The containment air is sampled by the following channels:

- 1(2) EMF 38 (L) - Unit 1 (2) Containment Particulate (Low Range)
- 1(2) EMF 39 (L) - Unit 1(2) Containment Gas (Low Range)
- 1(2) EMF 39 (H) - Unit 1(2) Containment Gas (High Range)
- 1(2) EMF 40 - Unit 1(2) Containment Iodine

Objective # 2

The above channels monitor the particulate, iodine and gaseous activity levels in the:

- **Containment atmosphere during normal unit operation.**
- **Containment purge exhaust flow during containment purge operations.**

These channels monitor containment to warn personnel if containment atmospheric activity exceeds preset limits and to secure liquid and atmospheric releases from containment.

Objective # 4

Three sample points, selected from the control console, provide coverage of the containment. Sample points are located in:

- **Upper Containment**
- **Lower Containment**
- **Incore Instrumentation Room**

2.1.15 Waste Gas Discharge Monitor

Objective # 2

Channels EMF 50 (L) - Waste Gas (Low Range) and EMF 50 (H) - Waste Gas (High Range) sense the activity level in the waste gas being discharged from the waste gas decay tanks to the environment through the unit vent. The waste gas discharge control valve, 1WG160, is controlled by a manual loader and interlocked to the low range detector. A pressure switch is connected to the manual loader output. This switch prevents opening of the valve unless the manual loader is first cranked to zero. If the manual loader is at zero and there is no high radiation alarm, the valve control switch may be operated to permit valve operation. The valve may now be opened using the manual loader.

Objective # 2, 3

On a Trip 2 high radiation alarm from EMF 50 (L) or 1 EMF 36 (L) (Unit Vent). The valve (WG-160) will be tripped closed. In order to reopen it, the alarm must be cleared and the manual loader must be reduced to zero.

Purpose of the auto action is to prevent exceeding the Unit Vent release rate limits for releases originating from the WG system.

The channel type is a dual range beta gas. The detectors are (Plastic Scint.) for the Low Range and (GM) for the high range.

2.1.16 Reactor Building Activity Monitor

Objective # 2

1(2) EMF 51A - Unit 1(2) Reactor Building Activity and 1(2) EMF 51B - Unit 1(2) Reactor Building Activity are used to assess fuel integrity and containment conditions following an accident. Range is 1 to 10^8 R/hr.

There are no control actions performed by this monitor.

The channel type is a Ionization chamber.

2.1.17 Interim Radwaste Facility Ventilation Monitor

Objective # 2

The Interim Radwaste Facility contains radioactive materials which if released to the environment could violate the 10CFR release limits. This facility is not designed to perform controlled radioactive releases however, there is the possibility that the ventilation system could become a vent path to the environment. EMF 52 -Interim Radwaste Facility Ventilation Monitor is used to monitor the gaseous activity level being exhausted to the atmosphere from the Interim Radwaste Facility.

This EMF has a meter range of 10 to 10^7 CPM. The control module is located in Interim Radwaste Facility. The Indicator and annunciator is all that is in the Control Room.

Shutdown Operation

Objective #2

(See Drawing 7.5)

Prior to reactor shutdown, we isolate the continuous purge from the VCT of both units, then place Shutdown Tank "B" in service (i.e. WG header to compressor, to tank, to recombiner). Eighteen (18) hours prior to reactor shutdown, we isolate H_2 overpressure to the VCT and align Shutdown Tank "B" to provide a N_2 overpressure. Eight (8) hours prior to the reactor subcriticality, we start VCT N_2 purge (this removes H_2 in the VCT and begins dropping H_2 in the NC system). When the reactor is subcritical, we start the more rapid phase of degas.

The gas flow from Shutdown Tank "B" splits – some flows to the VCT, and the rest is routed to the recombiner, then back to the compressor suction. This continues until the hydrogen concentration in the VCT is lowered to specifications (< 4%).

System flowpaths are similar to that for normal operation except that flow is through Shutdown Tank B.

Prior to reactor startup, the nitrogen is removed and hydrogen is added through similar flowpaths. The nitrogen removed from the system is stored in Shutdown Tank "B" and may be reused once or twice before recharging with fresh nitrogen.

Waste Gas Discharge

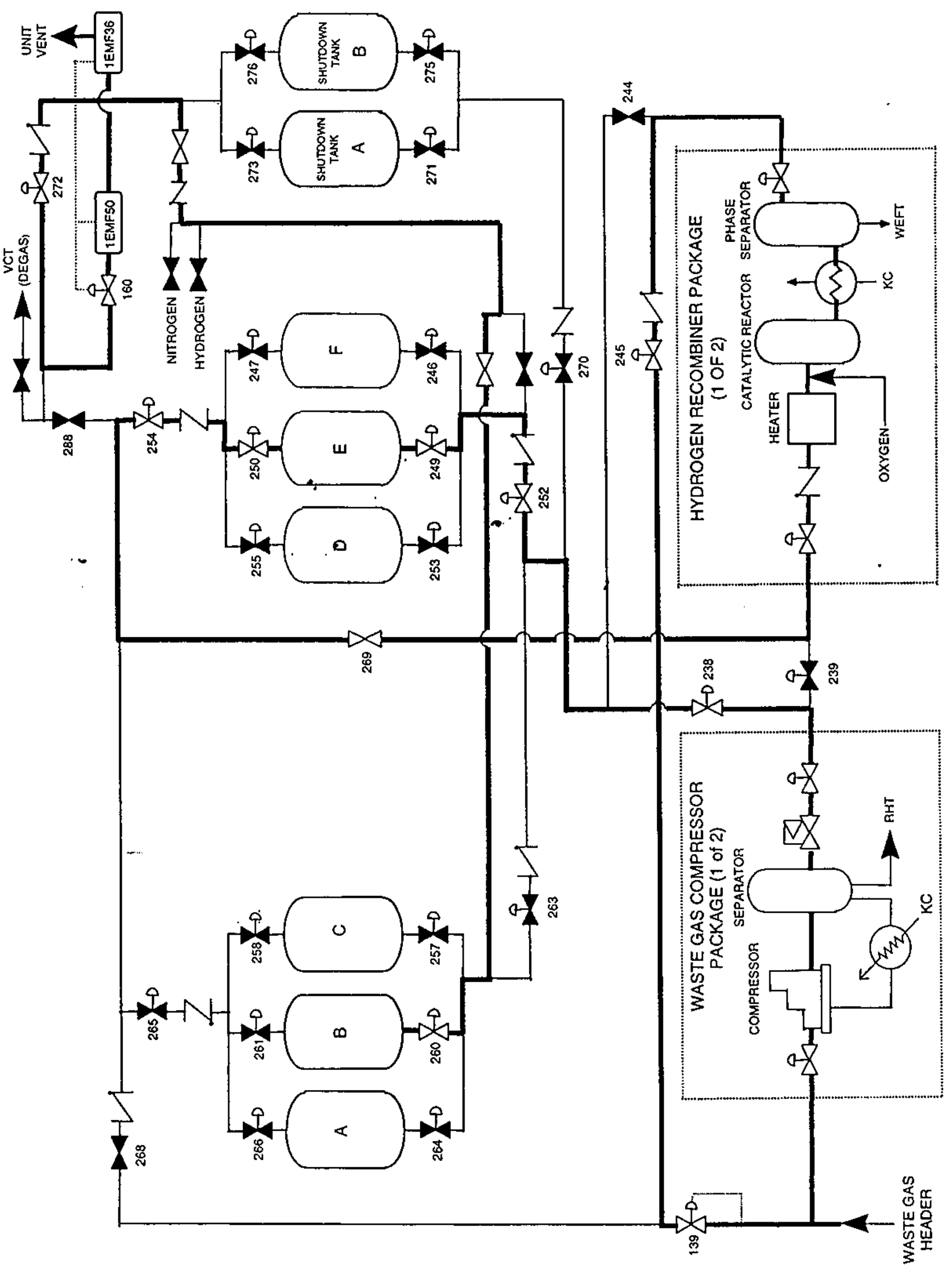
Objective #2

Releases of radioactive gases to the environment is covered in more detail in Lesson Plan WE-RGR, Radiological Gaseous Releases.

Waste gas tanks are in two banks. One bank can be isolated for discharge while one bank remains in service. Discharge gas flows through 1WG160, Waste Gas Discharge Flow Controller, then through 1EMF50 to the Unit Vent. (See Drawing 7.4)

Due to system arrangement we are unable to release a tank to the environment while the system is in recirc on the shutdown tank. (See Drawing 7.5)

7.4. Discharge From Tank "B", Tank "E" In Service, Recombining Hydrogen From Tank "E", Compressor to Tank to Recombiner Alignment (3/7/01)



1 Pt

Unit 1 has experienced a rupture of the RN piping inside containment. Emergency procedures prescribe successful response mechanisms if containment water level remains between 3.5 and 10.5 feet.

Why is safe plant recovery not assured for a design basis large break LOCA when containment water level exceeds 10.5 feet?

A. **Operation of critical ECCS components needed for safe recovery is endangered by submersion.**

B. **Operation of the NS pumps is endangered by excess debris fouling the containment suction strainers.**

C. **Operation of the hydrogen purge system is compromised by loss of direct access to the containment atmosphere.**

D. **Operation of the ND system is compromised by high suction pressure**

Bank Question: 891.2 ***Answer: A***

1 Pt

Unit 1 has experienced a rupture of the RN piping inside containment. Emergency procedures prescribe successful response mechanisms if containment water level remains between 3.5 and 10.5 feet.

Why is safe plant recovery not assured for a design basis large break LOCA when containment water level exceeds 10.5 feet?

A. **Operation of critical ECCS components needed for safe recovery is endangered by submersion.**

B. **Operation of the NS pumps is endangered by excess debris fouling the containment suction strainers.**

C. **Operation of the hydrogen purge system is compromised by loss of direct access to the containment atmosphere.**

D. **Operation of the ND system is compromised by high suction pressure**

Distracter Analysis:

A. **Correct**: The containment flood plane reference is at 10.5 ft. Submersion beyond this level will expose unqualified components to a hostile environment that they are not qualified for.

B. **Incorrect**: Submergence beyond the reference flood plane will not cause excess debris nor will it transport debris to the suction strainers, which are at the very bottom of the containment sump. Debris is generated by impingement of high energy releases against containment SSCs – the design basis will prevent excess debris if containment is maintained free of foreign material.
Plausible: Clogged suction strainers could occur if submergence of components was a mechanism, which could lift debris. This is a reason to keep foreign material out of containment.

C. **Incorrect**: The hydrogen purge system is far above the 10.5 ft flood plane and would not be compromised.
Plausible: If the hydrogen purge system was submerged, it would fail to operate.

D. **Incorrect**: 10.5 feet of water will not lift the ND suction relief, or if it did the relief returns to the PRT.
Plausible: High containment level increases ND suction pressure.

Level: RO

KA: EPE W/E 15 G2.1.7 (3.7/4.4)

Lesson Plan Objective: EP-MC-EP-

FRZ Obj. 4

Source: BANK

Level of knowledge: Memory

References:
1. OP-MC-EP-FRZ page 47

2.0 GENERIC KNOWLEDGES AND ABILITIES

2.1 Conduct of Operations

2.1.1 **Knowledge of conduct of operations requirements.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.7 SRO 3.8

2.1.2 **Knowledge of operator responsibilities during all modes of plant operation.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 4.0

2.1.3 **Knowledge of shift turnover practices.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 3.4

2.1.4 **Knowledge of shift staffing requirements.**
(CFR: 41.10 / 43.2)
IMPORTANCE RO 2.3 SRO 3.4

2.1.5 **Ability to locate and use procedures and directives related to shift staffing and activities.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.3 SRO 3.4

2.1.6 **Ability to supervise and assume a management role during plant transients and upset conditions.**
(CFR: 43.5 / 45.12 / 45.13)
IMPORTANCE RO 2.1 SRO 4.3

2.1.7 **Ability to evaluate plant performance and make operational judgments based on operating characteristics, reactor behavior, and instrument interpretation.**
(CFR: 43.5 / 45.12 / 45.13)
IMPORTANCE RO 3.7 SRO 4.4

2.1.8 **Ability to coordinate personnel activities outside the control room.**
(CFR: 45.5 / 45.12 / 45.13)
IMPORTANCE RO 3.8 SRO 3.6

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		0.5	0.5	0.5

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose of each procedure in the FR-Z series. EPFRZ001			X	X	
2	Discuss the entry and exit guidance for each procedure in the FR-Z series. EPFRZ002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the FR-Z series. EPFRZ003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the FR-Z series. EPFRZ004			X	X	X
5	Given the Foldout page, discuss the actions included and the basis for these actions. EPFRZ005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPFRZ006			X	X	X
7	Discuss the time critical task(s) associated with the FR-Z series procedures including the time requirements and the basis for these requirements. EPFRZ007			X	X	X

STEP 4 Notify Station Management of sump level and activity level to obtain recommended action.

PURPOSE: To notify station management of sump level and activity level.

BASIS: This step instructs the operator to provide management with information concerning the containment sump level and radioactive content of the water. Management should evaluate the event and provide specific recommendations to the operators concerning the high containment sump levels.

STEP 5 RETURN TO procedure and step in effect.

PURPOSE: To direct the operator to the proper procedure following successful completion of the steps in this procedure.

BASIS: Now that the procedure steps have been completed, the operator should continue plant recovery operations by returning to the procedure and step that was in effect at the time FR-Z.2 was entered.

FR-Z.2 Enclosures

Enclosure 1 – Foldout page

1. **Cold Leg Recirc Switchover Criteria (Same as FR-Z.1)**
2. **CA Suction Sources (Same as FR-Z.1)**
3. **Position criteria for 1NV-150B and 1NV-151A (NV Pumps Recirc) (Same as FR-Z.1)**

1 Pt

Unit 1 is operating at 100% power. The battery charger 1EDGA for the 1A emergency diesel generator battery has failed and will not provide a DC output.

Which one of the following statements correctly describes the effect on the 1A emergency diesel generator?

A. **The 1A emergency diesel generator will start but not continue to run for its design basis committed time period without the battery charger in service.**

B. **The 1A emergency diesel generator will not start without the battery charger in service.**

C. **The 1A emergency diesel generator will start and run because the battery charger has a vital DC backup power supply, and will automatically supply the vital loads after starting.**

D. **The 1A emergency diesel generator will start and run because all safety grade auxiliary loads are supplied from the 600VAC motor control center supplied from 1ELXA.**

Bank Question: 895.1 ***Answer: A***

1 Pt

Unit 1 is operating at 100% power. The battery charger 1EDGA for the 1A emergency diesel generator battery has failed and will not provide a DC output.

Which one of the following statements correctly describes the effect on the 1A emergency diesel generator?

A. The 1A emergency diesel generator will start but not continue to run for its design basis committed time period without the battery charger in service.

B. The 1A emergency diesel generator will not start without the battery charger in service.

C. The 1A emergency diesel generator will start and run because the battery charger has a vital DC backup power supply, and will automatically supply the vital loads after starting.

D. The 1A emergency diesel generator will start and run because all safety grade auxiliary loads are supplied from the 600VAC motor control center supplied from 1ELXA.

Distracter Analysis:

A. **Correct**: The D/G will start because the D/G battery will supply all starting loads. However, without the charger, the battery will expire and power will be lost to the governor, voltage regulator and other vital DC loads.

B. **Incorrect**: The D/G will start without the charger – power will be supplied from the D/G battery.
Plausible: if the candidate does not know that removing the inverter does not remove the battery from service. This would be true if the D/G control power breaker was opened.

C. **Incorrect**: DG is inoperable without the battery charger.
Plausible: Some batteries have this feature.

D. **Incorrect**: DG is inoperable without the battery charger.
Plausible: The battery will provide power to DG auxiliaries for some period of time – some vital D/G auxiliaries are supplied from the 600 VAC control center.

Level: RO

KA: APE 058 AK1.01 (2.8/3.1*)

Lesson Plan Objective: OP-MC-DG-EPQ Objs. 3, 4, 5, 6, 7

Source: BANK/Modified

Level of knowledge: comprehension

References:
1. OP-MC-DG-EPQ pages 15-19 & 25 odd pages only

APE: 058 Loss of DC Power

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of DC Power: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Battery charger equipment and instrumentation	2.8	3.1*
AK1.02	Electrical units: volts, amps, and dc	2.0	2.3
AK2.	**Knowledge of the interrelations between the Loss of DC Power and the following: (CFR 41.7 / 45.7)**		
AK2.01	Motors	1.9	2.2
AK2.02	Breakers, relays, and disconnects	2.2*	2.4*
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of DC Power: (CFR 41.5,41.10 / 45.6 / 45.1)**		
AK3.01	Use of dc control power by D/Gs	3.4*	3.7
AK3.02	Actions contained in EOP for loss of dc power	4.0	4.2
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of DC Power: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Cross-tie of the affected dc bus with the alternate supply	3.4*	3.5
AA1.02	Static inverter dc input breaker, frequency meter, ac output breaker, and ground fault detector	3.1*	3.1
AA1.03	Vital and battery bus components	3.1	3.3
AA2.	**Ability to determine and interpret the following as they apply to the Loss of DC Power: (CFR: 43.5 / 45.13)**		
AA2.01	That a loss of dc power has occurred; verification that substitute power sources have come on line	3.7	4.1
AA2.02	125V dc bus voltage, low/critical low, alarm	3.3*	3.6
AA2.03	DC loads lost; impact on ability to operate and monitor plant systems	3.5	3.9

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
0.5	0.5	0.5	0.5	0.5

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Diesel Generator Auxiliary Power System.	X	X	X	X	
2	Explain how AC control power is supplied to the Diesel Generator and its Auxiliaries during: • Manual Mode Operation • Automatic Mode Operation (S_s or Blackout)	X	X	X	X	
3	List typical loads supplied by the 600 VAC, 120 VAC and the 125 VDC Diesel Generator Control Power System.	X	X	X	X	
4	State the time limit each battery is required to be sized to carry all its DC loads without assistance.	X	X	X	X	
5	Describe how each battery is connected to its associated power system.	X	X	X	X	
6	Explain when each battery will automatically assume the DC bus loads.	X	X	X	X	
7	Discuss the normal demands placed upon the battery charger.	X	X	X	X	
8	Given a Limit and/or Precaution associated with an operating procedure, discuss its bases and when it applies.	X	X	X	X	X

2.3 125 VDC Diesel Generator Control Power System

Objective # 3

Provides power to the 125 VDC Diesel Generator Fuel Oil Booster Pump, Generator Field Flashing, and control loads necessary for proper diesel starting/operation during a blackout and/or a Safety Injection (SI) initiation.

The 125 VDC Diesel Generator Control Power System is designed as a unit system and is comprised of Diesel Generator 125 VDC Batteries and Battery Chargers 1EDGA, 1EDGB, 2EDGA, and 2EDGB which serve Diesel Generators 1A, 1B, 2A, and 2B, respectively. Each battery and its respective charger are housed in a metal/plexiglass enclosed cabinet located in their respective diesel room.

Battery Chargers 1EDGA, 1EDGB, 2EDGA, and 2EDGB are supplied power from Motor Control Centers 1EMXE, 1EMXF, 2EMXE, and 2EMXF, respectively. The chargers convert 600 VAC to 125 VDC.

Each diesel has its own separate 125 VDC System. Each system supplies a Diesel Fuel Oil Booster Pump and a Diesel Generator Control Panel.

Objective # 4

Each 125 VDC battery is sized to carry its duty cycle load without its battery charger for approximately 30 minutes during diesel generator operation.

Objective # 5 & 6

DC power is normally supplied by the charger. The battery is connected to the charger output as a back-up to the charger. The charger voltage is maintained slightly higher than battery voltage. This results in a continuous charge (float) on the battery. The batteries will automatically provide power to the DC loads without interruption on a loss of AC power or in the event of a malfunction of the battery charger.

Each D/G 125 VDC System has a local alarm module which feeds a C/R annunciator. Any of the following conditions will result in actuation of the respective system's C/R annunciator. (An operator must be dispatched to locally determine the cause of the alarm.)

- D/G DC Cont Pwr Undervoltage
- Battery Charger Breaker Open
- Battery Charger Trouble
- Battery Charger Blown Fuses
- Battery Breaker Open
- Battery Ground
- Battery Undervoltage
- Battery Charger Low DC Voltage
- Battery Charger AC Power Failure
- Battery Charger Fan Failure
- Battery Charger High DC Voltage
- Battery Charger High DC Voltage Trip
- Battery Charger Negative to Ground
- Battery Charger Positive to Ground
- Battery Chgr Loss of Ground Detect Circuit
- Battery Charger Failure

Objective # 5 & 6

The 125 VDC Batteries (EDGA, EDGB)

The battery consists of 92, nickel cadmium cells. Each battery is rated at 130 VDC, 38 AMP hours and **is sized to carry its duty cycle load without the battery charger for approximately 30 minutes during diesel generator operation. The battery automatically assumes all DC loads if there is a loss of the charger for any reason.**

Battery Chargers (EDGA, EDGB)

Input Requirements	600 VAC ± 10%, 10 amps, 60 Hz ± 3 Hz, Three phase
Output Rating	130 VDC 50 Amps (current limited to 27.5 Amps)
Float Voltage	130 VDC ± 5% (Nominal setpoint – 130 VDC)
Equalize Voltage	140 VDC ± 5% (Nominal setpoint - 140 VDC)
Low Voltage Alarm Pickup Voltage	127 VDC
High Voltage Alarm Pickup Voltage	146 VDC
Ambient Temperature	50°C Maximum

The chargers (EDGA, EDGB) are supplied power from MCC's EMXE and EMXF, respectively.

Charger startup requires that the AC input breaker be closed (charger energized) before its DC output breaker to allow the charger to operate without the battery connected, as required for maintenance. Charger shutdown is the reverse of this procedure. The battery bank will automatically assume all DC loads on a loss of the charger.

Objective # 7

Normal demands of the charger are that it maintains all DC loads while maintaining a float charge on its associated battery.

Objective # 3

A list of the 125 VDC loads are as follows:

- **Electronic governor**
- **Voltage regulator for field flashing**
- **Speed switches**
- **Starting solenoid valves**
- **D/G Starting Circuit Control Power**
- **Fuel Oil Booster Pump**

Each of the items listed above share a common supply breaker (D/G Control Power Breaker) except for the Fuel Oil Booster Pump, which has its own supply breaker. An open breaker will constitute a loss of power to the motor and control circuit. If the common supply breaker to all other components listed is opened, a loss of DC control power to the D/G occurs.

An under-voltage condition on the bus will alarm on the local alarm panel and in the Control Room.

3.0 SYSTEM OPERATION

3.1 Normal Operation

Objective # 8

3.1.1 Limits and Precautions

No smoking or open flames allowed in the battery area.

Basis: During the charging process, a battery will give off hydrogen as one of the by-products of the chemical reaction which takes place. Accumulation of hydrogen could result in a fire or explosion hazard.

The VD System should remain in operation during battery charger operation.

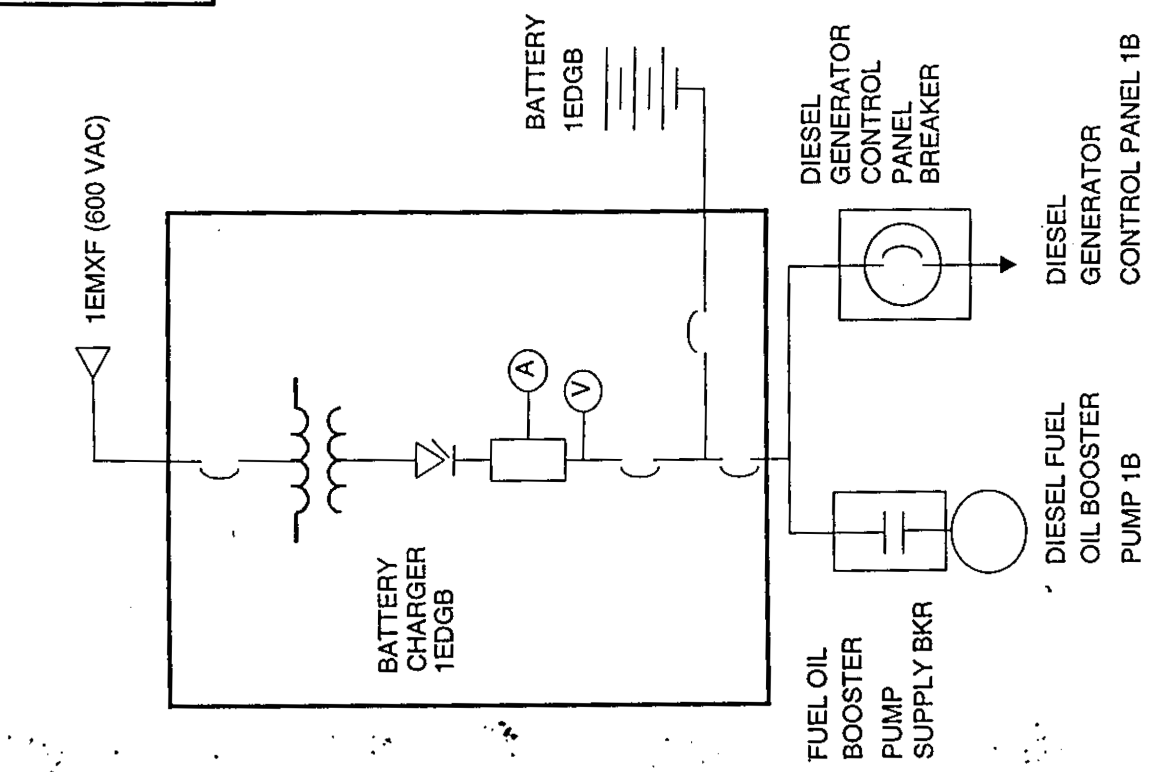
Basis: Maintaining the ventilation system in operation would prevent the accumulation of hydrogen in the area.

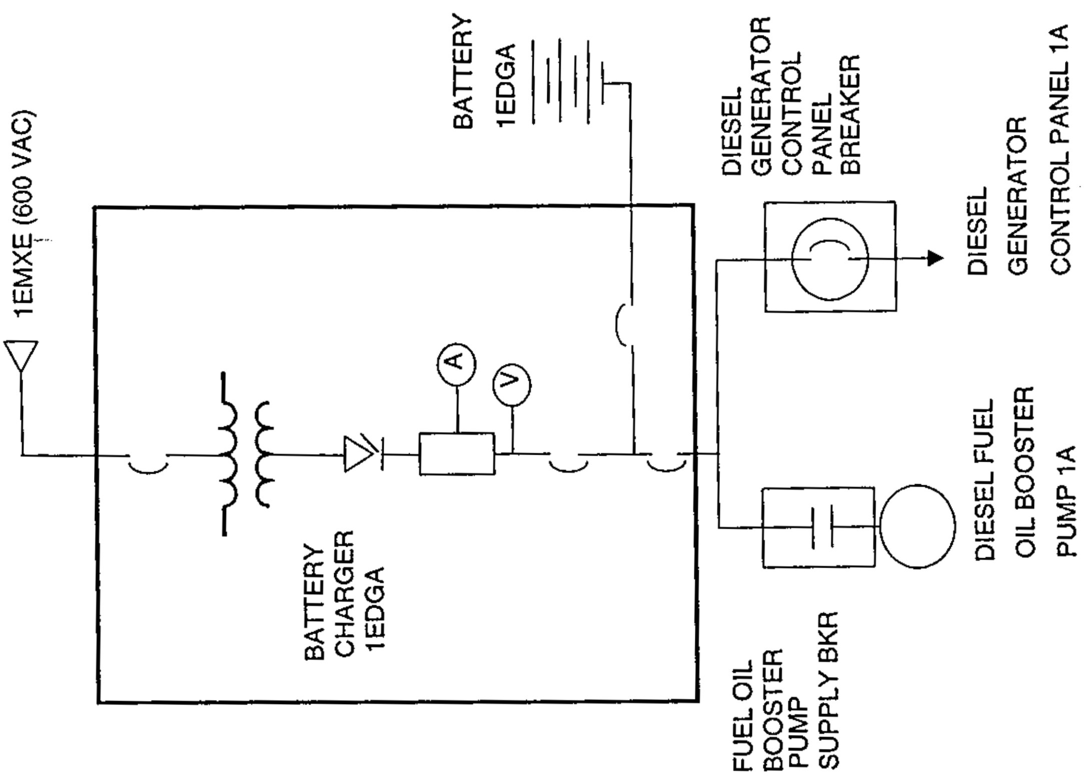
Notify IAE if battery voltage is outside limits specified in procedure.

Basis: Diesel Generator Supplemental Testing Requirements (TR 16.8.3.2) require overall DG battery voltage to be ≥ 125 volts under a float charge. Battery voltages outside of the specified range could indicate a defective charger or battery.

7.2 125 VDC D/G Control Power (3/17/99)

Objective # 5





1 Pt

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 exponentially until the design battery capacity is exhausted.**

C. **The discharge rate will increase exponentially 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.**

Bank Question: 906.1 ***Answer: C***

1 Pt

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 exponentially until the design battery capacity is exhausted.**

C. **The discharge rate will increase exponentially 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

KA: SYS 063 A1.01 (2.5/3.3)

Lesson Plan Objective: EL-EPL SEQ 12/20

Source: Bank

Level of knowledge: memory

References:
1. OP-MC-EP-EPL pages 65-67

SYSTEM: **063 DC Electrical Distribution System**

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the DC electrical system:**
(CFR: 41.7 / 45.7)

K6.01	Motors	1.8	1.7
K6.02	Breakers, relays and disconnects	1.9	2.1
K6.03	Test instruments	1.5	1.5

<u>ABILITY</u>

A1 **Ability to predict and/or monitor changes in parameters associated with operating the DC electrical system controls including:**
(CFR: 41.5 / 45.5)

A1.01	Battery capacity as it is affected by discharge rate	2.5	3.3
A1.02	Battery capacity, given ICV values	2.2	2.7*

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the DC electrical systems; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Grounds	2.5	3.2*
A2.02	Loss of ventilation during battery charging	2.3	3.1

A3 **Ability to monitor automatic operation of the DC electrical system, including:**
(CFR: 41.7 / 45.5)

A3.01	Meters, annunciators, dials, recorders, and indicating lights	2.7	3.1

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Major breakers and control power fuses	2.8*	3.1
A4.02	Battery voltage indicator	2.8*	2.9
A4.03	Battery discharge rate	3.0*	3.1

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
11	Describe the major difference between using the Standby Battery Charger during an equalizing charge and during standby service as a battery charger.		X	X	X	X
12	State the duty-cycle requirements, assumed within our safety analysis (UFSAR), associated with each 125 VDC Battery for the Vital Instrumentation and Control Power System.	X	X	X	X	X
13	Describe the purpose of the DC Tie Breakers associated with DC Distribution Centers; EVDA and EVDC, EVDB and EVDD.	X	X	X	X	
14	Explain how the 125 VDC and the 120 VAC Vital Instrumentation and Control Power Systems are interconnected.	X	X	X	X	
15	Describe operation of the Manual Transfer Switch associated with the Static Inverters for the Vital Instrumentation and Control Power System.	X	X	X	X	X
16	Describe any of the Kirk-Key Interlocks associated with the 120 VAC Vital Instrumentation and Control Power System and state the purpose of the Kirk-Key arrangement.	X	X	X	X	X
17	Describe operation of the "Auto Transfer Switch" associated with 1KRP and 2 KRP (Regulated Power Distribution Centers).	X	X	X	X	X

18	Describe the function of the following inverter indications and controls: • output amps • output voltage • output frequency • alternate AC source input frequency • pre-charge push-button • pre-charge light • in-sync light • alternate source off-frequency light • inverter supplying load light • alternate AC source supplying load light • main semi-conductor fuse failure light • low DC input voltage light • low AC output voltage light • high AC output voltage light • low alternate AC source voltage light • inverter failure light • overtemperature light • alarm bypass circuit trouble light • fan failure light • alarms bypassed key switch	X	X	X	X	X
19	Given a Limit and/or Precaution, associated with the 125 VDC and 120 VAC Vital Instrumentation and Control Power Systems, discuss its basis and applicability.	X	X	X	X	X
20	Describe the expected operation of the 125 VDC and 120 VAC Vital Instrumentation and Control Power Systems during a Blackout or LOOP (Loss of Off-Site Power) Event.	X	X	X	X	X

Therefore, based on the replacement of EVCC and the satisfactory testing of EVCA, EVCB, and EVCD, both McGuire Units resumed plant operation. However, the decision was made to replace all the Vital Batteries EVCA, EVCB, EVCC, and EVCD with conventional batteries by the end of 2EOC11 outage.

The replacement batteries are a standard lead-acid type (GNB NCN-27).

5.4 SER 3-99, Reactor SCRAM and Partial Loss of Class 1E AC and DC Power During Recovery.

On August 31, 1999, after a spurious automatic scram, Indian Point U2 lost power to a 480 VAC emergency bus and, seven hours late, a 125 VDC vital bus and more than 75% of the control room annunciators.

One of the root causes of this event was:
Poor coordination of recovery efforts resulting in a partial loss of DC power

DETAILED DESCRIPTION

On August 31, 1999, after a spurious automatic scram, degraded voltage relays sensed a low voltage condition on one of the 480 VAC essential buses. The relays actuated, stripping the four safety-related buses and starting the respective emergency diesel generators. Shortly after closing onto its bus, the No. 23 EDG output breaker tripped on overcurrent, the bus deenergized and locked out on overcurrent. The bus remained deenergized for the next 10 hours while station personnel investigated the problem and implemented a recovery plan

With the ESF bus deenergized, the 125 VDC vital bus and 118 VAC instrument buses were being powered from the No. 24 station battery. The battery discharged for the next 7.5 hours, at which time it could no longer supply adequate voltage to the instrument bus static inverter. The instrument bus deenergized and power was lost to most of the control room annunciators.

The post-scram events were complicated by the fact that there was no abnormal procedure for loss of power to a single ESF bus. The resulting ineffective resource allocation and insensitivity to degrading conditions contributed to excessive delay in restoring electrical power to the battery charger. Although the No. 24 battery voltage decreased continuously throughout the event, the degrading condition and the potential consequences were not sufficiently communicated to senior managers and senior management involvement in recovery planning was limited.

- One of the significant aspects of this event was that Indian Point station personnel were not adequately trained on the theory of battery operation, or how batteries behave when subjected to heavy loads for long periods. **Specifically, the initial slow drop in battery voltage led station personnel to believe that the battery would continue to discharge at a linear rate.** In fact, at initial discharge and near the end of the duty cycle, the discharge rate is non-linear. As individual cells start to drop out, the discharge rate becomes more non-linear.

SUMMARY

McGuire CEN Engineering has reviewed the battery-related aspects of this event. The Indian Point Unit 2 DC system design and operation is completely different than at McGuire. They are much more limited in alignment configurations and system performance capabilities. Based on these differences, a similar scenario affecting the McGuire 125 VDC Vital power systems is not plausible unless the event goes beyond single failure considerations and design basis of the station.

Operators at McGuire should be aware of how batteries behave when subjected to loads for long periods. Voltage decay rate will change over the battery duty cycle (i.e. the initial drop in voltage will be relatively slow, but the rate of decay will increase over the duty cycle). Therefore, one cannot rely on the initial decay rate to extrapolate and predict the rate of decay over the entire duty cycle. AP-15, ("Loss of Vital or Aux Control Power") provides actions to minimize drain on a station battery. Specifically, it will have the operator evaluate transferring the affected vital AC bus to the alternate power source to conserve battery power. In addition, if a battery reaches 105 volts, operators must evaluate opening the battery breaker to prevent further depletion of voltage and possible battery damage.

6.0 SUMMARY

Review class objectives

7.0 DRAWINGS

1 Pt The crew has verified natural circulation in ES-0.1 *(Reactor Trip Response)* based on decreasing core exit thermocouple readings and subcooling > 0 °F. Ten minutes later, the operator notes that the thermocouple 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 %.

Bank Question: 911.2 **_Answer: B_**

1 Pt The crew has verified natural circulation in ES-0.1 *(Reactor Trip Response)* based on decreasing core exit thermocouple readings and subcooling > 0 °F. Ten minutes later, the operator notes that the thermocouple 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**: dp range 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**: dp range 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

KA: 0017 A3.01 (3.6*/3.8*)

Lesson Plan Objective: EP-E0 Obj. 6

Source: BANK

Level of knowledge: Memory

References:

1. OP-MC-EP-E0 pages 117, 123
2. ES-0.1 page 15
3. ES-0.1 Enclosure 2 page 31

SYSTEM: 017 In-Core Temperature Monitor (ITM) System

A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ITM system controls including:** (CFR: 41.5 / 45.7)		
A1.01	Core exit temperature	3.7	3.9
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the ITM system; and (b) based on those predictions, use procedures to correct, control or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)		
A2.01	Thermocouple open and short circuits	3.1	3.5
A2.02	Core damage	3.6	4.1
A3	**Ability to monitor automatic operation of the ITM system including:** **(CFR: 41.7 / 45.5)**		
[redacted]			
A3.02	Measurement of in-core thermocouple temperatures at panel outside control room	3.4*	3.1*
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Actual in-core temperatures	3.8	4.1
A4.02	Temperature values used to determine RCS/RCP operation during inadequate core cooling (i.e., if applicable, average of five highest values)	3.8	4.1

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	2.0	2.0	1.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Describe the accidents that are diagnosed in E-0 and the diagnostic sequence. EPE0001			X	X	X
2	Explain the purpose for each procedure in the E-0 series. EPE0002			X	X	
3	Discuss the entry and exit guidance for each procedure in the E-0 series. EPE0003			X	X	
4	Discuss the symptoms of a reactor trip and/or safety injection. EPE0004			X	X	
5	Discuss the mitigating strategy (major actions) of each procedure in the E-0 series. EPE0005			X	X	X
6	Discuss the basis for any note, caution or step for each procedure in the E-0 series. EPE0006			X	X	X
7	Describe the immediate actions and include the RNO when appropriate. EPE0007			X	X	X
8	Describe the actions included on the E-0 Foldout page and the basis for these actions. EPE0008			X	X	X
9	Given the Foldout page, other than E-0, discuss the actions included and the basis for these actions. EPE0009			X	X	X

STEP 17 Transfer steam dumps to pressure control mode

PURPOSE: To transfer condenser steam dump control from T-ave mode to pressure control mode.

BASIS: A transfer to the pressure control mode is made because the pressure control mode is more flexible and can be more precise than the T-ave mode in controlling NC temperature at this time.

If the condenser is not available (e.g., due to increased condenser backpressure or loss of circulating water pumps) or MSIVs closed, steam release must be carried out by use of S/G PORVs.

STEP ~~18~~ 19 Check NC pump status - AT LEAST ONE ON.

PURPOSE: To inform the operator of a preferred order for starting the NC pumps.

To establish forced coolant flow, if possible, or to ensure natural circulation flow if NC pumps cannot be started.

BASIS: There are Pzr connections to one NC hot leg via the surge line and to two NC cold legs via the spray lines. Single pump operation in the loop that provides the best spray is preferred to obtain normal Pzr spray capability.

Forced coolant flow is the preferred mode of operation to allow for normal NC cooldown and to provide Pzr spray. NC pumps are normally started in a preferred order to obtain normal Pzr spray flow capability as soon as possible.

If NC pumps cannot be started, then natural circulation flow should be confirmed using Enclosure 2 to ensure adequate NC heat removal. If natural circulation is not present, steam dump should be increased to remove heat from the primary system and establish natural circulation.

Preference should be given to running 1B NC Pump first, the 1A NC Pump to provide Pzr spray flow.

5.5. ES-0.1 Enclosures

Enclosure 1 - Foldout

1. S/I Actuation Criteria

- **IF** NC subcooling based on core exit T/Cs is less than 0°F **OR** Pzr level cannot be maintained greater than 4%, **THEN** initiate S/I and **GO TO** EP/1/A/5000/E-0 (Reactor Trip or Safety Injection).
- IF S/I actuation occurs, **THEN GO TO** EP/1/A/5000/E-0 (Reactor Trip or Safety Injection).

BASIS: The actions in ES-0.1 stabilize the plant following a reactor trip without S/I in operation. If S/I is required (based on the inability to maintain Pzr level or NC subcooling) or occurs, then the appropriate actions are in E-0, Reactor Trip or Safety Injection.

2. CA Suction Sources (Same as E-0)

Enclosure 2 – Natural Circulation Parameters

1. The following conditions support or indicate natural circulation flow:

- NC Subcooling - GREATER THAN 0°F
- S/G pressures - STABLE OR GOING DOWN
- NC T-hots - STABLE OR GOING DOWN
- Core Exit T/Cs - STABLE OR GOING DOWN
- NC T-colds - AT SATURATION TEMPERATURE FOR S/G PRESSURE (WITHIN THE LIMITS OF THE GRAPH PROVIDED)

BASIS: These parameters are indicative of natural circulation flow.

2. IF natural circulation flow is not established, THEN raise dumping steam to establish Natural Circulation flow.

BASIS: By increasing steam demand, more steam is drawn from the S/Gs. This results in decreased temperature (increased density) in the cold legs. This denser/colder water flows down the cold leg to the core while the warmer (less dense) water in the hot leg flows up to the S/Gs. This density difference is the driving force for natural circulation.

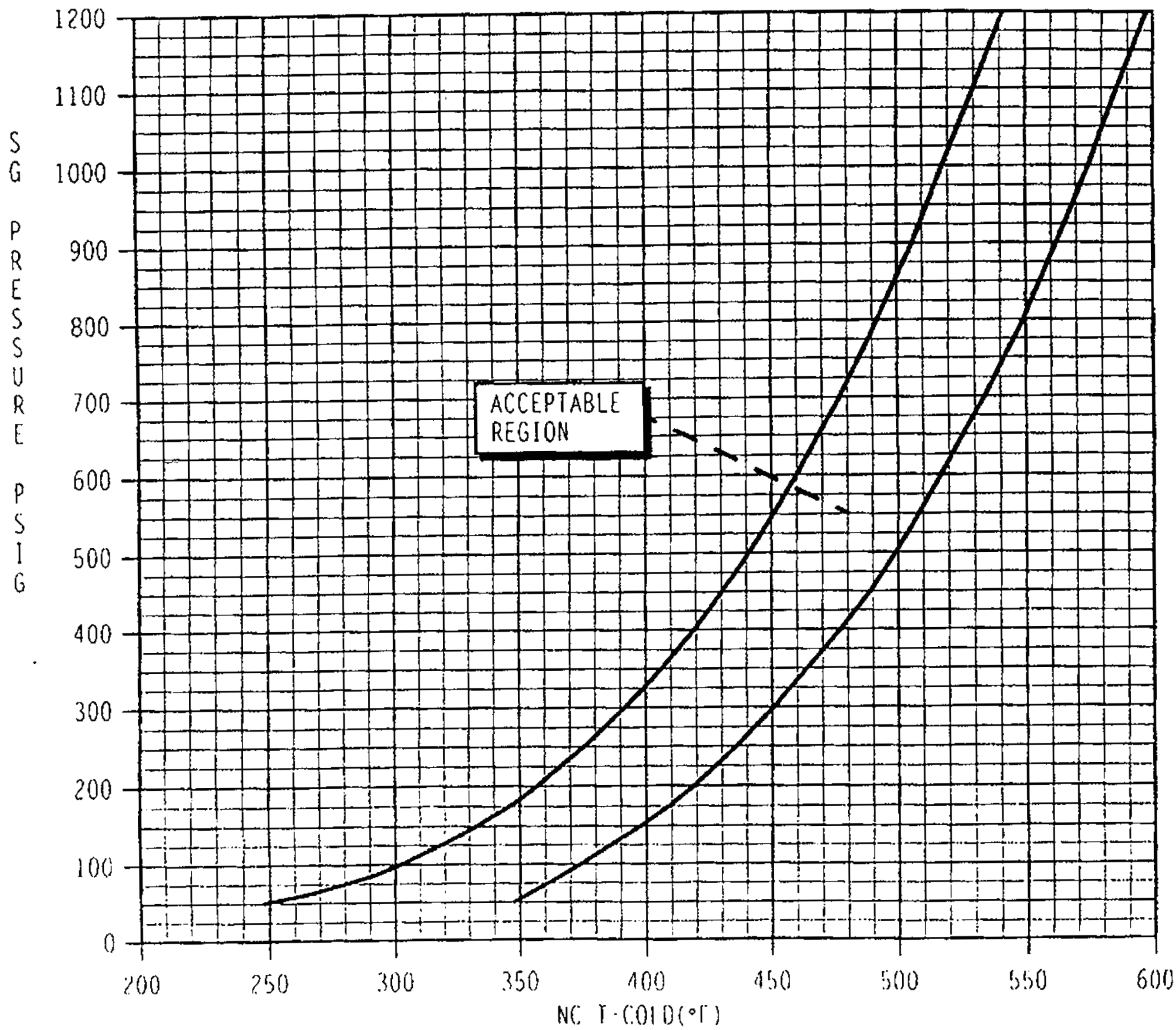
The graph plots S/G pressure versus cold leg temperature. The cold legs should be at saturation temperature for S/G pressure. Two curves are plotted. One curve is saturation plus instrument inaccuracies and the other curve is saturation minus instrument inaccuracies. The acceptable operating region is between the curves, or in other words, saturation ± instrument inaccuracies.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 19. **Check NC pump status - AT LEAST ONE ON.**	**Perform the following:** NOTE Preference should be given to running 1B NC Pump first, then 1A NC Pump to provide Pzr spray capability. __ a. Start one NC pump PER OP/1/A/6150/002 A (Reactor Coolant Pump Operation),Enclosure 4.1 (Startup and Operation). NOTE If steam dumps are available, and were placed in steam pressure mode in Step 18, then a slight heatup may be occurring (possibly to 10° F above no-load T-Ave, as steam pressure rises to 1092 PSIG). This is expected, and manual dumping of steam in Enclosure 2 (Natural Circulation Parameters) is not required unless temperature does not stabilize as expected. __ b. Ensure Natural Circulation flow PER Enclosure 2 (Natural Circulation Parameters), until an NC pump can be started.

1. The following conditions support or indicate natural circulation flow:

   - NC subcooling - GREATER THAN 0°F
   - S/G pressures - STABLE OR GOING DOWN
   - NC T-Hots - STABLE OR GOING DOWN
   - Core exit T/Cs - STABLE OR GOING DOWN
   - 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 raise dumping steam to establish Natural Circulation flow.



1 Pt

Unit 2 was operating at 100% when a complete loss of offsite power (LOOP) occurred. All systems were operable and in a normal alignment.

Which one of the following containment ventilation systems will have all operating fans/air handling units stopped after 5 minutes without any offsite power?

A. VU ventilation units

B. Pressurizer booster fans

C. Pipe tunnel booster fans

D. Steam generator booster fans

Bank Question: 957.1 ***Answer: D***

1 Pt

Unit 2 was operating at 100% when a complete loss of offsite power (LOOP) occurred. All systems were operable and in a normal alignment.

Which one of the following containment ventilation systems will have all operating fans/air handling units stopped after 5 minutes without any offsite power?

A. VU ventilation units

B. Pressurizer booster fans

C. Pipe tunnel booster fans

D. Steam generator booster fans

Distracter Analysis:

A. **Incorrect**: VU AHUs and return air fans will start on a LOOP/blackout – they have an emergency power supply.
Plausible: They will not start in a safety injection signal

B. **Incorrect**: Pressurizer booster fans will start on a LOOP from the B/O sequencer – they have an emergency power supply.
Plausible: If the candidate confuses the emergency power supply for the pressurizer booster fans with the steam generator booster fans

C. **Incorrect**: Pipe tunnel booster fans will start on a LOOP from the B/O sequencer – they have an emergency power supply.
Plausible: They will not start in a safety injection signal

D. **Correct**: Steam generator booster fans do not restart on a LOOP - B/O signal – they do not have an emergency power supply

Level: RO

KA: SYS 022 K2.01 (3.0*/3.1)

Lesson Plan Objective: CNT-VUL LPRO 5

Source: Bank

Level of Knowledge: memory

References:
1. OP-MC-CNT-VUL pages 35, 39

022 Containment Cooling System (CCS)

TASK:

Perform lineups of the CCS
Fill and vent the CCS
Start the CCS
Monitor the CCS (air and water sides)
What if lower containment temperature cannot be controlled within specified limits?
Shut down the CCS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	SWS/cooling system	3.5	3.7
K1.02	SEC/remote monitoring systems	3.7?	3.5?
K1.03	Auxiliary steam	2.4*	2.3*
K1.04	Chilled water	2.9*	2.9*
K2	**Knowledge of power supplies to the following:** (CFR: 41.7)		
K2.01	Containment cooling fans	3.0*	3.1
K2.02	Chillers	2.5*	2.4*
K2.03	MOVs	2.3*	2.3
K3	**Knowledge of the effect that a loss or malfunction of the CCS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment equipment subject to damage by high or low temperature, humidity, and pressure	2.9*	3.2*
K3.02	Containment instrumentation readings	3.0	3.3
K3.03	Electrical insulation	1.7	2.1
K4	**Knowledge of CCS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Cooling of containment penetrations	2.5*	3.0*
K4.02	Correlation of fan speed and flowpath changes with containment pressure	3.1*	3.4*
K4.03	Automatic containment isolation	3.6*	4.0
K4.04	Cooling of control rod drive motors	2.8	3.1
K4.05	Containment cooling after LOCA destroys ventilation ducts	2.6*	2.7
K4.06	Containment pipe chase cooling	2.1*	2.4*

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2.0	2.0	2.0	2.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1.	State the purpose of the following Containment Ventilation Subsystems • Upper Containment Ventilation System. • Lower Containment Ventilation System. • Control Rod Drive Ventilation System. • Incore Instrumentation Room Ventilation System.	X	X	X	X	
2.	State the source of cooling water to the upper and lower containment ventilation units.	X	X	X	X	
3.	Discuss the operation of the Containment Ventilation Systems (VU,VL,VR,VT) including the components operating during normal unit operations.	X	X	X	X	
4.	State the automatic actions that occur to the Lower Containment Ventilation units if containment pressure increases to 0.5 psig.	X	X	X	X	X
5.	Discuss the automatic alignment of the Containment Ventilation Systems (VU, VL, VR, VT) following a: • Safety Injection signal. • Blackout signal.		X	X	X	X
6.	Concerning the "Reset/Retransfer" switches: • List the units having a "Reset/Retransfer" switch. • Discuss the purpose and operation of the switch.	X	X	X	X	X
7.	Describe the local controls and indications associated with the Containment Ventilation Systems.	X	X	X	X	X
8.	Describe the Control Room controls and indications associated with the Containment Ventilation Systems.		X	X	X	X

Objective #9

3.1.1. Limits and Precautions

OP/1/A/6450/001, Containment Ventilation Systems.

2.1 Refer to Tech Specs, Containment Systems Air Temperature.

Basis: To ensure Tech Specs are not violated.

2.2 All VL Units should be operated at the same speed.

Basis: Mixed speed would cause inadequate flows for fans in slow speed.

2.3 Do not start VL Units in Hi speed.

Basis: Starting in slow speed and then shifting to high speed reduces wear and tear on the fans and motors.

2.4 Any VL AHU should be secured if a motor bearing temperature reaches the OAC alarm setpoint.

Basis: This is done to prevent further degradation of the AHU.

2.5 Only one Pipe Tunnel Booster Fan should be operated at a time. The operating fan will not allow the idle fans discharge damper to open.

Basis: This prevents operating the second fan with no discharge path which could lead to overheating and possible failure of the fan.

- It is permissible to operate the Pipe Tunnel Booster Fans in speeds different from the VL AHUs.

  Basis: Mixed speed is not a problem

- It is desirable to operate the Pipe Tunnel Booster Fan in "HIGH" speed in order to provide adequate cooling for DRPI Cabinets.

  Basis: Minimum cooling requirements.

3.2. Abnormal and Emergency Operation

Objective #5

3.2.1 Blackout event:

During a Blackout, the B/O Sequencer will start the VL Units in low speed regardless of their switch position. If the units were in off or low speed prior to the event, they will remain in low speed. If the VL units were in high speed, they will automatically shift to high speed following the low speed start. This could result in mixed speed operation which is undesirable. VL fan speeds can be changed under these conditions, but the fans can not be stopped until sequencer is reset.

3.2.2 Safety Injection (S_S)

Objective #5

The VL units and Pressurizer Booster Fans are shunt tripped off their normal supply when an S_S signal is initiated. The Pressurizer Booster Fans swap to their emergency power supply, if available, and the selected fan will start. The VL units are transferred to the emergency power source, if available, and will start in high speed regardless of their switch position. When powered from this emergency power, control from the HVAC is disabled. (Refer to PIP #1-M97-1861) Once transferred, manual re-transfer to the normal source is required.

The VR units are shunt tripped from essential power when an S_S is initiated. If unit load center power is available, a transfer switch will automatically align to the emergency power source and start all units (regardless of their switch position). Once transferred, manual re-transfer to the normal source is required.

The VT units are shunt tripped from essential power when an S_S is initiated. If unit load center power is available, a transfer switch will automatically align to the emergency power source and start all units (regardless of switch position). The fans can not be stopped under these conditions, however, normal or max cool can be selected as desired during this event. Once transferred, manual re-transfer to the normal source is required.

The VU units, Return Air Fans, and the Pipe Tunnel Booster Fans are shunt tripped off on the S_S signal. Control power and indication is lost to all these fans when the shunt trip opens the respective breakers.

The Steam Generator Booster Fans do not receive a S_S signal nor are they powered from an essential bus, therefore they continue to run as they were prior to the Safety Injection.

1 Pt Unit 2 was at 75% R.T.P. when a loss of condenser vacuum occurred. Given the following conditions:

- Rods are in automatic
- The steam dump select switch is selected to 'Tave' mode
- Condenser vacuum is slowly decreasing
- No component or instrument failures occurred
- No operator action taken

Which one of the following sequences best describes the actuation of the control rods to this event?

A. Control rods move in due to decreased condenser back pressure

B. Control rods move out due to decreased condenser back pressure

C. Control rods move in due to increased condenser back pressure

D. Control rods move out due to increased condenser back pressure

---

Bank Question: 963.1 ***Answer: D***

1 Pt Unit 2 was at 75% R.T.P. when a loss of condenser vacuum occurred. Given the following conditions:

- Rods are in automatic
- The steam dump select switch is selected to 'Tave' mode
- Condenser vacuum is slowly decreasing
- No component or instrument failures occurred
- No operator action taken

Which one of the following sequences best describes the actuation of the control rods to this event?

A. Control rods move in due to decreased condenser back pressure

B. Control rods move out due to decreased condenser back pressure

C. Control rods move in due to increased condenser back pressure

D. Control rods move out due to increased condenser back pressure

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Distracter Analysis:

A. Incorrect:
Plausible:

B. Incorrect: -
Plausible:.

C. Incorrect:
Plausible: -

D. Correct

Level: RO

KA: APE 000051 AA1.04 (2.5*/2.5*)

Lesson Plan Objective: OP-MC-STM-IDE Obj. 9

Source: Bank

Level of Knowledge: Comprehension

References:
1.OP-MC-STM-IDE pages 17-33 (odd only)

APE: 051 Loss of Condenser Vacuum

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Condenser Vacuum: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Relationship of condenser vacuum to circulating water, flow rate, and temperature	2.4*	2.4*
AK2.	**Knowledge of the interrelations between the Loss of Condenser Vacuum and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	1.6	1.6
AK2.02	Controllers and positioners	1.6	1.6
AK2.03	Pumps	1.6	1.5
AK2.04	Motors	1.6	1.5
AK2.05	Heat exchangers and condensers	1.7*	1.6
AK2.06	Sensors and detectors	1.6	1.5
AK2.07	Steam jet air ejectors and vacuum pumps	1.9*	1.7
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Condenser Vacuum: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Loss of steam dump capability upon loss of condenser vacuum	2.8*	3.1*
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Condenser Vacuum: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Condenser vacuum pump	1.9*	1.9
AA1.02	Condenser vacuum	2.3*	2.2*
AA1.03	Gland steam header pressure	2.0*	1.9
AA1.04	Rod position	2.5*	2.5*
AA1.05	Turbine header pressure	1.8*	1.7
AA1.06	Turbine throttle and governor valves position	2.0*	2.0
AA1.07	Feedwater flow	2.2*	2.2*
AA1.08	Air ejector steam supply	2.3*	2.1
AA1.09	Circulating water system	2.1*	2.0

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
NA	2	3	3	2

OBJECTIVES

No.	Objective	NLO	NLOR	LPRO	LPSO	LOR
1.	State the purpose of the Steam Dump Control System		X	X	X	
2.	List the banks of steam dumps and the number of valves in each bank.		X	X	X	
3.	Sketch the valve arrangement per Drawing 7.3, Steam Dump Valve Pneumatic Control.		X	X	X	
4.	Describe the effect of a failed or stuck open steam dump valve on primary plant parameters, and determine any compensatory Operator action			X	X	X
5.	Explain the operation of the system in steam pressure, plant trip and load rejection mode. Include the fast response "trip open bistables". Include the input signals for each control.		X	X	X	X
6.	Describe all control and permissive interlocks (C9, C7A, C7B, P4, P12) required for various modes of operation.		X	X	X	X
7.	DELETE					
8.	Describe all selector switches and their functions for various modes of operation		X	X	X	X
9.	Describe the effect on the system resulting from a failure of each input to the system.		X	X	X	X
10.	Explain what occurs in the IDE System during start-up, power operation, shutdown and cooldown of the plant. Include all manual functions required to be performed by the operator during these modes.			X	X	X
11.	Relate % steam dump demand indication to corresponding steam dump valve operation			X	X	X

2.2. Pneumatic Dump Valve Control - Atmospheric Dump Valves (Unit 2)

Objective #3

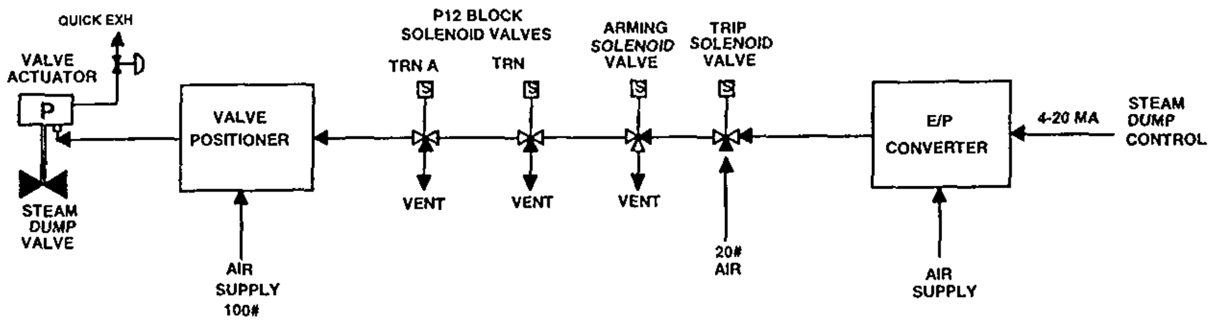

Figure 3, ATMOSPHERIC DUMP VALVE PNEUMATIC CONTROL 3/15/95

The Atmospheric Dump Valves use pneumatic valve actuators. On loss of air supply, the dump valves will close. The Steam dump control system supplies a 4-20ma electrical signal, which is converted to a 3-15 psig pneumatic control signal by an E/P converter (4ma = 3 psig = dump valve closed). The valve positioner provides the valve actuating air pressure and volume to position and maintain the valve position proportional to control signal.

NOTE: The valve positioner is between the P-12 solenoid valves and the actuator on the Atmospheric Dump Valves. This difference from the setup on the Condenser Dump Valves is required because the valve actuators are piston operated rather than diaphragm actuators used on the condenser dumps.

The three solenoid valves, P-12 Block (Train A&B) and the Arming solenoid, must be energized to allow the E/P to input the valve positioner to open steam dump valve. A trip solenoid valve, when energized, aids in faster valve response time to reach the full open position. When de-energized, control air is supplied to the positioner to modulate the required amount of air to open the valve. When energized, 20 psig air is sent directly to the valve positioner. 15 psig control air equates to a full open demand signal. The E/P converter is bypassed. Also, a Quick Exhaust Valve on the actuator opens. This results in the dump valve reaching the full open position faster. The trip solenoid valves for a particular bank of valves are energized by trip bistables when the error signal used to modulate the valves exceeds the value corresponding to a full open demand.

Limit switches provide control room indications when individual dump valves are fully open or closed. Both lights will be lit when valve is modulating.

2.3. Steam Dump Demand Signal

Refer to Figure 4 below.

2.3.1. The dump valve 'modulate open' (demand) signal is developed from one of three controllers:

- Load Rejection Controller

  Output proportional to $T_{avg} - T_{ref}$
- Plant Trip Controller

  Output proportional to $T_{avg} - T_{no\ load}$
- Steam Header Pressure Controller

  Output proportional to (Steam Header Pressure – M/A Setpoint) in Auto M/A station output in manual

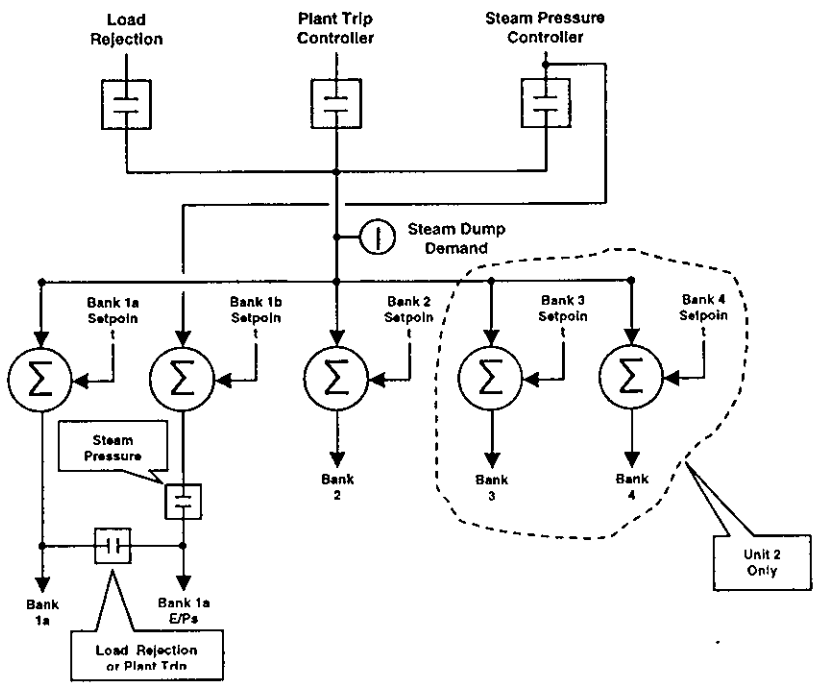

Figure 4, STEAM DUMP CONTROLLER MODES 1/27/03

Objective #11

2.3.2. The control (demand) signal used is selected according to the controller (load rejection, etc.) in use. These controllers will be covered in later sections. A control board indicator displays 0 - 100% Steam Dump Demand. For Unit 1, 100% Steam Dump Demand is equivalent to 40% of design full steam load. (At 45% demand, Banks 1 & 2 will be full open.) For Unit 2, 100% Steam Dump Demand is equivalent to 85% of design full load steam flow which is the total

(100%) capacity of the four steam dump banks. (40% for the condenser Banks 1 & 2 and 45% for the atmosphere Banks 3 & 4).

2.3.3. The steam dump demand signal is sent to summing amplifiers, one per bank, which compare it to a setpoint. The setpoint for each bank is the value of steam dump demand at which the associated Bank of valves will start to open. The output of the summer is the difference between the Steam dump demand and the setpoint, multiplied by the gain. The gain of the summing amplifier is set to provide a 20 ma output to the E/P converter when the steam dump demand reaches the value where the associated bank should be fully open.

Refer to the table below and Fig. 5 which depict the Steam dump bank response to steam dump demand.

Notice that Bank 1 will modulate from closed to full open between 0% to 25% steam dump demand. Bank 2 will begin to open when steam dump demand exceeds 25% and will be open at 45%. Bank 3 will begin to open when bank 2 is open and so forth until all are open at 100% at which time the total steam flow would be 85% of the Steam flow at 100% power. (Banks 3 & 4 only available on Unit 2.)

The effect is for the banks to modulate open in sequence proportional to the steam dump demand.

Notice also that Bank 1 valves are sequenced differently depending on the controller in effect. With the Load Rejection or Plant Trip controller in effect, the one summer with the 0 set point drives all 5 Bank 1 Valves. When the steam pressure controller is in effect, Bank 1a is driven by one summer while bank 1b is driven by second which begins opening at a steam dump demand of 5.5%. In either case all bank 1 valves will be open at 25% steam dump demand.

Bank	% Steam Dump Demand	% Full Load Steam Flow
1+	0-25	0-21
1a*	0-25	0-21
1b*	5.5-25	
2	25-45	21-40
3	45-72	40-64
4	72-100	64-85

NOTE: Setpoints shown above are approximate values.
+ Bank 1 for Load Rejection & Plant Trip modes
* Bank 1 split for Steam Pressure mode

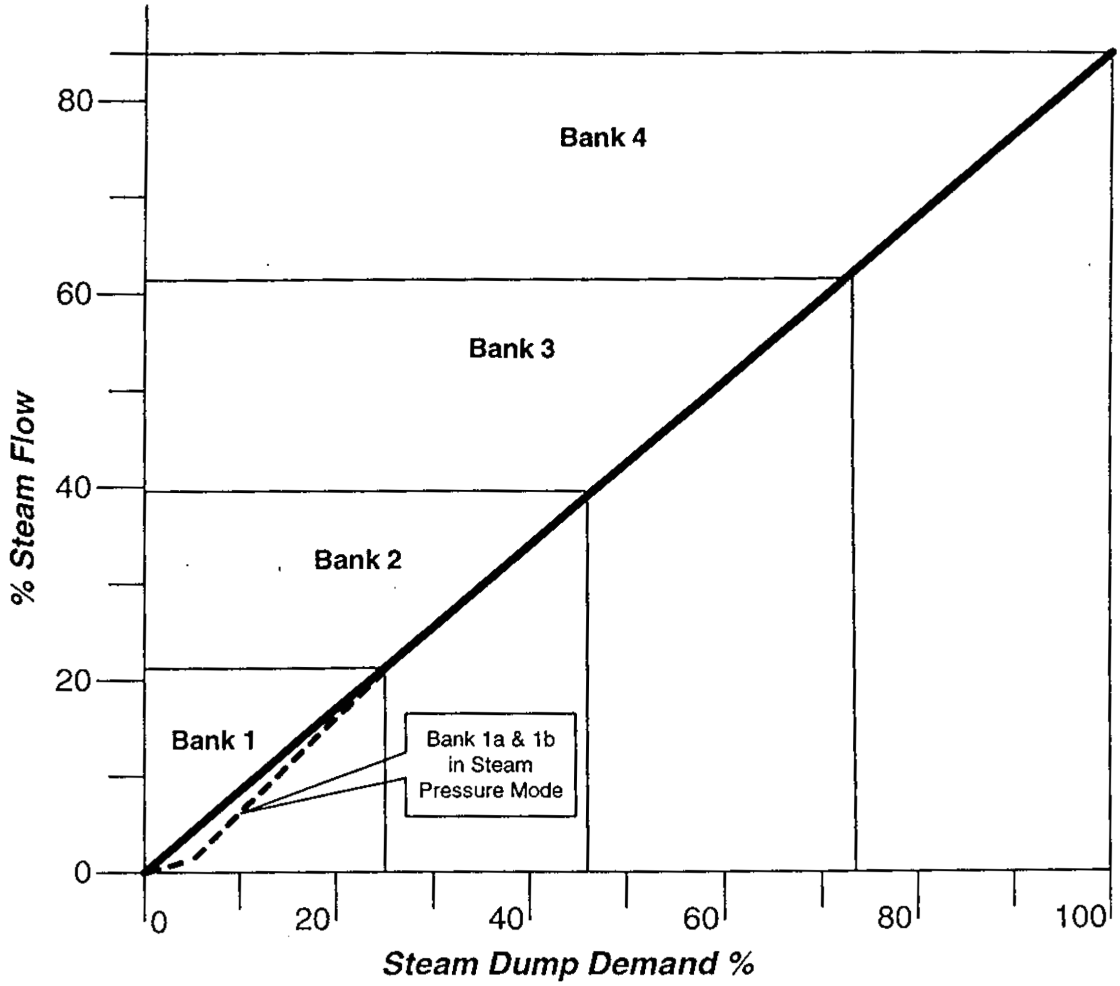

Figure 5, Bank Sequencing with Steam Dump Demand 3/19/02

2.3.4. For steam dump to occur in any of the three control modes, three conditions must be satisfied.

- There Must be a Steam Dump Demand
- The Dumps must be Armed (Arming Solenoids energized)
- The P-12 interlock must be reset or defeated

In the following sections we will discuss each of the three controllers to understand:

- The conditions required for the controller to be in effect
- How the steam dump demand signal is developed
- Which banks are armed and the conditions required to arm them.

2.4. Load Rejection Steam Dump Controller

2.4.1. The purpose of the controller is to prevent a large increase in reactor coolant temperature following a large, sudden load reduction.

2.4.2. The load rejection mode of control is "in effect" when both of the following conditions exist: (refer to Fig. 7.2 or 7.2a)

Objective #6,8

- Steam Dump Select Switch is in the 'T AVG' position
- The reactor is not tripped (no P-4 signal from Train B SSPS)

If the logic above is satisfied the output of the load rejection controller will be the "Steam Dump Demand" signal which is sent to the summers. Bank 1a & 1b will receive the same demand signal and will move together as one bank. This controller will be in effect during normal steady state power operation, however the dumps will not be "Armed" and no steam dump will occur even If there is an output from the controller.

Objective #5

2.4.3. The demand signal (output) from the load rejection controller is generated from a comparison of auctioneered Hi T_{avg} and T_{ref}.

The auctioneered Hi T_{avg} signal comes from the Reactor Control System. In the Reactor Control System, the hot and cold leg narrow range RTD temperature measurements are averaged for each loop. The highest loop T_{avg} is selected (auctioneered Hi) and is sent to the Steam Dump Control System. A compensation circuit compensates for lags in the plant thermal response and in valve positioning.

The T_{ref} signal also comes from the Reactor Control System where it is derived from the turbine first stage impulse chamber pressure (CH-1) which is proportional to turbine load. T_{ref} represents the T_{avg} setpoint for a given turbine load. Refer to Figure 6 below.

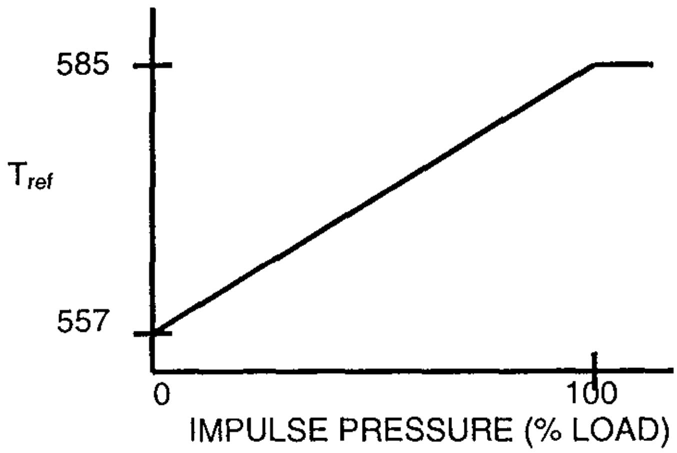

Figure 6, T_{ref} Signal Generation Based on Turbine Load 5/5/98

The load rejection controller output signal (Steam Dump Demand) is derived from T_{avg} - T_{ref}. Refer to Figure 7 below. Notice that the controller does not develop an output until the T_{avg} - T_{ref} reaches 3 °F. The 3 °F deadband allows the Reactor Control System to restore T_{avg} to T_{ref} following small transients without Steam Dump operation. At (T_{avg} - T_{ref}) of 8.8 °F the Steam Dump Demand will be 25% which is the value required to modulate Bank 1 fully open, 14.3 will demand Bank 2 to open fully and so forth.

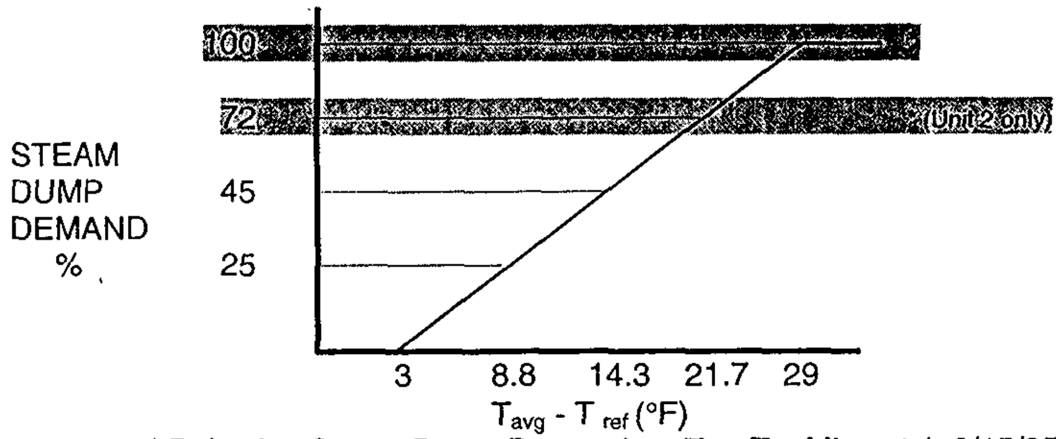

Figure 7, Load Rejection Steam Dump Demand on T_{avg}-T_{ref} Mismatch 3/15/95

2.4.4 The load rejection trip bistables are used to provide a separate dump valve trip open signal by energizing the trip solenoid valves for its associated bank when the (Tavg-Tref) signal reaches the value where the bank should be fully open. This provides faster response on rapidly increasing demand signals. The setpoints are:

Bank	T_{avg} - T_{ref} (°F)	
1	8.8	
2	14.3	
3	21.7	Unit 2
4	29	only

Trip bistables and valves are energized to actuate; thus, a signal failure will prevent tripping (modulation may still be available).

2.4.5 Arming the steam dumps in the load rejection mode.

Objective #6

To arm the Condenser Dump Valves in the load rejection mode, T-Avg mode must be selected on the Steam Dump select switch, the condenser available interlock (C-9) must be satisfied, and the loss of load interlock (C-7A) must be satisfied. When all are satisfied, control board status light COND STM DUMP (Unit 1) MODULATION and ATMOS/COND STM DUMP MODULATION (Unit 2) will illuminate.

2.5.4. Arming the steam dumps in the plant trip mode.

Following a reactor trip Auctioneered Hi T_{avg} will be greater than $T_{no\text{-}load}$ and a *steam dump demand signal proportional to the error* will be generated. The electrical demand signal will be converted to a control air signal in the E/P converter which will drive the valve positioner. The resultant air supply will reach the valve actuator provided the valve is 'armed' (arming solenoid valve energized).

Only the two condenser dump banks are armed in the plant trip mode. To do this, the condenser *available interlock (C-9) has to be satisfied*, and Train 'A' P-4 reactor trip signal needs to be present. Any time a Train 'A' P-4 signal is present, the atmospheric steam dump valves will **NOT** be armed (Unit 2).

2.5.5 Valve trip bistables.

The trip bistables are used to provide a separate dump valve trip open signal by energizing the trip solenoid valves for its associated bank when the (T_{avg}-$T_{No\ Load}$) signal reaches the value where the bank should be fully open. This provides faster response on rapidly increasing demand signals. The setpoints are:

Bank	T_{AVG} - T_{NoLoad}
1	16°
2	29°

Only Banks 1&2 are required since the plant trip controller only operates the two banks of condenser dumps, unlike the load rejection controller that potentially operates all four banks (Unit 2). Any of the bank trip signals are indicated by the single status panel window, 'ATMOS/COND STM DUMP TRIP OPEN' (Unit 2). COND STM DUMP TRIP OPEN (Unit 1).

2.6. Steam Header Pressure Controller

2.6.1. The Steam Header Pressure Mode is used to control reactor coolant temperature when the unit is below 15% power, during plant startup and shutdown and to cooldown the reactor coolant system to cold shutdown..

The condenser dump valves, Banks 1&2, are modulated in response to the steam dump demand output from the steam pressure controller. The steam dump demand is a function of Pressure Error between Steam Header Pressure and an operator determined setpoint or manual operator input. The atmospheric dump valves are not required and are therefore blocked by their arming solenoid valves being deenergized.

2.5. Plant Trip Controller

2.5.1. The purpose of the Plant Trip Controller is to reduce T_{avg} to the no-load value of 557 °F following a reactor trip.

2.5.2. The Plant Trip Controller will be in effect when both of the following conditions exist:

Objective #6,8

- STEAM DUMP SELECT switch is in the 'T AVG' position
- The reactor has tripped (P-4 signal from Train B SSPS)

Objective #5

2.5.3. The Plant Trip Controller output signal (Steam Dump Demand) is derived from a comparison of Auctioneered Hi T_{avg} to $T_{no\text{-}load}$. Auctioneered Hi T_{avg} was discussed in section 2.4.3.

$T_{no\text{-}load}$ is a fixed setpoint which is set for the no load reactor coolant temperature (557 °F).

The plant trip steam dump demand signal is equivalent to T_{avg} - $T_{no\text{-}load}$. There is no deadband. Refer to Figure 8 below.

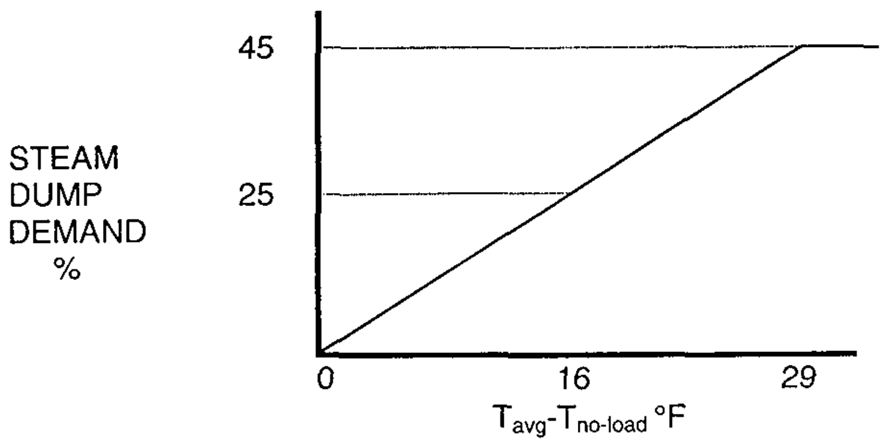

Figure 8, Plant Trip Steam Dump Demand on T_{avg} -$T_{no\text{-}load}$ Mismatch 3/15/95

NOTE: Figure 7 and 8 are available on the OAC (SB graphic)

Following a reactor (plant) trip, steam dump capacity requirement is only that necessary to maintain steam pressure below the steam generator safety valve setpoint. This is met by the 40% condenser dump capacity. Atmospheric dump valves are not armed since they are not required in this mode (Unit 2).

1 Pt Unit 1 is responding to a LOCA from a trip at full power. Given the following events and conditions:

- A safety injection occurred at 0200.
- FWST level reaches 33 in. at 0246.
- S/I, Sequencers, and Containment Spray have been reset for both trains.
- The 1B NS pump has been successfully swapped to the containment sump.
- 1NS-18A (A NS Pump Suct From Cont Sump) will not open.

Which one of the following is the reason 1NS-18A will not open?

A. **1NS-43A (*A ND to NS Containment Outside Isol*) is CLOSED**

B. **"NS SYS CPCS TRAIN A INHIBIT" light LIT**

C. **1NI-185A (*RB Sump to Train A ND & NS*) is CLOSED**

D. **1NS-43A (*A ND to NS Containment Outside Isol*) is OPEN**

Bank Question: 975.1 ***Answer: C***

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1 Pt Unit 1 is responding to a LOCA from a trip at full power. Given the following events and conditions:

- A safety injection occurred at 0200.
- FWST level reaches 33 in. at 0246.
- S/I, Sequencers, and Containment Spray have been reset for both trains.
- The 1B NS pump has been successfully swapped to the containment sump.
- 1NS-18A (A NS Pump Suct From Cont Sump) will not open.

Which one of the following is the reason 1NS-18A will not open?

A. 1NS-43A (*A ND to NS Containment Outside Isol*) is CLOSED

B. "NS SYS CPCS TRAIN A INHIBIT" light LIT

C. 1NI-185A (*RB Sump to Train A ND & NS*) is CLOSED

D. 1NS-43A (*A ND to NS Containment Outside Isol*) is OPEN

Distracter Analysis:

A. Incorrect:.
B. Incorrect
Plausible:
C. Correct:.
Plausible:.
D. Incorrect:.
Plausible:.

Level: RO

Source: BANK

KA: SYS 026 K4.07(3.8*/4.1*)

Lesson Plan Objective: OP-MC-ECC-NI Obj. 8 ,

Source: BANK

Level of knowledge: comprehension

References:
1. OP-MC-ECC-NS page 17

2. EP/1A/5000/ES-1.3 page 8
3. OP-MC-ECC-NI page 21

SYSTEM:	**026 Containment Spray System (CSS)**		
K4	**Knowledge of CSS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Source of water for CSS, including recirculation phase after LOCA	4.2	4.3
K4.02	Neutralized boric acid to reduce corrosion and remove inorganic fission product iodine from steam (NAOH) in containment spray	3.1	3.6
K4.03	Not Used	N/A	N/A
K4.04	Reduction of temperature and pressure in containment after a LOCA by condensing steam, to reduce radiological hazard, and protect equipment from corrosion damage (spray)	3.7	4.1
K4.05	Prevention of material from clogging nozzles during recirculation	2.8	3.3
K4.06	Iodine scavenging via the CSS	2.8	3.2*
K4.07	Adequate level in containment sump for suction (interlock)	3.8*	4.1*
K4.08	Automatic swapover to containment sump suction for recirculation phase after LOCA (RWST low-low level alarm)	4.1*	4.3*
K4.09	Prevention of path for escape of radioactivity from containment to the outside (interlock on RWST isolation after swapover) .	3.7*	4.1*
K5	**Knowledge of operational implications of the following concepts as they apply to the CSS:** (CFR: 41.5 / 45.7)		
K5.01	Water chemistry relationship to corrosion control	2.2	2.9*
K5.02	Principle of eductor flow	1.9*	2.2*
K5.03	Stratification of liquids: concentrated NaOH solution has a higher specific gravity than weak boric acid solution, so they must be vigorously mixed to make an effective spray	2.0	2.5*
K5.04	Chemistry control	2.0	2.7
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the CSS:** (CFR: 41.7 / 45.7)		
K6.01	Valves	2.0	2.1
K6.02	Pumps	2.4*	2.4*
K6.03	Sensors and detectors	2.2*	2.3
K6.04	Controllers and positioners	2.0	2.1
K6.05	Heat exchangers	2.1	2.2*

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.0	1.0	1.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Safety Injection System. ECCNI001	X	X	X	X	
2	Sketch the system drawing (Fig 7.1) including all major components and valves, show all tie-ins to associated systems (ND, NV, NC). ECCNI002	X				
3	Sketch the system drawing (Fig 7.2) including all major components and valves, show all tie-ins to associated systems. ECCNI003		X	X	X	
4	List the pressure at which the NI pumps will begin injecting water into the NC System and state the NI pumps design flowrate. ECCNI004	X	X	X	X	
5	State the power supplies for the NI pumps. ECCNI005	X	X	X	X	
6	List all protection signals that will automatically initiate Safety Injection. ECCNI006	X				
7	Describe the signals, setpoints, permissives, and logic required to initiate and reset Safety Injection. ECCNI007		X	X	X	X
8	Describe the interlocks associated with the NI System. ECCNI008		X	X	X	X

One valve per train (NS1 & 18) isolates the Containment Sump. These valves are normally aligned closed and would be opened to align the system for recirculation when the FWST reaches the low-low level setpoint (33").

An interlock prevents opening a Containment Sump Isolation Valve (NS1 or NS18) unless the Containment Sump Isolation Valve (NI184 or NI185) is open and the FWST Suction Valve (NS3 or NS20) is closed.

2.2. Containment Spray Pumps

Two identical containment spray pumps are installed in the Containment Spray System. Each pump is sized to deliver sufficient spray flow to the containment atmosphere through the spray heat exchangers, to meet containment cooling requirements, when supplemented with partial flow from a residual heat removal pump. The pumps deliver 3400 gpm to the spray headers. Pump discharge pressure is ≈200 psig.

Objective #12

The two containment spray pumps are of the vertical single stage, end-suction, side discharge centrifugal type driven by electric motors. The 400 hp, 4160 VAC, 60 cycle motors, are powered from the ETA/ETB Busses. The NS pumps have a start/stop pushbutton in the Control Room for manual operation.

The design head of the pumps is sufficient to continue operation at rated capacity with a minimum level in the Refueling Water Storage Tank against a head equivalent to the sum of the design pressure of the Containment, the head to the upper-most nozzles, line losses and nozzle pressure losses. Pump motors are direct-coupled and large enough for the maximum power requirement of the pump. Materials of construction suitable for use in mild boric acid solutions (such as stainless steel or equivalent corrosion resistant material) are used. The Containment Spray System is designed so that adequate net positive suction head (NPSH) is provided to the Containment Spray Pumps.

A flow element, located downstream of each Containment Spray Pump, provides indication of pump flow in the Control Room.

Objective #7

Each pump room has an Air Handling Unit (AHU) to provide a suitable environment for the NS Pump. The AHU starts when the pump starts or a safety injection signal is actuated. Cooling water for the AHU is provided by RN.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
8. (Continued)	
__ e. Check 1A NS Pump - AVAILABLE TO RUN.	__ e. **GO TO** Step 8.g.
f. Align A Train NS to containment sump as follows:	
__ 1) Check 1NI-185A (RB Sump To Train A ND & NS) - OPEN.	__ 1) **GO TO** Step 8.g.
__ 2) Close 1NS-20A (A NS Pump Suct From FWST).	__ 2) **GO TO** Step 8.g.
__ 3) Wait for 1NS-20A to close.	__ 3) **IF** 1NS-20A remains open or intermediate for over 30 seconds, **THEN GO TO** Step 8.g.
__ 4) Open 1NS-18A (A NS Pump Suct From Cont Sump).	__ 4) **GO TO** Step 8.g.
__ 5) Check "NS SYS CPCS TRAIN A INHIBIT" status light (1SI-12) - DARK.	__ 5) **GO TO** Step 8.g.
__ 6) Start 1A NS Pump.	__ 6) **GO TO** Step 8.g.
__ 7) Open 1RN-134A (A NS Hx Inlet Isol).	__ 7) **GO TO** Step 8.g.
__ 8) Throttle open 1RN-137A (A NS Hx Outlet Isol) to establish 3800 GPM to 1A NS Hx.	

Once the Seal-In logic is active, the momentary Reset is no longer required but P-4 must remain. Closing the Reactor Trip Breakers (removing P-4) will break the Seal-In logic and reinstate Automatic Safety Injection.

Objective # 8

2.4.5 Interlocks

- **To Open ND-58A (NV/NI pump Train A isolation): NI-115B and NI-144B or NI-147A must be Closed, and NI-185A must be Open.**
- **To Open NI-136B (ND to NI Train B): NI-115B and NI-144B or NI-147A must be Closed, and NI-184B must be Open.**
- **To Open NI-115B, NI-144B, or NI-147A: ND-58A and NI-136B must be Closed.**
- **To Open NI-184B: NS-1B and ND-4B must be fully Closed.**
- **Valve ND-4B will automatically Close when valve NI-184B is fully Open.**
- **To Open NI-185A: NS-18A and ND-19A must be fully Closed.**
- **Valve ND-19A will automatically Close when valve NI-185A is fully Open.**

1 Pt

Unit 2 is in an outage. All the fuel is in the spent fuel pool. A fuel shuffle is in progress in the spent fuel pool. During the shuffle a fuel assembly is accidentally damaged and 2EMF-42 (Fuel Building Ventilation Radiation Monitor) goes into Trip 2.

Which one of the following describes the effect on spent fuel pool ventilation system as a result of 2EMF-42 in Trip 2?

A. **The VF supply and exhaust fans trip and the filter is placed in the FILTRATION MODE.**

B. **No effect on VF system alignment.**

C. **The VF system is automatically placed in BYPASS MODE and the discharge dampers open and supply dampers close**

D. **The VF system is automatically placed in the FUEL HANDLING MODE OF OPERATION and the supply fans trip.**

Bank Question: 976.1 ***Answer: B***

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1 Pt

Unit 2 is in an outage. All the fuel is in the spent fuel pool. A fuel shuffle is in progress in the spent fuel pool. During the shuffle a fuel assembly is accidentally damaged and 2EMF-42 (Fuel Building Ventilation Radiation Monitor) goes into Trip 2.

Which one of the following describes the effect on spent fuel pool ventilation system as a result of 2EMF-42 in Trip 2?

A. **The VF supply and exhaust fans trip and the filter is placed in the FILTRATION MODE.**

B. **No effect on VF system alignment.**

C. **The VF system is automatically placed in BYPASS MODE and the discharge dampers open and supply dampers close**

D. **The VF system is automatically placed in the FUEL HANDLING MODE OF OPERATION and the supply fans trip.**

Distracter Analysis: When fuel handling is in progress the VF system is placed in Filter Mode as a result no system changes will occur.

A. **Incorrect:.**
Plausible:.
B. **Correct:**
C. **Incorrect:**
Plausible:
D. **Incorrect:**
Plausible:.

Level: RO

KA: SYS 072 A3.01 (2.9*/3.1)

Lesson Plan Objective: OP-MC-FH-VF Obj 8 & 9

Source: BANK

Level of knowledge: Comprehension

References:
1. OP-MC-FH-VF page 17

SYSTEM: 072 Area Radiation Monitoring (ARM) System

K6	**Knowledge of the effect of a loss or malfunction of the following will have on the ARM system:** (CFR: 41.7 / 45.5 to 45.8)		
K6.01	Sensors and detectors	2.1	2.6
K6.02	Valves	1.6	1.9
K/A NO.	ABILITY		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ARM system controls including:** (CFR: 41.5 / 45.5)		
A1.01	Radiation levels	3.4	3.6
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the ARM system- and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 43.3 / 45.13)		
A2.01	Erratic or failed power supply	2.7	2.9
A2.02	Detector failure	2.8	2.9
A2.03	Blown power-supply fuses	2.7	2.9
A3	**Ability to monitor automatic operation of the ARM system, including:** (CFR: 41.7 / 45.5)		
A3.01	Changes in ventilation alignment	2.9*	3.1
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Alarm and interlock setpoint checks and adjustments	3.0*	3.3
A4.02	Major components	2.5*	2.5
A4.03	Check source for operability demonstration	3.1	3.1

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2	2	2	2	2

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Fuel Handling Building Ventilation System.	X	X	X	X	
2	Draw the Fuel Handling Building Ventilation System (including all major components) per Training Drawing 7.1, Fuel Handling Building Ventilation System - Simplified.	X	X	X	X	
3	Describe the Auxiliary Building Panel controls / indications associated with operation of the Fuel Handling Building Ventilation System.	X	X	X	X	X
4	Explain the INTERLOCK(s) associated with operation of the Fuel Handling Building Ventilation System "supply" and "exhaust" fans.	X	X	X	X	X
5	Describe the HVAC Panel controls / indications associated with operation of the Fuel Handling Building Ventilation System.		X	X	X	X
6	State the cooling medium utilized for the Fuel Handling Building Ventilation System.	X	X	X	X	
7	State the heating medium utilized for the Fuel Handling Building Ventilation System.	X	X	X	X	
8	Explain the INTERLOCK associated with EMF-42 and the Fuel Handling Building Ventilation System.	X	X	X	X	X
9	Describe the major difference(s) between "normal system operation" and "fuel handling system operation" of the Fuel Handling Building Ventilation System.	X	X	X	X	X
10	Explain operation of the Fuel Handling Building Ventilation System to maintain "negative pressure" within the Fuel Handling Building.		X	X	X	X
11	Given a Limit and/or Precaution, associated with operation of the Fuel Handling Building Ventilation System, discuss it's basis and applicability.		X	X	X	X

2.2 Filter Train Unit

The Filter Train Unit consists of an Absolute (HEPA) Filter with a Charcoal (Adsorber) Filter. The Absolute Filter is capable of removing 99.9% of particles >.30 microns at a flow rate of 35,000 cfm ± 10% to prevent decreasing the efficiency of the Charcoal (Adsorber) Filter to remove iodine from the air being discharged to the Unit Vent.

Objective # 8

Both Fuel Pool Exhaust Fans operating will provide a "permissive" signal for BYPASS MODE operation (normal system operation). However, a Trip 2 condition on EMF-42, Fuel Building Ventilation Radiation Monitor, will result in automatic termination of BYPASS MODE operation and automatic alignment to the FILTRATION MODE of operation:

- **Filter Train Bypass Damper** (D-5) **CLOSED**
- **Filter Train Inlet Damper** (D-3) **OPEN**
- **Filter Train Outlet Damper** (D-4) **OPEN**

Objective # 5
Objective # 9

Filter Train alignment is controlled from the HVAC Panel within the Control Room. **A two-position (OPEN / CLOSED) selector switch is provided. This switch, VF EXH BYP DMPR CNTRL, is used to align the Filter Train Unit for BYPASS MODE or FILTRATION MODE of operation.**

Placing this switch to the OPEN position will align the Filter Train Unit for BYPASS MODE operation (normal system operation). BYPASS MODE of operation damper alignment:

- **Filter Train Bypass Damper** (D-5) * **OPEN**
- **Filter Train Inlet Damper** (D-3) **CLOSED**
- **Filter Train Outlet Damper** (D-4) **CLOSED**

***Operation of the Exhaust Filter Train Bypass Damper is verified at the HVAC Panel (OPEN / CLOSED status lights).**

Placing this switch to the **CLOSED** position **will align the Filter Train Unit for FILTRATION MODE operation (fuel handling system operation). FILTRATION MODE of operation damper alignment:**

- **Filter Train Bypass Damper** (D-5) * **CLOSED**
- **Filter Train Inlet Damper** (D-3) **OPEN**
- **Filter Train Outlet Damper** (D-4) **OPEN**

***Operation of the Exhaust Filter Train Bypass Damper is verified at the HVAC Panel (OPEN / CLOSED status lights).**

When in the FILTRATION MODE, flow through the charcoal filter must be locally verified by use of the ΔP gage at the filter unit (1MVFPG9180).

A *manually activated* FIRE PROTECTION System, associated with the Filter Train Unit, is provided with *alarms* and *status lights* at the HVAC Panel within the Control Room. Heat generated by the decay of radioactive iodine, trapped within the charcoal beads, would be the most probable cause of such a fire.

1 Pt

Unit 1 is at 100% power when indications are received of a "1B' Reactor Coolant Pump seal malfunction. AP/1/A/5500/08 *(Malfunction of NC Pump)* is implemented.

Which one of the following conditions describes a number two seal failure?

A. **# 1 Seal Leak off flow – GOING DOWN**
NC Pump number 2 Seal Standpipe low level alarm – LIT
NCDT input – STABLE, OR GOING DOWN

B. **# 1 Seal Leak off flow – GOING UP**
NC Pump number 2 Seal Standpipe high level alarm – LIT
NCDT input – STABLE, OR GOING DOWN

C. **# 1 Seal Leak off flow – GOING DOWN**
NC Pump number 2 Seal Standpipe high level alarm – LIT
NCDT input – GOING UP

D. **# 1 Seal Leak off flow – GOING UP**
NC Pump number 2 Seal Standpipe low level alarm – LIT
NCDT input – GOING UP

Bank Question: 977.1	***Answer: C***

1 Pt

Unit 1 is at 100% power when indications are received of a "1B' Reactor Coolant Pump seal malfunction. AP/1/A/5500/08 *(Malfunction of NC Pump)* is implemented.

Which one of the following conditions describes a number two seal failure?

A. **# 1 Seal Leak off flow – GOING DOWN**
NC Pump number 2 Seal Standpipe low level alarm – LIT
NCDT input – STABLE, OR GOING DOWN

B. **# 1 Seal Leak off flow – GOING UP**
NC Pump number 2 Seal Standpipe high level alarm – LIT
NCDT input – STABLE, OR GOING DOWN

C. **# 1 Seal Leak off flow – GOING DOWN**
NC Pump number 2 Seal Standpipe high level alarm – LIT
NCDT input – GOING UP

D. **# 1 Seal Leak off flow – GOING UP**
NC Pump number 2 Seal Standpipe low level alarm – LIT
NCDT input – GOING UP

Distracter Analysis:

A. **Incorrect**:
Plausible: #1 Seal L/O WILL go down

B. **Incorrect**:
Plausible: High Standpipe level alarm WILL lite.

C. **Correct**:

D. **Incorrect**:
Plausible: NCDT input WILL go up

Level: RO

KA: SYS 003 A3.03 (3.2/3.1)

Lesson Plan Objective: OP-MC-PS-NCP, Obj. 12

Source: Bank

Level of knowledge: Comprehension

References:
1. OP-MC-PS-NCP *pages 25-29*
2. AP/1/A/5500/08 Malfunction of NC Pump

SYSTEM: 003 Reactor Coolant Pump System (RCPS)

A3 **Ability to monitor automatic operation of the RCPS, including:**
(CFR: 41.7 / 45.5)

A3.01	Seal injection flow	3.3	3.2
A3.02	Motor current	2.6	2.5
A3.03	Seal D/P	3.2	3.1
A3.04	RCS flow	3.6	3.6
A3.05	RCP lube oil and bearing lift pumps	2.7*	2.6

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Seal injection	3.3	3.2
A4.02	RCP motor parameters	2.9	2.9
A4.03	RCP lube oil and lift pump motor controls	2.8	2.5
A4.04	RCP seal differential pressure instrumentation	3.1	3.0
A4.05	RCP seal leakage detection instrumentation	3.1	3.0
A4.06	RCP parameters	2.9*	2.9
A4.07	RCP seal bypass	2.6*	2.6
A4.08	RCP cooling water supplies	3.2	2.9

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Describe the controls and any interlocks associated with the Reactor Coolant Pump and Motor.	X	X	X	X	X
9	Given a parameter associated with the Reactor Coolant Pumps or Motors describe the indications for that parameter.			X	X	X
10	Given a limit and/or precaution associated with an operating procedure, discuss its basis and applicability.			X	X	X
11	Explain the reason for closing the NC Pump Seal Return valves when NCS pressure is below 100 psi.		X	X	X	X
12	Concerning the NC Pump seals: • Describe the general design of the NC Pump Seals. • Discuss the purpose of seal injection. • Discuss the flowpaths, flowrates and differential pressures associated with each seal. • Discuss the purpose of the seal injection throttle valves. • Discuss the purpose of the standpipes and the operation of the standpipe (draining and filling).	X	X	X	X	X
13	Describe the operation for adjusting NC Pump seal controlled leakage.		X	X	X	X
14	Concerning NC Pump Vibration Monitoring System:					
	• State the purpose of the system.			X	X	
	• Discuss the operation of the system.			X	X	X
15	State the parameters and setpoints which would require an NC Pump to be stopped.			X	X	X

2.3 Shaft Seal Section

Objective # 12

2.3.1 Seal Design

The shaft seal section consists of three shaft seals arranged in series such that reactor coolant leakage to the containment is essentially zero.

The No. 1 seal, the main seal of the pump, is a controlled leakage, film riding seal consisting of a runner which rotates with the shaft and a non-rotating seal ring attached to the seal housing. The ring and runner each have a silicon nitride faceplate. Injection water flows between the faceplates. Separation of the faces is controlled by face contours and system pressure. No surface contact will occur as long as the ΔP is maintained greater than 200 psid.

The No. 2 seal is a rubbing-face type seal consisting of a carbon insert which is shrunk into a stainless steel seal ring. The carbon insert rubs on a chrome carbide surface coating on a stainless steel runner which rotates with the shaft.

The No. 3 seal is also a rubbing-face type seal consisting of a carbon insert which is shrunk into a stainless steel seal ring. The seal ring insert, loaded by a stainless steel bellows and springs, rubs on a chrome carbide surface coating on a stainless steel runner which rotates with the shaft.

All three seals are contained within the main flange and seal housing.

2.3.2 Seal Operation

Objective # 7 & 12

Charging flow (from the NV System CCP's) is directed to each NC pump via a 0.45-micron seal water injection filter. This ensures a cool and clean supply of water to the seals. Seal water enters the pumps through the connection on the thermal barrier flange where the flow splits and a portion flows downward and enters the NC system via the thermal barrier cooler cavity. The remainder of the injection water flows up the pump shaft, cooling the pump radial bearing and leaves the pump via the No. 1 seal where its pressure is reduced to that of the Volume Control Tank (VCT).

INSTRUCTOR ACTIVITY

11	Explain the reason for closing the NC Pump Seal Return valves when NCS pressure is below 100 psi.		X	X	X	X
12	Concerning the NC Pump seals: • Describe the general design of the NC Pump Seals. • Discuss the purpose of seal injection. • Discuss the flowpaths, flowrates and differential pressures associated with each seal. • Discuss the purpose of the seal injection throttle valves. • Discuss the purpose of the standpipes and the operation of the standpipe (draining and filling).	X	X	X	X	X

Objective #11, 12

Each of the NC Pump No. 1 seal leakoff lines have seal return isolation valves. These valves are closed when NC System pressure is less than 100 psig in order to prevent any backflow from the NV System through the seal return filter to the NC Pump seals. Backflow would flush any contaminants/particulates out of the filter and into the seal.

These isolation valves are also used in the event of a failure (excessive leakage) of the No. 1 seal. When No. 1 seal leakoff flow is high, some of this flow comes from the NC System up through the thermal barrier. There may be insufficient heat removal by the thermal barrier heat exchanger to adequately cool the leakoff flow. This hotter water could cause damage to the No. 2 and 3 seals. When the seal return valve is closed, the No. 2 seal becomes the primary seal and maintains the large ΔP. The No. 2 seal is designed to withstand this high ΔP for a short period and the pump must be stopped within 30 minutes and the plant must be cooled down and depressurized so that repairs can be made.

The NC Pumps are equipped with a common No. 1 seal bypass valve. This valve is only opened, at low system pressures (100-1000 psig) when there is insufficient flow to adequately cool the seal (leakoff temperature >200°F).

The leakoff from each pump is piped to a common manifold and then via a seal water filter through a seal water heat exchanger where the temperature is reduced to about that of the VCT. Leakage past the No. 1 seal provides a constant pressure on the No. 2 seal and constant pressure on the No. 3 seal. A standpipe is provided to assure a backpressure of at least 7 feet of water on the No. 3 seal. In addition, the standpipe is used to warn of excessive No. 2 seal leakage flow to the reactor coolant drain tank (NCDT). Excessive No. 2 seal leakage results in a rise in the standpipe level and eventual overflow to the NCDT via a second overflow connection.

A total of 8 gpm is supplied to each NC pump for seal injection water. 5 gpm is directed down through the thermal barrier labyrinth seal and into the NC System. 3 gpm flows up through the lower radial bearing.

A minimum differential pressure of 200 psid is required across the No. 1 seal surfaces to ensure proper water film during pump operation. The inlet pressure is approximately 2250 psig (NC System pressure) and the outlet pressure is 15-50 psig (VCT pressure) during normal operation. Approximately 3 gpm leaks off from the No. 1 seal of which 3 gph flows to the No. 2 seal. Proper VCT pressure is required to ensure adequate backpressure for proper flow through the No. 2 seal.

Objective #12

Approximately 3 gph is directed through the No. 2 seal. The pressure drops from 50 psig to 3 psig across this seal. All the No. 2 seal leakoff, except for 100 cc/hr, is directed to a standpipe. The water level in the standpipe is maintained to provide sufficient backpressure on the No. 2 seal to ensure flow through the No. 3 seal. All excess water from the standpipe is discharged to the NCDT through an orifice. Improper standpipe level can adversely affect seal operation, therefore there is a high and low level alarm provided for the standpipe to warn of potential seal problems. A high level alarm could indicate excessive No. 2 seal leak-off flow.

INSTRUCTOR ACTIVITY

9	Given a parameter associated with the Reactor Coolant Pumps or Motors describe the indications for that parameter.			X	X	X

15	State the parameters and setpoints which would require an NC Pump to be stopped.			X	X	X

Approximately 100 cc/hr from the No. 2 seal is directed to the No. 3 seal. The pressure drops from 3 psig to atmospheric across this seal. After passing through the seal the leakoff is directed to the NCDT.

The minimum and maximum flow rates and temperatures for seal injection water are 6 gpm and 50° F and 12 gpm and 150° F, respectively.

Objective #9

No.1 seal temperature, injection flow, and ΔP indications are provided on the Main Control Board. Recorders are provided for No. 1 seal leakoff flow indicating low range (0-2 gpm) and high range (0-6 gpm) flow. Other indications are provided on the OAC.

2.4 NC Pump Monitor System

Objective #15

The purpose of the EME system is to monitor the voltage and frequency of the 6900V power source for the reactor coolant pump motors. Following a drop in either parameter below its setpoint, the monitoring system will provide a signal to the Solid State Protection System (SSPS) to indicate the condition. If an under-frequency condition exists on 2/4 monitored channels, all NC Pump circuit breakers will trip and if reactor power is greater than P-7 (10%), the reactor will also trip.

Due to the direct impact of the EME system on the performance of the Reactor Protection System (through the SSPS reactor trip circuit), it is classified as nuclear safety related. By definition, the Reactor Protection System is designed to shut down the reactor to protect against fuel cladding damage or loss of system integrity, which may result in the release of radioactive fission products into Containment.

The under-voltage and under-frequency monitors are voltage and frequency sensing devices, respectively. Each monitor's output sends a signal to its corresponding auxiliary relay which in turn sends a signal to the SSPS to indicate the condition. If 2 out of the 4 channels monitored indicate an under-voltage (or under-frequency) condition, the SSPS will initiate a reactor trip (1/4 causes an NC Pump Bus Alert alarm in the Control Room). As listed in Technical Specification Table 3.3.1-1 #11 and # 12, the under-voltage monitor shall indicate an under-voltage condition if the voltage drops to 5016V on the 6900V bus. Likewise, the under-frequency monitor shall indicate an under-frequency condition if the frequency drops to 55.9 Hz on the 6900V bus.

1 Pt Which one of the following pre-planned activities that has been evaluated and approved in advance by Operations can take place during shift turnover?

A. **Dilution to ECB**

B. **ZPPT**

C. **Drain to Mid-Loop**

D. ***Reactor Startup***

Bank Question: 984.1 ***Answer: A***

1 Pt Which one of the following pre-planned activities that has been evaluated and approved in advance by Operations can take place during shift turnover?

A. **Dilution to ECB**

B. **ZPPT**

C. **Drain to Mid-Loop**

D. **Reactor Startup**

Distracter Analysis:

A. ***Correct***:
B. **Incorrect**: Should not be scheduled during turnover
Plausible:
C. **Incorrect**:Should not be scheduled during turnover
Plausible
D. **Incorrect**: Should not be scheduled during turnover
Plausible:.

Level: RO

KA: G2.1.3 (3.0/3.4)

Lesson Plan Objective:

Source: Bank

Level of knowledge: memory

References:
1. OMP 2-2 page 31

2.0 GENERIC KNOWLEDGES AND ABILITIES

2.1 Conduct of Operations

2.1.1 **Knowledge of conduct of operations requirements.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.7 SRO 3.8

2.1.2 **Knowledge of operator responsibilities during all modes of plant operation.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 4.0

2.1.3 **Knowledge of shift turnover practices.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 3.4

2.1.4 **Knowledge of shift staffing requirements.**
(CFR: 41.10 / 43.2)
IMPORTANCE RO 2.3 SRO 3.4

2.1.5 **Ability to locate and use procedures and directives related to shift staffing and activities.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.3 SRO 3.4

2.1.6 **Ability to supervise and assume a management role during plant transients and upset conditions.**
(CFR: 43.5 / 45.12 / 45.13)
IMPORTANCE RO 2.1 SRO 4.3

2.1.7 **Ability to evaluate plant performance and make operational judgments based on operating characteristics, reactor behavior, and instrument interpretation.**
(CFR: 43.5 / 45.12 / 45.13)
IMPORTANCE RO 3.7 SRO 4.4

2.1.8 **Ability to coordinate personnel activities outside the control room.**
(CFR: 45.5 / 45.12 / 45.13)
IMPORTANCE RO 3.8 SRO 3.6

Transients:

Operations should notify Reactor Engineering as soon as practical either during or following transients resulting in reactivity changes.

3.2 **Philosophy for work activities during shift change:**

Positive reactivity changes should **NOT** be performed during shift turnover without proper pre-planning. This policy is **NOT** intended to prevent the operator from taking conservative action to respond to changing plant conditions. Example: Xe building in following a transient requiring dilution to offset the effects. Major activities such as startups should be performed per the following guidance.

Conservative unit operation relative to positive reactivity management can be achieved without stopping critical path activities during turnovers.

Planned critical activities should **NOT** be scheduled or performed through shift turnovers. All attempts should be made to schedule RX Startup, ZPPT and Drain to Mid-Loop away from shift turnover.

On occasion conditions may require a continuation of critical activities or startup through turnover. Under these circumstances management will request a delayed turnover or an increase in control room staffing prior to allowing continuation of the activity .

Activities such as plant cooldown, plant heatup, core loading, dilution to ECB can continue through shift turnover under the following guidelines.

These activities shall be pre-planned, evaluated and approved in advance by OPS management prior to implementation.

> *OWPM/Shift must recognize early that a critical activity will take place through* turnover. Resource plans should be put in place to address work through turnover.

Resources dedicated to providing the necessary oversight to the activity must be specified (SRO, RO, NLO, Eng etc.)

These resources must either come in prior to the turnover period and receive the necessary briefings or stay through turnover and beyond to complete the task while the rest of the shift is turning over. A shift would **NOT** normally stay greater than two hours beyond the end of their shift.

Other positions may turnover during ongoing activities as long as it doesn't disturb the evolution in progress. In this case the shift briefing would be held outside the control room. The other positions in the control room would receive a briefing from the CR SRO on a one on one basis.

The OATC is required to maintain focus on reactor operation through shift turnover if a critical activity is taking place.

1 Pt. Unit 1 is responding to a small break LOCA inside and outside containment. Given the following events and conditions:

- FWST Level indicates 340 inches
- Containment pressure indicates 1.5 psig
- Containment Sump Level indicates 1.05 ft
- 1EMF-41 (*AUX BLDG VENTILATION*) is in Trip 2 alarm
- Aux Building area radiation monitors are in alarm
- 1EMF-51A and B (*CONTAINMENT TRN A & B*) indicates 25 R/Hr
- Hydrogen Analyzer indicates 0.7% in containment
- NLO's report significant leakage at the seals of the "1A" ND pump

Which one of the following actions reduces excessive levels of radiation and guard against personnel exposure?

A. Monitor 1EMF-41 (*AUX BLDG VENTILATION)*

B. Dispatch NLO to energize Hydrogen Recombiners

C. Secure VA (Aux. Bldg. Ventilation System) to limit airborne contamination.

D. Identify and isolate the break

Bank Question: 1012.1 ***Answer: D***

1 Pt. Unit 1 is responding to a small break LOCA inside and outside containment. Given the following events and conditions:

- FWST Level indicates 340 inches
- Containment pressure indicates 1.5 psig
- Containment Sump Level indicates 1.05 ft
- 1EMF-41 (*AUX BLDG VENTILATION*) is in Trip 2 alarm
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Which one of the following actions reduces excessive levels of radiation and guard against personnel exposure?

A. Monitor 1EMF-41 (*AUX BLDG VENTILATION)*

B. Dispatch NLO to energize Hydrogen Recombiners

C. Secure VA (Aux. Bldg. Ventilation System) to limit airborne contamination.

D. Identify and isolate the break

Distracter Analysis: The initial conditions provide a LOCA into containment and a leakage path outside of containment. The question is which of the problems take priority? The purpose is not to memorize procedure steps but to answer this from a broader perspective.

A. **Incorrect**: Monitoring of rad levels does not minimize exposure.
Plausible: If the candidate thinks that the abnormal radiation level requires priority action.

B. **Incorrect**: Energizing the Hydrogen Recombiners does not limit rad exposure in the Aux. Bldg.
Plausible: Small Hydrogen Concentration inside containment exists).

C. **Incorrect**: This is needed to limit personnel exposure..
Plausible: If the candidate thinks there is an airborne problem.

D. **Correct**:

Level: RO

KA: G3.10 (2.9/3.3)

Lesson Plan Objective: EP-E1 OBJ 3

Source: BANK

Level of knowledge: comprehension

References:
1. OP-MC-EP-E1 page 231, 233, 235
2. EP/1/A/5000/ECA-1.2

2.3 Radiation Control (Continued)

2.3.10 **Ability to perform procedures to reduce excessive levels of radiation and guard against personnel exposure.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.9 SRO 3.3

2.3.11 **Ability to control radiation releases.**
(CFR: 45.9 / 45.10)
IMPORTANCE RO 2.7 SRO 3.2

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	5.0	5.0	4.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the E-1 series. EPE1001			X	X	
2	Discuss the entry and exit guidance for each procedure in the E-1 series. EPE1002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the E-1 series. EPE1003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the E-1 series. EPE1004			X	X	X
5	Given the Foldout page discuss the actions included and the basis for these actions. EPE1005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPE1006			X	X	X
7	Discuss the time critical task(s) associated with the E-1 series procedures including the time requirements and the basis for these requirements. EPE1007			X	X	X

9.0 ECA-1.2, LOCA OUTSIDE CONTAINMENT

9.1. Purpose

This procedure provides guidance for a LOCA that occurs outside containment. Specifically, the objective of this procedure is to provide actions to identify and isolate a LOCA outside containment.

There is one explicit transition to this procedure, which is contained in E-0, Reactor Trip or Safety Injection, on abnormal radiation in the auxiliary building due to a loss of NC inventory outside containment.

There are two transitions from this procedure. First, if the break is isolated based upon increasing NC pressure, the operator is transferred to E-1 Step 1. Second, if the break cannot be isolated, the operator is sent to ECA-1.1, since there will not be any fluid inventory in the containment sump to provide recirculation capability.

9.2. Symptoms/Entry Conditions

ECA-1.2 is entered when either of the following conditions occur:

1. In E-0, when abnormal radiation occurs in the Aux Building due to a loss of NC system inventory outside containment.
2. When it is determined in E-1 that the cause of abnormal radiation is due to a loss of NC inventory outside containment.

9.3. Major Actions

The recovery/restoration technique of ECA-1.2 includes the following three major action categories:

1. Verify proper valve alignment.
2. Identify and isolate the break.
3. Check if break is isolated.

The following subsections provide a more detailed discussion of each major category.

9.3.1 Verify Proper Valve Alignment

The first instruction given to the operator is to verify that all normally closed valves in low pressure lines that penetrate containment are closed. If a normally closed valve is open, this action may isolate the break.

9.3.2 Identify and Isolate Break

The operator then attempts to identify and isolate the break by sequentially closing all normally open valves in low pressure injection paths that penetrate containment.

9.3.3 Check if Break is Isolated

NC pressure is monitored to determine if the break has been isolated. A significant rise in NC pressure indicates the break is isolated and the operator is sent to E-1. If the break is not isolated, the operator transfers to procedure ECA-1.1 for further recovery actions.

9.4. Detailed Description of Procedural Steps

STEP 1 Check proper valve alignment:

PURPOSE: To ensure that normally closed valves are closed.

BASIS: This step instructs the operator to verify that all normally closed valves in low pressure lines and other MNS specified lines that penetrate containment are closed. The valving connecting the ND system to the NC is of particular interest in this step since the ND system is a low pressure system (600 psig) connected to the high pressure NC system (2500 psig). Therefore, a rupture or break outside containment is most probable to occur in the low pressure ND system piping.

STEP 2 Try to identify and isolate break:

PURPOSE: To attempt to identify and isolate a LOCA outside containment.

BASIS: This step instructs the operator to close and open all normally opened valves in paths that penetrate containment to identify and isolate the break outside containment. Again, as in Step 1, the valving connecting the 600 psig ND system to the NC is of primary interest, since the probability of a break occurring outside containment is most probable in this piping.

ERG substep is divided into three actions for clarity. Each flow path (valve) to be tested is isolated, pressure checked, and actions taken based on pressure response. This ensures only one isolation sequence is performed at a time and will provide details on when to reopen each valve.

When the NI valve to the cold legs is isolated, NI pump miniflow is ensured or the NI pumps are shutdown until after the valve is reopened.

STEP 3 Check if break is isolated:

PURPOSE: To determine if the LOCA outside containment has been isolated by previous actions.

BASIS: This step instructs the operator to check NC pressure to determine if the break has been isolated by previous actions. If the break is isolated, a significant NC pressure rise will occur due to the S/I flow filling up the NC with break flow stopped.

(R06-97)

Duke Power Company
PROCEDURE PROCESS RECORD

(1) ID No. EP/1/A/5000/ECA-1.2
Revision No. 1

INFORMATION ONLY

PARATION
Station McGuire Nuclear Station

(3) Procedure Title LOCA Outside Containment

(4) Prepared By **Mike Weiner** Date **December 7, 1998**

(5) Requires 10CFR50.59 evaluation?
- ☒ Yes (New procedure or revision with major changes)
- ☐ No (Revision with minor changes)
- ☐ No (To incorporate previously approved changes)

(6) Reviewed By S. Hackney (QR) Date 12/9/98

Cross-Disciplinary Review By ______ (QR) NA JSH Date ______

Reactivity Mgmt. Review By ______ (QR) NA JSH Date ______

(7) Additional Reviews

Reviewed By ______ Date ______

Reviewed By ______ Date ______

(8) Temporary Approval (*if necessary*)

By ______ (SRO/QR) Date ______

By ______ (QR) Date ______

(9) Approved By [signature] Date 12/9/98

RFORMANCE (Compare with Control Copy every 14 calendar days while work is being performed.)

(10) Compared with Control Copy ______ Date ______

Compared with Control Copy ______ Date ______

Compared with Control Copy ______ Date ______

(11) Date(s) Performed ______

Work Order Number (WO#) ______

COMPLETION

(12) Procedure Completion Verification

- ☐ Yes ☐ N/A Check lists and/or blanks initialed, signed, dated, or filled in NA, as appropriate?
- ☐ Yes ☐ N/A Listed enclosures attached?
- ☐ Yes ☐ N/A Data sheets attached, completed, dated and signed?
- ☐ Yes ☐ N/A Charts, graphs, etc. attached, dated, identified, and marked?
- ☐ Yes ☐ N/A Procedure requirements met?

Verified By ______ Date ______

(13) Procedure Completion Approved ______ Date ______

(14) Remarks (*attach additional pages, if necessary.*)

A. Purpose

This procedure provides actions to identify and isolate a LOCA outside containment.

B. Symptoms or Entry Conditions

This procedure is entered from:

- EP/1/A/5000/E-0 (Reactor Trip Or *Safety Injection*), Step 37, on abnormal radiation in the aux bldg due to a loss of NC System inventory outside containment.
- EP/1/A/5000/E-1 (Loss Of Reactor Or *Secondary* Coolant), Step 12, if it is determined that the cause of abnormal radiation is due to a loss of NC System inventory outside containment.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

C. **Operator Actions**

1. **Check proper valve alignment as follows:**

   a. Valves in ND pump suction from NC System - CLOSED:

   __ • 1ND-1B (C NC Loop to ND Pumps)

   __ • 1ND-2AC (C NC Loop To ND Pumps).

   RNO: a. Perform the following:

   __ 1) Dispatch operator to remove tag and close breaker for valve(s).

   __ 2) Close valve(s).

   3) IF valve can not be closed, **THEN** dispatch operator to close valve(s):

   __ • 1ND-1B (reactor bldg, 725+30, 182 Degrees, above lower containment charcoal filter 1B)

   __ • 1ND-2AC (reactor bldg, 738+5, 180 Degrees, B and C fan room).

   __ b. 1NI-183B (ND To B & C Hot Legs Isol) - CLOSED

   RNO: b. Perform the following:

   __ 1) Dispatch operator to remove tag and close breaker for valve.

   __ 2) Close valve.

   __ 3) IF valve can not be closed, **THEN** dispatch operator to close 1NI-183B (aux bldg, 733+10, FF-52, room 602, midget hole, enter from electrical penetration room, 4 ft from reactor bldg wall, 3 ft from ceiling).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1. (Continued)	
c. NI pump hot leg injection valves - CLOSED: __ • 1NI-121A (Train A NI To B & C Hot Leg) __ • 1NI-152B (Train B NI To A & D Hot Leg).	c. Perform the following: __ 1) Dispatch operator to remove tag and close breaker for valve(s). __ 2) Close valve(s). 3) <u>IF</u> valve(s) can not be closed, **<u>THEN</u>** dispatch operator to close valve(s): __ • 1NI-121A (aux bldg, 716+23, FF-52, room 602, 10 ft north of CAD door, 3 ft from reactor bldg wall) __ • 1NI-152B (aux bldg, 750+4, HH-52, southwest corner of UHI valve room, 1 ft from reactor bldg).
__ d. 1NV-840A (ND To Pzr Aux Spray Control)- CLOSED.	d. Perform the following: __ 1) Close valve. __ 2) <u>IF</u> valve can not be closed, **<u>THEN</u>** dispatch operator to close 1NV-840A (aux bldg, 733+8, KK-53, room 732, west of NS heat exchanger room 1B).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
2. ***Try to identify and isolate break as follows:***	
a. Isolate ND header 1A to cold legs as follows:	
__ 1) Dispatch operator to remove tag and close breaker for 1NI-173A (Train A ND To A & B CL).	
__ 2) Close 1NI-173A (Train A ND To A & B CL).	
__ 3) Check NC pressure - GOING UP.	3) Perform the following: __ a) Open 1NI-173A. __ b) **<u>GO</u> <u>TO</u>** Step 2.b.
__ 4) **<u>GO</u> <u>TO</u>** Step 3.	
b. Isolate ND header 1B to cold legs as follows:	
__ 1) Dispatch operator to remove tag and close breaker for 1NI-178B (Train B ND To C & D CL).	
__ 2) Close 1NI-178B (Train B ND To C & D CL).	
__ 3) Check NC pressure - GOING UP.	3) Perform the following: __ a) Open 1NI-178B. __ b) **<u>GO</u> <u>TO</u>** Step 2.c.
__ 4) **<u>GO</u> <u>TO</u>** Step 3.	

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
2. (Continued)	
c. *Isolate NI header to cold legs as follows:*	
1) Check the following - OPEN: __ • 1NI-115B (A NI Pump Miniflow) __ • 1NI-144B (B NI Pump Miniflow) __ • 1NI-147A (NI Pumps Miniflow Hdr Isol).	__ 1) Stop NI pumps.
__ 2) Dispatch operator to remove tag and close breaker for 1NI-162A (NI *Pumps Cold Leg Isol).*	
__ 3) Close 1NI-162A (NI Pumps Cold Leg Isol).	
__ 4) Check NC pressure - GOING UP.	4) *Perform the following:* __ a) Open 1NI-162A. __ b) **<u>IF</u>** NI pumps stopped in previous step, **<u>THEN</u>** restart.
3. **Check if break is isolated:**	
__ a. NC pressure - GOING UP	__ a. <u>GO</u> <u>TO</u> EP/1/A/5000/ECA-1.1 (Loss Of Emergency Coolant Recirc).
__ b. Initiate actions as necessary to complete isolation of leak.	
__ c. <u>GO</u> <u>TO</u> EP/1/A/5000/E-1 (Loss Of Reactor Or Secondary Coolant).	

<u>END</u>

1 Pt. Unit 1 is in mode 5 with the operators preparing for a plant startup by drawing a bubble in the pressurizer.

Given the following conditions:

1) LTOPs is in service
2) Pressurizer pressure is 325 psig
3) Pressurizer level is 25%
4) T_{ave} = 175 °F

If pressure increases to 400 psig, which one of the following describes the correct inputs for a PORVs to actuate in LTOP mode?

A. **"D loop Hot leg WR temperature < 320 degrees and WR pressure "D" loop >380 psig will actuate PORV NC-34A**

B. **"C" loop Cold Leg temperature < 320 degrees and NR pressure "A" loop > 380 psig will actuate PORV NC-32B**

C. **"D" loop Cold Leg temperature < 320 degrees and WR pressure "A" loop > 380 psig will actuate PORV NC-32B**

D. **"D" loop Hot Leg WR temperature < 320 degrees and NR pressure "D" loop > 380 psig will actuate PORV NC-34A**

Bank Question: 1022 ***Answer: D***

1 Pt. Unit 1 is in mode 5 with the operators preparing for a plant startup by drawing a bubble in the pressurizer.

Given the following conditions:

1) LTOPs is in service
2) Pressurizer pressure is 325 psig
3) Pressurizer level is 25%
4) T_{ave} = 175 °F

If pressure increases to 400 psig, which one of the following describes the correct inputs for a PORVs to actuate in LTOP mode?

A. "D loop Hot leg WR temperature < 320 degrees and WR pressure "D" loop >380 psig will actuate PORV NC-34A

B. "C" loop Cold Leg temperature < 320 degrees and NR pressure "A" loop > 380 psig will actuate PORV NC-32B

C. "D" loop Cold Leg temperature < 320 degrees and WR pressure "A" loop > 380 psig will actuate PORV NC-32B

D. "D" loop Hot Leg WR temperature < 320 degrees and NR pressure "D" loop > 380 psig will actuate PORV NC-34A

MISCINFO: RO

SOURCE: NEW

Level of Knowledge: Memory

Author: CWS

REFERENCES: OP-MC-PS-NC pages 45 & 49

LESSON: OP-MC-PS-NC

OBJECTIVE: OP-MC-PS-NC Obj. 21

K/A: APE 008 AA206 (3.3/3.6)

APE : **008 Pressurizer (PZR) Vapor Space Accident (Relief Valve Stuck Open)**

AA2. **Ability to determine and interpret the following as they apply to the Pressurizer Vapor Space Accident:**
(CFR: 43.5 / 45.13)

AA2.01	RCS pressure and temperature indicators and alarms	3.9	4.2
AA2.02	PZR spray valve position indicators and acoustic monitors	3.9	4.1
AA2.03	PORV position indicators and acoustic monitors	3.9	3.9
AA2.04	High-temperature computer alarm and alarm type	3.2	3.4
AA2.05	PORV isolation (block) valve switches and indicators	3.9	3.9
AA2.06	PORV logic control under low-pressure conditions	3.3	3.6
AA2.07	Feedwater flow indicators and pump controllers	2.4	2.4
AA2.08	Rod position indicators	2.1	2.2
AA2.09	PZR spray block valve controls and indicators	3.6	3.7
AA2.10	High-pressure injection valves and controllers	3.6	3.6
AA2.11	Turbine bypass header pressure indicators	2.3	2.4
AA2.12	PZR level indicators	3.4	3.7
AA2.13	High-pressure safety injection pump flow indicator, ammeter, and controller	3.8	3.9
AA2.14	Saturation temperature monitor	4.2	4.4
AA2.15	ESF control board, valve controls, and indicators	3.9	4.2
AA2.16	RCS in-core thermocouple indicators; use of plant computer for interpretation	3.8	4.1
AA2.17	Steam dump valve controller (position)	2.5	2.7*
AA2.18	Computer indications for RCS temperature and pressure	3.0	3.0*
AA2.19	PZR spray valve failure, using plant parameters	3.4	3.6
AA2.20	The effect of an open PORV on code safety, based on observation of plant parameters	3.4	3.6
AA2.21	The feed flow of different channels, using the feed regulator valve controller and indicators	2.1	2.2*
AA2.22	Consequences of loss of pressure in RCS; methods for evaluating pressure loss	3.8	4.2
AA2.23	Criteria for throttling high-pressure injection after a small LOCA	3.6	4.3
AA2.24	Value at which turbine bypass valve maintains header pressure after a reactor trip	2.6	2.6*
AA2.25	Expected leak rate from open PORV or code safety	2.8	3.4
AA2.26	Probable PZR steam space leakage paths other than PORV or code safety	3.1	3.4
AA2.27	Effects on indicated PZR pressure and/or level of sensing line leakage	2.9	3.2
AA2.28	Safety parameter display system indications	3.3*	3.9
AA2.29	The effects of bubble in reactor vessel	3.9	4.2
AA2.30	Inadequate core cooling	4.3	4.7

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
20	Concerning operation of the PRT: • Describe how the PRT can be vented to containment. • Describe how the PRT is purged with and without the Shutdown Tanks Available	X	X	X	X	
21	Describe how NCS temperature, pressure, flow and Pzr level are measured and indicated.		X	X	X	
22	Describe the operation and indication readout of the following NCS level instrumentation: • Ultrasonic level detection • WR level • NR level • Sightglass		X	X	X	X
23	State the nominal values for NC System pressure, Th, Tc, Tave, Pzr temperature for Hot Zero Power and Hot Full Power.	X	X	X	X	
24	Given a Limit and/or Precaution associated with the following procedures, discuss its basis and when it applies: • OP/1or2/A/6100/001 • OP/1or2/A/6100/SU1, 2, 3, 5, 6, 7, 8, 9, 10, 13, 15, 19, 20 • OP/1or2/A/6100/SO1, 2, 3 • OP/1or2/A/6100/002 • OP/1or2/A/6100/SD1, 2, 4, 7, 8, 11, 12, 14, 16, 20, 21, 22 • OP/1or2/A/6150/004		X	X	X	X

2.10 Instrumentation

Objective # 21

The instrumentation for the pressurizer, relief valves, safeties and PRT has been covered in their respective sections. Refer to **Drawing 7.1** for following sections.

The **Hot-Leg Wide Range Temperature** is measured by a RTD inserted into a temperature well located in the piping between the reactor vessel and the steam generator in each hot leg. The WR Th range is 0^0 F to 700^0 F and is displayed on a recorder on 1(2)MC6. Other indications of WR Th are:

- Loop D on Aux. S/D Panel
- Loops C and D on Train A ICCM
- Loops A and B on Train B ICCM
- Subcooling monitor from ICCM
- D loop interlock with NC34A LTOP operation

The **Cold Leg Wide Range Temperature** measurement is provided by a RTD located in each cold leg between the NCP and the reactor vessel. The WR Tc temperature span is from 0^0 F to 700^0 F and is displayed on a recorder on 1(2)MC5. Loop A and D WR Tc are displayed at the SSF. Loop C provides an interlock for NC32B LTOP operation.

The **Hot Leg Narrow Range Temperature** measurement is provided by three RTDs in each hot leg located in fast response thermowells installed in three separate scoops equally spaced around the circumference of the pipe to provide a representative sample of the hot leg water temperature. The output of the three RTDs are averaged in the 7300 PCS system to give NR Th indication for that loop. IAE can bypass a failed RTD from the averaging circuit. The Th NR span is from 530^0 F to 650^0 F

The **Cold Leg Narrow Range Temperature** measurement is provided by one RTD in a fast response thermowell in each loop located downstream of the NCP. There is also one installed spare in each loop. Only one detector is required due to the mixing provided by the NCP. The NR Tc temperature instrument span is from 510^0 F to 630^0 F.

The NR Tc and Th instruments do not have a meter indication on the control boards but are used by the 7300 PCS system to develop loop Tave, (Th + Tc)/2, and loop ΔT, (Th - Tc), which have meter indications on 1(2)MC6. The Tave meter range is 530^0 F to 630^0 F. The Auctioneered High Tave indication (highest indicating loop Tave) is displayed on a recorder on 1(2)MC2. Tave and ΔT provide input to :

- OPΔT Trip setpoint
- OTΔT Trip setpoint
- Lo Tave (P-4 and Tave Feedwater isolation)
- Lo Lo Tave P-12 Interlock

There are three Narrow Range NCS Pressure instruments. One instrument (NCP 5141) is connected to C loop hot leg on the same penetration line as the WR pressure instrument and has an indication on 1(2)MC10. The span of this meter is 0 to 800 psig and is in service during normal operation but is pegged high until NCS pressure drops below 800 psig. The other narrow range pressure instruments (NCPT5122 and NCP5142) are used for LTOP input. These instruments are placed in service by IAE during shutdown after NCS pressure is below 600 psig but before LTOP operation is required. These two indications are available on the OAC but do not have meter indication on the control boards.

Objective # 22

The Ultrasonic Level Measurement System (ULMS) provides Hot leg levels (A and C loops) during drain down and mid-loop operation. These instruments were designed to provide more accurate and reliable NCS level indication than the narrow range level instruments particularly during drain down. These instruments are important to ensure adequate NCS level for the ND pumps to preclude vortexing and possible loss of residual heat removal. The ultrasonic detectors are "non-intrusive" meaning that they strap to the outside of the coolant wall rather than mounting through the coolant pipe. The ULMS are placed into service at the beginning of cold shutdown operations. Each system's detector is placed on a calibration stand assembly and the instrument loop is calibrated for full pipe conditions. The detector is then removed from the calibration stand and taken into containment to its hot leg pipe mounted belt and holder. After removing the insulation " plug" the pipe is cleaned and an acoustic gel is applied to the detector face to ensure a good acoustical coupling to the pipe wall. The detector is snapped into its holder and interconnecting cables are connected. When operating, the system's electronic enclosure excites the ultrasonic detector to emit an acoustic pulse into the pipe. The system times the return echo from the air-water interface to develop the pipe water level. While calibrated for the full pipe, the system will not operate properly if level drops to approximately 40% or less (meter indication of about -3.0 inches). This is due to the need to ignore the echoes from the inside and outside pipe walls (ringing effect). As the water level in the pipe decreases, the pipe ringing from the acoustic pulse will take longer and longer to decay away. When the water level decreases to 40%, the magnitude of the pipe ringing will be so large that it will start to interfere with the return echo from the air-water interface water. The meter is marked in red from -3.0 inches to -14.5 inches to warn the operator of this problem. NCS Ultrasonic Level Indication for Loop A (1NCLT8460)& C (1NCLT8470) has meter indication on 1(2)MC5 with a **span of -14.5 to +14.5 inches WC. They also provide signals to the OAC for high (+14 inches) and low (+6 inches) level alarms**. The computer alarms are disabled when the detectors are removed from service. When taken out of service, the detectors are unsnapped from its holder, cables unplugged and removed from containment.

1 Pt. Initial Conditions:

- Unit 1 is at 100% power
- "A" train essential components are in service

OAC alarms indicate an increase in reactor coolant pump motor winding temperatures.

Which of the following describes the reason for the increase in temperatures?

A. 1RN-40A (Train A to Non Essential Hdr Isol) has closed

B. 1KC-338B (NCP Supply)has closed

C. 1RN-43A (Train 1B to Non Ess Hdr Isol) has closed

D. 1KC-228B (RB HDR supply) has closed

Bank Question: 1023 ***Answer: A***

1 Pt. Initial Conditions:

- Unit 1 is at 100% power
- "A" train essential components are in service

OAC alarms indicate an increase in reactor coolant pump motor winding temperatures.

Which of the following describes the reason for the increase in temperatures?

A. 1RN-40A (Train A to Non Essential Hdr Isol) has closed

B. 1KC-338B (NCP Supply)has closed

C. 1RN-43A (Train 1B to Non Ess Hdr Isol) has closed

D. 1KC-228B (RB HDR supply) has closed

Distracter Analysis:

A. Correct

B. KC system has no effect on motor stator temperatures

C. Closure of this valve will have no effect on stator temperatures

D. KC system has no effect on motor stator temperatures

Level: RO

KA: APE 015 AA2.01 (3.0/3.5)

Lesson Plan Objective: OP-MC-PS-NCP Obj 7
OPO-MC-PSS-RN Obj 10

Source: New

Author: CWS

Level of knowledge: memory

References:
1. OP-MC-PS-NCP page 5, 13 & 17
2. OP-MC-PSS-RN page 31 & 75

Date: 3/06/2003

APE : 015/017 Reactor Coolant Pump (RCP) Malfunctions

AA1.02	RCP oil reservoir level and alarm indicators	2.8	2.7
AA1.03	Reactor trip alarms, switches, and indicators	3.7*	3.8
AA1.04	RCP ventilation cooling fan run indicators	2.5	2.5
AA1.05	RCS flow	3.8	3.8
AA1.06	CCWS	3.1	2.9
AA1.07	RCP seal water injection subsystem	3.5	3.4
AA1.08	S/G LCS	3.0*	2.9
AA1.09	RCS temperature detection subsystem	3.1	3.2
AA1.10	RCP ammeter and trip alarm	2.7	2.6
AA1.11	RCP on/off and run indicators	2.5	2.4
AA1.12	Reactor coolant loop flow meters	2.8*	3.1
AA1.13	Reactor power level indicators	3.4*	3.4*
AA1.14	Power range remote flux meter	2.9*	3.0*
AA1.15	High-power/low-flow reactor trip block status lights	3.5*	3.6*
AA1.16	Low-power reactor trip block status lights	3.2*	3.5*
AA1.17	Station auxiliary transformer volt-amp meters	2.2*	2.2
AA1.18	Station auxiliary power supply breakers and indicators	2.3*	2.4
AA1.19	Power transfer confirm lamp	2.9*	3.0*
AA1.20	RCP bearing temperature indicators	2.7	2.7
AA1.21	Development of natural circulation flow	4.4	4.5
AA1.22	RCP seal failure/malfunction	4.0	4.2
AA1.23	RCP vibration	3.1	3.2

AA2. Ability to determine and interpret the following as they apply to the Reactor Coolant Pump Malfunctions (Loss of RC Flow): (CFR: 43.5 / 45.13)

AA2.01	Cause of RCP failure	3.0	3.5*
AA2.02	Abnormalities in RCP air vent flow paths and/or oil cooling system	2.8	3.0
AA2.03	Temperature differential across the RCP oil cooler	2.2	2.2
AA2.04	Temperature differential across the RCP air cooler	1.9	2.1
AA2.05	Relationship between RCP ammeter readings and RCS average temperature	1.9	2.2
AA2.06	Relationship between cooling air flow and oil reservoir temperature/level for RCP	1.8	2.3
AA2.07	Calculation of expected values of flow in the loop with RCP secured	2.1	2.9
AA2.08	When to secure RCPs on high bearing temperature	3.4	3.5
AA2.09	When to secure RCPs on high stator temperatures	3.4	3.5
AA2.10	When to secure RCPs on loss of cooling or seal injection	3.7	3.7
AA2.11	When to jog RCPs during ICC	3.4*	3.8*

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2.0	2.0	3.0	3.0	

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Concerning the Reactor Coolant Pumps/Motors: • State the purpose of the Reactor Coolant Pump. • State the purpose of the motor flywheel. • State the purpose of the NC Pump thermal barrier and heat exchanger. • State the purpose of the NC Pump Motor Oil Lift System. • State the purpose of the NC Pump seals.	X	X	X	X	
2	Discuss the basic operation of the Anti Reverse Rotation Device associated with each motor.	X	X	X	X	
3	Describe two reasons for using an Anti Reverse Rotation Device on a NC Pump.		X	X	X	X
4	Discuss any operational concerns with: • Loss of Thermal Barrier Heat Exchanger flow while maintaining Seal Injection flow • Loss of Seal Injection flow while maintaining Thermal Barrier Heat Exchanger flow. • Loss of Seal Injection with a loss of Thermal Barrier Heat Exchanger flow.	X	X	X	X	X
5	Describe the operation of the Thrust Bearing including how it functions as a pump to move oil through the oil cooler.	X	X	X	X	
6	Concerning the Oil Lift Pumps: • Explain the normal start/stop operation • Describe what happens to the running Oil Lift Pump if the associated NCP failed to start? (Safety breaker re-opens)		X	X	X	X
7	Discuss the various cooling water supplies to the Reactor Coolant Pump and Motor and the origin of each supply.	X	X	X	X	

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Describe the RN System Flow path (suction source, essential and non-essential header alignment and discharge point) for the following:					
	• Normal operation	X	X	X	X	
	• Operation following a Blackout	X	X	X	X	X
	• Operation following a Safety Injection	X	X	X	X	X
9	Explain the reason for taking a suction on the low level intake.	X	X	X	X	
10	Concerning the RN essential and non-essential headers:					
	• List the loads supplied by each header	X	X	X	X	
	• Identify which loads are automatically supplied on a Blackout, Safety injection and/or Phase B.	X	X	X	X	X
11	Explain the reason for **NOT** isolating the auxiliary building non-essential header on a Blackout signal.	X	X	X	X	X
12	Describe the operation including any interlocks for the following valves: • RN42A (AB Non Ess Supply Isol) • RN-70A (171B) (A(B) D/G Supply Isol) • 1RN1 (Low Level Intake Isolation) • Engineering Safeguards Modulating Control Valves and Reset Circuitry		X	X	X	X
13	Given a parameter associated with the RN system, describe the indications for that parameter.	X	X	X	X	
14	Given a Limit and Precaution associated with the RN System, discuss its basis and when it applies.		X	X	X	X

4) Supplies assured makeup for the following systems:
   - Auxiliary Feedwater (CA)
   - Component Cooling (KC)
   - Spent Fuel Pool Cooling (KF)
   - Diesel Generator Cooling (KD)

The RN return from the NS heat exchangers is monitored for radioactivity by EMF-45A & B to detect tube leakage. The NS heat exchangers have a wet lay-up loop associated with the shellside (RN) of the heat exchanger **(Refer to Drawing 7.7).** This wet lay-up loop was added to help reduce corrosion buildup on the shellside of the HX. The 2B NS heat exchanger wet lay up loop is on the tube side of the heat exchanger. This system is non-safety related and in case of a break in the system there are flow limiting orifices on the suction and discharge sides. This system is primarily the responsibility of the Chemistry Dept. with the exception of the isolation valves directly off the RN piping which will be Operations. The wet lay up system will normally be in service with the isolation valves open and the heat exchanger water solid. The recirc. pump will be run for sampling purposes and chemical additions as necessary.

The RN **Reactor Building non-essential header** is not redundant and is isolated on an S_P (Phase B) signal, when it is being supplied from the 'A' RN header. If 'B' train is supplying the header, flow will be lost to the NCP coolers on a BO or SS. This header contains the NCP motor coolers **(Refer to Drawing 7.6).** Loss of RN to the NCP motor cooler(s) requires the operator to trip the effected NCP(s).

Objective # 11

The RN **Auxiliary Building non-essential header** is not redundant and is isolated on an S_S signal. The components supplied by this header are: **(refer to Drawing 7.6)**

- Reciprocating Charging Pump Bearing oil cooler
- Reciprocating Charging Pump Fluid Drive oil cooler

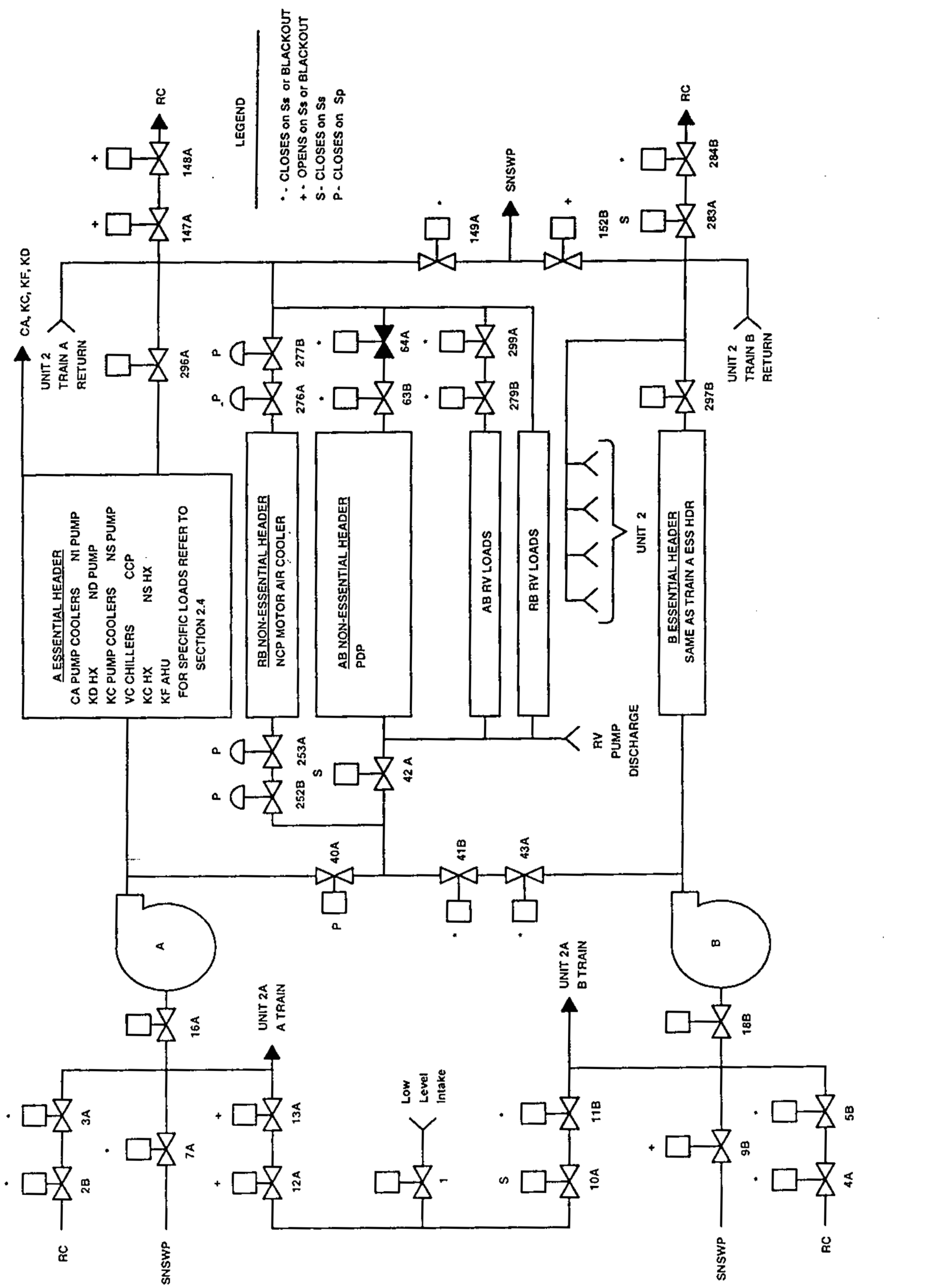
Note: The Steam Generator Blowdown Heat Exchanger has been flanged out and "abandoned in place" for Unit #1 (NSM 12430) and Unit #2 (NSM 22430).

Due to both units alignment to the RL Header, a cross-tie is created between the units through a 6 inch line. **(Refer to drawing 7.4)**

The reason that the Auxiliary Building non-essential header supply isolation valve (RN42) is <u>**NOT**</u> closed during a Blackout is to allow "A" RN pump supply the Reactor Building ventilation units **(refer to Drawing 7.11).** The "A" RN pump will have a greater NPSH since it will be supplied by the LLI . Also it is likely under Blackout conditions the RV pumps will not have power.

Due to fouling problems and repeated maintenance on the PD pump heat exchanger a decision was made to isolate the Aux. Bldg. non-essential header. As a result the normal position of 1RN-64 will be closed. When it is necessary to start/stop the PD pump 1RN -64 will be opened/closed per the NV procedure.

7.6 RN System Simplified Diagram (2/19/02)



CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2.0	2.0	3.0	3.0	

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Concerning the Reactor Coolant Pumps/Motors: • State the purpose of the Reactor Coolant Pump. • State the purpose of the motor flywheel. • State the purpose of the NC Pump thermal barrier and heat exchanger. • State the purpose of the NC Pump Motor Oil Lift System. • State the purpose of the NC Pump seals.	X	X	X	X	
2	Discuss the basic operation of the Anti Reverse Rotation Device associated with each motor.	X	X	X	X	
3	Describe two reasons for using an Anti Reverse Rotation Device on a NC Pump.		X	X	X	X
4	Discuss any operational concerns with: • Loss of Thermal Barrier Heat Exchanger flow while maintaining Seal Injection flow • Loss of Seal Injection flow while maintaining Thermal Barrier Heat Exchanger flow. • Loss of Seal Injection with a loss of Thermal Barrier Heat Exchanger flow.	X	X	X	X	X
5	Describe the operation of the Thrust Bearing including how it functions as a pump to move oil through the oil cooler.	X	X	X	X	
6	Concerning the Oil Lift Pumps: • Explain the normal start/stop operation • Describe what happens to the running Oil Lift Pump if the associated NCP failed to start? (Safety breaker re-opens)		X	X	X	X
7	Discuss the various cooling water supplies to the Reactor Coolant Pump and Motor and the origin of each supply.	X	X	X	X	

1.0 INTRODUCTION

1.1 Purpose

Objective #1

The Reactor Coolant Pump (NCP) serves to circulate the coolant through the Reactor Coolant System in order to transfer heat from the Reactor to the Steam Generators.

The NCP's are designed to provide sufficient flow rate so as to maintain DNBR (Departure from Nuclide Boiling Ratio) greater than design DNBR.

1.2 General Description

The NCP consists of three major sections: Motor, Pump and Seal sections.

Objective #7

The **Motor Section** utilizes three oil cooled bearings: an upper radial bearing, a lower radial bearing and a thrust bearing. The motor windings are air cooled. The air is cooled by an air/water heat exchanger supplied by the Nuclear Service Water System (RN). On top of the motor there is a flywheel and an anti-reverse rotation device. An oil lift system is provided to supply oil to the upper bearings prior to NCP start.

Objective #1

The **Seals Section** consists of a 3 seal arrangement that seals the NC system water from atmosphere by utilizing seal injection water from the NV System.

The **Hydraulic Section (pump)** consists of a single stage, centrifugal pump which delivers approximately 101,000 gpm per pump. The pump develops 279 ft (121 psid) of head at design flow.

2.0 COMPONENT DESCRIPTION

All four NC pumps are identical single-speed, motor driven centrifugal, shaft seal units. The shaft is vertical with the motor mounted above the pumps. The NC pumps function to ensure an adequate core cooling flow rate and hence sufficient heat transfer to prevent DNB. All parts of the pump in contact with the reactor coolant are austenitic stainless steel except for seals, bearings and special parts.

The pump shaft, seal housing, thermal barrier, main flange, and impeller can be removed from the casing as a unit without disturbing the NC piping. The pumps are capable of operation without mechanical damage at overspeeds up to and including 125 % of normal speed.

The pumps consist of three areas from bottom to top. They are the hydraulics (pump), the shaft seals, and the motor.

The **Lower Bearing Assembly** consists of an oil cooled radial guide bearing. The entire bearing assembly is located in the lower oil reservoir (25-gallon capacity). The lower oil reservoir is cooled by the Component Cooling Water System (KC). Both the upper and lower bearing coolers are provided with high and low bearing water flow alarms to alert the operator of abnormal conditions.

To prevent oil leakage problems, all oil carrying pipes and assemblies, at the lower bearing area, are located inside the motor air frame. All oil carrying pipes and assemblies, at the upper bearing area, are located inside a shroud external to the frame. The upper oil cooler, for water leak protection, is a double tube-double tube sheet design and is also inside the upper shroud.

The **NC Pump Oil Level Monitoring System** provides a means to remotely monitor the upper and lower motor bearing oil levels for each NC Pump. The system uses a Linear Variable Differential Transformer (LVDT) as a level sensor. The LVDT's produce an analog signal that is used to display actual oil level on an OAC Graphic as well as high and low level alarms. Oil level instrumentation is not Safety Related.

Objective #1

The top of the motor consists of a **Flywheel** with an anti-reverse rotation device. The flywheel (weighing approximately 15,000 lbs) on the shaft above the motor in conjunction with the impeller and motor assembly, provides additional inertia to extend pump coastdown time following a loss of power to ensure DNB limits are not exceeded. This extended coastdown time allows for a power source swapover. Sufficient pump rotation inertia is provided to allow adequate flow during coastdown. This flow following an assumed loss of pump power provides the core with adequate cooling.

The flywheel stores enough inertia to hold the 6.9 KV bus frequency and voltage up at a sufficient level allowing an automatic fast transfer of the bus to take place. The 6.9 KV bus automatic fast transfer feature is interlocked with NC Pump operation such that the NC Pumps fed from the faulted zone must have been running prior to the fault occurring to allow an automatic fast transfer.

The NC Pumps are required to be in operation because with no pumps running, bus voltage and frequency will decrease at a rate faster than the transfer scheme can operate. If frequency has decreased > 8 cycles, the closure of a 6.9KV breaker can cause severe damage due to the ratio of voltage and frequency. By the flywheel giving its energy back to the electrical system, voltage and frequency are held at a higher level for a longer period of time insuring the transfer can take place within that 8 cycle span. This minimizes the potential damage to the 6.9KV Normal and Standby Breakers during the power transfer.

Objective # 2 & 3

An **Anti-Reverse Rotation Device** is mounted on the motor flywheel. It functions to prevent the pump from rotating in the reverse direction for two reasons.

1. Preventing pump reverse rotation reduces the time required for the motor to achieve rated speed. If a motor is rotating in the reverse direction and started, first the reverse rotation must be stopped and then the motor must accelerate to rated speed. This extended period of time that the starting current must be applied may cause damage to the motor from overheating.

1 Pt. Unit 2 was operating at 100% power with the Pressurizer Pressure Control Switch in the '1-2' position and NC pressure in the normal operating band. Given the following plant conditions and events:

- NC pressure increases
- PORVs 1NC 32B and NC 36B open at 2335 psig
- Pressure modulates between 2315 psig and 2335 psig.

Which one of the following instrument failures would cause this plant response and what is the correct operator action perAP/11 (*Pressurizer Pressure Anomalies*)?

A. **PZR pressure channel I fails high**
Immediately swap controlling channels

B. **PZR pressure channel II fails low**
Place Pressurizer Pressure Master in Manual

C. **PZR pressure channel I fails low**
Place Pressurizer Pressure Master in Manual

D. **PZR pressure channel II fails high**
Immediately swap controlling channels.

Bank Question: 1024 ***Answer: C***

1 Pt. Unit 2 was operating at 100% power with the Pressurizer Pressure Control Switch in the '1-2' position and NC pressure in the normal operating band. Given the following plant conditions and events:

- NC pressure increases
- PORVs 1NC 32B and NC 36B open at 2335 psig
- Pressure modulates between 2315 psig and 2335 psig.

Which one of the following instrument failures would cause this plant response and what is the correct operator action perAP/11 (*Pressurizer Pressure Anomalies*)?

A. **PZR pressure channel I fails high**
Immediately swap controlling channels

B. **PZR pressure channel II fails low**
Place Pressurizer Pressure Master in Manual

C. **PZR pressure channel I fails low**
Place Pressurizer Pressure Master in Manual

D. **PZR pressure channel II fails high**
Immediately swap controlling channels.

Distracter Analysis:

A. **Incorrect**: - channel I failing high causes pressure to decrease
Plausible: -

B. **Incorrect answer** – *If a channel II fails low you immediately swap* controlling channels.

C. **Correct**:

D. **Incorrect**: -
Plausible: -

Level: RO Only

KA: APE 027 AK3.03 (3.7/4.1)

Lesson Plan Objective: PS-IPE Obj. 12

Source: NEW

Author: CWS

Level of knowledge: comprehension

References:
1. OP-MC-PS-IPE page 35

APE: 027 Pressurizer Pressure Control System (PZR PCS) Malfunction

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Pressurizer Pressure Control Malfunctions: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Definition of saturation temperature	3.1	3.4
AK1.02	Expansion of liquids as temperature increases	2.8	3.1
AK1.03	Latent heat of vaporization/condensation	2.6	2.9
AK2.	**Knowledge of the interrelations between the Pressurizer Pressure Control Malfunctions and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.1	2.2
AK2.02	Sensors and detectors	2.4	2.6
AK2.03	Controllers and positioners	2.6	2.8
AK2.04	Pumps	1.9	2.1
AK2.05	Motors	1.8	2.0
AK3.	**Knowledge of the reasons for the following responses as they apply to the Pressurizer Pressure Control Malfunctions: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Isolation of PZR spray following loss of PZR heaters	3.5*	3.8
AK3.02	Verification of alternate transmitter and/or plant computer prior to shifting flow chart transmitters	2.9*	3.0
AK3.03	Actions contained in EOP for PZR PCS malfunction	3.7*	4.1
AK3.04	Why, if PZR level is lost and then restored, that pressure recovers much more slowly	2.8	3.3

ABILITY

K/A NO.	ABILITY	IMPORTANCE RO	IMPORTANCE SRO
AA1.	**Ability to operate and / or monitor the following as they apply to the Pressurizer Pressure Control Malfunctions: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	PZR heaters, sprays, and PORVs	4.0	3.9
AA1.02	SCR-controlled heaters in manual mode	3.1*	3.0
AA1.03	Pressure control when on a steam bubble	3.6	3.5
AA1.04	Pressure recovery, using emergency-only heaters	3.9*	3.6*
AA1.05	Transfer of heaters to backup power supply	3.3*	3.2*

10.	Describe all alarms, control functions, and interlocks generated by pressurizer pressure which are not controlled by the Pressurizer Master Controller (include setpoints).		X	X	X	X
11.	Describe the protection (signals, setpoints, permissives) associated with Pressurizer pressure (logic not required).		X	X	X	X
12.	*For any Pressurizer Pressure Control System input signal failure, determine the effect and evaluate operator action to be taken.*			X	X	X
13.	Concerning the Technical Specifications related to the Pressurizer Pressure Control System:					
	• Given the LCO title, state the LCO (including any COLR values) and applicability.			X	X	X
	• For any LCO's that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any Tech. Spec. LCO's is (are) not met and any action(s) required within one hour.			X	X	X
	• Given a set of parameters or system conditions and the appropriate Tech Spec, determine the required action(s)			X	X	X
	• Discuss the bases for a given Tech. Spec. LCO or Safety Limit *** SRO ONLY**				X	*

3.2 Abnormal and Emergency Operation

3.2.1 Instrument Channel Failures

Objective #12

The following table covers Pzr pressure channel failures, the effect of the failure, and the appropriate Operator action to take for the failure. NOTE: The table assumes the Pzr Pressure Control Switch is in the 1-2 position prior to the failure.

CHANNEL	FAILURE	EFFECT	OPERATOR ACTION
I	HIGH	• Sprays will open fully • PORV NC34 will open With no Operator Action • Actual pressure decreases • PORV 34 closes @ 2185 psig • Low Press Rx Trip @ 1945 psig • Low Press SI @ 1845 psig	**Note**: Consult T. S. for all instr. failures. Select Position 3-2
	LOW	• All heaters on fully • Sprays will close (if open) • PORV NC34 will not open With no Operator Action • Press increases until PORV's 32&36 open @ 2335 psig • Press modulates 2335-2315 psig as PORV's cycle	Select Position 3-2
II	HIGH	• PORV's NC32 and 36 will open With no Operator Action • PORV's will be blocked closed @ 2185 as actual pressure decreases • Press Master Controller output will decrease, turning on Backup Heaters	Select Position 1-4
	LOW	• PORV's 32&36 will not auto open	Select Position 1-4
III	HIGH	• PORV's 32&36 will remain unblocked below 2185 psig	NONE
	LOW	• PORV's 32&36 will not open (in auto)	NONE
IV	HIGH	• PORV 34 remains unblocked below 2185 psig	NONE
	LOW	• PORV NC34 will not open (in auto)	NONE

1 Pt. Unit 1 is operating at 100% power when a small break LOCA occurs.

Given the following

a) Reactor Trip and Safety Injection Actuated
b) E-0 (*Reactor Trip or Safety Injection*) completed
c) Crew has exited E-0 to E-1 (*Loss of Reactor or Secondary Coolant*)
d) Both trains of ECCS equipment is functioning normally
e) Subcooling is 0 degrees
f) Pressurizer level is 2%
g) Containment pressure is 2.5 psig

Which one of the following should be the status of the reactor coolant pumps?

A. The reactor coolant pumps should still be running to provide forced cooling through the core.

B. The reactor coolant pumps should be stopped to prevent excessive depletion of the NC system water inventory.

C. The reactor coolant pumps should still be running to refill the pressurizer in order to terminate Safety Injection flow.

D. The reactor coolant pumps should be stopped to prevent pump damage due to loss of pump support systems.

Bank Question: 1025 ***Answer: B***

1 Pt. *Unit 1 is operating at 100% power when a small break LOCA occurs.*

Given the following

a) Reactor Trip and Safety Injection Actuated
b) *E-0 (Reactor Trip or Safety Injection)* completed
c) Crew has exited E-0 to E-1 (*Loss of Reactor or Secondary Coolant*)
d) Both trains of ECCS equipment is functioning normally
e) Subcooling is 0 degrees
f) Pressurizer level is 2%
g) Containment pressure is 2.5 psig

Which one of the following should be the status of the reactor coolant pumps?

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B. The reactor coolant pumps should be stopped to prevent excessive depletion of the NC system water inventory.

C. The reactor coolant pumps should still be running to refill the pressurizer in order to terminate Safety Injection flow.

D. The reactor coolant pumps should be stopped to prevent pump damage due to loss of pump support systems.

Distracter Analysis:

A. Incorrect – NCP should be stopped on loss of subcooling

B. Correct.

C. Incorrect

D. Incorrect: Do not lose support systems on 2.5 # in containment.

Level: RO

KA: APE 009 EK3.13 (3.4/3.7)

Lesson Plan Objective: OP-MC-EP-ECA-0 Obj. 4

Source: New

Level of knowledge: Comprehensive

Author: CWS

References:
1. OP-MC-EP-E1 page 53

EPE: 009 Small Break LOCA

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the small break LOCA:** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Natural circulation and cooling, including reflux boiling	4.2	4.7
EK1.02	Use of steam tables	3.5	4.2
EK2	***Knowledge of the interrelations between the small break LOCA and the following:*** (CFR 41.7 / 45.7)		
EK2.01	Valves	2.2	2.3
EK2.02	Pumps	2.3	2.6*
EK2.03	S/Gs	3.0	3.3*
EK2.04	Sensors and detectors	2.3	2.6
EK3	**Knowledge of the reasons for the following responses as the apply to the small break LOCA:** (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	CCW System automatic isolation on high delta flow/ temperature to RCP thermal barrier	3.1*	3.6*
EK3.02	Opening excess letdown isolation valve	2.8*	3.2*
EK3.03	Reactor trip and safety initiation	4.1	4.4
EK3.04	Starting additional charging pumps	4.1	4.3
EK3.05	CCWS radiation alarm	3.4	3.8
EK3.06	RCS inventory balance	3.9	4.0
EK3.07	Increasing indication on CCWS process monitor: indicates in-leakage of radioactive liquids	3.3	3.6
EK3.08	PTS limits on RCS pressure and temperature - NC and FC	3.6	4.1
EK3.09	Closing CCW surge tank vent	3.1*	3.4*
EK3.10	Observation of PZR level	3.4	3.6
EK3.11	Dangers associated with inadequate core cooling	4.4	4.5
EK3.12	Letdown isolation	3.4	3.7
EK3.13	**Stopping the affected RCP**	3.4	3.7
EK3.14	Monitoring RCP lower bearings	3.1	3.2
EK3.15	Closing of RCP thermal barrier outlet valves	3.2	3.2
EK3.16	Containment temperature, pressure, humidity and level limits	3.8	4.1
EK3.17	Automatic isolation of containment	4.0	4.3
EK3.18	Monitoring containment radiation levels	3.9	4.3
EK3.19	Operator initiation of containment vent isolation/indication	3.6?	3.9?
EK3.20	Tech-Spec leakage limits	3.5	4.3
EK3.21	Actions contained in EOP for small break LOCA/leak	4.2	4.5
EK3.22	Maintenance of heat sink	4.4	4.5
EK3.23	RCP tripping requirements	4.2	4.3
EK3.24	ECCS throttling or termination criteria	4.1	4.6
EK3.25	Monitoring of in-core T-cold	3.6	3.9
EK3.26	Maintenance of RCS subcooling	4.4	4.5
EK3.27	Manual depressurization or HPI recirculation for sustained high pressure	3.6	3.8
EK3.28	Manual ESFAS initiation requirements	4.5	4.5

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		1.5	1.5	1.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the ECA-0 series. EPECA001			X	X	
2	Discuss the entry and exit guidance for each procedure in the ECA-0 series. EPECA002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the ECA-0 series. EPECA003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the ECA-0 series. EPECA004			X	X	X
5	*Describe the immediate actions* and include the RNO when appropriate. EPECA005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPECA006			X	X	X
7	Discuss the time critical task(s) associated with the ECA-0 series procedures including the time requirements and the basis for these requirements. EPECA007			X	X	X

STEP 21 Consult plant management to evaluate long term plant status

PURPOSE: To determine long term plant status and future recovery actions.

BASIS: The equipment needed to function following a LOCA has been designed so that operation for extremely long times is possible. This allows the plant engineering staff time to evaluate the event and develop recovery procedures so that the plant can be repaired and brought back to service.

3.5. E-1 Enclosures

Enclosure 1, Foldout

1. NC Pump Trip Criteria

- **IF** the following conditions are satisfied, **THEN** trip all NC pumps while maintaining seal injection flow:
  - At least one NV or NI pump on
  - NC subcooling based on core exit T/Cs less than or equal to 0°F.

BASIS: Tripping the NC pumps, when the trip criteria is reached during accident conditions, is done to prevent excessive depletion of NC System water inventory through a small break in the NC System which might lead to severe core uncovery if the NC pumps were tripped for some reason later in the accident.

The effectiveness of the NC Pump #1 seal is not affected by pump rotation. To ensure continued performance of the seal, cool filtered water should be continuously supplied. The operator should not isolate the seal injection lines unless directed to in the procedures.

2. S/I Reinitiation Criteria

IF NC subcooling based on core exit T/Cs is less than 0°F OR Pzr level cannot be maintained greater than 11% (29% ACC), **THEN** start S/I pumps and realign NV S/I flowpath (suction, discharge, isolate normal charging) as necessary to restore subcooling and level.

BASIS: While in this procedure, S/I may be terminated if the proper conditions are established. The reinitiation criteria are included on the foldout page in case conditions deteriorate and require manual operation of S/I pumps.

1 Pt. Unit 2 is operating at 100% power when the following occurs:

- Loss of offsite power
- Neither Diesel Generator starts
- ECA-0.0 (*Loss of All AC Power*) is in effect
- *Standby Makeup pump for unit 2 tagged for maintenance*
- Reactor Coolant Pump seal injection valves have been closed

Twenty minutes later power is restored to Unit 2 ETA from Unit 1, and the crew enters ECA-0.1 (*Loss of All AC Power Recovery Without S/I Required).*

Which of the following best describes the proper method for restoring NCP seal flows in ECA-0.1?

A. Slowly restore seal injection cooling limiting the cooldown rate to 1 degree per minute

B Do not restore seal injection cooling due to potential damage to the KC thermal barrier heat exchanger.

C Restore seal injection cooling as rapidly as possible to minimize the potential for seal degradation.

D. Do not restore seal injection cooling due to potential damage of thermal shock to the reactor coolant pump seals.

Bank Question: 1026 ***Answer: D***

1 Pt. Unit 2 is operating at 100% power when the following occurs:

- Loss of offsite power
- Neither Diesel Generator starts
- ECA-0.0 (*Loss of All AC Power*) is in effect
- Standby Makeup pump for unit 2 tagged for maintenance
- Reactor Coolant Pump seal injection valves have been closed

Twenty minutes later power is restored to Unit 2 ETA from Unit 1, and the crew enters ECA-0.1 (*Loss of All AC Power Recovery Without S/I Required).*

Which of the following best describes the proper method for restoring NCP seal flows in ECA-0.1?

A. Slowly restore seal injection cooling limiting the cooldown rate to 1 degree per minute

B Do not restore seal injection cooling due to potential damage to the KC thermal barrier heat exchanger.

C Restore seal injection cooling as rapidly as possible to minimize the potential for seal degradation.

D. Do not restore seal injection cooling due to potential damage of thermal shock to the reactor coolant pump seals.

Distracter Analysis:

A. Incorrect – old procedure guidance

B. Incorrect do not restore seal cooling after needle valves closed.

C. Incorrect do not restore seal cooling after need le vavles closed

D. Correct

Level: RO

KA: APE 022 AK1.01 (2.8/3.2)

Lesson Plan Objective: OP-MC-EP-ECA-0 Obj. 3

Source: New

Level of knowledge: Comprehension

Author: CWS

References:
1. OP-MC-EP-ECA-0 page 79

APE: 022 Loss of Reactor Coolant Makeup

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to *Loss of Reactor Coolant Pump* Makeup: CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Consequences of thermal shock to RCP seals	2.8	3.2
AK1.02	Relationship of charging flow to pressure differential between charging and RCS	2.7	3.1
AK1.03	Relationship between charging flow and PZR level	3.0	3.4
AK1.04	Reason for changing from manual to automatic control of charging flow valve controller	2.9	3.0
AK2.	**Knowledge of the interrelations between the Loss of Reactor Coolant Pump Makeup and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.4	2.4
AK2.02	Sensors and detectors	1.9	2.1
AK2.03	Controllers and positioners	2.2	2.3
AK2.04	Pumps	2.3	2.3
AK2.05	Motors	2.1	2.1
AK2.06	Heat exchangers and condensers	1.9	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Reactor Coolant Pump Makeup: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Adjustment of RCP seal backpressure regulator valve to obtain normal flow	2.7	3.1
AK3.02	Actions contained in SOPs and EOPs for RCPs, loss of makeup, loss of charging, and abnormal charging	3.5	3.8
AK3.03	Performance of lineup to establish excess letdown after determining need	3.1*	3.3*
AK3.04	Isolating letdown	3.2	3.4
AK3.05	Need to avoid plant transients	3.2	3.4
AK3.06	RCP thermal barrier cooling	3.2	3.3
AK3.07	Isolating charging	3.0*	3.2

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		1.5	1.5	1.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the ECA-0 series. EPECA001			X	X	
2	Discuss the entry and exit guidance for each procedure in the ECA-0 series. EPECA002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the ECA-0 series. EPECA003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the ECA-0 series. EPECA004			X	X	X
5	Describe the immediate actions and include the RNO when appropriate. EPECA005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPECA006			X	X	X
7	Discuss the time critical task(s) associated with the ECA-0 series procedures including the time requirements and the basis for these requirements. EPECA007			X	X	X

4.3.2. Establish NC Pump Seal Cooling

The loss of all AC power event is accompanied by the loss of NC pump seal cooling and subsequent heatup of the NC pump seals. ECA-0.0 includes actions intended to:

1. Mitigate heatup and associated potential degradation of the NC pump seals during the loss of AC power, and
2. Protect the NC pump seals by preventing rapid restoration of seal cooling and associated thermal stress damage to the NC pump shafts and seals following restoration of AC emergency power. Since seal degradation due to heatup is in part a time dependent concern, NC pump seal cooling should be restored as soon as possible following restoration of AC power and in a manner that will minimize potential NC pump damage. Consequently, the second major action category in ECA-0.1 is to establish NC pump seal cooling.

Steps 3 and 18 of ECA-0.1 function to restore NC pump seal cooling (if lost) in a manner that will minimize potential NC pump damage. Step 3 checks the standby makeup pump on. In the event, the standby pump is off, the RNO ensures seal injection to the NC pumps is isolated before a NV pump is started. This step protects the NC pump shafts and seals from potential damage due to a rapid restoration of seal injection cooling. Step 18 RNO restores NC pump seal cooling in a controlled manner consistent with the objective of minimizing NC pump thermal stresses and potential damage to NC pump shafts and seals.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
15. **Isolate NC pump seals as follows:**	
__ a. Have operator at SSF close 1NV-94AC (NC Pumps Seal Ret Cont Inside Isol).	__ a. Dispatch operator to close 1NV-95B (NC Pumps Seal Ret Cont Outside Isol) (aux bldg, 733, DD-52, room 602A, midget hole, 2.5 ft from ceiling).
__ b. Have operator at SSF check standby makeup pump - ON.	b. Dispatch operator to close the following valves: __ • 1NV-28 (A NC Pump Seal Water Manual Control) (aux bldg, 733, VCT hallway at reactor bldg wall) __ • 1NV-44 (B NC Pump Seal Water Manual Control) (aux bldg, 733+2, HH-52, VCT hallway at reactor bldg wall) __ • 1NV-60 (C NC Pump Seal Water Manual Control) (aux bldg, 733+2, JJ-51, VCT hallway 15 ft southwest of BIT) __ • 1NV-76 (D NC Pump Seal Water Manual Control) (aux bldg, 716+14, JJ-51, room 603, 4 ft from reactor building wall) __ • 1KC-425A (NC Pumps Ret Hdr Cont Outside Isol) (aux bldg, 750+9, HH-52, room 817, 10 ft south of UHI blue valves).
16. **Check ND System status:**	
__ a. ND System - IN RHR MODE AT TIME OF LOSS OF POWER.	__ a. <u>GO TO</u> Step 17.
__ b. <u>REFER TO</u> AP/1/A/5500/19 (Loss of ND or ND System Leak).	

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
26. **Check S/I flow not required:**	
__ a. NC subcooling based on core exit T/Cs - GREATER THAN 0° F.	__ a. <u>GO TO</u> EP/1/A/5000/ECA-0.2 (Loss Of All AC Power Recovery With S/I Required).
__ b. Pzr level - GREATER THAN 11% (29% ACC).	b. Perform the following: __ 1) Control charging flow to maintain Pzr level. __ 2) <u>IF</u> Pzr level can not be maintained, **<u>THEN GO TO</u>** EP/1/A/5000/ECA-0.2 (Loss Of All AC Power Recovery With S/I Required).
__ 27. **<u>REFER TO</u> AP/1/A/5500/07 (Loss Of Electrical Power).**	
__ 28. **Check NC pump seal injection - ESTABLISHED.**	**Notify station management that:** __ • NC pump seal injection and thermal barrier cooling will be left isolated. __ • Cooldown of NC pump seals will occur as the entire NC sytem is cooled down. Timely performance of natural circ cooldown in subsequent procedures will minimize risk of NC pump seal degradation.
__ 29. <u>GO TO</u> EP/1/A/5000/ES-0.2 (Natural Circulation Cooldown).	

<u>END</u>

1 Pt. Unit 1 has experienced a large break LOCA.

Given the following conditions:

- E-0 (*Reactor Trip or Safety Injection*) is complete
- ES 1.3 (*Transfer to Cold Leg Recirc*) is complete
- Six hours have elapsed since the LOCA and ES 1.4 (*Hot Leg Recirc*) is being implemented.
- 1NI-121A (Train 'A' NI to B & C Hot Leg) will not open due to mechanical binding.
- ND train 'A' has been aligned for Hot Leg Recirc.

Which of the following best describes the effects on the ND system if the 'A' ND pump trips?

A. Flow is lost to the 'A' and 'B' hot legs

B. Flow is lost to the 'A', 'B', 'C' and 'D' hot legs

C. Flow is lost to the 'B' and 'C' hot legs

D. Flow is lost to 'A' and 'D' hot Legs

Bank Question: 1027 **_Answer: C_**

1 Pt. Unit 1 has experienced a large break LOCA.

Given the following conditions:

- E-0 (*Reactor Trip or Safety Injection*) is complete
- ES 1.3 (*Transfer to Cold Leg Recirc*) is complete
- Six hours have elapsed since the LOCA and ES 1.4 (*Hot Leg Recirc*) is being implemented.
- 1NI-121A (Train 'A' NI to B & C Hot Leg) will not open due to mechanical binding.
- ND train 'A' has been aligned for Hot Leg Recirc.

Which of the following best describes the effects on the ND system if the 'A' ND pump trips?

A. Flow is lost to the 'A' and 'B' hot legs

B. Flow is lost to the 'A', 'B', 'C' and 'D' hot legs

C. Flow is lost to the 'B' and 'C' hot legs

D. Flow is lost to 'A' and 'D' hot Legs

Distracter Analysis:

A. Incorrect – This is alignment for CLR

B. Incorrect all legs are not aligned for hot leg recirc

C. Correct

D. Incorrect flow is not go aligned to "A" and "D" hot legs

Level: RO

KA: APE 025 AK2.02 (3.2*/3.2)

Lesson Plan Objective: OP-MC-PS-ND Obj. 8

Source: New

Level of knowledge: memory

Author: CWS

References:
1. OP-MC-PS-ND pages 51 & 73

APE: 025 Loss of Residual Heat Removal System (RHRS)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Residual Heat Removal System: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Loss of RHRS during all modes of operation	3.9	4.3
AK2.	**Knowledge of the interrelations between the Loss of Residual Heat Removal System and the following: (CFR 41.7 / 45.7)**		
AK2.01	RHR heat exchangers	2.9	2.9
AK2.02	LPI or Decay Heat Removal/RHR pumps	3.2*	3.2
AK2.03	Service water or closed cooling water pumps	2.7	2.7
AK2.04	Raw water or sea water pumps	2.4	2.4
AK2.05	Reactor building sump	2.6	2.6
AK2.06	Valves	2.2	2.1
AK2.07	Sensors and detectors	2.1	2.2
AK2.08	Controllers and positioners	2.2	2.2
AK2.09	Pumps	2.2	2.2
AK2.10	Motors	1.8	1.7
AK2.11	Heat exchangers and condensers	2.1*	2.1
AK2.12	Breakers, relays, and disconnects	1.7	1.8
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Residual Heat Removal System: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Shift to alternate flowpath	3.1	3.4
AK3.02	Isolation of RHR low-pressure piping prior to pressure increase above specified level	3.3	3.7
AK3.03	Immediate actions contained in EOP for Loss of RHRS	3.9	4.1

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Explain the operation and flowpaths for normal cooldown, emergency injection and recirculation phases for the ND System. PSND008	X	X	X	X	X
9	Given a Limit and Precaution associated with the ND System, discuss its basis and when it applies. PSND009		X	X	X	X
10	Concerning AP/1or 2/A/5500/19; Loss of ND or ND System Leakage, explain the purpose of the AP PSND010			X	X	
11	Concerning the Technical Specifications related to the ND System:					
	• Given the LCO title, state the LCO (including any COLR values) and applicability.			X	X	X
	• For any LCO's that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any Tech Spec LCO's is(are) not met and any action(s) required within one hour.			X	X	X
	• Given a set of parameter values or system conditions and the appropriate Tech Spec, determine required action(s).			X	X	X
	• Discuss the bases for a given Tech. Spec. LCO or Safety Limit.				X	*
	* **SRO ONLY** PSND011					

3.2.5 Hot Leg Recirc

During emergency situations at high boron concentrations, flow through the core in one direction for extended periods of time will cause a stratification of boron on the surfaces of the fuel assemblies and in the flow channels. Hot leg recirc will reverse the flow through the core and will "flush" the surfaces putting the boron back into solution. EP/1/A/5000/E-1 directs the operator to **align the NI system for hot leg recirc six (6) hours after the initiation of the event. If the NI system can not be aligned, the ND system will be aligned for Hot Leg Recirc. The flow path for hot leg recirc is as follows: (refer to drawing 7.7)**

- **the ND system takes a suction on the containment sump through NI-184B and NI-185A to the ND pumps**
- **from the ND pumps through the ND heat exchangers**
- **from the ND heat exchangers, the flow divides to: (1) through ND-58A to the NV pumps' suctions, (2) through NI-136B to the NI pumps' suctions, (3) to the containment auxiliary spray header ring through NS-43A and NS-38B, and (4) to ND-29 and ND-14**
- **from ND-29 and ND-14 through ND-30A and ND-15B through NI-183B to the NCS hot legs.**

The ND system will be swapped from hot leg to cold leg recirc. as needed at the discretion of the TSC. For more information on the hot leg recirc alignment refer to EP/1 or 2/A/5000/ES-1.4 (Transfer to Hot Leg Recirc).

4.0 TECHNICAL SPECIFICATIONS AND SELECTED LICENSEE COMMITMENTS

Objective # 11

4.1 Tech Spec 3.4.6 RCS Loops – MODE 4

4.2 Tech Spec 3.4.7 RCS Loops – MODE 5, Loops Filled

4.3 Tech Spec 3.4.8 RCS Loops – MODE 5, Loops Not Filled.

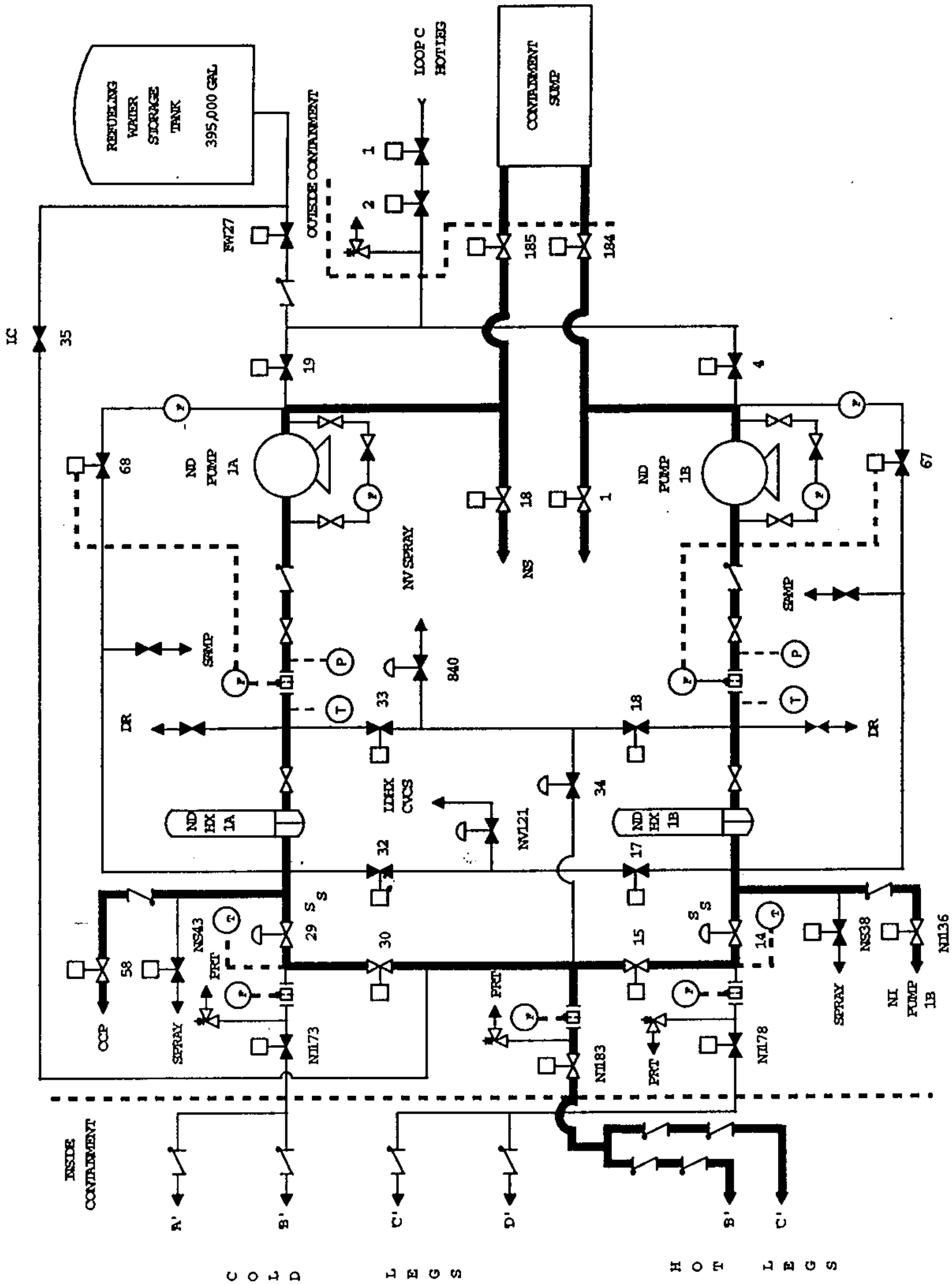
4.4 Tech Spec 3.5.2 ECCS - Operating

4.5 Tech Spec 3.5.3 ECCS - Shutdown

4.6 Tech Spec 3.9.5 Residual Heat Removal (RHR) and Coolant Circulation - High Water Level

4.7 Tech Spec 3.9.6 Residual Heat Removal (RHR) and Coolant Circulation - Low Water Level

7.7, ND Alignment for NCS Hot Leg Recirc. (03/17/00)



1 Pt. Unit 1 is operating at 100% power when the 'A' Main steam line ruptures outside containment and depressurizes the 'A' S/G.

Which of the following describes the logic and coincidence needed to actuate a Main Steam Isolation signal?

A. 1/4 on 1/4 steamlines

B. 2/3 on 2/4 steamlines

C. 1/4 on 2/4 steamlines

D. 2/3 on 1/4 steamlines

Bank Question: 1028 **_Answer: D_**

1 Pt. Unit 1 is operating at 100% power when the 'A' Main steam line ruptures outside containment and depressurizes the 'A' S/G.

Which of the following describes the logic and coincidence needed to actuate a Main Steam Isolation signal?

A. 1/4 on 1/4 steamlines

B. 2/3 on 2/4 steamlines

C. 1/4 on 2/4 steamlines

D. 2/3 on 1/4 steamlines

Distracter Analysis:

A. Incorrect –

B. Incorrect

C. Incorrect

D. Correct

Level: RO

KA: APE 040 AK3.01 (4.2/4.5)

Lesson Plan Objective: OP-MC-ECC-ISE Obj. 13

Source: New

Level of knowledge: memory

Author: CWS

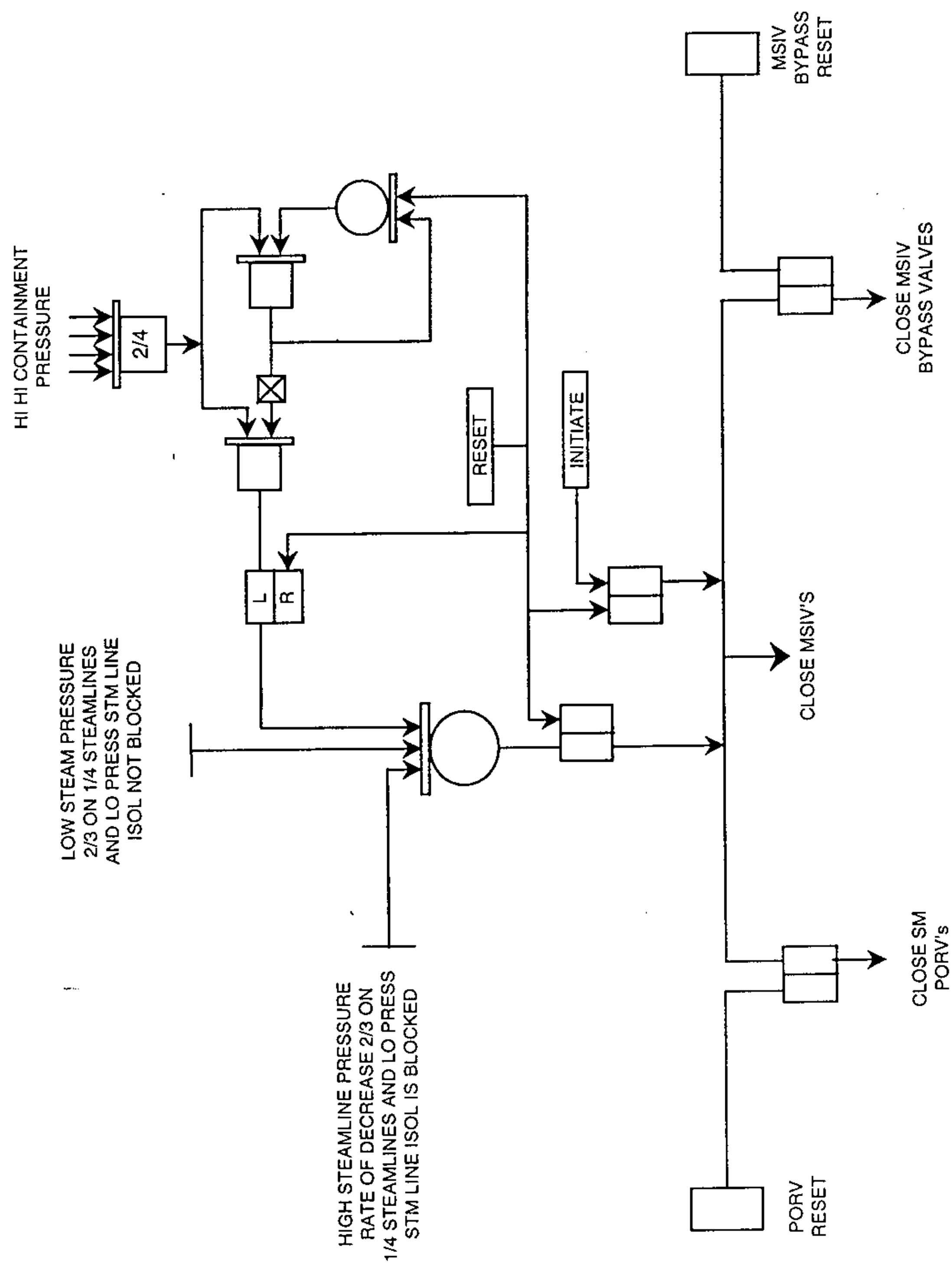
References:
1. OP-MC-ECC-ISE page 65

APE: 040 Steam Line Rupture

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Steam Line Rupture: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Consequences of PTS	4.1	4.4
AK1.02	Leak rate versus pressure change	3.2	3.6
AK1.03	RCS shrink and consequent depressurization	3.8	4.2
AK1.04	Nil ductility temperature	3.2	3.6
AK1.05	Reactivity effects of cooldown	4.1	4.4
AK1.06	High-energy steam line break considerations	3.7	3.8
AK1.07	Effects of feedwater introduction on dry S/G	3.4	4.2
AK2.	**Knowledge of the interrelations between the Steam Line Rupture and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.6*	2.5
AK2.02	Sensors and detectors	2.6*	2.6
AK2.03	Controllers and positioners	2.4*	2.4
AK2.04	Pumps	2.0	2.1
AK2.05	Breakers, relays, and disconnects	1.9	2.1
AK2.06	Motors	2.0	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Steam Line Rupture: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Operation of steam line isolation valves	4.2	4.5
AK3.02	ESFAS initiation	4.4	4.4
AK3.03	Steam line non-return valves	3.2*	3.5*
AK3.04	Actions contained in EOPs for steam line rupture	4.5	4.7
AK3.05	Airlock leak tests	2.1*	2.3
AK3.06	Containment temperature and pressure considerations	3.4	3.9

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
13	List the setpoints, permissives, and logic required to initiate the following: • Containment Spray (NS) Actuation • Phase "B" Isolation • Main Steam Isolation (MSI) • Main Feedwater Isolation (FWI)		X	X	X	X
14	Explain the relationship between SSPS Testing and the operability of the Systems and functions actuated from the Engineered Safety Features Actuation System.		X	X	X	X
15	Discuss the purpose of the ESF Monitor Lite Panel (BOP Panel).		X	X	X	
16	Concerning AP/1 or 2/A/5500/35, ECCS Actuation During Plant Shutdown. • State the purpose of the AP. • Recognize the symptoms that would require implementation of the AP.		X	X	X	X
17	Concerning the Technical Specifications related to the Engineered Safeguards Actuation System:					
	• Given the LCO title, state the LCO (including any COLR values) and applicability.			X	X	X
	• For any LCO's that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any Tech Spec LCO's is (are) not met and any action(s) required within one hour.			X	X	X
	• Given a set of plant parameters or system conditions and the appropriate Tech Specs, determine required actions.				X	X
	• Discuss the bases for a given Tech Spec LCO or Safety Limit.				X	*
	* - SRO Only					

7.11 Main Steam Isolation Logic (8/29/00)



1 Pt. Given the following Unit 1 initial conditions

- 100% power with Tave = Tref
- NC System Boron Concentration 953 ppm
- Control Bank 'D' rods are at 217 steps
- Control Bank 'D' Rod H-8 drops fully into the core
- AP/1A/5500/14 *Rod Control Malfunction* is entered and immediate actions are completed

Thirty minutes after the rod drops

- Load has been reduced to 95% power with Tave = Tref
- NC System Boron Concentration 953 ppm
- Control Bank 'D' rods are at 217 steps
- Rod H-8 has not been retrieved

Which one of the following describes the effect of the event on Rod Insertion Limits and Shutdown Margin?

A. **Rod insertion limit is unchanged and shutdown margin is increased.**

B. **Rod insertion limit is decreased and shutdown margin is unchanged.**

C. **Rod insertion limit is unchanged and shutdown margin is decreased.**

D. **Rod insertion limit is decreased and shutdown margin is decreased.**

Bank Question: 1029 ***Answer: D***

1 Pt. Given the following Unit 1 initial conditions

- *100% power with Tave = Tref*
- NC System Boron Concentration 953 ppm
- Control Bank 'D' rods are at 217 steps
- Control Bank 'D' Rod H-8 drops fully into the core
- AP/1A/5500/14 *Rod Control Malfunction* is entered and immediate actions are completed

Thirty minutes after the rod drops

- Load has been reduced to 95% power with Tave = Tref
- NC System Boron Concentration 953 ppm
- *Control Bank 'D' rods are at 217 steps*
- Rod H-8 has not been retrieved

Which one of the following describes the effect of the event on Rod Insertion Limits and Shutdown Margin?

A. Rod insertion limit is unchanged and shutdown margin is increased.

B. Rod insertion limit is decreased and shutdown margin is unchanged.

C. Rod insertion limit is unchanged and shutdown margin is decreased.

D. Rod insertion limit is decreased and shutdown margin is decreased.

--Distracter Analysis:

A. Incorrect:
Plausible:.
B. Incorrect:.
Plausible:.
C. Incorrect:
D. Correct:
Plausible: .

Level: RO

KA: 000003.AK1.07 (3.1/3.9)

Lesson Plan Objective:

Source: New

Author: CWS

Level of knowledge: comprehensive

References:

1. McGuire 1 Cycle 16 COLR pages 9,11 & 12
2. REACT (Reactor Engineering Analysis & Computer Tools) Shutdown Margin-Unit at Power, Modes 1 & 2 Calculations

APE: 003 Dropped Control Rod

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Dropped Control Rod: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Reason for turbine following reactor on dropped rod event	3.2	3.7
AK1.02	Effects of turbine-reactor power mismatch on rod control	3.1	3.4
AK1.03	Relationship of reactivity and reactor power to rod movement	3.5	3.8
AK1.04	Effects of power level and control position on flux	3.1	3.7
AK1.05	CVCS response to dropped rod	2.3*	2.6*
AK1.06	Control rod motion on S/G pressure	2.3	2.7
AK1.07	**Effect of dropped rod on insertion limits and SDM**	**3.4**	**3.9**
AK1.08	Reason for use of pulse/analog converter (determination of actual rod positions)	2.1*	2.5*
AK1.09	Definition of T-ave., T-ref., °F, linear scale, % megawatts, reactor power, Kw/ft, pcm, Δk/k, rate, % of level	2.3	2.6
AK1.10	Definitions of core quadrant power tilt	2.6	2.9
AK1.11	Long-range effects of core quadrant power tilt	2.5	3.5
AK1.12	Units of measure for power range indication	2.3*	2.5*
AK1.13	Interaction of ICS control stations as well as purpose, function, and modes of operation of ICS	3.2*	3.6
AK1.14	Theory of operation of rod drive motors	1.5	1.8
AK1.15	Definition and application of power defect	2.8	3.0
AK1.16	MTC	2.9	3.2
AK1.17	Fuel temperature coefficient	2.9	3.1
AK1.18	Voids coefficient	2.1	2.2
AK1.19	Differential rod worth	2.8	2.9
AK1.20	Integral rod worth	2.6	2.7
AK1.21	Delta flux (ΔI)	2.7	3.2
AK1.22	Calculation of power defect: algebraic sum of moderator temperature and fuel temperature defects	2.5	2.6
AK2.	**Knowledge of the interrelations between the Dropped Control Rod and the following: (CFR 41.7 / 45.7)**		
AK2.01	Controllers and positioners	2.1	2.1
AK2.02	Breakers, relays, and disconnects	2.1	2.2
AK2.03	Metroscope	3.1*	3.2*
AK2.04	Sensors and detectors	2.4	2.4
AK2.05	Control rod drive power supplies and logic circuits	2.5	2.8

McGuire 1 Cycle 16 Core Operating Limits Report

2.3 Moderator Temperature Coefficient - MTC (TS 3.1.3)

2.3.1 The Moderator Temperature Coefficient (MTC) Limits are:

The MTC shall be less positive than the upper limits shown in Figure 1. The BOC, ARO, HZP MTC shall be less positive than 0.7E-04 ΔK/K/°F.

The EOC, ARO, RTP MTC shall be less negative than the -4.1E-04 ΔK/K/°F lower MTC limit.

2.3.2 The 300 PPM MTC Surveillance Limit is:

The measured 300 PPM ARO, equilibrium RTP MTC shall be less negative than or equal to -3.2E-04 ΔK/K/°F.

2.3.3 The 60 PPM MTC Surveillance Limit is:

The 60 PPM ARO, equilibrium RTP MTC shall be less negative than or equal to -3.85E-04 ΔK/K/°F.

Where,

BOC = Beginning of Cycle (Burnup corresponding to the most positive MTC.)
EOC = End of Cycle
ARO = All Rods Out
HZP = Hot Zero Power
RTP = Rated Thermal Power
PPM = Parts per million (Boron)

2.4 Shutdown Bank Insertion Limit (TS 3.1.5)

2.4.1 Each shutdown bank shall be withdrawn to at least 226 steps. Shutdown banks are withdrawn in sequence and with no overlap.

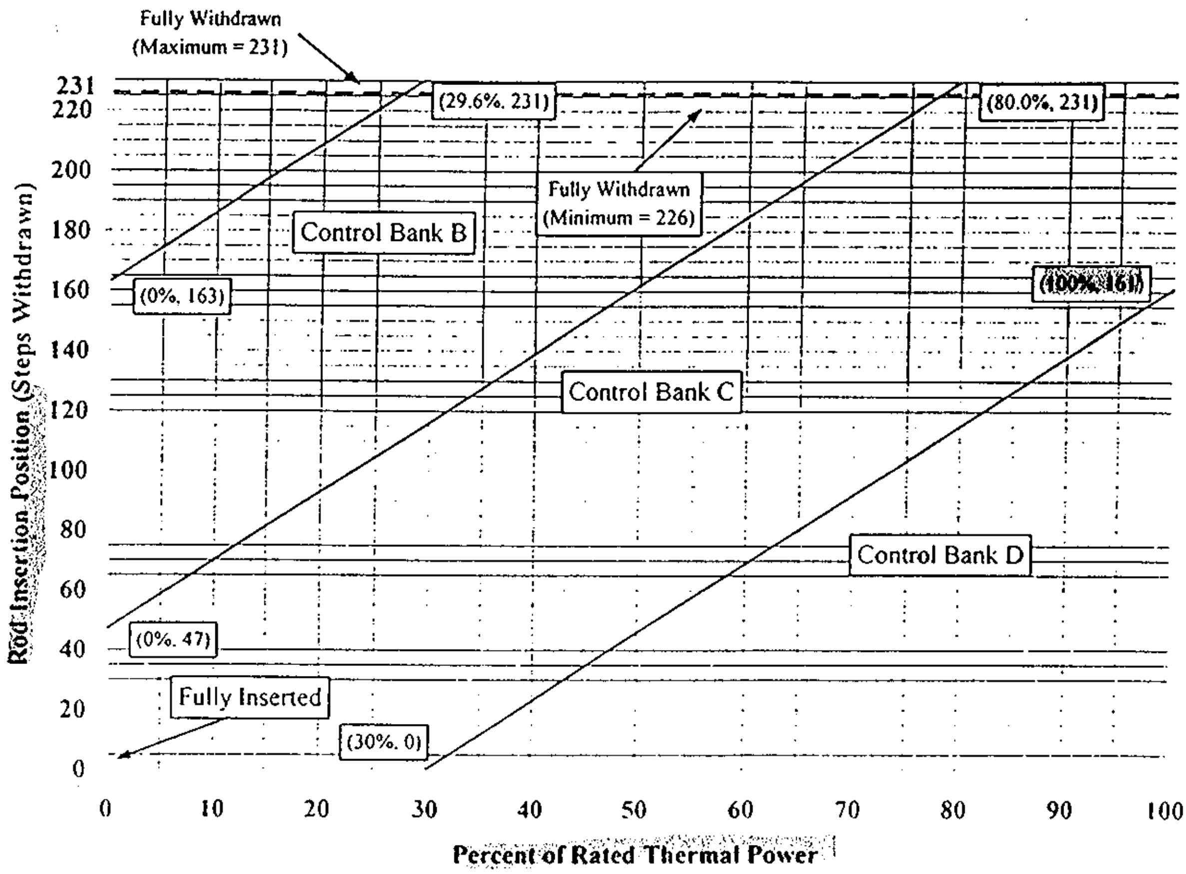
2.5 Control Bank Insertion Limits (TS 3.1.6)

2.5.1 Control banks shall be within the insertion, sequence, and overlap limits shown in Figure 2. Specific control bank withdrawal and overlap limits as a function of the fully withdrawn position are shown in Table 1.

McGuire 1 Cycle 16 Core Operating Limits Report

Figure 2

Control Bank Insertion Limits Versus Percent Rated Thermal Power



NOTE: Compliance with Technical Specification 3.1.3 may require rod withdrawal limits. Refer to OP/1/A/6100/22 Unit 1 Data Book for details.

McGuire 1 Cycle 16 Core Operating Limits Report

Table 1
RCCA Withdrawal Steps and Sequence

RCCAs Fully Withdrawn at 226 SWD

Control Bank A	Control Bank B	Control Bank C	Control Bank D
0 Start	0	0	0
116	0 Start	0	0
226 Stop	110	0	0
226	116	0 Start	0
226	226 Stop	110	0
226	226	116	0 Start
226	226	226 Stop	110

RCCAs Fully Withdrawn at 227 SWD

Control Bank A	Control Bank B	Control Bank C	Control Bank D
0 Start	0	0	0
116	0 Start	0	0
227 Stop	111	0	0
227	116	0 Start	0
227	227 Stop	111	0
227	227	116	0 Start
227	227	227 Stop	111

RCCAs Fully Withdrawn at 228 SWD

Control Bank A	Control Bank B	Control Bank C	Control Bank D
0 Start	0	0	0
116	0 Start	0	0
228 Stop	112	0	0
228	116	0 Start	0
228	228 Stop	112	0
228	228	116	0 Start
228	228	228 Stop	112

RCCAs Fully Withdrawn at 229 SWD

Control Bank A	Control Bank B	Control Bank C	Control Bank D
0 Start	0	0	0
116	0 Start	0	0
229 Stop	113	0	0
229	116	0 Start	0
229	229 Stop	113	0
229	229	116	0 Start
229	229	229 Stop	113

RCCAs Fully Withdrawn at 230 SWD

Control Bank A	Control Bank B	Control Bank C	Control Bank D
0 Start	0	0	0
116	0 Start	0	0
230 Stop	114	0	0
230	116	0 Start	0
230	230 Stop	114	0
230	230	116	0 Start
230	230	230 Stop	114

RCCAs Fully Withdrawn at 231 SWD

Control Bank A	Control Bank B	Control Bank C	Control Bank D
0 Start	0	0	0
116	0 Start	0	0
231 Stop	115	0	0
231	116	0 Start	0
231	231 Stop	115	0
231	231	116	0 Start
231	231	231 Stop	115

Effective Shutdown Margin for Present Conditions: 2,797 pcm

Required Shutdown Margin: 1300 pcm

Input Data:

Station: MNS Unit: 1 Cycle: 16

Current Burnup: 250 EFPD

Present Power: 100 %

NC System Boron Concentration: 953 ppm

Present Control Rod Position: Bank D Steps W/D 217

Number of Known Inoperable Control Rods (RCCA's): 0

Information Extracted from Data File:

Worst Case Reactivity Penalty of One Inoperable Rod: 941 pcm

Total Available Rod Worth: 4,933 pcm

Power Defect: 1,781 pcm

Rod Worth of Inserted Rods From Present Control Bank Position: 12 pcm

Maximum Reactivity Effect of Flux Redistribution: 344 pcm

Output Data:

Effective Shutdown Margin for Present Conditions: 2,797 pcm

Required Shutdown Margin: 1300 pcm

Effective Shutdown Margin for Present Conditions: 2,688 pcm

Required Shutdown Margin: 1300 pcm

Input Data:

1 Rod misaligned/dropped
Power decreased to maintain Tave = Tre

Station: MNS Unit: 1 Cycle: 16

Current Burnup: 250 EFPD

Present Power: 95 %

NC System Boron Concentration: 953 ppm

Present Control Rod Position: Bank D Steps W/D 217

Number of Known Inoperable Control Rods (RCCA's): 0

Information Extracted from Data File:

Worst Case Reactivity Penalty of One Inoperable Rod: 941 pcm

Total Available Rod Worth: 4,933 pcm

Power Defect: 1,690 pcm

Rod Worth of Inserted Rods From Present Control Bank Position: 12 pcm

Maximum Reactivity Effect of Flux Redistribution: 344 pcm

Output Data:

Effective Shutdown Margin for Present Conditions: 2,688 pcm

Required Shutdown Margin: 1300 pcm

1 Pt. Unit 1 is in Mode 3 at normal operating temperature and pressure. While performing trouble shooting activities 1NV-94AC (NC Pump Seal Return Containment Isolation Valve) closes.

Which of the following best describes the effect on the Reactor Coolant Pumps seal return flow?

A. Seal return flow continues and is routed to the NCDT.

B. Seal return flow continues through 1NV-95B to VCT.

C. Seal return flow continues and is routed to the PRT.

D. Seal return flow continues to the VCT through a bypass line around 1NV-94AC.

Bank Question: 1030 ***Answer: C***

1 Pt. Unit 1 is in Mode 3 at normal operating temperature and pressure. While performing trouble shooting activities 1NV-94AC (NC Pump Seal Return Containment Isolation Valve) closes.

Which of the following best describes the effect on the Reactor Coolant Pumps seal return flow?

A. Seal return flow continues and is routed to the NCDT.

B. Seal return flow continues through 1NV-95B to VCT.

C. Seal return flow continues and is routed to the PRT.

D. Seal return flow continues to the VCT through a bypass line around 1NV-94AC.

Distracter Analysis:

A. Incorrect – seal return flow goes to PRT

B. Incorrect 1NV-94 and 1NV-95 are in series Student may think the valves are in parallel.

C. *Correct*

D. Incorrect – check valve prevents this flow path

Level: RO

KA: SYS 003 K6.04 (2.8/3.1)

Lesson Plan Objective: OP-MC-PS-NV Obj. 5

Source: New

Level of knowledge: Memory

Author: CWS

References:
1. OP-MC-PS-NV pages 39, 41 & 115

SYSTEM: **003 Reactor Coolant Pump System (RCPS)**

K4 **Knowledge of RCPS design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	Minimizing power peaking	2.1	2.3
K4.02	Prevention of cold water accidents or transients	2.5	2.7*
K4.03	Adequate lubrication of the RCP	2.5	2.8
K4.04	Adequate cooling of RCP motor and seals	2.8	3.1
K4.05	Prevention of reverse rotation	2.3	2.7*
K4.06	Handling axial thrust (thrust bearing)	2.1	2.4
K4.07	Minimizing RCS leakage (mechanical seals)	3.2	3.4
K4.08	Anchoring the RCP and its associated piping	1.6	1.9
K4.09	Seal and pump venting	2.2	2.4
K4.10	Increasing pump inertia (flywheel)	2.3	2.5
K4.11	Isolation valve interlocks	3.0*	3.0*

K5 **Knowledge of the operational implications of the following concepts as they apply to the RCPS:**
(CFR: 41.5 / 45.7)

K5.01	The relationship between the RCPS flow rate and the nuclear reactor core operating parameters (quadrant power tilt, imbalance, DNB rate, local power density, difference in loop T-hot pressure)	3.3	3.9
K5.02	Effects of RCP coastdown on RCS parameters	2.8	3.2
K5.03	Effects of RCP shutdown on T-ave., including the reason for the unreliability of T-ave. in the shutdown loop	3.1	3.5
K5.04	Effects of RCP shutdown on secondary parameters, such as steam pressure, steam flow, and feed flow	3.2	3.5
K5.05	The dependency of RCS flow rates upon the number of operating RCPs	2.8*	3.0*
K5.06	Enthalpy increase associated with RCPs, and its effect upon calorimetric calculation of power	2.2	2.6
K5.07	The reason for "jogging" RCPs during venting or when starting under unusual conditions	2.4	2.6
K5.08	RCP current or supply voltage changes and cold versus hot operation	2.2	2.4*
K5.09	Effects of RCP operation on ΔP, especially at lower temperatures	2.3	2.6*

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the RCPS:**
(CFR: 41.7 / 45/5)

K6.01	RCP performance characteristics	1.9	2.4
K6.02	RCP seals and seal water supply	2.7	3.1
K6.03	RCP lift oil pump, lube oil pumps	2.4	2.6
K6.04	Containment isolation valves affecting RCP operation	2.8	[illegible]
K6.05	Impeller	1.6	1.9

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
5	Explain the basic operation of the NV System for the following: • Normal L.D. Purification • Seal Injection Flow • Chemical Addition • Charging • Centrifugal Charging Pumps • All Modes of Makeup • PD Pump Control • Safeguards Actuation • Charging/Letdown Flow Balance • Excess Letdown • Emergency Boration • Pressurizer Spray PSNV005	X	X	X	X	
6	Describe the various system parameters indicated in the Control Room associated with the NV System in <u>ALL</u> modes of operation. PSNV006		X	X	X	X
7	List the "fail" position of NV valves on loss of power or air. PSNV007		X	X	X	X
8	Describe the as-built configuration of the VCT level instrumentation. PSNV008	X	X	X	X	
9	Using fundamental instrumentation knowledge and given specific reference and variable leg configurations for the Volume Control Tank, predict the effect on indicated versus actual level for various failures. PSNV009	X	X	X	X	

Objective # 5

NV-20 is a spring-loaded check valve around NV-13B that opens at 200 psid to relieve any expansion of water that may be trapped on the tube-side in the regenerative heat exchanger.

Pressurizer auxiliary spray from the charging header is controlled by NV-21A. The normal PZR spray valves (NC-27C and NC-29C) must remain closed while NV-21A is open. The normal spray headers are not analyzed for the reverse flow that would be initiated in this condition (PIP M95-1876). This flow path is used for adding chemicals to the pressurizer, during natural circulation cooldown to depressurize the NC System, and to aid in cooling the pressurizer during normal cooldown. NV-21A can also be controlled at the ASP by a manual loader.

Caution: Spray to Pressurizer ΔT must be less than 320°F to prevent thermal shock of the spray nozzle.

Pressurizer spray from the ND system is from the crosstie between the ND pumps and ND heat exchangers. Flow is controlled by a manual loader on the control board for NV-840 and there is a disconnect key switch, which allows for isolating the air to NV-840 when it is required to be isolated. This line is used to provide pressurizer spray when the ND System is in operation.

2.16 NCP's Seal Injection

Objective # 5

The NC pumps seal injection flow is directed to the reactor coolant pumps via the seal water injection filters. The flow (nominally 32-gpm total, 8 gpm/pump) is controlled by a manual loader for NV-241 (Seal Injection Flow Control). Normal seal injection flow is 7-9 gpm per pump.

There are two seal injection filters in parallel with only one filter in service at a time. These filters remove particles that are greater than 5 microns (Filter sizes are variable, with 5 microns being the maximum). The filters have local ΔP indication and a remote high ΔP alarm in the Control Room. The flow then enters the pumps at a point between the thermal barrier cooler and the pump bearing. The flow splits and a portion (normally about 5 gpm) enters the NC system via the labyrinth seals and thermal barrier cooler cavity. The remainder of the flow (normally about 3 gpm) flows up the pump shaft (cooling the lower bearing) and leaves the pump via the No. 1 seal discharge.

The seal leakoff is removed from the NC system as a portion of the letdown flow. The No. 1 seal discharges flow to a common manifold, is joined by Excess Letdown flow, and then exits the containment. It then passes through the seal water filter, joined by CCP recirc flow, and then through the seal water heat exchanger to the VCT. An alternate path to the suction side of the reciprocating charging pump is provided, but not normally used. Back pressure on the No. 1 seal is the summation of flow resistance in the seal water return lines, seal water HX static head, and the VCT pressure.

Leakage past the No. 1 seal supplies the No. 2 seal with water. The pressure on the No. 2 seal is the summation of the flow resistances in the seal water return lines and the VCT pressure. Approximately 3 gph will pass through the No. 2 seal. A standpipe is provided to ensure a back pressure of at least 7 feet of water on the No. 2 seal and warn of excessive No. 2 seal leakage. The first outlet from the standpipe has an orifice to permit normal No. 2 seal leakage to flow to the Reactor Coolant Drain Tank (NCDT); excessive No. 2 leakage results in a rise in standpipe level and, eventually, overflow to the NCDT via a second overflow connection.

No. 1 seal bypass flow can be used during NCS pressure between 100# and 1000#. This ensures an adequate flow to cool the radial bearing during low seal flow conditions.

NOTE: There are other parameters that must be met prior to the bypass of the No. 1 seal. Refer to OP-MC-PS-NCP, Reactor Coolant Pump and Motor (NCP) lesson plan.

The seal water return flow then goes through the containment isolation valves (NV-94AC, inside containment, & NV-95B, outside containment). These valves will automatically close on a Phase "A" Containment Isolation (S_t). The inside containment isolation valve, NV-94AC, can also be controlled from the SSF. A relief valve, NV-96, relieves trapped pressure from the containment penetration back to the upstream side of NV-94AC. The seal return line, inside containment, is protected from overpressure by a relief valve, NV-93, when the line is isolated. The setpoint is 150 psig and the valve relieves to the PRT. The flow then enters the seal water return filter, which collects particulates. In addition to the seal return flow, the excess letdown flow also goes through the seal return filter.

The filter is designed for maximum seal leakage flow and excess letdown flow. This combined flow now enters the tube side of the seal water heat exchanger along with the CCP recirculation mini-flow. The seal water heat exchanger is cooled by Component Cooling (KC) water circulated through shell side of the heat exchanger.

2.17 Excess Letdown

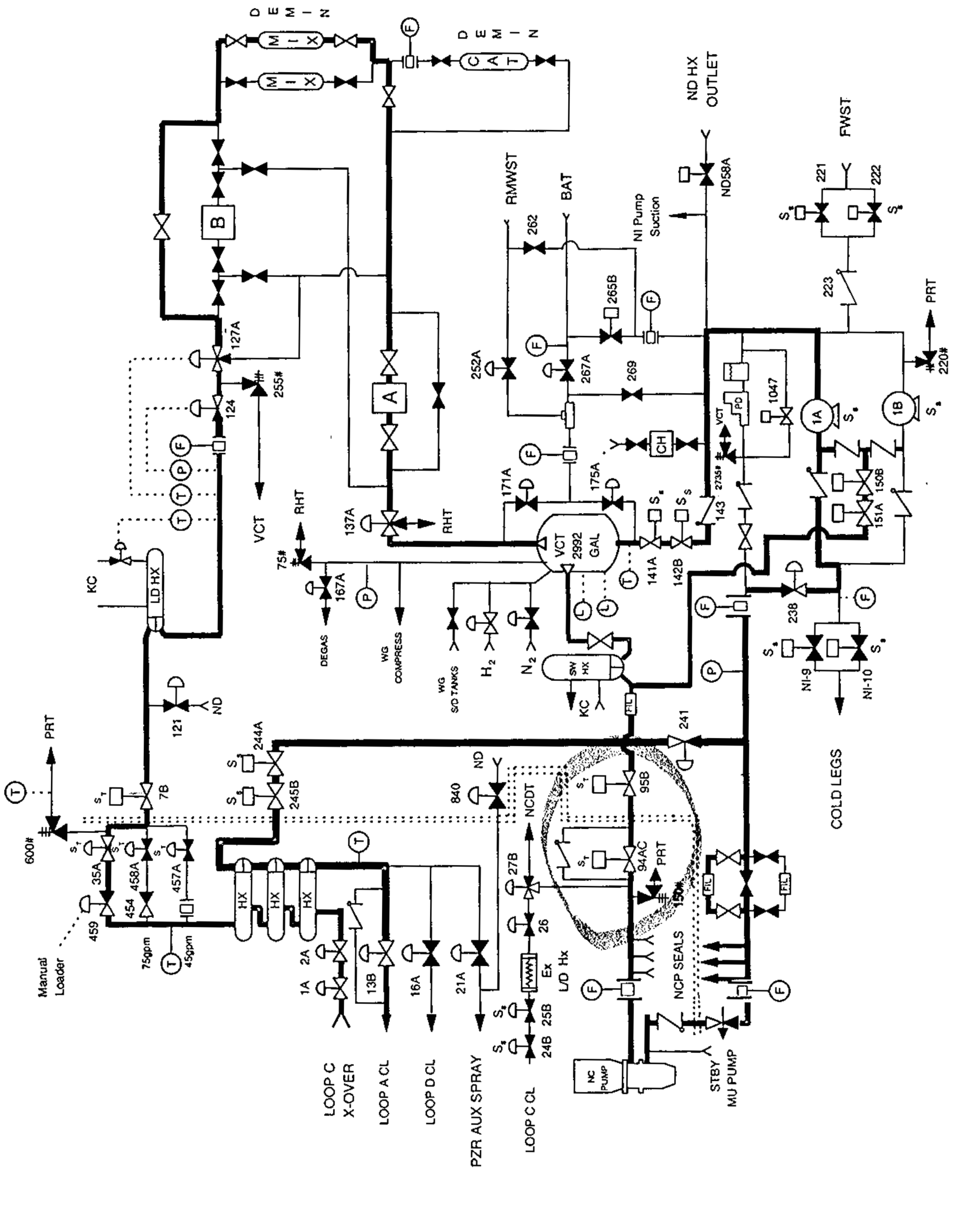
Objective # 5

Excess letdown is provided in the event that normal letdown is unavailable, to help maintain a constant NC inventory / PZR level. The flow comes from the NC Loop C Cold Leg through NV-24B and NV-25B, which can also be controlled from the ASP. The flow then goes through the excess letdown heat exchanger and then through NV-26. A manual loader, for flow control, controls NV-26, which can also be controlled from the ASP. NCS flow is through the tube side (outlet temperature ≈ 165°F) and Component Cooling (KC) water flows through the shell side. The excess letdown discharges to NV-27B, which controls the flow path to be taken, either the NCDT or the seal return to the VCT (normal flow path). NV-27B is controlled from the Control Room and will fail to the VCT position on Loss of Air.

The excess letdown flow of ≈ 20 gpm provides the capability to letdown the seal injection flow entering the NCS of ≈ 5 gpm per pump (≈ 20 gpm).

7.0 DRAWINGS

7.1 NV System Composite (1/28/03)



1 Pt. Unit 2 was operating at 49% power when the following indications were observed:

- Hi Hi Steam Generator level in the 2A S/G
- Feedwater flows decreasing
- Feedwater Isolation Signal actuated

Which of the following describes the plant response to the above condition?

A. Feedwater pump 'A' only has tripped.

B. Both *feedwater pumps have tripped*, the turbine and reactor have tripped.

C. Feedwater pump 'A' and the turbine only have tripped.

D. Both feedwater pumps and turbine have tripped, the reactor did not trip.

Bank Question: 1031 ***Answer: B***

1 Pt. Unit 2 was operating at 49% power when the following indications were observed:

- Hi Hi Steam Generator level in the 2A S/G
- Feedwater flows decreasing
- Feedwater Isolation Signal actuated

Which of the following describes the plant response to the above condition?

A. Feedwater pump 'A' only has tripped.

B. Both feedwater pumps have tripped, the turbine and reactor have tripped.

C. Feedwater pump 'A' and the turbine only have tripped.

D. Both feedwater pumps and turbine have tripped, the reactor did not trip.

Distracter Analysis:

A. Incorrect: – both FWPTs trip, turbine and reactor trips because above P-8 – 48%

B. Correct

C. Incorrect: - see A above

D. Incorrect: reactor trips above P-8 48%

Level: RO

KA: SYS 059 K4.01 (3.3/3/5)

Lesson Plan Objective: OP-MC-CF-CF Obj. 14
OP-MC-IC-IPE Obj. 10 & 11

Source: New

Level of knowledge: Comprehensive

Author: CWS

References:

1. OP-MC-CF-CF page 35
2. OP-MC-IC-IPE pages 79, 81 & 83

SYSTEM: **059 Main Feedwater (MFW) System**

K4 **Knowledge of MFW design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	MFW and startup feedwater valve combination.	2.4	2.6*
[redacted]			
K4.03	Adequate condensate flow	2.1	2.3*
K4.04	Heating of feedwater	1.9	2.2
K4.05	Control of speed of MFW pump turbine	2.5*	2.8*
K4.06	Comparison of actual D/P, between main steam and MFW pump discharge pressure, to programmed D/P when placing MFW pump in automatic mode	2.2*	2.4*
K4.07	Closing MFW pump drains	1.6*	1.7*
K4.08	Feedwater regulatory valve operation (on basis of steam flow, feed flow mismatch)	2.5	2.7
K4.09	Controlling MFW pump lube oil system	1.7	1.8
K4.10	Bearing oil signal to the turning gear start sequence	1.7	1.8
K4.11	Porting oil	1.8?	1.9?
K4.12	Sources of cooling water for MFW pump lube oil cooler	1.8	1.9
K4.13	Feedwater fill for S/G upon loss of RCPs	2.9	2.9
K4.14	Start permissives for MFW pumps	2.1	2.3 *
K4.15	Automatic starts for MFW pumps	2.2*	2.4*
K4.16	Automatic trips for MFW pumps	3.1*	3.2*
K4.17	Increased feedwater flow following a reactor trip	2.5*	2.8*
K4.18	Automatic feedwater reduction on plant trip	2.8*	3.0*
K4.19	Automatic feedwater isolation of MFW	3.2	3.4
K4.20	Automatic feed pump recirculation flow	1.9	2.2*

K5 **Knowledge of the operational implications of the following concepts as the apply to the MFW:**
(CFR: 41.5 / 45.7)

K5.01	Variation of flow discharge pressure	2.1	2.1
K5.02	Shrink and swell	2.4	2.6*
K5.03	Reason for maintenance of minimum D/P between main steam and MFW pump discharge pressure	2.1	2.2
K5.04	Definition of water hammer	2.3*	2.6*
K5.05	Reason for balancing MFW pump loads	2.0	2.2*
K5.06	Characteristics of level, flow, and pressure indications	1.8	2.1*
K5.07	Relationship between feedwater pump speed and feedwater regulating valve position	1.8	2.1*
K5.08	Reason for matching steam flow and feedwater flow	2.4	2.6*
K5.09	Effects of low temperature and high viscosity on oil system operations	1.6	1.7
K5.10	Theory of film-riding oil in journal bearing	1.4	1.6
K5.11	Definition of turbine windmilling	1.6	1.7
K5.12	Increased MFW pump discharge with increased turbine speed	2.2*	2.5*
K5.13	Reasons for monitoring feedwater pump suction flow/pressure	2.3	2.6*
K5.14	Quadrant power tilt	1.9	2.4*

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
11	Explain why and how CF flow is transferred from the CF nozzle to the CA nozzle and vise versa. CFCF011	X	X	X	X	
12	Explain the Feedwater Isolation actuation circuit. CFCF012	X	X	X	X	X
13	List the CF valves that isolate on a Feedwater Isolation Signal. CFCF013	X	X	X	X	X
14	Describe the automatic actions that occurs on: • Hi Hi Doghouse Level • Hi Hi S/G Level (P-14). CFCF014	X	X	X	X	X
15	Explain the purpose of the "Anticipated Transient Without Scram Mitigation System Actuation Circuitry" (AMSAC). CFCF015	X	X	X	X	X
16	Concerning AMSAC: • State the automatic action that occurs as a result of an AMSAC signal • List the parameters that will actuate the AMSAC automatic actions • Discuss the development of the actuation signals, to include the components monitored and setpoints. CFCF016	X	X	X	X	X
17	Concerning the AMSAC Block/Unblock switch: • State the purpose of each position (Block and Unblock) • State when each position may be used. • Differentiate between the "Manual" block function and "Auto" block functions (include the 2 minute time delay for auto blocking). CFCF017	X	X	X	X	X

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Describe the function of the First-Out annunciator panel. ICIPE008		X	X	X	
9	Given a Limit and/or Precaution associated with an operating procedure, discuss its basis and applicability. ICIPE009		X	X	X	X
10	List all the Reactor Trip Signals including the setpoints, logic permissives and bases/protection afforded by each. ICIPE010		X	X	X	X
11	List all the protective system permissive ("P" signal) interlocks to include input parameter(s), logic and function. For interlocks which provide Trip block, state the Trips affected and whether Auto or Manual block. ICIPE011		X	X	X	X
12	List all the protection system control ("C" signal) interlocks including logic and functions. ICIPE012		X	X	X	X
13	Briefly describe the incident that occurred at Salem Nuclear Plant and how this event affected McGuire Reactor Trip Breaker operation. ICIPE013		X	X	X	X

Objective #14

The P14 (Hi Hi S/G Level) actuation signal is designed to terminate the main feedwater contribution to a S/G(s) overfill event. An overfill event could occur from conditions such as a S/G tube rupture or a CF control system misoperation/failure (manual/auto) which results in overfeeding. A P14 actuation will initiate the following:

- FWI (Feedwater isolation)
- Both main CF pump turbines trip
- Main turbine trips

  Note: The tripping of both main feedwater pumps will result in an auto start of the Motor Driven CA pumps. The operator will have to manually control CA flow to prevent feeding the steam generator(s) that initiated the P14.

Objective #12

Operator action is required to restore control to FWI components: (refer to Drawing 7.10 and 7.11)

- If FWI was due to S_S; control of FWI components is regained by having S_S "Reset" and closing the reactor trip breakers. (The FWI "Reset" PB does not need to be depressed.)
- If FWI was due to P-14 with a Reactor trip; control of FWI components is regained by clearing the P-14 and closing the reactor trip breakers. (The FWI "Reset" PB does not need to be depressed.)
- If FWI was due to P-14 without a Reactor trip; control of FWI components is regained by clearing the P-14 (the reactor trip breakers will already be closed). (The FWI "Reset" PB does not need to be depressed.)
- If FWI was due to P-4/Low T-avg, control of FWI components may be regained by depressing the FWI "Resets", even with the initiating signal present (i.e., Rx trip breakers can be open and temp can be less than 553^{0}F degrees).
- If FWI was due to "Manual initiation"; control of FWI components is regained by depressing the FWI "Resets" (i.e., Rx trip breakers can be open).

7.5 Reactor Trips (3/27/01)

REACTOR TRIP	SETPOINT	LOGIC	PERMISSIVES	BASES
MANUAL	Sw. turned 45°	1/2 sw.		operator judgment
S.R. NI HIGH	10^5 CPS	1/2 ch.	P6, P10	uncontrolled rod withdrawal/ startup accidents
I.R. NI HIGH	amps-25% power	1/2 ch.	P10	uncontrolled rod withdrawal/ startup accidents
P.R. NI LOW	25% power	2/4 ch.	P10	reactivity excursion from low powers
P.R. NI HIGH	109% power	2/4 ch.		reactivity excursion from all powers DNB
P.R. POS RATE	+5%/2 sec	2/4 ch.		DNB (rod ejection)
PZR HIGH PRESS	2385 psig	2/4 ch.		coolant system integrity
PZR LOW PRESS	1945 psig	2/4 ch.	P7	DNB
PZR HIGH LEVEL	92%	2/3 ch.	P7	water through safeties (system integrity)
OTΔT	$\Delta T \geq OT\Delta Tsp$	2/4/ ch.		DNB
OPΔT	$\Delta T \geq OP\Delta Tsp$	2/4 ch.		KW/FT
NCP BUS LOW VOLT	74% of normal	2/4 ch.	P7	DNB (anticipatory loss of flow)
NCP BUS LOW FREQ	56 Hz	2/4 ch.	P7	DNB (anticipatory loss of flow)
S/G LO-LO LVL	17%	2/4 in 1/4 s/g		loss of heat sink
1 LOOP LOSS OF FLOW	88%	2/3 in 1/4 loops	P8	DNB
2 LOOP LOSS OF FLOW	88%	2/3 in 2/4 loops	P7	DNB
SAFETY INJECTION	any S/I signal actuated	1/2 S/I trains		trip reactor if trip not generated by trip instrumentation
GENERAL WARNING ALARM	loose card, loss of voltage, train in test, by-pass bkr connected/closed, logic ground return fuse blown	2/2 alarms		loss of protection
TURBINE TRIP	low Auto-stop oil press <45 psig or all 4 stop valves closed	2/3 ASO Press switches 4/4 valves	P8	trip reactor on turbine trip

7.6 Protection Permissive Interlocks (06/15/98)

INTERLOCKS	LOGIC	FUNCTION
P-4	Train A or B Reactor Trip	• Turbine Trip • Feedwater Isolation< Low T_{ave} • Arms condenser dumps • Allows reset of Safety Injection Signal after time delay
P-6	1/2 I.R. > 10^{-10} amps	Allows manual block of S.R. Reactor Trip. De-energizes high voltage to the Source Range detectors. On decreasing power, Source Range Level trips are automatically reactivated and high voltage restored.
P-7	2/4 P.R. > 10% FP (P-10) or 1/2 impulse pressure> 10% (P-13)	On increasing power P-7 automatically enables the following trips: • Pzr High Level • Pzr Low Pressure • Low NC Flow 2/4 Loops • NCP Undervoltage • NCP Underfrequency On decreasing power the above listed trips are automatically blocked.
P-8	2/4 P.R. > 48% FP	On increasing power P-8 enables the 1/4 loop loss of flow Reactor Trip and Reactor Trip on Turbine Trip. On decreasing power, P-8 automatically blocks the above listed trip.

T.S. REFERENCE
MANUAL

7.7 Protection Permissive Interlocks (12/17/99)

INTERLOCKS	LOGIC	FUNCTION
P-10	2/4 P.R. > 10% FP	On increasing power P-10 allows manual block of the Intermediate Range trip and rod stop (C-1). Allows block of the Power Range High Flux Low Setpoint trip and prevents the Source Range instruments from being Manually energized. (Will automatically de-energize both source range detectors if not previously de-energized at P-6.) Also provides an input to P-7. On decreasing power, the Intermediate Range trip and the Power Range trip are automatically reactivated, allows manual reset of SR High Voltage block if one IR channel does not decrease below P-6 to auto energize the SR circuit.
P-11	2/3 Pzr Press < 1955	On decreasing pressure (<1955 #) P-11 allows manual block of Low Pzr Pressure Safety Injection, Lo Press Stm Line Isol and CA Pump Auto start. Enables High Steam Rate Main Steam Isolation.
P-12	2/4 Lo-Lo Tave < 553 °F	Blocks steam dumps
P-13	1/2 Impulse Press > 10%	Input to P-7
P-14	2/3 Level on 1/4 S/G Hi-Hi Level > 83%	• Turbine Trip • FWPT Trip • Feedwater Isolation

T.S. REFERENCE
MANUAL

1 Pt. Given the following conditions:

- Unit 1 is at 100%
- No annunciators are in alarm
- TD CA pump is being started for post maintenance testing (oil change)
- RO places the #1 TD CA Pump to 'START'
- The TD CA pump starts but does not achieve rated speed.

Which of the following describes the potential reason the TD CA pump failed to reach rated speed?

A. The TD CA pump stop valve is not fully open.

B 1SA-48ABC (*1C S/G SM Supply to unit 1 TD CA Pump Turb Isol*) failed to OPEN

C The Control Room/Local switch at local panel is in Local control.

D. The Woodward Governor speed setting was not cycled after the last PT.

Bank Question: 1032 ***Answer: D***

1 Pt. Given the following conditions:

- Unit 1 is at 100%
- No annunciators are in alarm
- TD CA pump is being started for post maintenance testing (oil change)
- RO places the #1 TD CA Pump to 'START'
- The TD CA pump starts but does not achieve rated speed.

Which of the following describes the potential reason the TD CA pump failed to reach rated speed?

A. The TD CA pump stop valve is not fully open.

B 1SA-48ABC (*1C S/G SM Supply to unit 1 TD CA Pump Turb Isol*) failed to OPEN

C The Control Room/Local switch at local panel is in Local control.

D. The Woodward Governor speed setting was not cycled after the last PT.

Distracter Analysis:

A. Incorrect – would have an annunciator if the valve is not fully open.

B. Incorrect SA 48 and SA 49 are in parallel no effect.

C. Incorrect TD CA pump would not start if in local. There is a status light that would be lit if this switch were in local.

D. *Correct*

Level: RO

Source: NEW

KA: SYS 039 A4.04 (3.8/3.9)

Lesson Plan: OP-MC-CF-CA

Lesson Plan Objective: OP-MC-CF-CA Obj. 7

Level of knowledge: Memory

Author: CWS

References:

OP-MC-CF-CA pages 15, 23, 25 & 27

SYSTEM: **039 Main and Reheat Steam System (MRSS)**

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Main steam supply. valves	2.9*	2.8*
A4.02	Remote operators to auxiliary steam	2.1	1.9
A4.03	MFW pump turbines	2.8*	2.8*
A4.04	Emergency feedwater pump turbines	3.8	3.9
A4.05	Moisture separator reheater, checking its temperatures and steam pressures relative to heatup limits and operating limits	1.8	1.6
A4.06	Main steam drains	1.9	1.8
A4.07	Steam dump valves.	2.8*	2.9

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
3.0	2.0	3.0	3.0	1.5

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the CA System.	X	X	X	X	
2	Sketch the system drawing (Fig. 7.1) including all major components and valves, show all tie-ins to associated systems.	X	X	X	X	
3	Describe all CA suction supply sources, including venting requirements and actions.	X	X	X	X	
4	Discuss the auto-start of the motor driven and turbine driven auxiliary feedwater pumps, including concurrent BO/S_S signals and BO followed by S_S.	X	X	X	X	X
5	Describe the CA pump minimum flow and pump runout protection.	X	X	X	X	
6	Describe the function of the Auto Start Defeat Switches; include permissives.	X	X	X	X	X
7	Describe the power supplies and steam supplies for the CA pumps.	X	X	X	X	
8	State the flow rates of the CA pumps.	X	X	X	X	
9	Describe the sources of make-up to the Auxiliary Feedwater Storage Tank, include destination of overflow from the Auxiliary Feedwater Storage Tank.	X	X	X	X	X
10	Describe the interlock between the CA motor driven pump and the associated train RN pump. Include why the interlock is required.	X	X	X	X	X
11	Describe the interlock between the CA pump suction pressure and the RN assured makeup valves.	X	X	X	X	X
12	Describe the interlock between the RN assured makeup valves (CA-15, CA-18) and the DG Hx Inlet Valve. Include why the interlock is required.	X	X	X	X	X

An Auto-Start Defeat Switch can be used to defeat

- 2/4 low-low level in any SG
- Trip of both Main Feedwater pumps
- AMSAC (Both Main Feedwater Pumps Tripped)

NC System pressure must be below the P-11 setpoint (1955 psig) to enable the Auto-Start Defeat feature. The Auto-Start Defeat feature will "auto unblock" when pressure returns above the P-11 setpoint.

Objective # 10

The train related RN pump will automatically start upon any start (including Manual) of the corresponding CA pump to provide necessary cooling.

2.2 Turbine Driven CA Pump

Objective # 7, 8

Each unit has one Steam Turbine Driven CA pump. The turbine receives steam from "B" and "C" steamlines through two redundant valves. The turbine driven pump has a design flow rate of 900 gpm and supplies all four steam generators. Steam is admitted to the turbine through two piston operated isolation valves, SA-48ABC and SA-49AB. These valves are held closed by control air from normally energized solenoid valves. De-energizing any solenoid valve will bleed-off the control air, open its piston operated valve and admit steam to the turbine.

Objective # 4

Refer to Figure 7.12. The auto-start signals for the CA Turbine Driven pump (which open SA-48ABC and SA-49AB) are:

- 2/4 detectors low-low level in any two SGs (17%)
- Blackout (> 8 seconds)
- 1/1 detector from SSF SG Wide Range Low-Low Level on 2/4 SGs (72%) (only opens SA-48ABC)

NOTE: If a Blackout occurs first followed by a Safety Injection, the Sequencer will reset the start signal to the Turbine Driven CA Pump. If the Turbine Driven CA Pump is running at the time of the Safety Injection, it will continue to run. If the Safety Injection occurs first or coincident with the Blackout, the Safety Injection will BLOCK the Turbine Driven CA Pump start because the sequencer selects the Priority Mode. (This does not affect the Low-Low SG Level auto start signal or the SSF Low-Low Level start signal.)

NOTE: The turbine driven pump will also start on loss of VI or loss of power to the solenoid valves, due to the fail-open design of the valves (not considered an auto-start)

- Declaring Unit 1 and 2 "A" Train assured makeup to the TD CA pump inoperable. (TSAIL Tracking Entry is made for the TDCAP.)
- Closing and de-energizing 1CA-86A and 2CA-86A (TD CA pump supply from Train "A" RN).

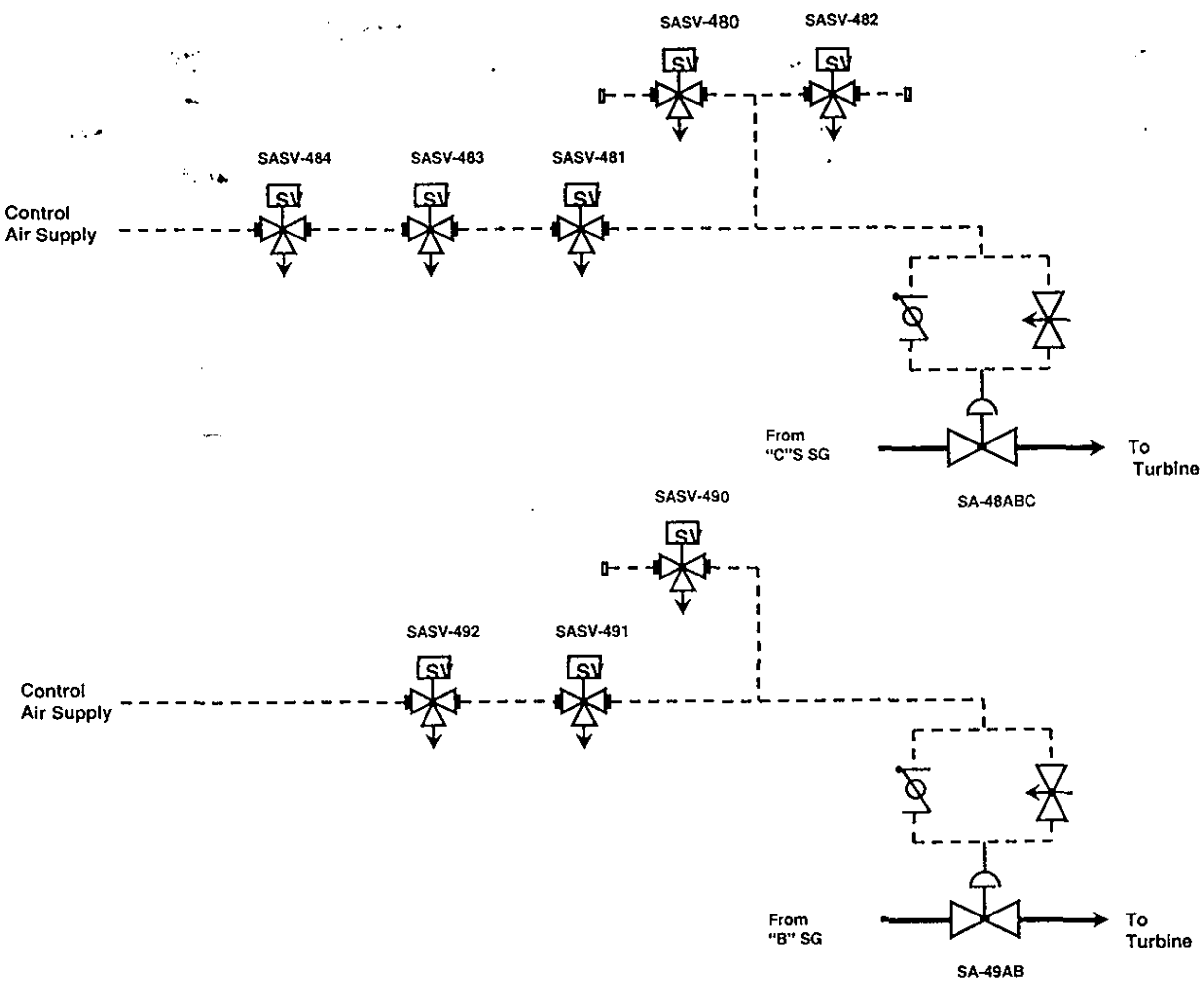
This air entrainment problem is not a concern for the "B" Train RN supply due to the difference in piping configuration.

2.4 CA Turbine Steam Supply Valves

Objective # 7

2.4 CA Turbine Steam Supply Valves

The CA turbine is supplied steam from the B and C steam generators via SA-49AB and SA-48ABC respectively. These piston operated isolation valves fail OPEN on a loss of power to any one of the solenoids, admitting steam to the turbine. On a Manual Start, Low Low Level on 2 S/Gs or Blackout, solenoid valves (SASV-480, 481 and 483) or (SASV-490, 491 and 492) de-energize and block control air to the piston operated valve and/or venting the existing air pressure, allowing the piston valve to open, admitting steam to the Turbine Driven CA Pump.



The other solenoid valves (482 and 484) de-energize for SSF actuation with two S/Gs below the wide range Low-Low Level setpoint. There is also an AUTO/OPEN switch located at the SSF control panel which will de-energize these solenoids (482 and 484) to open SA-48ABC. This switch may be used to manually start the TD CA Pump (by opening SA-48ABC) from the SSF and prevent the pump from cycling on and off around the SSF Low-Low S/G level setpoint.

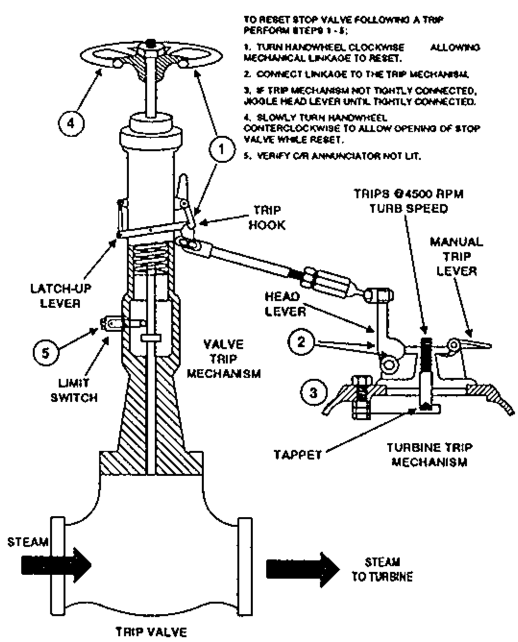
2.5 Turbine Stop Valve

Refer to Figure 7.9. The Stop Valve is used to isolate steam to the turbine in the event of an overspeed condition. Overspeed occurs when steam flow to the turbine causes its speed to increase to 4300-4500 rpm. Flyweights mounted on the turbine shaft move outward due to centrifugal force. The flyweights ultimately come in contact with a tappet which, when pushed upward, releases a head lever. The head lever then unlatchs the trip hook on the stop valve, allowing the stop valve trip mechanism to close the stop valve.

A manual trip lever is also mounted near the stop valve. To manually trip "closed" the stop valve, the operator pushes downward on the trip lever and the trip function occurs the same as with an overspeed.

To reset the Stop Valve perform the following steps:

- Turn the handwheel clockwise to allow the mechanical linkage to reset.
- Connect the linkage to the trip device.
- If the trip mechanism is not tightly connected, jiggle the head lever until it is tightly connected (to insure tappet falls into place).
- Slowly turn the handwheel conterclockwise to open the stop valve while it is reset.
- Verify control room annunciator "TD CA Pump Stop Valve Not Open" is not lit.



2.6 Turbine Governor Valve (GV)

Refer to Figure 7.10, 7.11. Speed adjustment of the governor is accomplished by controlling the position of three pistons: (1) the speed setting pilot valve plunger, (2) the speed setting servo piston, and (3) the power cylinder piston. Adjusting the Woodward Speed Setting knob (Manual Speed Adjusting knob) will position the pilot valve plunger to put more oil to (or vent oil from) the speed setting servo piston. The servo piston, working against spring pressure, will travel downward (upward) and open a port to admit more oil pressure to (or vent oil pressure from) the power cylinder piston, which is also working against spring pressure. The power cylinder piston will travel upward (downward) allowing increased (decreased) steam flow and speed of the CA turbine and Turbine Driven CA pump.

A combination of levers, springs, buffer piston, and flyweights provide a feedback mechanism to allow the turbine to settle in at the new speed setting by "closing off" the oil ports that were originally opened to initiate the speed change.

Prior to turbine operation, the governor oil level should be visible near the top of the sightglass. When the Turbine Driven CA pump is in operation, level should be visible in the sightglass.

To ensure proper operation of the governor after Turbine Driven CA Pump operation (and align for Standby Readiness), manually cycle the Woodward speed setting to its lowest speed setting (counterclockwise direction), return to the full open position (clockwise direction). This manual action repositions the speed setting pilot valve plunger and the speed setting servo piston to allow any trapped oil to vent to the sump. Upon restart, the CA turbine will accelerate to operating speed at the correct rate and not exceed the overspeed trip (4300-4500 rpm).

2.7 Auxiliary Feedwater Automatic Recirculation Valves

Objective # 5

The Auxiliary Feedwater (CA) Automatic Recirculation Valves (ARV), CA22, CA26 and CA31, provide an assured minimum pump flow path. These valves are self-modulating, 3-way valves that function without instrument air or electrical power. These valves are capable of functioning during all fire related events.

The ARV operates as a combined check valve and globe valve with the globe valve port providing an assured flow path to prevent deadheading conditions on the pump. The Check valve port is the main discharge flow path and is operated in the same manner as the previous discharge check valve. The ARV valve is designed such that the globe port closes as the check port opens assuring a continuous discharge path for the pump and automatically eliminating recirculation flow as sufficient normal discharge flow is established. This flowpath ensures that either the normal discharge flowpath or the recirculation flowpath is always available.

1 Pt. During the delivery of chlorine gas cylinders on site a cylinder fell from the truck and ruptured. All control room VC intakes closed except 1VC-9A (VC OTSD AIR INTAKE ISOL FROM UNIT 2) and 1VC-11B (VC OTSD AIR INTAKE ISOL FROM UNIT 2) which were mechanically bound and failed to close completely. Chlorine gas has entered the control room. AP/1/A/5500/17 (*Loss of Control Room*) has been implemented on both Units.

Which one of the following describes S/G pressure control for the condition described above?

A. **All S/G PORV's are controlling between 1092 psig and 1125 psig.**

B. **'A' and 'B' S/G PORV's are controlled manually to maintain less than 1170 psig.**

C. **'C' and 'D' S/G PORV's are controlled manually to maintain less than 1170 psig**

D. **Only 'A' and 'D S/G PORV's are controlling between 1092 psig and 1125 psig.**

Bank Question: 1034 ***Answer: A***

1 Pt. During the delivery of chlorine gas cylinders on site a cylinder fell from the truck and ruptured. All control room VC intakes closed except 1VC-9A (VC OTSD AIR INTAKE ISOL FROM UNIT 2) and 1VC-11B (VC OTSD AIR INTAKE ISOL FROM UNIT 2) which were mechanically bound and failed to close completely. Chlorine gas has entered the control room. AP/1/A/5500/17 (*Loss of Control Room*) has been implemented on both Units.

Which one of the following describes S/G pressure control for the condition described above?

A. All S/G PORV's are controlling between 1092 psig and 1125 psig.

B. 'A' and 'B' S/G PORV's are controlled manually to maintain less than 1170 psig.

C. 'C' and 'D' S/G PORV's are controlled manually to maintain less than 1170 psig

D. Only 'A' and 'D S/G PORV's are controlling between 1092 psig and 1125 psig.

Distracter Analysis: Manual control of S/G pressure if only taken if S/G pressure is greater than 1170 psig and the S/G safeties are lifting. Only the 'A' and 'D' S/G have local manual control available.

A. Correct:.
Plausible:
B. Incorrect: Can not control 'B' S/G manually
Plausible:
C. Incorrect: Can not control 'C' S/G manually.
D. Incorrect:. All S/G's would be functioning normally

Level: RO

KA: APE 000068 (3.7/4.0)

Lesson Plan Objective: OP-MC-AP-17 Obj. 2

Source: New

Level of Knowledge: Comprehension

References:
1. OP-MC-AP-17 Obj. 2
2. AP/1/A/5500/17 page 10 and Enclosure 7

3. AP/1/A/5500/17 Background document page 14

APE: 068 Control Room Evacuation

AA1.26	Unlocking of switches and operation of AFW valves	3.6*	3.8*
AA1.27	Local trip of main feed pumps and Condensate pumps	3.2*	3.4*
AA1.28	PZR level control and pressure control	3.8	4.0
AA1.29	Calculation of boron needed for xenon-free shutdown	3.1	3.6
AA1.30	Operation of the letdown system	3.4	3.6
AA1.31	ED/G	3.9	4.0
AA1.32	Natural circulation flow	3.9	4.1

AA2. Ability to determine and interpret the following as they apply to the Control Room Evacuation:
(CFR: 43.5 / 45.13)

AA2.01	S/G level	4.0	4.3
AA2.02	Local boric acid flow	3.7*	4.2*
AA2.03	T-hot, T-cold, and in-core temperatures	4.0	4.2
AA2.04	S/G pressure	3.7	4.0
AA2.05	Availability of heat sink	4.2	4.3
AA2.06	RCS pressure	4.1	4.3
AA2.07	PZR level	4.1	4.3
AA2.08	S/G pressure	3.9	4.1
AA2.09	Saturation margin	4.1	4.3
AA2.10	Source range count rate	4.2*	4.4*
AA2.11	Indications of natural circulation	4.3	4.4

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		1.0	1.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Concerning AP/1(2)/5500/17 (Loss of Control Room): • State the purpose of the AP • Recognize the symptoms that would require implementation of the AP. AP17001			X	X	X
2	Given scenarios describing accident events and plant conditions, evaluate the basis for any caution, note, or step. AP17002			X	X	X

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

CAUTION While in "LOCAL", 1A and 1B Pzr Heater Groups will not cycle to maintain Pzr pressure and will not trip on low Pzr level.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 15. Check Pzr pressure - AT 2235 PSIG.	Control Pzr pressure using the following as required: __ • IF Pzr level is greater than 20%, THEN Pzr heaters may be used. __ • IF normal letdown in service, THEN NV Aux Spray may be used PER Enclosure 5 (Aligning NV Aux Spray). __ • Pzr PORVs.
__ 16. WHEN time and manpower allow, THEN maintain Unit 1 CA suction sources PER Enclosure 6 (Maintaining CA Suction Sources).	
__ 17. Check S/G pressures - LESS THAN 1125 PSIG.	__ IF SM safeties lifting AND it is desired to reduce pressure below safety setpoint (1170 PSIG), THEN dispatch operator to control pressure with Unit 1 S/G PORVs PER Enclosure 7 (Manual Operation of PORVs).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

__ 1. **Establish communication from doghouses to SRO at Aux Shutdown Panel.**

NOTE A Main Steam Isolation signal or loss of VI will prevent operation of PORVs from manual loaders.

2. **Operate valves 1SV-19 (A SM PORV) and 1SV-1 (D SM PORV) (exterior doghouse) using manual loaders as follows:**

   a. Ensure the following controller knobs are in the full counter clockwise position:

   __ • Manual loader 1SMML5521 (1A SM PORV (1SV-19) Local Manual Loader)

   __ • Manual loader 1SMML5491 (1D SM PORV (1SV-1) Local Manual loader).

   b. Ensure the following valves are open:

   __ • A-1 (1A S/G Local Manual Loader Input Isol)

   __ • D-1 (1D S/G Local Manual Loader Input Isol).

   c. Close the following valves:

   __ • A-2 (1A S/G C/R Manual Loader Output Isol)

   __ • D-2 (1D S/G C/R Manual Loader Output Isol).

   d. Open the following valves:

   __ • A-3 (1A S/G Local Manual Loader Output Isol)

   __ • D-3 (1D S/G Local Manual Loader Output Isol).

RESPONSE NOT OBTAINED (Step 2):

Operate the following PER instruction tag near valves:

__ • 1SV-19 (A SM PORV)

__ • 1SV-1 (D SM PORV).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

2. (Continued)

__ e. Adjust "1A SM PORV (1SV-19) LOCAL MANUAL LOADER" as directed by SRO.

__ f. Adjust "1D SM PORV (1SV-1) LOCAL MANUAL LOADER" as directed by SRO.

3. **Operate the following PER instruction tag near valves:**

__ • 1SV-13 (B SM PORV)

__ • 1SV-7ABC (C SM PORV).

1 Pt. Given the following conditions on Unit 1:

- Blackout on ETB
- The 1B D/G started up in automatic mode and tripped due to overspeed
- Operator has been dispatched to depress Emergency Stop Pushbutton

Which one (1) of the following describes why the diesel generator restarted once the Emergency Stop Pushbutton was depressed?

A. **The Emergency Stop Pushbutton reset the engine overspeed trip, and the undervoltage condition was still present.**

B. **The Emergency Stop Pushbutton reset the sequencer to its ground state.**

C. **The Emergency Stop Pushbutton reset the sequencer and placed it in priority mode.**

D. **The Emergency Stop Pushbutton reset the engine overspeed trip, and the accelerated sequence relay timed out.**

Bank Question: 1036 ***Answer: A***

1 Pt. Given the following conditions on Unit 1:

- Blackout on ETB
- The 1B D/G started up in automatic mode and tripped due to overspeed
- Operator has been dispatched to depress Emergency Stop Pushbutton

Which one (1) of the following describes why the diesel generator restarted once the Emergency Stop Pushbutton was depressed?

A. The Emergency Stop Pushbutton reset the engine overspeed trip, and the undervoltage condition was still present.

B. The Emergency Stop Pushbutton reset the sequencer to its ground state.

C. The Emergency Stop Pushbutton reset the sequencer and placed it in priority mode.

D. The Emergency Stop Pushbutton reset the engine overspeed trip, and the accelerated sequence relay timed out.

Distracter Analysis: The actions needed to retart the diesel after an automatic start are listed in 'A' above.

A. Correct:
Plausible:
B. Incorrect:
Plausible:
C. Incorrect:
Plausible:
D. Incorrect
Plausible:

LEVEL: RO

KA: 00051 EA1.02 (4.3/4.4)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Analysis

AUTHOR: CWS

LESSON: OP-MC-DG-DG

OBJECTIVES: OP-MC-DG-DG Obj 10

REFERENCES: OP-MC-DG-DG pages 23

EPE: 055 Loss of Offsite and Onsite Power (Station Blackout)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the Station Blackout :** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Effect of battery discharge rates on capacity	3.3	3.7
EK1.02	Natural circulation cooling	4.1	4.4
EK2	**Knowledge of the interrelations between the and the following Station Blackout:** (CFR 41.7 / 45.7)		
EK2.01	Valves	2.0	2.2
EK2.02	Sensors, detectors and indicators	2.1*	2.2*
EK2.03	Controllers and positioners	1.9	2.1
EK2.04	Pumps		
EK2.05	Motors	2.0	2.2
EK2.06	Heat exchangers and condensers	1.7	2.1
EK2.07	Breakers, relays, and disconnects	2.2*	2.4*
EK3	**Knowledge of the reasons for the following responses as the apply to the Station Blackout:** (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	Length of time for which battery capacity is designed	2.7	3.4
EK3.02	Actions contained in EOP for loss of offsite and onsite power	4.3	4.6
	ABILITY		
EA1	**Ability to operate and monitor the following as they apply to a Station Blackout:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	In-core thermocouple temperatures	3.7	3.9
EA1.02	**Manual ED/G start**	**4.3**	**4.4**
EA1.03	Manual MT jacking	1.9*	1.9*
EA1.04	Reduction of loads on the battery	3.5	3.9
EA1.05	Battery, when approaching fully discharged	3.3	3.6
EA1.06	Restoration of power with one ED/G	4.1	4.5
EA1.07	Restoration of power from offsite	4.3	4.5

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.0	1.0	1.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Diesel Generators.	X	X	X	X	
2	Describe the three major accident situations the Diesel Generators are provided to respond to.	X	X	X	X	
3	Describe the Design Criteria Functional Requirements of each Diesel Generator.	X	X	X	X	
4	Explain the various modes of Diesel Generator Operation.	X	X	X	X	
5	List the thirteen (13) Manual Mode Trips of the Diesel Generators.	X	X	X	X	X
6	List the four (4) Automatic Mode Trips of the Diesel Generators.	X	X	X	X	X
7	List the one (1) Diesel Generator Automatic Start signal.	X	X	X	X	X
8	Given a Limit and/or Precaution associated with an operating procedure, discuss its bases and when the it applies.	X	X	X	X	X
9	List the permissives that will allow a diesel Auto Start.	X	X	X	X	X
10	Explain each of the following infrequently used Diesel Generator Controls: • Emergency Stop Pushbutton • Emergency Stop Reset Pushbutton • 86 D Lockout Relay (Explain consequences of not resetting relay) • Control Room Override Breakglass	X	X	X	X	X

2.4 Diesel Generator and Sequencer Reset

The sequencer has a feedback circuit, which will automatically reset the sequencer and reinitiate an emergency start if the Diesel Generator trips and it is needed. If the diesel is not needed, the sequencer will recognize it. If a blackout and safety injection occurs and the diesel is subsequently needed, the sequencer load sheds the bus. This will reinstate the logic, stating that the diesel is needed.

The sequencer will intentionally reset if the diesel trips and is needed. Upon operator action to reset the Emergency Stop Reset or 86D Lockout, the diesel will restart. The sequencer will then take the correct action for loading the diesel.

Depressing sequencer reset will always reset the sequencer back to ground state. If an actuation signal is still present the sequencer will recognize it and go again. One can reset and suspend sequencer operations for as long as the reset is depressed regardless of input conditions.

The diesel must be locally shutdown after an emergency start.

Objective # 10

For the safety trips:

The local emergency stop reset Pushbutton must be depressed to reset Overspeed, Low Lube Oil Pressure and Emergency Stop for the Automatic Mode of Operation and Fire Lockout for Control Room/Local Mode of Operation.

The 86D Lockout Relay must be reset after resetting the 87G (Generator Differential Relay) and/or the 51V (Generator Voltage Controlled Overcurrent).

You can expect the diesel to restart upon resetting either of the above after an auto start. The only exception is if the Sequencer Reset and local stop have been depressed in that order prior to resetting relays.

De-energizing the sequencer control power will effectively reset the sequencer and allow manual operation of the essential loads.

De-energizing the diesel control power will reset its logic, except for the 86D Lockout which must always be manually reset.

2.5 Instrumentation and Control

Three Redundant Speed Switches are provided for each diesel. They monitor speed of the diesel using magnetic pickups installed over the camshaft gear and perform certain functions at predetermined settings.

During startup the speed switches utilize four (4) adjustable internal relay outputs to initiate certain functions at 40%, 95%, 97% and 112% speed.

- At 40% speed, starting air is removed and the generator field is flashed.
- At 95% speed, the low lube oil pressure diesel trip is enabled with a 30 second time delay.
- At 97% speed, an accelerated sequence permissive is given to the Diesel Generator Load Sequencer.
- At 112% speed (2/3 sensors) the diesel trips.

1 Pt Given the following conditions:

- Unit 1 is operating at 25% power
- All electrical systems are in normal alignment
- The normal incoming breaker to 1EMXA trips because of a thermal overload.

Which one of the following describes the effect failing on EVDA?

A. **No effect; alternate power to Charger Connection box ECB-1 will swap within 8 cycles and maintain power to EVDA.**

B. **EVDA will be de-energized until manual swap to 1KRP is complete.**

C. **No effect; battery EVCA will continue to power EVDA.**

D. **EVDA will be de-energized until cross tied with EVDD.**

Bank Question: 1038 ***Answer: C***

1 Pt Given the following conditions:

- Unit 1 is operating at 25% power
- All electrical systems are in normal alignment
- The normal incoming breaker to 1EMXA trips because of a thermal overload.

Which one of the following describes the effect failing on EVDA?

A. **No effect; alternate power to Charger Connection box ECB-1 will swap within 8 cycles and maintain power to EVDA.**

B. **EVDA will be de-energized until manual swap to 1KRP is complete.**

C. **No effect; battery EVCA will continue to power EVDA.**

D. **EVDA will be de-energized until cross tied with EVDD.**

Distracter Analysis:.

A. **Incorrect**: Charger connection box is Kirk-keyed
Plausible:
B. **Incorrect**: Swap to 1KRP would power 1EKVA
Plausible:
C. **Correct**:
Plausible:
D. **Incorrect** Can't crosstie EVDA and EVDD
Plausible:

LEVEL: RO

KA: 00062 K1.03 (3.5/4.0)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-EP-EPL

OBJECTIVES: OP-MC-EP-EPL Obj 9

REFERENCES: OP-MC-EP-EPL pages 21 & 69

062 A.C. Electrical Distribution

TASK:

Line up the ac electrical distribution system
Circuit breaker tests
Operate a static inverter
Equipment/bus testing for faults
Monitor the ac electrical distribution system
De-energize a motor control center (MCC) bus
Perform transfer of power supply to 4kV unit service buses
Restore a motor control center (MCC) bus to service
Perform ac breaker lineup
De-energize an engineering safeguards (4160V vital) bus
Station blackout
Restore an engineering safeguards bus to service
Perform operation of circuit breakers and generator motor-operated disconnects
Backfeed unit auxiliary transformer from main transmission switchboard (main T/G links removed)
Rack out a 480V/600V bus load breaker
Rack in a 480V/600V bus load breaker
Rack out an auxiliary bus breaker
Rack in an auxiliary bus breaker (4160V/6900V)
Transfer a vital (120V) instrument power supply
What if normal supply breaker failed to open?
Perform ground isolation
What if normal feedbreaker to the unit board does not close?
Isolate the power control breakers (PCBs)
What if the D/G does not start satisfactorily?

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ac distribution system and the following systems:** (CFR: 41.2 to 41.9)		
K1.01	CO2 deluge	2.4	2.1*
K1.02	ED/G	4.1	4.4
K1.03	DC distribution	3.5	4.0
K1.04	Off-site power sources	3.7	4.2
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Major system loads	3.3	3.4
K3	**Knowledge of the effect that a loss or malfunction of the ac distribution system will have on the following:** (CFR: 41.7 / 45.6)		

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
3.0	3.0	2.0	2.0	2.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the 125 VDC and 120 VAC Vital Instrumentation and Control Power Systems.	X	X	X	X	
2	Draw a simplified composite of the 125 VDC and 120 VAC Vital Instrumentation and Control Power Systems as provided in Training Drawing 7.2, Simplified 125 VDC and 120 VAC Vital Instrumentation and Control Power Drawing.	X	X	X	X	
3	Provide a general description of the 125 VDC Vital Instrumentation and Control Power System.	X	X	X	X	
4	List the typical loads powered from the 125 VDC Vital Instrumentation and Control Power System Distribution Centers.	X	X	X	X	
5	Provide a general description of the 120 VAC Vital Instrumentation and Control Power System.	X	X	X	X	
6	List the typical loads powered from the 120 VAC Vital Instrumentation and Control Power System Power Panelboards.	X	X	X	X	
7	Describe the basis for the sizing (loading) of the battery charger associated with the 125 VDC Vital Instrumentation and Control Power System.	X	X	X	X	
8	Discuss the normal loading demands associated with the 125 VDC Battery Chargers for the Vital Instrumentation and Control Power System.	X	X	X	X	
9	Describe any of the Kirk-Key Interlocks associated with the 125 VDC Vital Instrumentation and Control Power System and state the purpose of the Kirk-Key arrangement.	X	X	X	X	X
10	Explain how the Standby Battery Charger is used during an equalizing charge of a 125 VDC Battery for the Vital Instrumentation and Control Power System.	X	X	X	X	X

Since the spare battery charger, EVCS, is identical to the other chargers it can be used to replace a normal charger (as necessary) by closing the appropriate key interlocked circuit breakers.

Objective # 8

The load demands normally placed on each unit battery charger will consist of its respective DC distribution center loads, as well as, the loads of the associated DC panelboards while still providing a "floating charge" (132 ± 1 volt) on its respective battery.

Each charger receives power from one of two redundant 600 VAC Essential Auxiliary Power System Motor Control Centers (one power supply from a Unit 1 MCC and the other from a Unit 2 MCC). The chargers are manually connected to either one of these two power supplies through their respective charger connection box.

1(2) EMXA are the MCCs feeding the connection boxes for EVCA and EVCC, while the MCCs feeding the connection boxes for EVCB and EVCD are 1(2) EMXB.

Objective # 9

The charger connection box breakers for EVCA, EVCB, EVCC, and EVCD are Kirk-Key Interlocked to allow only one breaker to be closed at a time. ***This prevents tying a Unit 1 power source to a Unit 2 power source.***

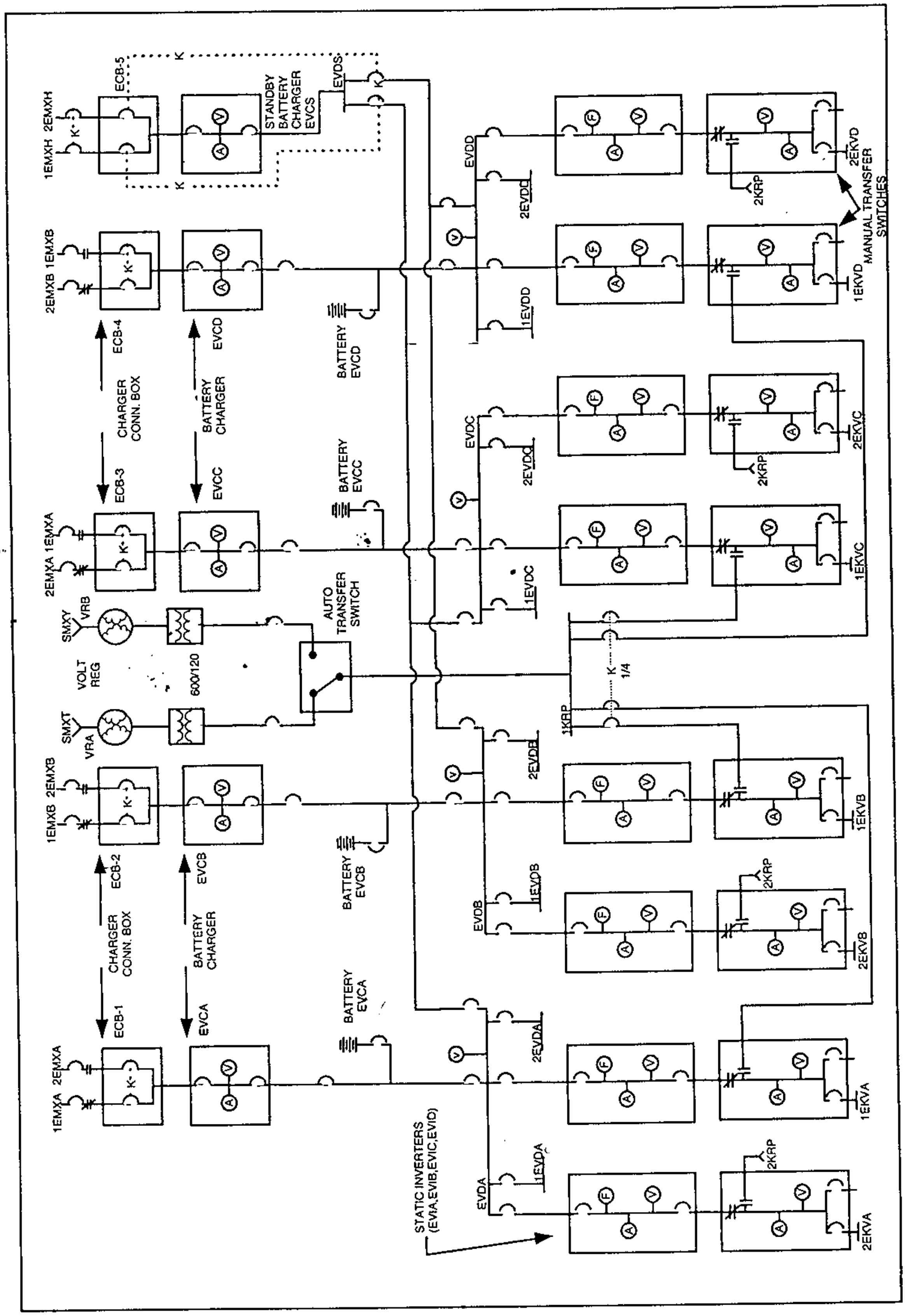
Charger startup involves closing the DC output breaker to the Distribution Center then the charger AC input breaker. The control board operator will then start the battery charger by depressing the start push-button, located on 1MC-8 in the Control Room, which closes a set of "M" contacts, located at the 600 V MCC, and provides AC power to the battery charger via the charger connection box. Then the Charger DC output breaker is closed connecting the charger to the DC loads.

Charger shutdown requires the control board operator to depress the stop push-button, located on 1MC-8 in the Control Room, followed by opening of the charger DC output, AC input breaker and then the DC output breaker to the Distribution Center.

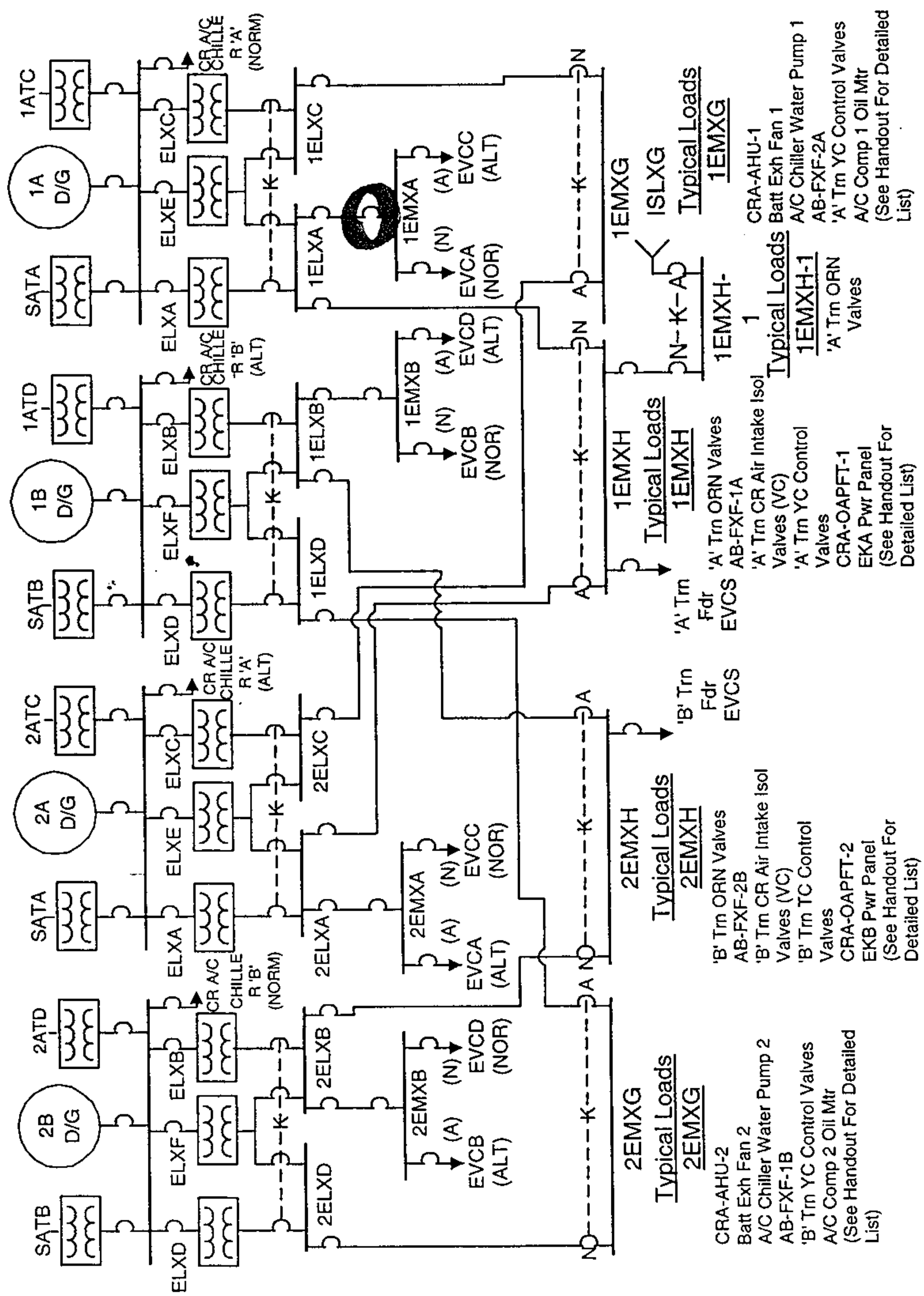
Objective # 10 & 11

The standby charger (EVCS) is used when one of the normal battery chargers is unavailable for service (standby mode) or during an "equalizing charge" to one of the batteries. The two feeder breakers, located at EVDS (distribution center for battery charger EVCS), provide proper alignment of the standby charger during its operation (standby mode or equalizing charge mode). The standby charger can supply the A Train Distribution Centers (EVDA or EVDC) or the B Train Distribution Centers (EVDB or EVDD). Kirk-Key Interlocks, provided with all of the associated breakers, ensure that only one train of distribution centers can be supplied, from EVDS, at a time.

7.1 125 VDC/120 VAC Vital I&C Power Composite Drawing (01-06-97)



7.8 Main Power Distribution Power Diagram for Shared Essential Loads (09/05/01)



1 Pt

Unit 2 was operating at 100% when a Floor Cooling Glycol High Temperature annunciator is received. A review of the RTD panel reveals that several ice condenser floor slabs have high temperature indications. An operator determines that 2NF-848 (*NF Floor Cooling Slab Temp Control*) has failed closed. An inspection of the lower ice condenser reveals that eight (8) ice condenser bays have experienced buckling.

Which one of the following statements describes the effect on peak containment pressure and time to reach peak containment pressure?

A. **Design containment pressure of 15 psig will not be exceeded. The time to reach peak containment pressure is ≤ 20 minutes.**

B. **Design containment pressure of 15 psig could be exceeded. The time to reach peak containment pressure is ≤ 1.75 hours.**

C. **Design containment pressure of 20 psig will not be exceeded. The time to reach peak containment pressure is ≤ 20 minutes.**

D. **Design containment pressure of 20 psig could be exceeded. The time to reach peak containment pressure is ≤ 1.75 hours.**

Bank Question: 1039 ***Answer: B***

1 Pt

Unit 2 was operating at 100% when a Floor Cooling Glycol High Temperature annunciator is received. A review of the RTD panel reveals that several ice condenser floor slabs have high temperature indications. An operator determines that 2NF-848 (*NF Floor Cooling Slab Temp Control*) has failed closed. An inspection of the lower ice condenser reveals that eight (8) ice condenser bays have experienced buckling.

Which one of the following statements describes the effect on peak containment pressure and time to reach peak containment pressure?

A. **Design containment pressure of 15 psig will not be exceeded. The time to reach peak containment pressure is ≤ 20 minutes.**

B. **Design containment pressure of 15 psig could be exceeded. The time to reach peak containment pressure is ≤ 1.75 hours.**

C. **Design containment pressure of 20 psig will not be exceeded. The time to reach peak containment pressure is ≤ 20 minutes.**

D. **Design containment pressure of 20 psig could be exceeded. The time to reach peak containment pressure is ≤ 1.75 hours.**

Distracter Analysis: There are 24 ice condenser bays in containment. With 8 bays having experienced buckling and the doors incapable of opening 1/3 of the total flowpath into the ice condenser is now blocked.

A. **Incorrect:** peak containment pressure is reached in 1.75 hours
Plausible: peak containment pressure is correct.

B. **Correct.**
Plausible:

C. **Incorrect Answer:** peak pressure to high, time to reach is too short

D. **Incorrect:** peak pressure to high.
Plausible: 20 psig is appropriate for some non-ice condenser plants..

Level: RO

KA: SYS 025K3.01(3.8*/3.8*)

Lesson Plan Objective: OP-MC-CNT-NF Obj. 20

Source: NEW

Level of knowledge: Comprehension

References:
1. OP-MC-CNT-NF pages 69 & 17
2. OP-MC-CNT-CNT pages 17 & 21

SYSTEM: 025 Ice Condenser System

TASK: Monitor the ice condenser system

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ice condenser system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Containment ventilation	2.7*	2.7*
K1.02	Refrigerant systems	2.7*	2.7*
K1.03	Containment sump system	3.2*	3.0*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Containment ventilation fans and dampers	2.2*	2.7*
K2.02	Refrigerant systems	2.0*	2.5*
K2.03	Isolation valves	2.0*	2.2*
K3	**Knowledge of the effect that a loss or malfunction of the ice condenser system will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment	3.8*	3.8*
K4	**Knowledge of ice condenser system design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Glycol expansion tank levels and ice condenser system containment isolation valves	2.2*	2.5*
K4.02	System control	2.8*	3.0*
K5	**Knowledge of operational implications of the following concepts as they apply to the ice condenser system:** (CFR: 41.5 / 45.7)		
K5 01	Relationships between pressure and temperature	3.0*	3.4*
K5 02	Heat transfer	2.6*	2.8*
K5.03	Gas laws	2.4*	2.8*
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the ice condenser system:** (CFR: 41.7 / 45.7)		
K6.01	Upper and lower doors of the ice condenser	3.4*	3.6*

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
11	Describe how the ice condenser temperature is maintained during normal operation.	X	X	X	X	X
12	State the purpose of the following NF Ice Making System components: • Glycol Recirc Pumps • "Run-Off-Fill" switches • Ice Making Solution Mixing Tank.	X	X	X	X	
13	*Discuss the basic flowpath of ice from the ice storage bin to* the ice baskets in the ice condenser.	X	X	X	X	
14	*Concerning the ice condenser chart recorder:* • State the purpose • List the information that can be accessed • Describe the modes of operation.		X	X	X	X
15	Given a limit and/or precaution associated with an NF System Operating Procedure, discuss its basis and applicability.		X	X	X	X
16	State the problems which will occur as a result of operating with elevated ice condenser temperature.		X	X	X	X
17	State the purpose of iodine removal from containment following a LOCA..	X	X	X	X	X
18	Explain how iodine removal from containment atmosphere is accomplished and the effect of (sodium tetraborate) $Na_2B_4O_7$ on the removal process.	X	X	X	X	X
19	Describe how a failure of the ice condenser doors to open on a LOCA will effect containment sump level.		X	X	X	X
20	Describe how a failure of the ice condenser doors to open on a HELBIC will effect peak containment pressure.		X	X	X	X

Objective # 15

- Chiller Compressor discharge pressure should always be < 265 psig.

  Basis: To ensure overpressurization of chiller compressor discharge components is not occurring, to ensure proper operation of the metering device associated with the refrigeration cycle is operating properly and to ensure there is no blockage in the refrigeration piping.

3.1.2 Normal Operation

The ice condenser is a passive system which requires no actuation signals. To keep the ice condenser at approximately 15^{0}F, each unit will have 30 AHUs operating to circulate air in the ice condenser, three or four operating chillers circulating glycol as cooling medium and two operating glycol pumps maintaining it at approximately 15^{0}F. The ice machines and ice loading equipment will not be operating.

Objective #16

Operating with elevated ice condenser temperatures during normal operation increases sublimation of the ice which requires ice replacement during outages.

(Sublimation is the process of turning a solid directly to a vapor without passing through the liquid phase.) Operating with elevated temperatures also creates a cyclic freeze/thaw cycle which has been identified with buckling/elevating the ice condenser wear slab which in turn has resulted in cracks adjacent to the inner portal frame. The combination of the elevation of the wear slab and cracks in the inner portal frame has shown to prevent the ice condenser doors from opening or exceeding their design opening torque.

The cyclic freeze/thaw cycle identified is the movement of the frost line in the foam concrete of the ice condenser floor. This movement is caused by the increase in temperature of the lower part of the floor during power operation. In the warmer spots the frost line moves up more, and water is free to work into cracks in the concrete.

- Drumseals are designed for leakage during operation. Check leakage to determine if catch containments are required. (PIP 0-M97-2854).

  Basis: Prevent spills and loss of solution.

Objective #16

When the plant cools during outages the frost line moves lower and more of the water freezes causing the ice to expand pushing the floor upward. The ice bays nearest the higher temperature areas in containment (near the S/G compartments) under go the greatest freeze/thaw amplitude and resulted in the greatest amount of door opening force when tested. Allowing elevated temperatures in the ice condenser aggravates the freeze/thaw cycle.

3.2 Abnormal and Emergency Operation

At the beginning of a LOCA, Lower containment pressure will be greater than upper containment pressure. When differential pressure is greater than 1.0 lbs/ft^2 the lower doors will open. The steam /air flow thru the ice condenser will open the intermediate and top deck doors. The ice will absorb large amounts of energy from the steam/hot air mixture as it passes through the ice condenser. This will reduce the peak pressure in containment.

Hydrogen accumulation inside containment during a LOCA presents an explosion hazard. Emergency procedure EP/1or2/A/5000/E-0 (Reactor Trip or Safety Injection) directs the operator to place the Hydrogen Igniters in operation and dispatch an operator to turn off the NF AHUs once a LOCA has been determined. The containment response to hydrogen combustion as a result of the deliberate ignition of hydrogen (Hydrogen Igniters) following core damage has been analyzed. This analysis has **not** been performed with the NF AHUs in service. Since the containment response analysis does **not** consider the impact of the operation of the NF AHUs, they should be stopped prior to the release of hydrogen in a core damage accident and prior to the operation of the igniters.

Objective #17, 18

Iodine presents a radiological problem (internal dose and dose at the site boundary in the event of containment leakage) in containment following a LOCA. By removing iodine, the radiological airborne hazard can be reduced. Some Iodine (about 80%) will be trapped in the containment sump water by hydrolysis:

$$3I_2 + 3H_2O \rightarrow 5I^- + IO_3^- + 6H^+$$

The efficiency of this interaction can be increased to almost 100% by increasing the pH of the solution. This is accomplished by adding sodium tetraborate to the ice making solution mixing tank.

Objective #19, 20

Operation of the ice condenser is critical to the containment response following a HELBIC. The ice condenser and containment spray work together to maintain containment pressure below 15 psig. If for some reason the ice condenser doors failed to open, containment pressure would exceed the design basis pressure. Excessive containment leakage or in worst case scenario, a breach of containment, could result in excessive dose to plant personnel and the general population near the plant. In addition, the ice melt provides borated water for the containment sump. Following a LOCA, the melted ice provides 2000 ppm borated water (Tech Spec minimum of 1800 ppm.) to aid in the containment sump inventory available for recirculation through the core.

2.0 COMPONENT DESCRIPTION

2.1 Containment System

Objective # 3

The free standing steel containment vessel and the containment isolation system are the primary barriers to the release of radioactivity following a loss of coolant accident (LOCA). **The maximum design internal pressure is 15 psig. This provides a margin of safety for the double ended main coolant pipe break which would provide the greatest expected peak pressure** calculated to be 14.5 psig.

The maximum design external pressure is 1.5 psig. A rise in external pressure could be caused by:

- **Rupture of a hot or high-pressure pipe in the Annulus.**
- **Inadvertent initiation of containment spray (NS) during normal operation.**
- **Inadvertent initiation of the containment air return fan (VX) during normal operation.**
- **Containment purge fan operation with the containment purge (VP) inlet valves closed.**

  NOTE: The maximum expected external pressure due to these 4 causes is approximately 0.8 psi.

The secondary boundary is the Annulus, which is maintained at less than atmospheric pressure following a loss-of-coolant accident and the outer concrete Reactor Building. The Reactor Building and the Annulus Ventilation System function to keep out-leakage minimal but are not factors in determining the design leak rate. The design leak rate is based on the steel containment vessel and its containment isolation system only. These structures form a double barrier to the escape of fission products should a loss-of-coolant accident occur.

2.2 Containment Isolation System

Objective #4

The Containment Isolation System provides a means of double barrier isolation of process lines on systems, which penetrate containment but are NOT required following an accident. This double barrier is meant to prevent the release of radioactivity to the outside environment. Piping systems penetrating the primary (steel vessel) reactor containment shall be provided with leak detection, isolation, and containment capabilities. These capabilities shall have redundancy, reliability and performance capabilities that reflect the importance of the piping systems.

2.3 Ice Condenser System

The ice condenser prevents high pressure in the containment and thus reduces the potential for the escape of fission products from the containment. When a pipe in the Reactor Coolant System ruptures/breaks, the pressure in lower containment increases causing the lower ice condenser doors to open (refer to Drawing 7.1, 7.4 and 7.5). The steam vapor mixture passes through the ice condenser where it is cooled and passes into upper containment. The ice condenser is designed to limit containment pressure to less than 15 psig for all reactor coolant pipe breaks up to and including a double ended severance. Analyses have shown that the accident that produces the highest blow-down rate (greatest release of mass and energy) into the ice condenser is the double-ended reactor coolant pipe severance.

For more information on the ice condenser refer to lesson plan OP-MC-CNT-NF.

2.4 Containment Air Return Fans

The containment air return fans aid in limiting the post accident containment pressure to the design value by returning air to the lower containment following a loss-of-coolant accident (refer to Drawing 7.6). This maximizes the benefits of the ice condenser by enhancing the flow of steam through it. Maximum containment pressure occurs approximately 1.75 hrs after a double-ended severance of the reactor coolant piping. This is due to depletion of the ice.

For more information on the Containment Air Return Fans, refer to lesson plan OP-MC-CNT-VX.

2.5 Emergency Hydrogen Mitigation (EHM) System

Objective # 5

Following a LOCA, there is a potential for hydrogen to be released into the containment atmosphere. In some areas/pockets there is a potential for flammable/explosive concentrations of hydrogen to collect. It is unlikely that a high concentration of H_2 would exist following a LOCA unless inadequate core cooling has occurred. The purpose of the Emergency Hydrogen Mitigation System is to protect the containment structure from a sudden overpressure, due to a hydrogen reaction, by igniting and burning off low concentrations of hydrogen gas. The system utilizes (70) hydrogen mitigation igniter boxes located throughout containment where H_2 gas pockets are likely to form. The igniter boxes are evenly split between Train A and Train B with one from each train at each location. Igniters are located in areas such as:

- **in the ice condenser upper plenum**
- **near upper containment dome**
- **near the tops of each S/G enclosure and the pressurizer enclosure**
- **above the reactor vessel**

1 Pt Which one of the following are the power supplies for the Unit 1 MG sets?

A. ***1LXE and 1LXF***

B. **1LXF and 1LXG**

C. **1SLXF and 1SLXG**

D. **1SLXG and 1SLXH**

Bank Question: 1040 ***Answer: B***

1 Pt Which one of the following are the power supplies for the Unit 1 MG sets?

A. 1LXE and 1LXF

B. 1LXF and 1LXG

C. 1SLXF and 1SLXG

D. 1SLXG and 1SLXH

Distracter Analysis:.

A. **Incorrect**: 1LXE is not correct
Plausible:
B. **Correct**:
Plausible:
C. **Incorrect**: *Power does not come from shared load centers*
Plausible:
D. Incorrect Power does not come from shared load centers
Plausible:

LEVEL: RO

KA: 00001 K2.05 (3.1*/3.5)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-IC-RTB

OBJECTIVES: OP-MC-IC-RTB Obj 11

REFERENCES: OP-MC-IC-RTB page 19

SYSTEM: **001 Control Rod Drive System**

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CRDS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	CCW	3.0*	3.2*
K1.02	CVCS	3.6*	3.7*
K1.03	CRDM	3.4	3.6
K1.04	RCS	3.2*	3.4*
K1.05	NIS and RPS	4.5	4.4
K1.06	WGDS	1.7*	2.0*
K1.07	Quench tank	1.7*	2.1*
K1.08	CCWS: must be shut down to prevent condensation on CRDM stators	2.2*	2.4*
K1.09	CCWS must be cut in before energizing CRDS	2.8*	3.1*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	One-line diagram of power supply to M/G sets.	3.5	3.6
K2.02	One-line diagram of power supply to trip breakers	3.6	3.7
K2.03	One-line diagram of power supplies to logic circuits	2.7*	3.1
K2.04	Control rod lift coil...	2.1*	2.7
K2.05	M/G sets	3.1*	3.3
K2.06	Circuit breakers	2.4	2.8
K2.07	Sensors and detectors...	2.1	2.4
K2.08	Motors	1.7	2.1
K3	**Knowledge of the effect that a loss or malfunction of the CRDS will have on the following:** (CFR: 41.7/45.6)		
K3.01	CVCS	2.9*	3.0*
K3.02	RCS	3.4*	3.5
K3.03	CCW	2.2*	2.4*
K4	**Knowledge of CRDS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Rod position indication	3.5	3.8
K4.02	Control rod mode select control (movement control)	3.8	3.8
K4.03	Rod control logic	3.5	3.8
K4.04	Circuitry and principle of operation for LVDT or reed switch	2.5	2.8

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
10	Explain what annunciators will warn the control room personnel of the following conditions: • MG set trip. • Bypass breaker in the connected and closed position.	X	X	X	X	X
11	List the power supplies to the motor generator sets.	X	X	X	X	
12	Briefly describe the incident that occurred at Salem Nuclear Plant and how this event affected McGuire reactor trip breaker operation.			X	X	X
13	Describe the basic procedure for MG set startup, parallel operation and shutdown using the following MG set controls and instrumentation: • MG Set Voltage Adjust. • Synchronize Switch. • Motor Circuit Breaker Control Switch. • Generator Circuit Breaker Control Switch. • Generator Field Flash Pushbutton. • Generator Line Volts Meter. • Generator Line Amp Meter. • M/G Set Circulating Current Volt Meter	X	X	X	X	
14	Given a Limit and/or Precaution associated with an operating procedure, discuss its basis and applicability.		X	X	X	X

Objective # 11

2.1.2 MG Set Power Supplies

Motor: 1(2)A MG - 1(2)LXF 600 V Load Center, 1(2)B MG - 1(2)LXG 600 V Load Center

Control Power: 1(2)A MG - DCA (125VDC), 1(2)B MG - DCB (125VDC)

2.2 Reactor Trip Breakers

Refer to Figure 7.4, 7.5. The reactor trip breaker system consists of four 1600 amp, 480 VAC, Westinghouse DS-416 circuit breakers. The breakers are arranged in a duplicate, two train configuration with a main reactor trip (RT) and a bypass (BY) breaker associated with each train. No protective relaying is associated with these breakers.

2.2.1 Main Reactor Trip Breakers

Objective # 3

The Main Reactor Trip Breakers, RTA and RTB, are located in a series arrangement so that only one of these train related breakers needs to open to remove power from the CRDM's, thus causing a reactor trip.

Objective # 4

Each breaker has two trip coils associated with it, undervoltage and shunt trip. (See Section 3.1.3, Reactor Trip Breaker Operation)

Undervoltage Coil (UV coil) - when the breaker is closed, the UV coil is energized from the SSPS and holds the UV trip attachment trip plunger out against spring force. Upon loss of power to the UV coil, trip plunger spring force will automatically open the breaker.

Shunt Trip Coil (ST coil) - this coil is de-energized when the breaker is closed. When energized, the shunt trip attachment will move the trip plunger causing the breaker to open.

Periodic testing of the SSPS and the reactor trip breakers is required by Technical Specifications in addition to cleaning and inspection of the breakers. Surveillance activities are normally performed during an outage but can be performed at power by using the bypass breakers.

Objective # 5

Located on the front of the breaker door cubicle is a red "TRIP" plate. Depressing this trip plate will operate a mechanical linkage to trip the breakers when closed. **This linkage is redundant to the Trip Plate on the breaker itself.**

1 Pt Which one of the following is the power supply for the 2B Hydrogen Recombiner?

A. **2TA**

B. **2ETA**

C. **2EMXC**

D. **2EMXD**

Bank Question: 1041 ***Answer: D***

1 Pt Which one of the following is the power supply for the 2B Hydrogen Recombiner?

A. **2TA**

B. **2ETA**

C. **2EMXC**

D. **2EMXD**

Distracter Analysis:.

A. **Incorrect:**
Plausible:
B. **Incorrect:**
Plausible:
C. **Incorrect:**
Plausible:
D. **Correct**
Plausible:

LEVEL: RO

KA: 0028 K2.01 (2.5*/2.8*)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-CNT-VX

OBJECTIVES:

REFERENCES: OP-MC-CNT-VX page 49

028 Hydrogen Recombiner and Purge Control System (HRPS)

TASK:
Perform lineups of the HRPS
Perform hydrogen recombiner test
Start up the hydrogen recombiners
Start up the hydrogen purge system
Monitor the HRPS
Shut down the hydrogen purge system
Operate the hydrogen analyzer

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the HRPS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Containment annulus ventilation system (including pressure limits)	2.5*	2.5
K1.02	Air supply system	2.0*	2.2*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
[redacted]			
K3	**Knowledge of the effect that a loss or malfunction of the HRPS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Hydrogen concentration in containment	3.3	4.0
K4	**Knowledge of HRPS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
	None		
K5	**Knowledge of the operational implications of the following concepts as they apply to the HRPS:** (CFR: 41.5 / 45.7)		
K5.01	Explosive hydrogen concentration	3.4	3.9
K5.02	Flammable hydrogen concentration	3.4	3.9
K5.03	Sources of hydrogen within containment	2.9	3.6*
K5.04	The selective removal of hydrogen	2.6?	3.2?
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the HRPS:** (CFR: 41.7 / 45.7)		
K6.01	Hydrogen recombiners	2.6	3.1

Hydrogen Recombiner

1A	1EMXC
1B	1EMXD
2A	2EMXC
2B	2EMX[illegible]

6.3 Review lesson plan objectives

7.0 DRAWINGS

1 Pt Given the following conditions on Unit 2:

- 75% power
- Annunciator “Subcooling Margin Alert” comes into alarm

Which one of the following describes the origin of the alarm?

Reference Provided

A. Wide Range Pressure Loop ‘C’ fails to ‘0’ psig

B. Wide Range Pressure Loop ‘D’ fails to ‘0’ psig

C. One safety related thermocouple fails to 725 degrees

D. Wide Range T hot ‘B’ loop failing high to 650 degrees

Bank Question: 1043 ***Answer B:***

1 Pt Given the following conditions on Unit 2:

- 75% power
- Annunciator "Subcooling Margin Alert" comes into alarm

Which one of the following describes the origin of the alarm?

Reference Provided
Steam Tables

A. Wide Range Pressure Loop 'C' fails to '0' psig

B. Wide Range Pressure Loop 'D' fails to '0' psig

C. One safety related thermocouple fails to 725 degrees

D. Wide Range T hot 'B' loop failing high to 650 degrees

Distracter Analysis:. The alarm 'Subcooling Margin Alert' is actuated due to 'A' train inputs only

A. **Incorrect**: Input to 'B' train
Plausible:
B. **Correct**:
Plausible:
C. **Incorrect**: 625 x 4 + 750 = 3225 / 5 =645 degrees which is not witin 2 degrees of 650 where the alarm would come in
Plausible: Average CETC temp at 100% is 624 degrees
D. **Incorrect** Input to 'B' train
Plausible:

LEVEL: RO

SOURCE: NEW

LEVEL OF KNOWLEDGE: Comphrension

KA: SYS 002 K6.06 (2.5/2.8)

AUTHOR: CWS

LESSON: OP-MC-IC-ICM

OBJECTIVES: OP-MC-IC-ICM Obj 9

REFERENCES: OP-MC-IC-ICM page 33

K5.13	Causes of circulation	3.5	3.9
K5.14	Consequences of forced circulation loss	3.8	4.2
K5.15	Reasons for maintaining subcooling margin during natural circulation	4.2	4.6
K5.16	Reason for automatic features of the Feedwater control system during total loss of reactor coolant flow	3.5	4.0
K5.17	Need for monitoring in-core thermocouples during natural circulation.	3.8	4.2
K5.18	Brittle fracture	3.3	3.6
K5.19	Neutron embrittlement	2.6	2.9
K5.20	Corrosion control principles	2.3	2.7

K6 **Knowledge of the effect or a loss or malfunction on the following RCS components:**
(CFR: 41.7 / 45.7)

K6.01	RCS valves that may pose and unusually high radiological Hazard because of trapped crud	2.2	2.9
K6.02	RCP	3.6	3.8
K6.03	Reactor vessel level indication	3.1	3.6
K6.04	RCS vent valves	2.5	2.9
K6.05	Valves	2.1	2.4
K6.06	Sensors and Detectors	2.5	2.8
K6.07	Pumps	2.5	2.8
K6.08	Controllers and Positioners	2.4	2.7
K6.09	Motors	2.1	2.5
K6.10	Breakers, relays, and disconnects	2.2	2.4
K6.11	Thermal sleeves	2.2	2.6
K6.12	Code Safety valves	3.0	3.5
K6.13	Reactor vessel and internals	2.3	2.8
K6.14	Core components	2.2	2.8
K6.15	Post-accident sampling	TBD	TBD

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RCS controls including:**
(CFR: 41.5 / 45.7)

A1.01	Primary and secondary pressure	3.8	4.1
A1.02	PZR and makeup tank level	3.6	3.9
A1.03	Temperature	3.7	3.8
A1.04	Subcooling Margin	3.9	4.1
A1.05	RCS flow	3.4	3.7
A1.06	Reactor power	4.0	4.0
A1.07	Reactor differential temperature	3.3	3.5
A1.08	RCS average temperature	3.7	3.8
A1.09	RCS T-ave	3.7	3.8
A1.10	RCS T-ref	3.7	3.8
A1.11	Relative level indications in the RWST, the refueling cavity, the PZR and the reactor vessel during preparation for refueling	2.7	3.2

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
6	Describe the three RVLIS Ranges of indication in terms of: • The relationship to RCS inventory and void content • Instrument span • Indication provided • Units of indication • The conditions under which each range provides valid indication, including whether or not a particular range is valid during natural circulation ICICM006		X	X	X	X
7	List the parameters used by the ICCM to calculate the RVLIS indication and briefly explain the purpose of each. ICICM007		X	X	X	X

8	Describe the Core Exit Thermocouple Monitor function in terms of:
	• Number of T/Cs and allotment per train
	• Reference junction temperature compensation
	• Indicated parameters:
	  • Quadrant maximum, minimum, and average
	  • 5 highest T/Cs
	  • Average of 5 highest T/Cs
	• Range of indication
	ICICM008
			X	X	X	X

9	Describe the Subcooling Margin Monitor Function of the ICCM in terms of: • Parameters used to determine subcooling margin for each train • Indication provided • Instrument uncertainty correction • Range of indication • Alarms provided ICICM009		X	X	X	X

2.3 Subcooling Margin Monitor

Objective # 9

This monitor calculates and displays the subcooling margin of the average of the 5 highest T/Cs and two loop wide range T_h and provides alarms for approaching and loss of subcooling.

The monitor calculates subcooling using the equation:

$$\text{Subcooling} = T_{sat} - T_{measured}$$

This comparison is made for:

- (T_{sat} - T/C 5 highest) = subcooling based on the average of 5 highest core exit T/Cs)
- ($T_{sat} - T_h$) = subcooling based on loop wide range T_h

The monitor determines T_{sat} by using wide range loop pressure and then adjusts the value for instrument error associated with the pressure and temperature instruments. The results is a saturation curve similar to the Data Book Curve which the operator uses if the instrument is inoperable. There are provisions for increasing the instrument error in the event containment pressure increases above 3 psig (S_P). This provision is not used at present since the pressure transmitters are located outside containment and would not be exposed to a hostile environment.

Inputs to the subcooling monitor are: (refer to Drawing 7.2)

- wide range loop pressure (loop "D" for Train A ICCM and loop "C" for Train B) from the 7300 Process Control System.
- average of the 5 highest T/Cs from the core exit thermocouple monitor calculation
- wide range Th (Train A ICCM uses loops "C" and "D" while Train B uses loops "A" and "B") from the 7300 Process Control System
- phase B contact is used to indicate that containment pressure is greater than 3 psi. This provides the monitor with the capability of changing the T_{sat} curve to account for post accident instrument uncertainty however, this function is not used since the displayed curves are the post-accident values.

The subcooling monitor provides the following Control Room Annunciators:

1) Subcooling Margin Alert (AD2-D4) This alarm is driven by the train A ICCM only. It will alarm under the following conditions:
   - 2^0F subcooling from average of 5 T/Cs or either WR Th
2) Loss of Subcooling (AD2-D5) This alarm is driven by the train A ICCM only. It will alarm under the following condition:
   - 0^0F subcooling from the average of the 5 highest T/Cs or, 0^0F subcooling from either WR T_h

INSTRUCTOR ACTIVITY

1 Pt Unit 1 was at 100% power when the 'A' FWPT trips. Rods fail to insert as required. The RO places the control rod mode select to manual. The combined power mismatch signal is +4. The operator drives rod in.

Which one of the following describes the response of the rod control system?

A. **Rods will insert at 72 steps per minute.**

B. **Rods will insert at 64 steps per minute.**

C. **Rods will insert at 40 steps per minute.**

D. **Rods will insert at 48 steps per minute.**

Bank Question: 1044 ***Answer: D***

1 Pt

Unit 1 was at 100% power when the 'A' FWPT trips. Rods fail to insert as required. The RO places the control rod mode select to manual. The combined power mismatch signal is +4. The operator drives rod in.

Which one of the following describes the response of the rod control system?

A. Rods will insert at 72 steps per minute.

B. Rods will insert at 64 steps per minute.

C. Rods will insert at 40 steps per minute.

D. Rods will insert at 48 steps per minute.

Distracter Analysis:.

A. **Incorrect**: this speed is for auto mode only at a 5 degree mismatch
Plausible:
B. **Incorrect**: this speed is for shutdown banks only
Plausible:
C. **Incorrect**: this speed is correct for auto rod movement at a 4 degree error
Plausible:
D. **Correct**
Plausible:

LEVEL: RO

KA: 014 A4.02 (3.4/3.3)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-IC-IRX

OBJECTIVES: OP-MC-IC-IRX Obj 8

REFERENCES: OP-MC-IC-IRX pages 21, 23, 25

SYSTEM: **014 Rod Position Indication System (RPIS)**

A3 **Ability to monitor automatic operation of the RPIS, including:**
(CFR: 41.7 / 45.5)

None

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Rod selection control	3.3	3.1
A4.02	Control rod mode-select switch	3.4	3.2
A4.03	Primary coil voltage measurement	2.6*	2.7*
A4.04	Re-zeroing of rod position prior to startup	2.7	2.7

CLASSROOM TIME (Hours)

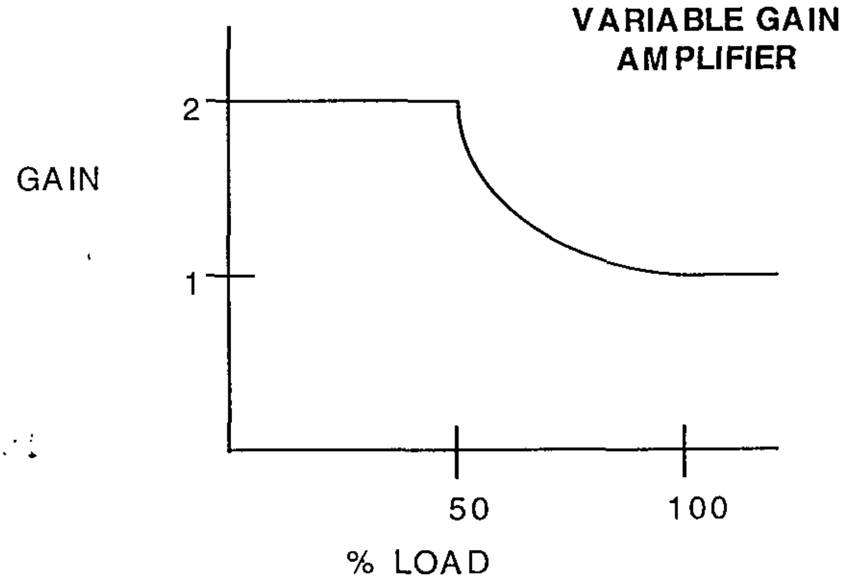
NLO	NLOR	LPRO	LPSO	LOR
N/A	1.5	1.5	1.5	1.5

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose of the Reactor Control System (IRX).		X	X	X	
2	Discuss the rod speed program for both rod insertion and withdrawal as per Drawing 7.4.		X	X	X	
3	Sketch the IRX block diagram, including all input and output signals, per Drawing 7.6.		X	X	X	
4	Describe how the T_{ref} program is generated, based on turbine impulse pressure, including minimum and maximum values of T_{ref}.		X	X	X	
5	Describe how the Temperature Mismatch signal is developed and used for rod movements.		X	X	X	X
6	Describe how the Power Mismatch signal is developed and used for rod movements.		X	X	X	X
7	Explain how the Combined Error signal is used to develop rod speed and direction signals.		X	X	X	X
8	State all rod speeds for both automatic and manual operation.		X	X	X	
9	Describe all interlocks affecting rod withdrawal to include setpoints, logic and mode of operation that is affected (Automatic or Manual).		X	X	X	X
10	Describe the system operation during transients.		X	X	X	X
11	Describe the system operation and operator response to various failed input signals.		X	X	X	X

2.6.1. Variable gain amplifier

The output of the non-linear gain unit is sent to the variable gain unit. This unit reduces its output as turbine power is increased. Below 50% power, the gain is 2. From 50% to 100% power, the gain is reduced until the gain equals 1 at 100% power. This minimizes power overshoot at higher power levels.



Objective #12

The power mismatch circuit generates an equivalent temperature error signal. This signal is then sent to the upper scale of Control Board bargraph indicator ±15 °F.

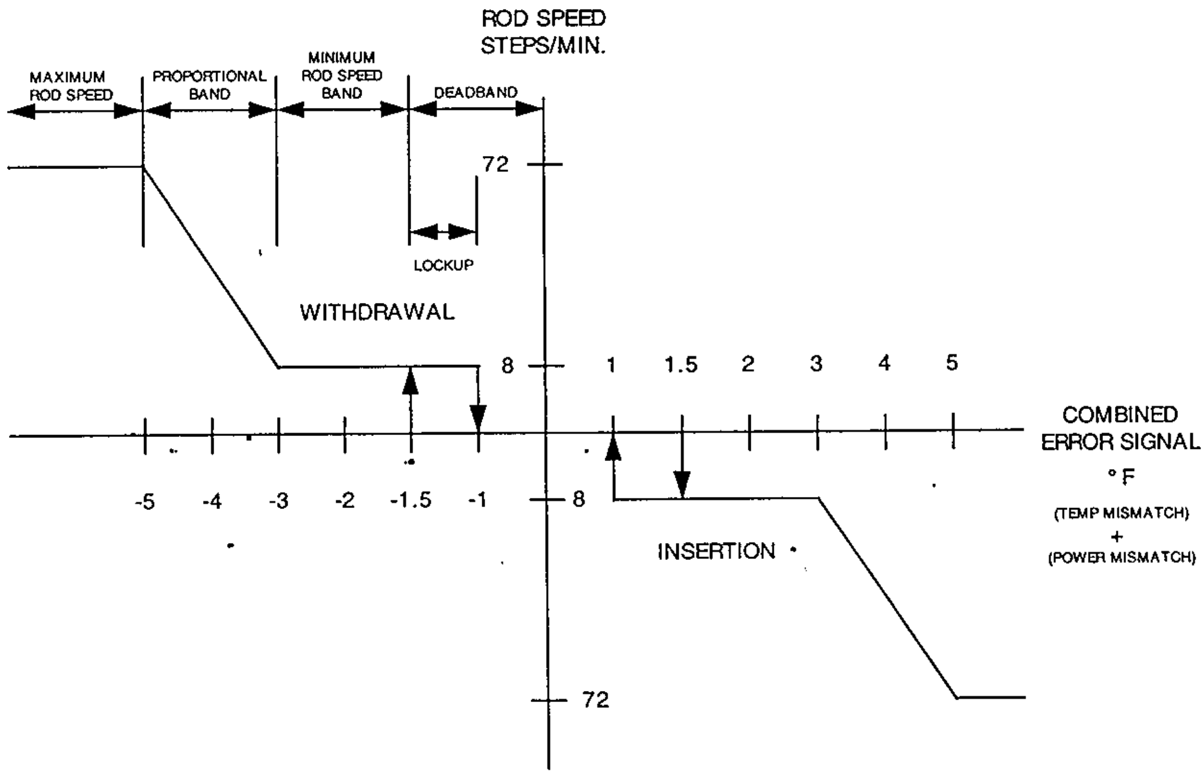
2.7. Combined Error Signal (Rod Speed and Direction Signal)

Objective #7, 8

The equivalent temperature error from the power mismatch circuit combines with the actual temperature error in the summer. The output of the summer inputs to the speed controller where conversion to a speed and direction signal occurs. A deadband of ± 1.5 °F, where no rod motion occurs prevents system oscillation and bistable chatter. A 0.5 °F lockup feature ensures that the error signal drops below a 1 °F mismatch. Between a 1.5 and 3.0 °F error, the rods will move at 8 steps per minute. The rod speed increases linearly from 8 steps per minute to 72 steps per minute when the error increases from 3 to 5 °F. When the error is greater than 5 °F, the rod speed is 72 steps per minute.

Power mismatch signal causes improved response (quicker) of output signal resulting in faster reaction of rod movement. It dominates initially on changing power mismatch signals. Temperature mismatch signal dominates during any slow load increases/or decreases.

During a rapid power mismatch transient, the temperature mismatch signal will eventually become the main or dominant rod movement signal after power mismatch change has subsided.



Polarity of the Combined Error Signal determines rod direction movement.

If the signal is positive rods step in.

- $T_{avg} > T_{ref}$
- Nuclear power increasing at a faster rate than turbine power.
- Turbine power decreasing at a faster rate than nuclear power.

If the signal is negative rods step out.

- $T_{avg} < T_{ref}$
- Nuclear power decreasing at a faster rate than turbine power.
- Turbine power increasing at a faster rate than nuclear power.

Objective #8, 12

Magnitude of the Combined Error Signal determines rod speed (8-72 steps/min). Control Board Rod Speed demand indication

- In auto, displays rod program based on combined error.
- In manual, displays 48 (control banks)or 64 (shutdown banks) depending on bank selector switch position.

2.8. Rod Speed Function

Sets the upper & lower speed limits on combined error signal input. In automatic, Control bank rod speed will vary proportionally to the combined error signal magnitude between upper and lower limits. (8-72 steps per minute)

2.9. Rod Direction Bistables

Provides commands to withdraw or insert the control rods. Rod movement (dead band) inhibited for error signals < 1.5 °F.

Rods out/Rods in, BISTABLE's energizes if combined error signal increases above the dead band. The polarity of the signal determines which BISTABLE energizes.

Lock-up band stops rod motion when combined error signal decreases to < 1°F. Rod motion begins when combined error signal increases to ≥ 1.5 °F.

2.10. Manual Rod Control

Objective #8

When the Bank Selector Switch on the Control Board is placed in the MANUAL position, the Control Banks can be operated at 48 steps/min (30 inches/min) while bank overlap and sequencing is maintained.

Under any manual operation, care should be taken to prevent causing any rapid temperature and pressure variations which could result in a reactor trip.

1 Pt A fire on the McGuire site has rendered the control room uninhabitable due to smoke in the control room. Both units have entered the AP/1/A/5500/17 (*Loss of Control Room*).

Which one of the following describes the RO actions described in AP/1/A/5500/17 *Loss of Control Room*?

A. **Go to Aux Shutdown Panel.**

B. **Go to main turbine front standard.**

C. **Go to Unit 1 CF pumps.**

D. **Go to "REACTOR PUMP WATER MAKEUP CONTROL PANEL" if dilution in progress.**

Bank Question: 1045 **Answer: D**

1 Pt A fire on the McGuire site has rendered the control room uninhabitable due to smoke in the control room. Both units have entered the AP/1/A/5500/17 (*Loss of Control Room*).

Which one of the following describes the RO actions described in AP/1/A/5500/17 *Loss of Control Room*?

A. Go to Aux Shutdown Panel.

B. Go to main turbine front standard.

C. Go to Unit 1 CF pumps.

D. Go to "REACTOR PUMP WATER MAKEUP CONTROL PANEL" if dilution in progress.

Distracter Analysis:.

A. **Incorrect**: this is an SRO function
Plausible:
B. **Incorrect**: this is an NLO function
Plausible:
C. **Incorrect**: this is an NLO function
Plausible:
D. **Correct**
Plausible:

LEVEL: RO

KA: G 2.4.34 (3.8/3.6)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-AP-17

OBJECTIVES: OP-MC-AP-17 Obj. 2

REFERENCES: AP 17 Background document pages 4-6
AP/1/A/5500/17 page 3

2.4 Emergency Procedures /Plan (Continued)

2.4.26 Knowledge of facility protection requirements including fire brigade and portable fire fighting equipment usage.
(CFR: 43.5 / 45.12)
IMPORTANCE RO 2.9 SRO 3.3

2.4.27 Knowledge of fire in the plant procedure.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.0 SRO 3.5

2.4.28 Knowledge of procedures relating to emergency response to sabotage.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2.3 SRO 3.3

2.4.29 Knowledge of the emergency plan.
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.6 SRO 4.0

2.4.30 Knowledge of which events related to system operations/status should be reported to outside agencies.
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.2 SRO 3.6

2.4.31 Knowledge of annunciators alarms and indications, and use of the response instructions.
(CFR: 41.10 / 45.3)
IMPORTANCE RO 3.3 SRO 3.4

2.4.32 Knowledge of operator response to loss of all annunciators.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.3 SRO 3.5

2.4.33 Knowledge of the process used track inoperable alarms.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2.4 SRO 2.8

2.4.34 Knowledge of RO tasks performed outside the main control room during emergency operations including system geography and system implications.
(CFR: 43.5 / 45.13)
IMPORTANCE RO 3.8 SRO 3.6

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		1.0	1.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Concerning AP/1(2)/5500/17 (Loss of Control Room): • State the purpose of the AP • Recognize the symptoms that would require implementation of the AP. AP17001			X	X	X
2	Given scenarios describing accident events and plant conditions, evaluate the basis for any caution, note, or step. AP17002			X	X	X

STEP DESCRIPTION FOR AP

STEP 1:

PURPOSE:

Ensure the correct AP has been implemented.

DISCUSSION:

The design basis for the Auxiliary Shutdown Panel and the assumption made in AP/17 is there has **not** been damage by fire OR the potential for damage by security events to controls required to safely shutdown the unit. A loss of control room with damage to controls is handled by the Standby Shutdown Facility (SSF) and AP/24. AP/24 provides the guidance for operation at the SSF.

Note also for a security event in a vital area that has a potential for damage, direction is given to go to AP/24. If you have to leave the control room in this event, AP/24 is appropriate since its' actions will isolate the damaged controls to ensure that in the worst case scenarios the plant will be safely shutdown and Hot Standby can be maintained.

REFERENCES:

STEP 2:

PURPOSE:

All actions in this step are not required. They are operational enhancements that take advantage of available time to perform certain actions that can improve the response to the LOCR.

DISCUSSION:

Stopping any power increase and securing any boron dilution in progress puts the plant in a stable condition while the transfer to the Aux Shutdown Panel (ASP) is taking place. Keys also exist locally in the plant to allow access to panels needed for AP/17, so it is not absolutely necessary to take the black box of keys. Making the page can marshal additional personnel resources.

REFERENCES:

STEP 3:

PURPOSE:

Initiate actions to restore control room habitability.

DISCUSSION:

Cueing this action early in the procedure will ensure it is initiated in a timely manner. Since the control room is the preferred control point due to it's additional monitoring and control capability, the earlier it is re-manned the less risk for unsafe operation.

REFERENCES:

STEP 4:

PURPOSE:

Operator enhancement to restore VI, if lost, to facilitate completion of the actions required by this procedure.

DISCUSSION:

Although a loss of VI is not assumed in this scenario, if it is lost, it will complicate the completion of the actions required by this AP.

STEP 5:

PURPOSE:

Pre-stage Operators at key locations to ensure effective control of the plant is established immediately on the initiation of the plant transient when the reactor is tripped. This will facilitate efficient completion of the first few steps, especially controlling NC cooldown following the reactor trip.

DISCUSSION:

When the first LOCR test was performed, Operators were not pre-staged. The result was a SI on excessive NC cooldown because of the delay in establishing NC temperature control. Avoiding a SI is consistent with the assumptions for the LOCR scenario. Also, an excessive cooldown could cause a loss of shutdown margin. The cautions in the step for the Operators at the reactor trip breakers and the main turbine to not perform their action until directed by the SRO is also consistent with the basis for pre-staging.

If a known dilution is in progress, direction is also given for the RO on the way down to the CA Panels to stop the Reactor Makeup Water Pumps. Stopping a dilution was addressed in an

earlier step, but is repeated here in case time was not available to do it from the control room. Stopping the Reactor Makeup Water Pumps when a dilution is in progress will prevent a reduction in shutdown margin. Although stopping a dilution event is not required by design basis, this action can mitigate the consequences of this concern in the unlikely event it is in progress. The RO on the way to the CA Panels is chosen for this task since this eliminates communications to outside operators (which can delay the action) and uses the existing assumed shift manning complement. The CA Panel alignment also takes just a couple of minutes, where the SRO aligning the ASP can take 15-20 minutes. So the RO has plenty of time to do this task, if required, and still have his panel aligned prior to the SRO completing alignment of the ASP.

STEP 6:

PURPOSE:

By establishing communications with the other three main players in the LOCR scenario, the SRO at the ASP can efficiently coordinate the first few critical steps that trip and stabilize the plant, and establish NC temperature control.

DISCUSSION:

Enclosure 3 addresses communications. It lists the priority for communication methods (two-way radio, then plant telephones), location of radios (kitchen), and lists key plant extensions. E-Plan bridge line extensions are provided (4500 for Unit 1 and 4833 for Unit 2) to allow efficient phone communication between all operators of a single unit.

Additional communications available, but not necessarily listed in Encl 3 are:

The ASP is provided with plant telephone ext., hands free intercom with CR, PA paging, Microwave trunk line, and a Southern Bell Trunk Line.

The ASP, CA Panels, D/G panels, 7Kv SWGR ROOM, and both Doghouses are connected with sound powered phones.

REFERENCES:

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

NOTE Keys to access Aux Shutdown Panel and CA Panels may be obtained from breakglass station at panels or from box taken in Step 2 (key #172).

5. **Dispatch operators to local operating locations as follows:**

__ a. One SRO to the Aux Shutdown Panel to align valves PER Enclosure 1 (Aux Shutdown Panel Alignment).

b. One RO to perform the following:

1) IF boron dilution is known to still be in progress, THEN locally stop Unit 1 Reactor Makeup Water Pumps at the "REACTOR MAKEUP WATER PUMPS CONTROL PANEL" (Aux Bldg 716, FW Pump area) as follows:

__ a) Select "LOCAL" for the running Reactor Makeup Water Pump.

__ b) Select "STOP" for the running Reactor Makeup Water Pump.

__ 2) Go to TD CA pump and MD CA pump local control panels and take control of CA PER Enclosure 2 (CA Pump Control).

CAUTION **The operator at the reactor trip breakers shall not trip the reactor until directed to do so by the SRO at the Aux Shutdown Panel.**

__ c. One operator (an RO if available) to Unit 1 reactor trip breakers and standby.

__ c. IF the reactor trip breakers are inaccessible, THEN dispatch operator to 1LXF and 1LXG, and standby.

CAUTION **The operator at the main turbine shall not trip the turbine until directed to do so by the SRO at the Aux Shutdown Panel.**

__ d. One operator to main turbine front standard and standby.

1 Pt *Given the following conditions on Unit 1:*

- Unit 1 is in Mode 5 after an outage.
- 'B' Train of ND is in RHR mode
- In the process of swapping to 'A' train ND
- An NLO is stationed outside the 'A" ND HX room to listen for excessive vibration.
- After the swap has been completed the following is noticed
  a. EMF 1 and EMF 41 in alarm
  b. NC level decreasing and temperature increasing
  c. ND flow increasing

Which one (1) of the following is the cause of the above failure?

A. Relief valve 1ND-56 (*Discharge Relief Valve*) has failed open to PRT

B. 1ND-34 (*A & B ND Hx Bypass*) fails OPEN

C. Relief valve 1ND-56 (*Discharge Relief Valve*) has failed open to NCDT.

D. Flange leak on 'A' RHR heat exchanger.

Bank Question: 1047 ***Answer: D***

1 Pt Given the following conditions on Unit 1:

- Unit 1 is in Mode 5 after an outage.
- 'B' Train of ND is in RHR mode
- In the process of swapping to 'A' train ND
- An NLO is stationed outside the 'A" ND HX room to listen for excessive vibration.
- After the swap has been completed the following is noticed
  a. EMF 1 and EMF 41 in alarm
  b. NC level decreasing and temperature increasing
  c. ND flow increasing

Which one (1) of the following is the cause of the above failure?

A. **Relief valve 1ND-56 (*Discharge Relief Valve*) has failed open to PRT**

B. **1ND-34 (*A & B ND Hx Bypass*) fails OPEN**

C. **Relief valve 1ND-56 (*Discharge Relief Valve*) has failed open to NCDT.**

D. **Flange leak on 'A' RHR heat exchanger.**

Distracter Analysis:. The procedure for swapping ND trains has an operator sent to the HX room to listen for excessive vibration. McGuire has experienced an event where a leak developed on the flange of the RHR HX as a result of a water hammer.

A. **Incorrect**: would not have auxiliary building EMFs in alarm
Plausible:
B. **Incorrect**: This would account for the temperature increasing
Plausible:
C. **Incorrect**: Relief goes to PRT
Plausible:
D. **Correct**
Plausible:

LEVEL: RO

KA: 005 K6.03 (2.5/2.6)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-PS-ND

OBJECTIVES: OP-MC-PS-ND Obj. 6

REFERENCES: OP-MC-PS-ND pages 21 and 61

SYSTEM: **005 Residual Heat Removal System (RHRS)**

K5 **Knowledge of the operational implications of the following concepts as they apply the RHRS:**
(CFR: 41.5 / 45.7)

K5.01	Nil ductility transition temperature (brittle fracture)	2.6	2.9
K5.02	Need for adequate subcooling	3.4	3.5
K5.03	Reactivity effects of RHR fill water	2.9*	3.1*
K5 04	Calculation of heat load on the RHR heat exchanger	2.1	2.3*
K5 05	Plant response during "solid plant": pressure change due to the relative incompressibility of water	2.7*	3.1*
K5.06	Special concerns regarding the use of water chemistry	1.9*	2.6*
K5.07	Relationship between PZR level, VCT level, and charging flow	2.2	2.4*
K5.08	PTS	2.4*	2.5*
K5.09	Dilution and boration considerations	3.2	3.4

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the RHRS:**
(CFR: 41.7 / 45.7)

K6.01	RHR pump performance characteristics	2.4	2.6
K6.02	"Packless" valves	1.8*	1.9*
K6.03	RHR heat exchanger	2.5	2.6
K6.04	Valves	1.9	2.1
K6.05	Pumps	1.9	2.1
K6.06	Motors	1.8	1.8
K6.07	Sensors and detectors	2.1	2.3
K6.08	Controllers and positioners	2.2	2.4
K6.09	Demineralizers and ion exchangers	1.6	1.9
K6.10	Breakers, relays, and disconnects	1.7	1.8
K6.11	RHR heat exchanger and outlet flow control	2.3	2.7*

<u>ABILITY</u>

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RHRS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Heatup/cooldown rates	3.5	3.6
A1.02	RHR flow rate	3.3	3.4
A1.03	Closed cooling water flow rate and temperature	2.5	2.6
A1.04	Relationship between RWST level and level in the spent fuel pool	2.1*	2.3
A1.05	Detection of and response to presence of water in RHR emergency sump	3.3*	3.3*
A1.06	Relationship (dependence) of time available to perform system isolation surveillance test to time for decay heat to reach high limit	2.7	3.1*
A1.07	Determination of test acceptability by comparison of recorded valve response times with Tech-Spec requirements	2.5	3.1*

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2	2	2	2	1.5

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose of the ND System. PSND001	X	X	X	X	
2	Sketch the ND System reflecting all major components and interconnections to associated systems (NC, NI, NS) per Drawing 7.1. PSND002	X	X	X	X	
3	Describe the instrumentation and alarms associated with the ND System. PSND003		X	X	X	X
4	List the power supplies for the ND pumps. PSND004	X	X	X	X	
5	Describe the operation of the following ND valves: • ND1B(2AC) - C Loop to ND Pump • ND4B (19A) - B(A) ND Pump Suction from FWST or NC • ND67B (68A) - B(A) ND Pump and B(A) ND HX Mini-Flow • ND15B (30A) - Train B(A) ND to Hot Leg Isolation • ND35 - ND System to FWST Isolation. PSND005		X	X	X	X
6	Explain overpressure protection for the ND System. PSND006		X	X	X	X
7	Explain the interlocks associated with the emergency auto-swap of ND pump suctions to the containment sump during an accident. PSND007	X	X	X	X	X

There are no automatic closure signals for ND-1B and ND-2AC. Annunciators on AD9, "ND-2A OPEN AND NC HI PRESS" and "ND-1B OPEN AND NC HI PRESS", will warn the operator if NCS pressure is 440 psig (or greater) with ND-1A or ND-2AC open/intermediate. The purpose of this annunciator is to alert the operator that a double barrier isolation between the NCS and ND systems does not exist when the plant is pressurized and **not** on ND cooling. Upon receipt of this alarm, the immediate operator action is to reduce NCS pressure until the alarm clears.

Objective #6

ND-1B and ND-2AC shall be closed with power removed while the ND system is aligned for standby readiness to prevent overpressurization of the ND system. Overpressure protection for the ND system is provided by the ND system suction relief valves which open at 450 psig and the ND to NCS cold leg and hot leg discharge relief valves which lift at 600 psig. Both suction and discharge relief valves discharge to the PRT.

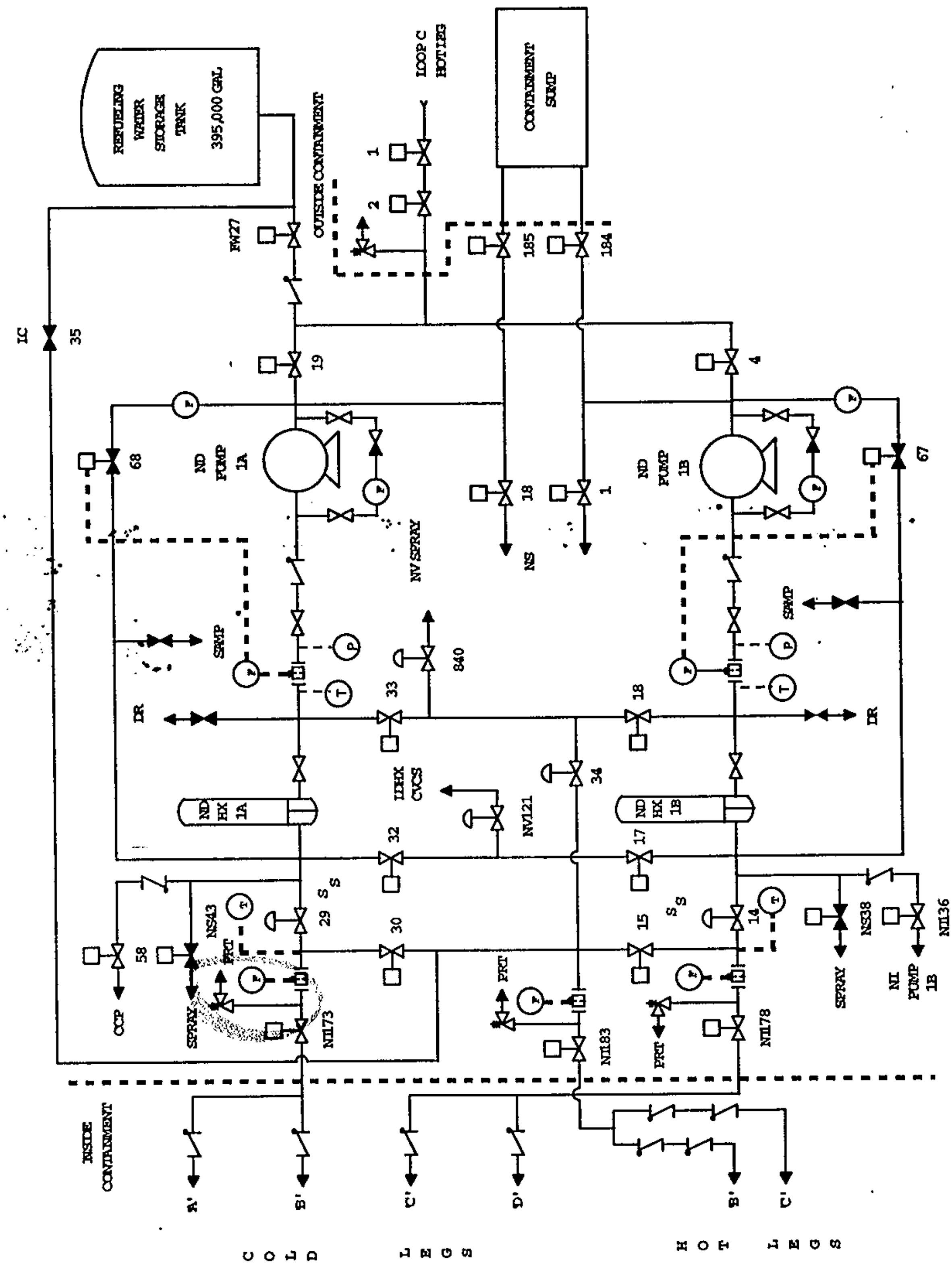
Valve ND-2AC shall be capable of closing to isolate the NC pressure boundary during a station blackout event. ND-1B and ND-2AC shall be capable of opening following a loss of offsite power and station blackout to help cool the unit to a safe shutdown condition. ND-1B and ND-2AC may be controlled from the Auxiliary Shutdown panel following a control room evacuation, to help bring the unit to a safe shutdown condition. ND-2AC can also be operated from the Safe Shutdown Facility (SSF) Control Panel.

Portable motor starter and control stations are provided to control residual heat removal letdown valves after a postulated fire disables normal power supplies to these valves. The power operation of these valves with portable equipment is required to achieve cold shutdown without the need to enter containment to manually operate valves. Emergency power is obtained from motor control centers (MCC) located in the Diesel Generator rooms and is connected to the valves through normal containment penetrations. Portable power supplies and receiver gauges are used to monitor the reactor coolant system pressure should normal indications be lost. This is required by 10CFR50 Appendix R for fire damage control.

ND-2AC performs a containment isolation function, together with check valve ND-3. With this arrangement, no single failure of an active valve or passive component can prevent the recirculation of core cooling water following a design basis event or adversely affect containment integrity.

The single failure of ND-1B or ND-2AC could prevent the use of the residual heat removal system. Temporary motor starters and actuator hand-wheels are provided to enhance reliability, and low ND flow alarms are provided to alert the operators of system isolation. Additionally, Duke Power committed to have power removed from ND-1B and ND-2AC while the reactor head is unbolted and the refueling canal was filled, to reduce the possibility of a loss of ND suction (Ref. FSAR Question 212.72).

7.1, ND System Composite (09/21/98)



1 Pt Given the following conditions on Unit 1:

- Unit 1 ETB normal breaker has opened
- '1B' Diesel Generator has started and has loaded the bus

Which one (1) of the following will trip the diesel generator?

A. Lube Oil Temperature 195 degrees

B. Jacket Water Temperature 205 degrees

C. Turning Gear Engaged

D. Overspeed 113%

Bank Question: 1048 ***Answer:D***

1 Pt Given the following conditions on Unit 1:

- Unit 1 ETB normal breaker has opened
- '1B' Diesel Generator has started and has loaded the bus

Which one (1) of the following will trip the diesel generator?

A. Lube Oil Temperature 195 degrees

B. Jacket Water Temperature 205 degrees

C. Turning Gear Engaged

D. Overspeed 113%

Distracter Analysis:.

A. Incorrect: Manual mode only
Plausible:
B. Incorrect: Manual mode only
Plausible:
C. Incorrect: Manual mode only
Plausible:
D. Correct
Plausible:

LEVEL: RO

KA: 064 K4.02 (3.9/4.2)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-DG-DG

OBJECTIVES: OP-MC-DG-DG Obj. 5 & 6

REFERENCES: OP-MC-DG-DG pages 39-43 odd pages only

SYSTEM: 064 Emergency Diesel Generator (ED/G) System

K4 **Knowledge of ED/G system design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	Trips while loading the ED/G (frequency, voltage, speed)	3.8	4.1
K4.02	Trips for ED/G while operating (normal or emergency)	3.9	4.2
K4.03	Governor valve operation	2.5	3.0
K4.04	Overload ratings	3.1	3.7
K4.05	Incomplete-start relay	2.8	3.2
K4.06	Speed droop control	2.2	2.7
K4.07	Field flashing	2.2	2.8
K4.08	ED/G fuel isolation valves	2.9*	3.5
K4.09	Field on ED/G	2.4	3.0
K4.10	Automatic load sequencer: blackout	3.5	4.0
K4.11	Automatic load sequencer: safeguards	3.5	4.0

K5 **Knowledge of the operational implications of the following concepts as applied to the ED/G system:**
(CFR: 41.5 / 45.7)

K5.01	Definition of frequency and synchronous frequency	2.0	2.2
K5.02	Reactive power control (using set voltage)	1.9	2.4*
K5.03	Real power control (using set frequency)	1.9	2.4*

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the ED/G system:**
(CFR: 41.7 / 45.7)

K6.01	Valves	2.4	2.4*
K6.02	Sensors and detectors	2.4*	2.4*
K6.03	Controllers and positioners	2.4*	2.4*
K6.04	Pumps	2.2	2.3
K6.05	Motors	2.1	2.1
K6.06	Breakers, relays, and disconnects	2.3*	2.5*
K6.07	Air receivers	2.7	2.9
K6.08	Fuel oil storage tanks	3.2	3.3

<u>ABILITY</u>

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ED/G system controls including:**
(CFR: 41.5 / 45.5)

A1.01	ED/G lube oil temperature and pressure	3.0	3.1
A1.02	Fuel consumption rate with load	2.5	2.8
A1.03	Operating voltages, currents, and temperatures	3.2	3.3
A1.04	Crankcase temperature and pressure	2.8	2.9
A1.05	ED/G room temperature	2.5	2.5
A1.06	Cylinder temperature differential	2.3	2.5
A1.07	Deleted		
A1.08	Maintaining minimum load on ED/G (to prevent reverse power)	3.1	3.4

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.0	1.0	1.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Diesel Generators.	X	X	X	X	
2	Describe the three major accident situations the Diesel Generators are provided to respond to.	X	X	X	X	
3	Describe the Design Criteria Functional Requirements of each Diesel Generator.	X	X	X	X	
4	Explain the various modes of Diesel Generator Operation.	X	X	X	X	
5	~~List the thirteen (13) Manual Mode Trips of the Diesel~~ Generators.	X	X	X	X	X
6	~~List the four (4) Automatic Mode Trips of the Diesel~~ Generators.	X	X	X	X	X
7	List the one (1) Diesel Generator Automatic Start signal.	X	X	X	X	X
8	Given a Limit and/or Precaution associated with an operating procedure, discuss its bases and when the it applies.	X	X	X	X	X
9	List the permissives that will allow a diesel Auto Start.	X	X	X	X	X
10	Explain each of the following infrequently used Diesel Generator Controls: • Emergency Stop Pushbutton • Emergency Stop Reset Pushbutton • 86 D Lockout Relay (Explain consequences of not resetting relay) • Control Room Override Breakglass	X	X	X	X	X

Starting the diesel

Once the diesel is started, the following conditions must be satisfied within twenty (20) seconds or the diesel will trip.

1. Crankcase vacuum must be greater than 0.5" H_2O,
2. Jacket Water Pressure must be greater than 15 psig.

When the diesel reaches 40% speed, the starting air solenoids are de-energized closed isolating air the engine. If speed is not greater than 40% within 20 seconds, starting air to the diesel is isolated.

The diesel is considered to be running when speed is ≥ 95%. If lube oil pressure is less than 33 psig on 2/2 pressure sensors, after an additional 30 second time delay on an initial diesel start, the diesel will trip. The low lube oil pressure trip is bypassed until diesel speed exceeds 95% with an additional 30-second time delay. The delay gives the Engine Driven Lube Oil Pump time to build pressure in the header. The lube oil pressure has to make the reset (33 psig) on at least one pressure switch. After the diesel is running, if lube oil pressure drops to <28 psig a low lube oil pressure trip occurs.

If engine speed exceeds 112% on 2/3 speed pick-ups, the diesel will trip. This trip is bypassed until diesel speed exceeds 95%. Once the diesel trips, a signal is sent to de-energize the solenoids supplying air to the Run/Shutdown Cylinders, allowing the fuel racks to be held closed. A signal is also sent to the Electronic Governor to place it in the Minimum Fuel position.

Objective # 5

All permissives required to be satisfied prior to a diesel start remain in effect as the diesel runs. The following is a list of the signals which will trip the diesel after a start in the Manual Mode of Operation:

1. Remote Stop Pushbutton depressed when selected to the Control Room Mode of Operation.
2. Local Stop Pushbutton depressed whether selected to Control Room, Local, or Control Room Emergency Mode of Operation.
3. Lube Oil Temperature High (>190 °F).
4. Jacket Water Temperature High (>200 °F).
5. Jacket Water Level Low (<1 Ft).
6. Engine Overspeed (>112% on 2/3 speed switches).
7. Turning Gear Engaged (1/2 Limit switches made).
8. Emergency Stop (Emergency Stop Pushbutton Depressed).
9. Low Lube Oil Pressure (<28 psig on 2/2 switches). This trip is reset only if oil pressure exceeds 33 psig on an initial diesel start.
10. 86D Lockout Relay Tripped (87G Differential or 51V Voltage Controlled Overcurrent relay actuated).
11. Fire Shutdown (Halon Actuation or Fire Relay Actuated).

12. Low Crankcase Vacuum (< .5" H_2O Vacuum).
13. Jacket Water Pressure Low (< 15 psig).

Each of these trips, except the 86D Lockout Relay, will give an alarm on the local diesel control panel as well as the Diesel Generator Panel Trouble alarm in the Control Room. Those alarms that affect diesel operability will also give an inoperable status light on the OAC 1.47 Graphic.

A fire shutdown will occur upon actuation of the fire relay. This diesel trip also trips and locks out all the fuel and lube oil pumps associated with the diesel, and shuts down the building ventilation. To regain diesel control following a fire shutdown, the Emergency Stop Reset push-button must be depressed.

3.3 Abnormal and Emergency Operations

Diesel Generator Startup in the Automatic Mode of Operation

Objective # 7

For the Diesel Generator to start in the Automatic Mode of Operation, a signal must be received from the Diesel Generator Load Sequencing System. This Sequencer Automatic Actuation (SAA) occurs either by an input from the Solid State Protection System (SSPS) due to a Safety Injection, or a loss of power event (Blackout). In either case an automatic signal is generated which starts the Diesel Generator

Objective # 9

Permissives required for an Automatic Mode start.

Most of the permissives required for a Manual Mode start of the Diesel Generator is bypassed in the Automatic Mode. The only permissives that remain in effect in the automatic mode are

- The Turning Gear must be disengaged,
- the Emergency Stop must be Reset, and
- The 86D Lockout Relay must be Reset.

If the Turning Gear is engaged, the Diesel Auto Start Relay GL (DASR) can never receive the start signal because the Turning Gear Limit Switches are aligned in series with the Auto Start Relay. If the Turning Gear is engaged, the limit switch contacts are open and the Auto Start Relay will not energize. Once the Diesel has started via the Auto Start Relay, the Turning Gear can no longer affect diesel operation because the Auto Start Relay (DASR) will seal itself in through seal in contacts wired through the Local Stop Pushbutton.

The signal from the Diesel Generator Load Sequencer must be reset before the Diesel can be stopped.

The Diesel Generator must be manually stopped after an Auto start from the local panel using the Local Stop Pushbutton.

NOTE: The Emergency Stop Pushbutton can also be used to stop the Diesel Generator, but this push-button is used only in an Emergency.

Objective # 10

The **Emergency Stop Reset Pushbutton** is used to regain control of the Diesel Generator following the three Automatic Mode Trips.

- Low Lube Oil Pressure.
- Engine Overspeed.
- Emergency Stop.

To prevent damage to the diesel following one of these Automatic Mode Trips, their signals are wired through the Emergency Stop Reset Switch. With the Auto Start signal still present, this prevents the diesel from attempting another auto start.

Objective # 10

This 86D Lockout Relay will automatically actuate and trip the diesel if either an 87G (Generator Differential) or 51V (Generator Voltage Controlled Overcurrent) relay has actuated. This relay will also trip and lockout the diesel breaker. To regain control of the diesel after either of these relays actuate, the 86D Lockout Relay must be Reset.

With all the Auto Start Permissives satisfied, the Diesel will Auto Start upon receiving a signal from the Sequencer.

The diesel is considered to be running when diesel speed is ≥ 95%. The Low Lube Oil Pressure trip becomes active when ≥ 95% and will function the same as with a manual start.

Objective # 6

The following is a list of the signals, which will trip the Diesel Generator after an Automatic Start.

1. Low Lube Oil Pressure (<28 psig on 2/2 switches). This trip resets when lube oil pressure exceeds 33 psig on an initial diesel start.
2. Overspeed (>112% on 2/3 speed switches).
3. Emergency Stop.
4. 86D Lockout Relay actuated (87G or 51V).

Each of these trips, except the 86D Lockout Relay, will give an annunciator alarm on the local diesel control panel as well as the Diesel Generator Panel Trouble alarm in the Control Room. Those alarms that affect diesel operability will also illuminate an inoperable status light on the OAC 1.47 Graphic.

Following any automatic start of the diesel generator, diesel shutdown is accomplished by way of the local stop switch on the local diesel generator control panel. This switch is connected in series with a diesel auto start relay seal in contact which keeps the auto start relay energized after the diesel load sequencer has been reset. By depressing the local stop switch after the diesel load sequence has been reset, the diesel auto start relay de-energizes, allowing the diesel to shut down.

1 Pt Diesel generator '1B' has been started per OP/1/A/6350/002. The diesel was started from the control room. The diesel has been carrying the load separated from the grid. *It is time in the procedure to transfer load back to* the grid and shutdown the diesel.

Which one (1) of the following describes the actions necessary to remove load from the diesel?

A. **Match D/G voltage with line voltage**
Place '1B D/G Sync Switch' to 'ON'
Adjust diesel speed to move slowly in the Fast direction using '1B D/G Gov Control' pushbutton
Close normal breaker when 3 minutes before 12 o'clock
Raise D/G output to 800 to 1000 KW
Adjust Power factor to .90 to .92

B. **Place '1B' Sync Switch' to 'ON'**
Adjust diesel speed to move slowly in the Fast direction using Voltage Adjust pushbutton
Transfer load from '1B' D/G to 1ATD by obtaining zero amps on 1ATD meter
Close normal breaker when 3 minutes before 12 o'clock
Raise D/G output to 800 to 1000 KW
Adjust Power factor to .90 to .92

C. **Place '1B Sync Switch' to 'ON'**
Adjust diesel speed to move slowly in the Fast direction using Gov Control pushbutton
Close normal breaker when 3 minutes before 12 o'clock
Raise D/G output to 100 to 200 KW
Adjust Power factor to .90 to .92
Match D/G voltage with line voltage

D. **Place '1B' Sync Switch' to 'ON'**
Adjust diesel speed to move slowly in the Fast direction using Voltage Adjust pushbutton
Transfer load from '1B' D/G to 1ATC by obtaining zero amps on 1ATC meter
Close normal breaker when 3 minutes before 12 o'clock
Raise D/G output to 100 to 200 KW
Adjust Power factor to .90 to .92

Bank Question: 1049 *Answer: A*

1 Pt Diesel generator '1B' has been started per OP/1/A/6350/002. The diesel was started from the control room. The diesel has been carrying the load separated from the grid. It is time in the procedure to transfer load back to the grid and shutdown the diesel.

Which one (1) of the following describes the actions necessary to remove load from the diesel?

A. **Match D/G voltage with line voltage**
Place '1B D/G Sync Switch' to 'ON'
Adjust diesel speed to move slowly in the Fast direction using '1B D/G Gov Control' pushbutton
Close normal breaker when 3 minutes before 12 o'clock
Raise D/G output to 800 to 1000 KW
Adjust Power factor to .90 to .92

B. **Place '1B' Sync Switch' to 'ON'**
Adjust diesel speed to move slowly in the Fast direction using Voltage Adjust pushbutton
Transfer load from '1B' D/G to 1ATD by obtaining zero amps on 1ATD meter
Close normal breaker when 3 minutes before 12 o'clock
Raise D/G output to 800 to 1000 KW
Adjust Power factor to .90 to .92

C. **Place '1B Sync Switch' to 'ON'**
Adjust diesel speed to move slowly in the Fast direction using Gov Control pushbutton
Close normal breaker when 3 minutes before 12 o'clock
Raise D/G output to 100 to 200 KW
Adjust Power factor to .90 to .92
Match D/G voltage with line voltage

D. **Place '1B' Sync Switch' to 'ON'**
Adjust diesel speed to move slowly in the Fast direction using Voltage Adjust pushbutton
Transfer load from '1B' D/G to 1ATC by obtaining zero amps on 1ATC meter
Close normal breaker when 3 minutes before 12 o'clock
Raise D/G output to 100 to 200 KW
Adjust Power factor to .90 to .92

Distracter Analysis:.

A. Correct:

Plausible:

B. **Incorrect:**

Plausible:

C. **Incorrect:**

Plausible:

D. **Incorrect**

Plausible:

LEVEL: RO

KA: 064 A4.07 (3.4/3.4)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Comprehension

AUTHOR: CWS

LESSON:

OBJECTIVES:

REFERENCES: OP/1/A/6350/002 Enclosure 4.4 page 2

SYSTEM:	**064 Emergency Diesel Generator (ED/G) System**		
A3.06	Start and stop	3.3	3.4
A3.07	Load sequencing	3.6*	3.7*
A3.08	Consequences of automatic transfer to automatic position after the ED/G is stopped	3.7?	4.0
A3.09	Functions (modes) of automatic transfer switch (to a startup bank)	4.0*	4.0
A3.10	Function of ED/G megawatt load controller	2.8	2.8*
A3.11	Need for setting offsite power breaker to automatic	3.1*	2.9*
A3.12	Purpose of automatic load sequencer	3.3*	3.5
A3.13	Rpm controller/megawatt load control (breaker-open/ breaker-closed effects)	3.0*	2.9
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4 01	Local and remote operation of the ED/G	4.0	4.3
A4 02	Adjustment of exciter voltage (using voltage control switch)	3.3	3.4
A4.03	Synchroscope	3.2	3.3
A4.04	Remote operation of the air compressor switch (different modes)	3.2*	3.2
A4.05	Transfer of ED/G control between manual and automatic	3.1	3.2
A4.06	Manual start, loading, and stopping of the ED/G	3.9	3.9
[redacted]			
A4.08	Opening of the ring bus	3.2*	3.2*
A4.09	Establishing power from the ring bus (to relieve ED/G)	3.2*	3.3*
A4.10	Need for, and consequences of, manually shedding (loads) safeguards bus	3.3	3.4
A4.11	The setting of droop voltage to zero	2.2	2.4
A4.12	Synchroscope	2.7*	2.6

_____ 3.4 <u>IF</u> D/G is carrying 1ETB separated from Duke grid, parallel D/G to grid as follows:

☐ 3.4.1 Check "Line Volts" 3960 - 4360 V.

_____ 3.4.2 Match D/G voltage with line voltage using "1B D/G Voltage Adjust".

_____ 3.4.3 Place "1B D/G Sync Switch" to "ON".

NOTE:	As a guide, have synchroscope traveling no faster than one revolution in 20 seconds.

_____ 3.4.4 Adjust D/G speed to allow synchroscope to move slowly in "FAST" direction using "1B D/G Gov Control" pushbutton.

_____ 3.4.5 <u>IF</u> desired to align 1ETB to normal supply (1ATD), perform the following:

NOTE:
- D/G load will drop to 0 amps when bus is paralleled to Duke grid.
- Increase D/G load quickly after closing breaker to prevent reverse power condition.

_____ 3.4.5.1 <u>WHEN</u> synchroscope pointer is within 3 minutes before 12 o'clock position, firmly press and promptly release "CLOSE" on "1ETB Normal Breaker".

3.4.5.2 Perform concurrently:

_____ • Quickly raise D/G output to 800 - 1000 KW using "1B D/G Gov Control"

_____ • Adjust power factor to 0.90 - 0.92 lagging using "1B D/G Voltage Adjust"

_____ 3.4.5.3 Place "1B D/G Sync Switch" to "OFF".

_____ 3.4.5.4 Evaluate Offsite Power operability.
SRO

☐ 3.4.5.5 Go to Step 3.5.5.

1 Pt Given the following conditions on Unit 1:

- Unit 1 heating up in Mode 3 following a refueling outage
- An NLO calls the RO and advises that the boric acid filter delta/p is pegged HIGH
- Discharge pressure on 1A Boric Acid Tank pump is pegged HIGH

Which one (1) of the following describes the effect on the boron injection flowpath from the Boric Acid Tank?

A. **No effect after swapping to the 1B BAT pump.**

B. **Boron injection flowpath from BAT via the boric acid pumps and charging pump to NC is inoperable.**

C. **No effect after swapping to standby filter in service.**

D. **Boron injection flowpath is operable due to availability of 1NV-265B.**

Bank Question: 1050 ***Answer: B***

1 Pt Given the following conditions on Unit 1:

- Unit 1 heating up in Mode 3 following a refueling outage
- An NLO calls the RO and advises that the boric acid filter delta/p is pegged HIGH
- Discharge pressure on 1A Boric Acid Tank pump is pegged HIGH

Which one (1) of the following describes the effect on the boron injection flowpath from the Boric Acid Tank?

A. No effect after swapping to the 1B BAT pump.

B. Boron injection flowpath from BAT via the boric acid pumps and charging pump to NC is inoperable.

C. No effect after swapping to standby filter in service.

D. Boron injection flowpath is operable due to availability of 1NV-265B.

Distracter Analysis:.

A. Incorrect:
Plausible:
B. Correct:
Plausible:
C. Incorrect:
Plausible:
D. Incorrect
Plausible:

LEVEL: RO

KA: 004 K1.16 (3.3/3.5)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Analysis

AUTHOR: CWS

LESSON: OP-MC-PS-NV

OBJECTIVES: OP-MC-PS-NV Objs. 5 & 15

REFERENCES: OP-MC-PS-NV pages 43, 51, & 133
SLC 16.9.9 Boration Systems – Flow Paths

SYSTEM **004 Chemical and Volume Control System**

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CVCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	PZR LCS	3.6	4.0
K1.02	PZR and RCS temperature and pressure relationships	3.5	3.8
K1.03	Operation, function and control of T/G	2.2	2.6
K1.04	RCPS, including seal injection flows	3.4	3.8
K1.05	CRDS operation in automatic mode control	2.7*	3.2
K1.06	Makeup system to VCT	3.1	3.1
K1.07	NIS	2.6	2.9
K1.08	Interface of CVCS with PRT	2.2	2.4
K1.09	Relationship between CVCS and RPIS	2.2*	2.7
K1.10	Pneumatic valves and RHRS	2.7	2.9
K1.11	Expected PRT response when opening PORV during bubble formation in PZR	2.9	3.2
K1.12	Nitrogen systems	2.4	2.6
K1.13	Hydrogen systems	2.8	2.9
K1.14	IAS	2.6	2.8
K1.15	ECCS	3.8	4.0
[redacted]			
K1.17	PZR	3.4	3.4
K1.18	CCWS	2.9	3.2
K1.19	Primary grade water supply	2.7	2.9
K1.20	Location of sample points for chemically sampled fluid systems	1.7	2.5
K1.21	WGDS	2.4	2.8
K1.22	BWST	3.4	3.7
K1.23	RWST	3.4	3.7
K1.24	RHRS	3.4	3.9
K1.25	Interface between HPI flow path and excess letdown flow path	2.7*	3.2*
K1.26	Flow path from CVCS to reactor coolant drain tank and holdup tank	2.7	2.8
K1.27	Relationship between seal filter and letdown filter	2.3*	2.3*
K1.28	Interface between high-activity waste tank and letdown filter drain	2.1*	2.4*
K1.29	Effect and detection of leaking PORV or relief on PZR level and pressure, including VCT makeup activity in automatic mode	3.4	4.0
K1.30	Relationship between letdown flow and RCS pressure	2.9	3.1
K1.31	Interface between CVCS and degassifier (WGDS)	2.3	2.5
K1.32	Minimum VCT pressure effect on RCP seals	2.8	3.1
K1.33	Interface between clean waste receiver tank and seal injection filters	2.3*	2.7*

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
5	Explain the basic operation of the NV System for the following: • Normal L.D. Purification • Seal Injection Flow • Chemical Addition • Charging • Centrifugal Charging Pumps • All Modes of Makeup • PD Pump Control • Safeguards Actuation • *Charging/Letdown Flow Balance* • Excess Letdown • Emergency Boration • Pressurizer Spray PSNV005	X	X	X	X	
6	Describe the various system parameters indicated in the Control Room associated with the NV System in <u>ALL</u> modes of operation. PSNV006		X	X	X	X
7	List the "fail" position of NV valves on loss of power or air. PSNV007		X	X	X	X
8	Describe the as-built configuration of the VCT level instrumentation. PSNV008	X	X	X	X	
9	Using fundamental instrumentation knowledge and given specific reference and variable leg configurations for the Volume Control Tank, predict the effect on indicated versus actual level for various failures. PSNV009	X	X	X	X	

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
14	Concerning the Technical Specifications related to the NV System;					
	• Given the LCO title, state the LCO (including any COLR values) and applicability.			X	X	X
	• For any LCOs that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any Tech Spec LCO(s) is (are) not met and any action(s) required within one hour.			X	X	X
	• Given a set of plant parameters or system conditions and the appropriate Tech Specs, determine required action(s).			X	X	X
	• Discuss the basis for a given Tech Spec LCO or Safety Limit.				X	*
	* SRO Only					
	PSSNV016					
15	Concerning the Selected Licensee Commitments (SLC) related to the NV System:					
	• For any commitments that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any commitment is (are) not met and any action(s) required within one hour.			X	X	X
	• Given a set of plant parameters or system conditions and the SLC Manual, determine the required action(s).			X	X	X
	• Discuss the basis for a given commitment.				X	*
	* SRO ONLY					
	PSSNV017					

Excess Letdown HX temperature, pressure and flow indications are provided in the Control Room.

NV-24B and NV-25B auto close on a Safety Injection (S_S) signal.

2.18 VCT Makeup System / Boration and Dilution

Objective # 5

Normal NC System makeup from the NV System provides water at the same boric acid concentration as the current NC System conditions.

Makeup quantities of boric acid solution are prepared in the boric acid batching tank where boric acid crystals are dissolved in hot water and drained to the boric acid storage tank. The batching tank is steam heated when required to keep the contents at 90°F for preparation of 4 weight percent boric acid. One boric acid transfer pump is normally operating in recirc, available to supply the reactor makeup control system. The pump will also start upon receipt of a demand signal from this subsystem. These pumps can also transfer the boric acid solution to or between the Boric Acid Tanks (BATs) or provide BAT recirculation. This flow to the BATs is either at a fixed rate (orifice-controlled) or at a rate set by the plant operator via a manual valve.

The two BATs are shared but each is normally aligned to a separate unit. The BAT for each unit is normally recirculated with a single BA pump. Boric acid reclaimed by the Boron Recycle System (NB) is returned to the BATs.

On a demand signal from the reactor makeup control system, a boric acid transfer pump and a reactor makeup water pump start and control valves control boric acid and reactor makeup flow to the boric acid blender. The mixture is then directed to either the VCT outlet header or is sprayed into the VCT inlet via the letdown spray nozzle. The normal flow path, during long dilution processes, is to the VCT where hydrogen pickup (for oxygen scavenging) is ensured. In the event that a xenon transient requires rapid boration, the VCT outlet can be used.

The VCT Makeup valves auto close if a BA/Total Blend Deviation alarm occurs.

Reactor make-up water is stored in two tanks (one for each Unit). Each tank has two pumps, which can be controlled manually or automatically from the Control Room.

- Boric Acid Tanks -Two (2) BATs, one (1) per unit, contain sufficient boric acid for refueling and for one Cold Shutdown following refueling with most reactive control rod stuck out.
- Boric Acid Filters - Collect particulate > 5 microns (μ). They are designed to pass flow of two (2) boric acid pumps.
- Reactor Makeup Water Storage Tanks -Two (2) RMWSTs, one (1) per unit sized to supply the water requirements for a Cold Shutdown followed by a startup from Cold Shutdown late in core life.
- Blender - Ensures adequate mixing of BA and RMW.

2.18.3 Emergency Boration and Dilution

Objective # 5

Emergency boration (AP/1or 2/A/5500/38) from the Control Room is performed by opening NV-265B and starting 1 or 2 BAT pump(s). Emergency boration performed locally and manually is done by sending an operator to open NV-269, opening NV-267, and then starting 1 or 2 BAT pump(s). In both cases, the operator must ensure that one CCP is operating. The Emergency Boration line is direct to the CCP suction and has significantly less piping restriction, so greater Boric Acid flow can be achieved (70-80 gpm vs. the normal flow path)

Dilution through NV-262 (Makeup Water Emergency Supply to Charging Pump) is performed by having continuous communication between a local operator and a Control Room Operator during the time NV-262 is not fully closed and then having the local operator unlock NV-262 and throttle open NV-262 once the Control Room Operator has started a Reactor Makeup Water pump. The local Operator adjusts NV-262 to obtain a desired flow rate of approximately 90 gpm as indicated on the Emergency Flow Monitor, 1NVP-5440. When the desired makeup is complete, stop the Reactor Makeup Water pump and lock closed NV-262.

2.19 NV-141A and NV-142B, VCT Outlet Isolation Valves

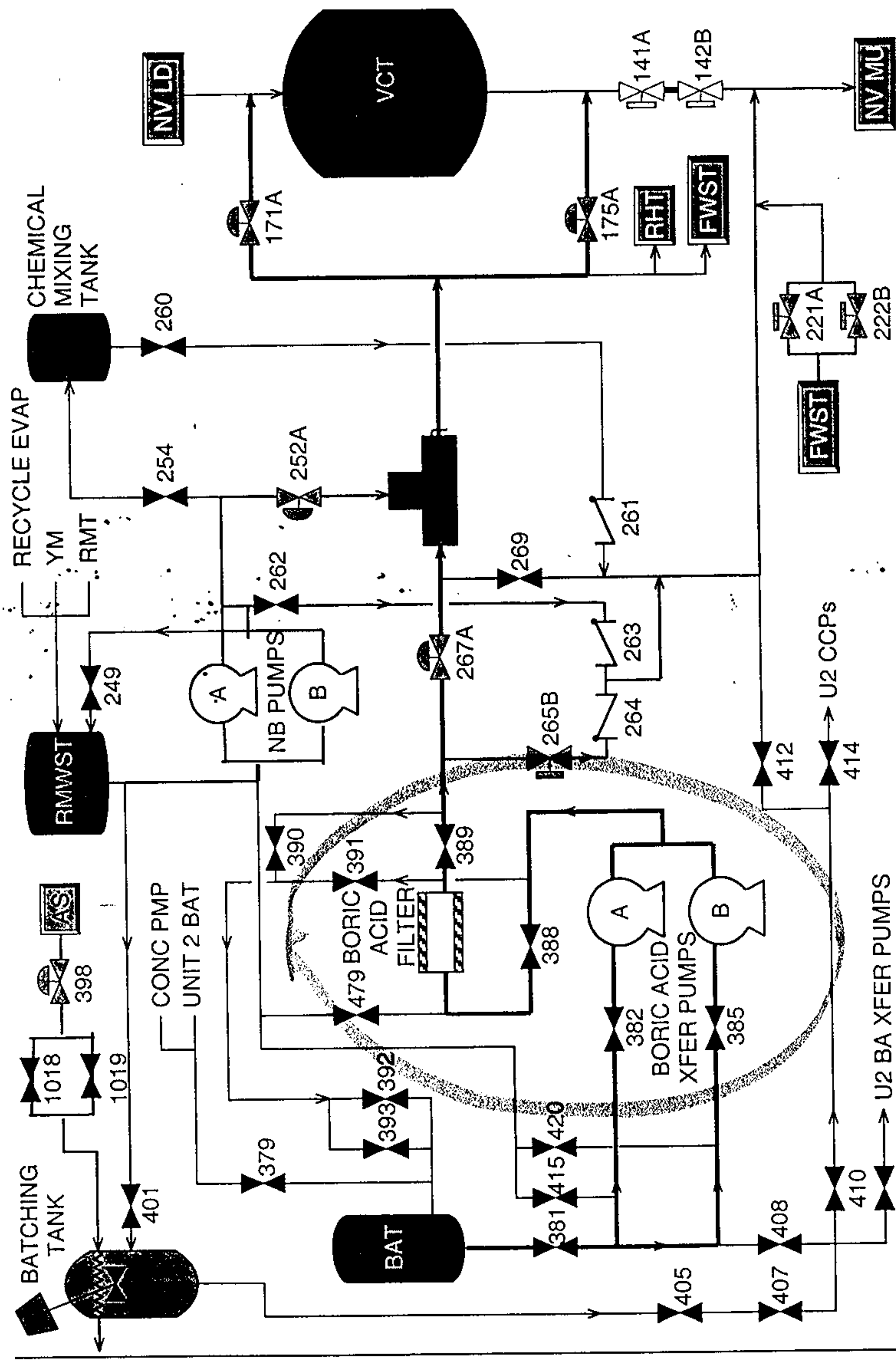
VCT Outlet Isolation Valves (NV-141A, NV-142B) ensure VCT isolation to maintain ECCS inventory or to ensure charging pump suction. Each valve receives an S_S signal to close but will only do so if the train related FWST Supply (NV-221A, NV-222B) is intermediate or open. Low low level in the VCT (both level channels) will also initiate closure if the train related FWST Supply (NV-221A, NV-222B) is intermediate or open.

2.20 NV System Valves

<u>Relief Valves</u>

NV-6 – Downstream of Letdown Orifices, protects the low-pressure piping. The setpoint is 600 psig. Relieves to PRT.

7.10 NV System Makeup (1/28/00)



16.9 AUXILIARY SYSTEMS

16.9.9 Boration Systems – Flow Path (Operating)

COMMITMENT

Two of the following three boron injection flow paths shall be OPERABLE:

a. The flow path from a boric acid tank via a boric acid transfer pump and a charging pump to the reactor coolant system, and

b. Two flow paths from the refueling water storage tank via charging pumps to the reactor coolant system.

Note: An OPERABLE charging pump used to satisfy OPERABILITY requirements of one boration flow path may not be used to satisfy OPERABILITY requirements for a second boration flow path.

APPLICABILITY

MODES 1, 2, and 3,
MODE 4 with all RCS cold leg temperatures > 300°F.

REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required boron injection flow path inoperable.	A.1 Restore the required boron injection flow path to OPERABLE status.	72 hours
B. Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 3. <u>AND</u> B.2 Borate to the SDM requirements of Tech Spec 3.1.1. <u>AND</u> B.3 Restore the required boron injection flow path to OPERABLE status.	6 hours 6 hours 7 days

(continued)

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Required Action and associated Completion Time of Condition B not met.	C.1 Be in MODE 4 with any RCS cold leg temperature ≤ 300°F.	30 hours

TESTING REQUIREMENTS

TEST		FREQUENCY
TR 16.9.9.1	Verify the temperature of piping associated with the flow path from the boric acid storage tanks is ≥ 65°F when it is a required water source	7 days
TR 16.9.9.2	Verify that each manual, power operated, or automatic valve in the flow path that is not locked, sealed, or otherwise secured in position, is in the correct position.	31 days
TR 16.9.9.3	Verify that each automatic valve in the flow path actuates to its correct position on a safety injection test signal.	18 months
TR 16.9.9.4	Verify that each charging pump's developed head at the test flow point is greater than or equal to the required developed head.	In accordance with the Inservice Testing Program
TR 16.9.9.5	Verify that the flow path from the boric acid tanks via a boric acid transfer pump and a charging pump delivers ≥ 30 gpm to the reactor coolant system.	18 months

BASES

The Boron Injection System ensures that negative reactivity control is available during each mode of facility operation. The components required to perform this function include: (1) borated water sources, (2) charging pumps, (3) separate flow paths, (4) boric acid transfer pumps, and (5) an emergency power supply from OPERABLE diesel generators.

With the RCS temperature above 300°F, a minimum of two boron injection flow paths are required to ensure single functional capability in the event an assumed failure renders one

BASES (continued)

of the flow paths inoperable. The boration capability of either flow path is sufficient to provide a SHUTDOWN MARGIN from expected operating conditions of 1.3% delta k/k after xenon decay and cooldown to 200°F. The maximum expected boration capability requirement occurs at EOL from full power equilibrium xenon conditions. Further discussion is provided in Bases for Shutdown Margin Requirements (Tech Spec 3.1.1 and 3.1.2).

REFERENCES

None

1 Pt

Which one of the following describes the operational differences to ESF systems for a double ended break inside containment versus a LOCA outside Containment?

A. **On a LOCA outside containment there will be no containment isolation signal.**

B. **There are no operational differences.**

C. **On a LOCA outside containment the containment sump valves do not automatically open on low FWST level.**

D. **As FWST inventory depletes there is no corresponding increase in containment sump level.**

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Bank Question: 1051 *Answer: D*

1 Pt Which one of the following describes the operational differences to ESF systems for a double ended break inside containment versus a LOCA outside Containment?

A. On a LOCA outside containment there will be no containment isolation signal.

B. There are no operational differences.

C. On a LOCA outside containment the containment sump valves do not automatically open on low FWST level.

D. As FWST inventory depletes there is no corresponding increase in containment sump level.

Distracter Analysis:.

A. **Incorrect**: A manual S/I will be generated on low pressurizer level and charging flow as a result a containment isolation signal will actuate.
Plausible:

B. **Incorrect**: Phase 'B' components will not actuate on LOCA outside containment
Plausible:

C. **Incorrect**: Not correct they will open on 180" FWST level whether there is water in the sump or not.
Plausible:

D. **Correct**
Plausible:

LEVEL: RO

KA: W/E-04 EK2.1 (3.5/3.9)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Comprehension

AUTHOR: CWS

LESSON: OP-MC-ECC-ISE
OP-MC-PS-ND

OBJECTIVES: OP-MC-PS-ND Obj. 7
OP-MC-ECC-ISE Objs. 5 and 13

REFERENCES: OP-MC-PS-ND page 29
OP-MC-ECC-ISE pages 15 & 29

<u>Westinghouse</u>

E04 LOCA Outside Containment

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (LOCA Outside Containment)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.5 SRO 3.9

EK1.2 Normal, abnormal and emergency operating procedures associated with (LOCA Outside Containment).
IMPORTANCE RO 3.5 SRO 4.2

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (LOCA Outside Containment).
IMPORTANCE RO 3.5 SRO 3.9

EK2. Knowledge of the interrelations between the (LOCA Outside Containment) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.5 SRO 3.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.8 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (LOCA Outside Containment)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.5

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2	2	2	2	1.5

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR.
1	Explain the purpose of the ND System. PSND001	X	X	X	X	
2	Sketch the ND System reflecting all major components and interconnections to associated systems (NC, NI, NS) per Drawing 7.1. PSND002	X	X	X	X	
3	Describe the instrumentation and alarms associated with the ND System. PSND003		X	X	X	X
4	List the power supplies for the ND pumps. PSND004	X	X	X	X	
5	Describe the operation of the following ND valves: • ND1B(2AC) - C Loop to ND Pump • ND4B (19A) - B(A) ND Pump Suction from FWST or NC • ND67B (68A) - B(A) ND Pump and B(A) ND HX Mini-Flow • ND15B (30A) - Train B(A) ND to Hot Leg Isolation • ND35 - ND System to FWST Isolation. PSND005		X	X	X	X
6	Explain overpressure protection for the ND System. PSND006		X	X	X	X
7	Explain the interlocks associated with the emergency auto-swap of ND pump suctions to the containment sump during an accident. PSND007	X	X	X	X	X

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2.5	1.5	1.5	1.5	1.5

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Engineered Safeguards System.	X	X	X	X	
2	Explain the need and reasoning behind the redundancy requirements for two trains of safety related systems.	X	X	X	X	
3	State how the operator would be aware if more than one protection cabinet door was opened simultaneously.		X	X	X	X
4	Define the following terms: S_s, S_t, S_P, S_H	X		X	X	
5	**List the conditions that will initiate the following:** • Safety Injection (S_s) • Phase "A" Isolation (S_t) • Containment Spray/Phase "B" Isolation (S_P) • Containment Ventilation Isolation (S_H) • Main Steam Isolation (MSI) • Main Feedwater Isolation (FWI) • VE (Annulus Ventilation) System Start • H_2 Skimmer and Air Return Fan Start (VX)	X				
6	List all Safety Injection (S_s) actuation signals, setpoints, logic, and the type of accident each signal provides protection for.		X	X	X	X
7	List the pumps that automatically start following a safety injection actuation.		X	X	X	X
8	State which Safety Injection (S_s) signal can be blocked.	X	X	X	X	X
9	Explain the reason for blocking a Safety Injection (S_s) signal.	X	X	X	X	X
10	List the interlock and parameter setpoint that allows blocking Safety Injection (S_s).		X	X	X	X
11	Describe the operator action needed to block Safety Injection.		X	X	X	X
12	List the conditions that allow <u>RESET</u> of Safety Injection.		X	X	X	X

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
13	List the setpoints, permissives, and logic required to initiate the following: • Containment Spray (NS) Actuation • Phase "B" Isolation • Main Steam Isolation (MSI) • Main Feedwater Isolation (FWI)		X	X	X	X
14	Explain the relationship between SSPS Testing and the operability of the Systems and functions actuated from the Engineered Safety Features Actuation System.		X	X	X	X
15	Discuss the purpose of the ESF Monitor Lite Panel (BOP Panel).		X	X	X	
16	Concerning AP/1 or 2/A/5500/35, ECCS Actuation During Plant Shutdown. • State the purpose of the AP. • Recognize the symptoms that would require implementation of the AP.		X	X	X	X
17	Concerning the Technical Specifications related to the Engineered Safeguards Actuation System:					
	• Given the LCO title, state the LCO (including any COLR values) and applicability.			X	X	X
	• For any LCO's that have action required within one hour, state the action.			X	X	X
	• Given a set of parameter values or system conditions, determine if any Tech Spec LCO's is (are) not met and any action(s) required within one hour.			X	X	X
	• Given a set of plant parameters or system conditions and the appropriate Tech Specs, determine required actions.				X	X
	• Discuss the bases for a given Tech Spec LCO or Safety Limit. * - SRO Only				X	*

ND-35 shall not be opened during Modes 1 - 4. Opening this valve during Modes 1 - 3 would allow both trains of ND to recirculate to the FWST, since ND-15B and ND-30A are required to remain open. With the ND to FWST recirculation path open, both trains of ND would be inoperable due to the insufficient ECCS injection flowrate to the NC loops. Opening this valve while in Mode 4 with the ND System in service could cause a rapid loss of reactor coolant inventory and void the 24" FW header with steam, making all ECCS trains inoperable. **Therefore, ND-35 shall remain locked closed during Modes 1 - 4.**

2.3.10 NI-184B (RB Sump to Train B ND & NS) and NI-185A (RB Sump to Train A ND & NS)

Objective # 7

NI-184B and NI-185A have open/close pushbuttons on the ND section of MC11. These valves are designed to automatically open on FWST low level (180 inches), following a safety injection signal, to swap the ND pump suction from the FWST to the containment sump. Each valve has an S-latch control circuit which ensures that the valves will not swap to the containment sump unless certain conditions exist (Refer to drawing 7.3). The S latch is activated by the train related safety injection signal and has two train related indication/switches on MC11. When the S_S signal is actuated, the S LATCHED indication will illuminate and remain lit until the SS RESET pushbutton is depressed. The S LATCH seals in the S_S SIGNAL, therefore the automatic swap will be enabled even if the S_S signal is reset. The S-latch allows the automatic opening of NI-184B and/or NI-185A on 2 of 3 FWST LO level bistables provided the FWST level instruments are not in test.

The S-latch switch also has a BYPASS pushbutton which has a mechanical latch which allows the operator to open the valves with their open pushbuttons in the event that:

- **the S_S signal did not actuate the S Latch**
- **the S-latch had been prematurely reset**
- **it is desired to transfer to the containment sump prior to the FWST LO Level setpoint, or**
- **testing of the circuit is required**

The BYPASS pushbutton allows opening of the containment sump valves with ND-19A (A ND Pump Suction from FWST or NC) and ND-4B (B ND Pump Suction from FWST or NC) open however, NS-1B (B NS Pump from Cont Sump) and NS-18A (A NS Pump from Cont Sump) must be closed. This accomplishes the auto transfer of ND Suction from FWST to the containment sump since ND-19A and ND-4B will automatically close once its train related containment sump isolation valve reaches the fully open position. The REL pushbutton removes the mechanical latch on the BYPASS pushbutton. This pushbutton is used when the BYPASS function is no longer needed.

If a transmitter fails during an accident, this could prevent actuation of its associated equipment. Therefore, a > 0.35 psig signal can be simulated via a test key switch and potentiometer. The key switches are located on the CPCS cabinets and the potentiometers are located in the CPCS cabinets. Train A CPCS cabinet (CPCC1) is located in Electrical Penetration Rm (750'). Train B CPCS cabinet (CPCC2) is located in Electrical Penetration Rm (733').

The NS pumps and NS discharge valves, VX return air fans/H_2 skimmer fans and Air Return damper circuits are interlocked such that if one is in test, the other test circuit is inhibited. This ensures NS and VX termination once containment pressure drops below 0.35 psig while a circuit is in test with a potentiometer simulating greater than 0.35 psig. This testing scheme will also help prevent inadvertent spray actuation.

Objective # 4

The following abbreviated terms are used to designate system components that receive an ESS signal.

S_s Safety Injection

S_t Phase "A" Isolation

S_P Phase "B" Isolation

S_H Containment Ventilation Isolation

2.1 Safety Signal Setpoints

Objective # 5

Safety Injection (S_S)

- **Lo-Pressurizer Pressure**
- **Hi Containment Pressure**
- **Manual**

Phase "A" Isolation Signal

- **Safety Injection (any of 3 signals)**
- **Manual**

Containment Spray (NS)

- **Hi Hi Containment Pressure (S_p) with CPCS**
- **Manual with CPCS**

Phase "B" Containment Isolation

- **Hi Hi Containment Pressure (S_R)**
- **Manual**

Objective # 13

Phase "B" Containment Isolation is actuated by:

Hi Hi Containment Pressure	**> 3.0 psig on $^2/_4$ channels**
Manually	**$^1/_2$ pushbuttons**

Phase B actuation secures Component Cooling Water (KC) to the Reactor Coolant pumps, Nuclear Service Water (RN) to the Reactor Coolant Pump Motor Coolers, Containment Ventilation Cooling Water (RV) and Instrument Air (VI) to the containment.

Phase "B" can be reset with signal still present, once resets are pushed, we regain control of valves that close on the Phase "B" signal.

Containment Ventilation Isolation (S_H) is initiated by any of the following:

- **Safety Injection (S_S)**
- **Manual Phase "A" (S_t)**
- **Manual NS/Phase "B"**
- **Trip 2 alarm on EMF-38, 39, or 40**

Containment Ventilation Isolation (S_H) signal secures VQ and VP.

To "Reset" Containment Ventilation Isolation following a Safety Injection, Manual Phase "A", or Manual Phase "B", the Containment Ventilation (S_H) "Reset" Pushbuttons must be depressed (can reset without resetting the initiating signal).

To "Reset" Containment Ventilation following an EMF 38, 39, 40 Trip II, the EMF must be reset, then the Containment Ventilation "Reset Pushbuttons must be depressed.

NOTE: **Resetting the S_H signal will allow manual control of VQ valves. VQ valves do not have an auto function.**

Annulus Ventilation System (VE) start maintains negative pressure in annulus. It is actuated automatically by a Hi Hi Containment pressure signal or manually by either depressing Manual "NS/Phase B" Pushbutton or placing VE (Annulus Ventilation) to "ON".

To reset the start signal we must reset the Phase "B" isolation, then, place VE (Annulus Ventilation) fan switch to "Reset" and place back in "auto".

H_2 Skimmer and Air Return Fan (VX) starts on a Hi Hi Containment Pressure (S_P) with CPCS or Manually by NS/Phase B pushbutton and CPCS after a 10 minute time delay.

1 Pt Which one (1) of the following provides separation between control system and protection system circuits?

A. **Isolation Amplifier**

B. **Diodes**

C. **Separate input signal**

D. **Or/And gate**

Bank Question: 1052 ***Answer: A***

1 Pt Which one (1) of the following provides separation between control system and protection system circuits?

A. **Isolation Amplifier**

B. **Diodes**

C. **Separate input signal**

D. **Or/And gate**

Distracter Analysis:.

A. **Correct:**
Plausible:
B. **Incorrect:**
Plausible:
C. **Incorrect:**
Plausible:
D. **Incorrect**
Plausible:

LEVEL: RO

KA: SYS 016 K5.01 (2.7*/2.8*)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-IC-IPE

OBJECTIVES:

REFERENCES: OP-MC-IC-IPE page 17

SYSTEM:	**016 Non-Nuclear Instrumentation System (NNIS)**		
K4.02	Sensing, signal processing, display, recording, and alarms	2.3*	2.7*
K4.03	Input to control systems	2.8*	2.9*
K5	**Knowledge of the operational implication of the following concepts as they apply to the NNIS:** (CFR: 41.5 / 45.7)		
K5.01	Separation of control and protection circuits	2.7*	2.8*
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the NNIS:** (CFR: 41.7 / 45.7)		
K6.01	Sensors and detectors	2.3*	2.5*
	<u>ABILITY</u>		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the NNIS controls including:** (CFR: 41.5 / 45.5)		
	None		
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the NNIS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)		
A2.01	Detector failure	3.0*	3.1*
A2.02	Loss of power supply	2.9*	3.2*
A2.03	Interruption of transmitted signal	3.0	3.3*
A2.04	Voltage to instruments, both too high and too low	2.5*	2.6*
A3	**Ability to monitor automatic operation of the NNIS, including:** (CFR: 41.7 / 45.5)		
A3.01	Automatic selection of NNIS inputs to control systems	2.9*	2.9*
A3.02	Relationship between meter readings and actual parameter value	2.9*	2.9*
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	NNI channel select controls	2.9*	2.8*
A4.02	Recorders	2.7	2.6*

1.0 INTRODUCTION

1.1 Purpose

Objective # 1

The purpose of the Reactor Protection System is to ensure the reactor core and primary system are prevented from exceeding their safety limits during normal operation and design bases anticipated operational occurrences, and to assist the Engineered Safeguards Actuation System in mitigating the consequences of an accident.

1.2 General Description

1.2.1 System Function

The Reactor Protection System monitors a variety of plant parameters and uses these signals to initiate protective actions. The protection system must be reliable enough to provide this protection during both normal operation and any postulated accident. In addition to these automatic protective actions, the system must generate a constant flow of information to keep the operator informed of the status of the protective system.

In order for the Reactor Protection System to perform reliably under all plant conditions, several important design features are utilized.

Diversification - several different methods are used to monitor the same parameter or indicate the same plant condition.

Redundancy - multiple instrumentation channels are used to monitor the same parameter.

Independence - each channel of measurement and each train of protection is physically and electrically independent.

Failsafe - the system is designed to supply a trip signal upon failure. All bistables will supply an initiation signal upon loss of power to the circuit or bistable.

Isolation From Control Circuits - the protective system and control systems circuits are isolated from each other with Isolation Amplifiers.

The Reactor Protection System is designed for a high degree of reliability such that a single channel failure will neither cause nor prevent a protective action. Two exceptions (Source Range and Intermediate Range Nuclear Instrumentation high flux trips) are allowed since these trips are in service for only a limited period of time and they are "backed up" by the Power Range high flux trips. This means that it would require a minimum of two instrumentation channels to initiate a protective action and a minimum of three channels would be require to meet the single failure criteria. The protection system would then respond if one of the three channels failed to generate a protective action and would not respond if a single channel failed in a manner to indicate that a protective action was required. This is called two-out-of-three (2/3) logic.

1 Pt Given the following conditions on Unit 1:

- Loss of Offsite Power coincident with a LOCA
- Power has been restored to ETA via '1A' D/G while in EP/1/A/5000/ECA-0.0 (*Loss of All AC Power*)
- NC Subcooling is -1 degree
- Pzr level is 0%
- 1NI-9A (*NC Cold Leg Inj from NV*) is closed
- 1NI-10B (*NC Cold Leg Inj from NV*) is closed

Which one (1) of the following procedure is required for optimal recovery of the plant?

A. Go to EP/1/A/5000/ECA-0.1 (*Loss of All AC Power Recovery Without S/I Required*)

B. Go to EP/1/A/5000/E-1 (*Loss of Reactor or Secondary Coolant*)

C. Go to EP/1/A/5000/ECA-0.2 (*Loss of All AC Power Recovery With S/I Required*)

D. Go to EP/1/A/5000/ES-1.2 (*Post LOCA Cooldown and Depressurization*)

Bank Question: 1056 ***Answer: C***

1 Pt Given the following conditions on Unit 1:

- Loss of Offsite Power coincident with a LOCA
- Power has been restored to ETA via '1A' D/G while in EP/1/A/5000/ECA-0.0 (*Loss of All AC Power*)
- NC Subcooling is -1 degree
- Pzr level is 0%
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Which one (1) of the following procedure is required for optimal recovery of the plant?

A. Go to EP/1/A/5000/ECA-0.1 (*Loss of All AC Power Recovery Without S/I Required*)

B. Go to EP/1/A/5000/E-1 (*Loss of Reactor or Secondary Coolant*)

C. Go to EP/1/A/5000/ECA-0.2 (*Loss of All AC Power Recovery With S/I Required*

D. Go to EP/1/A/5000/ES-1.2 (*Post LOCA Cooldown and Depressurization*)

Distracter Analysis:.

A. Incorrect:
Plausible:
B. Incorrect:
Plausible:
C. Correct:
Plausible:
D. Incorrect
Plausible:

LEVEL: RO

KA: 000056 AK1.04 (3.1*/3.2*)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Comprehension

AUTHOR: CWS

LESSON: OP-MC-EP-ECA-0

OBJECTIVES: OP-MC-EP-ECA-0 Obj 2

REFERENCES: OP-MC-EP-ECA-0 Page 61
EP/1A/5500/ECA 0.0 page 30

APE: 056 Loss of Offsite Power

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Offsite Power: CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Principle of cooling by natural convection	3.7	4.2
AK1.02	Definition of terms: volts, watts, amp, degrees F, %, psig, inches of mercury, gpm	1.9	2.1
AK1.03	Definition of subcooling: use of steam tables to determine it	3.1*	3.4*
AK1.04	Definition of saturation conditions, implication for the systems	3.1*	3.2*
AK2.	**Knowledge of the interrelations between the Loss of Offsite Power and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	1.8	1.8
AK2.02	Sensors, detectors, and indicators	2.0*	1.9
AK2.03	Controllers and positioners	1.9	1.9
AK2.04	Pumps	1.7	1.7
AK2.05	Motors	1.7	1.7
AK2.06	Heat exchangers and condensers	1.6	1.7
AK2.07	Demineralizers and ion exchangers	1.6	1.6
AK2.08	Breakers, relays, and disconnects	2.1*	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Offsite Power: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Order and time to initiation of power for the load sequencer	3.5	3.9
AK3.02	Actions contained in EOP for loss of offsite power	4.4	4.7
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Offsite Power: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Power relief controllers to maintain no-load T-ave	4.0*	3.8*
AA1.02	ESF bus synchronization select switch to close bus tie breakers	4.0*	3.9
AA1.03	Adjustment of ED/G load by selectively energizing PZR backup heaters	3.2*	3.3*
AA1.04	Adjustment of speed of ED/G to maintain frequency and voltage levels	3.2	3.1
AA1.05	Initiation (manual) of safety injection process	3.8	3.9
AA1.06	Safety injection pump	3.6*	3.6*
AA1.07	Service water pump	3.2*	3.2*
AA1.08	HVAC chill water pump and unit	2.5*	2.5
AA1.09	CCW pump	3.3	3.3
AA1.10	Auxiliary/emergency feedwater pump (motor driven)	4.3	4.3
AA1.11	HPI system	3.7*	3.7
AA1.12	Reactor building cooling unit	3.2	3.3
AA1.13	Fuel handling building exhaust fan	2.2	2.2
AA1.14	Relay room cooling unit	2.3*	2.3*
AA1.15	Service water booster pump	2.7*	2.9*
AA1.16	ESF switch gear room cooling unit	2.5	2.5
AA1.17	Service water building normal ventilation supply fan	2.3*	2.4*

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		1.5	1.5	1.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the ECA-0 series. EPECA001			X	X	
2	Discuss the entry and exit guidance for each procedure in the ECA-0 series. EPECA002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the ECA-0 series. EPECA003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the ECA-0 series. EPECA004			X	X	X
5	Describe the immediate actions and include the RNO when appropriate. EPECA005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPECA006			X	X	X
7	Discuss the time critical task(s) associated with the ECA-0 series procedures including the time requirements and the basis for these requirements. EPECA007			X	X	X

STEP 38 Select recovery procedure:

PURPOSE: To select the appropriate loss of all AC power recovery procedure.

BASIS: Step 38 provides the criteria by which the operator determines which recovery procedure actions to implement. The criteria are:

1. The existence of NC subcooling
2. The existence of pressurizer level
3. The confirmation that S/I equipment is not operating (NI-9 and NI-10 closed)

Two recovery procedures are provided based on these criteria. These are procedures ECA-0.1 and ECA-0.2.

If the operator determines all criteria are satisfied, ECA-0.1 should be implemented to attempt plant recovery utilizing normal operational systems.

If any criterion is not satisfied, ECA-0.2 should be implemented to recover the plant utilizing safeguards systems.

To ensure S/I has not actuated upon power restoration, the positions of the cold leg injection isolation valves (NI-9 and NI-10) are checked. These valves do not "seal in" the S/I signal and do not receive a signal through the D/G load sequencer that is deenergized. If an S/I signal was generated prior to power restoration, the procedure would reset the signal after the time delay and no equipment would reposition (NI-9 and NI-10 would remain closed). If either valve were open at this point in the procedure, it would indicate that an S/I signal was generated with power restored and certain valves may have repositioned; specifically valves that receive direct S/I signals. In this case, ECA-0.2 would direct the operator to the correct procedure to handle the accident or to terminate the spurious S/I.

3.5. ECA-0.0 Enclosures

Enclosure 1, SSF Actions – ECA-0.0 Actions

This enclosure provides actions to be taken upon manning the SSF. These actions, if necessary, include starting the SSF D/G, loading equipment on the bus (standby makeup pump, battery chargers) and monitoring D/G operation.

Enclosure 2, Transfer of EMXA-4 ECA-0.0 Actions

This one step enclosure provides the instructions necessary to transfer EMXA-4 to the SSF. A caution provides guidance for operating Kirk-key interlocked breakers. A note provides the fastest pathway from the Control Room to ETA room.

Enclosure 3, Automatic Actions When EMXA-4 is Swapped

This enclosure provides a list of automatic actions that occur when power is swapped to SMXG. No actions are required for this enclosure. It is provided for information only.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
38. **Select recovery procedure:**	
__ a. Check NC subcooling based on core exit T/Cs - GREATER THAN 0° F.	a. Perform the following: __ 1) Align additional RN valves **PER** Enclosure 22 (RN S/I Valves). __ 2) **GO TO** EP/1/A/5000/ECA-0.2 (Loss Of All AC Power Recovery With S/I Required).
__ b. Check Pzr level - GREATER THAN 11% (29% ACC).	b. Perform the following: __ 1) Align additional RN valves **PER** Enclosure 22 (RN S/I Valves). __ 2) **GO TO** EP/1/A/5000/ECA-0.2 (Loss Of All AC Power Recovery With S/I Required).
c. Check the following valves - CLOSED: __ • 1NI-9A (NC Cold Leg Inj From NV) __ • 1NI-10B (NC Cold Leg Inj From NV).	c. **IF** any NV pump on, **THEN** perform the following: __ 1) Align additional RN valves **PER** Enclosure 22 (RN S/I Valves). __ 2) **GO TO** EP/1/A/5000/ECA-0.2 (Loss Of All AC Power Recovery With S/I Required).
__ d. **GO TO** EP/1/A/5000/ECA-0.1 (Loss Of All AC Power Recovery Without S/I Required).	

END

1 Pt Given the following conditions on Unit 1:

- Large break LOCA occurred.
- Both trains of NV, NI, ND, NS are running

	Loop A	Loop B	Loop C	Loop D
S/G (NR) [%]	10	9	10	9

The operators are in E-0 (*Reactor Trip or Safety Injection*) step 17. The RO tells the SRO NC temperature is decreasing. The RO is instructed to implement Enclosure 3 *Uncontrolled NC System Cooldown.*

Which one of the following statements correctly describes the method for controlling feed flow?

REFERENCES PROVIDED

A. **When N/R level is greater than 11% in one S/G throttle feed flow to minimum and maintain N/R level greater than 11% in at least one S/G.**

B. **When N/R level is greater than 32% in all S/Gs throttle feed flow to minimum and maintain N/R level greater than 32% in all S/Gs.**

C. **If N/R level is less than 11% in all S/Gs throttle feed flow to minimize cooldown and maintain total feedwater flow greater than 450 gpm.**

D. **If N/R level is less than 32% in all S/Gs throttle feed flow to minimize cooldown and maintain total feedwater flow greater than 450 gpm.**

Bank Question: 1059 ***Answer: D***

1 Pt Given the following conditions on Unit 1:

- Large break LOCA occurred.
- Both trains of NV, NI, ND, NS are running

	Loop A	Loop B	Loop C	Loop D
S/G (NR) [%]	10	9	10	9

The operators are in E-0 (*Reactor Trip or Safety Injection*) step 17. The RO tells the SRO NC temperature is decreasing. The RO is instructed to implement Enclosure 3 *Uncontrolled NC System Cooldown.*

Which one of the following statements correctly describes the method for controlling feed flow?

REFERENCES PROVIDED:
E-0 Enclosure3

A. **When N/R level is greater than 11% in one S/G throttle feed flow to minimum and maintain N/R level greater than 11% in at least one S/G.**

B. **When N/R level is greater than 32% in all S/Gs throttle feed flow to minimum and maintain N/R level greater than 32% in all S/Gs.**

C. **If N/R level is less than 11% in all S/Gs throttle feed flow to minimize cooldown and maintain total feedwater flow greater than 450 gpm.**

D. **If N/R level is less than 32% in all S/Gs throttle feed flow to minimize cooldown and maintain total feedwater flow greater than 450 gpm.**

Distracter Analysis:

A. **Incorrect:**
Plausible:
B. **Incorrect:**
Plausible:
C. **Incorrect**
D. **Correct:**
Plausible:

Level: RO

KA: SYS 061 K5.01 (3.6/3.9)

Lesson Plan Objective: OP-MC-EP-E0 Obj. 6

Source: NEW

AUTHOR: CWS

Level of knowledge: Analysis

References:
1. OP-MC-EP-E-0 page 75
2. EP/1/A/5000/E-0 Enclosure 3 - PROVIDED

SYSTEM: **061 Auxiliary / Emergency Feedwater (AFW) System**

K3 **Knowledge of the effect that a loss or malfunction of the AFW will have on the following:**
(CFR: 41.7 / 45.6)

K3.01	RCS	4.4	4.6
K3.02	S/G	4.2	4.4

K4 **Knowledge of AFW design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	Water sources and priority of use	4.1	4.2
K4.02	AFW automatic start upon loss of MFW pump, S/G level, blackout, or safety injection	4.5	4.6
K4.03	Automatic blowdown/sample isolation	2.7	2.9*
K4.04	Prevention of AFW runout by limiting AFW flow	3.1	3.4
K4.05	Prevention of MFW swapover to AFW suction pressure is low	3.5*	3.7*
K4.06	AFW startup permissives	4.0*	4.2*
K4.07	Turbine trip, including overspeed	3.1*	3.3*
K4.08	AFW recirculation	2.7	2.9
K4.09	Crossties between multi-unit station	3.7	3.3
K4.10	Reset of MFW reactor trip logic	2.6	2.9*
K4.11	Automatic level control	2.7*	2.9*
K4.12	Natural circulation flow	3.5*	3.7
K4.13	Initiation of cooling water and lube oil	2.7	2.9
K4.14	AFW automatic isolation	3.5*	3.7*

K5 **Knowledge of the operational implications of the following concepts as the apply to the AFW:**
(CFR: 41.5 / 45.7)

K5.01	Relationship between AFW flow and RCS heat transfer	3.6	3.9
K5.02	Decay heat sources and magnitude	3.2	3.6
K5.03	Pump head effects when control valve is shut	2.6	2.9*
K5.04	Reason for warming up turbine prior to turbine startup	2.3	2.5*
K5.05	Feed line voiding and water hammer	2.7	3.2

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the AFW components:**
(CFR: 41.7 / 45.7)

K6.01	Controllers and positioners	2.5	2.8*
K6.02	Pumps	2.6	2.7
K6.03	Motors	2.0	1.9
K6.04	Breakers, relays, and disconnects	1.7	1.9
K6.05	Valves	2.3*	2.5*
K6.06	Sensors and detectors	2.1	2.4*
K6.07	Pump lube oil system and cooling	2.0	2.2
K6.08	Bearing oil supply for turbine drive pumps	2.1	2.3

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	2.0	2.0	1.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Describe the accidents that are diagnosed in E-0 and the diagnostic sequence. EPE0001			X	X	X
2	Explain the purpose for each procedure in the E-0 series. EPE0002			X	X	
3	Discuss the entry and exit guidance for each procedure in the E-0 series. EPE0003			X	X	
4	Discuss the symptoms of a reactor trip and/or safety injection. EPE0004			X	X	
5	Discuss the mitigating strategy (major actions) of each procedure in the E-0 series. EPE0005			X	X	X
6	Discuss the basis for any note, caution or step for each procedure in the E-0 series. EPE0006			X	X	X
7	Describe the immediate actions and include the RNO when appropriate. EPE0007			X	X	X
8	Describe the actions included on the E-0 Foldout page and the basis for these actions. EPE0008			X	X	X
9	Given the Foldout page, other than E-0, discuss the actions included and the basis for these actions. EPE0009			X	X	X

Enclosure 2 - Phase B HVAC Equipment

This enclosure provides the Balance of Plant operator with actions necessary to perform various Containment Ventilation alignments. These actions are performed outside the Control Room horseshoe area. This enclosure is entered from the RNO of a step that checks that containment pressure has remained less than 3 psig.

Check VE System Operation:

- **Check VE fans - ON.**
- **Ensure all VE damper mode select switches in "AUTO":**
- **Check annulus pressure being maintained - NEGATIVE.**

BASIS: These steps verify proper operation of the annulus ventilation system in maintaining a negative pressure in the annulus. This prevents an unfiltered release from containment to the environment.

Check VX System Operation:

WHEN ten minutes after Phase B signal have elapsed, THEN

- **Check Containment Air Return and H2 Skimmer Fan damper alignment.**
- **Check Containment Air Return and H2 Skimmer Fans on.**

BASIS: The Containment Air Return fans play an important role in maintaining containment pressure low during the long transient of a LOCA by circulating air through the ice condenser and mixing/circulating the air being cooled by the Containment Spray System.

The Hydrogen Skimmer System ensures that isolated pockets of hydrogen don't build up in dead-ended spaces in containment.

Enclosure 3 - Uncontrolled NC System Cooldown

This enclosure provides the operator at the controls with actions to stop an uncontrolled cooldown by;

1. Checking steam release paths isolated: Steam dump valves and PORVs closed and MSRs reset,
2. Throttling feed flow to minimize cooldown while maintaining total flow greater than 450 gpm until level in at least one S/G is greater than 11% (32% ACC),
3. IF cooldown continues, Close MSIVs and bypass valves.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 1. **Check steam dump valves - CLOSED.**	**Close steam dump valves as follows:** __ a. Place "STEAM DUMP SELECT" in steam pressure mode. __ b. <u>IF</u> steam dumps still open, <u>THEN</u> place "STM PRESS CONTROLLER" in manual and close. c. <u>IF</u> steam dumps still open, <u>THEN</u> select "OFF RESET" on the following switches: __ • "STEAM DUMP INTLK BYPASS CHANNEL A" __ • "STEAM DUMP INTLK BYPASS CHANNEL B".
__ 2. **Check all SM PORV(s) - CLOSED.**	**Perform the following:** __ a. Close affected SM PORV manual loader. b. <u>IF</u> SM PORV can not be closed, <u>THEN</u>: __ 1) Close its isolation valve. __ 2) <u>IF</u> SM PORV isolation valve can not be closed, <u>THEN</u> dispatch operator to close SM PORV isolation valve.
__ 3. Check MSR "RESET" light - LIT.	Perform the following on MSR controls: __ a. Depress "SYSTEM MANUAL". __ b. Depress "RESET".

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 4. **Check any NC pump - ON.**	**Perform the following:** __ a. IF any NC T-Cold is still going down, THEN GO TO Step 6. __ b. IF cooldown stopped, THEN exit this enclosure.
__ 5. **Check NC T-Ave - GOING DOWN.**	__ **IF cooldown stopped, THEN exit this enclosure.**
6. **Control feed flow as follows:** a. IF S/G N/R level is less than 11% (32% ACC) in all S/Gs, THEN throttle feed flow to achieve the following: __ • Minimize cooldown __ • Maintain total feed flow greater than 450 GPM. b. WHEN N/R level is greater than 11% (32% ACC) in at least one S/G, THEN throttle feed flow further to: __ • Minimize cooldown __ • Maintain at least one S/G N/R level greater than 11% (32% ACC).	
__ 7. Check MSIVs - ANY OPEN.	Perform the following: __ a. Close MSIV bypass valves. __ b. Exit this enclosure.
__ 8. **Close 1SM-15 (SM To 2nd Stage MSR).**	

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 9. **Check any NC pump - ON.**	**Perform the following:** __ a. IF any NC T-Cold is still going down, THEN GO TO Step 11. __ b. IF cooldown stopped, THEN exit this enclosure.
__ 10. **Check NC T-Ave - GOING DOWN.**	__ **IF cooldown stopped, THEN exit this enclosure.**
__ 11. **Notify Control room SRO that cooldown is continuing.**	
12. **IF cooldown continues, THEN close:** __ • All MSIVs __ • All MSIV bypass valves.	

1 Pt

Given the following conditions on Unit 1:

- RTP 100%
- A CM system transient has caused both FWPT's to trip.
- The turbine and reactor failed to trip automatically.
- The Operator at the Controls, per the immediate actions of FR-S.1 (*Response to Nuclear Power Generation/ATWS*), will
    1. Manually trip the Reactor if it fails to trip, insert control rods.
    2. Manually trip the Turbine if it fails to trip, runback the in fast action.

Which one (1) of the following describes the bases for the immediate actions in FR-S.1 (Response to Nuclear Power Generation/ATWS)

A. **The safeguards systems are designed assuming that the only heat being added to the NC system is decay heat and NC pump heat. If the reactor will not trip, then the rods are manually inserted to lower reactor power. For an ATWS event with a loss of normal feedwater, a Turbine trip within 30 seconds will prevent challenging the PZR PORV's.**

B. **The safeguards systems are designed assuming that the only heat being added to the NC system is decay heat and NC pump heat. If the reactor will not trip, then the rods are manually inserted to lower reactor power. For an ATWS event with a loss of normal feedwater, a Turbine trip within 30 seconds will maintain S/G inventory.**

C. **The safeguards systems are designed assuming that the only heat being added to the NC system is from less than 5% power. If the reactor will not trip, then the rods are manually inserted to lower reactor power to less than 5%. For an ATWS event with a loss of normal feedwater, a Turbine trip within 30 seconds will maintain S/G inventory.**

D. **The safeguards systems are designed assuming that the only heat being added to the NC system is from less than 5% power. If the reactor will not trip, then the rods are manually inserted to lower reactor power to less than 5%. For an ATWS event with a loss of normal feedwater, a Turbine trip within 30 seconds will prevent challenging the PZR PORV's**

Bank Question: 1061 ***Answer: B***

1 Pt *Given the following conditions on Unit 1:*

- RTP 100%
- A CM system transient has caused both FWPT's to trip.
- The turbine and reactor failed to trip automatically.
- The Operator at the Controls, per the immediate actions of FR-S.1 (*Response to Nuclear Power Generation/ATWS*), will
    1. Manually trip the Reactor if it fails to trip, insert control rods.
    2. Manually trip the Turbine if it fails to trip, runback the in fast action.

Which one (1) of the following describes the bases for the immediate actions in FR-S.1 (Response to Nuclear Power Generation/ATWS)

A. The safeguards systems are designed assuming that the only heat being added to the NC system is decay heat and NC pump heat. If the reactor will not trip, then the rods are manually inserted to lower reactor power. For an ATWS event with a loss of normal feedwater, a Turbine trip within 30 seconds will prevent challenging the PZR PORV's.

B. The safeguards systems are designed assuming that the only heat being added to the NC system is decay heat and NC pump heat. If the reactor will not trip, then the rods are manually inserted to lower reactor power. For an ATWS event with a loss of normal feedwater, a Turbine trip within 30 seconds will maintain S/G inventory.

C. The safeguards systems are designed assuming that the only heat being added to the NC system is from less than 5% power. If the reactor will not trip, then the rods are manually inserted to lower reactor power to less than 5%. For an ATWS event with a loss of normal feedwater, a Turbine trip within 30 seconds will maintain S/G inventory.

D. The safeguards systems are designed assuming that the only heat being added to the NC system is from less than 5% power. If the reactor will not trip, then the rods are manually inserted to lower reactor power to less than 5%. For an ATWS event with a loss of normal feedwater, a Turbine trip within 30 seconds will prevent challenging the PZR PORV's

Distracter Analysis:.

A. Incorrect:
Plausible:

B. **Correct:**
Plausible:
C. **Incorrect:**
Plausible:
D. **Incorrect**
Plausible:

LEVEL: RO

KA: 000029 EK1.01 (2.8/3.1)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Analysis

AUTHOR: CDC

LESSON: OP-MC-EP-FRS

OBJECTIVES: OP-MC-EP-FRS Obj 4

REFERENCES: OP-MC-EP-FRS pages 23 & 25
EP/1/A/5000/FR-S.1 page 2

EPE : 029 Anticipated Transient Without Scram (ATWS)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the ATWS:** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Reactor nucleonics and thermo-hydraulics behavior	2.8	[illegible]
EK1.02	Definition of reactivity	2.6	2.8
EK1.03	Effects of boron on reactivity	3.6	3.8
EK1.04	Interpretation of terms: milliamps, logs, mils, per-cent, and reactivity units	2.2	2.5*
EK1.05	definition of negative temperature coefficient as applied to large PWR coolant systems	2.8	3.2
EK2	**Knowledge of the interrelations between the and the following an ATWS:** (CFR 41.7 / 45.7)		
EK2.01	Valves	1.9	2.1
EK2.02	Sensors and detectors	2.2	2.5
EK2.03	Controllers and positions	2.1	2.3
EK2.04	Pumps	2.1	2.1
EK2.05	Motors	1.9	1.9
EK2.06	Breakers, relays, and disconnects	2.9*	3.1*
EK3	**Knowledge of the reasons for the following responses as the apply to the ATWS:** (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	Verifying a reactor trip; methods	4.2	4.5
EK3.02	Starting a specific charging pump	3.1	3.1
EK3.03	Opening BIT inlet and outlet valves	3.7*	3.6*
EK3.04	Closing the normal charging header isolation valves	3.1*	3.1*
EK3.05	Closing the centrifugal charging pump recirculation valve	3.4*	3.5*
EK3.06	Verifying a main turbine trip; methods	4.2	4.3
EK3.07	Using local turbine trip lever	3.1*	3.4*
EK3.08	Closing the main steam isolation valve	3.6*	3.8
EK3.09	Opening centrifugal charging pump suction valves from RWST	3.7*	4.0*
EK3.10	Manual rod insertion	4.1	4.1
EK3.11	Initiating emergency boration	4.2	4.3
EK3.12	Actions contained in EOP for ATWS	4.4	4.7
	ABILITY		
EA1	**Ability to operate and monitor the following as they apply to a ATWS:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	Charging pumps	3.4*	3.1
EA1.02	Charging pump suction valves from RWST operating switch	3.6*	3.3
EA1.03	Charging pump suction valves from VCT operating switch	3.5*	3.2
EA1.04	BIT inlet valve switches	3.9*	3.8*
EA1.05	BIT outlet valve switches	3.7*	3.6*
EA1.06	Operating switches for normal charging header isolation valves	3.2*	3.1
EA1.07	Operating switch for charging pump recirculation valve	3.4*	3.1*
EA1.08	Reactor trip switch pushbutton	4.5	4.5

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		.75	.75	.75

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the FR-S series. EPFRS001			X	X	
2	Discuss the entry and exit guidance for each procedure in the FR-S series. EPFRS002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the FR-S series. EPFRS003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the FR-S series. EPFRS004			X	X	X
5	Given the Foldout page, discuss the actions included and the basis for these actions. EPFRS005			X	X	X
6	Describe the immediate actions and include the RNO when appropriate. EPFRS006			X	X	X
7	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPFRS007			X	X	X
8	Discuss the time critical task(s) associated with the FR-S series procedures including the time requirements and the basis for these requirements. EPFRS008			X	X	X

STEP 2 Check Turbine Trip: (IMMEDIATE ACTION)

PURPOSE: To ensure that the turbine is tripped.

BASIS: 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. For other ATWS events, manual tripping of the turbine may yield a higher system pressure than would otherwise occur. However, this action has been determined to be necessary due to the analytical results discussed earlier. Since there 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.

If the turbine will not trip, a turbine runback (manual lowering of 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 and MSIV bypass valves should be closed.

STEP 3 Monitor foldout page.

PURPOSE: Remind the operators to monitor the Foldout Page.

BASIS: The Foldout Page contains three items:

1. Transfer to Cold Leg Recirculation if FWST low level is reached. This operator action is required no matter what EP is in effect to ensure the transfer is accomplished without delay.
2. CA Suction Source Monitoring.
3. Criteria for isolating and unisolating the NV Pump Recirculation Isolation Valves (NV-150 and NV-151).

3.4. DETAILED DESCRIPTION OF PROCEDURAL STEPS

STEP 1 Check Reactor Trip: (IMMEDIATE ACTION)

PURPOSE: To ensure that the reactor has tripped.

BASIS: Reactor trip must be verified to ensure that the only heat being added to the NC system is from decay heat and NC Pump heat. The safeguards systems that protect the plant during accidents are designed assuming that only decay heat and pump heat are being added. If the reactor cannot be tripped, then the control rods should be manually inserted into the core in order to lower reactor power.

FR-S.1 does not have foldout page criteria requiring NCP trip **based on subcooling**. Tripping NCPs is NOT a critical task in FR-S.1, though normal NCP trip criteria (hi bearing temperatures, hi-hi vibration, etc.) still apply. The NCP trip criteria ensures that peak clad temperature will stay within design basis limits for small break LOCAs. The ATWS event is not a design basis event. Whether the NCPs are tripped or not does not matter for the ATWS case. The licensing requirement to trip the NCPs within a timely manner to remain within the small break LOCA design basis is no longer applicable since the event is no longer a design basis event. There is nothing wrong with tripping NCPs. Operators are trained to trip NCPs when they meet any other normal trip criteria (such as high vibration). This should be adequate for this event.

1 Pt One of the functions of the Containment Spray System (NS) is to remove fission product iodine from the containment atmosphere during a design basis LOCA.

Which one (1) of the following describes how and when this is accomplished?

A. During the Injection phase by providing a spray of cold and subcooled borated water from the FWST into the upper containment volume.

B. During the Injection phase by providing a spray of water with an alkaline pH from the containment sump into the upper containment volume.

C. During the Recirculation phase by providing a spray of cold and subcooled borated water from the FWST into the upper containment volume.

D. During the Recirculation phase by providing a spray of water with an alkaline pH from the containment sump into the upper containment volume.

Bank Question: 1062 ***Answer: D***

1 Pt One of the functions of the Containment Spray System (NS) is to remove fission product iodine from the containment atmosphere during a design basis LOCA.

Which one (1) of the following describes how and when this is accomplished?

A. **During the Injection phase by providing a spray of cold and subcooled borated water from the FWST into the upper containment volume.**

B. **During the Injection phase by providing a spray of water with an alkaline pH from the containment sump into the upper containment volume.**

C. **During the Recirculation phase by providing a spray of cold and subcooled borated water from the FWST into the upper containment volume.**

D. **During the Recirculation phase by providing a spray of water with an alkaline pH from the containment sump into the upper containment volume.**

Distracter Analysis:.

A. **Incorrect:**
Plausible:
B. **Incorrect:**
Plausible:
C. **Incorrect:**
Plausible:
D. **Correct**
Plausible:

LEVEL: RO

KA: 027 K1.01 (3.4/3.7)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CDC

LESSON: OP-MC-ECC-NS

OBJECTIVES: OP-MC-ECC-NS Obj 1

REFERENCES: OP-MC-ECC-NS page 11
MNS Technical Specifications Bases for T.S. 3.6.6
Containment Spray System

027 Containment Iodine Removal System (CIRS)

TASK: Operate the containment iodine removal units
Monitor the containment iodine removal units

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CIRS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
[redacted]			
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Fans	3.1*	3.4*
K3	**Knowledge of the effect that a loss or malfunction of the CIRS will have on the following:** (CFR: 41.7 / 45.6)		
	None		
K4	**Knowledge of CIRS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
	None		
K5	**Knowledge of the operational implications of the following concepts as they apply to the CIRS:** (CFR: 41.7 / 45.7)		
K5.01	Purpose of charcoal filters	3.1*	3.4*
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the CIRS:** (CFR: 41.7 / 45.7)		
	None		
	ABILITY		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CIRS controls including:** (CFR: 41.5 / 45.5)		
	None		

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.0	1.0	1.0	1.0

OBJECTIVES

W

	Objective	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Containment Spray (NS) System.	X	X	X	X	
2	Draw the NS System per *Drawing 7.1 Containment Spray System*, valve numbers and instrumentation not required.	X	X	X	X	
3	Describe the local indications and controls associated with the NS System.	X				
4	Describe the controls and indications associated with the NS System.		X	X	X	X
5	Describe the signals and permissives required to initiate the NS System.	X				
6	Describe the signals, setpoints, permissives, and logic required to initiate and reset NS System.		X	X	X	X
7	Describe the operation of the NS Pump room Air Handling Unit	X	X	X	X	X
8	Describe the NS System Operation (including automatic alignments).		X	X	X	X
9	Evaluate local plant parameters to determine any abnormal system conditions that may exist.	X				
10	Evaluate plant parameters and status indicators to determine any abnormal system conditions that may exist.		X	X	X	X
11	Given a limit and/or precaution associated with the NS System, discuss it's basis and applicability.	X	X	X	X	X
12	List the power supplies of the NS Pumps.	X	X	X	X	

B 3.6 CONTAINMENT SYSTEMS

B 3.6.6 Containment Spray System

BASES

BACKGROUND

The Containment Spray System provides containment atmosphere cooling to limit post accident pressure and temperature in containment to less than the design values. Reduction of containment pressure and the iodine removal capability of the spray reduce the release of fission product radioactivity from containment to the environment, in the event of a Design Basis Accident (DBA). The Containment Spray System is designed to meet the requirements of 10 CFR 50, Appendix A, GDC 38, "Containment Heat Removal," GDC 39, "Inspection of Containment Heat Removal Systems," GDC 40, "Testing of Containment Heat Removal Systems," GDC 41, "Containment Atmosphere Cleanup," GDC 42, "Inspection of Containment Atmosphere Cleanup Systems," and GDC 43, "Testing of Containment Atmosphere Cleanup Systems" (Ref. 1).

The Containment Spray System consists of two separate trains of equal capacity, each capable of meeting the system design basis spray coverage. Each train includes a containment spray pump, one containment spray heat exchanger, spray headers, nozzles, valves, and piping. Each train is powered from a separate Engineered Safety Feature (ESF) bus. The refueling water storage tank (RWST) supplies borated water to the Containment Spray System during the injection phase of operation. In the recirculation mode of operation, containment spray pump suction is transferred from the RWST to the containment recirculation sump(s).

The diversion of a portion of the recirculation flow from each train of the Residual Heat Removal (RHR) System to additional redundant spray headers completes the Containment Spray System heat removal capability. Each RHR train is capable of supplying spray coverage, if required, to supplement the Containment Spray System.

The Containment Spray System and RHR System provide a spray of cold or subcooled borated water into the upper containment volume to limit the containment pressure and temperature during a DBA. The RWST solution temperature is an important factor in determining the heat removal capability of the Containment Spray System during the injection phase. In the recirculation mode of operation, heat is removed from the containment sump water by the Containment Spray System and RHR heat exchangers. Each train of the Containment Spray System, supplemented by a train of RHR spray, provides adequate spray coverage to meet the system design requirements for containment heat removal.

BASES

BACKGROUND (continued)

For the hypothetical double-ended rupture of a Reactor Coolant System pipe, the pH of the sump solution (and, consequently, the spray solution) is raised to at least 8.0 within one hour of the onset of the LOCA. The resultant pH of the sump solution is based on the mixing of the RCS fluids, ECCS injection fluid, and the melted ice which are combined in the sump. The alkaline pH of the containment sump water minimizes the evolution of iodine and the occurrence of chloride and caustic stress corrosion on mechanical systems and components exposed to the fluid.

The Containment Spray System is actuated either automatically by a containment pressure high-high signal or manually. An automatic actuation opens the containment spray pump discharge valves, starts the two containment spray pumps, and begins the injection phase. A manual actuation of the Containment Spray System requires the operator to actuate two separate train related switches on the main control board to begin the same sequence of two train actuation. The injection phase continues until an RWST level Low-Low alarm is received. The Low-Low alarm for the RWST signals the operator to manually align the system to the recirculation mode. The Containment Spray System in the recirculation mode maintains an equilibrium temperature between the containment atmosphere and the recirculated sump water. Operation of the Containment Spray System in the recirculation mode is controlled by the operator in accordance with the emergency operation procedures.

The RHR spray operation is initiated manually, when required by the emergency operating procedures, after the Emergency Core Cooling System (ECCS) is operating in the recirculation mode. The RHR sprays are available to supplement the Containment Spray System, if required, in limiting containment pressure. This additional spray capacity would typically be used after the ice bed has been depleted and in the event that containment pressure rises above a predetermined limit. The Containment Spray System is an ESF system. It is designed to ensure that the heat removal capability required during the post accident period can be attained.

The operation of the Containment Spray System, together with the ice condenser, is adequate to assure pressure suppression subsequent to the initial blowdown of steam and water from a DBA. During the post blowdown period, the Air Return System (ARS) is automatically started. The ARS returns upper compartment air through the divider barrier to the lower compartment. This serves to equalize pressures in containment and to continue circulating heated air and steam through the ice condenser, where heat is removed by the remaining ice.

1.0 INTRODUCTION

1.1. Purpose

Objective #1

The Containment Spray System is an engineered safeguard feature which serves to remove thermal energy from the containment in the event of a Loss-Of-Coolant Accident (LOCA) or a Main Steam Line Break. It performs this function in conjunction with the Emergency Core Cooling System (ECCS), which subcools the reactor by direct injection. The heat removal capability of the spray system keeps the Containment pressure below design pressure of 15 psig after all the ice has melted (≈1 hour), while steam generation in the core continues to enter the Containment. The NS System also serves to remove fission product iodine from the post-accident Containment atmosphere.

1.2. General Description

The Containment Spray System (NS) consists of two spray pumps and two spray heat exchangers in parallel, with associated piping, valves and spray headers per unit. These spray headers are located in the upper Containment volume. The system is supplemented with two Residual Heat Removal System (ND) pumps and heat exchangers in parallel, with associated piping, valves and individual spray headers per unit. These spray headers are also located in the upper Containment volume.

One spray system is defined as one spray pump with spray heat exchanger and partial flow from one RHR pump with heat exchanger.

Adequate Containment cooling is provided by one spray system operating in the following sequential modes:

1. Spraying a portion of the contents of the Refueling Water Storage Tank into the Containment atmosphere using a Containment Spray Pump. The NS Pumps provide approximately 3400 gpm spray flow to the main spray headers.

2. Recirculation of water from the Containment sump by the Containment Spray Pump through the spray heat exchanger and back to the Containment after the Refueling Water Storage Tank has been drained but while there is still ice remaining in the Ice Condenser System. This spray is useful in reducing the temperature of the water that has been collected in the lower compartment of the Containment.

BACKGROUND (continued)

The ice, together with the containment spray, is adequate to absorb the initial blowdown of steam and water from a DBA and the additional heat loads that would enter containment during several hours following the initial blowdown. The additional heat loads would come from the residual heat in the reactor core, the hot piping and components, and the secondary system, including the steam generators. During the post blowdown period, the Air Return System (ARS) returns upper compartment air through the divider barrier to the lower compartment. This serves to equalize pressures in containment and to continue circulating heated air and steam from the lower compartment through the ice condenser where the heat is removed by the remaining ice.

As ice melts, the water passes through the ice condenser floor drains into the lower compartment. Thus, a second function of the ice bed is to be a large source of borated water (via the containment sump) for long term Emergency Core Cooling System (ECCS) and Containment Spray System heat removal functions in the recirculation mode.

A third function of the ice bed and melted ice is to remove fission product iodine that may be released from the core during a DBA. Iodine removal occurs during the ice melt phase of the accident and continues as the melted ice is sprayed into the containment atmosphere by the Containment Spray System. The ice is adjusted to an alkaline pH that facilitates removal of radioactive iodine from the containment atmosphere. The alkaline pH also minimizes the occurrence of the chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation.

It is important for the ice to be uniformly distributed around the 24 ice condenser bays and for open flow paths to exist around ice baskets. This is especially important during the initial blowdown so that the steam and water mixture entering the lower compartment do not pass through only part of the ice condenser, depleting the ice there while bypassing the ice in other bays.

Two phenomena that can degrade the ice bed during the long service period are:

a. Loss of ice by melting or sublimation; and

b. Obstruction of flow passages through the ice bed due to buildup of ice.

Both of these degrading phenomena are reduced by minimizing air leakage into and out of the ice condenser.

1 Pt Given the following conditions on Unit 1:

- RTP is 100%
- B train is in operation
- CF&E sump HI level alarm is lit.
- NCP's *Motor Bearing* LO KC flow annunciators are lit.
- "B" NC Pump Upper Motor Bearing temperature is 197 degrees.
- AP-21(*Loss of KC or KC System Leakage*) has been implemented and completed to step 36.

Which one (1) of the following describes the operator's response to "B" NCP Upper Motor Bearing HI temperature?

REFERENCE PROVIDED:

A. **Close 1NC-29 (*B Loop PZR Spray Control*), trip the reactor, stop "B" NC Pump and go to EP/1/A/5000/E-0**

B. **Trip the reactor, stop "B" NC Pump and go to EP/1/A/5000/E-0**

C. **Trip the reactor, trip all NC Pumps and go to EP/1/A/5000/E-0**

D. **Close 1NC-29, trip the reactor, trip all NC Pumps and go to EP/1/A/5000/E-0**

Bank Question: 1063 ***Answer: C***

1 Pt Given the following conditions on Unit 1:

- RTP is 100%
- B train is in operation
- CF&E sump HI level alarm is lit.
- NCP's Motor Bearing LO KC flow annunciators are lit.
- "B" NC Pump Upper Motor Bearing temperature is 197 degrees.
- AP-21(*Loss of KC or KC System Leakage*) has been implemented and completed to step 36.

Which one (1) of the following describes the operator's response to "B" NCP Upper Motor Bearing HI temperature?

REFERENCE PROVIDED:
AP/1/A/5500/21 Loss KC

A. Close 1NC-29 (*B Loop PZR Spray Control*), trip the reactor, stop "B" NC Pump and go to EP/1/A/5000/E-0

B. Trip the reactor, stop "B" NC Pump and go to EP/1/A/5000/E-0

C. Trip the reactor, trip all NC Pumps and go to EP/1/A/5000/E-0

D. Close 1NC-29, trip the reactor, trip all NC Pumps and go to EP/1/A/5000/E-0

Distracter Analysis:.

A. Incorrect:
Plausible:
B. Incorrect:
Plausible:
C. Correct:
Plausible:
D. Incorrect
Plausible:

LEVEL: RO

KA: 000026 G2.4.47 (3.4/3.7)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Analysis

AUTHOR: CWS

LESSON: OP-MC-AP-21

OBJECTIVES: OP-MC-AP-21 Obj 4

REFERENCES: OP-MC-AP-21 page 4

2.4 Emergency Procedures /Plan (Continued)

2.4.44 **Knowledge of emergency plan protective action recommendations.**
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.1 SRO 4.0

2.4.45 **Ability to prioritize and interpret the significance of each annunciator or alarm.**
(CFR: 43.5 / 45.3 / 45.12)
IMPORTANCE RO 3.3 SRO 3.6

2.4.46 **Ability to verify that the alarms are consistent with the plant conditions.**
(CFR: 43.5 / 45.3 / 45.12)
IMPORTANCE RO 3.5 SRO 3.6

2.4.47 **Ability to diagnose and recognize trends in an accurate and timely manner utilizing the appropriate control room reference material.**
(CFR: 41.10,43.5 / 45.12)
IMPORTANCE RO 3.4 SRO 3.7

2.4.48 **Ability to interpret control room indications to verify the status and operation of system, and understand how operator actions and directives affect plant and system conditions.**
(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.5 SRO 3.8

2.4.49 **Ability to perform without reference to procedures those actions that require immediate operation of system components and controls.**
(CFR: 41.10 / 43.2 / 45.6)
IMPORTANCE RO 4.0 SRO 4.0

2.4.50 **Ability to verify system alarm setpoints and operate controls identified in the alarm response manual.**
(CFR: 45.3)
IMPORTANCE RO 3.3 SRO 3.3

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		1.0	1.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for AP/21 (Loss of KC or KC System Leakage). AP21001			X	X	X
2	Analyze the mitigating strategy (major actions) contained in the procedure. AP21002			X	X	X
3	Given scenarios describing accident events and plant conditions, evaluate the basis for any caution, note, or step. AP21003			X	X	X
[illegible]	Given scenarios describing accident events and plant conditions, evaluate conditions which require application of continuous action steps. AP21004			X	X	X

STEP DESCRIPTION FOR AP

STEP 1:

PURPOSE:

Cue the operator to monitor the foldout page.

DISCUSSION:

The use of a foldout page is unusual for an AP. One was chosen for this AP as a human-factors' consideration. Maintaining critical items on a separate page ensures they are performed in a timely manner. The foldout page contains actions that apply throughout the AP as described in items below:

1) "KC header isolation criteria" ensures the non-essential headers are isolated from the KC pump and essential header prior to emptying the surge tank. If a leak occurs, the non-essential headers should be isolated prior to air binding the KC pumps. If the leak is on the operating train KC essential header, isolating the non-essential headers will prevent them from draining (so they can be restored in a timely manner using other train). If the leak is on one of the non-essential headers, this isolation protects the essential header. Adequate protection of equipment cooled by the non-essential headers is provided by isolating letdown and by foldout page items 2 and 5. Note efforts to makeup to the surge tank and isolate leaks will be initiated for smaller leaks prior to having to isolate entire headers. This foldout partially addresses some concerns raised by the NRC in OEDB 98-017559, Loss of inventory from KC. A major concern was not getting a leaking non-essential header isolated in time to prevent the inoperability of the safety-related headers.

2) "NC pump trip criteria". Isolation of the reactor bldg non-essential header or loss of KC pumps may lead to NC pump trip criteria due to loss of cooling to motor bearings. Since bearing temperatures will slowly increase, this step needs to be a continuous action and is placed on the foldout page. Westinghouse calculations predict at least ten minutes of loss of KC cooling prior to reaching NC pump trip criteria on the bearing temperatures (refer to PIP M-94-1376 for calculations and McGuire plant trip Feb/96 due to loss of KC to NC pumps, where it took 33.5 minutes to reach trip criteria).

3) "ND pump trip and flow isolation criteria" is included to stop ND pump and isolate ND flow to affected ND/KC Hx if KC cooling is lost and NC temperature is >150F. A loss of KC while on RHR can cause KC water to boil in the ND Hx. This could lead to water hammers and other problems when the KC pump is subsequently restored. The ND cross-tie valves are also closed, since ND flow across cross-tie could occur if both ND trains were in service. If ND letdown were in service, closing the ND cross-tie ensures letdown flow does not continue to heat-up the KC water.

1 Pt Given the following conditions on Unit 1:

- Medium size LOCA has occurred
- S/I termination criteria are satisfied
- One NV pump has been secured
- Both NI pumps have been secured
- Both ND pumps have been secured

Pressurizer level is 10% and decreasing. Which one of the following describes the correct operator actions?

REFERENCE PROVIDED:

A. **Restart S/I pumps and realign NV S/I flowpath as necessary to restore subcooling and level, GO TO EP/1A/5000/E-1 (*Loss of Reactor or Secondary Coolant*).**

B. **Go to EP/1/A/5000/ES 1.2 (*Post LOCA Cooldown and Depressurization*).**

C. **Go directly to EP/1/A/5000/E-1.**

D. **Reinitiate Safety Injection and GO TO EP/1/A/5000/E-0 (*Reactor Trip or Safety Injection*).**

Bank Question: 1064 ***Answer: A***

1 Pt Given the following conditions on Unit 1:

- Medium size LOCA has occurred
- S/I termination criteria are satisfied
- One NV pump has been secured
- Both NI pumps have been secured
- Both ND pumps have been secured

Pressurizer level is 10% and decreasing. Which one of the following describes the correct operator actions?

REFERENCE PROVIDED:
ES 1.1

A. Restart S/I pumps and realign NV S/I flowpath as necessary to restore subcooling and level, GO TO EP/1A/5000/E-1 (*Loss of Reactor or Secondary Coolant*).

B. Go to EP/1/A/5000/ES 1.2 (*Post LOCA Cooldown and Depressurization*).

C. Go directly to EP/1/A/5000/E-1.

D. Reinitiate Safety Injection and GO TO EP/1/A/5000/E-0 (*Reactor Trip or Safety Injection*).

Distracter Analysis:.

A. Correct:
Plausible:
B. Incorrect:
Plausible:
C. Incorrect:
Plausible:
D. Incorrect
Plausible:

LEVEL: RO

KA: W/E-2 EK2.2 (3.5/3.9)

SOURCE: NEW

LEVEL OF KNOWLEDGE: ANALYSIS

AUTHOR: CWS

LESSON: OP-MC- EP-E-1

OBJECTIVES: OP-MC-EP-E-1 Obj. 4

REFERENCES: OP-MC-EP-E-1 pages 65 & 67
EP/1/A/5000/ES-1.1

<u>Westinghouse</u>
E02 SI Termination

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (SI Termination)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.2 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (SI Termination).
IMPORTANCE RO 3.4 SRO 3.9

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (SI Termination).
IMPORTANCE RO 3.5 SRO 3.8

EK2. Knowledge of the interrelations between the (SI Termination) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.4 SRO 3.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 3.9

EK3. Knowledge of the reasons for the following responses as they apply to the (SI Termination)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.3 SRO 3.6

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	5.0	5.0	4.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the E-1 series. EPE1001			X	X	
2	Discuss the entry and exit guidance for each procedure in the E-1 series. EPE1002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the E-1 series. EPE1003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the E-1 series. EPE1004			X	X	X
5	Given the Foldout page discuss the actions included and the basis for these actions. EPE1005			X	X	X
6	Given the appropriate procedure, evaluate a given scenario describing accident events and plant conditions to determine any required action and its basis. EPE1006			X	X	X
7	Discuss the time critical task(s) associated with the E-1 series procedures including the time requirements and the basis for these requirements. EPE1007			X	X	X

4.3. Major Actions

The recovery/restoration technique of ES-1.1 includes the following four major action categories:

1. Sequentially reduce S/I flow
2. Verify S/I flow not required
3. Realign the plant to Pre-S/I configuration
4. Maintain the plant in a stable condition

The following subsections provide a more detailed discussion of each major action category.

4.3.1 Sequentially Reduce S/I Flow

Since the appropriate criteria for reducing S/I flow should have been satisfied prior to entry into ES-1.1, the operator will reset the S/I and containment isolation signals to allow manual operation of the safeguards components. All NV pumps but one are stopped and NC pressure is checked.

If NC pressure starts going down after the pumps are stopped, then leak flow or NC shrink is greater than N/I flow and a transition to ES-1.2, Post LOCA Cooldown and Depressurization, for cooling down the plant under different S/I flow reduction criteria. NC pressure stable or going up indicates that flow is still adequate and the NV pump is aligned to the normal charging lineup.

If pressurizer level cannot be maintained, then the NV pump is realigned for NC cold leg injection and the operator transfers to ES-1.2, Post LOCA Cooldown and Depressurization, for cooling down ~~the plant under different S/I~~ flow reduction criteria.

If charging flow can maintain pressurizer level, then the operator checks NC pressure to determine if the NI pumps can be stopped. If NC pressure is stable or going up and greater than the shutoff head of the NI pumps, these pumps are stopped since they are not needed and are not delivering flow to the NC.

If the NI pumps are delivering flow, but a faulted S/G is still blowing down, the operator is instructed to wait until the faulted S/G drys out. If there are no faulted S/Gs or the criteria for stopping the NI pumps cannot be satisfied after the faulted S/G drys out, the operator is transferred to ES-1.2 for further action.

Note that it may take several minutes after S/G dryout to determine if NI pump may be stopped (allow time for NC pressure to go above 1600 psig if going up).

If the NI pumps can be stopped, then the operator will also stop the ND pumps and continue in ES-1.1 to realign and control the plant.

See ES-1.1 10 step

4.3.2 Verify S/I Flow Not Required

After the S/I pumps are stopped, the operator is instructed to check NC subcooling and Pzr level to verify that S/I flow is no longer required. If NC subcooling is less than the required criteria, S/I pumps are to be operated manually and a transition to E-1 is necessary. If Pzr level is less than that required, charging flow is to be controlled first to maintain level. However, if Pzr level cannot be maintained with charging, the operator is instructed to operate S/I pumps manually and transfer to E-1.

4.3.3 Realign the Plant to Pre-S/I Configuration

When the operator verifies that S/I flow is not required, the plant is realigned into a pre-S/I configuration, and pressurizer level, pressure, and NC temperature are stabilized.

4.3.4 Maintain the Plant in a Stable Condition

The plant is maintained in a stable state while the operator reverifies that S/I flow is not required. Finally, a determination must be made as to which normal plant procedure should be used (Unit Fast Recovery or Controlling Procedure for Unit Shutdown).

1 Pt. The SRO instructs the Unit 1 RO to adjust NC Pump seal leak off flow by cooling the VCT. The potentiometer on 1KC-132 (*Letdown Heat Exchanger Outlet Temperature Control*) was adjusted to lower VCT temperature 6 degrees.

Which one of the follow is the correct plant response to this adjustment?

A. **VCT temperature decreases**
KC pump flow decreases
KC pump discharge pressure increases
NC temperature increase
Main Steam pressure increases.

B. **VCT temperature decreases**
KC Pump flow increases
KC Pump discharge pressure decreases
NC temperature decrease
Main Steam pressure decreases

C. **VCT temperature decreases**
KC Pump flow increases
KC Pump discharge pressure decreases
NC temperature increase
Main Steam pressure increases

D. **VCT temperature decreases**
KC Pump flow decreases
KC Pump discharge pressure increases
NC temperature decreases
Main Steam pressure decreases

Bank Question: 1066 ***Answer: C***

1 Pt. The SRO instructs the Unit 1 RO to adjust NC Pump seal leak off flow by cooling the VCT. The potentiometer on 1KC-132 (*Letdown Heat Exchanger Outlet Temperature Control*) was adjusted to lower VCT temperature 6 degrees.

Which one of the follow is the correct plant response to this adjustment?

A. **VCT temperature decreases**
KC pump flow decreases
KC pump discharge pressure increases
NC temperature increase
Main Steam pressure increases.

B. **VCT temperature decreases**
KC Pump flow increases
KC Pump discharge pressure decreases
NC temperature decrease
Main Steam pressure decreases

C. **VCT temperature decreases**
KC Pump flow increases
KC Pump discharge pressure decreases
NC temperature increase
Main Steam pressure increases

D. **VCT temperature decreases**
KC Pump flow decreases
KC Pump discharge pressure increases
NC temperature decreases
Main Steam pressure decreases

Distracter Analysis:.

A. **Incorrect:**
Plausible:
B. **Incorrect:**
Plausible:
C. **Correct:**
Plausible:
D. **Incorrect**
Plausible:

LEVEL: RO

KA: SYS 008 A4.06 (2.5*/2.5)

SOURCE: NEW

LEVEL OF KNOWLEDGE: ANALYSIS

AUTHOR: CWS

LESSON: -

OBJECTIVES:

REFERENCES: OP/1A/6200/001 B page 1 & 2

SYSTEM: 008 Component Cooling Water System (CCWS)

A3	**Ability to monitor automatic operation of the CCWS, including:** (CFR: 41.7 / 45.5)		
A3.01	Setpoints on instrument signal levels for normal opera-tions, warnings, and trips that are applicable to the CCWS	3.2*	3.0
A3.02	Operation of the CCW pumps, including interlocks and the CCW booster pump	3.2	3.2
A3.03	All flow rate indications and the ability to evaluate the performance of this closed-cycle cooling system.	3.0	3.1
A3.04	Requirements on and for the CCWS for different condi-tions of the power plant	2.9	3.2
A3.05	Control of the electrically operated, automatic isolation valves in the CCWS	3.0	3.1
A3.06	Typical CCW pump operating conditions, including vibra-tion and sound levels and motor current	2.5	2.5
A3.07	Effects of recirculation within the CCWS	2.3*	2.2*
A3.08	Automatic actions associated with the CCWS that occur as a result of a safety injection signal	3.6*	3.7*
A3.09	Normal CRDM temperatures	2.4*	2.3
A3.10	CCW pump instruments and their respective sensors, including flow, pressure, oil level, and discharge temperature	2.9*	3.0
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5)		
A4.01	CCW indications and controls	3.3	3.1
A4.02	Filling and draining operations of the CCWS including the proper venting of the components	2.5*	2.5
A4.03	Throttling of the CCW pump discharge valve	2.7*	2.5*
A4.04	Startup of a CCW pump when the system is shut down.	2.6*	2.6
A4.05	Normal CCW-header total flow rate and the flow rates to the components cooled by the CCWS	2.7*	2.5*
A4.06	Remote operation of hand-operated throttle valves to regulate CCW flow rate	2.5*	[illegible]
A4.07	Control of minimum level in the CCWS surge tank	2.9*	2.9
A4.08	CCW pump control switch	3.1*	2.8
A4.09	CCW temperature control valve	3.0*	2.9*
A4.10	Conditions that require the operation of two CCW coolers	3.1*	3.1
A4.11	CCW pump recirculation valve and its three-way control switch	3.0*	2.9*

1. Limits and Precautions

1.1 Maximum NC Pump Seal Leakoff flow is 6 gpm.

2. Initial Conditions

None

3. Procedure

☐ 3.1 Evaluate all outstanding R&Rs that may impact performance of this procedure.

_____ 3.2 Determine method to maintain NC Pump Seal Leakoff flow: ____________________
ENG

_____ 3.3 **IF** desired to reduce Seal Leakoff flow by increasing NCDT cover gas pressure, go to OP/1/A/6500/001 (Liquid Waste System).

NOTE:	• Swapping Seal Injection Filters may alter Seal Leakoff flow by cleansing seal faces from a combination of cooler water, higher boron concentrated water and higher oxygen concentrated water. • Swapping Seal Injection Filters will either improve Seal Leakoff flow or no change will occur.

_____ 3.4 **IF** desired to alter Seal Leakoff flow by swapping Seal Water Injection Filters, swap per OP/1/A/6200/001 C (Chemical and Volume Control System Filters).

NOTE:	• Direct acting seal will exhibit a decrease leakoff flow with temperature decrease of seal injection water. • Reverse acting seal will exhibit an increase leakoff flow with temperature decrease of seal injection water.

3.5 Perform the following sections, as applicable:

- ☐ Section 3.6, Adjusting Seal Leakoff Flow by Cooling VCT
- ☐ Section 3.7, Adjusting Seal Leakoff Flow by Diverting Letdown with Makeup to VCT
- ☐ Section 3.8, Adjusting Seal Leakoff Flow by Adjusting KC Flow to Thermal Barriers
- ☐ Section 3.9, Adjusting Seal Leakoff Flow by Heating VCT
- ☐ Section 3.10, Increasing Seal Leakoff Flow by Decreasing NCDT Pressure

Unit 1

3.6 Adjusting Seal Leakoff Flow by Cooling VCT

NOTE:
- Cooling VCT (Letdown) increases boron affinity of NV Demineralizers resulting in a positive reactivity addition.
- Cooling VCT (Letdown) normally results in a long term seal leakoff flow decrease.

_____ 3.6.1 **IF** desired to cool VCT via KC Heat Exchanger High Velocity Flush, cool per OP/1/A/6400/006 (Nuclear Service Water System).

_____ 3.6.2 **IF** desired to cool VCT via Letdown HX, perform the following:

☐ 3.6.2.1 Record 1KC-132 (L/D HX Outlet Temp Control) potentiometer "As Found" setpoint: ____________

3.6.2.2 Maintain the following:

☐ VCT cooldown rate of less than 1°F per minute
☐ VCT temperature decrease of 4 - 10°F

_____ 3.6.2.3 Slowly adjust pot for 1KC-132 (L/D HX Outlet Temp Control) in the counter clockwise direction.

_____ 3.6.2.4 **WHEN** VCT temperature decreases 4 - 10°F, stabilize temperature by adjusting pot for 1KC-132 (L/D HX Outlet Temp Control).

☐ 3.6.3 Monitor the following for possible reactivity excursions due to dilution:

- SM pressure
- Reactor Power
- Tavg
- Rod motion

NOTE: 1 - 2 hours following a VCT temperature change, seal leakoff may go up, followed by a downward trend.

☐ 3.6.4 Monitor NC Pump Seal Leakoff flows.

_____ 3.6.5 **IF** desired to return 1KC-132 (L/D HX Outlet Temp Control) potentiometer to "As Found" position, perform Section 3.9, Adjusting Seal Leakoff Flow by Heating VCT.

Unit 1

1 Pt. Given the following conditions on Unit 1:

- ORANGE Path on Core Cooling
- RED Path on Heat Sink

Which one of the following describes why Red path on Heat Sink is addressed prior to the *Orange Path on Core Cooling*?

A. **A Red *path indicates* the CSF is under severe challenge and prompt operator action is required**

B. **A Red *path indicates* the CSF is not satisfied and operator action may be taken.**

C. ***Heat Sink has a higher* priority than Core Cooling due to position on status trees.**

D. **A Red *path indicates* the CSF is under extreme challenge and immediate operator action is required.**

Bank Question: 1068 ***Answer: D***

1 Pt. Given the following conditions on Unit 1:

- ORANGE Path on Core Cooling
- RED Path on Heat Sink

Which one of the following describes why Red path on Heat Sink is addressed prior to the Orange Path on Core Cooling?

A. A Red path indicates the CSF is under severe challenge and prompt operator action is required

B. A Red path indicates the CSF is not satisfied and operator action may be taken.

C. Heat Sink has a higher priority than Core Cooling due to position on status trees.

D. A Red path indicates the CSF is under extreme challenge and immediate operator action is required.

Distracter Analysis:.

A. Incorrect:
Plausible:
B. Incorrect:
Plausible:
C. Incorrect:
Plausible:
D. Correct Answer
Plausible:

LEVEL: RO

KA: G2.4.22 (3.0/4/0)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC- EP-INTRO

OBJECTIVES: OP-MC-EP-E-1 Objs. 1 & 3

REFERENCES: OP-MC-EP-INTRO pages 21,27,29

2.4 **Emergency Procedures /Plan (Continued)**

2.4.18 **Knowledge of the specific bases for EOPs.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.7 SRO 3.6

2.4.19 **Knowledge of EOP layout, symbols, and icons.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.7 SRO 3.7

2.4.20 **Knowledge of operational implications of EOP warnings, cautions, and notes.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.3 SRO 4.0

2.4.21 **Knowledge of the parameters and logic used to assess the status of safety functions including:**
1. Reactivity control
2. Core cooling and heat removal
3. Reactor coolant system integrity
4. Containment conditions
5. Radioactivity release control.

(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.7 SRO 4.3

2.4.22 **Knowledge of the bases for prioritizing safety functions during abnormal/emergency operations.**
(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.0 SRO 4.0

2.4.23 **Knowledge of the bases for prioritizing emergency procedure implementation during emergency operations.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.8 SRO 3.8

2.4.24 **Knowledge of loss of cooling water procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.3 SRO 3.7

2.4.25 **Knowledge of fire protection procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.9 SRO 3.4

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	3.0	3.0	3.0

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	List the six Critical Safety Functions in order of importance. EPINTRO001			X	X	
2	List the two EP's which provide the entry points into the EP set. EPINTRO002			X	X	
3	Explain when and how the CSF Status Trees are evaluated. EPINTRO003			X	X	
4	Apply the EP Rules of Usage to determine required actions for a step in an EP that is not satisfied when no contingency action (no RNO column) is provided. EPINTRO004			X	X	X
5	Apply the EP Rules of Usage to determine required actions while performing an EP contingency action when the action cannot be performed or is not successful. EPINTRO005			X	X	X
6	State when Foldout Page actions or transitions are applicable. EPINTRO006			X	X	
7	Describe how to determine if sequence is important when performing subtasks within a step of an EP. EPINTRO007			X	X	
8	Discuss the purpose and applicability of Notes and Cautions. EPINTRO008			X	X	
9	Define the "Constrained Language" terms listed in OMP 4-3, Use of Abnormal and Emergency Procedures. EPINTRO009			X	X	X

1.3. Critical Safety Functions

The concept of *Critical Safety Functions* (CSF's) came about after the TMI accident, and has been implemented in the WOG ERG's. The CSF's define parameters that if maintained within specific limits will assure that radioactive materials will not be released from the plant.

| Objective # 1 |

The six CSF's, in the order of their priority are:

1. **Achievement of Subcriticality (S)**
2. **Maintenance of Core Cooling (C)**
3. **Maintenance of the Heat Sink (H)**
4. **Maintenance of the Reactor Coolant System Integrity (P)**
5. **Protection of the Containment Boundary Integrity (Z)**
6. **Maintenance of the Reactor Coolant System Inventory (I)**

The ERG's address these concerns first, and only after challenges to the CSF's are handled is it appropriate to turn the attention of the operating crew to the event cause.

The CSF's address the secureness of the four boundaries that protect the general public from exposure to radioactive materials that could be released during an accident. These boundaries are the

- Fuel matrix/cladding,
- NC system pressure boundary,
- Containment barriers, and
- Site boundary.

The ERG's implemented as the Emergency Procedures (EP's), address only the first three of these. The Site Emergency Plan addresses the fourth.

2.3.3. Function Restoration Procedures

Objective # 3

Challenges to the Critical Safety Functions (CSF's) are addressed by the Function Restoration Procedures. Each CSF is monitored by *Status Tree* in order of priority. Monitoring of Status Trees begins either when directed by E-0, or upon any transition from E-0.

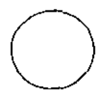
The six Status Trees, one for each CSF, are found in procedure F-0.

1. F-0.1, SUBCRITICALITY (Procedure series "S")
2. F-0.2, CORE COOLING (Procedure series "C")
3. F-0.3, HEAT SINK (Procedure series "H")
4. F-0.4, INTEGRITY (Procedure series "P")
5. F-0.5, CONTAINMENT (Procedure series "Z")
6. F-0.6, INVENTORY (Procedure series "I")

Objective # 3

Each Status Tree includes four color-coded challenges to the CSF being monitored. The color coding represents the severity of the challenge, and thus the priority of the required response. The table lists the colors in their order of priority, defines the challenge, and shows the symbols that are used in the CSF Status Trees.

Color prioritization is important. A red path is addressed before any orange path. Any orange path is addressed before any yellow path. If more than one Status Tree indicates the same color, then priority is addressed by the monitoring order of S - C - H - P - Z - I.

STATUS TREE PRIORITY IDENTIFICATION			
Color	**Severity of Challenge**	**Line Code**	**Symbol**
Red	The CSF is under extreme challenge. Immediate operator action is required.		
Orange	The CSF is under severe challenge. Prompt operator action is required.	v v v v v v	
Yellow	The CSF condition is off-normal or not satisfied. Operator action may be taken.	λλλλλλλ	
Green	The CSF is NOT challenged. No operator action is needed.		

There is only one entry point to each Status Tree in F-0. However, there are multiple exit points, but only one exit point is possible. The path depends on the plant parameters which are symptomatic of the particular CSF. The exit is always to one of the several procedures associated with the specific CSF Status Tree, or, if the path is green, to remain in the E series procedure being executed. If the exit is to an FR procedure, then the E series procedure is suspended. The FRP's are designed to restore the condition of the CSF and not the plant. When the FRP is exited, the operator is directed back to the appropriate ORP to continue plant recovery.

1 Pt. Unit 1 is in the process of cooling down to Mode 5 to enter refueling outage.

- Steam dumps in Steam Pressure Mode with Steam Dump Controller in Manual
- 15 minutes after cooldown has begun from 557 degrees steam dumps close.

Which one of the following describes the correct reason the steam dumps closed?

A. Potentiometer set too high on Steam Dump Controller.

B. Cooled down to P-12.

C. C-7A not reset.

D. Tave and Tref deviation is less than 3 degrees.

2

Bank Question: 1069 ***Answer: B***

1 Pt. Unit 1 is in the process of cooling down to Mode 5 to enter refueling outage.

- Steam dumps in Steam Pressure Mode with Steam Dump Controller in Manual
- 15 minutes after cooldown has begun from 557 degrees steam dumps close.

Which one of the following describes the correct reason the steam dumps closed?

A. Potentiometer set too high on Steam Dump Controller.

B. Cooled down to P-12.

C. C-7A not reset.

D. Tave and Tref deviation is less than 3 degrees.

Distracter Analysis:.

A. **Incorrect**: POT has no effect in manual steam dump control
Plausible:
B. **Correct**:
Plausible:
C. **Incorrect**: No effect
Plausible: condition required to arm steam dumps when in Tave mode
D. **Incorrect** No effect
Plausible: On a load rejection must have greater than 3 degrees for banks to start modulating

LEVEL: RO

KA: G 2.2.2 (3.5/3.9)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC-STM-IDE

OBJECTIVES: OP-MC- STM-IDE Obj. 10

REFERENCES: OP-MC-STM-IDE pages 35-49 odd only

2.2 Equipment Control

2.2.1 **Ability to perform pre-startup procedures for the facility, including *operating those controls* associated with plant equipment that could affect reactivity.**
(CFR: 45.1)
IMPORTANCE RO 3.7 SRO 3.6

2.2.2 **Ability to manipulate the console controls as required to operate the facility between shutdown and designated power levels.**
(CFR: 45.2)
IMPORTANCE RO 4.0 SRO 3.5

2.2.3 (multi-unit) **Knowledge of the design, procedural, and operational differences between units.**
(CFR: 41 / 43 / 45)
IMPORTANCE RO 3.1 SRO 3.3

2.2.4 (multi-unit) **Ability to explain the variations in control board layouts, systems, instrumentation and procedural actions between units at a facility.**
(CFR: 45.1 / 45.13)
IMPORTANCE RO 2.8 SRO 3.0*

2.2.5 **Knowledge of the process for making changes in the facility as described in the safety analysis report.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 1.6 SRO 2.7

2.2.6 **Knowledge of the process for making changes in procedures as described in the safety analysis report.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 2.3 SRO 3.3

2.2.7 **Knowledge of the process for conducting tests or experiments not described in the safety analysis report.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 2.0 SRO 3.2

2.2.8 **Knowledge of the process for determining if the proposed change, test, or experiment involves an unreviewed safety question.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 1.8 SRO 3.3

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
NA	2	3	3	2

OBJECTIVES

No.	Objective	NLO	NLOR	LPRO	LPSO	LOR
1.	State the purpose of the Steam Dump Control System		X	X	X	
2.	List the banks of steam dumps and the number of valves in each bank.		X	X	X	
3.	Sketch the valve arrangement per Drawing 7.3, Steam Dump Valve Pneumatic Control.		X	X	X	
4.	Describe the effect of a failed or stuck open steam dump valve on primary plant parameters, and determine any compensatory Operator action			X	X	X
5.	Explain the operation of the system in steam pressure, plant trip and load rejection mode. Include the fast response "trip open bistables". Include the input signals for each control.		X	X	X	X
6.	Describe all control and permissive interlocks (C9, C7A, C7B, P4, P12) required for various modes of operation.		X	X	X	X
7.	DELETE					
8.	Describe all selector switches and their functions for various modes of operation		X	X	X	X
9.	Describe the effect on the system resulting from a failure of each input to the system.		X	X	X	X
10.	Explain what occurs in the IDE System during start-up, power operation, shutdown and cooldown of the plant. Include all manual functions required to be performed by the operator during these modes.			X	X	X
11.	Relate % steam dump demand indication to corresponding steam dump valve operation			X	X	X

2.5.4. Arming the steam dumps in the plant trip mode.

Following a reactor trip Auctioneered Hi T_{avg} will be greater than $T_{no\text{-}load}$ and a steam dump demand signal proportional to the error will be generated. The electrical demand signal will be converted to a control air signal in the E/P converter which will drive the valve positioner. The resultant air supply will reach the valve actuator provided the valve is 'armed' (arming solenoid valve energized).

Only the two condenser dump banks are armed in the plant trip mode. To do this, the condenser available interlock (C-9) has to be satisfied, and Train 'A' P-4 reactor trip signal needs to be present. Any time a Train 'A' P-4 signal is present, the atmospheric steam dump valves will **NOT** be armed (Unit 2).

2.5.5 Valve trip bistables.

The trip bistables are used to provide a separate dump valve trip open signal by energizing the trip solenoid valves for its associated bank when the (T_{avg}-$T_{No\ Load}$) signal reaches the value where the bank should be fully open. This provides faster response on rapidly increasing demand signals. The setpoints are:

Bank	T_{AVG} - T_{NoLoad}
1	16°
2	29°

Only Banks 1&2 are required since the plant trip controller only operates the two banks of condenser dumps, unlike the load rejection controller that potentially operates all four banks (Unit 2). Any of the bank trip signals are indicated by the single status panel window, 'ATMOS/COND STM DUMP TRIP OPEN' (Unit 2). COND STM DUMP TRIP OPEN (Unit 1).

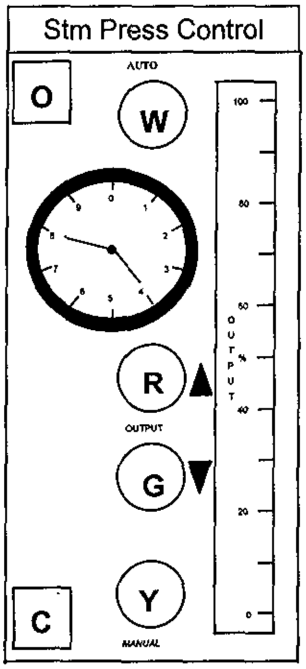
2.6. Steam Header Pressure Controller

2.6.1. The Steam Header Pressure Mode is used to control reactor coolant temperature when the unit is below 15% power, during plant startup and shutdown and to cooldown the reactor coolant system to cold shutdown..

The condenser dump valves, Banks 1&2, are modulated in response to the steam dump demand output from the steam pressure controller. The steam dump demand is a function of Pressure Error between Steam Header Pressure and an operator determined setpoint or manual operator input. The atmospheric dump valves are not required and are therefore blocked by their arming solenoid valves being deenergized.

Objective #8

2.6.2. The Steam Pressure controller is in effect when the STEAM DUMP SELECT switch is in the STM PRESS position. When the Steam Pressure mode is selected the Steam Press Control Manual /Auto station on the control board becomes the operator interface with the steam pressure controller.



Objective #5

2.6.3. The controller output is displayed on the M/A Output Meter and will be the Steam Dump Demand when in the Seam Pressure Mode.

With the M/A station in manual, controller output is adjusted by manipulating the output push-buttons ... Red will increase output which will open the dumps while the green button will reduce the output and close the dumps.

In Auto, the controller output is proportional to the difference between Steam Header Pressure and the Pressure Setpoint determined by the M/A station pot setting. The pot setting is determined by dividing the desired pressure setpoint by 1300 psig (range of the steam header pressure transmitter) and multiplying the result by 10 (the ten turns of the pot), (8.4 = 1092 psig)

Pressure transmitter SMPT5200 provides the main steam header pressure signal to the controller as well as to the Feedwater Pump Speed Control. The pressure is indicated in the control room: MAIN STEAM HEADER PRESSURE.

Figure 9 depicts the relation between the Setpoint Error and Steam Pressure Controller Output (Steam Dump Demand)

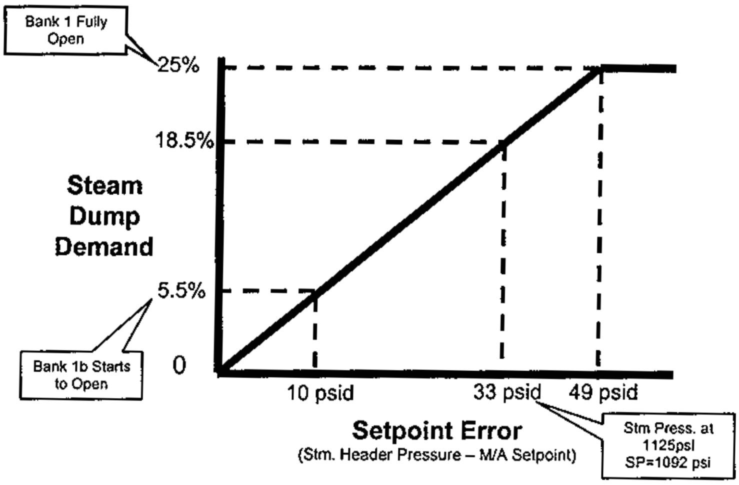


Figure 9
Steam Header Pressure Controller Demand Generation 3/19/02

2.6.4. Steam dump response to Steam Dump Demand

In the Steam Pressure mode the condenser dumps, Banks 1&2, will modulate open in sequence in response to increasing steam dump demand. As discussed previously in section 2.3.3 Bank 1 valves are split into 2 groups which are sequenced such that the 2 valves in Bank 1a begin opening first followed by the remaining three Valves in Bank 1b. The result is smother response at low values of steam dump demand.

Figure 10 shows bank response to steam dump demand.

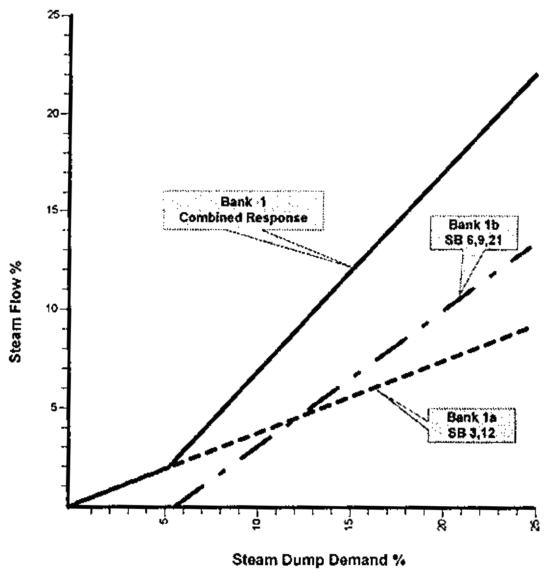


Figure 10

2.6.5 Arming the steam dumps in the steam header pressure mode of control.

Only the two banks of condenser dump valves are armed for the steam header pressure mode. To do this, the condenser available interlock (C-9) has to be satisfied, and the STEAM DUMP SELECT switch selected to the STM PRESS position. The control board status light COND STM DUMP MODULATION (Unit 1) ATMOS/COND STM DUMP MODULATION (Unit 2), will come on when the steam dump valves are armed.

NOTE: Cooldown below 553 °F is available using the steam pressure control, but P-12 must be bypassed.

Objective #6,8

2.6.6 Lo-Lo T-AVG P-12 Interlock

The following (refer to Figure 11) interlock circuit is redundant (CH-A and CH-B).

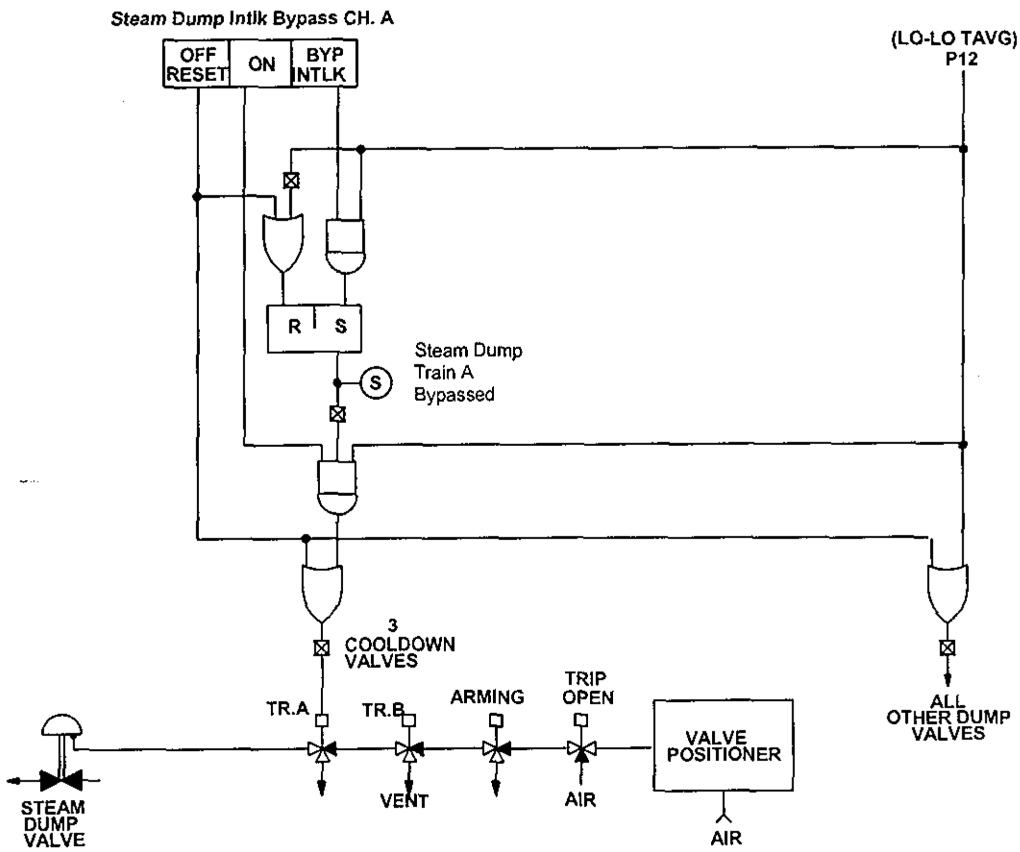


Figure 11, P-12 Interlock Circuitry, (5/15/00)

If a Low-Low T_{avg} signal (P-12 = 2/4 channels less than 553 °F) is received from the SSPS, steam dump is blocked to prevent excessive cooldown. The P-12 solenoids deenergize. If the steam dump channel switch on either train is turned OFF, the train related P-12 solenoids deenergize to block control air and vent air off all the valve actuators.

In normal operation, switches (both trains) will be ON and P-12 will not be present. In this case, the solenoids will be energized and the E/P signal will be permitted to all steam dump valve positioners and on to the valve actuators.

By turning both switches to the BYP INTLK (momentary) position after P-12 energizes, the latching relays will be energized and steam dump will be permitted to the three cooldown condenser dump valves. The status lights STM DUMP INTERLOCK TRAIN A(B) BYPASSED will come on.

> NOTE: The three condenser cooldown valves are the only steam dump valves with this feature.

If P-12 de-energizes, (T_{avg} > 553 °F), the bypass will be reset automatically (steam dump will now be permitted to all dump valves armed). To reset the interlock bypass, turn each steam dump channel switch to OFF momentarily.

3.0 SYSTEM OPERATION

Objective #10

3.1. Normal Operation

3.1.1. Limits and Precautions

When adjusting the "Stm Press Controller" potentiometer, consider the following:

- Changes affect Tcold which affect Pzr. Level and S/G shrink and swell
- Steam Dump Controls are more sensitive at low power and effects of adjustments are delayed.
- Changes in Main Steam headed pressure will result in a change in Tcold.

NOTE: Refer to Shutdown Procedure OP/A/6100/SD-2 and OP/A/6100/003.

3.1.3. Shutdown

Unit shutdown is accomplished by reducing reactor power by cutting turbine load until reactor power is approximately 15%. Up to this point the steam dumps system is in the Tave Mode and inactive, unless the load reduction activated the C7-A interlock, and Tavg is maintained within 1^{O}F of Tref. At this point the reactor is shutdown by either tripping it from 15% power of continuing the load reduction, taking the turbine off line and driving control rod in to shut down the reactor.

In either case the steam dumps will be transferred to the steam pressure mode so they can be used to control reactor coolant temperature.

In the case where the reactor is tripped from 15% power, the steam dumps remain in the Tave mode until the Reactor Trip Response procedure (EP/ES-0.1) or the Controlling Procedure for Unit Operation directs they be transferred to the Pressure Mode.

When the reactor is tripped, the Plant trip controller will provide the steam dump demand to modulate the condenser dumps open to reduce T_{avg} to $T_{no\ load}$. Depending on the decay heat load following the trip, the dumps will remain open due to the tendency of the plant to heat up. The dumps will be open (steam dump demand >0%) as necessary to remove decay heat.

After verifying stable plant conditions the procedures will direct transferring the dumps to the Steam Pressure mode. This is done by verifying the Setpoint pot set to 1092 psi. (8.4), placing the Steam Pressure Controller (M/A Station) in manual and adjusting the output to match the Steam Dump Demand on the Control Board meter. This provides a relatively bumpless transfer. The Steam Dump Select Switch is then selected to Stm. Press and the M/A station is placed in Auto. If the steam dump demand is < 5% only 2 of the 5 Bank 1 valves will be modulated. Prior to the transfer all 5 valves will have been open.

Since the steam pressure controller is a proportional controller, the steam pressure will stabilize above the setpoint pressure based on the heat input to the system. Referring to Fig. 9 & 10 reveals that for the dumps to be dissipating 1% power (decay heat) will require a 2% steam dump demand which will result from a 3 to 5 psid steam pressure error.

If the reactor is not to be tripped, the turbine load is reduced and at approximately 10 to 12% power, prior to taking the Generator off-line:

Verify Steam Press Controller set for 1092 psig (approximately 8.4 pot setting) and place in "AUTO". Verify T_{avg} is within ± 2 °F of T_{ref}. Transfer Steam Dump Select from "T-AVG" to "STM PRESS" mode. Verify proper operation after transfer to "STM PRESS" mode.

If the unit is to be maintained in hot standby condition, the venting of the steam will be reduced toward zero as the decay heat load is reduced.

If the unit is to be brought to cold shutdown, steam dump is continued to the condenser. Place the "Stm Press Controller" in "MAN" and adjust the output for desired cooldown rate **OR** verify the "Stm Press Controller" in "AUTO" and adjust potentiometer for desired cooldown rate.

When cooldown reaches the P-12 Low-Low T_{avg} point (553 F), turn both STEAM DUMP INTLK BYP CH switches to the BYP INTLK position (momentary).

NOTE: It is not necessary to operate both STEAM DUMP INTLK BYP CH switches simultaneously.

Steam dump will be permitted to the three cooldown condenser dump valves providing the condenser is available. The bypass is reset by turning both STEAM DUMP INTLK BYP CH switches momentarily to OFF. The bypass will be reset automatically if T_{avg} rises above P-12.

1 Pt. *Given the following conditions on Unit 1:*

- *RN system is in normal alignment*
- RN pump 'B' is running
- *RV pumps are in normal alignment*
- Unit 1 experiences a Safety Injection

Which one of the following describes the cooling water supply provided to lower containment ventilation loads?

A. 'A' RN pump

B. 'B' RN pump

C. RV pump in AUTO that starts on low non-essential header pressure.

D. RV pump in AUTO that starts on safety injection signal.

Bank Question: 1070 ***Answer: C***

1 Pt. Given the following conditions on Unit 1:

- RN system is in normal alignment
- RN pump 'B' is running
- RV pumps are in normal alignment
- Unit 1 experiences a Safety Injection

Which one of the following describes the cooling water supply provided to lower containment ventilation loads?

A. 'A' RN pump

B. 'B' RN pump

C. RV pump in AUTO that starts on low non-essential header pressure.

D. RV pump in AUTO that starts on safety injection signal.

Distracter Analysis:. 1RN-42A closed on S/I. Lose RN flow to non essential headers. RV pump in AUTO will start on low non essential header pressure. Operator needs to know S/I alignment for RN and when RV pumps start to answer question.

A. Incorrect:
Plausible:
B. Incorrect:
Plausible:
C. Correct:
Plausible:
D. Incorrect
Plausible:

LEVEL: RO

KA: SYS 076 A1.02 (2.6*/2/6*)

SOURCE: NEW

LEVEL OF KNOWLEDGE: Memory

AUTHOR: CWS

LESSON: OP-MC- CNT-RV

OBJECTIVES: OP-MC-CNT-RV Obj. 10

REFERENCES: OP-MC-CNT-RV pages 13 & 25
OP/0/A/6400/009 Enclosure 4.1
OP-MC-PSS-RN page 75

SYSTEM:	**076 Service Water System (SWS)**		
K5	**Knowledge of the operational implications of the following concepts *as the apply to the SWS:*** (CFR: 41.7 / 45.5)		
K6	**Knowledge of the effects of a loss or malfunction of the following will have on the SWS components:** (CFR: 41.7 / 45.7)		
K6.01	Valves	1.9	2.0
K6.02	Sensors and detectors	1.7	1.9
K6.03	Controllers and positioners	1.9	2.0
K6.04	Pumps	2.1	2.2*
K6.05	Motors	1.7	1.8
K6.06	Heat exchangers and condensers	2.2	2.4*
K6.07	Breakers, relays, and disconnects	1.7	1.9
K6.08	Cooling towers	1.7*	1.8*
K6.09	Traveling screens	1.6	1.7
K6.10	Strainers	1.5	1.6
	<u>ABILITY</u>		
A1	***Ability to predict* and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the SWS controls including:** (CFR: 41.5 / 45.5)		
A1.01	Line losses in SWS, by comparing SWS pump discharge and turbine building gauge	1.9	1.9
A1.02	**Reactor and turbine building closed cooling water temperatures.**	**2.6***	**2.6***
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the SWS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45/3 / 45/13)		
A2.01	Loss of SWS	3.5*	3.7*
A2.02	Service water header pressure	2.7	3.1
A3	**Ability to monitor automatic operation of the SWS, including:** (CFR: 41.7 / 45.5)		
A3.01	Normal-process heat loads	2.4	2.5
A3.02	Emergency heat loads	3.7	3.7

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.0			

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Containment Ventilation Cooling Water System. CNTRV001	X				
2	Describe the flowpath of water from the RV pump suction to the RN header discharge. CNTRV002	X				
3	Describe the RV pump strainer design. CNTRV003	X				
4	List the signals that will AUTO-START a RV pump. CNTRV004	X	X			
5	Describe how the RV pumps are protected during low flow conditions. CNTRV005	X	X			
6	List the loads supplied by the RV header. CNTRV006	X				
7	List the safety related components associated with the RV system. CNTRV007	X	X			
8	List the signal that will Auto-Close RN-301AC and RN-302B (RV pump suction supply header isolation valves). CNTRV008	X	X			
9	Describe the RV pump instrumentation and controls. CNTRV009	X				
10	Describe the normal operation of the RV System, including Manual operation of the RV pumps. CNTRV010	X	X			

Objective # 3

2.2 RV Pump Strainers

The RV System has a duplex strainer to remove large debris from the raw water before reaching the RV pumps. The strainer is equipped with local ΔP indication. On high ΔP, the strainer is Manually switched to the alternate basket without system interruption, then the dirty basket is backflushed. The backflush water is supplied from the pump discharge.

The RV Strainers have a permanent vacuum priming connection attached.

2.3 RV Pumps

The RV System contains three common RV Pumps that are capable of supplying loads in both units. The RN Pumps provide the normal supply to the RV components while the RV Pumps augmenting the supply as necessary to meet cooling demands. Each RV centrifugal pump has a design capacity of 3200 gpm with a Total Developed Head of 175 feet (≅76 psid) and a Shutoff Head of 240 feet (≅104 psid).

Objective # 4

The pumps are controlled from the Main Control Board. The pushbutton switch positions are AUTO/MAN/START/STP with at least one pump selected to AUTO, unless all three pumps are running. **The standby pump (AUTO) will automatically start when the non-essential RN header drops to 50 psig and will continue to run until manually secured.**

Objective # 5

Each pump is protected by a minimum flow valve that automatically opens on low flow (sensed by high ΔP across the pump) to recirculate flow back to the pump suction.

Objective # 6

2.4 RV System Loads

The normal RV System Unit-1 Loads (Unit-2 has similar loads) are as follows:

- **VU, Upper Containment Ventilation Units 1A, 1B, 1C, 1D**
- **VL, Lower Containment Ventilation Units 1A, 1B, 1C, 1D**
- **VA, Auxiliary Building Ventilation Units 1A, 1B**
- **VT, Incore Instrumentation Room Ventilation Units 1A, 1B**
- **VF, Fuel handling Area Ventilation Unit FPSU-1**
- **VA, Radwaste Chemistry Air Conditioners AB-AHS 3, 4**
- **Cask Rail Car Washdown Connections**

3.0 SYSTEM OPERATION

3.1 Normal Operation

Objective # 10

The preferred RV Pump configuration is one pump in "AUTO" and the remaining pumps in "MANUAL" (and off). One pump should always be in "AUTO" unless all three pumps are in service.

The RV system is designed for normal operation with supply coming from the RN Non-Essential Aux. Building Supply Header. The standby RV pump will start automatically on low header pressure (50 psig) when required. Other RV pumps may be Manually placed in service if required to maintain VL cooling water flow rates above 600 gpm or if additional VL cooling is desired.

RV Pump suction pressure is verified to be above negative 6 inches Hg (per local gage RVPG5171) twice daily per Service Building Rounds Sheet.

3.1.1 RV Strainer Backwash

Objective # 11

The in-service RV Strainer basket is cleaned upon reaching a high ΔP. Strainer ΔP is verified to be less than 75 inches WC (RVPG5170) per Service Building Rounds Sheet. This task is accomplished by verifying which strainer basket is in service, then verifying open the strainer vents. The new strainer is selected with the RV Strainer Chain Mechanism and verified to have proper ΔP. The original strainer Backwash Isolation and Backwash Drain valves are opened. After backwash is complete the backwash valves are closed.

Objective # 12

3.1.2 Limits and Precautions

- All electrically operated Engineered Safeguards valves must be operated electrically after any manual operation.

  Basis: To ensure reliable automatic operation.

- <u>WHEN</u> RV is isolated to any chiller packages, the affected chiller compressor should be tagged out to prevent damage.

  Basis: To prevent chiller operation with RV isolated.

- Particular attention should be paid to valve nomenclature since both RN **<u>AND</u>** RV valves are manipulated during alignments for testing Penetrations M-240 and M-279.

  Basis: Increased attention to detail will reduce the chance of a mis-positioning event due to valve manipulations on the wrong system or train.

1. Limits and Precautions

1.1 All electrically operated Engineered Safeguard valves must be operated electrically after any manual operation.

1.2 **WHEN** RV isolated to any chiller packages, affected chiller compressor should be tagged out to prevent damage.

2. Initial Conditions

_____ 2.1 RN in operation per OP/1/A/6400/006 (Nuclear Service Water) for Unit 1 **OR** OP/2/A/6400/006 (Nuclear Service Water) for Unit 2.

_____ 2.2 ZP System in operation per OP/1/B/6300/006 (Main Vacuum and Vacuum Priming System).

_____ 2.3 RV System filled and vented.

3. Procedure

NOTE:	For normal operating conditions, operating RN Train (Unit 1 or 2) should supply all operating RV Loads. RV Pumps should be place in service only if VL cooling water flow rates are abnormally low (less than 600 gpm) **OR** additional VL cooling desired.

☐ 3.1 Evaluate all outstanding R&Rs that may impact performance of this procedure.

3.2 Perform the following sections, as applicable:

- ☐ Section 3.3, Placing RV System in Service
- ☐ Section 3.4, Removing RV Pumps from Service

NOTE:	RV System aligned for normal operation with supply coming from RN Non-Essential Aux Building Supply Header. RV Pumps will start automatically on low header pressure (50 psig decreasing).

3.3 Placing RV System in Service

NOTE:	Preferred RV Pump configuration is one pump in "AUTO" and remaining pumps in "MANUAL". One pump should always be in "AUTO" unless all three pumps are in service.

_____ 3.3.1 Place one RV Pump in "AUTO" and remaining RV Pumps in "MANUAL".

_____ 3.3.2 **IF** RV Pump placed in "AUTO" starts **AND** cavitation present, throttle associated discharge valve closed sufficiently to stop cavitation.

- _____ • 1RV-8 (A RV Pump Outlet Isol)
- _____ • 1RV-9 (B RV Pump Outlet Isol)
- _____ • 1RV-10 (C RV Pump Outlet Isol)

_____ 3.3.3 **IF** more RV flow required, additional pumps can be started manually.

3.4 Removing RV Pumps from Service

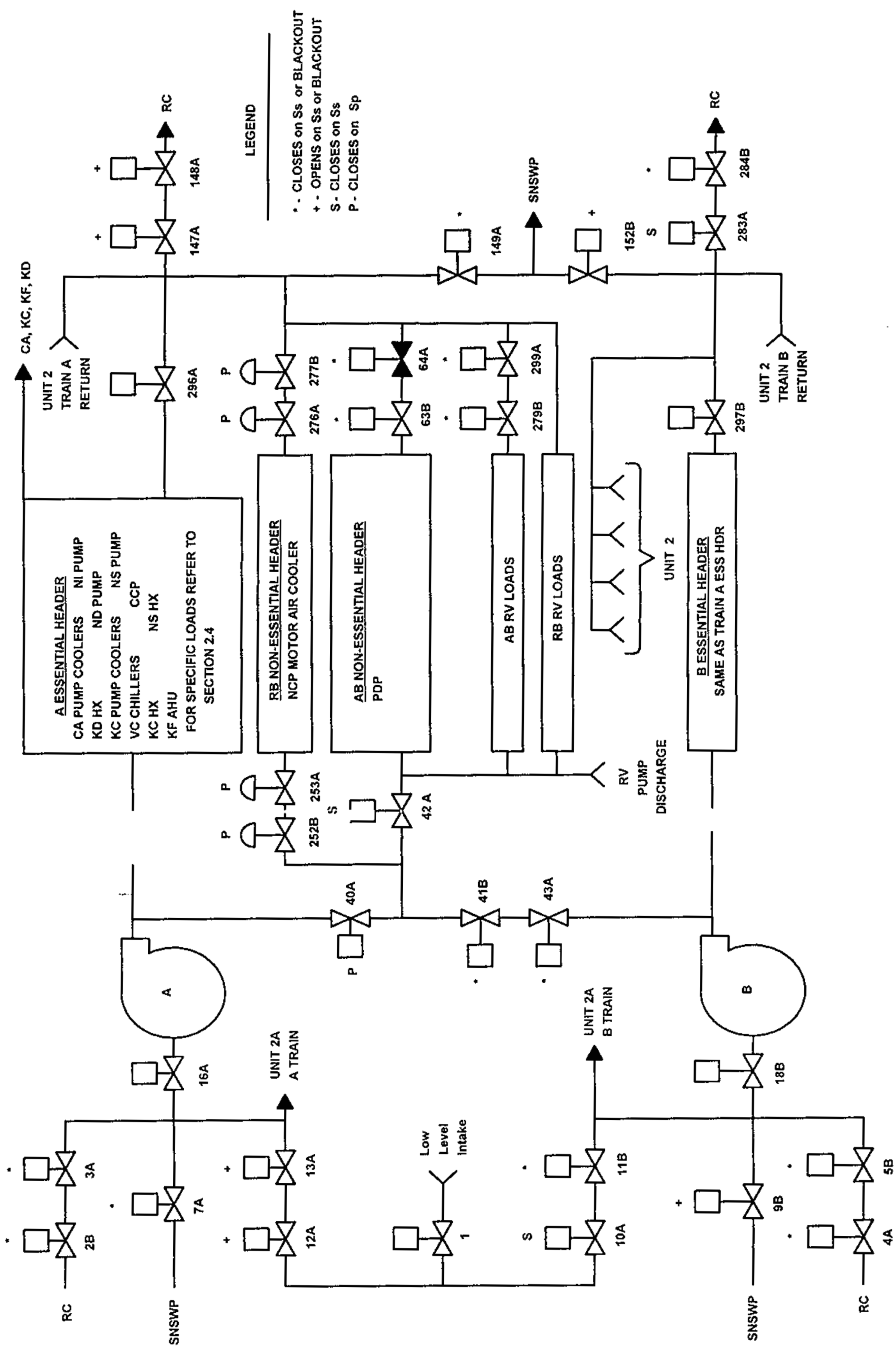
_____ 3.4.1 **IF** RV Pump in "AUTO", place control switch in "MAN".

3.4.2 Depress "STOP" for desired RV Pump:

- _____ • A RV Pump
- _____ • B RV Pump
- _____ • C RV Pump

End of Enclosure

7.6 RN System Simplified Diagram (2/19/02)



1 Pt While shifting to cold leg recirc during a LOCA, 1ND 58A (*NV/ NI pump Train A Isolation*) will not open.

Which one of the following is a possible cause of this problem?

A. 1NI-115B (*A NI Pump Miniflow*) must first be closed.

B. 1NI-185A (*TRAIN A ND TO NV & NI PUMPS*) must first be open.

C. 1ND-19A (*A ND Pump Suction From FWST or NC*) must first be open.

D. 1NI-144B (*B NI Pump Miniflow*) must first be closed.

SYSTEM: 006 Emergency Core Cooling System (ECCS)

K2 Knowledge of bus power supplies to the following:
(CFR: 41.7)

K2.01	ECCS pumps	3.6	3.9
K2.02	Valve operators for accumulators	2.5*	2.9
K2.03	Heat tracing	2.3	2.5
K2.04	ESFAS-operated valves	3.6	3.8

K3 Knowledge of the effect that a loss or malfunction of the ECCS will have on the following:
(CFR: 41.7 / 45.6)

K3.01	RCS	4.1	4.2
K3.02	Fuel	4.3	4.4
K3.03	Containment	4.2	4.4

K4 Knowledge of ECCS design feature(s) and/or interlock(s) which provide for the following:
(CFR: 41.7)

K4.01	Cooling of centrifugal pump bearings	2.6	2.9
K4.02	Relieving shutoff head (recirculation)	2.8	3.0
K4.03	Flushing of piping following transfer of highly concentrated boric acid	2.4	2.5
K4.04	System venting	2.3	2.5
K4.05	Autostart of HPI/LPI/SIP...	4.3	4.4
K4.06	Recirculation of minimum flow through pumps	2.7	3.0
K4.07	Normal water supply for SIS	3.3	3.6
K4 08	Recirculation flowpath of reactor building sump	3.2*	3.6*
K4.09	Valve positioning on safety injection signal	3.8	4.2
K4.10	Redundant pressure meters	2.9	3.2
K4.11	Reset of SIS	3.9	4.2
K4.12	HPI flow throttling	4.1*	4.3*
K4.13	Reset of containment isolation	3.8	4.1

K5 Knowledge of the operational implications of the following concepts as they apply to ECCS:
(CFR: 41.5 / 45.7)

K5.01	Effects of temperatures on water level indications	2.8	3.3
K5.02	Relationship between accumulator volume and pressure	2.8	2.9
K5.03	Weight percent calculation boron concentration	1.9	2.2
K5.04	Brittle fracture, including causes and preventative actions	2.9	3.1
K5.05	Effects of pressure on a solid system	3.4	3.8
K5.06	Relationship between ECCS flow and RCS pressure	3.5	3.9
K5.07	Expected temperature levels in various locations of the RCS due to various plant conditions	2.7	3.0
K5.08	Operation of pumps in parallel	2.9*	3.1*

Bank Question: 1046 ***Answer: B***

1 Pt While shifting to cold leg recirc during a LOCA, 1ND 58A (*NV/ NI pump Train A Isolation*) will not open.

Which one of the following is a possible cause of this problem?

A. 1NI-115B (*A NI Pump Miniflow*) must first be closed.

B. 1NI-185A (*TRAIN A ND TO NV & NI PUMPS*) must first be open.

C. 1ND-19A (*A ND Pump Suction From FWST or NC*) must first be open.

D. 1NI-144B (*B NI Pump Miniflow*) must first be closed.

LEVEL: RO

SOURCE: NEW

LEVEL OF KNOWLEDGE: MEMORY

LESSON: OP-MC-ECC-NI

OBJECTIVE: OP-MC-ECC-NI Obj. 8

REFERENCES: OP-MC-ECC-NI page 21

K/A: 006 K3.01 (4.1/4.2)

AUTHOR: CWS

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
1.0	1.0	1.0	1.0	1.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Safety Injection System. ECCNI001	X	X	X	X	
2	Sketch the system drawing (Fig 7.1) including all major components and valves, show all tie-ins to associated systems (ND, NV, NC). ECCNI002	X				
3	Sketch the system drawing (Fig 7.2) including all major components and valves, show all tie-ins to associated systems. ECCNI003		X	X	X	
4	List the pressure at which the NI pumps will begin injecting water into the NC System and state the NI pumps design flowrate. ECCNI004	X	X	X	X	
5	State the power supplies for the NI pumps. ECCNI005	X	X	X	X	
6	List all protection signals that will automatically initiate Safety Injection. ECCNI006	X				
7	Describe the signals, setpoints, permissives, and logic required to initiate and reset Safety Injection. ECCNI007		X	X	X	X
8	Describe the interlocks associated with the NI System. ECCNI008		X	X	X	X

Once the Seal-In logic is active, the momentary Reset is no longer required but P-4 must remain. Closing the Reactor Trip Breakers (removing P-4) will break the Seal-In logic and reinstate Automatic Safety Injection.

Objective # 8

2.4.5 Interlocks

- **To Open ND-58A (NV/NI pump Train A isolation): NI-115B and NI-144B or NI-147A must be Closed, and NI-185A must be Open.**
- **To Open NI-136B (ND to NI Train B): NI-115B and NI-144B or NI-147A must be Closed, and NI-184B must be Open.**
- **To Open NI-115B, NI-144B, or NI-147A: ND-58A and NI-136B must be Closed.**
- **To Open NI-184B: NS-1B and ND-4B must be fully Closed.**
- **Valve ND-4B will automatically Close when valve NI-184B is fully Open.**
- **To Open NI-185A: NS-18A and ND-19A must be fully Closed.**
- **Valve ND-19A will automatically Close when valve NI-185A is fully Open.**