Draft Submittal
(Pink Paper)

Reactor Operator Written Exam

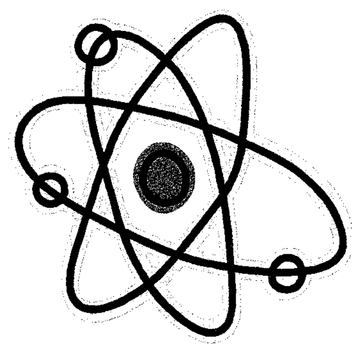
MCGUIRE MAY 2008 EXAM - 50-369, 370/2008-301
DRAFT RO WRITTEN EXAM (PART 2 OF 2)

NRC Examination

Written Exam

(Common)

Volume 2



McGuire Nuclear Station

45-day Submittal

March 17, 2008

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	GKA 2.4.46 (007)	
	Importance Rating	4.2	

(Emergency Procedures / Plan: Ability to verify that the alarms are consistent with the plant conditions.)

Proposed Question: Common 39

Unit 1 is operating at 100%. The following Main Control Board indications exist:

	Channel 1	**Channel 2**	**Channel 3**	**Channel 4**
NCP Bus Frequency (Hz)	56.0	57.0	57.0	58.0
Power Range (%)	107	108	108	109
S/G B NR Level (%)	18	18	19	20
Pzr Pressure (psig)	2383	2384	2385	2386

one should be <19

Which ONE (1) of the following Annunciators will be lit on 1FO-1?

A. 1FO-1/F-6, "NC Pump Bus Under Freq Rx Trip."

B. 1FO-1/B-7, "P/R Hi Flux Hi Stpt Rx Trip."

C. 1FO-1/B-2, "S/G B Lo-Lo Lvl Rx Trip."

D. 1FO-1/B-5, "Pzr Hi Press Rx Trip."

Proposed Answer: D

Explanation (Optional):

A. Incorrect. According to Figure 7.5 of OP-MC-IC-IPE (p83, Rev 27) the low NC Pump Bus Frequency trip occurs when 2 of 4 channels sense NCP Bus frequency $\leq$ 56hz. In this situation only channel 1 meets this required logic condition.

B. Incorrect. According to Figure 7.5 of OP-MC-IC-IPE (p83, Rev 27) the Power Range Hi Flux trip occurs when 2 of 4 channels sense Power Range Channels $\geq$ 109%. In this situation only channel 4 meets this required logic condition.

C. Incorrect. According to Figure 7.5 of OP-MC-IC-IPE (p83, Rev 27) the S/G

Narrow Range Level Low trip occurs when 2 of 4 channels in one SG sense narrow range level ≤ 17%. In this situation none of the channels meet this required logic condition.

D. Correct. According to Figure 7.5 of OP-MC-IC-IPE (p83, Rev 27) the High Pressurizer Pressure trip occurs when 2 of 4 channels sense Pzr Pressure ≥ 2385 psig. In this situation both channel 3 and Channel 4 meet this required logic condition.

Technical Reference(s): OP-MC-IC-IPE page 84, Rev 27 (Attach if not previously provided) (Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: IC-IPE #8, 10 (As available)

Question Source:
Bank #
Modified Bank #: McGuire NRC Bank #422 (Note changes or attach parent)
New

Question History: Last NRC Exam Not on 2005/2007 exams

Question Cognitive Level:
Memory or Fundamental Knowledge X
Comprehension or Analysis

10 CFR Part 55 Content:
55.41 7
55.43

Comments:
KA is matched because item evaluates alarms expected for listed conditions that will result in a reactor trip (selected EPE)

Modify Question 39

Question 422 ICIPEN03 ICIPEN03

1 Pt If the unit is operating at full load, which one (1) of the following groups of instrument readings will result in an automatic reactor trip?

				CH1	CH2	CH3	CH4
A.	NCP bus frequency (hertz):		56.0	57.0	57.0	58.0	
B.	Power range (percent):		107	108	108	109	
C.	S/G B NR level (percent):		17	18	19	20	
D.	PZR pressure (psig):	2383	2384	2385	2386		

Answer 422

Answer: D

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

2.7 System Alarms

Objective # 7

PCS 2/4 Protection Cabinet Doors Open - warns of a possible testing error. The potential for a Trip exists if work is being performed in cabinets at the same time.

SSPS Train A (B) Loss Of Power - Loss of power to any of the 4 input relay cabinets or the output cabinet of the associated SSPS Train.

PCS Power Supply Failure Protection Cabinet 1 (2, 3, 4) - Loss of power to the associated PCS cabinet or failure of a cabinet internal power supply.

Objective # 4

SSPS Train A (B) General Warning - indicates a reduction in protection caused by one of following:

- **Loss of a 48 VDC or 15 VDC power supply**
- **Printed circuit card not properly inserted**
- **Test Switch in Test**
- **Bypass Breaker in the connected position and Closed**
- **Logic ground return fuse blown**

Objective # 8

First Out Alarms - alarm for each Reactor Trip. The first trip will give a Red Alarm light while the subsequent trip signals give White Alarm lights. The first out alarm must NOT be reset until a note has been made of the cause.

Nomenclature: **NC PUMP BUS UNDER FREQ RX TRIP** Window: **F6**

Setpoint: 2/4 buses reading 56 HZ with Reactor Power or Impulse Pressure greater than P-7 (10% F.P.).

Origin:

1. Underfrequency relays sensing frequency at NC Pump switchgear.
2. P-7 Setpoint (2/4 N41, 42, 43, 44 or 1/2 Impulse Pressure channels indicating greater than 10% F.P.).

Probable Cause: Major frequency disturbance.

Automatic Action:

1. Reactor trip
2. Trips all NC pump breakers.

Immediate Action:

1. Ensure Automatic Actions occur.
2. Go to EP/1/A/5000/E-0 (Reactor Trip or Safety Injection).

Supplementary Action: None

References:

- McGuire UFSAR
- NSM MG-12126

End Of Response

Nomenclature: **P/R HI FLUX HI STPT RX TRIP** Window: **B7**

Setpoint: 2/4 Power Range channels >109% Reactor Power
(1/1 channel >5% during ZPPT)

Origin: Bistables in 2/4 PR drawers, Protection Sets I, II, III and IV
(1/1 channel during ZPPT)

Probable Cause:

1. Rod Control System Failure
2. Steam Dumps open at high power level.
3. During ZPPT, a power level of 5%.

Automatic Action: Reactor trip.

Immediate Action:

1. Ensure Automatic Actions occur.
2. Go to EP/1/A/5000/E-0 (Reactor Trip or Safety Injection).

Supplementary Action: None

References:

- McGuire UFSAR
- NSM MG-12126

End Of Response

Nomenclature:	S/G B LO-LO LVL RX TRIP	Window:	B2

Setpoint: 2/4 level channels for Steam Generator B at 16.7%.

Origin: S/G B NR level channels I, II, III and IV (MC1CFLT-5540, 6010, 5530, 5520)

Probable Cause:

1. Control malfunction
2. Inadvertent CF Isolation
3. Loss of CF Pump(s)

Automatic Action:

1. CA Pumps 1A and 1B start. **IF** Lo-Lo Lvl in 2 or more S/Gs, #1TD CA Pump starts.
2. Reactor trip.
3. Blowdown and sample line valves for all S/G's isolate.

Immediate Action:

1. Ensure Automatic Actions occur.
2. **IF** Reactor Trip has occurred **AND** NC System Pressure was greater than P-11, go to EP/1/A/5000/E-0 (Reactor Trip or Safety Injection).

Supplementary Action: None

References:

- McGuire UFSAR
- OMP 4-3 (Use of Abnormal and Emergency Procedures)

End Of Response

Nomenclature: **PZR HI PRESS RX TRIP** Window: **B5**

Setpoint: 2/4 Pressurizer pressure channels greater than 2385 PSIG.

Origin: Pressurizer pressure channels, I, II, III and IV (MC1NCPT-5160, 5150, 5170 and 5171).

Probable Cause:

1. Load reduction with pressure regulating equipment malfunction.
2. Failure of heaters to deenergize.
3. Failure of sprays or PORV to operate.

Automatic Action: Reactor trip

Immediate Action:

1. Ensure Automatic Actions occur.
2. Ensure proper operation of power operated relief valves, check heaters off and sprays open.
3. Go to EP/1/A/5000/E-0 (Reactor Trip or Safety Injection).

Supplementary Action: Cool the Pressurizer Relief Tank per OP/1/A/6150/04 (Pressurizer Relief Tank).

References: McGuire UFSAR

End Of Response

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Describe the function of the First-Out annunciator panel. ICIPE008			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
12	List all the protection system control ("C" signal) interlocks including logic and functions. ICIPE012			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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	008 AA1.03	
	Importance Rating	2.8	

(Ability to operate and / or monitor the following as they apply to the Pressurizer Vapor Space Accident: Turbine bypass in manual control to maintain header pressure)

Proposed Question: Common 40

The following conditions exist on Unit 2 following a Reactor Trip from high power:

- A break in the Pressurizer Steam Space has resulted in a Small Break LOCA.
- The operating crew has entered ES-1.2, "Post-LOCA Cooldown and Depressurization."
- Steam Dumps have been placed in the Steam Pressure Mode, and the Steam Dump Cooldown valves are presently throttled open.
- The Steam Dump Pressure Controller potentiometer is presently set at 6.9 Turns, and is operating in AUTO.
- The P-12 Interlock has been defeated.
- NC Temperature is stable.

Which ONE (1) of the following describes the action that will be taken to initiate and maintain a constant NC System Cooldown rate of < 100°F/hour?

A. Lower Steam Dump Pressure Controller potentiometer to 6.5 turns.

B. Raise Steam Dump Controller potentiometer to 7.4 turns.

C. Place the Steam Dump Pressure Controller in manual and raise output.

D. Place the Steam Dump Pressure Controller in manual and lower output.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. Lowering the pot setting will lower the Steam Header Pressure setpoint that the Steam Dump Controller will try to maintain. If NC Temperature is stable, lowering setpoint will cause pressure error to increase, increasing the output, and further opening the Steam Dump valves, starting an NC System Cooldown. However, as the Steam

Pressure is reduced the Steam Dump controller error will diminish and begin to close the valves. Unless the operator goes back and continues to make adjustments, the cooldown will eventually stop when steam header pressure is established.

B. Incorrect. Raising the pot setting will raise the Steam Header Pressure setpoint that the Steam Dump Controller will try to maintain. With setpoint higher than actual Steam Header pressure the Controller error will close the Steam Dump valves resulting in a heatup.

C. Correct. Placing the controller in manual and raising the output will open the Steam Dump valves further, initiating an NC System cooldown at a constant rate.

D. Incorrect. Placing the controller in manual and lowering the output will close the Steam Dump valves further. With the NC System presently stable, lowering the heat removal rate will cause the NC System to heat up..

Technical Reference(s)	OP-MC-STM-IDE p31, 33 Rev 29	(Attach if not previously provided)
	ES-1.2, Step 11, Rev 10	(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: STM-IDE #5 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam NA

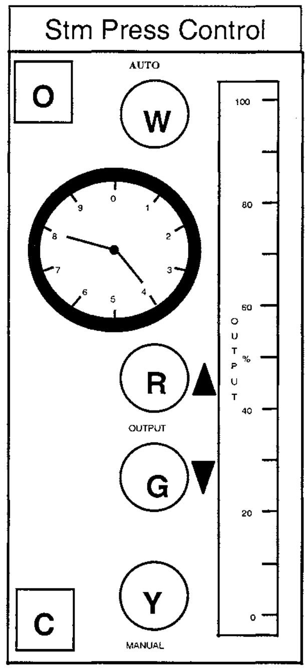
Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X
10 CFR Part 55 Content:	55.41	4, 10
	55.43	

Comments:

KA is matched because item evaluates actions that will be required to ensure Steam Dump operates correctly during a steam space LOCA

Objective #7

2.5.2. 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

2.5.3. The controller output is displayed on the M/A Output Meter and will be the Steam Dump Demand when in the Steam 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).

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, P4, P12) required for various modes of operation.		X	X	X	X
7.	Describe all selector switches and their functions for various modes of operation		X	X	X	X
8.	Describe the effect on the system resulting from a failure of each input to the system.		X	X	X	X
9.	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
10.	Relate % steam dump demand indication to corresponding steam dump valve operation			X	X	X

2.4.4. 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).

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.

2.4.5 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	14.4°
2	26°

Any of the bank trip signals are indicated by the single status panel window, COND STM DUMP TRIP OPEN.

2.5. Steam Header Pressure Controller

2.5.1. 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 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 to the Steam Press Control Manual/Auto station.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

NOTE After the Low Pressure Steamline Isolation signal is blocked, maintaining steam pressure negative rate less than 2 PSIG per second will prevent a Main Steam Isolation.

11. **Initiate NC System cooldown to Cold Shutdown as follows:**

__ a. **IF** ND in RHR mode, **THEN** use ND System to cooldown while maintaining rate in NC T-Colds less than 100°F in an hour.

__ b. Check "C-9 COND AVAILABLE FOR STEAM DUMP" status light (2SI-18) - LIT.

RESPONSE NOT OBTAINED:

b. Perform the following:

__ 1) Ensure Main Steam Isolation reset.

__ 2) Ensure SM PORVs reset.

__ 3) Dump steam using intact S/G SM PORVs while maintaining cooldown rate in NC T-Colds less than 100°F in an hour.

__ 4) **GO TO** Step 12.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
11. (Continued)	
__ c. Check MSIVs on all intact S/Gs - OPEN.	c. Perform the following: 1) Reset Main Steam Isolation signals: __ a) Main Steam Isolation. __ b) SM PORVs. __ c) MSIV Bypass Valves. __ 2) **IF** intact S/G MSIVs required closed to isolate a leak, **THEN GO TO** RNO for Step 11.f. __ 3) Place "STEAM DUMP SELECT" in steam pressure mode. __ 4) Place "STM PRESS CONTROLLER" in manual and close. __ 5) Open MSIV bypass valves on intact S/Gs to equalize pressure across MSIVs. 6) **WHEN** pressure equalized, **THEN**: __ a) Open all MSIVs on intact S/Gs. __ b) Close all MSIV bypass valves. __ c) Perform Steps 11.e and 11.f. __ 7) **GO TO** Step 12.
d. Perform the following to place steam dumps in steam pressure mode: __ 1) Place "STM PRESS CONTROLLER" in manual. __ 2) Adjust "STM PRESS CONTROLLER" output to equal "STEAM DUMP DEMAND" signal. __ 3) Place "STEAM DUMP SELECT" in steam pressure mode.	

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
11. (Continued)	
__ e. **WHEN** "P-12 LO-LO TAVG" status light (2SI-18) lit, **THEN** place steam dumps in bypass interlock.	
__ f. Dump steam to condenser from intact S/Gs while maintaining cooldown rate in NC T-Colds less than 100°F in an hour.	__ f. Dump steam using intact S/G SM PORVs while maintaining cool down rate in NC T-Colds less than 100°F in an hour.
__ 12. **Check NC subcooling based on core exit T/Cs - GREATER THAN 0°F.**	__ **GO TO Step 27.**
13. **Check if S/I in service using any of the following:**	__ **GO TO Step 23.**
__ • Any NI pump - ON	
OR	
__ • 2NI-9A (NC Cold Leg Inj From NV) - OPEN	
OR	
__ • 2NI-10B (NC Cold Leg Inj From NV) - OPEN	
OR	
__ • Any ND pump - ON WITH SUCTION ALIGNED TO FWST OR SUMP.	
14. **Ensure Pzr heaters remain off as follows:**	
__ • Place A, B, and D Pzr heaters in manual and off.	
__ • Open "C PZR HTR GRP SUP BKR".	

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	009 EK2.03	
	Importance Rating	3.0	

(Knowledge of the interrelations between the small break LOCA and the following: S/Gs

Proposed Question: Common 41

The following conditions exist on Unit 2 thirty (30) minutes after an automatic Reactor Trip due to a Loss of Offsite Power:

- NC Pressure — 1600 psig and going down slowly
- Core Exit Temperature — 582°F and stable
- Thot indication — 567 °F and stable
- Tcold indication — 555 °F and stable
- Pzr Level — 8% and slowly going down
- Containment Pressure — 2.5 psig and rising
- Steam Generator Pressures — Normal post-trip pressure for plant conditions
- Total CA Flow — 270 gpm

Which ONE (1) of the following describes the relationship between the NC System and the Steam Generators, and what procedure would be entered to mitigate the event?

A. The Steam Generators are a Heat Sink to the NC System and ES-0.2, Natural Circulation, will be implemented.

B. The Steam Generators are a Heat Sink to the NC System and E-1, Loss of Reactor or Secondary Coolant, will be implemented.

C. The Steam Generators are a Heat Source to the NC System and ES-0.2, Natural Circulation, will be implemented.

D. The Steam Generators are a Heat Source to the NC System and E-1, Loss of Reactor or Secondary Coolant, will be implemented.

Proposed Answer: B

Explanation (Optional):

Based on the Steam Tables, the Tsat for the NC System is at least 605°F while the Tsat for the Steam Generators is 559°F. Since Tsat NC System is > Tsat SG, the Steam Generators are a Heat Sink.

A. Incorrect. Although Heat Sink is identified, the conditions presented indicate that a Small LOCA is occurring inside Containment, and that SI has actuated. While ES-0.2 will utilize the Steam Generators to cooldown the NC System, it will not be addressed if an SI has occurred.

B. Correct. The SGs are a Heat Sink (See above) and the conditions presented indicate that a Small LOCA is occurring inside Containment, and that SI has actuated. E-1 will utilize the Steam Generators to cooldown the NC System under these conditions.

C. Incorrect. The SGs are NOT a Heat Source. While ES-0.2 will utilize the Steam Generators to cooldown the NC System, it will not be addressed if an SI has occurred.

D. Incorrect. The SGs are NOT a Heat Source. E-1 is the correct procedure use for this event

Technical Reference(s)	Steam Tables	(Attach if not previously provided)
	OP-BNT-TH07, p8,11,12 (Rev 5)	(Including version or revision #)
	ECC-ISE, p21 (Rev 30)	
	OP-MC-EP-E0 p119 (Rev 12)	
	OP-MC-EP-E1 p47,49, 99,113 (Rev 17)	
	OP-MC-EP-FRH p19, 27 (Rev 10)	

Proposed references to be provided to applicants during examination: Steam Tables

Learning Objective:	EP-E0 #3,10, EP-E1 #2, 6, EP-FRH #2, 6, OP-BNT-TH07, # 4 ECC-ISE # 5	(As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History:	Last NRC Exam	______
Question Cognitive Level:	Memory or Fundamental Knowledge	______
	Comprehension or Analysis	X
10 CFR Part 55 Content:	55.41	10,14
	55.43	______

Comments:
KA is matched because item evaluates SG relationship to RCS for a SBLOCA, and also further discriminates by evaluating the understanding of plant conditions leading to different EOP use

SEQ	HEAT TRANSFER ENABLING OBJECTIVES	BOT	GFES
1	Define the following terms:		
	A. Heat Transfer TH07001	X	
	B. Specific Heat Capacity (C_p) TH07002	X	
2	Describe three mechanisms or modes of heat transfer. TH07003	X	X
3	Given parameters for a heat exchanger or heat transfer process, use the proper heat transfer formulas to solve heat transfer problems TH07023	X	X
4	Explain the process of conduction heat transfer and the effect of each of the following on the rate of conduction heat transfer:		
	A. Temperature difference TH07004	X	
	B. Material Thermal Conductivity TH07005	X	
	C. Cross-Sectional Area TH07006	X	
	D. Material Thickness TH07007	X	
5	Describe thermal conductivity. TH07008		X
6	Explain the manner in which fluid films affect heat transfer. TH07010		X
7	Explain the process of convection heat transfer and the effect of each of the following on the rate of convection heat transfer:		
	A. Surface area TH07011	X	
	B. Temperature difference TH07012	X	
	C. Boundary layer characteristics TH07013	X	

1.0 INTRODUCTION

Objective 1A, 2

Heat transfer is the transfer of energy that occurs as a result of a temperature difference. The direction of transfer is from the higher to the lower temperature. There are three basic modes of heat transfer, (1) conduction, (2) convection, and (3) radiation.

Conduction involves the transfer of heat by the process of interactions between adjacent molecules of the material through which the heat is being transferred. The transfer of heat from one side of a condenser tube through the tube wall to the other side is an example of heat transfer by conduction.

Convection involves the transfer of heat by a process of bulk motion and mixing of macroscopic portions of a fluid. The term natural convection is used if this is motion and mixing is caused by density variations resulting from temperature differences within the fluid. The term forced convection is used if this motion and mixing is caused by an outside force, such as a pump. The transfer of heat from a hot water radiator to room air is an example of heat transfer by natural convection. The transfer of heat from the surface of a heat exchanger tube to the bulk of a fluid being pumped through the heat exchanger is an example of forced convection.

Radiation, or radiant heat transfer, involves the transfer of heat by electromagnetic radiation that arises due to the temperature of a body. Most energy of this type is in the infrared region, although some is visible. The term thermal radiation is frequently used to distinguish this form of electromagnetic radiation from other forms, such as radio waves, x-rays or gamma rays. The transfer of heat from a fireplace across a room in the line of sight is an example of radiant heat transfer.

In most heat transfer processes, all three modes of heat transfer occur simultaneously. Generally, however, there is one, or perhaps two primary modes for each process. For most heat transfer processes encountered in a PWR plant, conduction and convection are by far the most important modes of heat transfer. Because of the large mass flow rates, radiant heat transfer losses per pound-mass of working fluid are very small and can be neglected.

In many practical applications, the relationships between heat added and temperature change or between heat added and vaporization, must be combined.

Objective 3

Example 2

Feedwater enters the steam generator at 430°F and leaves at 551°F as saturated vapor. If the feedwater flow rate is 5 x 10^6 lb_m/hr, the specific heat of water at existing conditions is 1.3 Btu/lb_m-°F and the latent heat of vaporization is 640 Btu/lb_m at these conditions, what is the rate of heat addition?

$$\dot{Q} = \dot{m} c_p \Delta T + \dot{m}\ h_{fg}$$

$$\dot{Q} = \left(5 \times 10^6 \frac{lb_m}{hr}\right)\left(1.3 \frac{Btu}{lb_m - {}^oF}\right)(551^\circ F - 430^\circ F) + \left(5x\ 10^6 \frac{lb_m}{hr}\right)\left(640 \frac{Btu}{lb_m}\right)$$

$$\dot{Q} = 4.0 \times 10^9 \frac{Btu}{hr}$$

Heat flux is another term which is frequently used when talking about heat transfer. Heat flux is defined as the heat transfer rate per unit area, where the area is typically one (1) square foot.

$$\dot{Q}'' = \frac{\dot{Q}}{A}$$

Where:

$\dot{Q}''$ = heat flux (BTU/hr-ft^2)

$\dot{Q}$ = heat rate (BTU/hr)

A = area (ft^2)

3.0 MODES OF HEAT TRANSFER

3.1 CONDUCTION HEAT TRANSFER

Objective 4, 5

Heat transfer by conduction involves the transfer of kinetic energy by collisions between adjacent atoms of a material. Almost all heat transfer processes at a plant involve conduction. When bodies at different temperatures are brought together, the atoms in the high temperature body have more kinetic energy than the atoms in the low temperature body. At the surface of contact, collisions between atoms in the two bodies result in kinetic energy being transferred from the atoms in the hot body to those in the cold body. Thus, in the hot body, the average kinetic energy of the atoms decreases, the internal energy decreases and the temperature drops. In the cold body, the reverse happens. This transfer of energy continues, passing from atom to atom, until both bodies are at the same temperature. Conduction through a single body occurs in much the same fashion.

Several factors contribute to the rate of conduction heat transfer:

- **Difference in temperature** - The greater the difference in temperature (ΔT) between the hot region (called T_{HOT}) and the cold region (called T_{COLD}), the greater the interaction rate between molecules and thus the faster energy can flow from the high temperature location to the low temperature location. Thus, the rate of heat transfer is greater. This difference in temperature is often referred to as "thermal gradient".
- **Thermal conductivity of the material** - Thermal conductivity is simply a measure of how good a material is at conducting heat. Different materials have different "capacities" for transferring energy via molecular interactions. Thermal conductivity is represented by the symbol "K" and is expressed in units of Btu/hr-ft-°F. Typically, metals have high values of thermal conductivity; gases generally have low values. (This is the reason that a "dead air space" is a good insulator.) Ceramics, like UO_2, are relatively poor conductors, although better than gases. Unfortunately, the thermal conductivity of a material is not a constant, but varies with temperature, pressure, and composition changes.

MATERIAL	THERMAL CONDUCTIVITY (K) BTU/hr-ft-°F
Copper	133.0
Iron	39.0
90-10 Copper Nickel	23
416 Stainless Steel	14
316 Stainless Steel	9.4
Inconel 600	8.6
Inconel 690	7.8
Zirconium Alloys	≈12
Concrete	0.2 – 0.7
Air	0.0145
Saturated Steam @ 600°F	0.0301
Rock Wool	0.03

Table 1 Typical Thermal Conductivity Values

- **The cross-sectional area to the direction of heat flow** - Conduction depends upon molecular interaction, so the greater the area available for these interactions the greater the rate of heat transferred. We use "A" to indicate the area.

3.0 SYSTEM OPERATION

3.1 Normal Operation

Objective # 6

Safety Injection Actuation (S_S)

Actuation Signals and logic

Signal	Setpoint	Logic	Interlocks	Reason
Manual		**$^1/_2$ pushbuttons**		**Operator Judgment**
Lo-pressurizer pressure	**<1845 psig**	**$^2/_4$ channels**	**P-11**	**LOCA Protection**
Hi-containment pressure	**>1.0 psig**	**$^2/_3$ channels**		**LOCA and Steam Break Protection**

LOCA protection is provided by the Low Pressurizer Pressure (1845 psig) and the High Containment Pressure (1 psig) Safety Injection Signals.

Steam break protection is provided by the High Containment Pressure (1 psig) Safety Injection Signal.

Objective # 7

Safety Injection Signal (S_S) initiates the following functions:

- Reactor Trip (P4)
- D/G sequencer which in turn starts the following:
  1) **Centrifugal Charging Pumps (NV)**
  2) **Safety Injection Pumps (NI)**
  3) **Residual Heat Removal Pumps (ND)**
  4) **Idle train of Component Cooling Pumps (KC)**
  5) **Idle train of Nuclear Service Water Pumps (RN)**
  6) **Motor Driven Auxiliary Feedwater Pumps (CA)**
  7) Emergency Diesel Generator
  8) Provides start signal to normally running auxiliary building filtered exhaust fans and trips non-filtered exhaust fans

6.0 ES-0.2, NATURAL CIRCULATION COOLDOWN

6.1. Purpose

ES-0.2 provides actions to perform a natural circulation NC system cooldown and depressurization to cold shutdown, *with no accident in progress*, under requirements that will preclude any upper head void formation.

6.2. Symptoms/Conditions

Upon entry to ES-0.2, natural circulation of the NC has been established and stable plant conditions are being maintained. ES-0.2 is then entered from:

1. ES-0.1, Reactor Trip Response, when it has been determined that a natural circulation cooldown is required.
2. ES-1.1, Safety Injection Termination, after the plant conditions have been stabilized and no NC pumps can be started.
3. ECA-0.1, Loss Of All AC Power Recovery Without S/I Required, after the plant conditions have been stabilized following the restoration of AC emergency power.

There are three possible transitions out of this procedure.

1. If S/I actuation occurs, a transition to E-0, Reactor Trip or Safety Injection, should be made.
2. Since it is always desirable to have forced convection heat transfer from the core, the first step of the procedure attempts to start a NC pump. If this attempt is successful, a transition to the appropriate plant procedure is in order.
3. The third transition occurs if the plant staff determines that a natural circulation cooldown and depressurization must be performed at a rate that may form a steam void in the vessel. At that time a transition should be made to ES-0.3, Natural Circulation Cooldown with Steam Void in Vessel.

STEP 14 Check if NC System cooldown and depressurization is required:

PURPOSE: To determine the method of long-term plant recovery.

BASIS: The operator should stay in E-1 only for loss of NC accidents for which the NC pressure is less than the low-head S/I (ND) pump shutoff head and flow from the ND pumps has been verified. If NC pressure remains above the shutoff head pressure, or if proper flow cannot be verified, than a transfer to ES-1.2, Post LOCA Cooldown and Depressurization is made. ES-1.2 would then be used for plant recovery.

STEP 15 Check transfer to Cold Leg Recirc criteria:

PURPOSE: To guarantee coolant flow to the core by switching to cold leg recirculation if the FWST level is below the switchover setpoint.

BASIS: Since the low-head S/I pumps are injecting at this time, this indicates the presence of a large-break LOCA, and, hence, the eventual transfer to cold leg recirculation. When the switchover level in the FWST is reached, the operator should check to see if S/I systems are already aligned for Cold Leg Recirc. If they are not, then the operator is directed to go to ES-1.3, TRANSFER TO COLD LEG RECIRCULATION, to maintain coolant flow to the core. If, however, the switchover setpoint has not been reached when the operator encounters this step, a return to a previous step occurs. Here an evaluation of plant status continues while waiting for the FWST level to reach the switchover setpoint.

For a large break LOCA, where the FWST level is going down rapidly, it is important for the operator to be aware of the requirement to switch over to sump recirculation. A rapid drop in FWST water level corresponds to a situation where most or all of the high capacity safeguards pumps are operating and the FWST empties in a short time (e.g., 15 to 30 minutes).

STEP 16 Check if CLAs should be isolated:

PURPOSE: To prevent accumulator nitrogen from being injected into the NC.

BASIS: Procedure E-1 is used to recover from larger-sized LOCAs. Thus a significant amount of the accumulator nitrogen will be injected into the NC, along with the accumulator water, following the LOCA. In the longer-term recovery, the NC pressure could be reduced to a pressure even lower than occurred following the LOCA. This would result in even more accumulator nitrogen injection into the NC. Such discharge would impede further NC depressurization. To prevent this nitrogen injection, the accumulators should be isolated when the hot leg temperature criterion is met. To ensure the NC hot leg temperature is less than 354°F; at least two RTDs should be less than 354°F in case one RTD is giving an erroneous reading. This temperature corresponds to a saturation pressure of ≈126 psig. Calculations show that this would be the final pressure in the accumulators, when the cover gas has expanded to the entire tank volume.

If the hot leg temperature is greater than 354°F, then the NC saturation pressure will be high enough to preclude nitrogen entering the NC after the water is discharged.

Power to the CLA isolation valves is normally off and is controlled by disconnect switches in the Control Room. Placing power on and closing the valve can be done in one step from the Control Room. Switches are returned to normal disconnect position 5 sec. after the valves are indicate closed. The 5 sec. delay ensures the valves are closed prior to removal of power.

STEP 17 Check if intact S/G(s) should be depressurized to NC pressure:

PURPOSE: To cool down and depressurize the secondary side if intact S/G pressures are greater than NC pressure.

BASIS: At this point the NC pressure is low (below the low-head S/I pump shutoff head) and the plant is on cold leg recirculation. However, the secondary side may still be relatively hot and at a pressure significantly higher than the NC. If this is the case, the operator should cool down and depressurize the secondary side by dumping steam from any intact S/Gs to aid in further cooldown and depressurization of the NC. Steam should be dumped to the condenser, if possible, or directly to atmosphere using intact S/G PORVs. To minimize offsite radiation doses the operator is instructed not to dump steam from a S/G with high radioactivity.

NOTE After the Lo Pressure Steamline Isolation signal is blocked, maintaining steam pressure negative rate less than 2 PSIG per second will prevent a Main Steam Isolation.

BASIS: This note provides the operator with a limit on the depressurization rate of the S/G(s) to prevent a Main Steam Isolation from occurring.

5.0 ES-1.2, POST LOCA COOLDOWN AND DEPRESSURIZATION

5.1. Purpose

This procedure provides instructions to cool down and depressurize the NC to cold shutdown conditions following a loss of reactor coolant inventory. This procedure and supporting analyses are structured to deal primarily with small LOCAs (diameter less than several inches) where safety injection can keep up with break flow at pressures above the shutoff head pressure of the low-head S/I pumps. In addition, if a LOCA occurs and the high pressure S/I system fails, the procedure provides optimal recovery actions to try and prevent an inadequate core cooling condition while trying to restore S/I flow.

5.2. Symptoms/Entry Conditions

ES-1.2 is entered when any of the following conditions occur:

1. E-0 (Reactor Trip or Safety Injection) when NC system pressure goes down after stopping all but one NV pump.
2. E-0 (Reactor Trip or Safety Injection) when Pzr level can not be maintained using normal charging.
3. E-1 (Loss of Reactor or Secondary Coolant) when NC pressure is greater than the ND pump shutoff head.
4. ES-1.1 (Safety Injection Termination) when NC system pressure goes down after stopping all but one NV pump.
5. ES-1.1 (Safety Injection Termination) when Pzr level cannot be maintained with normal charging.
6. ES-1.1 (Safety injection Termination) when NC pressure is greater than the NI pump shutoff head.

ES-1.2 is always entered at Step 1. Based on these entry conditions, there should be at least one charging pump running. Unless other failures occur, both NI pumps should be running and at least have the capability of injecting flow.

If the narrow range level in any S/G increases in an uncontrolled manner, a transition is made from ES-1.2 to E-3, Steam Generator Tube Rupture. This can be either from a step in the procedure or from a Foldout page directive at any time.

If the FWST level decreases to the switchover setpoint, a transition is made to ES-1.3, Transfer to Cold Leg Recirculation. This transition is made from the Foldout page.

After reaching and maintaining cold shutdown conditions, the final step of ES-1.2 instructs the operators and plant engineering staff to evaluate the long term plant status. At this time, the NC will be cooled by the ND system or cold leg recirculation. If Pzr level could not be restored and maintained and boron precipitation is a concern, a decision to transfer to ES-1.4, Transfer to Hot Leg Recirculation, could be made. Other long term recovery actions can also be determined at this time.

STEP 9 Monitor shutdown margin during cooldown:

PURPOSE: To determine if shutdown margin is adequate for NC cooldown.

BASIS: Chemistry is notified to monitor shutdown margin during the cooldown to verify adequate NC boron concentration. Note that since S/I was in service, boron concentration is expected to be sufficient.

STEP 10 WHEN "P-11 PRESSURIZER S/I BLOCK PERMISSIVE" status light (1SI-18) lit, THEN depress "BLOCK" on Low Pressure Steamline Isolation block switches.

PURPOSE: To prevent main steamline isolation valve (MSIV) closure on low compensated steamline pressure during controlled NC cooldown.

BASIS: The Main Steam Line Isolation signal on low steamline pressure can be blocked during cooldown once the Pzr pressure decreases to less than 1955 psig. This prevents MSIV closure, thus allowing the cooldown by the preferred method of steam dump to the condenser.

NOTE After the Lo Pressure Steamline Isolation signal is blocked, Main Steam Isolation will occur if the high steam pressure rate setpoint is exceeded.

STEP 11 Initiate NC System cooldown to Cold shutdown:

PURPOSE: To begin or continue a controlled NC cooldown to cold shutdown using a preferred or alternate method with a specified maximum cooldown rate.

BASIS: The objective of a controlled cooldown is to reduce the overall temperature of the NC coolant and metal to reduce the need for supporting plant systems and equipment required for heat removal. The maximum cooldown rate of 100°F/hr will preclude violation of the Integrity Status Tree thermal shock limits. The preferred steam release path is to the condenser to conserve inventory; however, atmospheric release is the stated alternative. The ND system may have been placed in RHR mode later in the procedure, and should be used to cool down the NC to cold shutdown.

STEP 12 Check NC subcooling based on core exit T/Cs - GREATER THAN 0°F.

PURPOSE: To determine if the NC is subcooled so that subsequent actions dependent upon subcooling can be performed.

BASIS: If NC subcooling can be verified, the LOCA is most likely small and controllable, i.e., S/I flow equals or exceeds break flow. Subsequent steps that may be allowed include deliberate NC depressurization, NC pump restart, and S/I flow reduction. If subcooling is inadequate the operator is directed to increase S/I flow to restore subcooling.

3.0 FR-H.1, LOSS OF SECONDARY HEAT SINK

3.1. Purpose

This procedure provides actions to respond to a loss of secondary heat sink in all S/Gs.

3.2. Symptoms/Conditions

The table below shows the procedures and step numbers that provide a transition to FR-H.1.

TRANSITION PROCEDURE AND STEP NUMBER	SYMPTOM
E-0, Reactor Trip Or Safety Injection, Step 16	When minimum CA flow is not verified **AND** N/R level in all S/Gs is less than 11% (32% ACC).
F-0, Critical Safety Function Status Trees, Heat Sink	On a red condition.

CAUTION If a non-faulted S/G is available, then feed flow should only be established to non-faulted S/Gs in subsequent steps.

PURPOSE: To alert the operator to not reestablish feed flow to a faulted S/G if an intact or ruptured S/G is available to receive the feed flow.

BASIS: Reestablishment of feed flow to a S/G may result in thermal or mechanical shocks to the S/G tubes that could result in tube leakage or tube rupture. If feed flow is reestablished to a faulted S/G and tube leakage resulted, control of the leakage would not be possible until the S/G secondary boundary was restored. Flow restoration to a non-faulted S/G will provide an effective and controllable secondary heat sink.

STEP 2 Check if a secondary heat sink is required:

PURPOSE: To check if a secondary heat sink is required for heat removal.

BASIS: Before implementing actions to restore flow to the S/Gs, the operator should check if secondary heat sink is required. For larger LOCA break sizes, the NC system will depressurize below the intact S/G pressures. The S/Gs no longer function as a heat sink and the core decay heat is removed by the break flow. For this range of LOCA break sizes, the secondary heat sink is not required and actions to restore secondary heat sink are not necessary. For these cases, the operator returns to the procedure and step in effect.

Since Step 19 directs the operator to return to Step 1 if the loss of secondary heat sink parameters are not exceeded, break sizes that take longer to depressurize the NC system will be detected on subsequent passes through Step 1.

If NC system temperature is low enough to place the ND system in service in RHR mode, then the ND system is an alternate heat sink to the secondary system. Therefore, an attempt is made to place the ND system in service (Enclosure 2, Placing ND In RHR Mode) in parallel to the attempts to reestablish feedwater flow. NC system pressure must be below normal ND system pressure limits. When adequate ND cooling is established, then the operator is directed to return to the procedure and step in effect.

Generic Enclosure G-2 (Placing ND in RHR Mode) contains guidance to align one, or both trains, of ND in RHR Mode; leaving one, or no train, available for auto swap to sump; or leaving one train on sump and one train in RHR mode.

The decision for alignment will be made with concurrence/guidance from TSC, if available.

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
4	Define the following terms: S_s , S_t, S_P, S_H	X	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	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	X
7	List the pumps that automatically start following a safety injection actuation.	X	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	X
11	Describe the operator action needed to block Safety Injection.			X	X	X
12	List the conditions that allow RESET of Safety Injection.			X	X	X

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

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

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

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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	011 EK3.06	
	Importance Rating	4.3	

(Knowledge of the reasons for the following responses as the apply to the Large Break LOCA: Actuation of Phase A and B during LOCA initiation)

Proposed Question: Common 42

After a transient from 100% power, the following conditions exist on Unit 1:

- NC System pressure = Containment Pressure.
- Containment Radiation Monitors in Alarm.
- All systems operated as designed.

Which ONE (1) of the following is an expected response, and the basis for the response, of the Containment Isolation System?

A. Only Phase A Containment Isolation has actuated to ensure that the NCPs will be available later to mitigate the consequences of this event.

B. Only Phase A Containment isolation has actuated to ensure that all penetrations opened directly to the Containment Atmosphere are isolated.

C. Both Phase A and Phase B Containment Isolation have actuated to isolate non-ESF related Containment piping penetrations and prevent Containment leakage.

D. Both Phase A and Phase B Containment Isolation have actuated to isolate all Containment piping penetrations and prevent Containment leakage.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. Both phases actuate (See C below). The distractor is plausible because it recognizes that Phase B actuation limits/prevents NCP Operations. However, the NCPs will NOT be needed to support subsequent operations in a Large Break LOCA, but rather, the Small Break LOCA.

B. Incorrect. Both phases actuate (See C below). While it is true that Phase A isolates all penetrations that open directly to the Containment Atmosphere (i.e. VP), Phase B also actuates.

C. Correct. Section 6.2.4 of the McGuire UFSAR states that the Containment Isolation Systems provide a means of isolating fluid systems that pass through the Containment penetrations to confine radioactivity released during a DBA to the Containment. Section 6.2.4.1.2 of the McGuire UFSAR states that "Upon receipt of either a phase A (S_T) Containment Isolation signal which is derived from the Safety Injection signal or a phase B (S_P) Containment Isolation signal which is derived from the high-high Containment Pressure signal, the Containment Isolation System closes fluid line penetrations not required for ESF operation. In other words, all non-essential lines are isolated to ensure that Containment Leakage is prevented. With the stated conditions, a Safety Injection signal (S_S) will have occurred causing the Phase A signal. Because of the Large break LOCA conditions, Containment Pressure would be > 3 psig (high-high Containment Pressure) causing the Phase B signal. Both Phase A and B actuate to prevent Containment leakage.

D. Incorrect. Containment Phase A and B actuations close CIVs, they do not close all valves in all piping penetrations into and out of the Containment (i.e. ECCS piping which provide flowpath to inject FWST water into the reactor have valves that auto open under these conditions).

Technical Reference(s)	UFSAR Section 6.2.4 (11/06)	(Attach if not previously provided)
	OP-MC-ECC-ISE p21, 27,29 Rev 30	(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: ECC-ISE #5, 6 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	7
	55.43	

Comments:
KA is matched because the item directly evaluates knowledge of reason for containment isolation

6.2.3.5.2 Annulus Pressure

Annulus pressure is controlled by recirculating to the annulus or exhausting to the station vent, as required. Pressure transmitters are provided to control the annulus pressure between -0.5 in. and -3.5 in. of water.

6.2.3.5.3 Filter Train Differential Pressure

Pressure transmitters are provided to measure the differential pressure across each filter bank. Indication is provided in the Control Room.

6.2.3.5.4 Annulus Ventilation Fans Inlet Header Flow

Flow transmitters are provided to measure the flow in the inlet header to the annulus ventilation fans. Indication and low alarm are also provided in the Control Room.

6.2.3.5.5 Carbon Filter Temperature

Temperature sensors, embedded in the carbon filter, are provided to indicate excessive filter temperature. Indication is provided in the Control Room. On a high temperature signal, a set of water sprays can be actuated to inhibit an uncontrolled fire.

6.2.3.6 Materials

Since the Annulus Ventilation System is entirely outside the Containment it is not subject to radiolytic or pyrolytic decomposition.

6.2.4 Containment Isolation Systems

The Containment Isolation Systems, shown schematically in Figure 6-172, provide the means of isolating fluid systems that pass through Containment penetrations so as to confine to the Containment any radioactivity that may be released following a design basis event. The Containment Isolation Systems are required to function following a design basis event to isolate non-essential fluid systems penetrating the Containment.

6.2.4.1 Design Basis

The design bases for the Containment Isolation Systems are indicated below:

1. A double barrier is provided for all fluid penetrations to assure that no single failure or malfunction of an active component can result in loss of isolation or intolerable leakage, except as follows: (Penetration classifications are shown schematically on Figure 6-172.)

   a. Penetration Classification D5: This arrangement is used only for the residual heat removal heat exchanger line. With this system no single failure of an active or passive component can prevent the recirculation of core cooling water or adversely affect the integrity of the Containment; therefore, the intent of GDC 57 is met.

   b. Penetration Classification C1: This arrangement is used only for the Containment sump suction lines. Passive failures are not postulated in this piping due to the low stress levels. For further details on pipe break analysis and assumptions refer to Section 3.6.2.2.1.

   c. Process instrument impulse line penetrations: Impulse lines for process instrumentation located in the Annulus employ excess flow check valves outside Containment and appropriate orificing inside Containment to maintain Containment integrity in accordance with Regulatory Guide 1.11. Solenoid valves or motor operated valves must be used on lines connected to the containment atmosphere as insufficient differential pressure will exist to close the excess flow check valves in these applications.

d. Penetration Classification D3: This arrangement is used only for the main steam lines. This penetration type contains a drain valve which does not satisfy the requirements or meet the intent of GDC-57. Although this valve can be controlled from the control room, its controls are non-safety grade and may not work when called upon to mitigate an accident. See Figure 6-172 for pictorial representation of this penetration.

2. Upon receipt of either a phase A(T) Containment isolation signal which is derived from the safety injection signal or a phase B(P) Containment isolation signal which is derived from the high-high Containment pressure signal, the Containment Isolation System closes fluid line penetrations not required for Engineered Safety Features operation. The valves which are used to isolate purge line penetrations opening directly to the Containment atmosphere close upon occurrence of a phase A Containment isolation signal or a high Containment activity (H) signal.

   Isolation valves serving Engineered Safety Features do not automatically close with the Containment isolation signal or high-high Containment pressure signal, but have the ability to be closed by remote manual operation from the Control Room to isolate any Engineered Safety Features that may malfunction.

3. All Containment isolation valves are designed to assure leak tightness and reliability of operation.

4. Isolation valves outside the Containment are located as close to the Containment as practicable, and upon loss of actuating power, automatic isolation valves are designed to take the position that provides greater safety. That is, the selection of an isolation valve operator is predicated on safety considerations. Air operated valves are selected where fail closed is required. Piston operated valves are used in fail closed and in automatic mode applications. Spring operated valves are used for automatic mode operation. Hand wheel operated valves are used where no post-accident valve operation is anticipated.

5. Remote manually operated and automatic trip isolation valves are provided with control switches and position indicators in the Control Room.

6. Isolation valves are tested as part of the integrated leakage rate tests for the Containment system and as part of periodic valve operability tests.

7. The Containment isolation system is designed to satisfy the requirements of 10CFR50, Appendix A General Design Criterion 55, 56, and 57 and Regulatory Guide No. 1.11 except as noted in (a) and (d) above here.

8. Isolation valving systems from a seismic consideration are designed the same as the piping system and/or the penetration of which they are a part, whichever is the higher classification. Section 3.9.2.8 describes penetration design criteria, and Section 3.7.2.1 describes seismic design of valves including isolation valves.

The containment valve systems are designed such that resetting of the containment isolation signal will not cause any containment isolation valve to automatically reposition. Deliberate operator action is required to reposition isolation valves following a reset of the containment isolation signal.

Table 6-111 lists the penetrations with pertinent isolation valve data with the exception of approximately 125 penetrations for process instrumentation impulse lines.

3.0 SYSTEM OPERATION

3.1 Normal Operation

Objective # 6

Safety Injection Actuation (S_S)

Actuation Signals and logic

Signal	Setpoint	Logic	Interlocks	Reason
Manual		$^1/_2$ pushbuttons		Operator Judgment
Lo-pressurizer pressure	<1845 psig	$^2/_4$ channels	P-11	LOCA Protection
Hi-containment pressure	>1.0 psig	$^2/_3$ channels		LOCA and Steam Break Protection

LOCA protection is provided by the Low Pressurizer Pressure (1845 psig) and the High Containment Pressure (1 psig) Safety Injection Signals.

Steam break protection is provided by the High Containment Pressure (1 psig) Safety Injection Signal.

Objective # 7

Safety Injection Signal (S_S) initiates the following functions:

- Reactor Trip (P4)
- D/G sequencer which in turn starts the following:
  1) **Centrifugal Charging Pumps (NV)**
  2) **Safety Injection Pumps (NI)**
  3) **Residual Heat Removal Pumps (ND)**
  4) **Idle train of Component Cooling Pumps (KC)**
  5) **Idle train of Nuclear Service Water Pumps (RN)**
  6) **Motor Driven Auxiliary Feedwater Pumps (CA)**
  7) Emergency Diesel Generator
  8) Provides start signal to normally running auxiliary building filtered exhaust fans and trips non-filtered exhaust fans

Phase "A" Containment Isolation (S_t) is actuated by a Safety Injection (S_S) or Manually ($^1/_2$ pushbuttons). Phase "A" isolates all non-essential containment penetrations. A Manual Phase "A" (S_t) actuation will also actuate S_H (Containment Ventilation Isolation). The initiate pushbutton for Phase "A" (S_t) is also the initiate pushbutton for Containment Ventilation Isolation (S_H) but they have separate reset pushbuttons. Phase "A" can be reset with S_S (Safety Injection) signal present (not reset), via Control Board Pushbuttons.

Objective # 13

Containment Spray Actuation (NS) is actuated by:

Hi Hi Containment Pressure	**>3.0 psig on $^2/_4$ channels plus CPCS**
Manually	**$^1/_2$ pushbuttons plus CPCS**

NOTE: **Initiate pushbuttons for "Phase B and Containment Spray" are the same, however "Reset" pushbuttons are separate.**

The automatic actuation of Containment Spray is one of the only functions that requires the bistable to energize to perform its required action. It is not desirable to have a loss of power actuate containment spray, since the consequences of an inadvertent actuation of containment spray could be serious. Note that this function also has the inoperable channel placed in bypass rather than trip to decrease the probability of an inadvertent actuation.

The Containment Pressure Control System (CPCS) requires a 0.35 psig CPCS signal for permissive. NS can be manually actuated with this permissive. The signal can be manually reset by (2) separate train related pushbuttons.

When containment pressure decreases to < 0.35 psig, CPCS stops the NS Pumps and closes the NS pump discharge containment isolation valves. If the NS signal has not been reset and containment pressure increases to ≥ 0.35 psig, CPCS opens the NS valves. If pressure continues to increase, at ≥ 0.8 psig, pumps restart. Having the pump restart delayed reduces starting duty cycles.

If the NS signal has been reset and containment pressure is < 0.35 psig, NS will secure as stated above. NS will not restart automatically until containment pressure increases to > 3 psig again.

The NS signal can be reset with containment pressure > 3 psig. This would be done in order to transfer NS pump suction to the containment recirc sump in accordance with EP/1(2)/A/5000/ES-1.3 "Transfer to Cold Leg Recirc".

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.

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
4	Define the following terms: S_s , S_t, S_P, S_H	X	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	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	X
7	List the pumps that automatically start following a safety injection actuation.	X	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	X
11	Describe the operator action needed to block Safety Injection.			X	X	X
12	List the conditions that allow RESET of Safety Injection.			X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	015/017 AA1.16	
	Importance Rating	3.2	

(Ability to operate and / or monitor the following as they apply to the Reactor Coolant Pump Malfunctions (Loss of RC Flow): Low Power Reactor Trip Block Status Lights)

Proposed Question: Common 43

With Unit 2 in Mode 1 the reactor does NOT automatically trip when the safety breaker to the 2C NCP inadvertently opens.

The following Permissive Bistable Status light conditions are observed:

- P-7 Lo Power Rx Trips Blocked – DARK
- P-8 Hi Pwr Lo Flo Rx Trip Blocked - LIT
- P-10 Nuclear At Power - LIT
- P-13 Turbine Not At Power – LIT

Which ONE (1) of the following identifies initial plant conditions and correctly evaluates plant response?

A. Initial reactor power was < 10%, plant response is correct.

B. Initial reactor power was > 10%, plant response is correct.

C. Initial reactor power was < 10%, auto reactor trip has failed.

D. Initial reactor power was > 10%, auto reactor trip has failed.

Proposed Answer: **B**

Explanation (Optional):

A. Incorrect. P-7 Status light will be DARK if P-10 is LIT (2of4 PR >10%) OR P-13 is DARK (1of2 TIP > 10%). In this case, P-7 is DARK because P-10 is LIT indicating PR >10%. If P-10 is LIT, power level cannot be < 10%.

B. Correct. P-7 is Dark indicating power level (Nuclear or Turbine) is > 10%. When P-7 actuates (DARK) the lower power trips are NOT blocked which means that among others the low NC System flow trip is active at 2of4 logic. Since only one NCP has tripped the required logic for an automatic trip does NOT exist.

C. Incorrect. P-7 is Dark indicating power level (Nuclear or Turbine) is > 10%. However, insufficient logic exists to demand auto trip (2of4).

D. Incorrect. P-8 light is LIT indicating power is < 48%. If power level > 48%, and P-8 DARK auto trip should occur. For these conditions with power <P-7, P-8 would not be activated and only 1 RCP will not trip the unit

Technical Reference(s)	OP-MC-IC-IPE Drawings 7.31, 32 and 36 Rev 28	(Attach if not previously provided)
		(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: IC-IPE #,10 11 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	7
	55.43	

Comments:
KA is directly matched because item evaluates status of low power reactor trips and its result on plant response for failure of an NCP (RCP)

7.36 Control Board Status Panel (11/24/03)

I/N-31B S/R CHANNEL I TRIP BYPASS
I/N-32B S/R CHANNEL II TRIP BYPASS
I/N-35A I/R CHANNEL I TRIP BYPASS
I/N-36A I/R CHANNEL II TRIP BYPASS
SPRAY ACTUATION BYPASS CH. 1 TEST
SPRAY ACTUATION BYPASS CH. 2 TEST
SPRAY ACTUATION BYPASS CH. 3 TEST
SPRAY ACTUATION BYPASS CH. 4 TEST
NC-41L NUC OVERPOWER ROD STOP CH. 1 BYP
NC-42L NUC OVERPOWER ROD STOP CH. 2 BYP
NC-43L NUC OVERPOWER ROD STOP CH. 3 BYP
NC-44L NUC OVERPOWER ROD STOP CH. 4 BYP
STEAM DUMP INTERLOCK TRAIN A BYPASSED
STEAM DUMP INTERLOCK TRAIN B BYPASSED

S/R TRAIN A TRIP BLKD HI VOLTAGE OFF	S/R TRAIN B TRIP BLKD HI VOLTAGE OFF
I/R TRAIN A TRIP BLOCKED	I/R TRAIN B TRIP BLOCKED
P/R LO SETPOINT TRAIN A TRIP BLOCKED	P/R LO SETPOINT TRAIN B TRIP BLOCKED
STM LINE S/I TRAIN A BLOCKED	STM LINE S/I TRAIN B BLOCKED
PZR LO PRESS S/I TRAIN A BLOCKED	PZR LO PRESS S/I TRAIN B BLOCKED
COND STM DUMP TRIP OPEN	COND STM DUMP MODULATION
AUTO S/I BLOCKED	SAFETY INJECTION ACTUATED
C-3 OTDT ROD STOP & TURBINE RUNBACK	C-4 OPDT ROD STOP & TURBINE RUNBACK
C-5 LO TURB IMPULSE PRESS ROD BLOCK	
C-7A LOSS OF LOAD INTLK COND DUMP	C-9 COND AVAILABLE FOR STEAM DUMP
P-6 S/R BLOCK PERMISSIVE	P-7 LO POWER RX TRIPS BLOCKED
P-8 HI PWR LO FLO RX TRIP BLOCK	P-10 NUCLEAR AT POWER
P-11 PRESSURIZER S/I BLOCK PERMISSIVE	P-12 LO-LO TAVG
P-13 TURBINE NOT AT POWER	BANK D 200 STEPS AUTO ROD WITHDRAWAL STOP

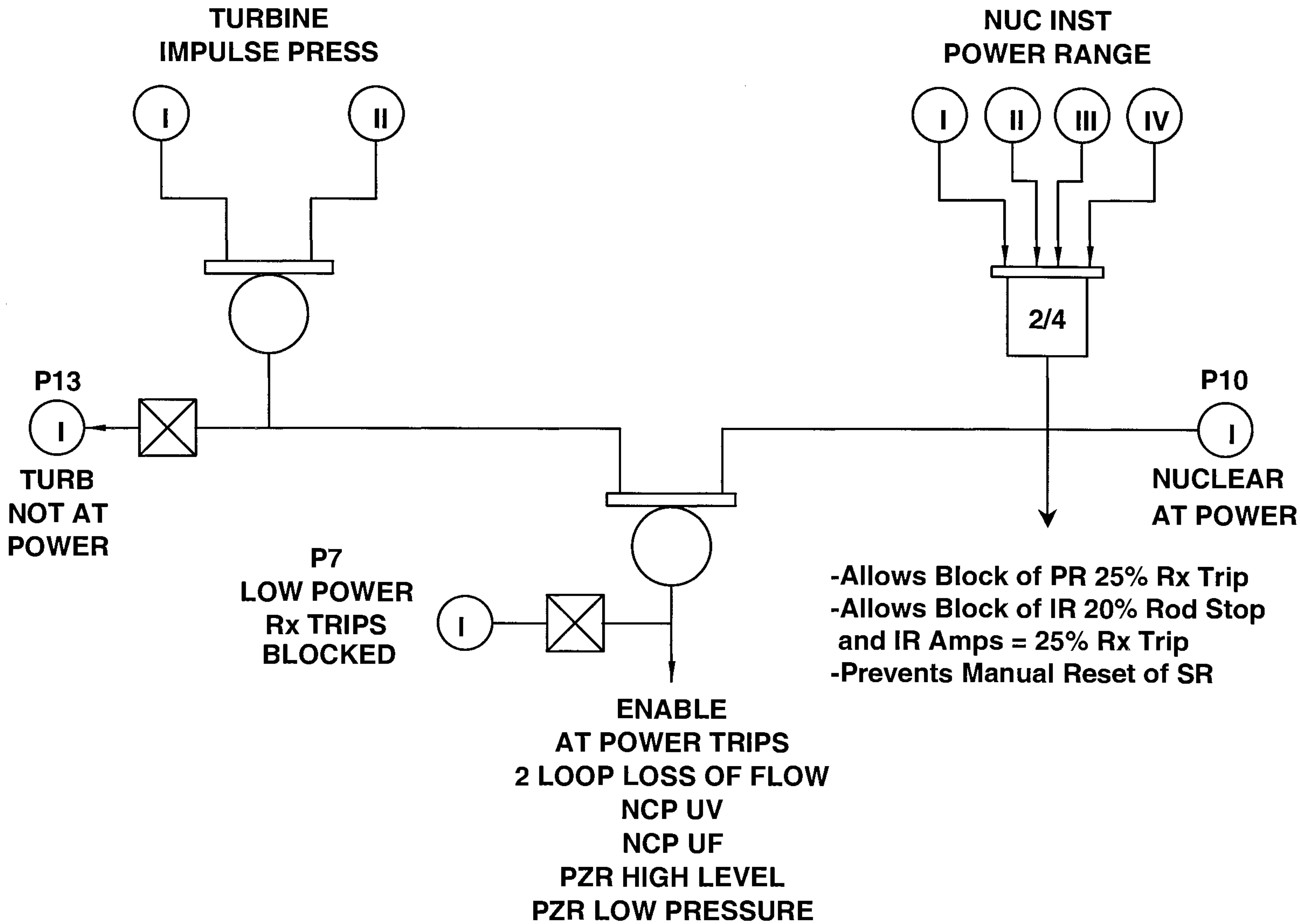
7.6 Protection Permissive Interlocks (06/15/98)

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.

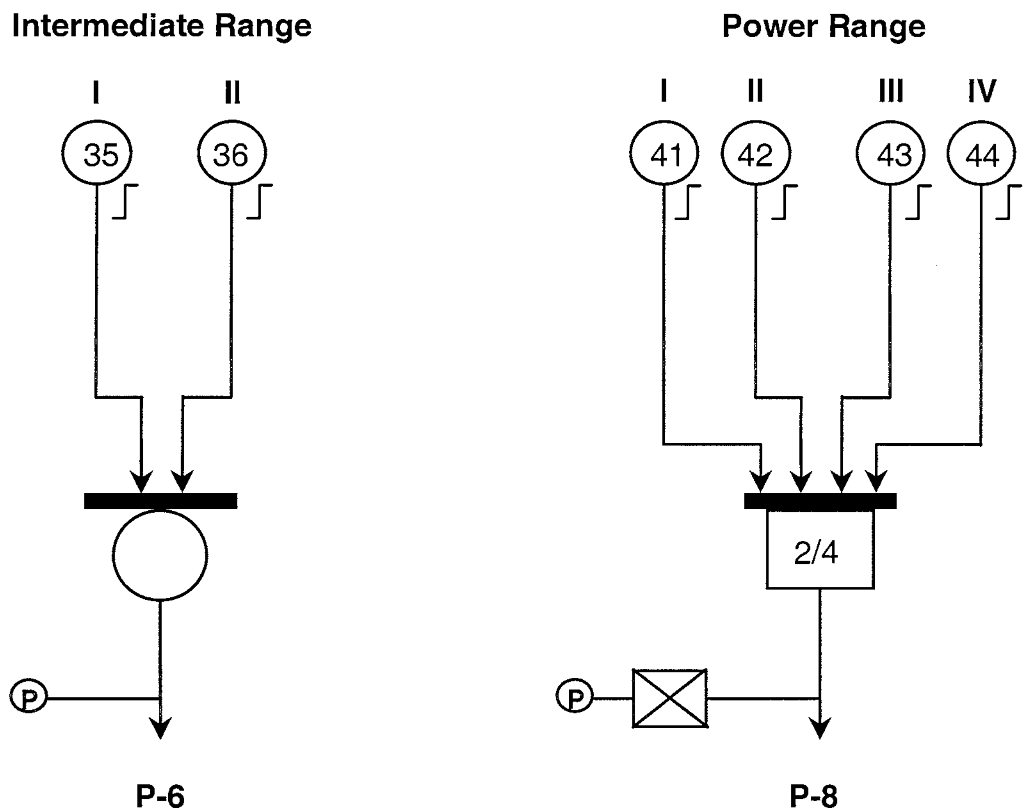
7.7 Protection Permissive Interlocks (12/17/99)

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

7.32 Permissives P-7, P-10 and P-13 (09/23/99)



7.31 Permissives P-6 and P-8 (06/15/98)



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 # 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%.

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Describe the function of the First-Out annunciator panel. ICIPE008			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
12	List all the protection system control ("C" signal) interlocks including logic and functions. ICIPE012			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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	022 AA2.04	
	Importance Rating	2.9	

(Ability to determine and interpret the following as they apply to the Loss of Reactor Coolant Makeup: How long PZR level can be maintained within limits)

Proposed Question: Common 44

The following conditions exist on Unit 2:

- 100% Steady-State conditions.
- All charging flow is lost.
- Letdown has been isolated.
- The Standby Makeup Pump cannot be started.
- Seal leakoff flow from #1 Seal on each NC Pump is 3 gpm.

Assuming that no operator action is taken, which ONE (1) of the following predicts the approximate time that MCB Annunciator 2AD-6/E-7, "Pzr Lo Level Deviation," will alarm?

(Reference Provided)

A. 1 hour.

B. 2 hours.

C. 4 hours.

D. 8 hours.

Proposed Answer: **A**

Explanation (Optional):
According to OP/2/A/6100/010G, E-7, "Pzr Lo Level Deviation," will alarm at 5% < Programmed Level.

A. Correct. If charging is lost, the net loss to the NC System is 12 gpm through the NCP seals. Using OP/1/A/6100/022 Enclosure 4.3 the operator determines that the loss of Pzr Volume required to drop level from 55% to 50% (Alarm setpoint) is ≈600 gallons (X axis to 55% yields ≈7800 gallons(on Y Axis) – X axis to 50% yields ≈7200 gallons (on Y axis) = 600 gallons). A total of 600 gallons/12 gpm = 50 minutes until Low level deviation alarm comes in.

B. Incorrect. Wrong setpoint for level alarm, inaccurate or inappropriate use of Pzr volume vs. level curve, wrong leakage assumed could result in B, C or D being selected.

C. Incorrect. See B

D. Incorrect. See B

Technical Reference(s)	OP/2/A/6100/22 Curve 7.38 Rev 434	(Attach if not previously provided)
	OP/2/A/6100/010G, E-7 Rev 47	(Including version or revision #)

Proposed references to be provided to applicants during examination: OP/2/A/6100/22 Curve 7.38 Rev 434

Learning Objective: PS-ILE #9 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam NA

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	7
	55.43	

Comments:

KA is directly matched because a loss of makeup has occurred, and applicant must determine how long PZR level will remain above alarm setpoint, based on interpretation of total seal leakoff flow

Nomenclature: **PZR LO LEVEL DEVIATION**

Window: **E7**

Setpoint: Actual level greater than or equal to 5% below programmed level

Origin: Pressurizer level channel 1 or 3, depending on position of "Pzr Level Cntrl Select" switch (2NCLT-5160 or 5170)

Probable Cause:

- Charging and/or letdown flow mismatch
- Instrument and malfunction (Level or T_{avg})
- Load transient condition
- Primary system leak

Automatic Action: None

Immediate Action:

1. Monitor Pressurizer actual level and reference level and ensure actual level is returning to program.
2. **IF** instrument malfunction, place "Pzr Level Cntrl Select" to unaffected channels.
3. **IF** reference malfunction, manually control charging flow at the appropriate man/auto station:
    - Pzr Level Master
    - 2NV-238 (Charging Line Flow Control)
    - PD Pump Speed Cntrl

Supplementary Action: Refer to Tech Specs for minimum instrument requirements.

References:

- Tech Specs
- MCFD-2553
- MCM-1399.03-47, Sh. 27

End Of Response

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

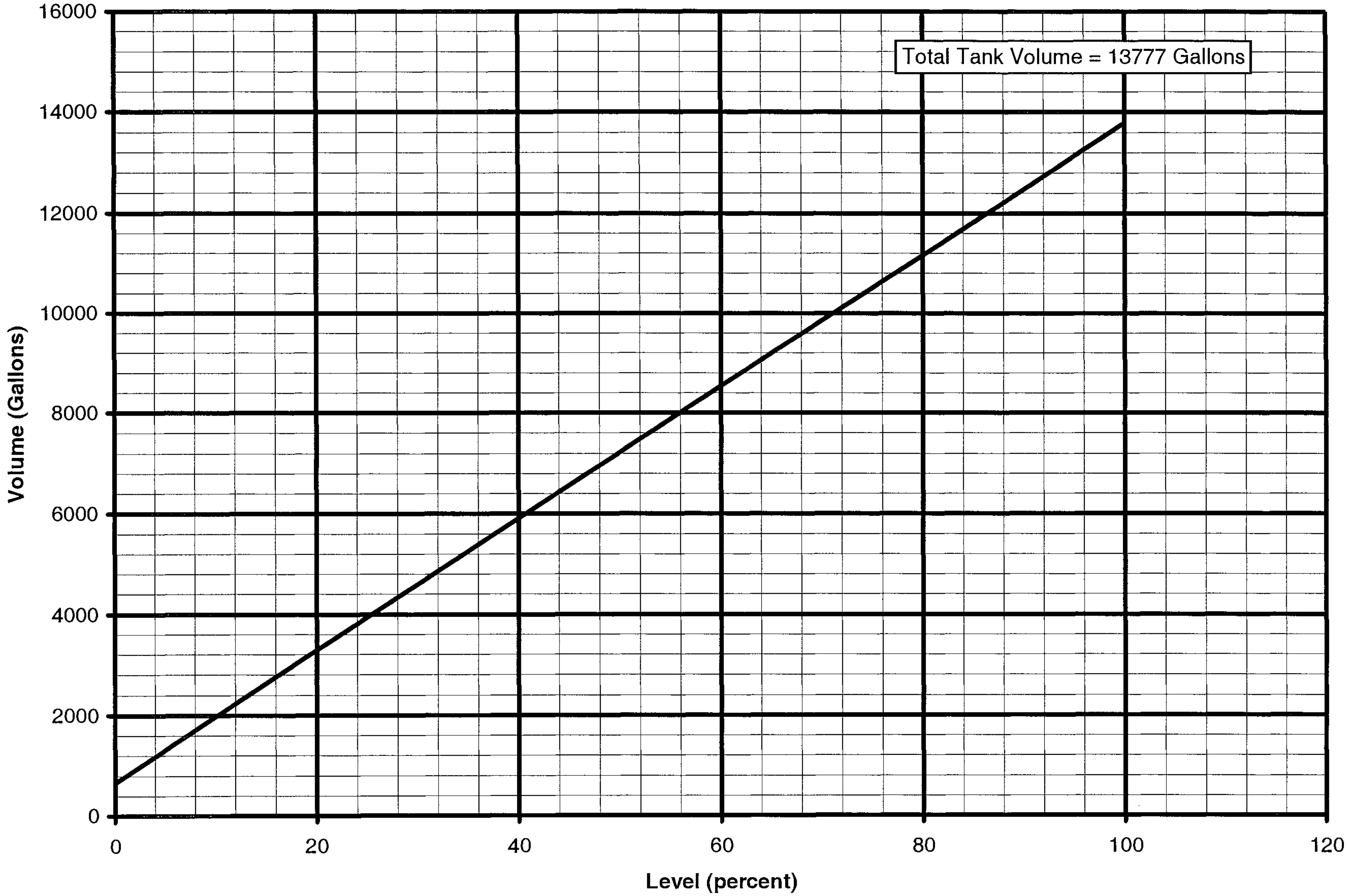
If level should decrease to less than 5% below program level an Annunciator alarm, PZR LO LEVEL DEVIATION, alerts the operator of the low level condition.

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

UNIT 2

OP/2/6 ,022
ENCLOSURE 4.3
CURVE 7.38
PRESSURIZER
(VOLUME VS. TANK LEVEL)



This data is also provided on the OAC.

UNIT 2

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	State the purpose of the Pressurizer Level Control System.			X	X	
2	Draw the Pressurizer Level Control System per training drawing 7.2.			X	X	
3	Describe the Pressurizer Level Control System Program (include values and source signal for program development).			X	X	X
4	Describe how the level in the Pressurizer is raised or lowered to match the Program Level by the Pressurizer Level Control System.			X	X	X
5	Describe the controls and indications associated with the Pressurizer Level Control System.			X	X	X
6	Describe the effect that the integral function has on the output of the Pressurizer Level Master Controller.			X	X	X
7	Describe the effect on the Pressurizer Level Control System when the setting on the potentiometer on the Pressurizer Level Master Controller is changed.			X	X	X
8	Describe the effect on the Pressurizer Level Control system when the Level Master output is increased or decreased while the controller is in manual.			X	X	X
9	Describe all automatic control functions (alarms and protection) that occur when Pressurizer level deviates from programmed level (include setpoint).			X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	025 AK2.03	
	Importance Rating	2.7	

(Knowledge of the interrelations between the Loss of Residual Heat Removal System and the following: Service water or closed cooling water pumps)

Proposed Question: Common 45

Given the following events and conditions:

- Unit 1 is approaching Mode 5 to replace a leaking Pressurizer PORV
- NC Cooldown is in progress
- A Train ND is in the RHR mode.
- A Train KC is in service at maximum design flow
- A Train RN is in service
- 1A1 KC Pump breaker trips (Overcurrent Relay)

Which ONE (1) of the following describes the effect on the NC System cooldown rate?

A. The Reactor Coolant System heats up, the KC System is unaffected.

B. No effect on the Reactor Coolant System, the KC System begins to heat up.

C. The Reactor Coolant System cooldown rate decreases as the KC System heats up.

D. The KC System only begins to heat up, but the ND System maintains a stable Reactor Coolant System cooldown rate.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. The NCS will not heatup because flow through the ND HX has not changed, and there is still some KC flow going through the HX. KC will NOT be unaffected, there is less flow trying to cool the same flow of NC. It will heat up.

B. Incorrect. The NCS will be affected. There is now less cooling water then there previously was, and the mass flowrate of the NC System has NOT changed. The KC System will begin heating up as there is less flow trying to cool the same flow of NC.

C. Correct. Previously a cooldown rate was established. The NCS will not heatup because flow through the ND HX has not changed, and there is still some KC flow going through the HX, however the cooldown rate has decreased. The KC System will begin heating up as there is less flow trying to cool the same flow of NC.

D. Incorrect. The ND System maintains a stable system flowrate, cooldown rate is dependent upon cooling system flows (KC/RN).

Technical Reference(s): OP-MC-PS-ND p.13, 27, Rev 37 (Attach if not previously provided) (Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: PS-ND, objective 8 (As available)

Question Source: Bank # McGuire NRC Bank # 521

Modified Bank # (Note changes or attach parent)

New

Question History: Last NRC Exam Not on 2005/2007 Exams

Question Cognitive Level:

Memory or Fundamental Knowledge

Comprehension or Analysis X

10 CFR Part 55 Content: 55.41 7

55.43

Comments:

Only formatting changes made from McGuire NRC Bank Question #81.

KA is matched because item evaluates effect of a loss of KC (CCW) on the ND system (RHR) and therefore, RCS

1.0 INTRODUCTION

1.1 Purpose

Objective # 1

The primary function of the Residual Heat Removal (ND) System is to transfer heat from the Reactor Coolant (NC) System to the Component Cooling (KC) System to reduce the temperature of the reactor coolant to the cold shutdown temperature at a controlled rate during the second part of normal unit cooldown and maintain this temperature until the unit is started up again.

As a secondary function, the ND System also serves as part of the Emergency Core Cooling System (ECCS) during the injection and recirculation phase of a loss of coolant accident and has the capability of providing flow to the Containment Spray (NS) System.

The ND System can also be used to transfer refueling water between the Refueling Water Storage Tank (FWST) and the refueling cavity before and after refueling operations.

1.2 General Description

Objective # 2

The ND System has two parallel flow paths each containing a pump, heat exchanger, associated piping, valves and instrumentation **(Refer to Drawing 7.1)**.

For normal cooldown (RHR Mode), the ND System takes a suction on the "C" NC loop hot leg through the ND pump and heat exchanger and discharges back into the NC cold legs. The cooldown rate is controlled by regulating ND flow through the heat exchanger. The ND System is placed in operation approximately four hours after shutdown when the temperature and pressure of the NCS are approximately 300^{0}F to 350^{0}F and less than 385 psig respectively. Assuming the two heat exchangers and two pumps are in service and that each heat exchanger is supplied with component cooling water at design flow and temperature, the ND system is designed to reduce the temperature of the reactor coolant from 350^{0}F to 140^{0}F within 16 hours. With one train available, this cooldown would take approximately 34 hours. The heat load handled by the ND System during the cooldown includes residual and decay heat from the core and reactor coolant pump heat. The design heat load is based on the decay heat fraction that exist 20 hours following reactor shutdown from an extended run at full power.

On a Safety Injection Signal (S_S), the ND pumps will automatically start and will inject water into the NC System (provided NC pressure is less than ND pump shutoff head) by taking a suction on the FWST and pumping the water into the NC cold legs (Injection Mode).

IF one KC Pump tagged, KC to associated ND HX should be throttled to less than 4000 gpm using HX manual isolation (2KC-52 or 2KC-55). (To prevent KC pump runout)

IF total KC flow to ND HXs is greater than 6000 gpm close Aux Bldg Non Essential Header crossties there is a concern that pump runout would occur during a blackout if only 2 KC pumps are energized. (One 4160V bus fails to energize.)

3.1.2. Single train operating to provide required heat loads.

Two KC pumps, one KC Heat Exchanger Auxiliary Building and Reactor Building.

One of two Reactor Building non-essential header isolation valves closed, to prevent single failure. Alarm in Control Room if both valves are open.

3.1.3 Recirc Valves

In automatic open at 1000 gpm, close at 1500 gpm.

Manual operations, if recirculation required for chemistry mixing.

3.1.4. All KC drains are routed to KC drain tank.

Drain tank pump discharged aligned to KC surge tank.

Level instrumentation automatically controls drain tank operation in "auto" by starting the drain tank pump on high level and stopping it on low level.

3.1.5 Refueling

Removes decay heat from NCS via ND Heat Exchanger. Both trains may be required to remove heat.

Objective #10

3.1.6. Control Room Indications

Component Cooling A1 & A2 pump discharge pressure (0-200 psig).

Component Cooling Heat Exchanger A inlet flow (0-10,000 gpm).

Component Cooling Heat Exchanger B inlet flow (0-10,000 gpm).

Component Cooling B1 & B2 pump discharge pressure (0-200 psig).

KC surge tank compartment B level (0-9 ft).

KC surge tank compartment A level (0-9 ft).

ND Heat Exchanger A outlet flow (0-6000 gpm).

ND Heat Exchanger B outlet flow (0-6000 gpm).

Manual Loaders

Fuel pool Heat Exchanger B outlet flow (0-2750 gpm).

Fuel pool Heat Exchanger A outlet flow (0-2750 gpm).

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 the composition of an RHR loop listed in the LCO section of Bases (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					

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	027 AK1.03	
	Importance Rating	2.6	

(Knowledge of the operational implications of the following concepts as they apply to Pressurizer Pressure Control Malfunctions: Latent heat of vaporization/condensation)

Proposed Question: Common 46

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 leaking by its seat.

Which ONE (1) of the following identifies the temperature that would be indicated on the associated safety valve discharge RTD?

(Reference Provided)

A. 258-262 °F

B. 227-231 °F

C. 161-165 °F

D. 123 -127 °F

Proposed Answer: **A**

Explanation (Optional):

A. Correct.

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.

Technical Reference(s)	OP-BNT-TH04 p34, 35, 36 Rev 5	(Attach if not previously provided)
		(Including version or revision #)

Proposed references to be provided to applicants during examination: Steam Tables

Learning Objective: OP-BNT-TH04 #31 (As available)

Question Source:	Bank #	McGuire NRC Bank # 608	
	Modified Bank #		(Note changes or attach parent)
	New		

Question History: Last NRC Exam Not on 2005/2007 Exams

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	3, 14
	55.43	

Comments:

Only formatting changes made from McGuire NRC Bank Question #608.

KA is directly matched because indications of a PZR pressure control system failure resulting in discharge to the PRT must be interpretated using knowledge of the selected KA topic.

SEQ	THERMODYNAMIC PROCESSES ENABLING OBJECTIVES	BOT	GFES
29	Define throttling. TH04042		X
30	Use the General Energy Equation to explain the results of a throttling process. TH04043	X	
31	Given a h-s (Mollier) diagram and / or the steam tables and the upstream conditions, derive downstream conditions from a throttling process. TH04044, TH04045, TH04046	X	X

$$\eta_p = \frac{w_{p,\,ideal}}{w_{p,\,real}}$$

Solving for $w_{p,\,real}$:

$$w_{p,\,real} = \frac{w_{p,\,ideal}}{\eta_p}$$

Substituting W_p with Δh:

$$h_{out\ real} = \frac{(h_{out} - h_{in})_{ideal}}{\eta_p} + h_{in,\,real}$$

Solving Δh_{ideal}:

$$(h_{out} - h_{in})_{ideal} = (600 - 200)\ \frac{BTU}{lb_m}$$

$$= 400\frac{BTU}{lb_m}$$

Substituting Δh_{ideal}:

$$h_{out,\,real} = \frac{400\frac{BTU}{lb_m}}{0.75} + 200\ \frac{BTU}{lb_m}$$

$$h_{out,\,real} = 533.3\ \frac{BTU}{lb_m} + 200\ \frac{BTU}{lb_m}$$

$$h_{out,\,real} = 733.3\ \frac{BTU}{lb_m}$$

5.6 THROTTLING

5.6.1 GENERAL ENERGY EQUATION ANALYSIS

Objective 29, 30

A throttling process is one in which the fluid is made to flow through a restriction (for example, a partially opened valve, or orifice, although the concept also applies to a pipe break) causing a considerable drop in the pressure of the fluid.

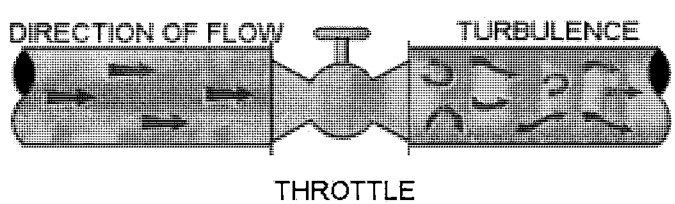


Figure 15 Throttling Process by a Valve

In performing an analysis of the throttling process, we again assume steady flow conditions ($\dot{m}_1 = \dot{m}_2$). We also select boundary locations sufficiently away from the throttling location for flow to have returned to a stable, uniform flowing condition. With these conditions, we can analyze the process as follows:

The elevation change from boundary 1 to boundary 2 is insignificant.	$PE_1 = PE_2$
Inlet piping and outlet piping diameter are equal and there is no change in fluid velocity.	$KE_1 = KE_2$
There is no work done on or done by the fluid as it flows through the throttle.	$W_{IN} = W_{OUT} = 0$
The piping is perfectly insulated so there is no heat transferred into or out of the fluid.	$Q_{IN} = Q_{OUT} = 0$

This gives us the following results for a throttling process:

$$\frac{P_1 v_1}{J} + u_1 = \frac{P_2 v_2}{J} + u_2$$

$$h_{in} = h_{out}$$

Equation 17

An ideal throttling process is a constant enthalpy process.

Throttling is a constant enthalpy process as shown in the T-s and h-s diagrams in Figure 16. Enthalpy remains constant while entropy increases, no work is done, and no heat is added. The result is a pressure drop and slight velocity increase.

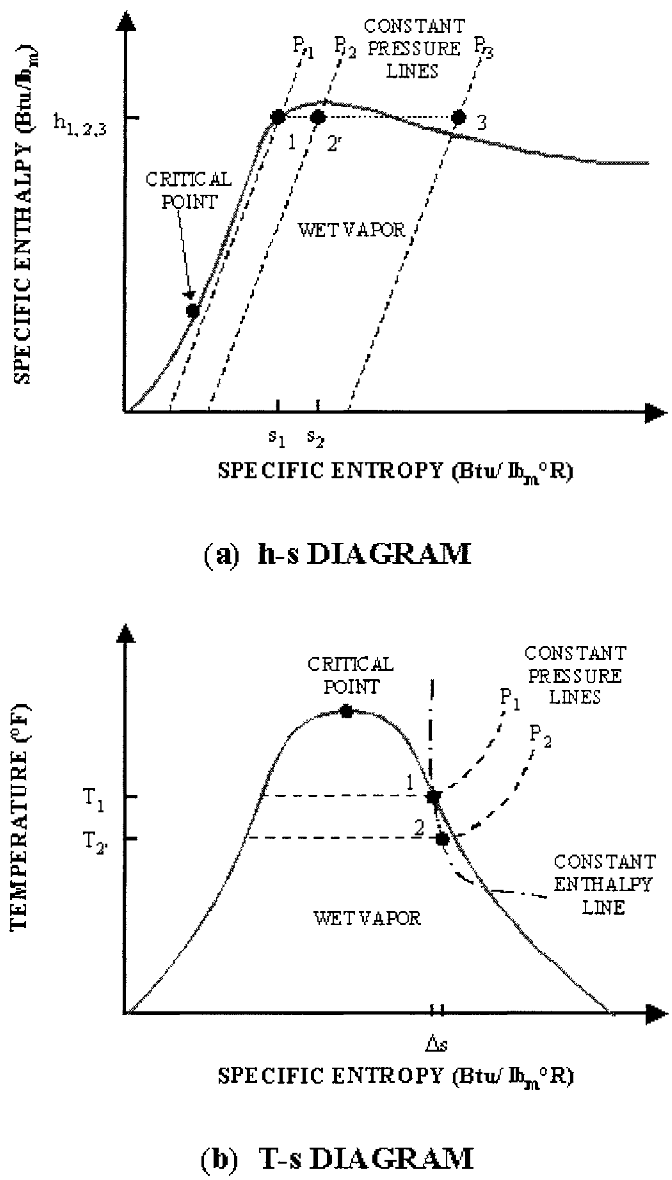


Figure 16 Property Diagrams of a Throttling Process

Throttling can be beneficial, particularly in controlling flow rate to maintain desired conditions in a system. However, the nature of the process (that is, constant enthalpy) must be understood in order to recognize throttling conditions. This was a key indication that was not clearly recognized by operators during the event at Three Mile Island.

Objective 31

Throttling problems involving steam are easily solved by using a Mollier diagram. First, determine the condition upstream of the throttle (temperature, pressure, quality or superheating) and find the corresponding point on the Mollier diagram, Then determine the downstream pressure. Go from the initial condition point along a perfectly horizontal line (constant enthalpy) until the constant pressure line for the downstream pressure is reached. The final condition is established by this point (temperature, quality or superheating).

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	029 EK2.06	
	Importance Rating	2.9	

(Knowledge of the interrelations between the and the following an ATWS: Breakers, relays, and disconnects)

Proposed Question: Common 47

The following conditions exist:

- Unit 1 is at 90% power.
- RPS Testing is in progress.
- Reactor Trip Breaker A is CLOSED.
- Reactor Trip Breaker B is OPEN.
- Reactor Trip Bypass Breaker B is Racked In and CLOSED.

During the testing the following occurs:

- The A NC Pump Shaft seizes causing a low flow reactor trip condition.
- The Reactor does NOT trip.
- Manual attempts to trip the Reactor are **successful.**

Which ONE (1) of the following identifies the Reactor Trip/Bypass Breaker trip coil that **has operated as designed** throughout the event?

A. RTA Undervoltage Coil.

B. RTA Shunt Trip Coil.

C. BYB Undervoltage Coil.

D. BYB Shunt Trip Coil.

Proposed Answer: D

Explanation (Optional):

A. Incorrect. According to Section 2.5.4 of OP-MC-IC-IPE the RTA has an undervoltage coil that when de-energized will cause trip plunger spring force will automatically open the breaker. This did not occur on the Lo flow Rx Trip signal from SSPS.

B. Incorrect. According to Section 2.5.4 of OP-MC-IC-IPE the RTA has a shunt trip coil that when energized will move the trip plunger causing the breaker to open. This did not occur on the Lo flow Rx Trip signal from SSPS.

C. Incorrect. According to Section 2.5.4 of OP-MC-IC-IPE the BYB has an undervoltage coil that when de-energized will cause trip plunger spring force will automatically open the breaker. This did not occur on the Lo flow Rx Trip signal from SSPS.

D. Correct. According to Section 2.5.4 of OP-MC-IC-IPE the BYB has a shunt trip coil that energizes for manual Rx trips and SI signals, and will move the trip plunger causing the breaker to open. This occurred as designed.

Technical Reference(s): OP-MC-IC-IPE, p21, 23, 29 Rev 28 (Attach if not previously provided) (Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: IC-IPE #3 (As available)

Question Source: Bank # ____
Modified Bank # ____ (Note changes or attach parent)
New X

Question History: Last NRC Exam NA

Question Cognitive Level: Memory or Fundamental Knowledge ____
Comprehension or Analysis X

10 CFR Part 55 Content: 55.41 7
55.43 ____

Comments:

KA is matched because operation of trip and bypass breakers is evaluated throughout an event where ATWS occurs but manual trip is successful

2.3 Solid State Protection System (SSPS)

The Solid State Protection System consist of two three-bay cabinets in the control room (Train "A" and Train "B"). The bays are designated the Input Bay, Logic Bay and the Output Bay. The SSPS receives input signals from the process and NIS channels and combines the inputs into the required logic combinations to produce Automatic Reactor Trips and Safeguards Actuations.

2.4 Reactor Coolant Pump Monitor Panel

The Reactor Coolant Pump Monitor Panel has four channels, one per pump. The system monitors voltage and frequency for each of the pumps. Under frequency is sensed between the 6.9kV breaker and the pump safety (start) breaker, while under voltage is sensed between the safety breaker and the pump itself.

Both the under voltage and the under frequency reactor trips are "at power" trips which are in effect above 10% power. A 2/4 channel logic is required in each case.

NOTE: 2/4 under frequency also trips all four NC pump safety breakers. This prevents rapid deceleration caused by decaying frequency, and allows the fly wheel inertia to prolong pump coast down.

2.5 Reactor Trip Switchgear

The control rods are powered from two parallel Rod Drive MG Sets through the reactor trip breakers. The reactor trip breaker system consists of four 1600 amp, 480 VAC, Westinghouse DS-416 circuit breakers. The breakers are arranged in a series, two train configuration with a main reactor trip (RT) and a bypass (BY) breaker associated with each train. No electrical protective relaying is associated with these breakers.

2.5.1 Main Reactor Trip Breakers

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 CRDMs thus causing a reactor trip.

Objective # 3

Each breaker has two trip coils associated with it, undervoltage and shunt trip. (See Section 2.5.4, 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.

Objective # 3

Shunt Trip Coil (SH TR 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. Originally the shunt trip attachment energized for Manual Trips and Manual Safety Injections only, however after the Salem ATWS event, the circuitry was modified such that all trips including automatic trips from SSPS energize the shunt trip coil and attachment for the main breakers. This design modification, to the main breaker switchgear compartments, added an ST relay in parallel with the UV coil. **Upon loss of SSPS 48 VDC to the UV coil, the ST relay also de-energizes closing a "b" contact to energize the SH TR coil.** The modified circuitry includes provision to test the UV trip device, the shunt trip (SH TR) device and the ST coil independently. The modification was to the main trip breaker "switchgear compartments" and NOT the "breakers," so the function applies to the main breaker compartments and not the bypass breaker compartments.

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.

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.

Inside the cubicle, located on the breaker, are:

- *Trip Plate (red) - this plate is used to ensure that the breaker is tripped prior to engaging the breaker racking tool. This plate must be depressed to allow opening the Racking Shutter.*
- *Racking Shutter (Levering Plate) - covers the area where the racking tool is inserted. To lower this plate, you must depress the trip plate and then pull down on this plate.*
- *Springs Charged/Discharged indication window.*
- *"Push-To-Close" pushbutton.*
- *Manual Charging Lever for manual charging of springs.*
- *Test-Connect-Disconnect position indicator.*

Located in the back of the reactor trip breaker cabinet are two test pushbuttons:

- *ST Test - used to test the shunt trip coil. Depressing this pushbutton will energize the shunt trip coil and open the reactor trip breaker.*
- *UV Test - this pushbutton is used to prevent the Shunt coil from energizing during a test of the UV coil. This allows verification that the UV coil and not the ST coil caused the breaker to open.*

Objective # 3

2.5.4 Reactor Trip Breaker Operation.

Any AUTOMATIC Reactor Trip sends a trip signal to two (2) breakers:

1. ***Trips the corresponding train's main reactor trip breakers by de-energizing the UV coil which in turn will energize that breaker's shunt coil as described in Note 3.***
2. ***De-energizes the opposite train's bypass reactor trip breaker's UV coil through the SSPS.***

Any MANUAL Trip (MANUAL SI OR MANUAL Reactor Trip) sends a trip signal to three (3) breakers:

1. ***Trips the corresponding train's main reactor trip breakers by directly energizing the shunt coil and de-energizing the UV coil which will also energize the shunt as described in Note 3.***
2. ***Trips the corresponding train's bypass reactor trip breaker by energizing its shunt coil.***
3. ***Trips the opposite train's bypass reactor trip breaker by de-energizing the UV coil through the SSPS.***

Main Reactor Trip Breakers:

1. The UV coils are de-energized by any trip signal. The shunt trip coils are energized by any trip signal (See **Note 3**).
2. The shunt coils are energized directly by any MANUAL trip or MANUAL SI actuation.

Bypass Reactor Trip Breakers:

1. The UV coils are de-energized by any trip signal from the opposite train.
2. Shunt coils are energized only by MANUAL trips (or MANUAL SI actuations) on the associated train as described in **Note 4**.

Note 1: The UV coil must be de-energized for it to trip the Reactor.

Note 2: The shunt coil must be energized for it to trip the Reactor.

Note 3: Anytime the main reactor trip breaker's UV coil is de-energized, a coil (ST relay) in parallel with the UV coil will also de-energize and close a contact in the shunt coil circuit which will energize the shunt trip coil.

Note 4: The reactor trip bypass breaker's UV coil circuitry (external to the breaker) does not have an ST relay in parallel with it which will energize the shunt coil as described in Note 3.

All Reactor Trip Breakers and Bypass Breakers are identical. The UV coil features in Notes 3 and 4 are associated with the cubicles, external to the breakers themselves, allowing the breakers to be used interchangeably.

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
	1.5	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
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
7	Describe how the operator knows when more than one Protection Cabinet Door is Open. ICIPE007			X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	055 EK3.02	
	Importance Rating	4.3	

(Knowledge of the reasons for the following responses as the apply to the Station Blackout: Actions contained in EOP for loss of offsite and onsite power)

Proposed Question: Common 48

A sustained total Loss of AC has occurred on Unit 1 and the Steam Generators are in the process of being depressurized to 210 psig.

The operator is cautioned prior to this action to avoid lowering Steam Generator Pressure to 110 psig.

Which ONE (1) of the following describes the basis for this Caution?

A. Depressurizing the Steam Generator to this pressure will cause reactor vessel head voiding to occur.

B. Depressurizing the Steam Generator to this pressure will cause the reactor to achieve criticality due to the cooldown.

C. Depressurizing the Steam Generator to this pressure will cause nitrogen to be injected from the accumulators.

D. Depressurizing the Steam Generator to this pressure will cause narrow range Steam Generator Level to be lost.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. While the action of depressurizing the Steam Generators will decrease NC Pressure and subcooling, and it is likely that Reactor Head voiding will occur, the Caution is not provided to alert the operator that depressurization should be stopped. In fact, a subsequent Note is provided, also before Step 26, to alert the operator to the fact that it is probable that voiding will occur, and that the depressurization should not be stopped because of this.

B. Incorrect. While the action of depressurizing the Steam Generators will reduce NC System temperature and add positive reactivity, the Caution is not provided to alert the operator that restart will occur at a specific Steam Generator pressure or corresponding NC System temperature. Rather, subsequent steps (27) are provided for the operator to check if a positive SUR exists, and if so, terminate the depressurization to allow NC System heatup and the addition of negative reactivity.

C. Correct. The Caution in ECA-0.0 prior to the performance of Step 26 states that “Lowering Steam Generator pressures to less than 110 psig will cause injection of CLA N2 into the NC System.” The background document (OP-MC-EP-ECA-0) adds that the introduction of N2 into the NC System will impede Natural Circulation in the NC System.

D. Incorrect. While the depressurization will cause narrow range level in the Steam Generators to decrease, the Caution is not provided to alert the operator that the level will be lost at a specific Steam generator pressure. Rather, a substep of Step 26 is provided to direct the operator to terminate the depressurization if narrow range level drops below 11%, restore level, and then re-initiate the depressurization.

Technical Reference(s)	ECA-0.0 Rev. 24	(Attach if not previously provided)
	OP-MC-EP-ECA-0 p45, 47, 49 Rev. 12	(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: ________ (As available)

Question Source:	Bank #		
	Modified Bank #	2348	(Note changes or attach parent)
	New		

Question History: Last NRC Exam ________

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:
KA is matched because reason for action is evaluated for a blackout condition that requires SG depresurization

Question 2348 EPECA0016 EPECA0016
1 Pt(s) During performance of ECA-0.0, (Loss of All AC Power), the S/Gs are depressurized to 210 psig.

What is the purpose of the depressurization?

A. Reduce NCS pressure to inject water from the accumulators.

B. Reduce NCS temperature to prevent inadvertent criticality.

C. Reduce decay heat load to minimize possibility of S/G dryout.

D. Reduce S/G pressure and temperature to prevent chemical hideout return.

Answer 2348
A
EP-ECA0, objective 4

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

CAUTION **Lowering S/G pressures to less than 110 PSIG will cause injection of CLA N_2 into the NC System.**

NOTE
- Depressurizing S/Gs at maximum rate will minimize NC System inventory loss.
- Control room operation of 1SV-7ABC (1C Main Steam Line PORV) is not available due to swap to SSF.
- Pzr level may be lost and reactor vessel head voiding may occur due to depressurization of S/Gs. Depressurization should not be stopped to prevent these occurrences.

26. **Depressurize intact S/Gs to 210 PSIG as follows:**

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ a. Check S/G N/R level in any intact S/G - GREATER THAN 11% (32% ACC).	a. Perform the following: __ 1) Maintain maximum CA flow until N/R level greater than 11% (32% ACC) in at least one S/G. __ 2) **WHEN** N/R level greater than 11% (32% ACC) in at least one S/G, **THEN** perform Steps 26.b through 26.h. __ 3) **GO TO** Step 27.
__ b. Ensure operator monitors Enclosure 16 (S/G Depressurization Limits) throughout the S/G depressurization.	
__ c. **WHEN** "P-11 PRESSURIZER S/I BLOCK PERMISSIVE" status light (1SI-18) lit, **THEN** depress "BLOCK" on Low Pressure Steamline Isolation block switches.	

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
26. (Continued)	
__ h. Throttle SM PORVs to maintain S/G pressures at 210 PSIG.	__ h. Dispatch operator to throttle SM PORVs to maintain S/G pressures at 210 PSIG.
27. **Check reactor subcritical as follows:**	__ **Throttle SM PORVs to stop S/G depressurization and allow NC System to heatup to obtain a negative start up rate.**
__ • I/R start up rate - ZERO OR NEGATIVE	
__ • S/R start up rate - ZERO OR NEGATIVE	
__ • W/R Neutron Flux - STABLE OR GOING DOWN.	
28. **Check S/I signal status as follows:**	
__ a. Check S/I - HAS BEEN ACTUATED.	a. Perform the following: __ 1) <u>IF AT ANY TIME</u> S/I actuated, <u>THEN</u> do Steps 28.b, 29 and 30. __ 2) <u>GO TO</u> Step 31.
__ b. Reset S/I.	
29. **Check Containment Phase A Isolation as follows:**	
__ a. Phase A - ACTUATED.	__ a. Initiate Phase A.

<u>CAUTION</u> **In the following enclosure, it is time critical to locally close 1WL-322B (Unit 1 VUCDT Inlet Cont Outside Isol), since this penetration could provide direct air path between containment and the aux bldg.**

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ b. Ensure Phase A valves closed <u>PER</u> Enclosure 17 (Phase A Containment Isolation).	

CAUTION Restoring vital battery chargers in the next step is a time critical action.

STEP 23 Align DC Busses PER Abnormal Procedure AP/1(2)/A/5500/007 (Loss of Electrical Power), Enclosure 7 (DC Bus Alignment).

PURPOSE: To conserve DC power supply by shedding non-essential DC loads from the DC busses as soon as practical.

BASIS: Following loss of all AC power, the station batteries are the only source of electrical power. The station batteries supply the DC busses and the AC vital instrument busses.

If opposite unit unavailable to supply chargers, then battery power supply must be conserved to permit monitoring and control of the plant until AC power can be restored.

STEP 24 Check NC System Integrity as follows:

PURPOSE: To check whether an immediate cooldown and depressurization is required.

BASIS: Due to the fact MNS has an independent NC pump seal injection supply system, an immediate cooldown and depressurization may not be required. Inventory should not be lost through the seals unless the SSF standby makeup pump cannot be started.

STEP 25 GO TO Step 28

PURPOSE: This step allows skipping steps associated with cooling down the plant if the SSF is operating properly and plant conditions are stable.

BASIS: Since MNS has an independent NC pump seal injection supply system, an immediate cooldown may not be required.

CAUTION Lowering S/G pressures to less than 110 PSIG will cause injection of CLA N_2 into the NC System.

PURPOSE: To alert the operator that S/G pressures must be maintained above the specified limit (110 PSIG.)

BASIS: S/Gs should be depressurized to maximize delivery (into the NC) of the water contained in the S/I accumulators while minimizing delivery of nitrogen. Maintaining S/G pressures above a value that prevents introduction of a significant volume of nitrogen into the NC ensures accumulator nitrogen will not impede natural circulation.

NOTE 1 **Depressurizing S/Gs at maximum rate will minimize NC System inventory loss.**

NOTE 2 **Control Room operation of 1SV-7ABC (C SM PORV) is not available due to swap to SSF.**

NOTE 3 **Pzr level may be lost and reactor vessel head voiding may occur due to depressurization of S/Gs. Depressurization should not be stopped to prevent these occurrences.**

PURPOSE: To inform the operator of the following.

1. The desired rate of S/G depressurization.
2. The control room does not have control of SV-7 (C SM PORV) due to swap to SSF.
3. Reactor vessel upper head voiding is possible during S/G depressurization.

BASIS:

1. The intact S/Gs should be depressurized as quickly as possible, to minimize NC inventory loss, but within the constraint of controllability. Controllability is required to ensure S/G pressures do not undershoot the specified limit.
2. The design of the SSF system provides for control of various valves from the SSF. When control is swapped to the SSF, the control room no longer has control of these valves. Some of these valves fail to their required position and remote control is not available.
3. Loss of pressurizer level and reactor vessel upper head voiding may result from the rapid depressurization of the intact S/Gs. Such a condition is anticipated and should not interfere with operator actions to depressurize the S/Gs to reduce NC pressure and temperature and to minimize NC inventory loss out of the NC seals.

STEP 26 Depressurize intact S/Gs to 210 PSIG as follows:

PURPOSE: To depressurize the intact S/Gs.

To inform the operator of the importance of maintaining at least one intact S/G N/R level above the top of the U-tubes during depressurization.

BASIS: During the rapid depressurization performed in Step 25, S/G level could drop out of the N/R, resulting in a loss of adequate heat sink. If this situation occurs, the depressurization should be stopped and CA flow reestablished until S/G N/R level is raised to greater than 11% (32% ACC).

Step 25 depressurizes the intact S/Gs, thereby reducing NC temperature and pressure to reduce NC pump seal leakage and minimize NC inventory loss.

Once intact S/G pressure is reduced to 210 PSIG, the S/G PORVs and CA flow should be controlled to maintain S/G pressure at that level until AC power is restored.

STEP 27 Check reactor subcritical:

PURPOSE: To ensure the reactor does not return to a critical condition during S/G depressurization.

BASIS: Step 26 checks for a zero or negative startup rate on the intermediate and source range channels. If a positive startup rate is detected, the RNO action requires secondary depressurization be terminated and NC temperature be allowed to go up to shut down the reactor. This step addresses the core criticality concern associated with S/G depressurization and NC cooldown.

STEP 28 Check S/I signal status:

PURPOSE: To check if an S/I signal exists.

BASIS: The secondary depressurization initiated in Step 25 will result in S/I actuation, if not already actuated, on low Pzr pressure. The operator should check S/I actuation status and reset S/I as soon as the reset delay time has expired. This reset action is consistent with the philosophy of defeating automatic loading of the emergency bus upon AC power restoration. Resetting S/I will open the individual output relays from the solid state protection cabinets, thus permitting the operator to manually load S/I equipment as instructed in the recovery procedures.

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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	056 AA1.12	
	Importance Rating	3.2	

(Ability to operate and / or monitor the following as they apply to the Loss of Offsite Power: Reactor building cooling unit)

Proposed Question: Common 49

Given the following:

- Unit 2 was operating at 100% with all systems operating normally.
- A loss of off-site power occurred.
- All equipment functioned as designed.

Which ONE of the following describes the operation of Containment Ventilation Systems ONE (1) minute after the event?

	VU Ventilation Units	VL Fans	Pipe Tunnel Booster Fans
A.	Running	Low Speed	Running
B.	Running	Low Speed	Off
C.	Running	High Speed	Off
D.	Off	High Speed	Running

Proposed Answer: **A**

Explanation (Optional):

A. Correct. All of the listed fans will be running, with VL fans in SLOW speed following a LOOP.

B. Incorrect. Pipe tunnel fans will restart, but other booster fans will NOT restart Therefore, plausible.

C. Incorrect. VL fans will be running in Low Sped, and Pipe Tunnel Booster Fans will be running.

D. Incorrect. VU ventilation units will be running, but plausible if applicant believes that they will only be running if SI occurs

Technical Reference(s)	OP-MC-CNT-VUL p41 Rev 27	(Attach if not previously provided)
		(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: CNT-VUL #5 (As available)

Question Source: Bank #
Modified Bank # (Note changes or attach parent)
New X

Question History: Last NRC Exam

Question Cognitive Level: Memory or Fundamental Knowledge X
Comprehension or Analysis

10 CFR Part 55 Content: 55.41 7, 10
55.43

Comments:
KA is matched because Containment Cooling system operation after a loss of offsite power is the entire basis for the test item

NOTE: If a Loss of Offsite Power occurs prior to a Safety Injection, the transfer to emergency power will not occur. (PIP-2-M94-0027)

The following table provides a basic summary of AHU and Fan status following an emergency signal. Please refer to the appropriate sections of this lesson for more intricate operational details.

	BLACKOUT (on affected bus)	**SAFETY INJECTION**
VL UNITS	BOTH START IN LOW SPEED. (Regardless of Switch Position)	SHUNT TRIPPED OFF, SWAPS TO EMERGENCY POWER, STARTS & RUNS IN HIGH SPEED (Regardless of Switch Position)
PIPE TUNNEL FANS	FAN STARTS AND RUNS IN LOW (Regardless of Switch Position)	SHUNT TRIPPED OFF (Control Power and Indication lost)
PZR BOOSTER FAN	THE TRAIN RELATED FAN WILL START IF SELECTED.	SHUNT TRIPPED OFF, SWAPS TO EMERGENCY POWER AND SELECTED FAN STARTS
S/G BOOSTER FANS	NOT AFFECTED IF BLACKOUT (Not on essential bus) IF LOOP THEY WILL BE OFF (No power – must be manually restarted when power restored)	NOT AFFECTED
VR FANS	BOTH START (Regardless of Switch Position)	ALL FANS SWAP TO EMERGENCY POWER AND START (Regardless of Switch Position)
VT UNITS	START (Regardless of Switch Position) (Can be swapped to "NORM" or "MAX")	ALL FANS SWAP TO EMERGENCY POWER AND START (Regardless of Switch Position) (Can be swapped to "NORM" or "MAX")
VU UNITS	BOTH START (Regardless of Switch Position) (Can be swapped to "NORM" or "MAX")	SHUNT TRIPPED OFF (Control Power and Indication lost)
RA FANS	BOTH START (Regardless of Switch Position)	SHUNT TRIPPED OFF (Control Power and Indication lost)

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	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

Examination Outline Cross-reference:

Level	RO	SRO
Tier #	1	
Group #	1	
K/A #	057 AK3.01	
Importance Rating	4.1	

(Knowledge of the reasons for the following responses as they apply to the Loss of Vital AC Instrument Bus: Actions contained in EOP for loss of vital ac electrical instrument bus)

Proposed Question: Common 50

Unit 1 is at full power with all systems selected to automatic. Given the following event:

- All Channel 1 Status lights are LIT.

Which ONE (1) of the following identifies why the crew would have to place Rod Control in Manual?

A. Power Range N41 has failed high.

B. Loop A Tavg has failed low.

C. Turbine Impulse Pressure Channel 1 has failed low.

D. Tref has failed high.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. While it is true that Power Range Channel 41 does fail on loss of 1EKVA (Indicated by Channel 1 Status lights LIT), it fails low, and auctioneered high power is used to develop the Rod Control signal. This failure will have no affect on Rod Movement.

B. Incorrect. While it is true that Loop A Tavg does fail on loss of 1EKVA (Indicated by Channel 1 Status lights LIT), it fails low, and auctioneered high Tavg is used to develop the Rod Control signal. This failure will have no affect on Rod Movement.

C. Correct. According to the AP15 Background Document, the failure of 1EKVA (Indicated by Channel 1 Status lights LIT) would cause Turbine Impulse Pressure to fail low. Since this input is used to compare Turbine power to Reactor power in the rod control circuitry, rod control would inappropriately think turbine power has gone down, and drive rods in an attempt to match reactor power.

D. Incorrect. According to the AP15 Background Document, the failure of 1EKVA (Indicated by Channel 1 Status lights LIT) would cause Turbine Impulse Pressure to fail low. Since this input is used to generate T-ref, which would fail low calling for T-avg to be lower. Tref will NOT be high.

Technical Reference(s)	AP-15 Background Document p14, 6 Rev 20	(Attach if not previously provided)
	OP-MC-IC-IRX p13, 15, 17, 43, 45 Rev 23	(Including version or revision #)
	AP-15, p3 Rev 19	

Proposed references to be provided to applicants during examination: None

Learning Objective: IC-IRX Obj 4, 5, 6, 11
AP-15, Obj 3 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	7
	55.43	

Comments:
KA is matched because the applicant must determine that a loss of power has occurred, and evaluate the reason for the action taken (rods in manual due to Tref failed low from loss of power – prevent rod motion)

The T_{ref} signal is sent to the Steam Dump Control System to determine the output of the Load Rejection Controller, the T_{avg}/T_{ref} recorder on Control Board and to the Plant computer.

T_{ref} filter provides transient suppression prior to comparing with T_{avg}.

2.5. Temperature Mismatch Signal

Objective #5, 12

Auctioneered high T_{avg} is compared to T_{ref} and a temperature mismatch signal is developed. The summer output signal is then sent to the lower scale of Control Board bargraph indicator ± 15 °F.

If $T_{avg} > T_{ref}$ a positive temperature mismatch exists and rod insertion may be required. If $T_{avg} < T_{ref}$ a negative temperature mismatch exists and rod withdrawal may be required.

2.6. Power Mismatch Signal

Objective #6, 12

The auctioneered high reactor power circuit selects the highest of all power range instruments for the output signal. The auctioneered High Nuclear Power is compared to the Turbine Power (impulse pressure) in order to anticipate changes in T_{avg}.

If reactor power and turbine power are changing at different rates, there will be an output error signal. A difference between reactor power and turbine load will not generate a mismatch signal if neither signal is changing. Reactor power could be 60% and turbine load 40% steady state and there would not be a mismatch.

Any Nuclear Power Channel removed from service should be defeated using the Power Mismatch Bypass switches.

2.6.1. Derivative Circuit

This provides an output which is proportional to the rate of change of the difference in nuclear power and turbine power. The derivative is really a rate-lag unit (rate comparator). If the rate of change between nuclear power and turbine power is zero, the long term output of the derivative will be zero, even if nuclear power does not equal turbine power. When a rate of change occurs, an output results. When the rate of change returns to zero, the output will decay to zero, but it will take several minutes.

NOTE: If input error signal is not changing, derivative circuit output would be zero.

2.2. Auctioneered High T_{avg}

The auctioneered high T_{avg} circuit selects the highest of all input loops for the output signal. The signal is processed by a compensation circuit which increases the signal for rapidly changing T_{avg}. This improves overall system response. A compensated Hi-T_{avg} filter reduces noise in the signal and prevents short duration temperature transients from affecting the Reactor Control System.

A T_{avg} Defeat Switch can be used to block a faulty signal from the auctioneered circuit, (only one loop can be cut-out). When any T_{avg} channel is removed from service, that channel should be removed from the Reactor Control System by use of the T_{avg} Defeat Switch.

Objective #12

The Auctioneered High T_{avg} signal is used in the following;

1. It is compared with each loop T_{avg} and alarms in the Control Room if it differs from any individual loop T_{avg} by ± 2 °F.
2. It is compared with 100% power T_{ref} -585°F and alarms in the Control Room if it exceeds 588 °F. This could indicate channel testing, instrument malfunction, or improper rod control (AUCT HI T-AVG).
3. It is compared with T_{ref} and generates an alarm in the Control Room if it exceeds T_{ref} by greater than ± 3 °F (T-REF/T-AUC ABNORMAL)
4. It is used for PZR Level program of 25 - 55% for 557 - 585 °F.
5. It is used to determine the output of the Load Rejection or Plant Trip Controllers in the Steam Dump Control System.
   - Hi-T_{avg} vs. No-Load T_{avg} (557 °F) (Plant Trip Mode)
   - Hi-T_{avg} vs. T_{ref} (Load Rejection Mode)
6. T_{avg}/T_{ref} summer for Temperature Mismatch signal development.
7. T_{avg}/T_{ref} Recorder (Control Room) Plant computer.

2.3. Turbine Impulse Pressure

Main Turbine First Stage Pressure Channel 1 is used to provide various indications and control system inputs. Isolation amplifiers are used to isolate control circuits from protection circuits in the event of a fault.

The impulse pressure signal is used in the following;

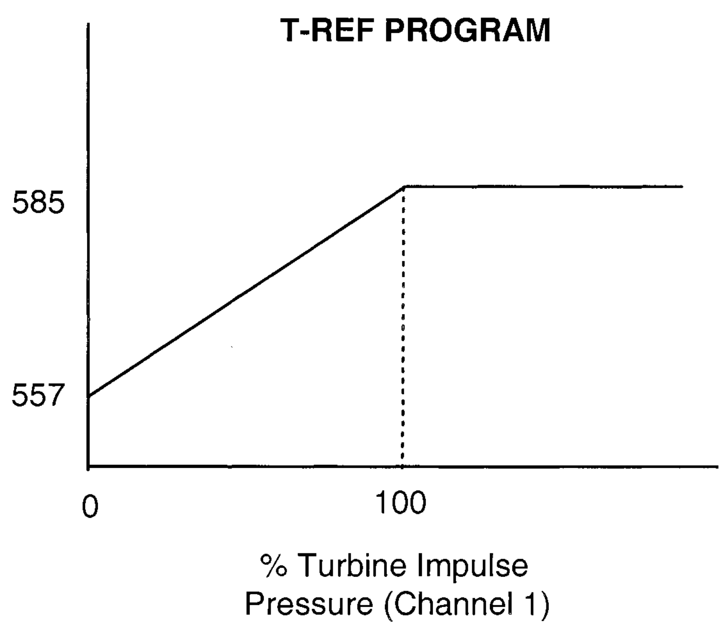
1. Permissive interlock P-13, TURBINE NOT AT POWER.
2. Develops T_{ref} program 557 - 585°F for Reactor Control circuit input.
3. Compared with auctioneered high nuclear power signal to develop an anticipatory signal for control rod response (power mismatch circuit).
4. Used for power reference in variable gain amplifier of power mismatch circuit.
5. Supplies control board indicator (0-800 psig) and plant computer.

Impulse pressure increases with increased load, even though Main Steam header pressure decreases.

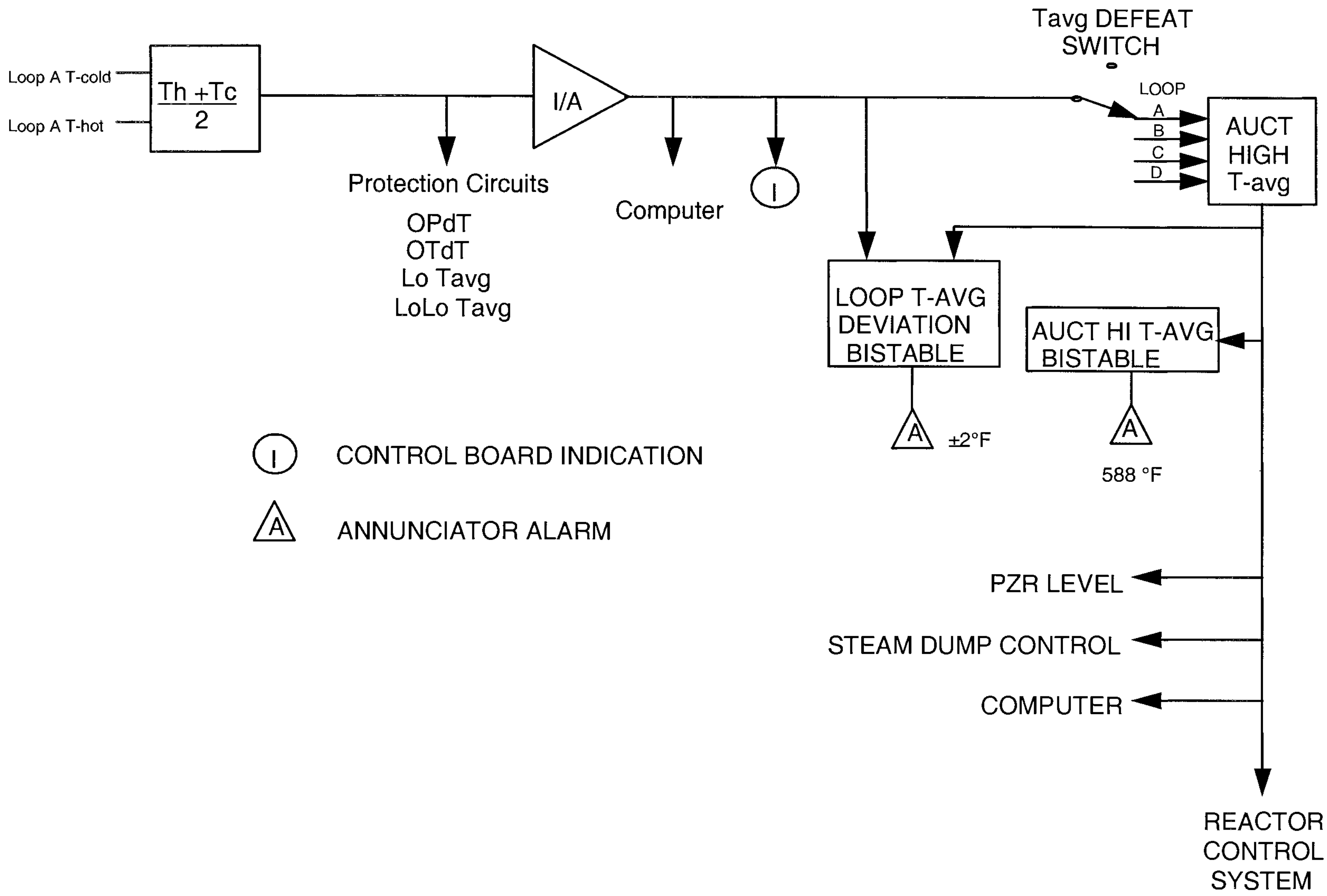
2.4. T_{ref} Program

Objective #4

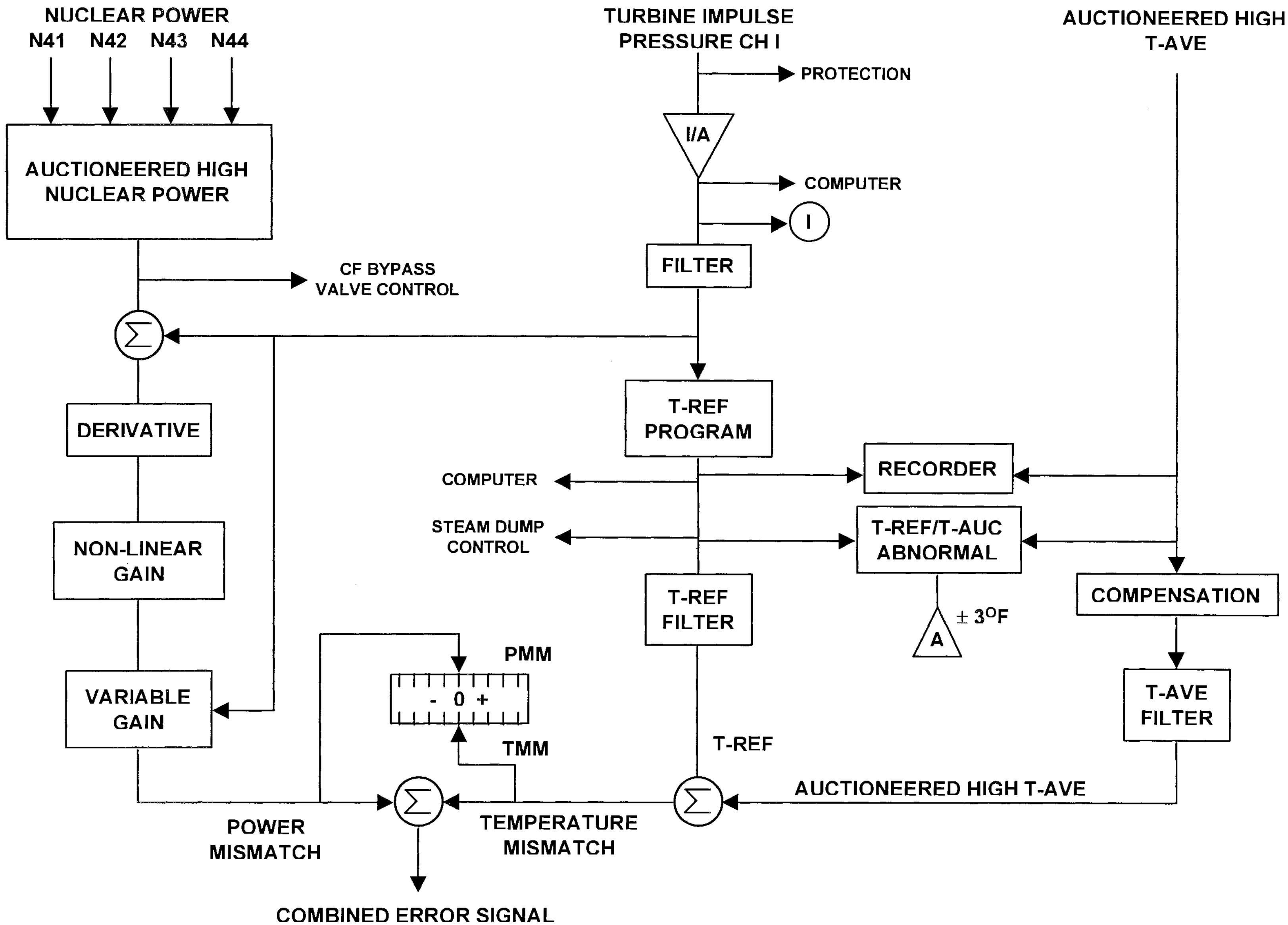
Turbine Impulse Pressure is used to generate the T_{ref} signal in order to establish a desired reference temperature for a given turbine load condition. Since impulse pressure is proportional to load, a linear ramp program is developed. A lower limit of 557 °F at 0% Load, and an upper limit 585°F at 100% Load is established.



7.1. Auctioneered High Tavg Circuit (02/22/05)



7.2. Combined Error Signal Development (8/12/02)



ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

C. Procedure Steps

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ (1.) **Check Channel 1 and Channel 2 status lights - NORMAL.**	**Perform the following:** __ a. **IF** Channel 1 failed, **THEN** place control rods in manual. b. **IF** S/G controlling channel failed, **THEN** perform the following: __ 1) Place affected CF control valves in manual. __ 2) Restore S/G levels to program. __ 3) **GO TO** Step 3.
__ 2. **GO TO Step 4.**	
3. **Ensure the following switches are selected to operable channel on each S/G:** __ • Feed flow __ • Steam flow __ • S/G level.	
__ 4. **Check ND - IN RHR MODE.**	__ **GO TO Step 7.**

STEP DESCRIPTION FOR AP

STEP 1:

PURPOSE:

Perform immediate actions to stabilize unit.

DISCUSSION:

Turb Imp Press Ch 1 is powered up from vital AC bus 1EKVA. Therefore, a loss of this bus, diagnosed by Channel 1 status lights being lit, would cause this indication to fail low. Since this input is used to compare Turbine power to Reactor power in the rod control circuitry, rod control would inappropriately think turbine power has gone down, and drive rods in an attempt to match reactor power. This input is also used to generate T-ref, which would fail low calling for T-avg to be lower, so; it's appropriate to place control rods in MANUAL. This is an immediate action step since the expectation is any time unwarranted rod motion is detected, the Operator is expected to attempt to regain rod control. Rod movement without control of the Operator is a serious condition, which could lead to flux anomalies and fuel damage if left unattended. This is the first step in the AP since reactivity management is the highest priority of the Operator. Even though other AP's (i.e., AP-14, Rod Control Malfunction) would have the Operator do this same step as an immediate action, it's appropriate to also include it in this AP. This is because a loss of an instrument bus can cause numerous alarms and indication changes, and the Operator may diagnose an instrument bus failure and enter this AP before entry into the other AP's.

A loss of EKVA will cause channel 1 inputs to the S/G level control system to fail low, while a loss of EKVB will affect Channel 2. The following transient will most likely occur. If the channels selected for control have failed, the S/G level control system will sense no level in the S/G's and rapidly open the CF control valves in an attempt to raise S/G level. This will result in CF header pressure dropping, causing the CF pump speed control system to increase pump speed and the standby Hotwell and Condensate Booster pumps to start.

The operator must take manual control of the S/G level control system by throttling closed the CF control valves to prevent S/G levels from reaching P-14 (Hi Hi S/G level). Simulator validations have shown that prompt operator action (on the order of 15 to 25 seconds) is required to prevent a S/G overfill from occurring. The operator must manually operate as many valves simultaneously as possible to prevent a reactor trip.

REFERENCES:

STEP 2:

PURPOSE:

Flowpath controlling step.

DISCUSSION:

The next step only applies to events that involve failure of vital channel 1 or 2 (EKVA or EKVB).

REFERENCES:

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
		3	3	2

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for AP/15 (Loss of Vital or Aux Control Power). AP15001			X	X	X
2	Analyze the mitigating strategy (major actions) contained in the procedure. AP15002			X	X	X
3	Given scenarios describing accident events and plant conditions, evaluate the basis for any caution, note, or step. AP15003			X	X	X
4	Given scenarios describing accident events and plant conditions, evaluate conditions which require application of continuous action steps. AP15004			X	X	X

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

- VCT level control will be affected by a loss of several control power busses (EVDA, EKVA, KXA, and KXB). Increased operator monitoring of VCT level will be necessary in these instances. On a loss of one of these buses, normal VCT make-up is unavailable, and VCT level is maintained by periodically swapping NV pump suction to the FWST. (FSAR sections consulted: 9.3.4.2, 6.3.2.2, 15.4.6.1) (Tech Specs consulted: 3.5.2)

- On a loss of a vital AC bus, the associated T-avg and power range channel will fail, which inputs the Reactor Control System. These malfunctioning instruments need to be removed from service in order to restore the reactor control system to operation, and to eliminate possible invalid alarms such as QPTR due to the malfunctioning power range detector. Steps to remove these instruments are in accordance with AP-16 (Malfunction of Nuclear Instrumentation). Removal of these instruments ensures proper operation of the Reactor Control System and various reactor power alarms such as QPTR and Power mismatch. (FSAR sections consulted: 7.7.1) (Tech Specs consulted: 3.2.4, 3.2.5)

- On a loss of KXA for Unit 1 (KXB for Unit 2), it is probable that a loss of letdown will occur due to NV-26 and NV-459 failing closed. No procedural method exists at this time to restore letdown without the use of one of these valves. Contingency actions to deal with Pressurizer level increasing are to minimize charging and for station management to evaluate performing a unit cooldown to shrink the Pressurizer water inventory until power is restored. Emergency boration will occur concurrently to ensure adequate shutdown margin exists during the cooldown. With charging at a minimum, only a small cooldown rate will be needed to accomplish this shrinkage. After verifying adequate shutdown margin, existing Operating Procedures will be used for initiating the cooldown. Credit for Xenon can be used in the SDM calculation for cooldowns to 500 Deg. (FSAR sections consulted: 4.3.2.4, 4.3.1.5, 15.4) (Tech Specs consulted: 3.1.1.1)

- One possible scenario that leads to a loss of a DC bus begins with the associated battery charger tripping. The battery will assume the loads immediately; but over time, battery voltage will decrease. At 115 volts an undervoltage annunciator will alarm in the control room, which is a symptom of this AP. Enclosure 2 will aid the operator in responding to this type of failure. Existing operating procedures will be utilized to restore a battery charger to service. However, if a charger cannot be started and battery voltage decreases to a set value (107 volts for aux control power battery), an operator will be dispatched to open the battery output breaker, thus fully deenergizing the DC bus. At 105 volts, station management will evaluate whether or not to open a vital DC battery output breaker. This is required for two reasons. First, DC components will begin to fail at a battery voltage less than that value. Secondly, the battery could be badly damaged if required to supply loads at a significantly low voltage. Below this voltage value, the battery has met its duty cycle requirements. Calc File # MCC-1381.06-00-0062 and MCC-1381.05-00-0200 substantiate these values. (FSAR sections consulted: 8.3.2, Table 8-13) (Tech Specs consulted: 3.8.2.1)

- The NF containment isolation valves fail closed on a loss of control power. If NF-233B (RB Glycol Return Cont Inside Isol) fails closed, it is imperative that the operator ensure that the supply side of the Reactor building header is also isolated to prevent a glycol spill from occurring inside containment. Guidance is given to perform this action as well as shutting down NF pumps, which would be running in a reduced flow condition. ESF alignment is unaffected by these actions. (FSAR sections consulted: 7.6.5.2.2, 6.2.2.15.1) (Tech Specs consulted: 3.6.3)

- For each control power bus, there is an enclosure identifying significant loads affected by the loss of that bus. These enclosures are for information only, and serve as a guide for the operator to use in determining Tech Spec concerns and additional operational impacts.

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	058 AK1.01	
	Importance Rating	2.8	

(Knowledge of the operational implications of the following concepts as they apply to Loss of DC Power: Battery charger equipment and instrumentation)

Proposed Question: Common 51

Unit 1 was operating at 100% power when a total loss of onsite and offsite power occurred. Given the following events and conditions:

- 1EVDA is supplying normal full power loads.
- **No** battery charger is available.
- All systems operate normally for current conditions.

Which ONE (1) of the following statements correctly describes the minimum length of time that bus 1EVDA is designed to sustain loads and what action will protect the DC bus loads?

A. After 1 hour, the vital battery bus breaker will open automatically when bus voltage falls to 105 volts.

B. After 1 hour, the vital battery breaker must be manually opened when bus voltage falls to 105 volts.

C. After 4 hours, the vital battery breaker will open automatically when bus voltage falls to 107 volts.

D. After 4 hours, the vital battery breaker must be manually opened when bus voltage falls to 107 volts.

Proposed Answer: **B**

Explanation (Optional):

A. Incorrect. The vital battery breaker does not automatically open. Plausible: partially correct - the design time for sustaining loads is 1 hour.

B. Correct. Below this value the battery could be damaged or components will begin to fail.

C. Incorrect. The battery is expected to last for 1 hour and there is no automatic trip associated with low voltage. Plausible: the 4 hour requirement for battery performance is typical of the aux batteries - voltage limit is 107 volts. (AP-15, Note prior to Step 1)

D. Incorrect. The vital batteries are not designed to sustain loads for 4 hours. Plausible: partially correct - DC bus protection is achieved by manually opening the breaker - voltage limit is 107 volts.

Technical Reference(s)	OP-MC-EL-EPL p2, 25, Rev 22	(Attach if not previously provided)
	ECA-0.0 Step 23 Rev 24	(Including version or revision #)
	AP7 Enclosure 7 Step 31, Rev 27A	
	AP-15, p 51 Rev 19	
	AP-7 Basis Document p 118, 119 Rev 6	

Proposed references to be provided to applicants during examination: None

Learning Objective: EL-EPL Obj 12 (As available)

Question Source:	Bank #	McGuire NRC Bank # 79	
	Modified Bank #		(Note changes or attach parent)
	New		

Question History: Last NRC Exam Not on 2005/2007 Exams

Question Cognitive Level:
Memory or Fundamental Knowledge X
Comprehension or Analysis

10 CFR Part 55 Content:
55.41 7, 10
55.43

Comments:

Only formatting changes made from McGuire NRC Bank Question #79.

KA is matched because a loss of DC will occur after 1 hour, and 105 volts will be minimum indication for use of battery without damage to components

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
22. **Check if S/G tubes intact as follows:**	**Perform the following:**
• The following secondary EMFs - NORMAL:	__ a. Attempt to identify the ruptured S/G(s).
__ • 1EMF-33 (Condenser Air Ejector Exhaust)	b. **WHEN** ruptured S/G(s) identified, **THEN** isolate the ruptured S/G(s) as follows:
__ • 1EMF-34(L) (S/G Sample (Lo Range))	__ 1) Isolate ruptured S/G(s) **PER** Enclosure 14 (Faulted or Ruptured S/G Isolation).
__ • 1EMF-24 (S/G A)	2) **WHEN** each ruptured S/G(s) pressure less than 1092 PSIG, **THEN** perform the following:
__ • 1EMF-25 (S/G B)	__ a) Ensure ruptured S/G(s) SM PORV closed.
__ • 1EMF-26 (S/G C)	b) **IF** ruptured S/G(s) SM PORV cannot be closed, **THEN** perform the following:
__ • 1EMF-27 (S/G D).	__ (1) Close SM PORV isolation valve.
__ • S/G levels - STABLE OR GOING UP IN A CONTROLLED MANNER.	__ (2) **IF** SM PORV isolation valve cannot be closed, **THEN** dispatch operator to close SM PORV isolation valve.
	__ 3) Ensure ruptured S/G(s) remains isolated throughout this procedure.

CAUTION **Restoring vital battery chargers in the next step is a time critical action.**

NOTE The enclosure in next step has control room and local actions. It should be coordinated from control room by SRO or other licensed operator.

__ 23. **Align DC Busses PER abnormal procedure AP/1/A/5500/07 (Loss of Electrical Power), Enclosure 7 (DC Bus Alignment).**

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

31. **IF AT ANY TIME any vital power distribution center voltage reaches 105 volts AND at least 1 hour after blackout, THEN perform the following without delay:**

CAUTION

- **If operator is dispatched to deenergize EVDA or EVDD in next step, it is critical to continue and perform Steps 31.b through 31.c immediately to control CA flow. Time critical local actions in CA pump room will be required to control CA flow on any unit with TD CA pump on.**
- **If required to deenergize two vital distribution centers, an S/I may occur on both units. If greater than P-11, EPs should be performed to terminate S/I. If less than P-11, AP/1/A/5500/35 (ECCS Actuation During Plant Shutdown) gives guidance to quickly terminate S/I and gain control of ND in RHR mode.**

a. Evaluate dispatching operator to open battery output breaker on distribution center with low voltage:

- IF EVDA Distribution Center has low voltage, **THEN** open the following breaker:

__ • EVDA - 2A (Battery EVCA Switch).

- IF EVDB Distribution Center has low voltage, **THEN** open the following breaker:

__ • EVDB - 2A (Battery EVCB Switch).

- IF EVDC Distribution Center has low voltage, **THEN** open the following breaker:

__ • EVDC - 2A (Battery EVCC Switch).

- IF EVDD Distribution Center has low voltage, **THEN** open the following breaker:

__ • EVDD - 2A (Battery EVCD Switch).

STEP DESCRIPTION FOR ENCLOSURE 7, DC Bus Alignment

In the Unit 2 AP, a check is made if Unit 1 is already addressing the concern with restoring Vital and Aux control power battery chargers. If so these steps are skipped in the Unit 2 enclosure.

VITAL Battery Chargers:

The enclosure first addresses the issue of vital battery chargers since this may be time critical. If this enclosure is initiated within 30 minutes of the BO, and it takes 10 minutes to dispatch an Operator to the battery chargers to perform the enclosure for swapping battery charger power supplies, then the operator should have the power supplies swapped in an additional 20 minutes. This should meet the 1-hour life expectancy for a vital battery without a charger.

Before checking EVCA-D chargers, EVCS is checked if in service prior to the event. If EVCS was in service, note that it can be powered from either Train “A” or Train “B” essential power, from either unit. Direction is given to use the Enclosure for swapping Battery Charger power supplies if needed to reenergize the charger.

Next Battery Chargers EVCA-D are checked running. Note there is no direct indication of a charger running on the OAC. However, if the charger is not running, there should be a “Trbl” alarm on the OAC graphic for that charger. Also, the OAC indicates if the charger is aligned to an energized bus. The absence of a trbl alarm and alignment to an energized bus should be sufficient to indicate the charger is running. If the charger is not aligned to an energized bus, direction is given to use the Enclosure for swapping Battery Charger power supplies.

Aux Control Power Battery Chargers:

If the 6900V busses have not been lost, it’s assumed these chargers have not lost power, since they are powered from shared motor control centers, which swap to the energized unit if necessary. For station loops, these chargers will be off. If this event lasts more that two hours, direction is given to use the SSF D/G to power up CXA charger. DCA/DCB batteries are good for 4 hours, so if this evolution is started within two hours, this should allow an additional two hours to make the alignments.

250VDC Auxiliary Power System

If a loss of offsite power has occurred, then the chargers for the 250 VDC batteries is lost. Direction is given after 90 minutes to reduce loads on the batteries (unneeded dead lights and emergency bearing oil pumps for CF Turbs and main turbine at zero speed). This should extend the life of this battery for the LG Air Side Backup Pump. For an extended loss of power, direction is given to open the battery output breaker at 150V to prevent damage to the battery.

Extended loss of a Vital or Aux Control Power Battery Charger:

For an extended loss of a Vital Battery Charger, the option is given if offsite power is available to swap that channels' inverters to KRP. This could extend the life of this battery.

For an extended loss of an Aux Control Power Charger, the option is given if offsite power is available to swap its inverters to alternate source. The option is also given to remove the OAC's from service to extend the battery, Unit 1 for DCA or Unit 2 for DCB.

Drop dead voltages (107V for Aux Control power and 105V for Vital) are also given to open the battery output breakers. This prevents them from being damaged so they will be available for later use, and will allow enough juice so that when power becomes available breaker control power can be restored to facilitate making the necessary breaker alignments.

Dual unit LOOP discussion:

During a dual unit LOOP, aux control power battery chargers CXA and CXB will lose power. If power cannot be restored to the battery chargers by restoring offsite power or using the SSF prior to depletion of batteries, a total loss of aux control power will occur. Since 7300 process control cabinets 5-8 are powered from aux control power, various control systems will lose power. Steps that deenergize DCA and DCB take the following actions:

- Loss of VCT level control will require swapping NV pump suction to the FWST.
- Loss of Pzr level control will require local operation of NV-238.
- Loss of Pzr pressure control will require manual control of Pzr heaters and PORVs to maintain NC pressure.
- Loss of power to TD CA pump start/stop switch will cause the pump to start. It may be desirable to trip the stop valve to eliminate complications in controlling CA flow and prevent having to run the pump in recirc long term.
- Loss of power to various fail-closed valves may isolate normal and excess letdown. Reactor vessel head vents will be used instead.

In the standby mode of operation EVCS will replace the out-of-service battery charger. During this mode of operation the out-of-service battery charger is disconnected from its distribution center with the spare charger connected to the distribution center through one of the distribution center (EVDS) breakers, discussed above. In addition, the tie breaker to the distribution center with the out-of-service battery charger must be closed.

During the "equalizing charge" mode the normal battery charger is disconnected from its distribution center and will be aligned in parallel with its respective battery. The normal battery charger will be placed in "Equalize" mode of operation. Battery charger (EVCS) will then supply the distribution center with the tie breakers closed (cross-tied with its "sister" channel). This same alignment is utilized during normal charger maintenance and battery discharge testing. During these operations, the normal charger remains in the "Float" mode.

Objective # 9

As discussed above, the breakers, associated with standby battery charger EVCS are Kirk-Key Interlocked. Referencing Training Drawing 7.1, Composite Vital I/C Drawing, may help in your understanding of the interlocks described below:

- The breakers at distribution center EVDS are Kirk Key Interlocked with each other and their respective connection box (ECB5) such that:
    1) The A Train feeder breaker from 1EMXH in ECB5 cannot be closed unless the A Train supply breaker for EVDA or EVDC (located at distribution center EVDS) is closed. ***This prevents the A Train source from supplying the B Train buses.***
    2) The B Train feeder breaker from 2EMXH in ECB5 cannot be closed unless the B Train supply breaker for EVDB or EVDD (located at distribution center EVDS) is closed. ***This prevents the B Train source from supplying the A Train buses.***
    3) Only one breaker from EVDS can be closed at a time. ***This prevents the standby charger from supplying both A Train and B Train buses.***
- In addition, the supply breakers to ECB5 (Connection Box) from 1EMXH and 2 EMXH are Kirk-Key Interlocked to prevent closure of both breakers at the same time. ***This interlock scheme in conjunction with 1 & 2 above prevent cross connection of A & B Train AC sources and minimizes mutual exposure of the two trains.***

2.2. 125 VDC Vital Instrumentation and Control Power System Batteries

Both units (Unit 1 and 2) are provided with only four 125 VDC Vital Instrumentation and Control Power System batteries. Each battery consists of 60 total cells; with each cell packaged in a clear plastic, non-combustible, shock-absorbing container with the appropriate covers, racks, and accessories. The battery is connected to its respective DC distribution center, in parallel with its respective battery charger, and located in an individual and physically separate room within the main battery room.

Objective # 12

Each battery is sized to supply the continuous emergency loads and momentary loads fed from its distribution center **(two DC buses which includes the two inverters and their panelboards)**, plus supply the loads of its sister distribution center **(two DC buses which includes the two inverters and their panelboards)**, if required, for a period of one hour. The basis for selecting a one-hour capacity is a conservative time estimate for the restoration of power to the battery chargers under the most adverse credible conditions. This one-hour duty cycle capacity was assumed during the plant's safety analysis (documented in the UFSAR) and is verified every 18 months during a battery service test.

The minimum design ambient temperature in the battery room is 60 °F; hence the battery is sized based on its capacity at 60° F since the battery capacity would be greater at a higher temperature.

Since each battery is, electrically, in parallel with its battery charger, and the battery charger output voltage is slightly higher than the battery voltage, during the "floating charge"; the battery charger actually supplies power to the respective DC loads during normal operation. However, the battery will automatically assume those DC loads, without interruption, upon loss of its respective battery charger or AC power source.

Battery bus voltage is indicated by voltmeters located on the 125 VDC vital control distribution centers. The battery bus voltage is also monitored by under-voltage relays, which alarm, on Annunciator Alarm Panel 1AD-11 (Electrical), when the battery bus voltage reaches 127 volts (at this voltage the battery is still capable of performing its intended safety function).

2.3 125 VDC Vital Instrumentation and Control Power System Distribution Centers

Each of the four distribution centers (EVDA, EVDB, EVDC, and EVDD) receive power from a battery and/or a battery charger, and supplies power to two of the eight 125 VDC power panelboards (1EVDA, 1EVDB, 1EVDC, 1EVDD, 2EVDA, 2EVDB, 2EVDC, and 2EVDD), and two of the eight static inverters (1EVIA, 1EVIB, 1EVIC, 1EVID, 2EVIA, 2EVIB, 2EVIC, and 2EVID).

Objective # 13

Either of the two same train-related buses (EVDA and EVDC / Train "A" buses or EVDB and EVDD / Train "B" buses) can be tied together through their respective bus tie breakers. This will allow two distribution centers to be fed from one battery / battery charger combination.

This system is shared between the two units (Unit 1 and 2) and provides four normally independent power channels for reactor control and instrumentation. Three of the four channels will ensure that the overall system functional capability is maintained, comparable to the original design standards for safe operation. However, a loss of any two of these channel sources will result in a reactor trip or forced reactor shutdown (Technical Specifications) of both units (Unit 1 and 2).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

NOTE Batteries are capable of carrying their associated loads for approximately the following times:

- Aux Control Power batteries - at least 4 hours
- Vital Control Power batteries - at least 1 hour.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1. **Check the following busses - ALIGNED TO OFFSITE POWER:** __ • 1ETA __ • 1ETB __ • 2ETA __ • 2ETB.	**Perform the following:** __ a. **IF AT ANY TIME** the DC bus is lost, **THEN RETURN TO** Step 1 in the body of this procedure. b. **GO TO** applicable procedure: __ • AP/1/A/5500/07 (Loss Of Electrical Power) OR __ • AP/2/A/5500/07 (Loss of Electrical Power) OR __ • EP/1/A/5000/ECA-0.0 (Loss of All AC Power) OR __ • EP/2/A/5000/ECA-0.0 (Loss of All AC Power).
__ 2. **Check EVCS - IN SERVICE PRIOR TO THIS EVENT.**	__ **Observe Note prior to Step 4 and GO TO Step 4.**

ENCLOSURES:

Unit 1 Encl 1 Response to Degraded DC Bus Voltage:

For the situation where a charger has tripped and the DC Battery is still carrying the bus, the bus voltage will degrade over time. A step in the body of this AP refers the Operator to this enclosure for compensatory actions. The Operator is reminded that under worst case situations, the Vital Batteries will last at least 1 hour, and the Aux Batteries will last at least 4 hours. Depending on which channel is lost and plant conditions, the batteries may last considerably longer. The point at which they're considered lost is when the voltage degrades to the point where the output breaker is opened (107VDC for Aux., 105VDC for Vital), as directed later in this enclosure. An overview of the enclosure is as follows:

First, the enclosure attempts to restore the affected charger to service using the following methods: swap power supplies to charger, check breaker alignment, cross tie to another bus, or use standby charger.

Secondly, the enclosure contains guidance in the event that a charger cannot be started. These actions will be implemented only if bus voltage reaches the undervoltage annunciator setpoint. At 115 volts, the battery still has significant life remaining, but comp measures should be implemented to conserve remaining battery power and prepare for total loss of DC bus. These actions include: (1) swapping the affected bus inverters to alternate source to extend battery life and prevent loss of associated AC bus, (2) reviewing the applicable load list enclosure(s) for the possibility of losing power to the bus, (3) opening the associated battery output breaker once the battery is exhausted. (Note that battery voltage is expected to decrease linearly over time from 115 volts to 105-107 volts, so the operator should be able to estimate when the battery will be exhausted.)

Unit 1 Encl 2 - 5 Restoring Power to Vital DC busses:
Unit 2 Encl 1 - 4

(Note that Unit 2 only attempts to restore power to the Unit 2 panelboard. If the entire distribution center has lost power, Unit 1's AP will address this condition.)

The cautions at the beginning of the enclosure deal with the issue of a tripped breaker. Depending on plant conditions, closing a tripped breaker may be justified prior to visual inspection and troubleshooting. Getting the bus energized quickly to avoid major operational problems versus waiting until it's certain there is no fault on the bus may be worth it from a risk/reward standpoint. Past experience has shown that breakers are capable of tripping more than once to isolate fault conditions. On the other hand, if a fault is known to exist or the breaker is visibly damaged, it would be wise to isolate the fault and repair the breaker prior to energizing the bus, since a high potential for explosion exists upon closure of a degraded circuit (PIP 1-M96-3574). Another caution emphasizes the point of not standing in front of a tripped breaker when re-closing. Although this is a good precaution anytime a breaker is closed, it is especially pertinent in this case, since an unknown fault could cause breaker failure.

First, the enclosure attempts to reclose any tripped open panelboard breaker. If this works, the enclosure is exited. If this isn't the problem, the next steps open the supply breaker to the inverters (they're not running anyway), and evaluate placing the AC bus on KRP per applicable enclosure. Then the bus is energized from its charger or via tiebreakers, whichever is desired. Generally it is preferred to energize a DC bus with its charger instead of tiebreakers, because the tiebreakers don't meet Tech Spec operability requirements and places the system at reduced redundancy. In the step that cross ties busses, opening the Main Incoming Fuse to the Distribution Center could be extremely important because it prevents tying the sister charger to a potentially degraded battery, which could draw an excessive amount of current and trip the running charger and/or result in degraded voltage on sister distribution center as well.

	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	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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	062 AA2.06	
	Importance Rating	2.8	

(Ability to determine and interpret the following as they apply to the Loss of Nuclear Service Water: The length of time after the loss of SWS flow to a component before that component may be damaged)

Proposed Question: Common 52

With Unit 1 at 100% power the following events occur:

- 1A RN Pump trips.
- Attempts to manually start 1B RN Pump fail.

The following pumps were running at the start of the event:

- 1A NV Pump
- 1A1 KC Pump
- 1A2 KC Pump

Which ONE (1) of the following identifies the pump or pumps that will reach an operating limit most quickly, and the time frame within which the limit will be reached?

A. 1A NV Pump, 15-20 minutes.

B. 1A1 and 1A2 KC Pumps, 15-20 minutes.

C. 1A NV Pump, 50-60 minutes.

D. 1A1 and 1A2 KC Pumps, 50-60 minutes.

Proposed Answer: **A**

Explanation (Optional):

A. Correct. The AP20 Background document states that the operating NV Pump will approach its operating limit in approx. 15 min.

B. Incorrect. The AP20 Background document states that with RN isolated to the KC pumps, actual operating experience has shown that the KC pumps should operate under normal flow conditions for 50 - 60 minutes prior to reaching the high temp limit.

C. Incorrect. The AP20 Background document states that the operating NV Pump will approach its operating limit in approx. 15 min.

D. Incorrect. The AP20 Background document states that with RN isolated to the KC pumps, actual operating experience has shown that the KC pumps should operate under normal flow conditions for 50 - 60 minutes prior to reaching the high temp limit.

Technical Reference(s)	AP20 Background Document p11-13, Rev 2	(Attach if not previously provided)
		(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: AP-AP20 #2 (As available)

Question Source:
Bank # ______
Modified Bank # ______ (Note changes or attach parent)
New X

Question History: Last NRC Exam ______

Question Cognitive Level:
Memory or Fundamental Knowledge X
Comprehension or Analysis ______

10 CFR Part 55 Content:
55.41 5
55.43 ______

Comments:
KA is directly matched because item evaluates loss of RN to components and length of time they may operate without RN (Service Water) Cooling

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

NOTE The intent of this step is to have one RO perform Enclosures 10 and 11 while the crew continues efforts to restore RN.

20. **Monitor bearing and stator temperatures on running pumps as follows:**

    a. Designate an operator to perform the following enclosures concurrently while remainder of crew continues in the body of this procedure:

    __ • **IF** NV pump running, **THEN** perform Enclosure 10 (Charging Pump Operation without RN Cooling)

    __ • **IF** KC pump running, **THEN** perform Enclosure 11 (KC Pump Operation without RN Cooling).

possibly **increase** if cooling to the seals is reestablished because of warping of the seal components. This could push the seal leak-off flow rate beyond the capacity of normal charging to maintain NC inventory.

If an NV pump is running, an operator is dispatched to standby outside the NV pump rooms. If necessary, motor cooler drain valves can be opened to establish cooling via gravity drain to the sump.

<u>REFERENCES:</u>
DW-94-011 and WCAP-105541
PIP-99-1700, Calc file MCC-1223.24-00-0082
PIP M-95-1841

<u>CASE I STEP 20</u>:

<u>PURPOSE:</u>

Monitor NV and KC Pumps for overheating and stop them if high temperatures are reached.

<u>DISCUSSION:</u>

Actions are taken in this step (and the associated enclosure) to attempt to maintain an NV pump or PD pump in operation. Charging pumps can be swapped back and forth as they heat up, buying time to restore RN and possibly not have to open pump drains or start Standby Makeup Pump. The operating NV Pump will approach its operating limit in approx. 15 min. At this time a swap is made to the idle NV Pump, if available. Since the idle pump is starting with ambient bearing temperatures, the operating limit will be approached in approx. 30 min (PIP-99-1700, Calc file MCC-1223.24-00-0082). If its limits are approached, a swap to the PD pump is made. After the PD Pump has been run, a swap to the original NV Pump is made and if RN or RV cooling has not yet been restored, the pump drains are opened. Along with opening the pump and motor cooler drains, the NV cooler RN outlet is closed. The cooling water flow path is back from the discharge header through other essential header components, to the supply side on the NV pump, through the coolers and out the drains. If a RN Pump is subsequently restored, this alignment will have to be undone to allow normal cooling flow.

After restoring RN cooling, the drains (20 GPM per pump) should be closed as soon as possible to alleviate flooding concerns. If temperature limits are approached with the drains open, the Standby Makeup Pump is started, the NV Pump is stopped and drains closed

Note: the temperature limits listed in the AP are 10°F below the maximum allowed operating limits for the pumps to allow time for compensatory action to be taken without actually exceeding the limits. The exception is the second NV pump temperature is 20°F below the limit because extra time is needed to get a PD Pump running, before the NV pump can be secured.

With RN isolated to the KC pumps, actual operating experience has shown that the KC pumps should operate under normal flow conditions for 50 - 60 minutes prior to reaching the high temp

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)/5500/20 (Loss of RN): • State the purpose of the AP • Recognize the symptoms that would require implementation of the AP. AP2001			X	X	X
2	Given scenarios describing accident events and plant conditions, evaluate the basis for any caution, note, or step. AP2002			X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	065 AA2.08	
	Importance Rating	2.9	

(Ability to determine and interpret the following as they apply to the Loss of Instrument Air: Failure modes of air-operated equipment)

Proposed Question: Common 53

Given the following:

- Both Units are at 100% power.
- MNS experiences a total loss of VI.
- Operators on both Units implement the appropriate response procedures.
- VI Header pressure on both units is 30 psig and decreasing.

Assuming VI header pressure continues to decrease, which ONE of the following will be the FIRST failure to cause a reactor trip?

A. OT Delta T trip due to MSIVs failing closed.

B. High-High SG level trip because Feedwater Reg Valves fail open.

C. Turbine Trip due to Feed Pump Trip because Feedwater Reg Valves fail closed.

D. High Pressurizer Level trip due to the Charging Flow Control Valve failing open with Letdown isolated.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. If MSIVs fail closed it could cause a trip on LO-LO SG level or on OTDT due to Tave rising. FRVs failing will cause the trip significantly faster than MSIV failure. Plausible because until a recent mod, the MSIVs did fail close on a loss of VI.

B. Incorrect. Feedwater reg valves fail closed, but plausible because this is the reactor trip mechanism if they did fail open.

C. Correct. Reactor trip will occur due to turbine trip. If fedwater reg valves fail closed, Feed Pumps will trip on high discharge pressure, which directly causes a turbine trip.

D. Incorrect. This would cause a reactor trip, but at a significantly later time than feedwater reg valve failure. Charging flow control valve fails open and letdown isolates on loss of air, so PZR level will be rising

Technical Reference(s)	AP-22 Background Document (p22 Rev 12)	(Attach if not previously provided)
	AP/1/A/5500/22 Enclosure 12 p104 106, Rev 27	(Including version or revision #)
	CF-CF p19 Rev 32	

Proposed references to be provided to applicants during examination: ______

Learning Objective: CF-CF Obj 4 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam ______

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	5
	55.43	

Comments:
KA is matched because item evaluates the failure mode of air operated equipment that will cause a reactor trip

STEP 25:

PURPOSE:

Ensure MSIVs are placed in their safeguards position

DISCUSSION:

The MSIVs have a safety related air accumulator on each MSIV to provide an air-assist-to-close function. As long as accumulator pressure is above 60 PSIG, the accumulator will provide an assured pressure source for one valve closure. If VI header pressure goes below 60 PSIG, air in the accumulator may eventually leak below the 60 PSIG operability limit for the tank. To ensure the MSIVs will be in their safeguards position during a safeguards event, they are manually closed before the accumulator tank has a chance to leak below 60 PSIG.

Another feature of the MSIV air accumulator tank is that it will prevent the MSIVs from failing closed following a loss of VI event. If air in the tank were allowed to fully deplete, spring pressure would probably be sufficient to close the valve, even without the air-assist-to-close feature. If the MSIVs were left open after the pressure in the accumulator tank bled down, the valves would begin to fail closed. Then if the valves were in an intermediate position when VI was restored, they would automatically reopen, potentially causing a cooldown and/or steamline hammer. A secondary purpose of this step is to ensure the MSIVs are closed prior to this occurring.

REFERENCES:

NOTE The valves listed in this enclosure fail at various air pressures.

1. **BB valves:**

   a. The following BB valves fail closed:

   __ • 1BB-1B (1A S/G Blowdown Cont Outside Isol Control)
   __ • 1BB-2B (1B S/G Blowdown Cont Outside Isol Control)
   __ • 1BB-3B (1C S/G Blowdown Cont Outside Isol Control)
   __ • 1BB-4B (1D S/G Blowdown Cont Outside Isol Control)
   __ • 1BB-5A (A S/G BB Cont Inside Isol)
   __ • 1BB-6A (B S/G BB Cont Inside Isol)
   __ • 1BB-7A (C S/G BB Cont Inside Isol)
   __ • 1BB-8A (D S/G BB Cont Inside Isol)
   __ • 1BB-123 (1A S/G Blowdown Throttle Control)
   __ • 1BB-124 (1B S/G Blowdown Throttle Control)
   __ • 1BB-125 (1C S/G Blowdown Throttle Control)
   __ • 1BB-126 (1D S/G Blowdown Throttle Control).

2. **CA valves:**

   a. The following CA valves fail open:

   __ • 1CA-60A (1A CA Pump Disch To 1A S/G Control)
   __ • 1CA-56A (1A CA Pump Disch To 1B S/G Control)
   __ • 1CA-44B (1B CA Pump Disch To 1C S/G Control)
   __ • 1CA-40B (1B CA Pump Disch To 1D S/G Control)
   __ • 1CA-64AB (U1 TD CA Pump Disch To 1A S/G Control)
   __ • 1CA-52AB (U1 TD CA Pump Disch To 1B S/G Control)
   __ • 1CA-48AB (U1 TD CA Pump Disch To 1C S/G Control)
   __ • 1CA-36AB (U1 TD CA Pump Disch To 1D S/G Control).

3. **CF valves:**

   a. The following CF valves fail closed:

   __ • 1CF-32AB (1A S/G CF Control)
   __ • 1CF-23AB (1B S/G CF Control)
   __ • 1CF-20AB (1C S/G CF Control)
   __ • 1CF-17AB (1D S/G CF Control)
   __ • 1CF-104AB (1A S/G CF Control Bypass)
   __ • 1CF-105AB (1B S/G CF Control Bypass)
   __ • 1CF-106AB (1C S/G CF Control Bypass)
   __ • 1CF-107AB (1D S/G CF Control Bypass).

Objective # 4

The conditions which will result in both main feed pumps tripping:

- if all three CBPs trip
- on a Safety Injection actuation
- on S/G Hi-Hi-level (P-14)(83%)
- on Hi Hi Dog House level in either inner or outer Dog House (12 inches)

The conditions which will result in tripping the associated main feed pump:

- two out of three of its suction pressure switches are low (230 psig)
- two out of three of its discharge pressure switches are high (1435 psig)
- manual trip
- two out of three low bearing oil pressure (7 psig)
- two out of three low vacuum (14 inches Hg)
- overspeed
- fire lockout
- thrust bearing wear (0.01 inch axial movement)

The status of the suction and discharge pressure switches can be determined from the "Condensate 2 of 3 Logic Panel" located in the Turbine Building basement near the BB demineralizer room across for Column 1F24 (refer to Drawing 7.3).

When A(B) CF pump is tripped, solenoid valve 1CFSV0010 (1CFSV0040) is energized which closes A(B) CF Pump piston operated discharge check valve CF1 (CF4). This will prevent flow reversals through the idle pump and prevent damage to the pump and piping due to waterhammer.

The CF pump suction (CM266 and CM272) and discharge (CF2 and CF4) valves are motor operated valves which can be controlled using OPEN/CLOSE pushbuttons from MC-10 (refer to Drawing 7.4). The A(B) CF pump turbine high and low pressure stop valves can not be raised (opened) until its suction valve CM266 (CM272) and its discharge valve CF2(CF5) are open, as well as the CM Booster Pump recirc valve CM250 and CF System Flush Valve CF124 are closed. In addition CF124 can not be opened unless A CFP suction valve (CM266) and discharge valve (CF 2) are open OR B CFP suction valve (CM272) and discharge valve (CF 5) are open, and both CF pump turbines are tripped.

8. **NV valves:**

a. The following NV valves fail open:

- __ • 1NV-16A (NV Supply To D NC Loop Isol)
- __ • 1NV-13B (NV Supply To A NC Loop Isol)
- __ • 1NV-34A (A NC Pump Seal Return Isol)
- __ • 1NV-50B (B NC Pump Seal Return Isol)
- __ • 1NV-66A (C NC Pump Seal Return Isol)
- __ • 1NV-82B (D NC Pump Seal Return Isol)
- __ • 1NV-124 (Letdown Pressure Control)
- __ • 1NV-238 (Charging Line Flow Control)
- __ • 1NV-241 (U1 Seal Water Inj Flow Control)
- __ • 1NV-267A (Boric Acid To Blender Control).

b. The following NV valves fail to the VCT position:

- __ • 1NV-27B (Excess L/D Hx Otlt 3-Way Cntrl)
- __ • 1NV-127A (L/D Hx Outlet 3-Way Temp Cntrl)
- __ • 1NV-137A (NC Filters Otlt 3-Way Cntrl).

c. The following NV valves fail closed:

- __ • 1NV-1A (NC L/D Isol To Regen Hx)
- __ • 1NV-2A (NC L/D Isol To Regen Hx)
- __ • 1NV-21A (NV Spray To PZR Isol)
- __ • 1NV-24B (C NC Loop To Exs L/D Hx Isol)
- __ • 1NV-25B (C NC Loop To Exs L/D Hx Isol)
- __ • 1NV-26 (U1 Excess L/D Hx Outlet Cntrl)
- __ • 1NV-35A (Variable L/D Orifice Outlet Cont Isol)
- __ • 1NV-39A (A NC Pump Standpipe Fill)
- __ • 1NV-55B (B NC Pump Standpipe Fill)
- __ • 1NV-71A (C NC Pump Standpipe Fill)
- __ • 1NV-87B (D NC Pump Standpipe Fill)
- __ • 1NV-92A (NC Pumps Seal Byp Return Hdr Isol)
- __ • 1NV-121 (U1 ND Letdown Control)
- __ • 1NV-167A (VCT Vent To WG Isol)
- __ • 1NV-171A (BA Blender To VCT Inlet)
- __ • 1NV-175A (BA Blender to VCT Outlet)
- __ • 1NV-457A (45 GPM L/D Orifice Outlet Cont Isol)
- __ • 1NV-458A (75 GPM L/D Orifice Outlet Cont Isol)
- __ • 1NV-459 (U1 Variable L/D Orifice Outlet Flow Cntrl)
- __ • 1NV-840A (U1 ND To Pzr Aux Spray Control).

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
2.5	2.5	2.5	2.5	1.5

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose of the Main Feedwater System.	X	X	X	X	
2	Describe or sketch the Main Feedwater System per Drawing 7.1.	X	X	X	X	
3	Discuss the normal (CF) pressures prior to entering and after leaving the Main Feed pumps.	X	X	X	X	
4	Evaluate the trips of the Main Feedwater pump turbine.	X	X	X	X	
5	Explain the windmill protection for the Main Feedwater pumps.	X	X	X	X	X
6	Explain the operation of the CFP recirc valve manual loader and its lineup during normal operation.		X	X	X	
7	Discuss the CF flow setpoints between which the CFP recirc valves modulate open and closed.		X	X	X	
8	Explain the operation of the CFP recirc valve closure circuit.		X	X	X	X
9	Discuss the temperature increase across both sets of High Pressure Heaters.	X	X	X	X	
10	Explain the operation of the Main Feedwater Containment Isolation Valves.	X	X	X	X	

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	E04 EK1.2	
	Importance Rating	3.5	

(Knowledge of the operational implications of the following concepts as they apply to the (LOCA Outside Containment): Normal, abnormal and emergency operating procedures associated with (LOCA Outside Containment).)

Proposed Question: Common 54

Given the following:

- Unit 1 has tripped.
- A LOCA Inside **and** Outside Containment is in progress.
- ND relief valves are lifting and stuck open.
- The PRT has ruptured.
- Containment pressure is rising.
- NS actuation has occurred.
- The crew is performing ECA-1.2, LOCA Outside Containment.

The following conditions exist:

- ND Pumps secured.
- Leak isolation has NOT been verified.
- Containment pressure 4.5 psig.
- BOTH trains of NS operating, aligned to FWST

Which ONE of the following describes the action required for NS operation in accordance with ECA-1.2?

A. Both NS Pumps must be stopped to conserve FWST inventory.

B. ONLY ONE (1) NS pump may be stopped to minimize depletion rate of FWST.

C. Both NS pumps will remain running until actions of FR-Z.1, Response to High Containment Pressure, are complete.

D. Both NS pumps will remain running until no longer required after transition to E-1, Loss of Reactor or Secondary Coolant.

Proposed Answer: A

Explanation (Optional):

A. Correct. If Containment Presure is below 10 psi, then both NS pumps must be secured.

B. Incorrect. Plausible because it is the action that would be taken if containment pressure was above 10 psi

C. Incorrect. ECA-1.2 provides its own guidance for operation of NS pumps. FR-Z.1 would also provide guidance, but ECA-1.2 would be the governing procedure

D. Incorrect. Plausible because operation of NS pumps is addressed in E-1, but ECA-1.2 is the governing procedure for operation of these pumps at this time.

Technical Reference(s): ECA-1.2 Rev. 3 (Attach if not previously provided)

EP-E1 p251 Rev 17 (Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: EP-E1 #4 (As available)

Question Source:
Bank # ______
Modified Bank # ______ (Note changes or attach parent)
New X

Question History: Last NRC Exam ______

Question Cognitive Level:
Memory or Fundamental Knowledge ______
Comprehension or Analysis X

10 CFR Part 55 Content:
55.41 10
55.43 ______

Comments:
KA is matched because the item evaluates operation of NS (containment spray)

during specific conditions with a LOCA Outside Containment

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

4. **Stop ND pumps and isolate potential FWST depletion path as follows:**

__ a. Reset S/I.

__ b. Reset Sequencers.

__ c. Stop both ND pumps.

d. Close the following valves:

__ • 1ND-19A (1A ND Pump Suction From FWST or NC Isol)

__ • 1ND-4B (1B ND Pump Suction From FWST or NC Isol)

__ • Enable power disconnect and close 1FW-27A (Unit 1 FWST to ND Pumps Isol).

NOTE

- ND relief valves go to PRT. If relief valves are also open, this may lead to NS actuation. NS must be secured if loss of inventory is occurring both inside and outside containment to conserve FWST inventory.
- The next step takes priority over steps that start NS pumps in EP/1/A/5000/FR-Z.1 (Response To High Containment Pressure), even after exiting this EP. FR-Z.1 should not be implemented while in this procedure.

5. **IF AT ANY TIME NS actuates, AND NS suction is aligned to FWST, THEN operate NS pumps as follows:**

• **WHEN** containment pressure is less than 10 PSIG, **THEN** ensure both trains of NS are off as follows:

__ a. Reset Containment Spray.

__ b. Stop both NS pumps.

__ • **WHEN** containment pressure is greater than 10 PSIG, **THEN** operate one NS pump.

NOTE: **ND relief valves go to PRT. If relief valves are also open, this may lead to NS actuation. NS must be secured if loss of inventory is occurring both inside and outside containment to conserve FWST inventory.**

The next step takes priority over steps that start NS pumps in FR-Z.1, even after exiting this EP. Z.1 should not be implemented while in this procedure.

STEP 5 **IF AT ANY TIME NS actuates, AND NS suction is aligned to FWST, THEN operate NS pumps as follows:**

BASIS: (applies to notes also)

ND relief valves during an ISLOCA may eventually cause a containment spray signal (3 PSIG in containment). With a LOCA outside containment occurring, we cannot risk transfer of ECCS pumps to the sump, since sump inventory may be inadequate. ND pumps may also not be available to support sump recirc. NS actuation would deplete the FWST needed for NV and NI pumps and core cooling. Containment pressure setpoint used for manual operation of NS is consistent with ECA-1.1.

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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	GKA 2.1.23 (E11)	
	Importance Rating	4.3	

(Conduct of Operations: Ability to perform specific system and integrated plant procedures during all modes of plant operation.)

Proposed Question: Common 55

The following conditions exist on Unit 1:

- Large Break LOCA inside containment.
- No ND Pumps are available.
- Control Room has implemented ECA-1.1, Loss of Emergency Coolant Recirc.
- 1A NV Pump running at 400 gpm.
- 1A NI Pump running at 400 gpm.
- 1B NI Pump running at 400 gpm.
- The Standby Makeup Pump is unavailable.
- The Reactor Trip occurred 31 minutes ago.

You have been directed to use Enclosure 9 of ECA-1.1 to determine required SI flow, and minimize SI flow by stopping one or more SI pumps while maintaining greater than or equal to the required flow.

Which ONE (1) of the following actions is required in accordance with ECA-1.1?

(Reference Provided)

A. Stop both 1A and 1B NI Pump.

B. Stop either 1A or 1B NI Pump.

C. Stop the 1A NV Pump, and either 1A or 1B NI Pump.

D. Leave the NV and NI Pumps running because they are needed for cooldown.

Proposed Answer: **B**

Explanation (Optional):

The direction is provided by Step 21 RNO of ECA-1.1. This step would be implemented if Cold Leg recirculation is unavailable, the reactor core is cooled, but sufficient subcooling does not exist to terminate SI flow altogether. In this situation the basis of the step is balancing the need for ECCS flow, and the need to minimize FWST depletion.

Using Enclosure 9, the operator will find the small 3 between the large 10 and 100 on the X axis, and then travel up the vertical line until the curve is intersected. At the intersection point, the operator will read the corresponding value of Minimum SI Flowrate on the Y Axis (≈445 gpm). With all three pumps delivering 400 gpm, two of the three will need to remain operating. The lowest volume pump should be selected to remain operating. The 1A NV Pump should be maintained operating because seal flow should be maintained to the NCPs, and the Standby Makeup pump is unavailable. At least one of the two NI pumps will be required to remain operating. The remaining pump(s) should be stopped. In this case either 1A or 1B NI Pumps should be stopped.

A. Incorrect. This will create a situation where there is insufficient SI flow for the stated conditions.

B. Correct. (See above).

C. Incorrect. This will create a situation where there is insufficient SI flow for the stated conditions.

D. Incorrect. This will create a situation where the FWST is unnecessarily depleted.

Technical Reference(s)	ECA-1.1 Step 21, Rev 10	(Attach if not previously provided)
	EP-E1 p213 Rev 17	(Including version or revision #)

Proposed references to be provided to applicants during examination: ECA-1.1, Enclosure 9

Learning Objective: EP-E1 #6 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

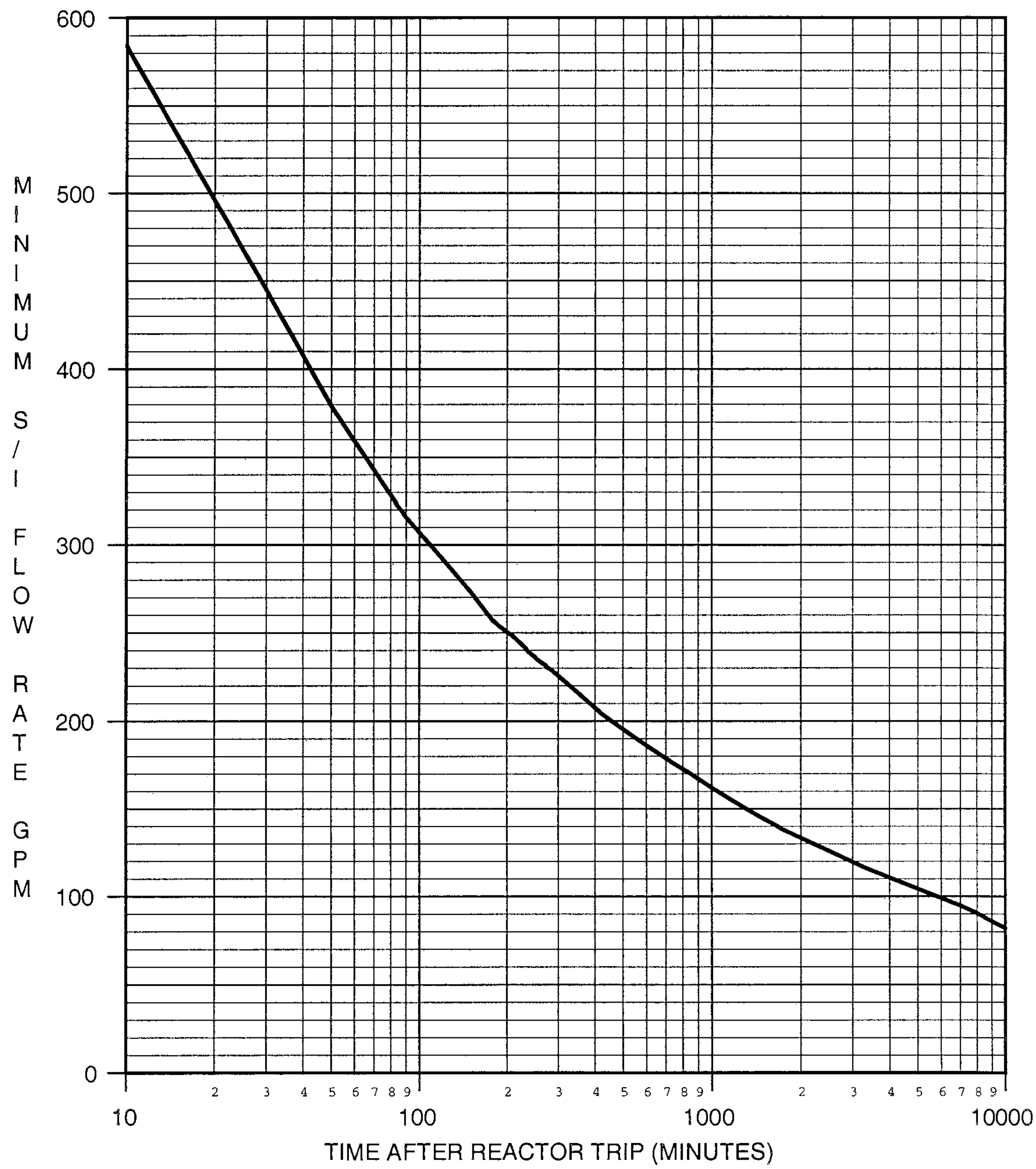
Question History: Last NRC Exam ____

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:
KA is matched because applicant must determine procedure actions for loss of Emergency Coolant Recirc based upon a specific set of plant conditions

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
21. **Check if S/I can be terminated:**	
a. Check RVLIS indication:	__ a. **GO TO** Step 27.
__ • **IF** all NC pumps off, **THEN** check "REACTOR VESSEL LR LEVEL" - GREATER THAN 60%.	
OR	
__ • **IF** at least one NC pump on, **THEN** check "REACTOR VESSEL D/P" - GREATER THAN REQUIRED D/P FROM Enclosure 7 (Minimum Dynamic RVLIS Indication).	
__ b. NC subcooling based on core exit T/Cs - GREATER THAN 50°F.	b. Perform the following: __ 1) Determine minimum S/I flow required **PER** Enclosure 9 (Flow Required to Match Decay Heat). __ 2) Minimize S/I flow by stopping one or more S/I pumps while maintaining greater than or equal to flow required by Enclosure 9 (Flow Required to Match Decay Heat). __ 3) **GO TO** Step 27.
22. **Reset the following:**	
__ • Phase A Isolation	
__ • Phase B Isolation.	



MINIMUM S/I FLOW RATE GPM
600
500
400
300
200
100
0
10
100
1000
10000
2 3 4 5 6 7 8 9
TIME AFTER REACTOR TRIP (MINUTES)

STEP 21 Check if S/I can be terminated:

PURPOSE: To determine if conditions have been established which indicate that one train of S/I flow is no longer required.

BASIS: Having established one train of S/I in an earlier step, NC conditions may be within acceptable limits to allow for S/I termination. The combination of a minimum subcooling and sufficient level in the vessel to cover the core provides less restrictive S/I termination criteria in this step because S/I flow may prevent a subsequent reduction in NC pressure and cause considerable depletion of the FWST. The subcooling criterion will ensure subcooled conditions and the RVLIS indication ensures the existence of an adequate vessel inventory such that core cooling is ensured.

If NC pumps are running, this information is in table format since the values seen by the RVLIS will depend on which NC pump is operating and which train of RVLIS is used.

If the termination criteria are not satisfied, then S/I is required to ensure core cooling and should not be terminated. The operator is the instructed to establish the minimum S/I flow needed to match decay heat in order to further decrease S/I flow and thus delay FWST depletion.

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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	1	
	K/A #	GKA 2.1.20 (E12)	
	Importance Rating	4.6	

(Conduct of Operations: Ability to interpret and execute procedure steps.)

Proposed Question: Common 56

Given the following event and conditions:

- A steam line rupture has occurred on the common header downstream of the MSIVs.
- All four MSIVs have failed to automatically or manually close from the Main Control Board.
- The crew has entered ECA-2.1 (Uncontrolled Depressurization of All S/Gs).

Which ONE (1) of the following describes the next action that will be taken to close the MSIVs?

A. Dispatch an operator to the Battery Room to open the EVDA and EVDD breakers powering the MSIV control circuits.

B. Dispatch an operator to the Doghouse to isolate VI to the MSIVs.

C. Direct Maintenance personnel to loosen VI pipe flanges as necessary to bleed VI from the MSIV actuators.

D. Direct Maintenance personnel to apply mechanical agitation to the valves.

Proposed Answer: **A**

Explanation (Optional):

A. Correct. Step 3 of ECA-2.1 addresses the status of the MSIVs. If they are NOT closed, the operator is directed to Enclosure 3 which provides two separate steps for closing the valves; removing control power (preferred), and bleeding off air.

B. Incorrect. Enclosure 3 identifies this action as a back up to the preferred method. Additionally, this action is only one-half of the process necessary to bleed VI from the MSIV Actuators.

C. Incorrect. Enclosure 3 identifies this action as a back up to the preferred method. Additionally, this action is only one-half of the process necessary to bleed VI from the MSIV Actuators.

D. Incorrect. Mechanical agitation of the valve is NOT an identified procedural strategy. It is plausible because enough mechanical agitation in any situation normally is successful.

Technical Reference(s)	ECA-2.1 Step 3, Enclosure 3 Rev 13	(Attach if not previously provided)
	EP-E2 p37 Rev 08	(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: EP-E2 #6 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:
KA is matched because given plant conditions, the applicant must execute a procedure step in an attempt to mitigate the event

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

C. Operator Actions

__ 1. **Monitor Foldout page.**

__ 2. **IF TD CA pump is the only source of feedwater, THEN maintain steam flow to it from at least one S/G.**

NOTE S/Gs may be done in any order in next step. If local actions are required, it is preferable to concentrate on one S/G at a time, to quickly restore integrity to at least one S/G.

3. **Check secondary pressure boundary:**

a. For 1A S/G:

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1) Check the following - CLOSED:	1) Perform the following:
__ • MSIV	__ a) Close valves.
__ • MSIV bypass valve.	__ b) **IF** MSIV bypass valve can not be closed, **THEN** dispatch operator to fail air to valve.
	__ c) **IF** MSIV can not be closed, **THEN** dispatch operator to close MSIVs **PER** Enclosure 3 (Local Closure Of MSIVs).
__ 2) Check SM PORV - CLOSED.	2) Perform the following:
	__ a) Close SM PORV.
	__ b) **IF** PORV can not be closed, **THEN** close SM PORV isolation valve.
	__ c) **IF** SM PORV isolation valve can not be closed, **THEN** dispatch operator to close SM PORV isolation valve.

NOTE MSIVs will be closed by removing control power. If this method is unsuccessful, then maintenance personnel will be required to assist operators in failing air to the MSIVs locally in the doghouses.

1. **Remove control power from MSIVs as follows:**

   a. Open the following breakers on Unit 1 panelboard 1EVDA (aux bldg, 733, battery room):

   __ • 1EVDA Breaker 18

   __ • 1EVDA Breaker 21.

   b. Open the following breakers on Unit 1 panelboard 1EVDD (aux bldg, 733, battery room):

   __ • 1EVDD Breaker 18

   __ • 1EVDD Breaker 21.

   __ c. Contact Control Room to check position of all MSIVs.

   __ d. **IF** all MSIVs are closed, **THEN GO TO** Step 6.

   __ e. **IF** any MSIV not fully closed, **THEN** notify maintenance personnel to assist operators in closing affected MSIV(s) in the following steps.

NOTE

- Interior doghouse equipment is on page 2, exterior doghouse equipment is on page 3.
- Steps 2 through 5 may be performed in any order.

2. **IF 1SM-5AB (B S/G SM Isol) will not close, THEN fail air to valve as follows:**

__ a. Close 1VI-2040 (VI Supply to 1SM-5AB Control Panel Isol) (Unit 1 Interior Doghouse, 793, on wall behind 1SM-5AB).

__ b. Have Maintenance loosen VI flange and separate as necessary to vent air out of VI line (flange located on wall behind 1SM-5AB, approximately 8 inches directly below 1VI-2042 (VI Supply (Open) to 1SM-5AB Isol)).

3. **IF 1SM-3AB (C S/G SM Isol) will not close, THEN fail air to valve as follows:**

__ a. Close 1VI-2030 (VI Supply to 1SM-3ABC Control Panel Isol) (Unit 1 Interior Doghouse, 793, on wall behind 1SM-3ABC).

__ b. Have Maintenance loosen VI flange and separate as necessary to vent air out of VI line (flange located on wall behind 1SM-3AB, approximately 8 inches directly below 1VI-2032 (VI Supply (Open) to 1SM-3ABC Isol)).

4. **IF 1SM-7AB (A S/G SM Isol) will not close, THEN fail air to valve as follows:**

__ a. Close 1VI-2020 (VI Supply to 1SM-7AB Control Panel Isol) (Unit 1 Exterior Doghouse, 793, on wall behind 1SM-7AB).

__ b. Have Maintenance loosen VI flange and separate as necessary to vent air out of VI line (flange located on wall behind 1SM-7AB, approximately 8 inches directly below 1VI-2022 (VI Supply (Open) to 1SM-7AB Isol)).

5. **IF 1SM-1AB (D S/G SM Isol) will not close, THEN fail air to valve as follows:**

__ a. Close 1VI-2010 (VI Supply to 1SM-1AB Control Panel Isol) (Unit 1 Exterior Doghouse, 793, on wall behind 1SM-1AB).

__ b. Have Maintenance loosen VI flange and separate as necessary to vent air out of VI line (flange located on wall behind 1SM-1AB, approximately 8 inches directly below 1VI-2012 (VI Supply (Open) to 1SM-1AB Isol)).

6. **WHEN time allows, THEN notify TSC that the following valves were deenergized by this enclosure:**

__ • All MSIVs

__ • All MSIV bypass valves

__ • 1BB-1B (1A S/G Blowdown Cont Outside Isol Control)

__ • 1BB-2B (1B S/G Blowdown Cont Outside Isol Control)

__ • 1VX-33B (Cont Sample Supply Insd Isol) (used for manual post accident gas sampling).

4.4. Detailed Description of Procedural Steps

STEP 1 Monitor foldout page.

PURPOSE: To remind the operator that the ECA-2.1 Foldout page should be open.

BASIS: The Foldout page, included as Enclosure 1, provides a list of important items that should be continuously monitored. If any of the parameters exceed their limits, the appropriate operations should be initiated.

NOTE, S/Gs may be done in any order in next step. If local actions are required, it is preferable to concentrate on one S/G at a time, to quickly restore integrity to at least one S/G.

STEP 2 IF TD CA pump is the only source of feed water, THEN maintain steam flow to it from at least one S/G.

STEP 3 Check secondary pressure boundary:

PURPOSE: To warn the operator that the steamline to the TD CA pump must not be isolated if it is the only source of feed flow to the S/Gs.

To reestablish a secondary pressure boundary in any S/G to allow controlled use of a S/G.

BASIS: Feedwater isolation status lights for each S/G receive inputs from all the valves that close on a feedwater isolation. By checking the status lights lit, then all feedwater isolation valves can be assured closed for a S/G as required. If proper status light indication is not confirmed, then valves are individually closed in RNO.

The valves that close on a feedwater isolation provide double isolation verifiable from the control room. The RNO will provide control room and, if necessary, local actions if isolation can not be checked from the control room. Other lines that are automatically isolated will not have local actions (some can not be locally isolated, i.e., CF Containment Isolation hydraulic valves).

The steamline drain upstream of the MSIVs is isolated as additional secondary piping that could cause S/G depressurization.

The operator should check that all valves providing isolation to other systems (such as feedwater and S/G blowdown systems) are closed and not responsible for the uncontrolled depressurization of all S/Gs. If the valves cannot be closed manually, then an operator is dispatched to locally close the valves in one loop, before continuing to the next loop. Valves are closed one loop at a time in order to ensure a complete, local check of the valves for each S/G to restore integrity to at least one S/G as early as possible. Even if integrity cannot be restored, the isolation process minimizes the cooldown of the NC and the mass and energy release from the S/Gs.

If the TD CA pump is the only operable source of feed flow to the S/Gs (i.e., no other MD CA pumps or other operable pumps are capable of providing feed flow to the S/Gs), then isolation of its steam supply line in Step 2 may degrade system conditions and result in a transition to FR-H.1. Therefore, this isolation must not be performed.

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	.75	.75	.75

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the E-2 series. EPE2001			X	X	
2	Discuss the entry and exit guidance for each procedure in the E-2 series. EPE2002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the E-2 series. EPE2003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the E-2 series. EPE2004			X	X	X
5	Given the Foldout page discuss the actions included and the basis for these actions. EPE2005			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. EPE2006			X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	005 AA1.02	
	Importance Rating	3.7	

(Ability to operate and / or monitor the following as they apply to the Inoperable / Stuck Control Rod: Rod selection switches)

Proposed Question: Common 57

Given the following:

- While performing an RCCA Movement test on Unit 2, Control Bank D Group 2 rod M-12 becomes misaligned and stuck.
- IAE determines that the stuck rod is due to a blown fuse in the associated Rod Control Power Cabinet.
- The fuse has been replaced.
- IAE determines that rod realignment is permissible.
- The method to realign rods will be to align rod M-12 to Control Bank D Group 2.
- The Lift Coils for Control Bank D rods, with the exception of Rod M-12, have been disconnected.

In accordance with AP/14, Rod Control Malfunctions, which ONE of the following describes the CRD Bank Selector switch position, and indications observed during the realignment?

A. CRD Bank Selector Switch placed in CB-D; ROD CONTROL URGENT FAILURE alarm will be received, but rod motion may continue.

B. CRD Bank Selector Switch placed in CB-D; BOTH Bank D Group Demand Counters will change during rod motion.

C. CRD Bank Selector Switch placed in MANUAL; ROD CONTROL URGENT FAILURE alarm will be received, but rod motion may continue.

D. CRD Bank Selector Switch placed in MANUAL; BOTH Bank D Group Demand Counters will change during rod motion.

Proposed Answer: **A**

Explanation (Optional):

A. Correct. Rod withdrawal in individual bank select mode. Urgent failure is received due to regulation failure due to other group in the bank seeing a rod motion signal, but not moving due to lift coils being deenergized

B. Incorrect. Plausible because of bank select position, and also normal group demand operation. Only 1 group will move because all rods in the opposite group will be disconnected. If ANY rod in a group is connected, counters will move.

C. Incorrect. Rods would not be withdrawn in manual, because the bank overlap unit would be in the circuit, causing more than 1 intended rod to move. Plausible because the first action for this failure is to place rods in manual.

D. Incorrect. Rods would not be withdrawn in manual, because the bank overlap unit would be in the circuit, causing more than 1 intended rod to move. Plausible because the first action for this failure is to place rods in manual.

Technical Reference(s)	OP-MC-IC-IRE p25, 27 Rev 19	(Attach if not previously provided)
	AP-14 p25 Rev 25	(Including version or revision #)
	AP-14 Basis Document p 37, 38	

Proposed references to be provided to applicants during examination: None

Learning Objective: IC-IRE #10 (As available)

Question Source:
- Bank # ____
- Modified Bank # ____ (Note changes or attach parent)
- New X

Question History: Last NRC Exam NA

Question Cognitive Level:
- Memory or Fundamental Knowledge ____
- Comprehension or Analysis X

10 CFR Part 55 55.41 6, 10

Content:

55.43 _______

Comments:

New question, but concept has been used before

KA is matched because operation of the Bank Selector switch is an integral part of the item

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

__ 19. **Open coil disconnect switches on all lift coils in affected bank except for misaligned rod(s).**

CAUTION **Failure to pause between each bank selected may result in dropping rods.**

__ 20. **Transfer rod control from manual to affected bank using "CRD BANK SELECTOR".**

__ 21. **Check "ROD CONTROL URGENT FAILURE" alarm (1AD-2, A-10) - DARK.**

RESPONSE NOT OBTAINED: **Perform the following:**

__ a. Dispatch IAE to investigate alarm.

__ b. Do not continue until alarm reset.

22. **Insert misaligned rod(s) as follows:**

NOTE
- The demand counter for the group being moved will be the only counter to change.
- The "ROD CONTROL URGENT FAILURE" (1AD-2, A-10) alarm will not occur if the rod is in Shutdown Bank C, D, or E.

__ a. **WHEN** "ROD CONTROL URGENT FAILURE" (1AD-2, A-10) alarm occurs, **THEN** acknowledge alarm and continue rod movement in the "BANK SELECT" position.

__ b. Maintain constant T-Ave by adjusting turbine load or boron concentration.

select, bank overlap is defeated, so the operator must ensure bank overlap is maintained manually.

If control rods cannot be realigned to within 12 steps, then station management must provide guidance based on rod control problem.

Encl. 2 - STEP 19:

PURPOSE:

Ensures the other rods in the affected bank don't move when the misaligned rod is realigned.

DISCUSSION:

In preparation for repositioning the misaligned control rod, the coil disconnect switches for all the lift coils in the affected bank are opened or de-energized, except for the misaligned control rod. This will allow the lift coil to receive the appropriate current signals to position the movable gripper and allow for realignment of the control rod without moving any other control rod.

Encl. 2 - STEP 20:

PURPOSE:

The step places the Control Rod Drive Selector to the affected control bank in preparation of realigning the control rod.

DISCUSSION:

With a "Rod Control Urgent Failure" alarm present, both automatic and manual rod motion are blocked for the affected Power cabinet. Control rods from the misaligned rod Power cabinet can be moved if placed in individual bank select. Note: Only the misaligned rod with it's lift disconnect switch still connected will move. Once the individual bank is selected by the CRD Bank Selector Switch, the bank overlap function is defeated for the control banks. Control rods in the shutdown banks are not overlapped so this is not an issue when individual shutdown banks are selected.

Encl. 2 - STEP 21:

PURPOSE:

This step is an evaluation of the presence of the alarm that is generated from the Power and Logic cabinets prior to attempting to retrieve the dropped control rod.

DISCUSSION:

If the "Rod Control Urgent Failure" (1AD-2, A-10) alarm is present at this point in the procedure, the problem has either not been corrected or reset. Control rods should not be moved until the alarm has been corrected and reset. If an attempt is made to move control rods in the individual bank select mode before the alarm is reset, a dropped rod could result. This may occur from incorrect operation of the CRDM if the failure is in the Slave Cycler for any of the control rods in the Power cabinet with the dropped control rod. Resetting the "Rod Control Urgent Failure" alarm is covered by IAE procedures.

Encl. 2 - STEP 22:

PURPOSE:

This step provides guidance for repositioning the misaligned high control rod with its associated group and bank.

DISCUSSION:

The notes prior to the step make the operator aware that only the group demand step counter of the affected control rod will change and that the "Rod Control Urgent Failure" alarm will not occur if the misaligned control rod is in Shutdown Banks C, D or E. These banks have only 1 group of control rods.
As the control rod, which has been misaligned higher than its associated bank, is inserted, the operator must acknowledge the "Rod Control Urgent Failure" alarm. . The "Rod Control Urgent Failure" alarm (1AD-2,A-10) will occur due to a regulation failure on ordered current not matching demand current for the other group of control rods in that bank that have their lift coil disconnect switches de-energized. This is an expected alarm.

As the control rod is being inserted, negative reactivity is being added and T-Ave must be maintained by either reducing turbine load or by changing the NC System boron concentration. It is preferable to reduce turbine load which reduces reactor power at the same time. The misaligned control rod is inserted one step at a time until DRPI indication changes. This provides a positive indication of position. The position of the misaligned control rod is then calculated and its group demand step counter is set to the calculated value.

The Rod Speed Demand Indication indicates "demanded" rod speed in AUTO, MANUAL, or individual bank select.

2.4.3. Control Room Annunciators

The Rod Control Urgent Failure is caused by an Urgent Alarm in either a Power Cabinet or Logic Cabinet. The alarm must be manually reset after the condition is corrected.

Objective #10

Possible causes of a Power Cabinet Rod Control Urgent Failure are:

A Regulation Failure - "actual" current does not match demanded "current," or FULL current demanded longer than setpoint for every rod in that Power Cabinet. Any rod in a Power Cabinet that has "actual" matching "demanded" will prevent Req. failure in that Power Cabinet.

A Phase Failure - excessive ripple indicating loss of one phase of the M/G set AC output, or a thyristor not conducting or has lost gate control.

A Logic Error - senses loss of current command signals (simultaneous ZERO commands) to the stationary and moveable coils at the same time (could cause a rod drop).

A Multiplexing Error - trying to move more than one group in a Power Cabinet at the same time. This indicates a multiplexing thyristor has failed.

A loose or removed card.

NOTE: When the Reactor Trip breakers open an Urgent Failure Alarm will be generated due to loss of power producing Regulation and Phase failure conditions being sensed.

Effects of a Power Cabinet Urgent Failure on Rod Motion:

If Power Cabinet Urgent Failure is in power cabinet 1BD, then *group 1* of Bank *B* and Bank *D* will not move. However rod motion in manual or automatic or individual bank selection is still possible in Group *2* of Bank *B* or Bank *D* and all groups of other banks. The preference is still not to allow any rod motion. This is the reason for putting rods in "Manual" when using AP/14 for "Rod Malfunction".

If rods are selected in automatic, then the rods that will move will be dependent on where you are in power and bank overlap. In the above example, if a Turbine/Generator Runback was to occur with rods in automatic, then the rods will move in but Group 1 of Bank D and Group 1 of Bank B would not move.

If Power Cabinet Urgent Failure is in power cabinet 1AC or 2AC then Group 1 and 2 of Bank D could still move. But we would lose Bank Overlap.

If a Power Cabinet Urgent Failure occurs the Rod Control System orders "Reduced" current to associated stationary coils and to the movable gripper coils for the group selected for motion in the affected cabinet. (Manual or Auto considering bank overlap)

In the case of recovering a dropped rod, the Power Cabinet Urgent Failure Alarm will alarm when the dropped rod is to be retrieved. The reason for this is that the Power Cabinet (the one with all lift switches disconnected for the group that is not to be moved) sees "actual current" vs "demand current" as not being met. (A Regulation Failure)

Objective #6

Possible causes of Logic Cabinet Rod Control Urgent Failure are:

A Slave Cycler failure - receives Go pulse before finishing previous step.

A Pulser failure.

A loose or removed card.

The Logic Cabinet Urgent Failure will stop rod motion in Auto and Manual. There is a possibility of getting rod motion when individual rod banks are selected. The preference is still not to allow any rod motion.

CLASSROOM TIME (Hours)

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

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose of the Rod Control System.		X	X	X	
2	State the number of control banks, shutdown banks, and total number of rods.		X	X	X	
3	Explain the sequence of events performed by the Control Rod Drive Mechanism for rod movement.		X	X	X	
4	Discuss the function of the Logic Cabinet.		X	X	X	
5	Discuss the Bank Overlap function.		X	X	X	
6	Explain all "Non-Urgent" and "Urgent" alarms from the Logic Cabinet, include any effects on Rod Control.		X	X	X	X
7	Discuss the function of the Power Cabinet.		X	X	X	
8	Explain the use of lift coil disconnect switches.		X	X	X	
9	Describe the function of the DC Hold Power System.		X	X	X	
10	Explain all "Non-Urgent" and "Urgent" alarms from the Power Cabinet, include any effects on Rod Control.		X	X	X	X
11	Discuss the Instrumentation and Controls on the Main Control Board.		X	X	X	X
12	Explain the operation of the Rod Control System during startup and shutdown.		X	X	X	X
13	Discuss the rod speeds during various modes of operation.		X	X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	024 AA2.03	
	Importance Rating	2.9	

(Ability to determine and interpret the following as they apply to the Emergency Boration: Correlation between boric acid controller setpoint and boric acid flow)

Proposed Question: Common 58

The following conditions exist on Unit 2:

- Power is reduced to 30% using AP/2/A/5500/04, Rapid Downpower."
- 2AD-2/B-9, "Rod Control Bank Lo-Lo Limit," is LIT.
- Shutdown Margin has been verified to be adequate.
- Boration is in progress to restore rods above RIL.
- The CRSRO has directed that a boration flowrate of 18 gpm be established.

Which ONE (1) of the following identifies the number of turns from zero that the potentiometer setting on NVSS5450 (Boric Acid Flow Controller) must be turned to establish this boration rate?

A. 4.5 Turns.

B. 6.25 Turns.

C. 7.5 Turns.

D. 8.75 Turns.

Proposed Answer: **A**

Explanation (Optional):

A. Correct. BA Flowrate/4 = 18/4 = 4.5 turns

B. Incorrect. Correct if establishing 25 gpm with a 10 Turn pot.

C. Incorrect. Correct if establishing 30 gpm with a 10 Turn pot.

D. Incorrect. Correct if establishing 35 gpm with a 10 Turn pot.

Technical Reference(s)	OP/2/A/6100/010 C OP/2/A/6100/022, Table 5.2, Rev 434	(Attach if not previously provided)
	PS-NV P49 Rev 55	(Including version or revision #)
	OP/2/A/6150/009 Encl 4.2 Rev 74	

Proposed references to be provided to applicants during examination: None

Learning Objective: PS-NV #5 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam NA

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	6, 10
	55.43	

Comments:
KA Match:
This event could be considered "emergency boration" because we are in a TS action statement. We could use the "Borate" enclosure to borate and would set the potentiometer to achieve the desired flow rate.

Nomenclature:	CONTROL ROD BANK LO-LO LIMIT	Window:	B9

Setpoint: Variable calculated, based on auctioneered high Delta T and rod position demand.

Origin: Calculated at 7300 Cabinets

Probable Cause:
- Boron concentration too low for power or xenon conditions
- Zero Power Physics Testing

Automatic Action: None

Immediate Action: **IF NOT** in one of the following conditions, go to AP/2/A/5500/038 (Emergency Boration). {PIP-0-M-98-3114}

- Runback
- Normal Reactor Shutdown
- Zero Power Physics Testing
- Rapid Downpower

Supplementary Action:
- **IF** alarm due to runback, rapid downpower **OR** Normal Reactor Shutdown, within one (1) hour, ensure compliance with ITS 3.1.6 (Control Bank Insertion Limits). {PIP-0-M-98-3114}
- **IF** alarm due to Zero Power Physics Testing, no further action is required.

References:
- Tech Specs
- Core Operating Limits Report (COLR)
- UFSAR, Figure 7-1 (9 of 16)
- NSM MG-22126
- PIP 0-M-98-1372
- PIP-0-M-98-3114

End of Response

A selected RMWP starts and makeup stop valve NV-171A, blender discharge to VCT outlet valve NV-175A and blender control valve NV-252A open. VCT level is controlled by diversion as described in the Dilute section above. When the preset quantity of reactor makeup water has been added, the batch integrator stops the RMWP and closes valves NV-171A, NV-175A and NV-252A. The alternate dilute mode of operation may be terminated at any time by actuating the makeup "STOP" selector switch.

Borate

Objective # 5

The borate mode of operation permits the addition of a preselected quantity of concentrated boric acid solution at a preselected flow rate to the NC System.

With the M/U Controller switch set to the "BORATE" position, the concentrated boric acid flow controller (NVSS5450) setpoint is adjusted to the desired flow rate and the concentrated boric acid batch integrator set above the desired quantity. Actuation of the makeup start will then initiate the borate mode of operation.

A selected BATP starts and makeup stop valve NV-175A and boric acid control valve NV-267A open. The concentrated boric acid is added to the NV Pump suction header. When the preset quantity of concentrated boric acid has been added, the batch integrator causes the BATP to stop and closes valves NV-175A and NV-267A. This operation may be terminated at any time by actuating the makeup "STOP" selector switch.

Manual

Objective # 5

The manual mode of operation permits the addition of a preselected quantity and blend of boric acid solution to the FWST, the Recycle Holdup Tanks or to NV system. While in the manual mode of operation, automatic makeup is precluded. An operator must manually align the valves to the desired system other than the NV system.

With the M/U Controller switch in "MANUAL", the boric acid and reactor makeup water batch integrator setpoints are adjusted above the desired quantity. Actuating the makeup “start” then starts the process. The operator would set the integrator quantities above the requirements and manually intervene to halt the makeup process at the conclusion of the evolution.

A preselected RMWP and BATP starts and valves NV-267A and NV-252A open. When the desired volume has been added, the manual mode of operation may be terminated by actuation of the makeup "STOP" switch. An operator must realign the valves after the manual operation is complete.

2.18.2 Reactor Makeup Components

Components used for reactor makeup include:

- Boric Acid Pumps (75 gpm)-Two (2) per unit with one normally in operation. The Mini-flow goes back to the BAT.

Table 5.2
Makeup Concentration Equations

To determine the boric acid flow rate:

To determine the boric acid flow rate for a desired VCT makeup boron concentration, use the following equation:

$$\frac{\text{Desired VCT boron concentration (ppmB)} \times \text{Total blender flow rate (gpm)}}{\text{Boric acid tank boron concentration (ppmB)}}$$

To set the potentiometer on NVSS5450, use the following equation:

$$\text{Potentiometer setting} = \frac{\text{Boric acid flow rate (gpm)}}{4}$$

Current total blender flow rate in automatic is 90 gpm.

NOTE: If the unit has operated continuously for several months, significant Boron 10 depletion may have occurred. The effective boron concentration of the NC system may be lower than indicated by Chemistry samples. NC temperature should be carefully monitored following VCT makeups.

For diluting or borating while in Modes 3, 4 or 5:

Use the correction factor, K, for a dilution/boration performed in Modes 3, 4 or 5. Obtain the volume of water/boric acid for the desired dilution/boration from Table 5.1. Then apply the appropriate K listed below to the volume from Table 5.1.

Plant Conditions			Correction
Pressure (psig)	Tavg (°F)	Pressurizer Level	Factor (K)
2235	557 - 588	Normal Operating	1.00
1600	500	No-Load	1.05
1200	450	No-Load	1.10
800	400	No-Load	1.16
400	350	No-Load	1.18
400	300	No-Load	1.20
400	300	Solid Water	1.35
400	200	No-Load	1.28
400	200	Solid Water	1.40
400	100	Solid Water	1.47

2. Initial Conditions

☐ 2.1 **IF** in Mode 1 **OR** 2, ensure R3 Reactivity management controls established per SOMP 01-02 (Reactivity Management). (R.M.)

☐ 2.2 Boron Concentration Control System aligned for automatic makeup per Enclosure 4.1 (Automatic Makeup).

3. Procedure

NOTE:
- Borating the NC System will add negative reactivity to the core by increasing the percentage of neutron absorbers in the NC System. With the reactor critical and above the point of adding heat (POAH), a corresponding decrease in NC System temperature will occur. (R.M.)
- Inadequate mixing of the NC System during boration can result in pockets of boric acid within the NC System which can cause unexpected NC System temperature response. (R.M.)

☐ 3.1 Evaluate all outstanding R&Rs that may impact performance of this procedure.

☐ 3.2 **WHEN** changing NC System boron concentration, evaluate energizing additional pressurizer heaters per OP/2/A/6100/003 (Controlling Procedure For Unit Operation) to enhance system mixing. (R.M.)

☐ 3.3 Determine amount of boric acid needed to obtain desired boron concentration using McGuire Data Book, OAC, Reactor Group Guidance, or plant parameters (T-Ave, Steam Pressure, Xenon worth, etc.). (R.M.)

Total Boric Acid: ________________ gal

NOTE:
- Integrator Thumbwheel covers should **NOT** be opened unless associated counter reset pushbutton depressed.
- Integrator Thumbwheel covers must be closed for NC Makeup System to operate.
- Flow integrators may count up 1 - 5 gallons after makeup termination.

☐ 3.4 Ensure Total Make Up Counter reset to zero. (R.M.)

☐ 3.5 Set Boric Acid Flow Counter to value determined per Step 3.3. (R.M.)

☐ 3.6 **WHEN** Boric Acid Flow Counter cover closed, check counter at desired value. (R.M.)

☐ 3.7 Select "BORATE" on "NC Sys M/U Controller".

NOTE:	• **<u>IF</u>** boric acid flowrate is less than or equal to 0.2 gpm (BA Flow Control potentiometer setting less than or equal to 0.05) the Boric Acid Flow Counter will **<u>NOT</u>** count. This will prevent automatic termination of boric acid flow. (R.M.) • EOL "BA Flow Control" potentiometer setting will result in very low boric acid flowrate and a slow addition rate.

☐ 3.8 **<u>IF</u>** "BA Flow Control" potentiometer setpoint less than or equal to 0.05, set potentiometer at 0.1.

☐ 3.9 **<u>IF</u>** it is desired to further increase boric acid flowrate, increase "BA Flow Control" potentiometer setpoint.

☐ 3.10 Maintain normal VCT level using 2NV-137A (NC Filters Otlt 3-Way Control).

NOTE:	• Steps 3.11 - 3.19 may be completed and then checked off as time allows. • Step 3.11 may be performed at any time during the performance of this procedure. (R.M.)

☐ 3.11 **<u>IF</u>** plant parameters require termination of boration, place "NC System Make Up" to "STOP". (R.M.)

☐ 3.12 Momentarily select "START" on "NC System Make Up". (R.M.)

☐ 3.13 Check "NC System Make Up" red light lit.

☐ 3.14 Check 2NV-175A (BA Blender To VCT Outlet) open.

☐ 3.15 Check 2NV-267A (Boric Acid To Blender Control) throttled.

☐ 3.16 **<u>IF</u>** in "AUTO", check BA Trans Pump starts.

☐ 3.17 Monitor Boric Acid Flow Counter. (R.M.)

3.18 Do **<u>NOT</u>** continue until one of the following occurs:

- ☐ Amount of boric acid recorded per Step 3.3 added

  OR

- ☐ Boric acid addition manually terminated

☐ 3.19 Ensure boration terminated as follows: (R.M.)

☐ 3.19.1 **IF** in "AUTO", ensure the following off:

☐ 2A BA Trans Pump
☐ 2B BA Trans Pump

3.19.2 Ensure the following closed:

☐ 2NV-175A (BA Blender To VCT Outlet)
☐ 2NV-267A (Boric Acid To Blender Control)

☐ 3.20 **IF** "BA Flow Control" potentiometer setpoint adjusted per Step 3.8 **OR** Step 3.9, perform the following: (R.M.)

☐ 3.20.1 Determine "BA Flow Control" potentiometer setpoint for desired boron concentration:

$$\frac{(\text{Desired VCT Boron Concentration (ppmB)}) \text{ X } (90 \text{ (gpm)})}{(\text{BAT Concentration (ppmB)})} = \text{Boric Acid Flow Rate (gpm)}$$

$$\frac{(\_\_\_\_\_\_\_\_ \text{(ppmB)}) \text{ X } (90 \text{ (gpm)})}{(\_\_\_\_\_\_\_\_ \text{(ppmB)})} = \_\_\_\_\_\_\_\_ \text{ Boric Acid Flow Rate (gpm)}$$

$$\frac{(\text{Boric Acid Flow Rate (gpm)})}{4} = \text{"BA Flow Control" Potentiometer Setting}$$

$$\frac{(\_\_\_\_\_\_\_\_ \text{(gpm)})}{4} = \_\_\_\_\_\_\_\_ \text{ "BA Flow Control" Potentiometer Setting}$$

☐ 3.20.2 Set "BA Flow Control" potentiometer to value determined per Step 3.20.1.

☐ 3.21 Ensure 2NV-137A (NC Filters Otlt 3-Way Control) in "AUTO".

NOTE:	CR SRO concurrence required if flush of blender **NOT** performed.

☐ 3.22 **IF** desired to flush blender, go to Enclosure 4.5 (Manual Makeup to VCT Using "NC System Makeup" Controller) and flush with 60 gallons blended flow.

☐ 3.23 Select "AUTO" for "NC Sys M/U Controller".

☐ 3.24 Momentarily select "START" on "NC System Make Up".

☐ 3.25 Check "NC System Make Up" red light lit.

3.26 Ensure the following reset to zero:

☐ Total Make Up Counter
☐ Boric Acid Flow Counter

☐ 3.27 Record in Auto Log that final blender content is Boric Acid.

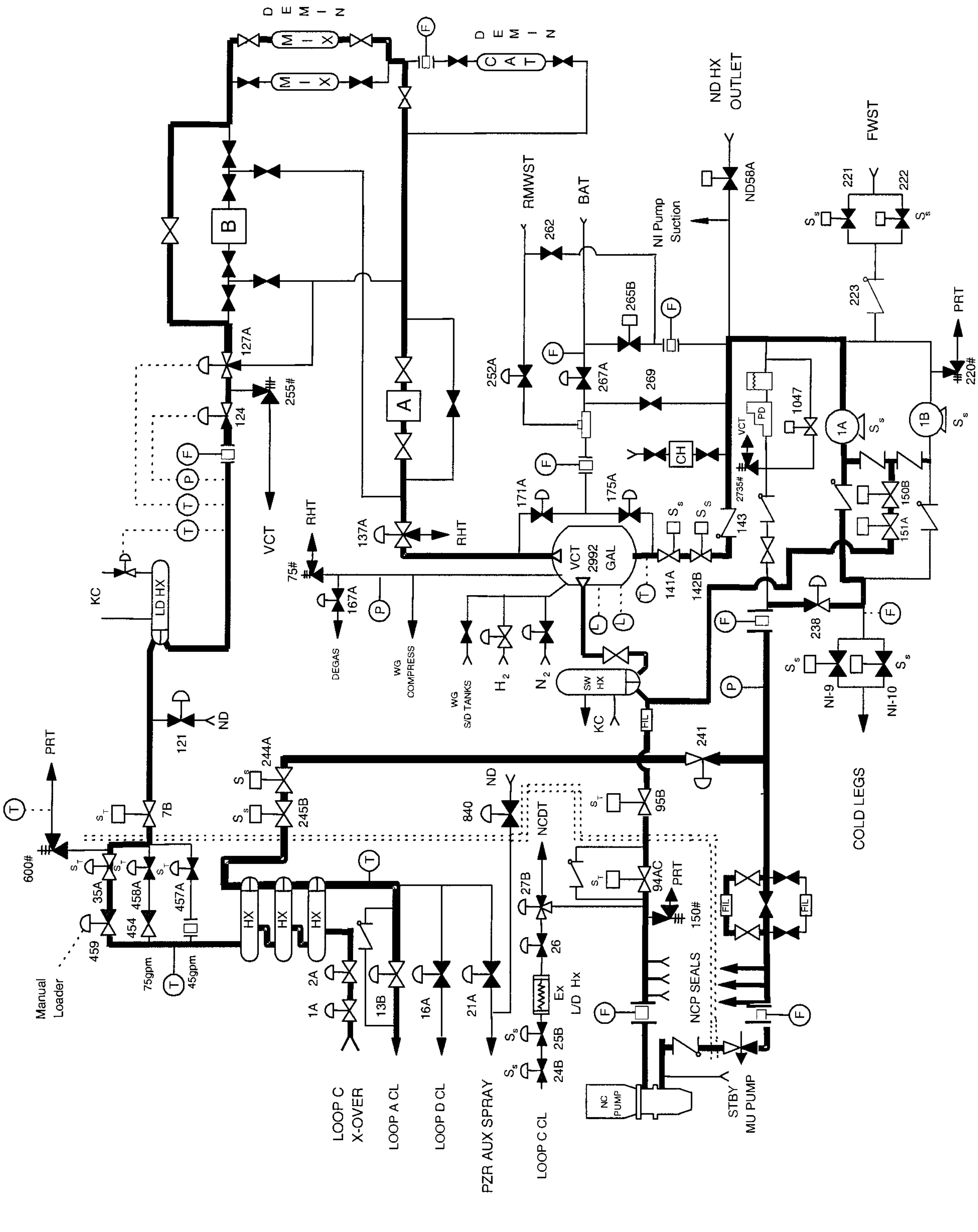
End of Enclosure

Unit 2

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	X	X	X	X	
6	Describe the various system parameters indicated in the Control Room associated with the NV System in ALL modes of operation.			X	X	X
7	List the "fail" position of NV valves on loss of power or air.			X	X	X
8	Describe the as-built configuration of the VCT level instrumentation.	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.	X	X	X	X	

7.0 DRAWINGS

7.1 NV System Composite (1/28/03)



Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	032 AK1.01	
	Importance Rating	2.5	

(Knowledge of the operational implications of the following concepts as they apply to the loss of Source Range Instrumentation: Effects of voltage changes on performance)

Proposed Question: Common 59

Given the following:

- A reactor startup is in progress.
- Intermediate Range indication is coming on scale.
- Proper NI detector overlap is observed.
- Subsequently, the following indication is observed on Source Range Channel N-31.
  - Count Rate is 10^3 CPS and lowering at approximately 0.3 DPM.
- All other NI indications remain normal.

Which ONE of the following describes the cause of Source Range N-31 indication?

A. Control Power fuse failure.

B. Instrument Power fuse failure.

C. Pulse Height Discriminator failed low.

D. Source Range High Voltage supply failure.

Proposed Answer: **D**

Explanation (Optional):

A. Incorrect. This failure would result in a reactor trip for the current conditions, due to deenergization of the RPS bistable.

B. Incorrect. An instrument power fuse failure would result in a trip because with the level trip bypass in NORMAL (normal ops) then loss of power will deenergize bistable.

C. Incorrect. If the PHD failed low, actual indication for the affected channel would rise, because less gamma would be discriminated out

D. Correct. If the voltage driving the detector fails low, then indication for that detector would also lower.

Technical Reference(s)	IC-ENB, p15-21Rev 26	(Attach if not previously provided)
		(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: IC-ENB #3 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	7
	55.43	

Comments:

KA is matched because item evaluates knowledge of a loss of SR high voltage on the detector itself, and resulting operation of the detector. The applicant must determine that this particular failure has caused the observed indication

1.3 Gas Filled Detectors

Objective # 3

The detectors in the nuclear instrumentation system are the gas filled chamber type. The center electrode is insulated from the chamber walls by the inert gas. A voltage is applied between the electrodes and the wall. A charged particle passing within the gas filled chamber ionizes some of the gas atoms along its path. The negative particles produced move toward the central electrode and the positive ones move toward the wall of the chamber. This causes a current flow which then can be related to the radiation being detected. The voltage applied to the chamber is important because this will determine detector current. If the voltage applied to a detector in a constant radiation field is varied, then the number of ions collected at the electrodes will vary. In the **Recombination Region**, the electric field produced by the applied voltage is not strong enough to keep all of the ion pairs separated; thus some ion pairs recombine after momentary separation.

In the **Ionization Region**, recombination does not occur and all of the ion pairs formed by direct ionization reach the electrodes. This means that as ions are formed they move toward and are collected by the appropriate electrode. Since the rate of collection of ions in the chamber volume is directly coupled to the rate of formation of those same ions, a steady flow of current results. Thus, a chamber operating in the Ionization Region can be made to produce a flow of current which reflects exactly the flow of ionizing radiation.

In the **Proportional Region**, the voltage is high enough to cause the ion pairs to accelerate toward the electrodes at sufficient velocity to cause additional ionization of the gas. These "secondary ionizations" in turn can cause other secondary ionizations. This phenomenon is called gas multiplication. The number of ions collected is proportional to the primary ionization (and the applied voltage), which gives the name Proportional Region.

At some point the number of secondary ionizations reach a limit. This is called the **Limited Proportional Region**. In the **Geiger Region** (named after the type of detector used in this high voltage region - Geiger-Mueller tube or G-M tube) a complete avalanche of secondary ionizations spreads throughout the whole detector. Thus, a plateau region exits wherein for one radioactive particle causing a primary ion pair we get a complete discharge of the whole tube. The tube recovers after each discharge with a certain time-constant, but if other radioactive particles arrive at the detector during the period of discharge and recovery, the instrument will not respond properly or fully. Beyond the Geiger region, the detectors will undergo continuous discharge. This region is not useable in any application of interest to us.

The three different types of gas filled detectors used by the Excore Nuclear Instrumentation are:

- BF3 Proportional Counter (operates in the Proportional Region) filled chamber - Source Range.
- Compensated Ion Chamber (operates in the Ion Chamber Region) - Intermediate Range.
- Uncompensated Ion Chamber (operates in the Iron Chamber Region) - Power Range.

The detector type used by the Wide Range Gamma-Metrics system:

- Fission Chamber.

In a gas filled detector, gammas can cause gas ionization directly through Compton Scattering, Photoelectric Effect, and Pair Production. Charged particles, Alpha and Beta, can also cause direct ionization of a gas filled detector. The neutron does not have a charge and must undergo some other reaction prior to producing ionization in the gas filled detector. The Excore detectors use Boron-10 either as BF3 gas or a boron coating within the detector. The Wide Range Gamma-Metrics system uses U-235 in a fission chamber.

When a Boron-10 atom absorbs a neutron, the resulting excited nucleus decays into highly charged Li-7 and α (He-4) nuclei which readily cause ionization in the gas filled detector. When a Uranium-235 atom absorbs a neutron, the resulting excited nucleus fissions producing highly charged fission fragments and other products which cause ionization in the gas filled detector. The detectors produce a current pulse for each ionization event as the ions are collected on the electrodes.

2.0 COMPONENT DESCRIPTION

2.1 Source Range

2.1.1 Source Range Detectors

Reference **Figure 7.3**. Two independently operating detectors are used to monitor and indicate neutron flux, and indicate rate of change of neutron flux (Startup Rate) during shutdown and initial startup. The Source Range Detectors utilize BF_3 Proportional Counter gas filled detectors. The detectors detect gammas and neutrons leaking from the core. Polyethylene is used to thermalize neutrons prior to entering the Source Range detectors. The BF_3 gas contains the Boron necessary for neutron detection. The neutron induced ionization pulses are much larger than the gamma pulses allowing the circuitry to distinguish or discriminate between the two.

2.1.2 Source Range Circuitry

Objective # 4

Reference **Figure 7.4**. The Source Range Detector output pulses are directed to a Preamplifier (preamp). The preamp will enlarge or amplify the small detector signal pulses. In order to minimize electronic noise, the preamp is located as close as possible to the detector. Any induced electronic noise picked up after the preamp will be of smaller magnitude relative to the true signal pulses. To reduce the effects of electrically/electronically noisy outage activities, such as welding, 100 kΩ resistors have been added in series with the detector canister ground straps.

Objective # 6

The Pulse Amplifier/Discriminator amplifies the preamp signal and discards the smaller pulses from noise and gamma sources. Only the larger neutron pulses are of significant height to pass through to the output of this stage. The output is fed to the Pulse Shaper and to an isolation amplifier for the Audio Count Rate circuit. The isolation amplifier prevents downstream faults from feeding back through the isolation device to the protection portions of the circuit.

The Pulse Shaper shapes pulses into uniform square waves.

The Pulse Driver matches impedance between the Pulse Shaper and the Log Pulse Integrator.

The Log Pulse Integrator changes the pulse signal to a voltage output proportional to logarithm of pulse rate.

The Level Amplifier amplifies the signal from the Log Pulse Integrator to drive bistables, indicators and other circuits.

A Bistable Relay Driver provides the "**High Flux at Shutdown**" Alarm and the "**Containment Evacuation**" Alarm whenever the source range counts exceed the setpoint. Another Bistable Relay Driver provides the "**High Level Trip**" signal (10^5 cps).

An isolation amplifier feeds the OAC, SUR Circuitry, Control Board Meter, and the NR-45 Chart Recorder.

2.1.3 Source Range Outputs

Both Source Range channels read out on the Control Board with a range of 10^0 to 10^6 counts per second (cps). The Source Range level can be monitored on the NR-45 Control Room Chart Recorder. In addition to counts per second, Source Range Start-up Rate (SUR) is indicated for each channel in decades per minute (-0.5 to 5.0 DPM).

The High Flux at Shutdown alarm actuates when source range level reaches the setpoint of one half decade above normal shutdown counts. High Flux at Shutdown also actuates the Containment evacuation alarm inside the containment. A 5 second time delay precludes short duration spikes from actuating the Hi Flux at Shutdown and Containment Evacuation alarms.

2.1.4 Source Range Drawer Panel (Reference **Figure 7.5**).

Objective # 8

Detector Volts Meter - Indicates high voltage supplied to proportional counter detector.

Neutron Level Meter - Scale 10^0 to 10^6 cps.

Instrument Power "ON" Lamp - 118 volts AC Instrument power applied to drawer.

Control Power "ON" Lamp - 118 volts AC Control Power applied to drawer.

Channel "On Test" Lamp - Indicates the operation selector switch is in a position other than "NORMAL".

Loss of Detector Volt Lamp - Indicates high voltage to detector off or low.

Level Trip Lamp - indicates neutron level greater than trip setpoint in Source Range.(10^5 cps)

Level Trip Bypass Lamp - On when Level Trip switch in "Bypass" for test or calibration.

High Flux at Shutdown Lamp - Neutron level greater than 1/2 decade above normal shutdown level in Mode 6 and $\leq$ 5 times shutdown level in Modes 3,4&5.

Bistable Trip Spare Lamp - No function.

Instrument Power Fuses - Overcurrent protection for power supply circuits. Instrument power supplies the meters, circuit processing components, high voltage supply and detector power. This is true for the IR and PR drawers/circuits also.

Control Power Fuses - Overcurrent protection for control signal circuit transformers. Control power supplies the lights on the drawer and 118 VAC to the bistable relay drivers to the plant relays. (High flux at shutdown alarm and SR high level trip). This is true for the IR and PR drawers/circuits also.

NOTE (Reference **Figure 7.21**): If either instrument or control power fuses are removed, the bistables will trip. Level Trip Bypass will prevent bistable trip for Instrument Power fuses only.

Objective # 10

Level Trip Switch - Two position switch: Normal - Switch Inactive; Bypass - Enables Operation Selector Switch for test and calibration; Provides AC signal to prevent Rx trip signal during testing.

Operation Selector Switch - Eight position switch enabled by Level Trip Switch to 'Bypass' position. Channel On Test lamp lights when not in Normal. Normal - Switch Inactive; Six Test Positions with Preset cps test values; Level Adjust - Level Adjust Potentiometer in circuit.

Level Adjust Potentiometer - Adjustable test signal into level amp. - Enables adjustment of the trip level of various bistables.

Objective # 10

High Flux at Shutdown Switch - Two position switch. Normal -allows circuit to provide "High Flux at Shutdown" and "Containment Evacuation" alarm when setpoint is exceeded; Block-used during startup - Blocks High Flux at Shutdown Alarm and Containment Evacuation Alarm.

2.2 Intermediate Range

2.2.1 Intermediate Range Detectors

Objective # 6

Reference **Figure 7.6**. Both intermediate range channels use compensated ion chambers to determine reactor power. These detectors are located just above the source range detectors in the same housing. The compensated ion chamber (CIC) uses two concentric Nitrogen gas filled, volumes: the "outer" is sensitive to both neutrons and gamma (boron lined); the "inner" sensitive only to gamma. As the two volumes are mounted concentrically in one unit, both are in essentially the same radiation field. By placing a negative potential on the inner lead, the gamma signal generated in the inner volume is made to compensate or cancel out the gamma signal generated in the outer volume. Since the two volumes can not be manufactured exactly the same size, the high voltage to the center electrode is variable to adjust the sensitivity of the inner volume. Operating in the recombination region, a change in inner volume detector voltage will vary the gamma current for a given flux level. The outer volume operates in the ion chamber region where all the ion pairs are collected.

Objective # 5

Gamma radiation becomes a smaller percentage of the detector interactions as power increases and becomes insignificant after 10^{-9} amps (first two decades). Above this power level gamma compensation is no longer required for accurate indication.

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
	2.0	3.0	3.0	2.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Nuclear Instrumentation System.		X	X	X	
2	Explain why it is necessary to use three ranges of Excore Nuclear Instrumentation.		X	X	X	
3	Explain the operation of the detector used in each range of instrumentation.		X	X	X	
4	Sketch the outputs of each range of Nuclear Instrumentation, to include all indication, control and protective circuits.		X	X	X	
5	Explain why gamma compensation is necessary in the Source Range and Intermediate Range but not in the Power Range.		X	X	X	
6	Describe the methods of gamma compensation used by the Source and Intermediate Ranges.		X	X	X	
7	Describe the effects of 'over' and 'under' compensation on the Intermediate Range.		X	X	X	
8	Explain the functions of the control switches for each range of Nuclear Instrumentation.		X	X	X	X
9	Concerning the channel current comparator and detector current comparator:					
	• Explain the function of each.		X	X	X	
	• List the alarm setpoints for each.		X	X	X	X
10	Explain the functions of all related bypass and block switches on the Nuclear Instrumentation miscellaneous panels.		X	X	X	X
11	List the Reactor Trips associated with the Nuclear Instrumentation System. (Include setpoints, logic and interlocks)		X	X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	033 AA1.02	
	Importance Rating	3.0	

(Ability to operate and / or monitor the following as they apply to the Loss of Intermediate Range Nuclear Instrumentation: Level trip bypass)

Proposed Question: Common 60

Given the following:

- A reactor startup is in progress.
- IR power indicates 8 X 10-11 amps on both channels and stable.
- SR High Flux Trip has NOT been blocked.
- IR N-35 starts behaving erratically.
- All other NI indication is normal.
- The crew enters the appropriate AP and places N-35 Level Trip Bypass Switch in BYPASS.

Which ONE of the following describes the effect of placing the switch in BYPASS?

A. Intermediate Range High Flux Trip is bypassed. NO other functions are affected.

B. Intermediate Range High Flux Trip and Intermediate Range High Flux Rod Stop are bypassed. NO other functions are affected.

C. Intermediate Range High Flux Trip is bypassed. Ensures that a Control Power Fuse failure will NOT result in a reactor trip. NO other functions are affected.

D. Intermediate Range High Flux Trip and Intermediate Range High Flux Rod Stop are bypassed. Ensures that a Control Power Fuse failure will NOT result in a reactor trip.

Proposed Answer: **B**

Explanation (Optional):

A. Incorrect. Plausible because it is one of 2 functions affected

B. Correct. Level Trip Bypass will bypass rod stop as well as trip.
C. Incorrect. Level Trip Bypass will prevent bistable trip for Instrument Power fuses by maintaining the trip bistable energized when in "Bypass." Control Power fuse failure will deenergize the channel, causing a trip anyway
D. Incorrect. Level Trip Bypass will prevent bistable trip for Instrument Power fuses by maintaining the trip bistable energized when in "Bypass." Control Power fuse failure will deenergize the channel, causing a trip anyway

Technical Reference(s)	OP-MC-IC-ENB p19, 21 Rev 26	(Attach if not previously provided)
	AP16 Rev 10	(Including version or revision #)
	AP16 Background Document p13, Rev 4	

Proposed references to be provided to applicants during examination: None

Learning Objective: IC-ENB Obj 8 (As available)

Question Source:
- Bank #
- Modified Bank # (Note changes or attach parent)
- New X

Question History: Last NRC Exam NA

Question Cognitive Level:
- Memory or Fundamental Knowledge X
- Comprehension or Analysis

10 CFR Part 55 Content:
- 55.41 10
- 55.43

Comments:
KA is matched because item evaluates operation of the selected switch during a loss of IR Nuclear Instrument

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 3. **Place failed channel "LEVEL TRIP" switch on I/R Drawer to "BYPASS".**	
4. **Check the following - LIT:**	__ **Notify IAE.**
__ a. "LEVEL TRIP BYPASS" indicating light on failed I/R drawer.	
__ b. "S/R OR I/R TRIP BYPASS" alarm (1AD-2, E-2).	
c. The failed channel's status light on 1SI-19:	
__ • "1/N-35A I/R CHANNEL I TRIP BYPASS"	
OR	
__ • "1/N-36A I/R CHANNEL II TRIP BYPASS".	
__ 5. **Place operable I/R channel to record on NIS Recorder.**	
__ 6. **<u>IF</u> <u>AT</u> <u>ANY</u> <u>TIME</u> I/R fuses are pulled above P-10, <u>THEN</u> they should be inserted prior to lowering power below P-10 (to prevent a reactor trip).**	
__ 7. **Check I/R channel - FAILED LOW.**	__ **<u>WHEN</u> reactor less than P-6 during any subsequent shutdown (with failed I/R channel), <u>THEN</u> place "SOURCE RANGE SELECT" switches to "RESET" to energize S/R detectors.**

3) If two I/R Instruments are inoperable between P-6 and P-10, the required action is to immediately suspend operations involving positive reactivity additions and get below P-6 within two hours

The only Tech Spec required action addressed by this step is the immediate action one to suspend positive reactivity additions. Sufficient time is available for the Operators to refer to T.S. for the other requirements. The AP also conservatively directs the Operator to trip the reactor and go to E-0 if **no** NIS indication is available, even though T.S. allows 2 hours for a controlled shutdown. This action is conservative since changing core reactivity conditions would be undetected, so placing the core reactivity into a known condition, shutdown, seems prudent. In addition, tripping the reactor should place the core power into the S/R Instrument range, restoring monitoring capability.

STEP 2:

PURPOSE:

Alert plant personnel of failed instrument.

DISCUSSION:

Plant pages of abnormal conditions can have two benefits. One is alerting any personnel that actions they have taken could have led to the abnormal condition (with the expectation that they contact the CR). The other is alerting personnel to help with the abnormal condition (STA to the control room, NLOs mobilized, etc.).

STEP 3:

PURPOSE:

With only **ONE** I/R instrument inoperable, per Technical Specifications, operation can continue with the reactor trip breakers closed (although Operation between P-6 and P-10 is only allowed for two hours per I.T.S). This step is intended to prevent an inadvertent reactor trip signal from the failed channel.

DISCUSSION:

The I/R reactor trip signal logic is one out of two channels. If the failed channel reaches amps equivalent to 25%, or instrument power is lost, a reactor trip signal will result. Placing a channel's "LEVEL TRIP" switch in "BYPASS" will prevent this as long as control power is available on that channel. The channel is placed in "BYPASS" at this time even though these conditions may not yet be true, because before the process is complete to restore the channel, these conditions may occur (i.e., IAE troubleshooting and/or calibration may bring in trip bistable).

STEP 4:

The Pulse Shaper shapes pulses into uniform square waves.

The Pulse Driver matches impedance between the Pulse Shaper and the Log Pulse Integrator.

The Log Pulse Integrator changes the pulse signal to a voltage output proportional to logarithm of pulse rate.

The Level Amplifier amplifies the signal from the Log Pulse Integrator to drive bistables, indicators and other circuits.

A Bistable Relay Driver provides the "**High Flux at Shutdown**" Alarm and the "**Containment Evacuation**" Alarm whenever the source range counts exceed the setpoint. Another Bistable Relay Driver provides the "**High Level Trip**" signal (10^5 cps).

An isolation amplifier feeds the OAC, SUR Circuitry, Control Board Meter, and the NR-45 Chart Recorder.

2.1.3 Source Range Outputs

Both Source Range channels read out on the Control Board with a range of 10^0 to 10^6 counts per second (cps). The Source Range level can be monitored on the NR-45 Control Room Chart Recorder. In addition to counts per second, Source Range Start-up Rate (SUR) is indicated for each channel in decades per minute (-0.5 to 5.0 DPM).

The High Flux at Shutdown alarm actuates when source range level reaches the setpoint of one half decade above normal shutdown counts. High Flux at Shutdown also actuates the Containment evacuation alarm inside the containment. A 5 second time delay precludes short duration spikes from actuating the Hi Flux at Shutdown and Containment Evacuation alarms.

2.1.4 Source Range Drawer Panel (Reference **Figure 7.5**).

Objective # 8

Detector Volts Meter - Indicates high voltage supplied to proportional counter detector.

Neutron Level Meter - Scale 10^0 to 10^6 cps.

Instrument Power "ON" Lamp - 118 volts AC Instrument power applied to drawer.

Control Power "ON" Lamp - 118 volts AC Control Power applied to drawer.

Channel "On Test" Lamp - Indicates the operation selector switch is in a position other than "NORMAL".

Loss of Detector Volt Lamp - Indicates high voltage to detector off or low.

Level Trip Lamp - indicates neutron level greater than trip setpoint in Source Range.(10^5 cps)

Level Trip Bypass Lamp - On when Level Trip switch in "Bypass" for test or calibration.

High Flux at Shutdown Lamp - Neutron level greater than 1/2 decade above normal shutdown level in Mode 6 and $\leq$ 5 times shutdown level in Modes 3,4&5.

Bistable Trip Spare Lamp - No function.

Instrument Power Fuses - Overcurrent protection for power supply circuits. Instrument power supplies the meters, circuit processing components, high voltage supply and detector power. This is true for the IR and PR drawers/circuits also.

Control Power Fuses - Overcurrent protection for control signal circuit transformers. Control power supplies the lights on the drawer and 118 VAC to the bistable relay drivers to the plant relays. (High flux at shutdown alarm and SR high level trip). This is true for the IR and PR drawers/circuits also.

NOTE (Reference **Figure 7.21**)**:** If either instrument or control power fuses are removed, the bistables will trip. Level Trip Bypass will prevent bistable trip for Instrument Power fuses only.

Objective # 10

Level Trip Switch - Two position switch: Normal - Switch Inactive; Bypass - Enables Operation Selector Switch for test and calibration; Provides AC signal to prevent Rx trip signal during testing.

Operation Selector Switch - Eight position switch enabled by Level Trip Switch to 'Bypass' position. Channel On Test lamp lights when not in Normal. Normal - Switch Inactive; Six Test Positions with Preset cps test values; Level Adjust - Level Adjust Potentiometer in circuit.

Level Adjust Potentiometer - Adjustable test signal into level amp. - Enables adjustment of the trip level of various bistables.

Objective # 10

High Flux at Shutdown Switch - Two position switch. Normal -allows circuit to provide "High Flux at Shutdown" and "Containment Evacuation" alarm when setpoint is exceeded; Block-used during startup - Blocks High Flux at Shutdown Alarm and Containment Evacuation Alarm.

2.2 Intermediate Range

2.2.1 Intermediate Range Detectors

Objective # 6

Reference **Figure 7.6**. Both intermediate range channels use compensated ion chambers to determine reactor power. These detectors are located just above the source range detectors in the same housing. The compensated ion chamber (CIC) uses two concentric Nitrogen gas filled, volumes: the "outer" is sensitive to both neutrons and gamma (boron lined); the "inner" sensitive only to gamma. As the two volumes are mounted concentrically in one unit, both are in essentially the same radiation field. By placing a negative potential on the inner lead, the gamma signal generated in the inner volume is made to compensate or cancel out the gamma signal generated in the outer volume. Since the two volumes can not be manufactured exactly the same size, the high voltage to the center electrode is variable to adjust the sensitivity of the inner volume. Operating in the recombination region, a change in inner volume detector voltage will vary the gamma current for a given flux level. The outer volume operates in the ion chamber region where all the ion pairs are collected.

Objective # 5

Gamma radiation becomes a smaller percentage of the detector interactions as power increases and becomes insignificant after 10^{-9} amps (first two decades). Above this power level gamma compensation is no longer required for accurate indication.

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
	2.0	3.0	3.0	2.0

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose of the Nuclear Instrumentation System.		X	X	X	
2	Explain why it is necessary to use three ranges of Excore Nuclear Instrumentation.		X	X	X	
3	Explain the operation of the detector used in each range of instrumentation.		X	X	X	
4	Sketch the outputs of each range of Nuclear Instrumentation, to include all indication, control and protective circuits.		X	X	X	
5	Explain why gamma compensation is necessary in the Source Range and Intermediate Range but not in the Power Range.		X	X	X	
6	Describe the methods of gamma compensation used by the Source and Intermediate Ranges.		X	X	X	
7	Describe the effects of 'over' and 'under' compensation on the Intermediate Range.		X	X	X	
8	Explain the functions of the control switches for each range of Nuclear Instrumentation.		X	X	X	X
9	Concerning the channel current comparator and detector current comparator:					
	• Explain the function of each.		X	X	X	
	• List the alarm setpoints for each.		X	X	X	X
10	Explain the functions of all related bypass and block switches on the Nuclear Instrumentation miscellaneous panels.		X	X	X	X
11	List the Reactor Trips associated with the Nuclear Instrumentation System. (Include setpoints, logic and interlocks)		X	X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	036 AK2.01	
	Importance Rating	2.9	

(Knowledge of the interrelations between the Fuel Handling Incidents and the following: Fuel handling equipment)

Proposed Question: Common 61

While shutdown for Refueling, Unit 1 is in Mode 6, with Fuel Handling operations in progress in the Spent Fuel Pool, when the following occurs:

- Refueling Cavity is full and 1KF-122 is OPEN.
- MCB Annunciator 1RAD-3/D-2, "1 EMF 17 Spent Fuel Bldg Refuel Brdg," alarms.
- 1EMF 17 is in Trip 2.
- Spent Fuel Pool Level is +0.4 feet.
- Spent Fuel Pool Temperature is 90°F.
- A KF Pump operating.

Which ONE (1) of the following is the most likely cause of these conditions?

A. Complete stoppage of air flow through a NAC-UMS dry storage cask within the last 30 minutes.

B. Failure of the KF System.

C. Damage to a Fuel Assembly while being lifted or lowered.

D. A Cavity Seal Failure.

Proposed Answer: **C**

Explanation (Optional):
A. Incorrect. NAC-UMS FSAR indicates that total loss of air flow for periods of days, rather than minutes will cause fuel damage. If applicants believes that loss of convection cooling to the dry storage canister would cause fuel damage in the 30 minute time it lost cooling flow. Per the FSAR, pg 11.1.4-1, it would take longer than 24 hours before approaching temp limits.). Plausible if the applicant thinks that 2 trains are always running during refueling or if he thinks level is too low.

AP25 Background Document indicates that inadvertent lifting and dropping an assembly are common causes of fuel handling incidents in the industry. The stated symptoms (1EMF 17) in alarm is an identified.

B. Incorrect. Only 1 train is needed due to heat load (FH-KF, page 43). KF failure is plausible if applicant thinks that level is too low.

D. Incorrect. Pool level is above normal (KF, pg 27 Low flow through demineralizer means less clean up of activity. Low level could mean less scrubbing of volatile activity. symptom of AP25, Spent Fuel Damage.

SFP Level is normal. If Cavity Seal Failure, level would be going down if KF-122 is open.

Technical Reference(s)	AP25 Rev 8	(Attach if not previously provided)
	AP25 Background Document, p2 Rev 4	(Including version or revision #)
	OP-MC-FH-KF p19, 23, 27, 43, Rev 29	
	NAC-UMS FSAR	

Proposed references to be provided to applicants during examination: None

Learning Objective: AP-AP25 # 2 (As available)

Question Source:
- Bank # ____
- Modified Bank # ____ (Note changes or attach parent)
- New X

Question History: Last NRC Exam NA

Question Cognitive Level:
- Memory or Fundamental Knowledge ____
- Comprehension or Analysis X

10 CFR Part 55 Content:
- 55.41 10,11
- 55.43 ____

Comments:
KA Match:
Improper operation or **malfunction of fuel handling equipment** could result in dropping a fuel

assembly, potentially damaging one or more fuel assemblies. This is considered a **Fuel Handling Incident** designed to withstand a postulated drop accident in the UMS® Universal Transport Cask without precluding the subsequent removal of the fuel (i.e., the fuel tubes do not deform such that they bind the fuel assemblies).

Personnel radiation exposure during handling and closure of the canister is minimized by the following steps:

1. Placing the shield lid on the canister while the transfer cask and canister are under water in the fuel pool.
2. Decontaminating the exterior of the transfer cask prior to draining the canister or performing canister closure operations with the transfer cask partially submerged to preserve the shielding benefit of the water.
3. Using temporary shielding.
4. Using a retaining ring on the transfer cask to ensure that the canister is not raised out of the shield provided by the transfer cask.
5. Placing a shielding ring over the annular gap between the transfer cask and the canister.

2.3.2.2 Cask Cooling

The loaded Vertical Concrete Cask is passively cooled. Cool (ambient) air enters at the bottom of the concrete cask through four inlet vents. Heated air exits through the four outlets at the top of the cask. Radiant heat transfer also occurs from the canister shell to the concrete cask liner. Consequently, the liner also heats the convective air flow. Conduction does not play a substantial role in heat removal from the canister surface. This natural circulation of air inside the Vertical Concrete Cask, in conjunction with radiation from the canister surface, maintains the fuel cladding temperature and all of the concrete cask component temperatures below their design limits. The cask cooling system is described in detail in Sections 4.1 and 4.4.

2.3.3 Protection by Equipment and Instrumentation Selection

The Universal Storage System is a passive storage system that does not rely on equipment or instruments to preserve public health or safety and to meet its safety functions in long-term storage. The system employs support equipment and instrumentation to facilitate operations. These items, and the actions taken to assure performance, are described below.

11.1.4 Failure of Instrumentation

The Universal Storage System may use a temperature-sensing system to measure the outlet air temperature at each of the four air outlets on each concrete cask. The air temperatures at the outlets may be measured and reviewed daily.

11.1.4.1 Cause of Instrumentation Failure Event

The temperature instrumentation failure event could occur as a result of instrumentation component failure, or as a result of any event that interrupted power or altered temperature sensor output.

11.1.4.2 Detection of Instrumentation Failure Event

The temperature instrumentation failure event may be identified by the lack of, or an inappropriate, reading at the temperature reader terminal. The event could also be identified by disparities between outlet temperatures in a cask or between similar casks.

11.1.4.3 Analysis of Instrumentation Failure Event

For concrete casks incorporating daily temperature-monitoring programs, the maximum time period during which an increase in outlet air temperatures may go undetected is 24 hours. The principal condition that could cause an increase in temperature is the blockage of the air inlets and/or outlets. Section 11.2.13 shows that even if all of the inlets and outlets of a single cask are blocked immediately after a temperature measurement, it would take longer than 24 hours before any component approaches its allowable temperature limit. Therefore, there would be sufficient time to identify and correct temperature instrumentation failure events prior to critical system components reaching their temperature limits. During the period of loss of instrumentation, no significant change in canister temperature will occur under normal conditions. Therefore, instrument failure would be of no consequence when the affected storage cask continues to operate in a normal storage condition.

Because the canister and the concrete cask are a large heat sink, and because there are few conditions that could result in a cooling air temperature increase, the temporary loss of remote

NOTE: *120°F assumes both cooling trains are operating; with only one cooling train in operation, normal heat load would increase temperature to 140°F.

****140°F assumes both cooling trains are operating; with only one cooling train in operation, abnormal heat load would increase temperature to 212°F.**

The Spent Fuel Pool Cooling System piping is arranged for dewatering protection; such that failure of any pipeline cannot drain the Spent Fuel Pool below the water level required for radiation shielding (a water level of ten feet or more above the top of the stored spent fuel assemblies).

SFP temperature is now procedurally maintained <90 F during normal operating conditions in order to minimize evaporation of the SFP water. Evaporation of SFP water is a major source of airborne tritium released from the site.

Spent Fuel Pool Purification Loop

The *purification loop* removes particulates, dissolved fission products, and surface dust from the fuel pool and the canal; maintaining optical clarity for visual observation of underwater operations within the canal or fuel pool. In addition, the purification subsystem can also be used to remove dissolved fission products from the Refueling Water Storage Tank.

Spent fuel pool water or refueling water is circulated through a fuel pool cooling pre-filter, for particulate removal. This filtered water is directed through the demineralizer, for ionic exchange, and discharged through the fuel pool cooling post-filter before it returns to the Spent Fuel Pool or the Refueling Water Storage Tank.

The *purification subsystem* consists of a spent fuel pool skimmer loop, which removes floating debris from the spent fuel pool surface by use of an adjustable skimmer trough, a strainer, a skimmer pump, and a filter. The suction and return lines of the skimmer loop are arranged so that the maximum area of surface water is circulated through the skimmer loop.

The Spent Fuel Pool stores fuel assemblies approximately 33 feet 4 inches below the fuel pool operating deck with approximately 25 feet of borated water above the top of each fuel assembly.

Objective # 7

Control Room Indication is provided for Spent Fuel Level and Temperature. *(Refer to Training Drawing 7.3, Spent Fuel Pool Control Room Indication.)*

In each of the Spent Fuel Pools and refueling cavities there is an Aztec Level Gauge. The angle iron pointing out into the water is at elevation 771' 4¾". This is the normal design level and corresponds to "0" on the gauge in the Control Room. Each step on the side edge of the gauge is two inches. (Refer to picture 7.5)

2.2 Spent Fuel Pool Cooling Pumps

Objective # 7

Two Spent Fuel Pool Cooling Pumps (KF Pumps) are provided for each Unit. The controls and indications, associated with Spent Fuel Pool Cooling Pump operation, located on the Main Control Board (MC-11), consist of the following:

- START / STOP Control Switch

  These momentary START / STOP pushbuttons allow the operator to START and STOP the pump, as desired.

  During a Blackout the KF Pump(s) will initially lose power *(load shed)* but receive a *manual start permissive* when Load Group 9 is loaded onto the bus.

  During a Safety Injection Signal, the KF Pump(s) running prior to SI will continue to run. The KF Pump(s) *not running*, prior to SI, will receive a *manual start permissive* when Load Group 9 is loaded onto the bus.

  Any KF Pump(s) running or manually started, while the SI Signal is present, **cannot** be stopped until the *SI Signal is RESET.*

- ON / OFF (Red / Green) Indicating Lights

  These ON / OFF (Red / Green) indicating lights are mounted on the START / STOP Control Switch and provide indication when the KF Pump breaker is CLOSED (ON) or OPEN (OFF).

Typical flow through the heat exchanger and purification loop is 2500 gpm combined (approximately 2200 gpm through Hx and 300 gpm through purification). Each pump is designed for 3050 gpm and limited by procedure to 2900 gpm, and each takes suction from the Spent Fuel Pool, *four feet below pool level,* and discharge back into the Spent Fuel Pool, *six feet above the fuel assemblies.* Holes drilled into the Spent Fuel Pool Discharge Header act as a vacuum breaker and limit siphon draining to two feet below normal Spent Fuel Pool level.

In addition, each KF Pump is designed to circulate water through the *cooling* and *purification loop* at the same time. Under normal operating conditions only one pump is utilized to supply flow through ***only one*** *cooling loop* and the *purification loop*. During two pump operation each pump will supply flow through a *cooling loop* but one pump

3.1.2 Operating Procedures

Depending upon the heat load requirements, either one or both trains of the system are brought into operation. One train operation is expected during normal plant operation (100% power) with approximately 2300 gpm flow through the in-service KF Heat Exchanger, approximately 300 gpm flow through the demineralizer and its associated purification loop, with >50 gpm skimmer flow rate.

OP/1(2)/A/6200/05, Spent Fuel Cooling System, provides the following direction:

- KF Pumps Operation (Enclosure 4.1)

  KF Pump Startup

  KC Flow, for the associated KF Heat Exchanger, is throttled to ≥ 100 gpm. The Purification Loop is removed from service by closing KF-12. Options are then given to either:

  - Stop the operating train and start the idle train in the "Single Pump **Parallel** Heat Exchanger" alignment. When operating in this configuration, the idle pump is racked out and its discharge valve is closed. Both KF-10 and KF-11 are opened and flow through each Heat Exchanger is throttled to 1350 -1450 gpm.
  - Start the idle train in parallel with the operating train. Each pump is aligned to its respective heat exchanger. Flow through each Heat Exchanger is throttled to 2200 -2450 gpm. If purification is desired, **either** KF-10 **OR** KF-11 is opened and the other valve is closed to protect against pump runout in case one pump trips.
  - Stop the operating train and start the idle train in the "Single Pump **Single** Heat Exchanger" alignment. Flow through its Heat Exchanger is throttled to 2200 - 2450 gpm. If purification is desired, the associated KF Pump Disch to Purification Hdr Isol valve is opened and the idle train's KF Pump Disch to Purification Hdr Isol valve is closed. This is the most common or normal alignment.

  In each case, once the pump is started, its AHU is verified to be operating. Then, KC Flow through the Heat Exchanger is adjusted to maintain the desired Spent Fuel Pool temperature. If the purification loop is placed into service, further adjustments of KF Heat Exchanger Outlet valves will be necessary to maintain flows within the ranges stated above.

  KF Pump Shutdown

  If the entire KF System will be shutdown, the Purification Loop is removed from service prior to stopping the KF Pump. The pump is then stopped. If operating in the **Single** Heat Exchanger alignment, the associated KF Pump Disch to Purification Hdr Isol valve is closed.

Borated water, from the Refueling Water Storage Tank (FWST), should be used for makeup if the ***last SFP boron sample indicated < 2775 ppm or boration is desired.***

Objective # 4 & 5

Non-borated lake water *(Assured Makeup)*, from the Nuclear Service Water System (RN), can be used for makeup. The *Assured Makeup* **should only be used if borated and demineralized water are not available for makeup** *and* **the Spent Fuel Pool Level is low enough to cause a** *radiation hazard to employees or the public*.

Electrical Power Supply

Objective # 6

Each Spent Fuel Pool Cooling Pump receives power from its respective *Essential Bus, 1(2)ETA* **(4160V)** *or 1(2)ETB* **(4160V)** *(the same buses that can be powered by the Emergency Diesel Generators).*

Each KF AHU receives power from its respective *Essential Motor Control Center, 1(2) EMXA* **(600V)** *or 1(2) EMXB* **(600V).**

The Fuel Pool Skimmer Pump receives power from one of the normal station buses *1(2) MXK* **(600V)** and can be operated anytime the bus is energized. However, this pump is not required during emergency operations.

Motor-operated valve 1(2)KF-12, Purification Loop Isolation Valve, is also powered from a normal station bus *1(2) MXJ* **(600V)** and can be operated remotely anytime the bus is energized. *Manual operation of this valve can be performed if power is unavailable.*

Spent Fuel Pool Chemistry

One spent fuel pool water volume is circulated, through the *purification loop,* every 24 hours. This allows proper maintenance of Spent Fuel Pool chemistry as specified and required by the Chemistry Department.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

B. Symptoms

- "1EMF-36 UNIT VENT GAS HI RAD" alarm
- "1EMF-38 CONTAINMENT PART HI RAD" alarm
- "1EMF-39 CONTAINMENT GAS HI RAD" alarm
- "1EMF-40 CONTAINMENT IODINE HI RAD" alarm
- "1EMF-42 FUEL BLDG VENT HI RAD" alarm
- "1EMF-16 CONTAINMENT REFUELING BRIDGE" alarm
- "1EMF-17 SPENT FUEL BLDG REFUEL BRDG" alarm
- Gas bubbles originating from the damaged assemblies
- Visible evidence of spent fuel damage anywhere on site with the potential for radioactive releases.

INTRODUCTION

This purpose of this procedure is to ensure proper response in the event of spent fuel damage.

A review of the OEDB for fuel handling events for "fuel damage" reveals about 100 industry events to date. This is about one per plant, on the average. McGuire has had one event where a Unit 2 fuel rod broke during reconstitution (refer to PIP M-93-00655).

The industry events have had a wide range of initiating causes. Inadvertent lifting is a common cause (refer to IN 80-01 and IN 86-58) because in a lot of cases the assembly ends up in an unintended location, which can result in striking objects. Dropping an assembly is also a fairly common cause (refer to IN 80-01).

ENTRY CONDITIONS

This AP covers fuel handling accidents anywhere on site, including dry cask storage. This procedure can be entered any time the listed symptoms are encountered. Most of the industry experience has shown visible damage and/or gas bubbles as a likely symptom. Another symptom encountered has been the area monitors on the refueling bridges, during some of the unintentional lifting scenarios. None of the fuel damage events have resulted in airborne activity for a symptom, but these events haven't had significant fuel damage (most or all the rods in an assembly breached.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

7. **Isolate Refueling Cavity from Spent Fuel Pool as follows:**

   __ a. Notify Fuel Handling Crew to move the fuel transfer cart to the Spent Fuel Pool Building.

   b. Dispatch two operators to perform the following:

      __ 1) **WHEN** fuel transfer cart is in the Spent Fuel Pool Building, **THEN** close 1KF-122 (Unit 1 Fuel Transfer Tube Isol) (spent fuel bldg, 780, PP-51, top of fuel pool at south east corner).

__ 8. **Place Containment Aux Carbon Filter Unit in service, PER OP/1/A/6450/015 (Containment Purge System), Enclosure 4.1 (Containment Aux Carbon Filter System Operation).**

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)/5500/25 (Spent Fuel Damage): • State the purpose of the AP • Recognize the symptoms that would require implementation of the AP. AP25001			X	X	X
2	Given scenarios describing accident events and plant conditions, evaluate the basis for any caution, note, or step. AP25002			X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	067 AA2.12	
	Importance Rating	2.9	

(Ability to determine and interpret the following as they apply to the Plant Fire on Site: Location of vital equipment within fire zone)

Proposed Question: Common 62

With Unit 1 at 100% power the following occurs:

- Zone 148 Alarm on EFA Computer, "RCP 1B Motor."

After acknowledging this alarm, the operator notes the following:

- Lower Containment Weighted Average Hourly is 100°F and slowly increasing.
- Containment pressure is 0.11 psig and slowly increasing.

Which ONE (1) of the following identifies the plant procedure that must be used to identify vital equipment that may be affected, and actions taken to protect this equipment?

A. AP/1/A/5500/08, "NC Pump Malfunction."

B. AP/1/A/5500/24, "Loss of Plant Control Due to Fire or Sabotage."

C. AP/1/A/5500/45, "Plant Fire."

D. RP/0/A/5700/25, "Fire Brigade Response."

Proposed Answer: **C**

Explanation (Optional):
The indications provided indicate that an actual fire event is taking place. The mitigation strategy will be handled by addressing AP45, and dispatching the Fire Brigade into the Containment.

A. Incorrect. The purpose of this procedure is to ensure proper response in the event of a malfunction of an NC pump and to identify the appropriate actions in the event of an NC Pump Seal or Pump Lower Bearing Malfunction, an NC Pump Motor or Motor Bearing Malfunction, or Excessive

Vibration. While the event may degrade to these types of problems, the entry conditions are not yet met.

B. Incorrect. The purpose of this procedure is to describe steps to be taken to achieve and maintain Hot Standby following a fire event that results or could result in a loss of plant control from the Control Room or Aux Shutdown Panel. This procedure will also be used following security events that could result in a loss of plant control from the Control Room or Aux Shutdown Panel. This procedure will also be used when referenced by any procedure that requires plant shutdown using the SSF. While the event may degrade to these types of problems, the entry conditions are not yet met.

C. Correct. This procedure provides guidance to mitigate the effects of a fire that has the potential of causing loss of control of safeguards systems during MODEs 1-3. It will send the operator to an Enclosure based on the determination of an active fire, and then identify vital equipment within the area, and steps that must be taken to protect the equipment.

D. Incorrect. While this procedure may be entered, it is purely a "managing the human response" procedure. It will not assist the operator in identifying plant equipment that should be protected.

Technical Reference(s)	AP/1/A/5500/08 Rev 9	(Attach if not previously provided)
	AP/1/A/5500/24 Rev 26	(Including version or revision #)
	AP/1/A/5500/45 Rev 6	
	AP 45 Background Document Rev 7	
	RP/0/A/5700/25 Rev 11	

Proposed references to be provided to applicants during examination: None

Learning Objective: AP-AP45 #1, 2 (As available)

Question Source:
Bank # ____
Modified Bank # ____ (Note changes or attach parent)
New X

Question History: Last NRC Exam NA

Question Cognitive Memory or Fundamental Knowledge X

Level: ______

Comprehension or Analysis ______

10 CFR Part 55 Content: 55.41 10

55.43 ______

Comments:

KA Match:

Plant Fire on Site – fire is in Unit 1 containment; **Location of vital equipment** – recognition that NC Pump 1B is in the fire zone that is in alarm.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

B. Symptoms

- **NC pump number 1 seal leakoff flow going up**
- **NC pump number 1 seal leakoff flow going down**
- **NC pump number 1 seal outlet temperature going up**
- **NC pump lower bearing temperature going up**
- **"NC PMP NO. 1 SEAL LO D/P" alarm.**

C. Operator Actions

1. **Check NC pump parameters within operating limits:**

   __ IF trip criteria valid, THEN GO TO Step 4.

   __ • All NC pump lower bearing temperatures - LESS THAN 225°F

   __ • All NC pump number 1 seal outlet temperatures - LESS THAN 235°F

   __ • All NC pump number 1 seal D/Ps - GREATER THAN 200 PSID.

__ 2. **IF AT ANY TIME any operating limit exceeded, THEN GO TO Step 4.**

__ 3. **GO TO Step 5.**

4. **Stop affected NC pump as follows:**

   a. IF A or B NC pump is the affected pump, THEN close associated spray valve:

   __ • 1NC-27 (A Loop PZR Spray Control)

   __ • 1NC-29 (B Loop PZR Spray Control).

   __ b. Check all NC pump number 1 seal leakoff flows - LESS THAN 6 GPM.

   RNO: __ b. Observe Caution prior to Step 4.e and GO TO Step 4.e.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

B. Symptoms

- **NC pump stator winding temperature going up**
- **NC pump motor bearing temperatures going up**
- **High NC pump motor amps**
- **Any NC pump motor lower bearing high KC flow alarm**
- **Any NC pump motor lower bearing low KC flow alarm**
- **Any NC pump motor upper bearing high KC flow alarm**
- **Any NC pump motor upper bearing low KC flow alarm**
- **NC pump upper/lower oil reservoir level computer alarm.**

C. Operator Actions

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1. **Check NC pump parameters within operating limits:** __ • All NC pump stator winding temperatures - LESS THAN 311°F __ • All NC pump motor bearing temperatures - LESS THAN 195°F __ • All NC pump oil reservoir level computer points - INDICATING BETWEEN (-)1.25 AND (+)1.25.	__ **IF trip criteria valid, THEN GO TO Step 4.**
__ 2. **IF AT ANY TIME any operating limit exceeded, THEN GO TO Step 4.**	
__ 3. **GO TO Step 5.**	

A. Purpose

The purpose of this procedure is to describe steps to be taken to achieve and maintain Hot Standby following a fire event that results or could result in a loss of plant control from the Control Room or Aux Shutdown Panel.

This procedure will also be used following security events that could result in a loss of plant control from the Control Room or Aux Shutdown Panel.

This procedure will also be used when referenced by any procedure that requires plant shutdown using the SSF.

INTRODUCTION

This procedure provides guidance to mitigate the effects of a fire that has the potential of causing loss of control of safeguards systems during MODEs 1-3.

SUMMARY

This procedure is NOT concerned with fires in the service or turbine building, or while the unit is in MODE 4, 5, 6, or no-mode.

In general, the actions of each enclosure are intended to maintain the functionality of the DESIGNATED safeguard train. This AP does not address problems that might arise to the non-designated trains. Other APs may address non-designated train problems if they have associated APs for them, so these APs would be implemented as time allows.

In a few cases there may be actions in this AP associated with a non-designated trains' equipment, but the basis of the step is still to maintain the functionality of the designated train. An example of this is there may be a step closing a non-designated trains' PORV isolation. The intent of the step is to maintain inventory control to the extent the designated train equipment can keep up with the inventory requirements. Note, one of the assumptions for Appendix R type scenarios is there are no accompanying secondary or primary breaks.

ENTRY CONDITIONS

This procedure can be entered any time the listed symptoms are encountered.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

NOTE Alternate indications of an active fire in containment are containment pressure and temperature going up.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 1. **Check fire status - ACTIVE.**	__ **RETURN TO Step 5 in body of this procedure.**

CAUTION **A fire in this area could affect systems operated from the SSF. B Train is the assured Safe Shutdown Train for a fire in this area.**

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ 2. **Check Unit 1 - IN MODE 1, 2, OR 3.**	**Perform the following:** __ a. IF requested by fire brigade leader, THEN ensure open 1RF-821A (Unit 1 RF Cont Outside Isol). __ b. RETURN TO Step 4 in body of this procedure.

NOTE Step 3 is time critical and must be completed within 10 minutes of declaring the fire active.

3. **Close the following Pzr PORV isolation valves:**

   __ • 1NC-33A (PZR PORV Isol)

   __ • 1NC-31B (PZR PORV Isol)

   __ • 1NC-35B (PZR PORV Isol).

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

B. Symptoms

- **Fire has caused, or has the potential of causing, loss of control of safeguards systems required to safely maintain the plant in MODEs 1-3.**
- **A Fire in one of the following areas while in MODEs 1-3:**
  - Unit 1 Containment
  - Unit 2 Containment
  - AB 695' Common Area
  - Unit 1 M/D CA Pump Room
  - Unit 2 M/D CA Pump Room
  - Unit 1 T/D CA Pump Room
  - Unit 2 T/D CA Pump Room
  - AB 716' Common Area
  - 1A D/G Room
  - 1B D/G Room
  - 2A D/G Room
  - 2B D/G Room
  - AB 733' 1ETB Room (includes 1ETB Swgr AHU Room)
  - AB 733' Unit 1 Electrical Pen Room
  - AB 733' 2ETB Room (includes 2ETB Swgr AHU Room)
  - AB 733' Unit 2 Electrical Pen Room
  - AB 733' Battery Room
  - AB 733' Common Area
  - AB 750' 1ETA Room (includes 1ETA Swgr AHU Room)
  - AB 750' Unit 1 Electrical Pen Room
  - AB 750' 2ETA (includes 2ETA Swgr AHU Room)

STEP DESCRIPTION FOR AP

STEP 1 NOTES:

PURPOSE:

Provide the operator with some basis to make the determination on whether a fire is active or not.

DISCUSSION:

The presence of flames is clearly an "active" fire. An EFA fire detector that alarms and does not clear is not a positive indicator a fire is active. Other conditions can cause a fire detector to alarm, such as the release of compressed air or a steam leak. Generally we would want to confirm the presence on an ongoing fire (flames) before declaring a fire is active. Procedurally this is addressed by dispatching an Operator to determine the status of the fire. If a “credible” report from other plant personnel make it obvious an active fire is present, then the fire can be considered active without waiting for the Operator report. During the couple minutes it takes the Operator to get to the fire, if fire suppression has reduced the fire to smoke or burning embers the fire is not active.

There may be some scenarios where it is not possible to quickly determine if flames are present. If an Operator is unable to access an area because of the presence of heavy smoke or heat, then the conservative action is to declare the fire active. The smoke collaborates there at least was a fire concern instead of one of the other plant conditions that can alarm EFA detectors. Then later if the fire brigade (dressed out) can access the area and determines there are no flames or quickly extinguishes the fire it becomes inactive at that time.

Example given: An EFA detector alarms for an NV pump. The Operator dispatched gets to the area and can't access the room because of heavy smoke. The fire is determined to be active, and the appropriate enclosure is entered. A few minutes later the fire brigade arrives, enters the room, and determines the fire has burned itself out. There is a small amount of smoke still being generated. The fire is now inactive.

Determining if a fire is active in Containment is treated a little differently. This is because entry usually can't be made in a conservative period of time. If the ONLY symptom of a fire in containment is an EFA detector that alarms, the fire is not considered active. However, if there are any other collaborating indications there may be a fire, then the fire is determined to be active without waiting for visual confirmation. Examples of collaborating indications in containment are pressure and temperature increasing. Other indications may be decreasing NC Pump oil reservoir levels or increasing bearing temperatures. Note that conservatively performing the actions of the containment enclosure will not by itself result in a loss of Unit Operation.

Fire Brigade Response

1. Symptoms

Fire, explosions or conditions (smoke, smoldering, burning) associated with a fire have been reported to the Control Room or to the OSC/TSC when activated.

This procedure provides guidance to Shift personnel and Emergency Coordinator for response, actions and coordination associated with an incident involving real or suspected fires.

2. Immediate Actions

Initial

_____ 2.1 **IF** the fire, explosion, or condition (smoke, smoldering, burning) occurs on the island during non-regular working hours, contact Industrial Security at 5050 and request Industrial Security to open the gate to the Island and leave it open until the fire, explosion, or condition is brought to closure.

_____ 2.2 **REFER TO** Enclosure 4.1, (Fire Brigade Response - Routine Operations) for response guidelines during routine operations.

_____ 2.3 **REFER TO** Enclosure 4.2, (Fire Brigade Response - OSC/TSC Activation) for response guidelines during times when the OSC and TSC are activated.

3. Subsequent Actions

NOTE:	Appendix F is a fire area analysis which identifies components that may be affected by a fire in a specified area.

_____ 3.1 **REFER TO** AP/0/A/5500/045 (Plant Fire).

_____ 3.2 **IF** fire is within the Protected Area, notify Station Management to **REFER TO** Appendix F of MCS - 1465.00-00-0022 (MNS Appendix R Safe Shutdown Analysis DBD) as applicable.

_____ 3.3 **REFER TO** Enclosure 4.4 (Fire Brigade Leader Response Guidelines).

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	069 AK3.01	
	Importance Rating	3.8	

(Knowledge of the reasons for the following responses as they apply to the Loss of Containment Integrity: Guidance contained in EOP for loss of containment integrity)

Proposed Question: Common 63

Which ONE (1) of the following Emergency Procedure actions is taken so that any radiological release will be minimized?

A. Feeding a ruptured Steam Generator until level is above the tubes, and then stopping feedflow.

B. Stopping the ND Pumps and isolating them from the FWST during a LOCA Outside Containment.

C. Isolating steam flow from and feed into a Faulted Steam Generator.

D. Making sure the Pzr PORVs are closed on a Total Loss of AC.

Proposed Answer: A

Explanation (Optional):

A. Correct. The E-3 background document (EP-E-3 p57 Rev 6) states that feeding a ruptured SG until the tubes are covered, and then stopping flow will minimize radiological releases.

B. Incorrect. The E-1 Background document (EP-E-1 p250 Rev 17) states that Stopping the ND Pumps and isolating them from the FWST during a LOCA Outside Containment is done to ensure that FWST inventory is available to the NV and NI to cool the core.

C. Incorrect. The E-2 Background document (EP-E-2 p 25 Rev 8) states that isolation of the steam and feed out of and into a Faulted SG is accomplished to limit the NC Cooldown and maintain the inventory for cooldown capability.

D. Incorrect. The ECA-0.0 Bacground document (EP-ECA p27 Rev 12) states that the check to make sure that the Pzr PORVs are closed is done to ensure that all NC System inventory outflows are isolated.

Technical Reference(s)	EP-E-3 p57 Rev 6	(Attach if not previously provided)
	EP-E-1 p249 Rev 17	(Including version or revision #)
	EP-E-2 p 25 Rev 8	
	EP-ECA p27 Rev 12	

Proposed references to be provided to applicants during examination: ______

Learning Objective:	EP-E3 #4, EP-E1 #4, EP-E2 #4, EP-ECA #4	(As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam NA

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:
KA Match:
Loss of Containment Integrity – SGTR event; **guidance in EOP for loss of containment integrity** – ensuring level in ruptured S/G covers the tubes to prevent thermal stratification, possibly increasing primary to secondary leak.

STEP 5 Control ruptured S/G(s) level

PURPOSE:

1. To establish and maintain a water level in the ruptured S/Gs above the top of the U-tubes [greater than 11% (32% ACC)] in order to promote thermal stratification to prevent ruptured S/G depressurization.
2. To stop feed flow to the ruptured S/Gs to minimize the potential for S/G overfill.

BASIS: Water level in the ruptured S/G should be maintained above the top of the U-tubes (i.e., greater than 11% (32% ACC)). When the primary system is cooled in subsequent steps, the S/G tubes in the ruptured S/G will approach the temperature of the NC, particularly if NC pumps continue to run. If the steam space in the ruptured S/G expands to contact these colder tubes, condensation will occur which would lower the ruptured S/G pressure. This would reduce the NC subcooling margin and/or raise primary-to-secondary leakage, possibly delaying S/I termination or causing S/I reinitiation. Consequently, the water level must be maintained above the top of the tubes to insulate the steam space. This also ensures a secondary side heat sink in the event no intact S/G is available and also provides protection against misdiagnosis of the ruptured S/G due to an imbalance of feed flow.

Following a SGTR, primary-to-secondary leakage into the affected S/G will exceed steam flow and lead to an accumulation of water in the S/G. Feed flow will raise the rate of accumulation and reduce the time at which S/G overfill would occur. Hence, feed flow to the ruptured S/G should be isolated.

If feed flow to the ruptured S/G is stopped due to level being in the narrow range (N/R) and later the level drops below the N/R, feed flow to the ruptured S/G should be reinitiated to reestablish level in the N/R. Step 27 directs the operator to continuously monitor ruptured S/G level as a long term activity following termination of break flow. If level drops below 11% (32% ACC) the operator is directed back to this step to establish feed flow and restore level

In most cases, the ruptured S/G level will continue to rise even after feed flow has been completely terminated. However, for some multiple failure events, such as an unisolatable SGTR, level may drop during NC cooldown due to steaming. Consequently, level in the ruptured S/G should be monitored periodically to ensure that it remains above the tubes unless the ruptured S/G is also faulted. In addition to ensuring a heat sink if no intact steam generator is available, this also minimizes radiological releases.

STEP 3 and 4 Check if ND pumps should be stopped and isolated.

Stop ND pumps and isolate potential FWST depletion path

BASIS:

As identified in PIP M02-247, isolating FWST depletion in a timely manner is critical to maintaining core cooling. Because it takes a long time for us to isolate the ISLOCA, the FWST depletion must be secured first. This ensures FWST inventory is available for NV and NI pumps. The step first checks to see if ND could be injecting into the NC system by checking NC pressure. This ensures operators have not misdiagnosed the event. If the event is a large break LOCA, causing ND injection to NC system, this EP should not be implemented. ND should be allowed to inject to NC system if it is used for core cooling. The step verifies the break is on the ND system before isolating ND suction. The step only isolates ND suction from FWST and stops ND pumps if they are not being used for core cooling.

STEP 7 Check faulted S/G(s) PORVs - CLOSED.

STEP 8 Reset CA modulating valves.

STEP 9 IF TD CA pump is the only source of feed water, THEN maintain steam flow to it from at least one S/G.

PURPOSE: To warn the operator that the steamline to the TD CA pump must not be isolated if it is the only source of feed flow to the S/Gs.

BASIS: If the TD CA pump is the only operable source of feed flow to the S/Gs (i.e., no other MD CA pumps or other operable pumps are capable of providing feed flow to the S/Gs), then isolation of its steam supply line in Step 2 may degrade system conditions and result in a transition to FR-H.1. Therefore, this isolation must not be performed.

STEP 10 Isolate faulted S/G(s) as follows:

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

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

CA modulating valves must be reset before any CA valves can be closed.

Feedwater isolation status lights for each S/G receive inputs from all the valves that close on a feedwater isolation. By checking the status lights lit, then all feedwater isolation valves can be assured closed for a S/G as required. If proper status light indication is not confirmed, then valves are individually closed in RNO.

CA pump to S/G isolation valves are closed as well as BB and steamline drains upstream of MSIVs. If B or C S/G is faulted, the steam supply isolation to the T/D CA pump is also isolated locally.

STEP 11 Close 1AS-12 (Main Steam to Aux Steam)

PURPOSE: Isolating this flowpath prevents the opposite unit from potentially feeding a steam break through the aux steam system.

BASIS: Until aux steam is isolated, steam from the equalization header may continue to flow in the reverse direction through a closed MSIV into the faulted S/G.

7.16 Selected Definitions

Some words used in the emergency procedures have unique meanings. These unique meanings should be understood based upon training and experience or by the specific use of the word in the context of the step being performed. Some words with unique meanings are listed below:

Check	-	to determine present status. (no action)
Ensure	-	to take necessary actions to guarantee that the component or reading is as specified. (Local actions in EPs and APs are only required if step specifies to dispatch personnel though).
Faulted	-	refers to a steam generator that has a secondary break.
Ruptured	-	refers to a steam generator that has a primary to secondary leak (SGTR).
Implement	-	begin a required program or series of procedures.
Intact	-	refers to a steam generator that is **NOT** faulted or ruptured and is available as a heat sink.
GO TO	-	discontinue use of present procedure and stay in the referenced procedure. The referenced procedure is always entered at the first step unless otherwise specified.
REFER TO, PER		user is directed to a supplemental procedure/enclosure for actions but will remain in the controlling procedure.
Stable	-	Maintained steady. **IF** a parameter is being controlled within a desired range, or if a slight trend in either direction is occurring, operator judgment may be used to determine if parameter is considered stable.
Evaluate	-	Appraise the situation. Includes taking action based on evaluation.

7.17 Tolerances

Ranges or tolerances are provided if it is important to maintain a parameter within a given band. **WHEN** a range or tolerance (e.g., 5-15%) is provided, it is understood to mean extra attention should be paid to maintain the parameter within this range.

WHEN a single value is given, it is assumed the value is an ideal value. **WHEN** an ideal value (e.g., at no load or 350 psig) is provided, it is understood to mean attention should be paid to maintain the parameter at the ideal value but **NOT** be overly concerned if the exact value is **NOT** achieved.

STEP 6 Check NC System - ISOLATED.

PURPOSE: To ensure all NC system outflow paths are isolated.

BASIS: A check for NC system isolation is included to ensure NC system inventory loss is minimized. The valves itemized are those in major NC system outflow lines that could contribute to rapid depletion of NC system inventory.

The sequence for checking valves is based on capacity of the outflow lines and potential for NC system inventory loss.

1. The Pzr PORVs are checked first. Since the TD CA pump should be running, the secondary side is removing decay heat and NC system pressure should be under the Pzr PORV setpoint.
2. The letdown line isolation valves adjacent to the NC loop are checked second. These valves are normally open and receive a low Pzr level isolation signal. If these valves, in conjunction with the letdown orifice isolation valves, remain open, a leak path to the PRT via the letdown line relief valve may exist. These valves, including the letdown orifice isolation valves should be manually closed as soon as possible to isolate the letdown line and minimize NC system inventory loss prior to automatic isolation on low Pzr level. Note, isolating the letdown line at the containment penetration will not isolate the letdown relief valve leak path to the PRT.
3. The excess letdown line isolation valves adjacent to the NC loop are checked third. These valves are normally closed and do not receive a low Pzr level isolation signal. If these valves are open, a leak path to the PRT via the NC pump seal return relief valve may exist. These valves should be closed to isolate the excess letdown line. Note, isolating the seal return line at the containment penetration will not isolate excess letdown inventory loss to the PRT via the seal return relief valve.
4. The ND Letdown Control Valve, 1NV-121, is checked fourth.

Following completion of this step, the only NC system inventory leakage path should be the NC pump controlled leakage seals.

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

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

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	N/A	.75	.75	.75

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	Explain the purpose for each procedure in the E-2 series. EPE2001			X	X	
2	Discuss the entry and exit guidance for each procedure in the E-2 series. EPE2002			X	X	
3	Discuss the mitigating strategy (major actions) of each procedure in the E-2 series. EPE2003			X	X	X
4	Discuss the basis for any note, caution or step for each procedure in the E-2 series. EPE2004			X	X	X
5	Given the Foldout page discuss the actions included and the basis for these actions. EPE2005			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. EPE2006			X	X	X

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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	076 AK2.01	
	Importance Rating	2.6	

(Knowledge of the interrelations between the High Reactor Coolant Activity and the following: Process radiation monitors)

Proposed Question: Common 64

Unit 2 was operating at 100% power when a loss of power to 2B NCP occurred and was compounded by an ATWS event. Given the following events and conditions:

- Control rods were locally tripped two minutes after the NCP lost power.
- Emergency boration increased NC boron concentration by 15 ppm.
- T_{ave} stabilized at 557°F following the trip.
- The 2B NCP has been restarted.
- Containment radiation levels have doubled as indicated by:
    - 2EMF-2 (Rx Bldg Incore Inst Rm)
    - 2EMF-3 (Rx Bldg Refuel Brdg)
    - 2EMF-5 (NC Flt.2A)

Which ONE (1) of the following describes the most probable cause of the increase in containment radiation levels following the event?

NCS activity has increased due to...

A. mechanical shock of Reactor Trip and NCP cycling.

B. the boron concentration change and NCP cycling.

C. mechanical shock of ECCS actuation.

D. a loss of letdown flow through the NV Demineralizers.

Proposed Answer: **A**

Explanation (Optional):

A. Correct. Mechanical shock (reactor trip and NCP cycling) causes a crud burst.

B. Incorrect. Activity increases are primarily due to mechanical shock. Plausible: based on the amount of boric acid, the NCS will not change enough to see any difference in activity. A larger pH change can cause a crud burst (chemical shock) - but this emergency boration will not cause a significant pH change.

C. Incorrect. ECCS doesn't automatically actuate during an ATWS.

D. Incorrect. Activity increases are primarily due to mechanical shock. Plausible: loss of letdown will stop the filtration of crud and fission products and is the action required to return the activity to normal following a crud burst - but will not result in a rapid change of activity because it is not the predominant causal mechanism.

Technical Reference(s)	OP-MC-CH-PC p21, Rev 17	(Attach if not previously provided)
		(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: CH-PC #4 (As available)

Question Source:	Bank #	McGuire NRC Bank # 119	
	Modified Bank #		(Note changes or attach parent)
	New		

Question History: Last NRC Exam Not on 2005/2007 Exams

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	5, 11, 14
	55.43	

Comments:
Only formatting changes made from McGuire NRC Bank Question #119.

KA Match:
Question deals with a mechanically induced crud burst causing **High Reactor Coolant Activity.** The higher activity will be detected by the **process radiation monitors** in the rx building and the NC filter in service.

Activated corrosion products are primarily made-up of the following insoluble corrosion and wear products; Manganese-54, Cobalt-58, and Cobalt-60.

The production of Manganese-54 (Mn-54) comes from a neutron, proton reaction with Iron-54 (Fe-54), found in Inconel and Stainless Steel (used in primary plant components), as illustrated below:

Fe-54 (η, ρ) Mn-54

The production of Cobalt-58 (Co-58) comes from a neutron, proton reaction with Nickel-58 (Ni-58), found in Inconel and Stainless Steel (used in primary plant components), as illustrated below:

Ni-58 (η, ρ) Co-58

The production of Cobalt-60 (Co-60) comes from a neutron, gamma reaction with Cobalt-59 (Co-59), found in stellite (used primarily for valve seats in primary plant valves), as illustrated below:

Co-59 (η,γ) Co-60

2.2 Radioactive Crud

Objective # 4

The four mechanisms which may result in a "crud burst" are:

- **Chemical shock**
- **Thermal shock**
- **Mechanical shock**
- **Hydraulic shock**

Some examples of typical plant evolutions that result in "crud bursts" are chemical additions to the primary coolant, plant heatup, changes in power level, plant cooldown, Reactor Trip, and / or Safety Injection actuation. Typical "crud" levels, within the coolant, during normal plant operation are <10 ppb. However, during a "crud burst" these levels can increase to 2000 ppb or more.

Immediately following a "crud burst", NV (Chemical Volume and Control System) letdown flow through the demineralizers and filters should be increased to reduce redeposition of the crud throughout the plant. For example, at the normal letdown flow rate of 75 gpm, it takes almost 21 hours to pass one entire volume of reactor coolant through the NV System. But a letdown flow rate of 120 gpm will circulate one entire volume of reactor coolant in approximately 12 hours (at 120 gpm letdown flow, 50% of the crud is removed every 12 hours).

Further analysis has determined that flowrates of 150-180 gpm are acceptable for short duration. This would shorten crud burst clean up time even further.

CLASSROOM TIME (Hours)

NLO	NLOR	LPRO	LPSO	LOR
N/A	3	3	3	3

OBJECTIVES

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
1	State the purpose for controlling primary plant chemistry. CHPC001		X	X	X	
2	List the two major sources of radioactive materials within the primary coolant (Reactor Coolant System - NCS) and describe their mechanism of entry. CHPC002		X	X	X	X
3	List the three major groups of NCS activation products. CHPC003		X	X	X	X
4	List four mechanisms which may result in a "crud burst" and describe the potential adverse effects. CHPC004		X	X	X	X
5	List the chemicals routinely added to the Reactor Coolant System (NCS) for primary chemistry control and describe their purpose. CHPC005		X	X	X	X
6	Describe the radiological significance associated with tritium. CHPC006		X	X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	1	
	Group #	2	
	K/A #	GKA 2.4.8 (E02)	
	Importance Rating	3.8	

(Emergency Procedures / Plan: Knowledge of how abnormal operating procedures are used in conjunction with EOP's.)

Proposed Question: Common 65

Following an inadvertent SI actuation from 100% power on Unit 1, the following conditions exist:

- The crew is performing ES-1.1, SI Termination.
- Normal Charging is aligned.
- NI Pumps are stopped.
- ND Pumps are stopped.
- Pressurizer level is 32% and rising.
- Letdown is established.

Subsequently, the following occurs during verification of NC Pump cooling in ES-1.1:

- Seal Injection flow is lost to all NC Pumps.
- Charging flow indicates 0 GPM
- Pressurizer level is going down.
- Letdown isolates.
- Pressurizer level stabilizes after Letdown isolation.

Which ONE of the following describes the procedure usage required for this event?

A. Return to step 1 of ES-1.1 and reestablish Charging and Letdown.

B. Continue in ES-1.1; concurrent AP use in this plant condition is not allowed.

C. Continue in ES-1.1 and concurrently attempt to restore Charging and Seal Injection in accordance with AP/12, Loss of Letdown, Charging, or Seal Injection.

D. Suspend action performed in ES-1.1; perform actions required to restore Charging and Seal Injection in accordance with AP/12. When Seal

Injection is restored, continue in ES-1.1.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. If Charging and letdown are lost, the crew will not go back to the original steps, but will perform actions based on continuous action requirements or foldout page items

B. Incorrect. Plausible because concurrent AP use is typically not recommended per OM-4.3.

C. Correct. ES-1.1 directs performance of the AP if Charging/Seal Injection is lost.

D. Incorrect. ES-1.1 would not be suspended, but the AP would be 'handed off' to an available RO to perform while the EPs were still being followed.

Technical Reference(s): OMP-4.3 p22 Rev 26 (Attach if not previously provided) (Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: ________ (As available)

Question Source:
Bank # ________
Modified Bank # ________ (Note changes or attach parent)
New X

Question History: Last NRC Exam NA

Question Cognitive Level:
Memory or Fundamental Knowledge ________
Comprehension or Analysis X

10 CFR Part 55 Content:
55.41 7, 10
55.43 ________

Comments:

KA is matched because item evaluates use of AOPs in conjunction with selected topic (SI Termination)

7.18 Multiple Use of EPs and APs.

The Control Room SRO will determine how many procedures can be implemented at a time and their priority based on manpower availability and the particular event in progress. More than one EP shall **NOT** be run concurrently unless directed by the procedure. Generally the use of APs in conjunction with EPs should be avoided. In some instances it would be proper to use an AP concurrently during a major accident which is being addressed by the EPs. An example of this is upon loss of all Nuclear Service Water in the middle of an accident, the operators would need to utilize the AP for Loss of RN also. **IF** an AP is used during an S/I event, USE CAUTION. APs are generally written assuming an S/I has **NOT** occurred (exception - AP/35, ECCS Actuation During Plant Shutdown). Evaluate any AP steps in post S/I events to ensure the steps do **NOT** conflict with any EP in effect. **NOT** all AP actions would be appropriate if an S/I occurred. (Enclosures in EP/G-1 (Generic Enclosures) may be used when reference by EPs or APs.)

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.1.18	
	Importance Rating	3.6	

(Ability to make accurate, clear and concise logs, records, status boards, and reports.)

Proposed Question: Common 66

While reviewing the Control Room Unit Log for Unit 1 two hours into a shift, the OATC determines that a momentary entrance and exit into a Technical Specification Action Statement on the previous shift was NOT included in the log entry associated with a plant transient that occurred on that shift.

The OATC checked TSAIL and determined that no entry was made regarding the Technical Specification Action Statement.

Which ONE (1) of the following describes the correct course of action?

A. The CRSRO makes a TSAIL entry, and then immediately clear the entry because the condition no longer exists.

B. The OATC makes a follow-up entry in the current log explaining the situation. No TSAIL entry will be made.

C. The CRSRO makes the correction to the previous shift's log.

D. The OATC makes the TSAIL entry, and then immediately clears the entry because the condition no longer exists, and follows up with an entry in the current log.

Proposed Answer: **B**

Explanation (Optional):

A. Incorrect. Section 7.2 of OMP 5-2 states that entry into a TS Action Statement for which a TSAIL entry will NOT be made requires entry into the Control Room Unit Log. If conditions no longer exist, then TSAIL entry will not berequired

B. Correct. Section 6.4 of OMP 5-2 states that the OATC can make Control Room Log entries. Section 6.15.2 of OMP 5-2 states that editing of archived logs should NOT normally be done. Rather, errors in archived logs should be explained in follow-up entries in current active logs.

C. Incorrect. Section 6.12 of OMP 5-2 states that log archiving is to take place in the first 15 minutes of the shift. Therefore, the previous shift logs are archived logs. Section 6.15.2 of OMP 5-2 states that editing of archived logs should NOT normally be done.

D. Incorrect. TSAIL entry is not required, and OATC would not perform that action if it was required.

Technical Reference(s)	OMP 5-2 Section 6.4, 6.106.12, 6.15, and 7.2 Rev 14	(Attach if not previously provided)
		(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: ADM-OMP #9 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam NA

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:

KA Match:

Make accurate, clear, and concise **logs**, records, status boards and reports. Question addresses how to properly **update the Control Room Unit Log**

7. Log Entries

7.1 The Initial entry for each log will be made using the currently approved computer stamp, for the applicable unit and mode.

7.2 The following types of activities and occurrences shall be entered in the appropriate Control Room Unit Log:

- All personnel induced reactivity changes, intentional or otherwise
- Any unexpected changes in reactivity (Note: normal reactivity changes due to core operation such as burn-up, xenon build-in or decay, or those caused by already logged events such as power changes, system transients, etc. need **NOT** be logged.
- Significant notifications to or from plant personnel of equipment status, daily sample results, or requests for particular evolutions or system alignments.
- Unexpected or out-of-specification chemistry results
- Major equipment status changes such as:
  - Diesel Generator starts and/or stops and reason
  - Shifting of operating trains of equipment
- Major system and equipment testing such as:
  - SSPS Testing
  - RPS Testing
- Entry/exit into EPs/APs
- Personnel accidents or injuries resulting in MERT team response or transportation of injured persons offsite
- Entry into a Technical Specification Action Statement, which will **NOT** be entered into the TSAIL
- Exit from a Technical Specification Action Statement, which will **NOT** be entered into the TSAIL
- Issued R&R's with the serial number, primarily affected equipment number and nomenclature (usually only one piece of equipment need be identified) and a short description of the reason for removal
- Cleared R&R's
- Safety-related or other important equipment maintenance in progress
- Significant changes in radiological conditions
- Planned releases of radioactive effluents, including Release No., Tank, Start/Stop Date & Time, and Volume Released.

NOTE:	Any abnormal occurrence during a release (i.e., high radiation alarm, automatic EMF actions, etc.) should also be logged.

- Unexpected releases of radioactive effluents, including start and stop dates and times
- Implementation of the Emergency Plan
- Potentially reportable occurrences

6.7 Entries shall be made in a style to provide a complete and inclusive history of events and/or evolutions including final disposition of the evolution or event. This will ensure the "information loop" for log entries is properly closed. Logs shall be maintained at a level of detail that will allow reconstruction of shift activities by personnel that do **NOT** have the benefit of a face-to-face discussion with off-going personnel. For example, when a major piece of equipment is started or stopped, the log entry should include the reason for the equipment change. Also, during unexpected conditions or transients that occur, a final log entry shall be included that will detail the reasons, what action was taken to correct the condition, and any pertinent information that will clarify the situation. It must be understood that this final entry may **NOT** be feasible until the following shift when more information is available. This will necessitate an accurate transfer of information between reactor operators on different shifts to insure the final log entry will be added. Duplicate Rounds log entries are **NOT** required for entries that would normally be logged in the Control Room Unit logs. For example, starting/stopping major equipment, fire brigade drills, etc. are normally logged in the Control Room unit log; therefore a separate entry in the appropriate Rounds log is **NOT** required. Similarly, if an operator starts/stops a piece of equipment during a round that would **NOT** normally be logged in the Control Room, a separate Control Room log entry is **NOT** required.

6.8 Entries concerning equipment shared by both units shall be denoted in both Units' logs. This may be accomplished by making the detailed entry in the Unit 1 log, followed by a reference entry in the Unit 2 log. The Service Building log is a sub log of the Unit 1 log. Therefore, separate rounds entries for shared equipment is **NOT** required. Administrative entries which are **NOT** unit specific need only be made in the Unit 1 Log. For example:

6.8.1 Administrative items such as official weather watches and warnings

6.8.2 Non unit specific regulatory or Duke Power Co. senior management notifications

6.8.3 Non unit specific security notifications or events

6.8.4 Transportation of injured persons offsite

6.8.5 Non unit specific fires

6.9 Fire drills regardless of unit affected shall be logged in the Unit one log only.

6.10 The Technical Specification Action Item Log (TSAIL - computer version) is considered an extension of the Control Room Unit Logs and info logged therein need **NOT** be duplicated in the Control Room Unit Log.

6. General Instructions

6.1 A separate Control Room Unit Log shall be maintained for each unit.

6.2 Operations Logs shall be considered a legal record and limited to factual information.

6.3 Operations Logs shall be kept with clear, concise, and complete entries.

6.4 Control Room Log entries should normally be made by or at the direction of the acting OATC or Control Room SRO. However, anyone may make entries in accordance with the requirements of this procedure, but only by permission of the OATC or Control Room SRO. Rounds Logs entries should normally be made by or at the direction of the Rounds Operator. However, anyone may make entries associated with the Round in accordance with requirements of this procedure. Log entries for operations activities **NOT** performed by the Rounds Operator should be logged by the lead operator assigned to the task. The assigned Rounds Operator should be notified when these entries are made.

6.5 Control Room Log entries should normally be made promptly. However, during significant transients it may **NOT** be practical to make prompt entries. In this case, a rough log shall be kept with as much detail as possible by an individual designated by the Control Room SRO. The information from this rough log will than be used to construct the "official" Control Room Unit Logs. The official logs entries shall be completed prior to the affected shift leaving for the day. Rounds Log entries should also be made promptly after the first round. Activities requiring subsequent entries should be made as soon as practical. **IF** prompt entry is **NOT** practical then the official log entry shall be made prior to the affected shift leaving for the day.

6.6 The on-coming OATC and Control Room SRO, and Rounds Operator shall begin the log by signing on with his/her individual ID at their respective work stations.

6.11 At the beginning of each shift, the Control Room SRO shall enter the signature stamp from the drop down box in both units autolog and type in his/her name. The Control Room SRO shall then print the Unit 1 and Unit 2 "combined" logs (ensures "All Logs" is selected for viewing prior to printing). By printing out "All Logs", the Operations and all sub-logs of Autolog are printed. This ensures retention requirements are met for all users of Autolog. The printed logs will be routed to Master File along with other end of shift paperwork for retention purposes.

6.12 After printing, both Control Room Unit Logs and Rounds Logs ("All Logs" selected) shall be archived by the on-coming Control Room SRO at the beginning of each shift. This should normally be done between 0700 (1900) and 0715 (1915). The SRO shall sign the archived log below the signature stamp. This signature acknowledges that this document is the official document of record entered by the previous Operations shift.

6.13 The on-coming OSM, Control Room SRO, respective unit OATC and Balance of Plant Reactor Operator (BOP), and Rounds Operators shall review log entries from the previous shift(s). Previous shifts log entries shall be reviewed for the time period absent from the station, up to a maximum of the previous 7 days of log entries.

6.14 **IF** for some reason the Control Room Unit Log computer program is unavailable, the unit logs will be handwritten on Attachment 1 and Rounds logs will be handwritten on Attachment 2. These attachments will then be attached to the end of shift paperwork and routed to Master File.

6.15 Autolog sublogs in Operations, Chemistry, and RP may be edited to correct errors in log entries (Active or Archived Logs) by specified personnel in the respective groups. The following criteria applies:

6.15.1 Authorization.

6.15.1.1 For Operations the OSM/OSM designee may edit archived logs.

6.15.1.2 For Non-Operations groups, the respective Group Head shall approve editing of archived logs.

6.15.1.3 The respective group's designated supervisory personnel shall approve editing of active logs. Operations ROs and NLOs have the authority to edit their own active logs prior to archiving with the C/R SRO concurrence. SROs may edit their own active log entries as needed.

6.15.2 Editing of archived logs should **NOT** normally be done. Errors in these logs should normally be explained in follow-up entries in current active logs (errors in current active logs may also be explained in follow-up entries). **IF** necessary to edit an archived log, concurrence shall first be obtained from the respective group's Department Head.

5. Reporting Requirements

Refer to NSD 417 (Nuclear Facilities/Generation Status Communications), Appendix A (Shift OPS Notification Matrix).

6. General Instructions

6.1 All entries shall be made by or at direction of an SRO.

6.2 **IF** necessary to make handwritten entries, then all such entries shall be made in ink in a neat and legible fashion. A single line will be drawn through mistakes, errors or changes and initialed and dated by writer.

6.3 A separate log shall be maintained for each licensed unit. Items affecting both units should be logged in shared (0) log.

6.4 All entries should be made (i.e., assigned a date/time inoperable) at time of occurrence or when knowledge of occurrence is first obtained.

6.5 Ensure redundant train of an affected Safety Function is checked operable before removing equipment from service.

6.6 Prior to declaring component operable, supporting documentation shall be reviewed to ensure that work needed to be done prior to returning that component back to operable status has been completed. Some examples of supporting documentation are: R&R completed, red tags cleared, work request completed, performance retest complete. More than one of preceding documents may be required to be reviewed to return some components to operable. The individual declaring a component operable should be satisfied beyond any doubt that component is operable and has seen supporting documentation specific to that component. Some examples of completed documentation needed for specific jobs are:

Example 1 - Seal Leak on NV Pump

1) Completed Restoration Section of an R&R

2) Completed work request with all necessary functional verification and/or retest satisfactorily documented

Example 2 - Slave Relay Testing

1) Applicable portion of slave relay test procedure completed

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
9.	Concerning OMP 5-2, Maintenance of Operations Logbooks: • Identify examples of logbook entries required by this OMP. • Identify any other logbook that is considered part of the Control Room Unit Logbooks • Discuss logbook review when "Relieving the Watch". • Discuss criteria for editing "Autolog" entries. ADMOMP006				X	X
10.	Concerning OMP 5-3, Technical Specifications Action Items Log: • State the responsibility of the Control Room SRO, other (second) licensed operator, and Shift Operations Manager as it pertains to the Technical Specifications Action Items Log. • Discuss the criteria for Logging Items ADMOMP007			X	X	X
11.	Concerning OMP 5-4, Diesel Generator Logbook: • Discuss the responsibilities of the "OATC" or designee. ADMOMP008	X	X	X	X	X
12.	Concerning OMP 5-5, Surveillance Monitoring: • Discuss the "PHIT". • Discuss the Surveillance Expectations • Discuss the Surveillance Standards ADMOMP009	X	X	X	X	X
13.	Concerning OMP 5-6, RO Turnover. • Describe the procedure for RO Turnover. ADMOMP033			X	X	X
14.	Concerning OMP 5-8, Shift Supervision Turnover. • Describe the turnover process • Given attachments be able to complete attachments. • Describe the Control Room SRO Relief Process and the requirement for listing Minimum Shift Staffing Requirements ADMOMP034				X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.1.13	
	Importance Rating	2.5	

(Knowledge of facility requirements for controlling vital / controlled access.)

Proposed Question: Common 67

A maintenance worker must enter a vital area to complete a task that will only take 5 minutes. He has unescorted access but his security badge is not coded to allow access to this area.

An operator is making rounds in the area and the worker requests that he open the security door and allow him to go inside for 5 minutes.

Which ONE (1) of the following identifies the correct response from the operator?

A. The worker must go to the Security Office and obtain approval for permanent access to Vital Area.

B. The operator can escort the worker provided he first obtains permission from Security to assume visitor escort duties for the worker.

C. The operator is allowed to escort the worker into the area provided that he maintains the worker under his control at all times.

D. The operator is allowed to open the door using his/her CAD key to allow the worker to enter provided Security can account for the worker exiting the area within the expected period of time.

Proposed Answer: **A**

Explanation (Optional):

A. Correct. The Plant Access Training Student Guide indicates that "Tailgating" occurs when one individual follows another individual into a vital area without swiping their Security Badge. This practice is prohibited.

B. Incorrect. Involves Tailgating and is a workaround of a Security Procedure.

C. Incorrect. Involves Tailgating.

D. Incorrect. Involves Tailgating.

Technical Reference(s)	2008 PAT Student Guide Slide 27	(Attach if not previously provided)
	Duke 2008 PAT p7	(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: ______ (As available)

Question Source:	Bank #	McGuire NRC Bank # 5	
	Modified Bank #		(Note changes or attach parent)
	New		

Question History: Last NRC Exam Not on 2005/2007 Exams

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:

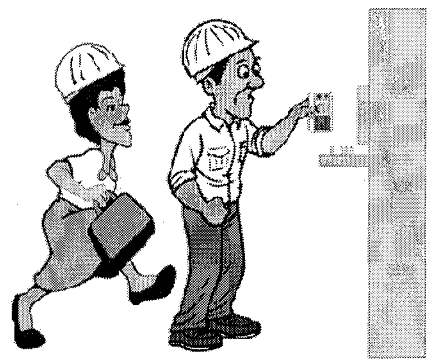
Only formatting changes made from McGuire NRC Bank Question #5.

KA Match:

Question deals with the escorting **requirements for access to a vital area**.

Tailgating

Following another person into a card reader controlled area without properly using the card reader is called tailgating. Tailgating is strictly forbidden. Failure to use your badge to access the area bypasses the security measures put in place and may allow unauthorized personnel into the area. Tailgating also makes personnel accountability more difficult in the event of an emergency.



Exiting the Protected Area

The following procedure is used to exit the Protected Area for badged employees:

Swipe your Security I.D. Badge through the card reader at the exit turnstile. This will unlock the turnstile, to rotate 1/3 of a revolution, allowing you to exit the Protected Area.

Proceed through the exit turnstile.

Entering a Vital Area

Personnel requiring unescorted entry to a vital area must have a Security I.D. Badge and specific authorization for that area. It is the each persons responsibility to know what areas they are authorized to enter.

Visitors needing to enter a vital area must be escorted by an authorized individual. If you are not sure of your authorization status for an area, contact Security before attempting to enter.

All personnel must log in and out of vital areas by swiping their Security I.D. Badge through the card reader at the door.

Duke Energy.

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.1.8	
	Importance Rating	3.4	

(Ability to coordinate personnel activities outside the control room.)

Proposed Question: Common 68

Given the following:

- Unit 1 is refueling.
- Fuel movement is in progress.
- A leak has developed which has caused Spent Fuel Pool level to drop.
- The Spent Fuel Pool Level Low computer alarm is activated.
- The SFP was initially at normal level and radiation level was 7 mr/hr.
- After 20 minutes, Pool level has decreased by more than 12 inches and radiation level is 18 mr/hr.

Which ONE of the following actions is required?

A. Dispatch an operator to initiate makeup to the SFP from the Boric Acid Tank.

B. Direct the Fuel Handling Crew to move the fuel transfer cart to the reactor side and dispatch operators to close 1KF-122, Fuel Transfer Tube block valve.

C. Direct the Fuel Handling Crew to move the fuel transfer cart to the spent fuel pool side and dispatch operators to close 1KF-122, Fuel Transfer Tube block valve.

D. Dispatch operators to coordinate with Maintenance to place the Weir Gate in position and inflate the seals.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. This action would not be performed unless other actions to restore level were unsuccessful

B. Incorrect. The transfer cart will be placed on the SFP side prior to closing KF-122

C. Correct

D. Incorrect. Action may be performed later, but will take a significant amount of time to complete. Action would not be required if action in C was successful

Technical Reference(s)	AP-41 p7 Rev 6	(Attach if not previously provided)
	AP-40 p3, 4, 7 Rev 6	(Including version or revision #)
	FH-KF p21, 23 Rev 29	
	AP-40 Basis Document p 4, 5 Rev 2	

Proposed references to be provided to applicants during examination: None

Learning Objective: AP-AP-40 Obj 2; FH-KF Obj 4 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam ______

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:
KA is matched because item involves direction of activities outside control room during a fuel handling incident

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

B. Symptoms

- **"SPENT FUEL POOL LEVEL - LO" OAC alarm**
- **Level in Spent Fuel Pool going down**
- **1EMF-17 (Spent Fuel Bldg Refuel Bldg) alarm**

C. Operator Actions

__ 1. **Announce occurrence on page.**

2. **Check fuel pool isolated from refueling canal by at least one of the following:**

   __ • 1KF-122 (Unit 1 Fuel Transfer Tube Isol) (spent fuel bldg, 780, PP-51, top of fuel pool at south east corner) - CLOSED

   OR

   __ • Unit 1 Spent Fuel Pool Weir Gate - INSTALLED

   OR

   __ • Unit 1 Fuel Transfer Tube Blind Flange - INSTALLED.

   RESPONSE NOT OBTAINED: __ **GO TO AP/1/A/5500/40 (Loss Of Refueling Cavity Level).**

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

10. **<u>IF AT ANY TIME</u> "KF POOL LEVEL" goes below minus two feet, <u>THEN</u>:**

__ a. Stop KF pump.

b. Dispatch operator to deenergize underwater lights before they become uncovered by opening the following breakers:

__ • Panelboard 1L18A, Breakers 1-5 (fuel bldg, 778, PP-48)

__ • Panelboard 1L18, Breakers 1-17 (aux bldg, 778, KK-51, located next to entrance to Upper Containment).

__ c. Ensure VF has been placed in filter mode by placing "VF EXH BYP DMPR CNTRL" to "CLOSE".

d. Ensure operator has been dispatched to ensure all Unit 1 spent fuel pool bldg doors are closed:

__ • Rollup doors

__ • Personnel doors.

__ e. Notify RP.

<u>CAUTION</u> **If necessary to makeup to the Spent Fuel Pool with unborated water, 1KF-122 (Fuel Transfer Tube Block) must be closed to prevent potentially diluting the NC System.**

<u>NOTE</u> Sub-criticality of the pool is assured without the presence of soluble boron. Do not hesitate to use RN in next step if pool level is dropping rapidly.

__ f. Initiate makeup to Spent Fuel Pool **<u>PER</u>** OP/1/A/6200/005 (Spent Fuel Cooling System), Enclosure 4.4 (Spent Fuel Pool Level Control).

__ 11. **Ensure Containment Integrity during Refueling Operations established <u>PER</u> PT/1/A/4200/002 C (Containment Closure/Integrity).**

Spent Fuel Pool Makeup

Objective # 4

Spent Fuel Pool *makeup* capability is provided to control and maintain water volume *(shielding)*, within the fuel pool, during plant operation. **However, all means of makeup must be *manually initiated* and *manually terminated.***

Due to concerns with elevated site airborne Tritium being released compared with industry averages, YM is now the preferred make up source. The FWST and RMWST Contain higher levels of Tritium than the SFP and due to evaporation, the SFP is a major source of the airborne Tritium release from the site. The SFP makeup from YM is accomplished via routing a red rubber hose from a YM connection near the pool and requires coordination with RP and Chemistry. (PIP M-04-04820)

Non-borated demineralized water, via YM (**Preferred** Source) or the Reactor Makeup Water Pumps and the Reactor Makeup Water Storage Tank, **can be used** for makeup **if the last weekly boron sample was >2775 ppm or dilution is desired.** The following table is an example of the amount of demin water needed to make appropriate boron changes. This table is in the lesson plan only as an example. Further update of actual values is not needed in the future.

A table within *OP/1(2)/A/6200/05, Spent Fuel Cooling System* provides a conservative addition for makeup to the Spent Fuel Pool using Demineralized Water based upon the last boron sample:

Last Boron Sample	Demin Water Addition to Maintain Boron Concentration >2675 ppm
2700 ppm	2 inches
2725 ppm	5 inches
2750 ppm	7 inches
2775 ppm	10 inches
2800 ppm	12 inches
2825 ppm	15 inches
2850 ppm	18 inches
2875 ppm	20 inches
2900 ppm	23 inches
2925 ppm	25 inches
2950 ppm	28 inches

Borated water, from the Refueling Water Storage Tank (FWST), should be used for makeup if the ***last SFP boron sample indicated < 2775 ppm or boration is desired.***

Objective # 4 & 5

Non-borated lake water *(Assured Makeup)*, from the Nuclear Service Water System (RN), can be used for makeup. The *Assured Makeup* **should only be used if borated and demineralized water are not available for makeup** *and* **the Spent Fuel Pool Level is low enough to cause a** *radiation hazard to employees or the public.*

Electrical Power Supply

Objective # 6

Each Spent Fuel Pool Cooling Pump receives power from its respective *Essential Bus, 1(2)ETA* **(4160V)** *or 1(2)ETB* **(4160V)** *(the same buses that can be powered by the Emergency Diesel Generators).*

Each KF AHU receives power from its respective *Essential Motor Control Center, 1(2) EMXA* **(600V)** *or 1(2) EMXB* **(600V).**

The Fuel Pool Skimmer Pump receives power from one of the normal station buses *1(2) MXK* **(600V)** and can be operated anytime the bus is energized. However, this pump is not required during emergency operations.

Motor-operated valve 1(2)KF-12, Purification Loop Isolation Valve, is also powered from a normal station bus *1(2) MXJ* **(600V)** and can be operated remotely anytime the bus is energized. *Manual operation of this valve can be performed if power is unavailable.*

Spent Fuel Pool Chemistry

One spent fuel pool water volume is circulated, through the *purification loop,* every 24 hours. This allows proper maintenance of Spent Fuel Pool chemistry as specified and required by the Chemistry Department.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

NOTE Any available core location may be used when lowering a fuel assembly during emergency conditions.

3. **Contact fuel handling SRO to have fuel handling crew perform the following:**

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
__ a. Lower any fuel assembly in the reactor building manipulator crane to fully down in the core.	__ a. Release brake and hand crank hoist down.
__ b. Lower any fuel assembly in the spent fuel manipulator crane to fully down.	__ b. Release brake and hand crank hoist down.
__ c. Lower any fuel assembly in either upender to fully down.	__ c. Release brake and hand crank upender down.
__ d. Move fuel transfer cart to the spent fuel (Pit) side.	__ d. Release brake and hand crank transfer cart to spent fuel (Pit) side.
__ e. Lower any radioactive component in the spent fuel pool or refueling cavity to fully down.	e. Perform the following: __ • Reinstall component. OR __ • Place component as far below the water as safely possible.

__ 4. **Stop #1 FW pump.**

__ 5. **Dispatch operator to ensure 1FW-13 (Unit 1 Refueling Cavity To FW Pump Cont Outside Isol) (aux bldg, 716+15, JJ-51, room 605, 10 ft southeast of 1B NB Pump, 3 ft from reactor bldg wall) is closed.**

PURPOSE:

Ensure irradiated fuel assemblies and/or radioactive components remain shielded with water.

DISCUSSION:

If cavity water level is decreasing, components in the cavity may become uncovered. Fuel assemblies in the cavity are either lowered in the core, where they can't become uncovered, or transferred over to the pool. In both cases, they are removed from the cavity. Fuel assemblies in the spent fuel pool are also lowered to fully down, where they can't be uncovered by decreasing level (eventually, the pool may be separated from the cavity).

If the manipulator crane hoist, upender hoist, or transfer cart hoist is not functioning, the assemblies can still be lowered using a hand-cranked hoist. A star shaped knob is threaded into a location that will release the hoist brake, allowing the hand crank to be used to control the lowering of the component.

The guidance provided in this step is required by SOER 85-1, Reactor Cavity Seal Failure.

REFERENCES:
SOER 85-1, Reactor Cavity Seal Failure

STEP 4:

PURPOSE:

Secure the Big FW pump due to possible source of inventory loss.

DISCUSSION:

The refueling cavity could potentially be tied to the spent fuel pool through the KF purification loop. In that alignment, the FW pump takes suction off the cavity through FW-13, discharges to the KF purification loop (to the KF filter and demineralizer) and back to the cavity. In preparation for closing FW-13, the FW pump is secured.

STEP 5:

PURPOSE:

Isolate flowpath that could be cause of inventory loss.

DISCUSSION:

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

6. **Dispatch two operators to perform the following:**

__ a. **WHEN** fuel transfer cart is in the spent fuel building, **THEN** close 1KF-122 (Fuel Transfer Tube Block) (spent fuel bldg, 780, PP-51, top of fuel pool at south east corner).

RESPONSE NOT OBTAINED:

a. **IF** 1KF-122 cannot be closed, **THEN**:

1) Have dispatched operators ensure all spent fuel pool bldg doors are closed:

__ • Rollup doors

__ • Personnel doors.

__ 2) Notify RP to begin continual radiation surveys of the spent fuel pool area.

__ 3) Evaluate having maintenance install transfer canal weir gate to isolate pool from refueling canal.

__ 4) Ensure VF in filter mode by placing "VF EXH BYP DMPR CNTRL" to "CLOSE".

7. **Perform the following:**

- **IF** time permits, **THEN** dispatch operator or have fuel handling SRO deenergize the refueling cavity underwater lights before they become uncovered by opening the following breakers:

  __ a. Panelboard 1LR14, Breakers 1-10 (Unit 1 reactor bldg, 778, 302°)

  __ b. Panelboard 1LR15, Breakers 1-11 (Unit 1 reactor bldg, 778, 248°).

__ • Evacuate nonessential personnel from containment **PER** RP/0/A/5700/011 (Conducting a Site Assembly, Site Evacuation, or Containment Evacuation).

__ • Evacuate nonessential personnel from spent fuel bldg.

This step closes FW-13 to isolate the flow path from the cavity to the FW pump. Performed to ensure this flow path out of the cavity is isolated. (A mispositioned valve in the FW flow path could be causing the loss of water from the canal).

STEP 6:

PURPOSE:

Isolate the spent fuel pool from the refueling cavity to prevent pool level from decreasing along with cavity level.

DISCUSSION:

KF-122 is closed to prevent draining the pool along with the cavity. If the conveyor is in containment it can interfere with the closing of KF-122, Fuel Transfer Tube Block valve, so direction is given to move it to the Spent Fuel Pool Building. Dispatching two operators instead of one will ensure KF-122 is closed in a timely manner. Closing this valve faster will limit the amount of water that would drain.

If KF-122 can't be closed, then compensatory actions are specified. One is to notify RP to continually survey rad levels in the pool area, since shielding water is decreasing. Another is to consider installing the weir gate, which could limit just the transfer cavity draining. VF is placed in the filter mode to prevent unfiltered releases. The spent fuel doors are closed to prevent uncontrolled releases.

STEP 7:

PURPOSE:

Prevent damage to the refueling cavity underwater lights. Prevent unnecessary personnel exposure.

DISCUSSION:

Underwater lights are de-energized to protect them. The heat load on the underwater lights requires them to be surrounded by water when energized. If the water level drops below the lights when energized, insufficient heat is transferred to the surrounding air, and the lights will overheat. Decreasing water levels could raise the radiation levels in the buildings, depending on how low the water gets. It's prudent to remove nonessential personnel at this time. What constitutes "essential" personnel is a judgement call that weighs the value of the task being performed to the dose that may be received. It would require an important task to risk a high radiation dose.

The guidance provided in this step is required by SOER 85-1, Reactor Cavity Seal Failure.

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)/5500/40 (Loss of Refueling Cavity Level): • State the purpose of the AP • Recognize the symptoms that would require implementation of the AP. AP40001			X	X	X
2	Given scenarios describing accident events and plant conditions, evaluate the basis for any caution, note, or step. AP40002			X	X	X

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 Spent Fuel Pool Cooling System.	X	X	X	X	
2	Draw a simplified diagram of the Spent Fuel Pool Cooling System (including all major components) per Training Drawing 7.1, Spent Fuel Pool Cooling System - Simplified.	X	X	X	X	
3	State the flowrates through each of the following flowpaths: • Spent Fuel Pool Cooling Loop • Spent Fuel Pool Purification Loop • Spent Fuel Pool Skimmer Loop	X	X	X	X	
4	List the sources of makeup to the Spent Fuel Pool Cooling System; including the source grade (i.e., borated, non-borated demineralized, and non-borated lake water).	X	X	X	X	
5	Explain the conditions which would require *"assured makeup"*, from the Nuclear Service Water System, to the Spent Fuel Pool Cooling System.	X	X	X	X	X
6	List the power supply for the following Spent Fuel Pool Cooling System Pumps (Unit 1 and Unit 2): • KF Pump(s) • KF Skimmer Pump(s)	X	X	X	X	
7	Describe the controls, indications, and/or alarms, associated with Spent Fuel Pool Cooling System operation, located <u>within</u> the <u>Control Room</u>.			X	X	X
8	Describe how the KF Pump motor(s) is cooled during system operation.	X	X	X	X	
9	State the cooling medium for the Spent Fuel Pool Cooling System Heat Exchanger(s).	X	X	X	X	
10	Describe the controls, indications, and/or alarms, associated with Spent Fuel Pool Cooling System operation, located <u>outside</u> the <u>Control Room</u>.	X	X	X	X	

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.2.40	
	Importance Rating	3.4	

(Ability to apply technical specifications for a system.)

Proposed Question: Common 69

While performing a cooldown on Unit 1 from Mode 3 to Mode 5 the following parameters were logged.

Time	NC PRESS	NC TEMP	PZR LIQ SPACE TEMP
0200	2200 psig	553°F	650°F
0230	1550 psig	527°F	606°F
0300	1135 psig	505°F	560°F
0330	765 psig	447°F	494°F
0400	400 psig	402°F	440°F

Which ONE of the following describes the technical specification implications of these conditions?

A. NCS cooldown rate limits were exceeded; TS action is required within a maximum of 30 minutes.

B. NCS cooldown rate limits were exceeded; TS action is required within a maximum of 60 minutes.

C. PZR cooldown rate limits were exceeded; TS action is required within a maximum of 30 minutes.

D. PZR cooldown rate limits were exceeded; TS action is required within a maximum of 60 minutes.

Proposed Answer: A

Explanation (Optional):

A. Correct. Greater than 100 degrees F in 1 hour, exceeds limits

B. Incorrect. Action is required within 30 minutes. 60 minutes is plausible because it is within 1 hour, but is outside of the required action time.
C. Incorrect. PZR cooldown rate limits are 200 degrees per hour. Plausible if applicant applies the 100 degree per hour limit to PZR
D. Incorrect. PZR cooldown rate limits are 200 degrees per hour. Plausible if applicant applies the 100 degree per hour limit to PZR

Technical Reference(s)	TS 3.4.3	(Attach if not previously provided)
	SLC 16.5.8	(Including version or revision #)

Proposed references to be provided to applicants during examination: ____

Learning Objective: PS-NC Obj 24, 25 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam Various similar – different times

Question Cognitive Level:	Memory or Fundamental Knowledge	
	Comprehension or Analysis	X

10 CFR Part 55 Content:	55.41	5
	55.43	

Comments:

KA is matched because TS actions for violation of RCS cooldown limits are being applied

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.3 RCS Pressure and Temperature (P/T) Limits

LCO 3.4.3 RCS pressure and RCS temperature shall be limited during RCS heatup and cooldown, criticality, and inservice leak and hydrostatic testing in accordance with:

a. A maximum heatup rate as specified in Figure 3.4.3-1, Figure 3.4.3-2, Figure 3.4.3-3, or Figure 3.4.3-4;

b. A maximum cooldown rate as specified in Figure 3.4.3-5 or Figure 3.4.3-6; and

c. A maximum temperature change of ≤ 10°F in any 1 hour period during inservice leak and hydrostatic testing operations above the heatup and cooldown limit curves.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ------------NOTE------------ Required Action A.2 shall be completed whenever this Condition is entered. -------------------------------- Requirements of LCO not met in MODE 1, 2, 3, or 4.	A.1 Restore parameter(s) to within limits. AND A.2 Determine RCS is acceptable for continued operation.	30 minutes 72 hours
B. Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 5 with RCS pressure < 500 psig.	6 hours 36 hours

(continued)

MATERIAL PROPERTY BASIS

LIMITING MATERIAL: LOWER SHELL LONGITUDINAL WELD
LIMITING ART VALUES AT 34 EFPY: 1/4T, 202°F
3/4T, 146°F

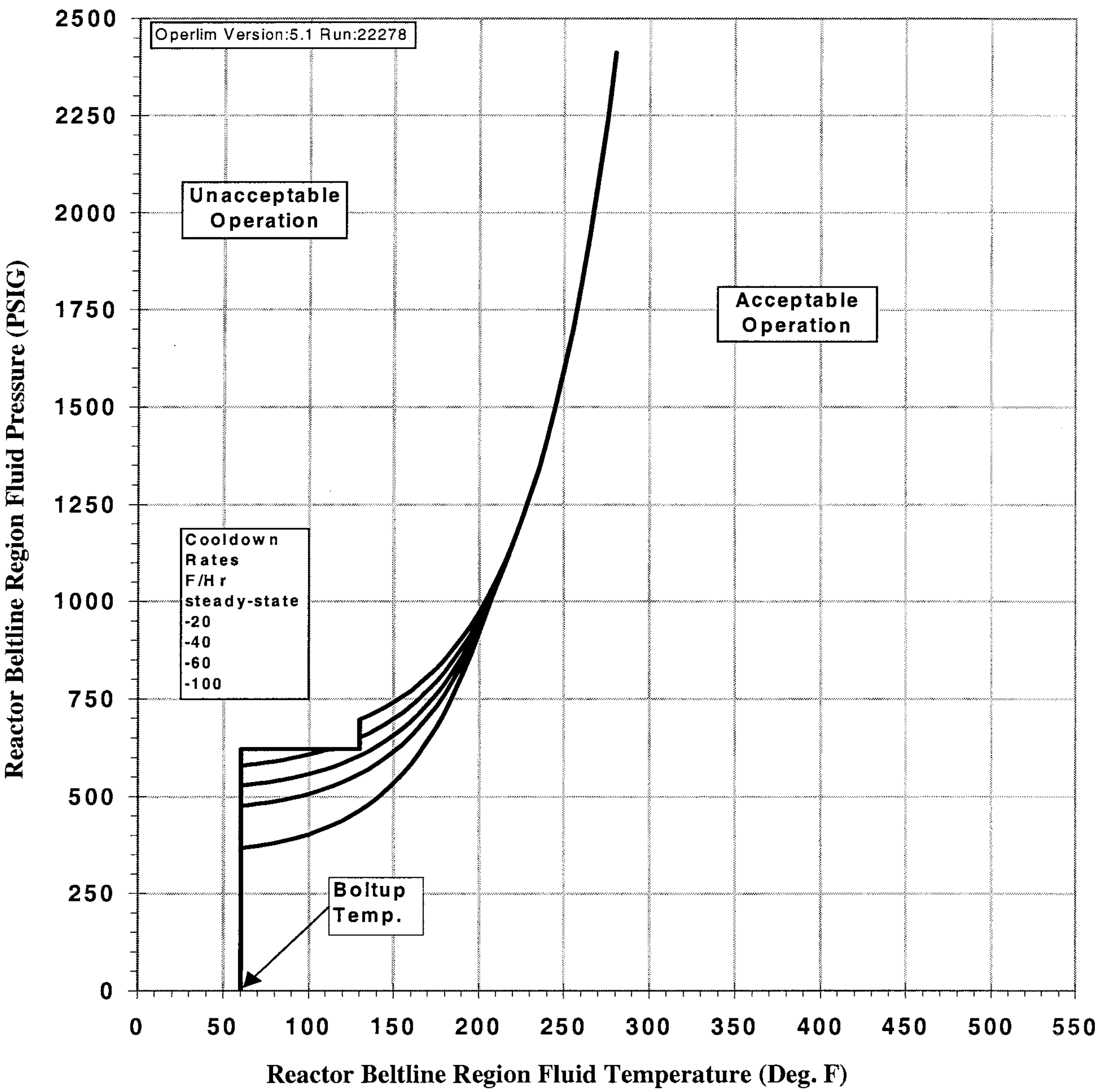


Figure 3.4.3-5 McGuire Unit 1 Reactor Coolant System Cooldown Limitations (Cooldown Rates up to 100°F/hr) Applicable for the First 34 EFPY (Without Margins for Instrumentation Errors) Using 1996 App.G Methodology & ASME Code Case N-641

16.5 REACTOR COOLANT SYSTEM

16.5.8 Pressurizer

COMMITMENT The pressurizer temperature shall be limited to:

a. A maximum heatup of 100°F in any 1-hour period,

b. A maximum cooldown of 200°F in any 1-hour period, and

c. A maximum spray water temperature differential of 320°F.

APPLICABILITY At all times.

REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ------------NOTE----------- All Required Actions must be completed whenever this Condition is entered. ------------------------------- Pressurizer temperature not within limits.	A.1 Restore pressurizer temperature to within limits.	30 minutes
	AND	
	A.2 Perform engineering evaluation to determine effects of the out-of-limit condition on the structural integrity of the pressurizer.	72 hours
	AND	
	A.3 Determine that the pressurizer remains acceptable for continued operation.	72 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3.	6 hours
	AND	
	B.2 Reduce pressurizer pressure to < 500 psig.	36 hours

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
20	Describe how NCS temperature, pressure, flow and Pzr level are measured and indicated.		X	X	X	
21	Describe the operation and indication readout of the following NCS level instrumentation: • Ultrasonic level detection • WR level • NR level • Sightglass		X	X	X	X
22	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	
23	Given a Limit and/or Precaution associated with the NC System, discuss its basis and when it applies.		X	X	X	X
24	Concerning the Technical Specifications related to the NC System: • Given the LCO title, state the LCO (including any COLR values) and applicability. • For any LCO's that have action required within one hour, state the action. • Given a set of parameter values or system conditions, determine if any Tech Spec LCO's is(are) not met and any actions(s) required within one hour. • Given a set of parameter values or system conditions and the appropriate Tech Spec, determine required action(s). • Discuss the bases for a given Tech. Spec. LCO or Safety Limit. * SRO ONLY			X X X X	X X X X X	X X X X *

OBJECTIVES

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
25	Concerning the Selected Licensee Commitments (SLC) related to the Reactor Coolant 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(s) is (are) 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 required action(s).			X	X	X
	• Given the SLC Manual , discuss the basis for a given commitment.				X	*
	* SRO only					

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.2.13	
	Importance Rating	4.1	

(Knowledge of tagging and clearance procedures.)

Proposed Question: Common 70

At the end of a shift, there is an outstanding Configuration Control Card (CCC), because a component could not be returned to its 'as found' position.

Which ONE of the following describes the correct disposition of the CCC?

A. Document the CCC as part of your turnover at shift relief.

B. Return the CCC to the CRSRO to determine whether it should be turned over or if a procedure change will be required.

C. Return the CCC to the OSM. An R&R will be issued prior to shift turnover.

D. Return the CCC to the WCC SRO. The CCC will be tracked as open until the component can be repositioned to it's 'as found' position.

Proposed Answer: **C**

Explanation (Optional):

A. Incorrect. Component will be out of position. Must be resolved more than just documents.

B. Incorrect. Plausible because conditions may exist for either, but the actual CCC will NOT be turned over

C. Correct. Tags would be required if a component could not be returned to as found. This would be done prior to turnover

D. Incorrect. CCC goes to CRSRO, not WCC SRO. CCC will not be left open for turnover

Technical Reference(s)	SOMP 2-1 Rev 3	(Attach if not previously provided)
		(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: ADM-OP #40 (As available)

Question Source: Bank #
Modified Bank # (Note changes or attach parent)
New X

Question History: Last NRC Exam

Question Cognitive Level: Memory or Fundamental Knowledge X
Comprehension or Analysis

10 CFR Part 55 Content: 55.41 10
55.43

Comments:
KA is matched because the applicant must determine when an R&R (tagout) must be issued for configuration control

5. Responsibilities

5.1 Superintendent of Operations:

- Shall determine the Operational Control Group (OCG) for equipment and systems.
- Approval of this procedure.

5.2 Operations Shift Manager (OSM):

5.2.1 Ensure shift personnel abide by this standard.

5.2.2 Review CCCs generated on-shift to ensure the component manipulation(s) are in compliance with this standard and initial the CCC.

5.2.3 With respect to CCCs generated, ensure any procedure changes or R&Rs are initiated as needed.

5.2.4 Retain the CCC in the "CCC Box" provided in the OSM Office.

5.3 Operations Manager:

5.3.1 Approve exceptions to Red Tag Placement (Exception Tags) when the restrictions for use of Exception Tags are met.

5.4 Operations Human Performance Group (OHPG):

5.4.1 Retrieve CCCs from the OSM "CCC Box" at the end of each month at a minimum and file the CCCs by month and retain for a period of two (2) years.

5.5 Chemistry Manager:

5.5.1 Granted authority by the Superintendent of Operations to be responsible for tagging of assigned equipment and systems.

5.5.2 Approval of this procedure.

5.5.3 Or designee is responsible for periodic review of the CCC process to ensure all Chemistry personnel abide by this standard.

5.5.4 Or designee review CCCs generated to ensure the component manipulation(s) are in compliance with this standard and initial the CCC.

5.5.5 Or designee with respect to CCCs generated, ensure any procedure changes or R&Rs are initiated as needed.

5.5.6 Or designee retain the CCC in the "CCC Box" in the Chemistry Staff Office area.

2.4 Oconee

- OMP 1-2 (Rules of Practice)
- OMP 2-1 (Duties and Responsibilities of On-Shift Personnel)
- OMP 2-15 (OPS Work Process Group Responsibilities)
- CSM 3.40 (Rules of Practice)

3. Regulatory Requirements

3.1 Technical Specifications require development and maintenance of all applicable procedures listed in Appendix A to RG 1.33 Rev 2. Equipment Control (locking and tagging) is one of the procedures listed in Appendix A. This is the basis for NSD 500 (Red Tags/Configuration Control Tags) being Tech Spec related.

3.2 This SOMP implements the requirements of NSD 500. Evaluate any removal or removal addendum enclosure that is placed for greater than or equal to 90 days in accordance with 10 CFR 50.59.

4. Description

4.1 Removal and Restoration (R&R)

4.1.1 Provides explanation on how the Removal & Restoration (R&R) process shall be used by Operations and Chemistry groups to remove equipment from service for maintenance, safety considerations, and Tech Spec issues, or other off normal situations, and to return that equipment to service.

4.1.2 Provide requirements for ensuring documentation of plant configuration control during the execution of tagouts.

4.2 Configuration Control Card

4.2.1 The Configuration Control Card (CCC) provides an additional configuration control tool to enable Operations to maintain *short-term* plant configuration control.

4.2.2 The CCC provides a method to track and control component position when those component positions are **NOT** otherwise being tracked and controlled by a technical procedure or R&R.

12. Configuration Control Card (CCC) Requirements

12.1 Prior to changing the configuration of any component, a review of outstanding R&Rs, CCCs, and procedure enclosures should be performed and any conflicts in configuration resolved prior to changing the status of the component.

12.2 Where there is an approved procedure that covers a specific activity, that activity shall be conducted in accordance with the provisions of the applicable approved procedure with consideration that some procedural steps may be NA'd if feasible to adapt the procedure to permit its use for configuration control.

12.3 Typically, a CCC should only be used to document a components position - the guidance to manipulate a component shall be provided by an approved procedure if a procedure is required per NSD 703 Appendix G. NSD 703 Appendix G (Technical Procedure Questionnaire) should be referenced to determine whether a procedure is required. The use of this questionnaire as a guide should be considered for cases where the need for a procedure is **NOT** clearly defined for the proposed activity – this guide is **NOT** inclusive of every situation or circumstance.

12.4 Prior to using a CCC, determine if the CCC is the appropriate configuration control method to be used for plant equipment manipulation and obtain Supervisor permission prior to use unless it is an emergency situation.

12.4.1 The Supervisor shall evaluate use of the CCC against this standard and determine if the CCC is an appropriate configuration control method based on the tasks complexity, volume, and vulnerability to error.

12.4.2 All operators utilizing a CCC shall understand the specific actions and intent of the CCC and its affect on plant operation.

12.5 **WHEN** appropriate action is taken in an emergency to place the plant in a safe condition, independent of procedures:

12.5.1 Documentation of the manipulation via a CCC or an R&R shall be used to maintain configuration control.

12.5.2 **IF** these actions include the adjustment of a setpoint by Maintenance, a WR and PIP should be generated to ensure the setpoint adjusted is returned to the proper value.

12.5.3 During an Emergency Event, when the OSC has been activated, Operations and Chemistry will report to the OSC and shall bring with them all CCCs that have been filled out. The cards taken to the OSC shall be given to the OPS SRO in the OSC.

12.6 **IF** a component **CANNOT** be returned to the "As Found Position", the normal process will be to issue an R&R prior to shift turnover. All CCCs shall be returned to the OSM or Chemistry Manager/designee at the end of shift.

12.7 CCC (Attachment 13.7) should be used under the following conditions:

- **WHEN** performing alignments **NOT** covered by an approved procedure or R&R.

- Actions taken per Annunciator or OAC Alarm Response procedures or any other applicable procedure which does **NOT** provide for documented configuration control.

- **WHEN** positioning components within the boundaries of an R&R to allow additional venting / draining capacity.

- To perform simple, short-term equipment alignments to enable functional verifications of equipment following maintenance per an existing work order or work request.

- In an emergency where quick action is required to correct rapidly degrading plant conditions that threaten areas such as: {PIP M-03-1709}

  - Personnel safety
  - Plant reliability or availability
  - Equipment damage

- A CCC **SHALL** be filled out any time a component is positioned in the plant as directed by an AP or EP procedure and the following conditions are met:

  - The person doing the positioning does **NOT** have a procedure or R&R in his possession and

  - The action is **NOT** documented on the controlling procedure at the time that the action is performed.

- Any component that is positioned on the control board to work around equipment failures or isolate leaks that are **NOT** specifically covered in the EP/AP shall be documented on the CCC.

12.8 **CCC** should **NOT** be used under the following conditions:

- To implement long-term component/system alignments.

  - To perform alternate component or system alignments which are **NOT** within the original design and intent of the associated system.

  - To perform troubleshooting activities – instead, a Troubleshooting Procedure should be used for other than normal system alignments for determination of abnormal operation or due to system malfunction.

13. Attachments

13.1 Removal and Restoration Record Sheets

13.2 Manual Tagging Log

13.3 Blank R&R Enclosures

13.4 Flowchart For Low Voltage Panel Breaker Tagging

13.5 Removal and Removal Addendum Checklist

13.6 Tag Lift Checklist

13.7 Configuration Control Card (CCC)

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
39.	Concerning SOMP 01-02 Reactivity Management • Discuss the purpose of SOMP 01-02 • State who has ownership of Reactivity Management impact from equipment problems • State who is responsible for monitoring reactivity addition and its results • Define the reactivity changes that need to be communicated to the SRO.	X	X	X	X	X

40.	Concerning SOMP 02-01, Safety Tagging And Configuration Control:
	• Describe the process used when conducting a tag out to fill and vent a portion of the system.
	• Describe the conditions when an R&R should not be used.
	• Discuss the responsibility and position of:
	  • Preparer
	  • Reviewer
	  • Approver
	  • Individual Placing Tags
	• Describe when a configuration control card (CCC) could be used.
	• Explain proper disposition of CCC's at the end of shift.
	• State who writes, reviews and approves R&Rs.
	• Discuss the requirements for configuration control when a control switch has a "AUTO" position.
	• Discuss the requirements for listing equipment as "VAR" position.
	• Discuss isolating a system which contains a High Energy Portion and Low Energy Portion.
	ADMOMP014
		X	X	X	X	X

41.	Concerning SOMP 02-02, Operations Roles In The Risk Management Process
	• Discuss the Purpose of this SOMP
	• Discuss the responsibilities of:
	  o OWPM Group
	  o OWPG Group
	  o OSM
	  o WCC SRO
	  o Control Room Supervisor
	State the five (5) colors of Risk Level Management action Categories covered in this OMP DMOMP042
				X	X	X

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.2.6	
	Importance Rating	3.0	

(Knowledge of the process for making changes to procedures.)

Proposed Question: Common 71

During performance of PT/2/A/4200/01E, Upper Containment Personnel Airlock Leak Rate Test, by the NLO, two steps need to be performed out of sequence. After deliberation by the SRO and the NLO, it is determined that this deviation from the procedure sequence is needed and will not alter the intent of the procedure.

Which ONE (1) of the following statements describes the action(s) required for performing these procedural steps out of sequence in accordance with NSD 704 and SOMP 04-02?

A. An explanation of the sequence deviation within the REMARKS SECTION of the Procedure Process Record initialed by the NLO approving the change.

B. An explanation of the sequence deviation within the REMARKS SECTION of the Procedure Process Record initialed by the NLO and the SRO approving the change.

C. An explanation of the sequence deviation documented within the procedure body or procedure cover sheet and initialed by the NLO and the SRO approving the change.

D. An explanation of the sequence deviation documented within the procedure or procedure cover sheet by the NLO and the SRO, and initialed by the OSM approving the change.

Proposed Answer: **D**

Explanation (Optional):

A. Incorrect. Document in body of procedure or cover sheet, need performer, supervisor and OSM initials.

B. Incorrect. Document in body of procedure or cover sheet, need OSM initials.

C. Incorrect. Need OSM approval.

D. Correct. Section 7.11.2.B of NSD 704 states that an explanation for the sequence change shall be documented within the procedure body or on the cover sheet and initialed by the performer and the supervisor. Section 9.4.1 of SOMP 04-02 states that OSM must approve any change of sequence of OPS procedures.

Technical Reference(s)	NSD 704 Section 7.11.2.A Rev 15	(Attach if not previously provided)
	SOMP 04-02 Step 9.4.1 Rev 001	(Including version or revision #)

Proposed references to be provided to applicants during examination: ____________

Learning Objective: ADM-OP, objective 16 (As available)

Question Source:	Bank #		
	Modified Bank #	McGuire NRC Bank # 20	(Note changes or attach parent)
	New		

Question History: Last NRC Exam Not on 2005/2007 Exams

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:
KA Match:
Process for making changes to procedures. SOMP 04-02 provides the processes for procedure use and adherence, including documenting a change in step sequence.

During performance of PT/2/A/4200/01E, Upper Containment Personnel Airlock Leak Rate Test, by the Operation Test Group, two steps need to be performed out of sequence. After deliberation by the Test Team Supervisor and the SRO, it is determined that this deviation from the procedure sequence is needed and will not alter the intent of the procedure.

Which one of the following statements describes the action(s) required for performing these procedural steps out of sequence in accordance with OMP 4-1?

A. OSM approval documented within the REMARKS SECTION of the Procedure Process Record.

B. Test Team approval documented within the REMARKS SECTION of the procedure and a copy of the "SUBMITTED" procedure change attached.

C. An explanation of the sequence deviation documented within the procedure or procedure cover sheet and initialed by the Test Team Supervisor and the SRO approving the change.

D. An explanation of the sequence deviation documented within the procedure and initialed by the OSM approving the change, the Test Team Supervisor and the SRO recommending the change.

9.3 Rules for when procedure steps may be marked NA:

9.3.1 OSM must approve non conditional NA of OPS procedures.

9.3.2 (ONS ONLY) OSM or Test Group Supervisor must approve non conditional NA of OPS Test Group procedures.

9.3.3 (ONS ONLY) OSM or Keowee Supervisor must approve non conditional NA of Keowee procedures.

9.4 Rules for steps sequence:

9.4.1 OSM must approve any change of sequence of OPS procedures.

9.4.2 (ONS ONLY) OSM or Test Group Supervisor must approve change of sequence of OPS Test Group procedures.

9.4.3 (ONS ONLY) OSM or Keowee Supervisor must approve change of sequence of Keowee procedures.

9.5 Rules for performing a surveillance PT that requires a channel check:

9.5.1 Use only operable channels/instruments when determining the average of the channels.

9.5.2 Perform the required channel check using the operable channels/instruments.

9.5.3 Fill out a Procedure Discrepancies Process Record (NSD 704 Appendix C) for the inoperable channel/instrument and attach it to the PT.

9.6 **IF** work is to be halted due to non routine or unexpected conditions during an in progress procedure section or enclosure:

9.6.1 Ensure adverse consequences (spills, Tech Spec violations, equipment failure, etc.) will **NOT** occur.

9.6.2 **IF** the reason for delaying completion of the procedure is **NOT** obvious, a supervisor signature and written explanation should be provided.

9.6.3 Place the procedure in the appropriate "Procedure In Progress" file location.

B. The performer determines the work scope is more limited than the procedure was written to accomplish or plant conditions are such that the step clearly does not apply.

C. The performer shall ensure explanation for marking the step NA is documented beside the step in the procedure, on the Procedures Process Record Form, or Electronic Library Cover Sheet, or somewhere within the procedure.

D. The performer shall NA and initial the step(s). To NA a consecutive group of steps, place NA in the first step and last step and draw a vertical line through the remaining steps involved.

E. The supervisor shall ensure the explanation for marking the step NA is documented and appropriate.

F. The supervisor shall initial at the step(s) marked NA, on the Procedure Process Record Form or on the electronic cover sheet.

G. If the step being marked NA would position equipment whose configuration control is the responsibility of another group, the supervisor shall obtain an additional review and initial from the Operational Control Group before the NA occurs.

H. When entire pages of a procedure are NA, it is not necessary to retain these pages for documentation unless these pages contain the reason or the supervisor approval for not using these pages.

4. <u>Exception to requirement in Step 704.7.10.3 to obtain approval prior to marking a non-conditional procedure step NA and continuing with the procedure</u> – If the non-conditional procedure steps are part of a Maintenance Group Procedure and this procedure is being performed on systems or components which have been removed from service, then the performer is not required to obtain approval by their supervisor prior to proceeding to the next step. However, sub-steps A - G of Step 704.7.10.3 must be met prior to restoring the system or component to service.

7.11 When Step Sequence may be changed:

1. Do not deviate from the sequence of steps, unless approved.

- Numbered or lettered steps shall be performed in the sequence written unless otherwise noted in the procedure.
- Bulleted or unnumbered steps may be performed in any order.
- Checklists may be performed in any order unless otherwise stated in the checklist.

2. To perform steps out of sequence:

A. A supervisor and the performer shall review the procedure to ensure the desired sequence will cause no adverse effects. The supervisor shall be technically cognizant or qualified to the procedure or task or shall obtain concurrence from an individual who is, before authorizing performance of steps out of sequence. Deviation from the <u>intent</u> of the procedure shall not be allowed without an approved procedure change.

B. An explanation for the sequence change shall be documented within the procedure body or on the cover sheet and initialed by the performer and supervisor.

C. Document the new sequence using one of the following methods (or a similar method that accomplishes the goal of documenting and approving the new sequence):

1) Using a black ink pen, insert a note that describes the sequence change.

The performer and supervisor shall place their initials near the new note.

Example: "Step 12.3 is to be performed before Step 12.2", or "Steps 12.2, 12.3, and 12.4 may be performed in any order."

2) Using a black ink pen, renumber the steps in the new sequence. The performer and supervisor shall place their initials near each new step number (or on each page if multiple steps/pages are affected).

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.3.4	
	Importance Rating	3.2	

(Knowledge of radiation exposure limits under normal or emergency conditions.)

Proposed Question: Common 72

Units 1 and 2 are at 100% power. Given the following events and conditions:

- Unit 2 has experienced several fuel pin failures.
- The mechanical seal has failed on the 2B NI pump.
- The 2B NI pump room general area is 400 mrem/hr.
- In order to reach the 2B NI pump room the worker must transit through a 6 Rem/hr high radiation area for 2 minutes and return via the same path.
- The worker has an accumulated annual dose of 400 mrem.

Which ONE (1) of the following identifies the maximum allowable time that the worker can participate in the seal repair on the 2B NI pump and not exceed the **exclude exposure limit** for external exposure?

A. No longer than 2 hours.

B. No longer than 2.5 hours.

C. No longer than 3 hours.

D. No longer than 3.5 hours.

Proposed Answer: **B**

Explanation (Optional):

The operator should determine that the exclusion flag exposure limit is 90% of 2000 mrem admin limit = 1800 mrem. Transient exposure is 400 mrem (6000mrem/hr x 2/60hr). (During transit to and from the job). 200 mrem + 200 mrem = 400 mrem; 1800 mrem - 400 mrem = 1400 mrem allowable before reaching exclusion flag exposure admin limit. Already has 400 mrem; 1400 mrem -400 mrem = 1000mrem, 1000 mrem/ 400 mrem/hr = 2.5 hours.

A. Incorrect. The answer is 2.5 hours. Plausible: based on using alert flag limit (1600) versus exclude flag.
B. Correct. See Above.
C. Incorrect. The answer is 2.5 hours. Plausible: based on calculating a one-way transit dose.
D. Incorrect. The answer is 2.5 hours. Plausible: based on using admin limit (2000) and a one-way transit dose.

Technical Reference(s): DUKE RWT 2008 Limits and Guidelines pg 2, 3, 6. (Attach if not previously provided) (Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: RWT Obj 2 (As available)

Question Source: Bank # McGuire NRC Bank # 564.
Modified Bank # ______ (Note changes or attach parent)
New ______

Question History: Last NRC Exam Not on 2005/2007 Exams

Question Cognitive Level:
Memory or Fundamental Knowledge ______
Comprehension or Analysis X

10 CFR Part 55 Content:
55.41 12
55.43 ______

Comments:

Formatting changes and changes for calculation errors made from McGuire NRC Bank Question #564.

KA Match:

Knowledge of radiation exposure limits under normal or emergency conditions. This question requires knowledge of the Duke Administrative TEDE limits and the "Exclude" limit.

TERMINAL OBJECTIVE

Upon completion of this lesson, be aware of the Duke Energy administrative limits on radiation dose.

ENABLING OBJECTIVES

1. State the Duke Energy administrative limits / guidelines for radiation dose.
2. State the actions to be taken if the Duke Energy administrative dose limits are being approached.
3. State the Duke Energy administrative limit / guideline for a declared pregnant worker.
4. State the rights of a declared pregnant worker.
5. State where individuals can obtain information about their dose.

Duke Energy.

10CFR20 Limits / Duke Limits

Conditions of Exposure	NRC(10CFR20) Limits	Duke Basic Administrative Control	Duke Maximum Administrative Control
Adult Total Effective Dose Equivalent (TEDE)	5.0 rem/year	2.0 rem/year	5.0 rem/year
Adult Lens Dose Equivalent (LDE) (Lens of Eye)	15.0 rem/year		15.0 rem/year
Adult Shallow-Dose Equivalent (SDE)Skin	50 rem/year		50 rem/year
Adult Shallow-Dose Equivalent (SDE)Extremities	50 rem/year		50 rem/year
Any Internal Organ (CDE) (for example, thyroid)	50 rem/year		50 rem/year
Minors (less than 18 years of age)	10 % of adult limit and may not enter a High Radiation Area		2% of adult and may not enter a High Radiation Area

Duke Energy.

As workers approach their established dose limits, Alert and **Exclude** warnings are used in RM&C computer program. Exposure status is given by:

A = ALERT

1. Individual has reached 80% (or greater), but less than 90% of established administrative maximum allowable exposure (MAE).

2. Individual should notify his / her supervisor.

3. Individual must receive RP supervisor approval to enter a High Radiation Area
or Locked High Radiation Area.

E = EXCLUDE

Individual has reached 90% (or greater) of their established administrative maximum allowable exposure (MAE)

Individual is **"excluded"** from further work in the RCA or RCZ outside of RCA, until an exposure extension is granted, unless approved by the Radiation Protection Manager (RPM)

Duke Energy.

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.3.11	
	Importance Rating	3.8	

(Ability to control radiation releases.)

Proposed Question: Common 73

Unit 1 has tripped from 100% power and the following conditions exist:

- 1RAD1/C-1, "1EMF 71 S/G A Leakage Hi Rad."
- 1RAD1/D-1, "1EMF 72 S/G B Leakage Hi Rad."
- 1RAD1/D-2, "1EMF 73 S/G C Leakage Hi Rad."
- 1RAD1/D-3, "1EMF 74 S/G D Leakage Hi Rad."
- 1RAD1/B-1, "1EMF 33 Cond Air Eject Exh Hi Rad."
- 1RAD3/E-5, "1EMF 24, 25, 26, 27 S/G A, B, C, D Steamline Hi Rad."

Both MD CA Pumps are running.

Steam Generator parameters are as follows:

	SG A	SG B	SG C	SG D
NR Level	10% (increasing)	20% (decreasing)	15% (increasing)	15% (stable)
CA Flow	200 gpm	0 gpm	0	50 gpm

Which ONE (1) of the following actions must be taken to minimize the radiation release?

A. Isolate the Steam Supply from the B SG to the TD CA Pump

B. Isolate the Steam Supply from the C SG to the TD CA Pump.

C. Increase CA flow to the B SG.

D. Increase CA flow to the C SG.

Proposed Answer: **B**

Explanation (Optional):

A. Incorrect. B SG is not ruptured, level is decreasing with no feed flow.

B. Correct. C SG is ruptured, level is increasing with no feed flow. Isolation steps include closing the SG PORV, isolating Steam to the TD CA Pump, isolating Blowdown and closing the MSIV. Each of these steps are taken to minimize the release of radiation.

C. Incorrect. Increasing feed flow may be a good idea and may occur. However, it does NOT minimize the radiation release.

D. Incorrect. Increasing the feed flow to the C SG would minimize the radiation release if level was < 11%.

Technical Reference(s): E-3 Rev 16 (Attach if not previously provided)

EP-E3 p 54-55 Rev 6 (Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: EP-E3 # 3, 4 (As available)

Question Source: Bank # ____

Modified Bank # ____ (Note changes or attach parent)

New X

Question History: Last NRC Exam NA

Question Cognitive Level: Memory or Fundamental Knowledge ____

Comprehension or Analysis X

10 CFR Part 55 Content: 55.41 10

55.43 ____

Comments:

Only formatting changes made from McGuire NRC Bank Question #629.

KA Match:

Ability to control radiation releases. This question deals with **controlling radiation releases** during a SGTR.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
4. (Continued)	
__ c. Check S/Gs 1B and 1C - INTACT.	c. Isolate TD CA pump steam supply from ruptured S/G as follows: __ 1) Ensure operators dispatched in next step immediately notify control room SRO when valves are closed. 2) Immediately dispatch 2 operators to double verify, unlock and close valves on ruptured S/G(s): • For 1B S/G: __ • 1SA-2 (1B S/G SM Supply to Unit 1 TD CA Pump Turb Maint Isol) (Unit 1 interior doghouse, 767+12, FF-53) __ • 1SA-78 (1B S/G SM Supply to Unit 1 TD CA Pump Turb Loop Seal Isol) (Unit 1 interior doghouse, 767+10, FF-53). • For 1C S/G: __ • 1SA-1 (1C S/G SM Supply to Unit 1 TD CA Pump Turb Maint Isol) (Unit 1 interior doghouse, 767+10, FF-53, above ladder) __ • 1SA-77 (1C S/G SM Supply to Unit 1 TD CA Pump Turb Loop Seal Isol) (Unit 1 interior doghouse, 767+10, FF-53). __ 3) **IF AT ANY TIME** local closure of SA valves takes over 5 minutes, **THEN** isolate TD CA pump steam supply **PER** Enclosure 2 (Tripping TD CA Pump Stop Valve or Alternate Steam Isolation).

STEP 4 Isolate steam flow from ruptured S/G(s)

PURPOSE:

1. To isolate flow from the ruptured S/Gs to minimize radiological releases.
2. To maintain pressure in the ruptured S/Gs greater than the pressure in at least one intact S/G following cooldown of the NC in subsequent steps.

BASIS: Isolation of the ruptured S/G(s) effectively minimizes release of radioactivity from this generator. In addition, isolation is necessary to establish a pressure differential between the ruptured and non-ruptured S/Gs in order to cool the NC and stop primary-to-secondary leakage. Pressure in the ruptured S/G should be established greater than that in at least one intact S/G.

There are two reasons for establishing this condition with respect to stable conditions without primary-to-secondary leakage. First, note that in order to remove heat generated in the primary system the ruptured steam generator pressure and NC pressure must be maintained greater than the non-ruptured S/G pressures. Secondly, as this pressure differential is raised, so is the subcooling in the primary system. If sufficient pressure differential cannot be maintained, leakage from the NC will continue since NC pressure will remain greater than the ruptured S/G pressure in order to remove decay heat. In this case, the operator is directed to ECA-3.1, SGTR with Loss of Reactor Coolant - Subcooled Recovery Desired to minimize this leakage.

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
16. **Check CA flow:**	
__ a. Total CA flow - GREATER THAN 450 GPM.	a. Perform the following: 1) **IF** N/R level in all S/Gs is less than 11% (32% ACC), **THEN**: __ • Ensure correct valve alignment __ • Start CA pumps. 2) **IF** N/R level in all S/Gs is less than 11% (32% ACC) **AND** feed flow greater than 450 GPM can not be established, **THEN**: __ • Implement EP/1/A/5000/F-0 (Critical Safety Function Status Trees). __ • **GO TO** EP/1/A/5000/FR-H.1 (Response To Loss Of Secondary Heat Sink).
__ b. Check VI header pressure - GREATER THAN 60 PSIG.	__ b. **IF** CA flow can not be throttled with CA control valves in subsequent steps, **THEN** control flow **PER** EP/1/A/5000/G-1 (Generic Enclosures), Enclosure 16 (CA Flow Control With Loss of VI).
__ c. **WHEN** N/R level in any S/G greater than 11% (32% ACC), **THEN** control CA flow to maintain N/R levels between 11% (32% ACC) and 50%.	

ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
11. **Control intact S/G levels:**	
__ a. Check N/R level in any intact S/G - GREATER THAN 11% (32% ACC).	a. Perform the following: __ 1) Maintain total feed flow greater than 450 GPM until at least one intact S/G N/R level greater than 11% (32% ACC). 2) **IF** total feed flow greater than 450 GPM can not be established, **THEN** contact station management for guidance to establish feed flow from alternate source: __ • CF __ • CM __ • Alternate low pressure water source.
__ b. Throttle feed flow to maintain all intact S/G N/R levels between 22% (32% ACC) and 50%.	b. **IF** N/R level in any intact S/G continues to go up in an uncontrolled manner, **THEN**: __ 1) Stop any operator controlled cooldown. __ 2) **RETURN TO** Step 1.

STEP 11 Control intact S/G levels:

PURPOSE:

1. To control feed flow to the intact S/Gs to prevent excessive NC cooldown and S/G overfill.
2. To maintain an adequate secondary side heat sink.
3. To identify a previously undetected S/G tube failure which could potentially result in S/G overfill.

BASIS:

1. In most cases, feed flow will exceed steam flow from the intact S/Gs resulting in an accumulation of water in the S/Gs. This excess feed flow will also result in a cooldown of the NC at a rate dependent upon the feed flow rate and heat generation rate in the primary system. Consequently, feed flow must be adjusted to control S/G level and reactor coolant temperature.

This step also provides for monitoring level in the intact S/Gs to detect multiple or subsequent tube failures. In that case, the operator is returned to Step 1 to isolate the affected S/G and repeat the recovery actions.

If reactor trip occurs from a high power level, the water level may shrink below the N/R causing a temporary loss of reliable S/G water level indication. During this time, feed flow should be maintained greater than 450 GPM to ensure an adequate secondary side heat sink. This minimum feed flow requirement satisfies the feed flow requirement of the Heat Sink Status Tree until level in at least one S/G is restored into the narrow range. Narrow range level is reestablished in all intact S/Gs to maintain symmetric cooling of the NC.

Once intact SG level has been reestablished in the narrow range, the operator is directed to establish a control band between 22% (the CA actuation setpoint plus 5%) and 50%. This control range ensures an adequate inventory will be maintained close to the typical SG level control band and prevent the actuation of the CA signal. Actuation of the CA signal could result in potential releases from the ruptured SG through the opened steam supply valves to the turbine-driven CA pump if the ruptured SG contained the steam supply tap.

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

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.4.17	
	Importance Rating	3.9	

(Knowledge of EOP terms and definitions.)

Proposed Question: Common 74

Which ONE (1) of the following events, followed by a failure of the Reactor Trip Breakers to open, would be considered an Anticipated Transient Without Scram (ATWS)?

A. A Turbine Trip from 50% power.

B. With the Channel I Pzr Pressure instrument out of service for maintenance, the Channel II Pzr Pressure instrument fails high.

C. During a Reactor Startup with Intermediate Range Channels at 10^{-8} amps, Intermediate Range Channel N36 fails high.

D. Trip of 1D NC Pump from 40% power.

Proposed Answer: **A**

Explanation (Optional):

A. Correct. According to Section 7.8 of OMP 4-3, "Use of Abnormal and Emergency Procedures," an ATWS is defined as a Transient followed by a failure of the Reactor Trip Breakers. This section goes onto say that instrument failures by themselves are not necessarily transients. An instrument failure that is followed by a failure of the automatic portion of the Reactor Trip Breakers is not an ATWS, but merely a failure of the RPS. Examples of transients are given as: (1) Loss of all NC Pumps, (2) Tripping of the Turbine Generator, (3) Loss of Condenser Vacuum, and (4) Loss of off-site power.

B. Incorrect. This is an instrument failure.

C. Incorrect. This is an instrument failure.

D. Incorrect. This would not cause an automatic reactor trip because P-8 is not satisfied

Technical Reference(s)	OMP 4-3 Section 7.8 Rev 26	(Attach if not previously provided)
	IC-IPE, p47, 49,83, 85	(Including version or revision #)

Proposed references to be provided to applicants during examination: None

Learning Objective: ADM-OMP #8; IC-IPE Obj 10 (As available)

Question Source:	Bank #		
	Modified Bank #		(Note changes or attach parent)
	New	X	

Question History: Last NRC Exam NA

Question Cognitive Level:	Memory or Fundamental Knowledge	X
	Comprehension or Analysis	

10 CFR Part 55 Content:	55.41	10
	55.43	

Comments:

KA Match:

Know EOP terms & definitions. Distinguish between two **terms** discussed in OMP 4-3: ATWS vs RP failure OMP 4-3 covers the use of APs and EOPs

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

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.

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%.

Objective # 11

P-8 (2/4 PR instruments > 48% power) - enables Single Loop Loss of Flow and Reactor Trip upon Turbine Trip.

P-10 (2/4 PR instruments > 10%) - allows Manual Block of PR High Flux / Low Setpoint reactor trip. Allows Manual block of IR High Flux Rod Stop (C-1) and Reactor Trip, blocks Manual reset of SR high voltage and SR reactor trip > P-10. P-10 provides an input to P-7. Below P-10 (3/4 PR instruments < 10%) - allows Manual reset of SR High Voltage and Reactor trip. This is used if one IR channel does not decrease below P-6 to Auto energize the SR circuit.

P-11 (2/3 Presurizer Pressure instruments < 1955 psig) - allows Manual Block of Lo-Pzr pressure SI (Auto instate > P-11); allows Manual block of Lo Press Stm Line Isol (Auto instate > P-11); Allows Manual block of motor driven CA pump Auto-start (Auto instate > P-11); and initiates opening of Cold Leg Accumulator isolation valves when > P-11.

P-12 (2/4 Lo-Lo TAVG < 553°F) - provides Auto-block of steam dumps preventing excessive cooldown by the steam dumps.

P-13 (1/2 Impulse Pressure instruments > 10%) - this turbine at power permissive provides an input to P-7.

P-14 (2/3 Hi-Hi level instruments on 1/4 SGs > 83%) - actuates a Turbine Trip, CFPT Trip and Feedwater Isolation.

3.1.4 Control Interlocks

Objective # 12

C-1 (1/2 IR channels amps > 20%) - blocks Auto and Manual rod withdrawal.

C-2 (1/4 PR channels amps > 103%) - blocks Auto and Manual rod withdrawal.

C-3 (2/4 ΔT channels within 2% of OTΔT setpoint) - blocks Auto and Manual rod withdrawal plus actuates a turbine runback at 200%/min for 2.3 seconds out of 30 seconds.

C-4 (2/4 ΔT channels within 2% of OPΔT setpoint) - blocks Auto and Manual rod withdrawal plus actuates a turbine runback at 200%/min for 2.3 seconds out of 30 seconds.

C-5 (1/1 Impulse Pressure channels < 15%) - blocks Auto rod withdrawal.

C-7A (1/1 Impulse Pressure channel Ch II rate of change decrease > 5%/min or a step change decrease > 10%) - arms condenser dump valves on a load rejection.

SEQ	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8	Describe the function of the First-Out annunciator panel. ICIPE008			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
12	List all the protection system control ("C" signal) interlocks including logic and functions. ICIPE012			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

7.8 ATWS

An ATWS (Anticipated Transient Without Scram) is defined in 10 CFR 50.62 as an anticipated operational occurrence followed by the failure of the reactor trip portion of the protective system. An anticipated operational occurrence is defined in 10 CFR 50, Appendix A, as those conditions of normal operation which are expected to occur one or more times during the life of the nuclear power unit and include but are **NOT** limited to loss of power to all NC pumps, tripping of the turbine generator, isolation of the main condenser and loss of all offsite power. Clearly, to have an ATWS there must be transient followed by a failure of the reactor trip breakers.

Instrument failures, by themselves, are **NOT** necessarily transients. For example, if one channel of Power Range Nuclear Instrument was out of service for preventive maintenance (bistable in tripped condition) and if another Power Range Nuclear Instrument channel failed, a reactor trip signal would be generated. **IF** the reactor failed to trip, this would be a failure of the reactor trip breakers and the automatic trip features of the reactor protection system and **NOT** an ATWS event. Obviously, the control operators would have to recognize and check that the channel failure was indeed a channel failure by checking the other two channels in this example. This would, however, force OPS to shutdown the affected unit to at least Hot Standby per Tech Specs.

7.9 Adverse Containment Setpoints

Many setpoints in the EPs are presented in a dual format with a second setpoint enclosed in parentheses. This second setpoint is used to account for the additional error in the setpoint due to the containment environment following a high-energy line break. The setpoint in parentheses will be used whenever containment pressure has exceeded 3 psig.

	OBJECTIVE	NLO	NLOR	LPRO	LPSO	LOR
8.	Concerning OMP 4-3, Use of Abnormal and Emergency Procedures:			X	X	X
	• Describe the responsibility of licensed operators for maintaining knowledge of and implementation of immediate actions.					
	• State management's expectations for manual initiation of Safequards Actions.					
	• State the expected action RO's and SRO's are to take if an automatic action, which should have occurred, failed.					
	• Describe the Operations policy on when Non-procedural blocking of Automatic Safety Actuations could be done.					
	• Given a set of plant conditions, determine if an A.T.W.S. (Anticipated Transient Without Scram) which would require a manual Reactor Trip has occurred or if a failure of the reactor trip breakers or the automatic trip feature of the reactor protection system had occurred which would require a plant shutdown.					
	• State three subsequent actions that can be taken prior to procedure direction (include conditions that allow these actions to be taken).					
	• State when Adverse Containment Setpoints are used.					
	• Describe the Control Room Team Responsibilities During the use of EP/APs.					
	• Define the following items: Check, ensure, faulted, ruptured, implement, intact, go to, refer to, per, stable, evaluate.	X	X			
	• Describe the "rules of use" of the Two Column Format Procedure. ADMOMP004	X	X			

Examination Outline Cross-reference:	Level	RO	SRO
	Tier #	3	
	Group #	NA	
	K/A #	GKA 2.4.14	
	Importance Rating	3.8	

(Knowledge of general guidelines for EOP usage.)

Proposed Question: Common 75

Reactor trip and safety injection have occurred on Unit 2.

- Off-Site power is lost subsequent to safety injection actuation.
- Equipment failures during performance of E-1, Loss of Reactor or Secondary Coolant, resulted in the following conditions:
  - Bus ETB is de-energized due to a fault.
  - CSF Status Trees indicate as follows:
    - Subcriticality GREEN
    - Core Cooling ORANGE
    - Heat Sink RED
    - Integrity GREEN
    - Containment YELLOW
    - Inventory YELLOW

Which ONE (1) of the following describes the requirement for Critical Safety Function Status Tree Monitoring in accordance with OM-4.3, Use of Abnormal and Emergency Procedures?

A. Monitor for Information Only

B. Continuous Monitoring Required

C. Monitor every 10 – 20 minutes using Control Board indications OR OAC SPDS unless a change in plant status occurs.

D. Monitor every 10 – 20 minutes using ONLY Control Board indications unless a change in plant status occurs.

Proposed Answer: **B**

Explanation (Optional):

A. Incorrect. Monitor for information only is done in ECA-0.0 when no action can be taken to restore a CSF

B. Correct. OMP 4-3 states that if an orange or red condition exits, continuous monitoring is required.

C. Incorrect. Would be correct if red or orange condition did not exist.

D. Incorrect. Would be correct same as C but also if OAC failure or input failure to SPDS was evident.

Technical Reference(s): OMP 4-3 Rev 26 (Attach if not previously provided) (Including version or revision #)

Proposed references to be provided to applicants during examination: ______

Learning Objective: EP-Intro #3 (As available)

Question Source:
Bank # X
Modified Bank # ______ (Note changes or attach parent)
New ______

Question History: Last NRC Exam ______

Question Cognitive Level:
Memory or Fundamental Knowledge ______
Comprehension or Analysis X

10 CFR Part 55 Content:
55.41 10
55.43 ______

Comments:

WTSI Bank Various similar with slightly different distractor options

KA Match:

EOP use guidelines. Asking how often the CSF status trees are monitored during different plant conditions is one of the EOP usage requirements (per OMP 4-3, “EP/AP Use”)

7. Use Of Approved Procedure

7.1 EP/AP Usage

Generally, entry into the emergency procedure set is limited to two conditions:

- **IF** a safety injection or reactor trip occurs or is required with initial conditions above P-11, the operator will enter EP/1,2/A/5000/E-0 (Reactor Trip or Safety Injection). (During a normal plant heatup, selected rods may be withdrawn as available source of negative reactivity insertion. **IF** these rods are dropped with initial conditions below P-11, most of the EP steps do **NOT** apply, so implementing EPs is **NOT** required. APs dealing with reason rods were dropped should provide adequate guidance to address this situation.)

NOTE: The following reactor trips do **NOT** require entry into E-0:

- Control rod drop tests performed at power levels below 5% full power.
- Trip was initiated and specifically called for in an in-progress test procedure or was part of a planned shutdown.
- Trip with initial conditions less than P-11 as discussed above.

- **IF** a complete loss of power on both emergency busses takes place, the operator will enter EP/1,2/A/5000/ECA-0.0 (Loss of All AC Power). This includes any time during the performance of any other EP.

During periods when EPs are **NOT** being implemented, the SPDS and critical safety function status trees may be used to determine or identify abnormal conditions. Emergency procedures referenced by them may be used to correct the alarming condition.

7.2 Use of Control Copies

Since EPs and APs are used during emergency situations and require immediate access, the Control Copy of the procedure will be used to perform the steps. The Control Copy of any EP or AP should be replaced by the SSA. The procedure group should be contacted after the use of any EP or AP.

Use of most APs that have foldouts will likely be terminated when a reactor trip or S/I occurs. There are a few APs with foldouts that could potentially be implemented concurrently with an EP though (Loss of VI or Loss of KC for example). Rules of foldout page use as specified in Section 7.12 should be applied in this situation also. Although unlikely, it is possible that the crew may have one EP foldout in effect at the same time as one of the AP foldouts. Implementation and priority of the AP foldouts will be evaluated as discussed in paragraph above.

ROs may be given procedure responsibilities when APs and EPs or multiple APs are in effect at the same time.

7.19 The STA/OSM Interface

The STA monitors the CSFs and otherwise ensures Core Safety through monitoring of activities and parameters. **IF** any one CSF is other than green, the STA will check whether the CSF non-green status is valid or being caused by an invalid input. **IF** the non-green CSF is invalid, the STA will notify the operating crew of the invalidity. For Red or Orange path procedures, the STA will immediately notify the operating crew that the condition exists and give the associated functional restoration procedure to the crew to implement as the controlling procedure. For Yellow path procedures, the STA will pull the functional restoration procedure and evaluate whether to implement the procedure, with the OSM concurrence, as time allows. This evaluation should consider whether the Optimal Recovery procedure is properly addressing the current plant conditions in as timely a manner as the functional restoration procedure.

Once status tree monitoring is initiated, the STA should monitor status trees continuously if an orange or red condition is found to exist. **IF** no condition more serious than yellow is found, monitoring frequency may be reduced to 10-20 minutes, unless some significant change in plant status occurs. Status tree monitoring may be performed using OAC SPDS display or EP/1,2/A/5000/F-0 (Critical Safety Function Status Trees). **IF** the OAC SPDS display is being used, the STA will validate the OAC SPDS status every 10-20 minutes using control board indications.

IF the STA is **NOT** available, the OSM shall assume the STA responsibilities or delegate the STA responsibilities to another licensed operator.

7.15.1.8 SPDS

Normally, the condition of the status trees is continuously monitored and displayed by the OAC. The OAC can be used to check any off-normal alarm and to determine which EP to implement. The entire Control Room crew is responsible for monitoring the SPDS.

SPDS indication must be validated using reliable control board indicators prior to implementing CSF procedure.

7.15.1.9 How Long to Monitor Status Trees

Monitoring of status trees may be stopped when any of the following are met:

- Cold shutdown and TSC concurrence

OR

- Transition to normal recovery procedure (OP)

OR

- Transition to a Severe Accident Mitigation Guideline (SAMG)

7.15.1.10 CSF procedures should **NOT** be entered until the entry condition is met, except under conditions of 50.54x (reference Section 9).

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