

Final Submittal

**CRYSTAL RIVER AUGUST
EXAM 50-302/2003-301**

AUGUST 25 - 29, 2003

1. Reactor Operator Written Examination

**U.S. Nuclear Regulatory Commission
Site-Specific
Written Examination**

Applicant Information

Name:	Region: II
Date: 08/22/03	Facility/Unit: Crystal River
License Level: RO	Reactor Type: B&W
Start Time:	Finish Time:

Instructions

Use the answer sheets provided to document your answers. Staple this cover sheet on top of the answer sheets. The passing grade requires a final grade of at least 80.00 percent. Examination papers will be collected six hours after the examination starts.

Applicant Certification

All work done on this examination is my own. I have neither given nor received aid.

Applicant's Signature

Results

Examination Value: _____ Points

Applicant's Score: _____ Points

Applicant's Grade: _____ Percent

1. The following plant conditions exist:

- The reactor has been at 100% power for 12 days.
- Rod index is 290%.
- 300 EFPD.
- 1100 ppm boron.

Due to erratic indications in the CRD system engineering has requested a rod index of 260% to perform trouble shooting activities. Determine the final boron concentration required to reach this rod index while maintaining 100% reactor power. (disregard Xenon)

- A. 1034 ppm boron
- B. 1040 ppm boron
- C. 1052 ppm boron
- D. 1056 ppm boron

2. Which of the following describes the effect on PZR conditions during a large reactor coolant insurge?
- A. Actual liquid temperature will decrease; T_{sat} of the surface liquid will decrease.
 - B. Actual liquid temperature will decrease; T_{sat} of the surface liquid will increase.
 - C. Actual liquid temperature will decrease; T_{sat} of the surface liquid will remain the same.
 - D. Actual liquid temperature will remain the same; T_{sat} of the surface liquid will increase.

3. A reactor startup is in progress with the reactor critical. Control rod 5-4 drops into the core and the following parameters are noted:

- The reactor is still critical.
- Tave is 524° F.

Which of the following describes the actions that should be taken and the reasons for these actions?

- A. Increase Tave to $\geq 525^\circ \text{ F}$, using secondary parameters, to maintain instrumentation on scale.
- B. Increase Tave to $\geq 525^\circ \text{ F}$, using small control rod withdrawals, to maintain the plant within analyzed accident ranges.
- C. Fully insert all control rods to establish and maintain Mode 3 reactivity conditions since criticality is prohibited at $< 525^\circ \text{ F}$.
- D. Fully insert control rod groups 5-7 to establish and maintain Mode 2 reactivity conditions since criticality is prohibited at $< 525^\circ \text{ F}$.

4. The following conditions are observed for the "A" Reactor Coolant Pump.

- | | |
|-------------------------------------|-----------|
| - Reactor Coolant System pressure | 2150 psig |
| - Second stage seal cavity pressure | 2100 psig |
| - Third stage seal cavity pressure | 1055 psig |
| - Controlled bleedoff flow | increased |
| - Seal leakage flow | no change |

Which of the following failures would cause the above indications?

- A. The first stage seal.
- B. The second stage seal.
- C. The third stage seal.
- D. The restriction bushing.

5. The following plant conditions exist at 100% power:

'A' OTSG Level	80%	'B' OTSG Level	80%
'A' MFW Flow	5.4 E6 lbm/hr	'B' MFW Flow	5.4 E6 lbm/hr
Core ΔT	45° F		

A problem develops with RCP-1C and the decision is made to run the plant back and secure the pump. At 80% power RCP-1C trips and an ICS runback occurs to 75% power. Which of the following describes the approximate expected plant parameters, as compared to the above values, after the plant stabilizes at 75% power?

- A. 'A' OTSG Level unchanged
'B' OTSG Level 50% of original
'A' MFW Flow unchanged
'B' MFW Flow 50% of original
Core ΔT 45° F
- B. 'A' OTSG Level unchanged
'B' OTSG Level 50% of original
'A' MFW Flow unchanged
'B' MFW Flow 50% of original
Core ΔT 34° F
- C. 'A' OTSG Level 75% of original
'B' OTSG Level 50% of original
'A' MFW Flow 75% of original
'B' MFW Flow 50% of original
Core ΔT 45° F
- D. 'A' OTSG Level 75% of original
'B' OTSG Level 50% of original
'A' MFW Flow 75% of original
'B' MFW Flow 50% of original
Core ΔT 34° F

6. The plant is operating at 100% power when the SW Return valve from RCP-1C (SWV-86) closes. Attempts to reopen the valve have failed.

Which of the following describe the action required to be taken with respect to RCP-1C?

RCP-1C:

- A. must be shutdown within 5 minutes due to loss of motor cooling.
- B. must be shutdown within 5 minutes due to loss of RCP seal cooling.
- C. may continue operation as long as RCP Seal Injection is maintained.
- D. may continue operation because cooling is maintained by internally circulating RCS.

7. The following plant conditions exist:

- Plant is near EOC at 90% power.
- Deborating demins are in service.
- OP-304, Soluble Poison Concentration Control, calculation requires 60 gpm letdown flow for one hour.

Due to a malfunction with MUV-51, letdown flow control valve, actual letdown flow was 80 gpm.

Which of the following describes how the plant will respond?

- A. Control rods will insert; reactor power will decrease.
- B. Control rods will insert; reactor power will remain approximately the same.
- C. Control rods will withdraw; reactor power will increase.
- D. Control rods will withdraw; reactor power will remain approximately the same.

8. The following plant conditions exist:

- A LOCA is in progress.
- RCS pressure is 400 psig.
- Two High Pressure Injection Pumps are operating.
- Two Low Pressure Injection Pumps are operating.

Which of the following is the correct flow path for core heat removal?

- A. Manual alignment of piggy-back flow through the Makeup Pumps with the Decay Heat pumps taking a suction from the Reactor Building Sump prior to BWST level decreasing to < 7 feet.
- B. Automatic alignment of piggy-back flow through the Makeup Pumps with the Decay Heat pumps taking a suction from the Reactor Building Sump prior to BWST level decreasing to < 7 feet.
- C. Manual alignment of piggy-back flow through the Makeup Pumps with the Decay Heat pumps taking a suction from the Reactor Building Sump prior to BWST level reaching 15 feet.
- D. Automatic alignment of piggy-back flow through the Makeup Pumps with the Decay Heat pumps taking a suction from the Reactor Building Sump prior to BWST level reaching 15 feet.

9. Which of the following describes the purpose and operation of the HPI Throttle valves (MUV-590, 591, 592 & 593)?

To limit:

- A. MUP flow to the MUT. These valves may be throttled from the Control Room.
- B. MUP flow to the RB sump in the case of a high MUT level. These valves are fixed in position.
- C. EDG loading and balance HPI flow. These valves may be throttled from the Control Room.
- D. EDG loading and balance HPI flow. These valves are fixed in position.

10. The plant is conducting a shutdown and cooldown with Reactor Coolant System (RCS) pressure at 1200 psig and temperature at 400° F. The High Pressure Injection (HPI) portion of the Engineered Safeguards (ES) actuation system has been bypassed per procedure. An RCS pressure transient occurs which raises RCS pressure to 1820 psig. How does the ES system react to this condition?
- A. The actuation and bypass bistables will automatically reset. There will be no actuation of the HPI systems.
 - B. The actuation and bypass bistables will NOT automatically reset. There will be a full actuation of the HPI systems.
 - C. The actuation bistable will automatically reset, but the bypass bistable will NOT automatically reset. There will be no actuation of the HPI systems.
 - D. The actuation bistable will NOT automatically reset, but the bypass bistable will automatically reset. There will be a full actuation of the HPI systems.

11. The following plant conditions exist:

- Reactor coolant average temperature is 579° F.
- Reactor coolant pressure is 2100 psig and decreasing at 100 psig/min.
- Pressurizer temperature is 643° F and decreasing at 6° F/min.
- Makeup flow is 8-10 gpm higher than normal.
- The Reactor Coolant Drain Tank level and pressure are stable.
- PZR level is stable.
- Reactor power is 40%.

Which of the following is the most probable cause for the above indications?

- A. RCS pressure transmitter tubing rupture.
- B. Partially stuck open PORV.
- C. Code safety valve flange leak.
- D. MUV-567, letdown isolation valve, bonnet leak.

12. The following sequence of events have occurred:

- The plant was in Mode 3 with Group 1 withdrawn and RCS pressure at 2155 psig.
- The PORV failed open and the RO closed the PORV block valve.
- RCS pressure is currently 1875 psig and increasing slowly.
- Currently Group 1 is still withdrawn.

Which of the following describes the *immediate* action(s) that should be taken for these conditions?

- A. Enter AP-490, RCS Boration, and start emergency boration.
- B. Enter AP-520, Loss of RCS Coolant or Pressure, to recover RCS pressure.
- C. Depress the Rx trip pushbutton, enter EOP-2, Vital System Status Verification and, if Group 1 is still withdrawn, open breakers 3305 and 3312.
- D. Depress the Rx trip pushbutton, enter EOP-2, Vital System Status Verification and, if Group 1 is still withdrawn, depress the 'HPI MAN ACT' pushbuttons for Trains A and B to initiate emergency boration.

13. Which of the following describes the normal method for maintaining/controlling the level in the Nuclear Services Closed Cycle Cooling System Surge Tank (SWT-1)?
- A. Manual control by the Primary Plant Operator.
 - B. Automatic valve control set to maintain level between two setpoints.
 - C. Manual operation of the control switch for the fill valve on the Main Control Board.
 - D. Manual operation of the Demin Water transfer pumps on the Main Control Board.

14. The following plant conditions exist:

- Reactor Coolant (RCS) pressure 2220 psia.
- Reactor Coolant Drain Tank (RCDT) pressure is 50 psia.
- The PORV is stuck partially open.

What is the approximate temperature and phase of the fluid downstream of the PORV?

- A. 649°F and Superheated
- B. 298°F and Superheated
- C. 281°F and Saturated
- D. 259°F and Saturated

15. The following plant conditions exist:

- A small break LOCA (SBLOCA) event is in progress.
- RCS pressure is 1500 psig.

Which of the following describes the reason for maintaining the OTSGs available as a heat sink?

- A. To ensure RCS heat removal while RCPs are operating.
- B. To provide an alternate means of RCS pressure control.
- C. RCS pressure may remain too high for adequate HPI cooling.
- D. Boiler-condenser cooling is the primary method for heat removal during a SBLOCA event.

16. While at power, a feedwater transient caused a rapid out-surge of the pressurizer followed by a rapid in-surge. Due to a pressurizer heater control problem all heaters are in manual and off. The following conditions exist:

- Pressurizer temperature is 630° F.
- T_{hot} is 600° F.
- T_{cold} is 555° F.
- Pressurizer level is at 240 inches and slowly returning to normal.

With no operator action RCS pressure will stabilize at approximately:

- A. 1100 psig.
- B. 1550 psig.
- C. 1900 psig.
- D. 2155 psig.

17. A note in EOP-8, LOCA Cooldown, states the following:

"Do not open PORV or use high pressure Aux spray to depressurize RCS if ICC Region 3 was previously entered."

Which of the following describes the reason for this note?

- A. The RCS may contain large amounts of non-condensable gasses and opening the PORV could result in additional gas bubbles forming in the hot legs.
- B. Due to documented PORV failures in the industry, the risk of losing excess additional RCS inventory if the core had previously entered Region 3 has been determined to be unacceptable.
- C. Engineering calculations have determined that the effectiveness of high pressure Aux spray is greatly diminished if the core had previously entered Region 3 and does not create a success path for this condition.
- D. A commitment to the NRC to justify not installing the RV head vent requires the use of the hot leg high point vents only for RCS depressurization.

18. While in a plant cooldown the following conditions exist:

- Reactor Coolant Pressure is 400 psig.
- RCS temperature is 350° F.
- Control Rod Group 1 is withdrawn.
- The "D" Reactor Protection System channel is tripped.

The "C" RPS channel is bypassed for trouble shooting activities. The I & C technician asks permission to pull the RCS flow module in the "C" RPS channel. If permission is granted what will be the condition of the Control Rod Drive (CRD) breakers?

- A. All CRD breakers are open.
- B. All CRD breakers are closed.
- C. The "C" breaker is open; all other CRD breakers remain closed.
- D. The "C" and "D" breakers are open; all other CRD breakers remain closed.

19. The following plant conditions exist:

- AHF-1A is ES selected for "A" ES Train operation.
- AHF-1B is ES selected for "B" ES Train operation.
- AHF-1C is tagged out due to a motor ground.
- HPI actuation on 1625 psig has occurred on both trains.

Which of the following statements describes AHF-1A and AHF-1B operation one minute after the actuation?

- A. AHF-1A and AHF-1B should be running in slow speed.
- B. AHF-1A and AHF-1B should be running in fast speed.
- C. AHF-1A should be running in slow speed and AHF-1B should be off.
- D. AHF-1B should be running in fast speed and AHF-1A should be off.

20. The following plant conditions exist:

- An RBIC actuation has occurred.
- One 4 psig pressure switch in the "A" train has failed in the non-actuated position.
- Two 4 psig pressure switches in the "B" train are failed in the non-actuated position.

Assuming no input to any isolation valves from diverse isolation (HPI), which of the following statements describes the status of the RBIC actuation and the RB isolation safety function for these conditions?

- A. Both "A" and "B" trains of RBIC would actuate. The safety function would be met.
- B. "A" train of RBIC would actuate, "B" train would not actuate. The safety function would be met.
- C. "A" train of RBIC would actuate, "B" train would not actuate. The safety function would not be met.
- D. Neither train of RBIC would actuate. The safety function would not be met.

21. In the Control Rod Drive system which of the following will cause an OUT INHIBIT when the diamond panel is in automatic control?

- A. Asymmetric fault with reactor power less than 60%.
- B. Loss of safety rods out limit with reactor power greater than 60%.
- C. Loss of motor power supply with reactor power less than 60%.
- D. A sequence inhibit with reactor power greater than 60%.

22. During a power increase the RO notices the following NI indications. The power increase is stopped and the plant is stabilized. The following indications are recorded.

- NI-5 upper chamber	42.0%	NI-7 upper chamber	42.4%
- NI-5 lower chamber	43.3%	NI-7 lower chamber	44.4%
- NI-6 upper chamber	43.3%	NI-8 upper chamber	48.0%
- NI-6 lower chamber	44.6%	NI-8 lower chamber	49.4%

Which of the following describes the required actions, if any, for the above indications?

- A. Reduce thermal power to $< 60\%$ of the allowable thermal power within two hours AND reduce the nuclear overpower trip setpoint to $\leq 65.5\%$ of the allowable thermal power within 10 hours.
- B. Reduce thermal power $\geq 2\%$ RTP from the allowable thermal power for each 1% of QPT greater than the steady state limit within 30 minutes AND restore QPT to less than or equal to the transient limit within two hours.
- C. No TS actions are required. These indications are expected due to the increased shielding from Tcold at lower power levels.
- D. No TS actions are required. These indications are expected due to the decreased shielding from Tcold at lower power levels.

23. The following plant conditions exist:

- The plant is at 40% power with turbine control in ICS/Auto.
- Turbine is selected to "A" header pressure for control.
- The header pressure setpoint is currently set at 46 for maintenance trouble shooting activities of the turbine header pressure control circuit.

Which of the following describes the plant response if the selected "A" header pressure transmitter failed rapidly to mid-scale?

- A. SASS will swap to the unaffected transmitter. Turbine and TBV control will not be affected.
- B. SASS will swap to the unaffected transmitter. Turbine control will not be affected but the TBV associated with the failed transmitter must be controlled in manual.
- C. SASS will *not* swap to the unaffected transmitter. The turbine and TBVs must be controlled in manual.
- D. SASS will *not* swap to the unaffected transmitter. Turbine control will not be affected but the TBV associated with the failed transmitter must be controlled in manual.

24. Ten minutes after an RBIC actuation occurred a malfunction results in the closure of SWV-36, AHF-1A Cooling Water Inlet isolation valve. Which of the following describes the affected component(s) and required operator action(s)?

- A. Only AHF-1A's cooling coils will lose SW cooling water; cooling water supply should be swapped to Industrial Cooling (CI) within 5 minutes.
- B. AHF-1A's cooling coils and motor cooler will lose SW cooling water; cooling water supply should be swapped to Industrial Cooling (CI) within 5 minutes.
- C. Only AHF-1A's cooling coils will lose SW cooling water; AHF-1B should be started in slow speed and AHF-1A should be secured.
- D. AHF-1A's cooling coils and motor cooler will lose SW cooling water; AHF-1B should be started in slow speed and AHF-1A should be secured.

25. The following plant conditions exist:

- Turbine is ready to sync on line.
- PZR level normal.
- Letdown flow is 75 gpm.
- Seal injection flow is 40 gpm.
- MUV-31 has failed closed.
- MUV-31 bypass flow indicates 20 gpm.

PZR level \approx 12 gal/inch

Assuming no operator action approximately how long would it take for the PZR Low level alarm to annunciate? (disregard CBO flow)

- A. 8 minutes
- B. 12 minutes
- C. 16 minutes
- D. 20 minutes

26. When aligning the DHR system for boron precipitation, EOP-14, Enclosure 20, Boron Precipitation Control, directs that the seal-in circuits for DHV-42 and 43 be defeated. Enclosure 20 also directs that the valve control switch be held in the open position for 6 seconds before the DH drop-line valves are opened.

Which of the following describes a possible consequence if DHV-42 or 43 were fully open when drop-line flow commenced?

The resulting drop-line flow could cause:

- A. vortexes in the core region.
- B. RB sump screen damage and loss of the running DHR/LPI pump.
- C. voiding in the core region from the rapid pressure drop that would occur.
- D. inadequate mixing of the RB sump water with the trisodium phosphate (TSP) resulting in a higher than calculated pH required for adequate iodine removal.

27. The following plant conditions exist:

- Breakers 4900 & 4902 have opened (feeders to the OPT).
- A LOCA in containment is in progress.
- RB pressure is 34 psig.
- RCS pressure is 725 psig.

Based on the above conditions which of the following describes the status of DHP-1A, BSP-1A, DHV-110 and BSV-3? (assume sufficient time has elapsed for all automatic actions to occur)

- | | | |
|----|---------|-----------|
| A. | DHP-1A | Off |
| | BSP-1A | Running |
| | DHV-110 | Open |
| | BSV-3 | Throttled |
| B. | DHP-1A | Off |
| | BSP-1A | Running |
| | DHV-110 | Throttled |
| | BSV-3 | Throttled |
| C. | DHP-1A | Running |
| | BSP-1A | Running |
| | DHV-110 | Throttled |
| | BSV-3 | Open |
| D. | DHP-1A | Running |
| | BSP-1A | Off |
| | DHV-110 | Open |
| | BSV-3 | Closed |

28. Multiple CRDM high stator temperature alarms are in. Which of the following conditions could cause these indications?

- A. Standby SW booster pump auto-start and CRD filter delta P > 30 psid.
- B. SWV-763, CRD Temperature control valve, fails to its maximum closed position.
- C. The low SW flow interlock to the SW booster pumps fails and sends a low flow signal to the pumps.
- D. During performance of SP-344A, RWP-2A, SWP-1A and Valve Surveillance, RWV-150, recirc to RW pit valve, fails full open.

29. With the plant operating at 65% power a 'Sudden Pressure' relay actuates on the Startup Transformer.

Based on the above conditions which of the following electrical line-ups could be used to supply power to the 'A' Train PZR heaters?

- A. MTDG-1; 4160V Rx Aux Bus 3; 480V Rx Aux Bus 3A.
- B. EDG-1A; ES 4160V Bus 3A; ES 480V Bus 3A; 480V Rx Aux Bus 3A.
- C. BEST; ES 4160V Bus 3A; ES 480V Bus 3A; 480V Rx Aux Bus 3A.
- D. EDG-1B; ES 4160V Bus 3B; 480V Plant Aux Bus; 480V Rx Aux Bus 3A.

30. The following plant conditions exist:

- Plant is at 100% power.
- The selected PZR level transmitter rapidly fails low.

Which of the following describes what effect, if any, this malfunction will have on MUV-31 (PZR level control valve) operation?

MUV-31:

- A. will throttle closed in an attempt to restore PZR level.
- B. will throttle open in an attempt to restore PZR level.
- C. is interlocked to freeze in position without a valid PZR level signal.
- D. operation will be unaffected because SASS will transfer to the alternate level control signal.

31. The following plant conditions exist:

- Reactor power is 50%.
- RCS pressure is 1950 psig.
- RCS Thot is 604° F.
- FW flow is 2.6 E6 lbm/hr in each loop.

Based on the above conditions determine if an ATWS event has/has not occurred and which of the following actions should be taken?

- A. An ATWS event has occurred. Immediate actions of EOP-2 should be performed and a manual turbine trip is required if reactor power remains at 50%.
- B. An ATWS event has occurred. Immediate actions of EOP-2 should be performed and RCS boration is required if reactor power remains at 50%.
- C. An ATWS event has *not* occurred. Excessive FW has caused the RCS pressure decrease and FW flow should be lowered.
- D. An ATWS event has *not* occurred. A steam leak has caused the RCS pressure decrease and the reactor should be tripped if the leak cannot be isolated.

32. The plant is in Mode 5 with an RB purge in progress. High radiation in the containment atmosphere has now resulted in RM-A1 gas and RM-A6 gas channels going into high alarm.

Which of the following describes the expected automatic actions for these conditions?

- A. Both RB purge exhaust fans will be tripped by RM-A1 interlocks.
- B. AHV-1A, 1B, 1C, and 1D will be closed by RM-A1 interlocks.
- C. Both RB purge exhaust fans will be tripped by RM-A6 interlocks.
- D. AHV-1A, 1B, 1C, and 1D will be closed by RM-A6 interlocks.

33. A plant startup is in progress with the indications below. If the "C" RPS cabinet were to lose power which of the following sets of conditions would have met overlap requirements and allow continued power ascension?

- | | | |
|----|----------------|---------------------|
| A. | NI-3 | 1×10^{-5} |
| | NI-4 | 1×10^{-5} |
| | NI-5, 6, 7 & 8 | 3% |
| B. | NI-3 | 1×10^{-5} |
| | NI-4 | 1×10^{-5} |
| | NI-5, 6, 7 & 8 | 12% |
| C. | NI-1 | 9×10^5 |
| | NI-2 | 9×10^5 |
| | NI-3 | 3×10^{-10} |
| | NI-4 | 3×10^{-10} |
| D. | NI-1 | 9×10^5 |
| | NI-2 | 9×10^5 |
| | NI-3 | 3×10^{-11} |
| | NI-4 | 3×10^{-11} |

34. RCP-1B has been secured due to an oil leak. A plant shutdown is in progress to repair the leak. Which of the following describes how OTSG levels are controlled once Low Level Limits are reached on the "A" OTSG?
- A. The ΔT_c circuit ensures additional flow will be maintained to the "B" OTSG to maintain ΔT_c at 0° F.
 - B. The RCS Flow Ratio circuit ensures additional flow will be maintained to the "B" OTSG to maintain ΔT_c at 0° F.
 - C. The Total FW Flow Control circuit ensures additional flow will be maintained to the "B" OTSG to maintain LLL in the "A" OTSG.
 - D. The FW Temperature Compensation circuit ensures additional flow will be maintained to the "B" OTSG to maintain LLL in the "A" OTSG.

35. The crew has entered EOP-6, Steam Generator Tube Rupture, and minimized subcooling margin by RCS depressurization as required.

Which of the following describes the reason for minimizing subcooling margin?

Minimizes:

- A. RCS leakage through the leaking OTSG tube.
- B. time required for cooldown of the RCS.
- C. potential of lifting Main Steam Safety Valves.
- D. tensile stresses on affected OTSG tubes.

36. The following plant conditions exist:

- A 150 gpm OTSG tube rupture has occurred on the "A" OTSG.
- A Loss of Off-site Power (LOOP) and Reactor trip have occurred.
- "B" OTSG has been isolated because of an unisolable steam leak.
- A plant cooldown and depressurization is in progress in accordance with EOP-6.
- The Reactor Coolant System (RCS) is presently at 491°F (Tincore) and 1225 psig.
- "A" OTSG is being maintained at its natural circulation level by EFP-3.
- Initial Dose Equivalent (DE) I-131 was 1.35 µci/g.
- Borated Water Storage Tank (BWST) level is 38.5 feet.

Based on these conditions, which of the following describes the action which should be taken?

- A. The "A" OTSG should be isolated because TRACC limits are being exceeded.
- B. The "A" OTSG should be steamed to atmosphere and cooldown rates maintained within normal limits.
- C. Cooldown rate should be increased to 240°F/hr until "B" OTSG is recovered or Off-site power is available.
- D. Cooldown must be stopped until the "B" OTSG or Off-site power can be recovered.

37. The reactor has just been taken critical when an atmospheric dump valve fails open.

Which of the following describes what will happen to T_{ave} and nuclear power and what operator actions should be taken?

- A. T_{ave} will rise; final power will be at the point of adding heat (POAH). The ADV should be closed and rods inserted to restore T_{ave} .
- B. T_{ave} will rise; final power will exceed the POAH. The ADV should be closed and secondary parameters used to restore T_{ave} .
- C. T_{ave} will lower; final power will be at the POAH. The ADV should be closed and rods withdrawn to restore T_{ave} .
- D. T_{ave} will lower; final power will exceed the POAH. The ADV should be closed and secondary parameters used to restore T_{ave} .

38. The plant is currently at 95% power and decreasing power due to an unisolable steam leak two feet downstream of MSV-53, MN STM to FWP & TURB BP, STM GEN A ISOL. What effect, if any, will closing this valve have on the "A" MFWP?

When reactor power decreases to $\approx 80\%$ the:

- A. swap to reheat steam can occur as normal.
- B. swap to auxiliary steam can occur as normal.
- C. MFWP will trip since the swap to main steam cannot occur.
- D. MFWP will trip since the swap to auxiliary steam cannot occur.

39. With the plant at full power the following conditions exist:

- The AULD is OOS.
- Tave has decreased about 2° F.
- Reactor power has increased about 3%.

Which of the following failures could have caused these conditions and what would be the appropriate action to take?

- A. A MSSV has failed open. The associated MSIV should be closed.
- B. A MSSV has failed open. The associated isolation valve should be closed.
- C. A TBV has failed open. The associated MSIV should be closed.
- D. A TBV has failed open. The associated isolation valve should be closed.

40. The following plant conditions exist:

- A reactor/turbine trip has occurred.
- The turbine governor valves indicate "CLOSED".
- The turbine throttle valves indicate "OPEN".
- "B" OTSG has developed a small steam leak and pressure is steady at approximately 800 psig.

The "A" OTSG pressure should *stabilize* at approximately:

- A. 800 psig.
- B. 885 psig.
- C. 1010 psig.
- D. 1025 psig.

41. The following plant conditions exist:

- A LOOP has occurred with the plant previously at 40% power.
- EFP-2 did not start.
- EFP-3 has a red light on the control handle but no flow is indicated.

Which of the following "prompt and prudent" actions should be taken?

Attempt to:

- A. start EFP-1.
- B. start FWP-7.
- C. open MSV-55 and/or MSV-56 (EFP-2 steam isolation valves).
- D. open ASV-5 and/or ASV-204 (EFP-2 steam control valves).

42. Step 3.4 of EOP-12 Station Blackout directs the operator to:

"Actuate MSLI on both OTSGs."

Which of the following describes the reason for this step?

- A. Limit cooldown to aid in maintaining RCS inventory.
- B. To prevent OTSG dryout due to the loss of Main Feedwater.
- C. To ensure OTSGs are isolated due to the loss of power to automatic Main Steam Line Isolation logic.
- D. To maintain greater than 100 psig in the OTSGs due to the loss of turbine bypass valve control.

43. The following plant conditions exist:

- A LOOP has occurred.
- 'A' EDG did not start due to an electrical lockout.
- 'B' EDG initially started and loaded on the bus and then the output breaker tripped open for no apparent reason. The EDG engine remained at 900 rpm.

Which of the following describes the electrical lockouts, at a minimum, which must be reset if *both* EDGs are to be loaded on the ES buses?

- A. 'A' EDG - 86DG, generator differential current lockout relay
'B' EDG - 86B, lockout relay
- B. 'A' EDG - 4160V undervoltage lockout relay
'B' EDG - 4160V undervoltage lockout relay
- C. 'A' EDG - 86B, lockout relay
'B' EDG - 86DG, generator differential current lockout relay
- D. 'A' EDG - 86DG, generator differential current lockout relay
'B' EDG - 86DG, generator differential current lockout relay

44. Which of the following describes the direct signal that decreases condensate flow demand on a loss of one MFW pump at 80% power?

- A. A signal from the DFT high level interlock.
- B. A runback signal from the ULD sub-section of the ICS.
- C. A signal that compares existing CD flow with FW flow and HW level.
- D. A signal that compares existing CD flow with FW flow and DFT level.

45. The plant has been in a Station Blackout for approximately three hours when Annunciator P-4-1, Inverter A Failure, comes into alarm. Which of the following is the reason for this alarm?
- A. The inverter has lost its AC power supply due to failure of the static transfer switch and its DC power supply due to battery depletion.
 - B. The inverter has lost its AC power supply due to the Station Blackout and its DC power supply when the static transfer switch failed.
 - C. The inverter has lost its AC power supply due to the Station Blackout and its DC power supply due to battery depletion.
 - D. The inverter has lost its AC power supply and DC power supply due to a static transfer switch failure.

46. The following plant conditions exist:

- Plant is operating \approx 20% power.
- SUCV position \approx 95% open.
- LLCV position \approx 5% open.

I & C technicians have requested that the 'B' train SUCV and LLCV H/A stations be taken to hand in order to record some data on the proportional/integral module supplying the input to these stations. Permission is received and these stations are placed in manual. After the technicians are finished, with no problems noted, preparations are made to return these stations to automatic.

Which of the following describes the appropriate actions to return these stations to automatic?

- A. Place the SUCV in auto first, then place the LLCV in auto.
- B. Place the LLCV in auto first, then place the SUCV in auto.
- C. Open the SUCV to 100% to allow the LLCV full control. Place the LLCV in auto first and then the SUCV.
- D. Close the LLCV to allow the SUCV full control. Place the SUCV in auto first and then the LLCV.

47. Based on the following plant conditions:

- FWV-28 (Feedwater Cross Connect) - OPEN
- "B" Main Feedwater Pump (FWP-2B) - TRIPPED
- "A" Startup Control Valve's Differential Pressure - 85 psig
- "B" Startup Control Valve's Differential Pressure - 75 psig

Which of the following statements describes the "A" Main Feedwater Pump (FWP-2A) control mode?

- A. Lowest loop FW flow error.
- B. Individual loop FW flow error.
- C. Delta Pressure across the "A" loop control valves.
- D. Delta Pressure across the "B" loop control valves.

48. A maintenance worker inadvertently hits the power supply wiring for EFV-57, EFP-3 to 'B' OTSG control valve, pulling the wire out of the valve body. The control room is immediately notified and a decision is made to isolate this EFW line and ensure it cannot feed if an EFIC actuation were to occur.

Which of the following action(s), if any, could be taken to ensure this line is isolated?

- A. No action is necessary. EFV-57 has failed closed due to the loss of power.
- B. Select manual and closed at EFV-57's control station and select closed EFV-33, block valve for EFV-57, on the main control board.
- C. Select closed EFV-33, block valve for EFV-57, at the control board and de-energize its power supply at DPDP-8C.
- D. Select closed EFV-33, block valve for EFV-57, at the control board and de-energize its power supply at DPDP-8D.

49. The following plant conditions exist:

- RWP-1 is in operation.
- SP-354B, Monthly Test of EDG-1B, is in progress with the diesel paralleled to the bus.
- A steam leak occurs in the RB and pressure increases to 5 psig.

Which of the following describes the response of the RW system?

- A. RWP-1 trips due to an ES trip command.
- B. RWP-2A starts on low RW pressure due to the loss of RWP-1.
- C. RWP-2B starts on low RW pressure due to the loss of RWP-1.
- D. RWP-3A starts due to an ES start command.

50. With RCS temperature at 190° F which of the following conditions would require entry into a Technical Specification?

- A. VBDP-7 is aligned to its alternate AC power supply.
- B. Total stored EDG lube oil inventory of 260 gallons.
- C. The Offsite Power Transformer is OOS due to an oil leak.
- D. "A" EDG is OOS due to a turbo charger failure.

51. The following plant conditions exist:

- A Loss of Offsite Power has occurred.
- RB pressure is 32 psig.
- RCS pressure 900 psig.
- Adequate subcooling margin does exist.
- A 480V overcurrent lockout has occurred on breaker 3310 (feeder breaker for the 'B' ES bus).

Which of the following describes all running equipment that must be secured because of these conditions? (assume all components have sequenced on as designed)

- A. BSP-1B, MUP-1C and RWP-3B.
- B. RWP-2B and RWP-3B.
- C. BSP-1B, MUP-1B and RWP-3B.
- D. DHP-1B, MUP-1C, BSP-1B and RWP-3B.

52. The following readings were taken on the "A" battery charger following a BATTERY A DISCHARGE HIGH alarm in the control room:

- 120 volts
- 75 amps

Shortly after these readings were taken the amp meter increases to 360 amps.

Which of the following action(s) will occur following this increase?

- A. The "A" and "C" inverter will trip.
- B. The "A" battery charger will trip and the battery will supply bus loads.
- C. The "A" and "C" inverter will not trip but will swap to the AC input.
- D. The "A" battery charger will trip and the "C" battery charger will automatically be placed in service.

53. SP-354A, Monthly Functional Test of EDG-1A, is in progress.

"A" ES 4160 V Bus

4160 volts
60 hz

"A" EDG

4190 volts
60 hz

Based on these conditions which of the following indications are expected when the EDG-1A output breaker is closed and what action should be taken?

There will be:

- A. VARS out. Excitation voltage should be decreased.
- B. VARS out. Excitation voltage should be increased.
- C. VARS in. Excitation voltage should be decreased.
- D. VARS in. Excitation voltage should be increased.

54. With the plant at full power which of the following conditions would require entry into a Technical Specification LCO?

- A. EFP-1 has excessive packing leakage. EFP-2 & 3 are operable.
- B. AHF-1C motor bearing has seized. AHF-1A & 1B are operable.
- C. MUP-1A has a large oil cooler leak. MUP-1B & 1C are operable.
- D. AHV-1A leakage is outside its limit. AHV-1B, 1C & 1D are operable.

55. A small leak has just occurred in the Waste Gas Decay Tank area. Which of the following describes the *first* radiation monitor that should detect this leak and the automatic actuations that should occur?

- A. RM-A4; trips AHF-10
- B. RM-A3; trips AHF-11A/B and closes AHD-29 & 36.
- C. RM-A3; trips AHF-11A/B, closes WDV-393, 394, & 395 (recycle isolation valves) and closes WDV-439 (common waste gas isolation).
- D. RM-A11; closes WDV-393, 394, & 395 (recycle isolation valves) and closes WDV-439 (common waste gas isolation).

56. The following plant conditions exist:

- SWP-1A, RWP-2A and MUP-1B are running.
- Computer points for three CRDM stators have reached their "Hi Warning" setpoint of 113°F and are slowly trending up.
- MUP-1B lube oil temperature is slowly trending up.
- RWP-2A discharge is currently 56 psig and has increased 4 psig over the last four hours.
- Spent Fuel pool level has increased 1 inch over the last four hours.

Which of the following could cause these indications and what actions should be taken?

- A. Enter AP-330, Loss of Nuclear Service Cooling, ensure both SW Booster pumps are running and place the spare CRDM filter in service. The on-line CRDM filter is clogged.
- B. Use OP-408, Nuclear Services Cooling System, and isolate SW flow to the Spent Fuel coolers. The leak has caused decreased SW flow to other components.
- C. Enter AP-330, Loss of Nuclear Service Cooling, place the standby SWHE in service and remove the fouled one. At least one of the in service SWHEs is excessively fouled.
- D. Use OP-408, Nuclear Services Cooling System, and close the discharge valves on RWP-1 and RWP-2B. Backflow through the standby RWPs has decreased RW flow.

57. With IAP-3C running as the Lead compressor, IAP-3B running as the First Lag and IAP-3A running as the Second Lag compressor the power supply to the compressor motors should be as follows:

- A. IAP-3A powered from 480V Rx Aux Bus 3A
IAP-3B powered from 480V Rx Aux Bus 3B
IAP-3C powered from the 12kV line
- B. IAP-3A powered from 480V Rx Aux Bus 3A
IAP-3B powered from the 12kV line
IAP-3C powered from 480V Rx Aux Bus 3B
- C. IAP-3A powered from the 12kV line
IAP-3B powered from 480V Rx Aux Bus 3A
IAP-3C powered from 480V Rx Aux Bus 3B
- D. IAP-3A powered from 480V Rx Aux Bus 3B
IAP-3B powered from 480V Rx Aux Bus 3A
IAP-3C powered from the 12kV line

58. The Halon system has actuated. Multiple cable spreading room smoke detectors still detect smoke. What operator actions must be taken, if any, to ensure both banks of Halon have discharged?

- A. The operator must select the alternate Halon bank.
- B. The operator must select the alternate Halon bank and actuate the pull station located in the control room.
- C. No additional operator actions are required. Both banks will automatically discharge to ensure a Halon concentration of at least 5%.
- D. No additional operator actions are required. After the selected bank discharges a preset timer will start. Once this time has elapsed, and smoke is still detected by at least one detector in each zone, the other bank will automatically discharge.

59. The following plant conditions exist:

- A small break LOCA has occurred in the RB.
- RB pressure is 4.6 psig.
- ES status lights are as indicated.

<i>Component</i>	<i>Light</i>	<i>Component</i>	<i>Light</i>
AHV-1A	AMBER	SWV-79	GREEN
AHV-1B	AMBER	SWV-80	GREEN
AHV-1C	AMBER	SWV-81	GREEN
AHV-1D	AMBER	SWV-82	GREEN
LRV-70	GREEN	SWV-83	GREEN
LRV-71	GREEN	SWV-84	GREEN
LRV-72	GREEN	SWV-85	GREEN
LRV-73	GREEN	SWV-86	GREEN

Based on the above conditions which of the following describes the status of these containment isolation valves?

The AH valves are indicating:

- A. open and should be closed; all other components are in their expected position.
- B. closed and should be open; all other components are in their expected position.
- C. open and should be closed; the SW valves are indicating closed and they should be open.
- D. closed and should be open; the SW valves are indicating open and they should be closed.

60. The following plant conditions exist:

- Plant is at 70% power.
- MFW Booster pump 1A suction valve receives a false signal and strokes 10% in the closed direction and then stops.

Which of the following describes the required operator actions for this condition?

- A. Ensure plant runback to 52% power.
- B. Manually trip one MFWP and ensure plant runback to 52% power.
- C. Reduce power to 45% and manually trip MFW Booster pump 1A.
- D. There will be sufficient flow through the valve since it is still 90% open. Troubleshooting efforts should be initiated immediately.

61. The following plant conditions exist:

- The plant is at 15% power.
- The turbine is latched.
- The "A" MFWP is on turning gear.
- Condenser vacuum has just decreased to 5 in/HgA coincident with a loss of the "B" MFWP.

Which of the following describes the operator's immediate actions and the expected plant response?

- A. Ensure the turbine is tripped. TBVs will control steam pressure at 885 psig.
- B. Ensure the reactor and turbine are tripped. TBVs will control steam pressure at 885 psig.
- C. Ensure the turbine is tripped. Due to the low condenser vacuum the ADVs will control steam pressure at 1025 psig.
- D. Ensure the reactor and turbine are tripped. Due to the low condenser vacuum the ADVs will control steam pressure at 1025 psig.

62. The plant is at 70% power with the following maintenance activities in progress:

- "B" SCHE shoot and clean activities.
- "B" CWP breaker investigation (breaker tripped open for no apparent reason).

The "Cond. Pump Pit Sump Level High" alarm has just annunciated in conjunction with the SPO reporting water coming out of the SCHE and that CWV-5, "B" SCHE inlet valve from CWP-1D, has failed partially open. Water level in the CDP pit is about 1' and rising slowly.

Based on these conditions which of the following actions are required?

- A. Trip the reactor and transition to EOP-02; then stop all CWPs.
- B. Trip the reactor and transition to EOP-02; then stop CWP-1D.
- C. Concurrently perform AP-510; when reactor power is < 60% stop CWP-1D.
- D. Concurrently perform AP-510; when reactor power is < 45% trip the turbine; stop CWP-1D and transition to AP-660.

63. The following plant conditions exist:

- An Inadequate Heat Transfer event is in progress due to a loss of Main and Emergency Feedwater.
- HPI/PORV cooling has been established in accordance with EOP-4, Inadequate Heat Transfer.
- The Subcooling Margin Monitor now indicates -7 SC.
- AFW restoration is expected.
- OTSG integrity does exist.

Based on these conditions which of the following describes the actions that should be taken?

- A. Remain in EOP-4, Inadequate Heat Transfer.
- B. Transition to EOP-3, Inadequate Subcooling Margin.
- C. Transition to EOP-7, Inadequate Core Cooling.
- D. Transition to EOP-8, LOCA Cooldown.

64. The plant has just experienced a spurious reactor trip from 100% full power. Due to control signal interference the output voltage signal from the high select module associated with NI-5/6 remains at 100% reactor power. Select the statement below which describes the operator's actions with the above conditions.

Perform EOP-2, Vital System Status Verification, Immediate Actions and:

- A. continue with the followup actions in EOP-2. No adverse conditions were created with the above failure.
- B. due to the above failure transitioning to EOP-3, Inadequate Subcooling Margin, would be necessary.
- C. due to the above failure transitioning to EOP-4, Inadequate Heat Transfer, would be necessary.
- D. due to of the above failure transitioning to EOP-5, Excessive Heat Transfer, would be necessary.

65. The following plant conditions exist:

- The RCS has suffered a Small Break LOCA and a reactor trip has occurred.
- RCS pressure has stabilized at 1450 psig.
- RB pressure is 20 psig and increasing slowly.
- The Operator has carried out actions of EOP-13, Rule #2, HPI Control, for Bypassing/Resetting ES actuations for the "A" train of ES but has NOT done "B" train.

Which of the following statements correctly describes the response of BSP-1A & 1B when RB pressure reaches 30 psig? (assume no other operator actions taken)

- A. BSP-1A & 1B will NOT auto start.
- B. BSP-1A & 1B will auto start.
- C. BSP-1A will auto start but not BSP-1B.
- D. BSP-1B will auto start but not BSP-1A.

66. The following plant conditions exist:

- RCS pressure is 1500 psig and slowly lowering.
- PZR level is slowly lowering.
- Feedwater flows and OTSG levels are normal.
- "RB Fan A Condensate High" alarm is in.

Based on the above conditions which of the following could cause these indications?

- A. An OTSG tube leak.
- B. A main steam leak inside containment.
- C. A loss of coolant accident inside containment.
- D. A loss of coolant accident outside containment.

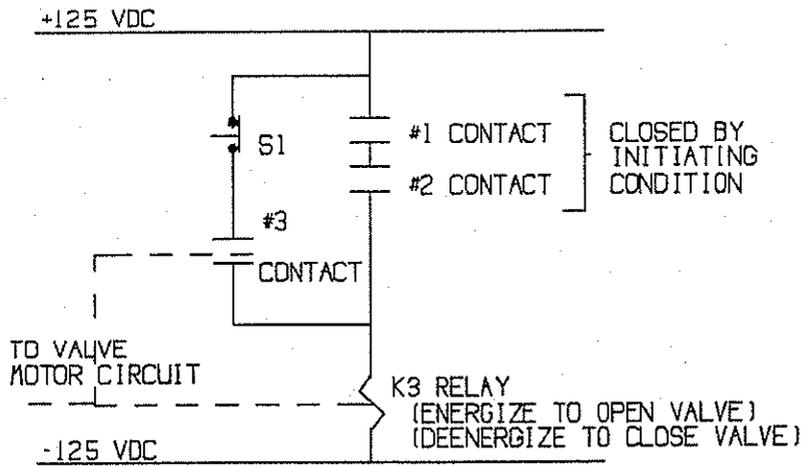
67. A LOOP, concurrent with a SBLOCA, has resulted in a loss of adequate subcooling margin. The "A" EDG has not started and the "A" 4160V ES bus is dead.

When the operator verifies proper HPI discharge flowpath the following is observed:

MUV-23 (HPI Injection valve to A RCP discharge) has no power and is closed.
MUV-24 (HPI Injection valve to B RCP discharge) has no power and is closed.
MUV-25 (HPI Injection valve to C RCP discharge) is open.
MUV-26 (HPI Injection valve to D RCP discharge) is partially open (amber light).
MUV-586 (HPI Crosstie valve) is open.
MUV-587 (HPI Crosstie valve) is open.

What of the following describes the appropriate operator actions per EOP-3?

- A. Align alternate power to MUV-23 and 24 and open them.
- B. Send the PPO to attempt to manually open MUV-26.
- C. Send the PPO to attempt to manually open MUV-23 and 24.
- D. Continue on; a proper HPI flowpath exists with the "B" Train.



TYPICAL VALVE CONTROL CIRCUIT

68.

Using the above drawing which of the following will close the valve?
(initial valve position is open) (drawing shown in shelf state)

- A. Loss of 125 VDC.
- B. Both #1 and #2 contacts open.
- C. Either #1 or #2 contact opens.
- D. Depressing the S1 pushbutton with the initiating condition present.

69. The following plant conditions exist:

- A plant heatup and pressurization are in progress.
- LPI ES actuation bistables are currently bypassed.

Which of the following describes a required operator action in regard to the LPI ES actuation bistables?

- A. Manually reset the LPI actuation bistables when RCS pressure is greater than 500 psig and increasing.
- B. Manually reset the LPI actuation bistables when RCS pressure is greater than 900 psig and increasing.
- C. Verify automatic reset of the LPI actuation bistables when RCS pressure is greater than 500 psig and increasing.
- D. Verify automatic reset of the LPI actuation bistables when RCS pressure is greater than 900 psig and increasing.

70. The following plant conditions exist:

- Plant shutdown in progress.
- Reactor power at 2%.
- OTSG pressure is 885 psig.
- Shutdown Margin is -4.6% $\Delta k/k$ from a calculation using -3.62% $\Delta k/k$ reactivity from xenon.

Which of the following statements will apply? Assume that the xenon reactivity will decay to 0% $\Delta k/k$.

Section 6 of Enclosure 1 in SP-421:

- A. must be completed. Sufficient shutdown margin will be preserved even when xenon decays to zero.
- B. must be completed. Insufficient shutdown margin will result when xenon decays to zero. Boron must be increased to maintain adequate shutdown margin.
- C. need not be completed. Sufficient shutdown margin will be preserved even when xenon decays to zero.
- D. need not be completed. Insufficient shutdown margin will result when xenon decays. Boron must be increased to maintain adequate shutdown margin.

71. Which of the following defines a "VERY HIGH RADIATION AREA" and describes the control requirements for this type of area?

- A. An area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 foot from a radiation source or from any surface that the radiation penetrates and the area must be locked and controlled in such a manner that an individual cannot walk or climb into it.
- B. An area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 1000 rads in 1 hour at 1 foot from a radiation source or from any surface that the radiation penetrates and the area must be conspicuously posted and contain a flashing light.
- C. An area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 meter from a radiation source or from any surface that the radiation penetrates and the area must be locked and controlled in such a manner that an individual cannot walk or climb into it.
- D. An area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 1000 rads in 1 hour at 1 meter from a radiation source or from any surface that the radiation penetrates and the area must be conspicuously posted and contain a flashing light.

72. As a radiation worker you are expected to keep your radiation exposure as low as reasonably achievable. Which of the following shows a radiation exposure that is outside CR-3's administrative limits for a radiation worker with a current dose history (NRC form 5) on file? (Note: This is the first exposure of the year for each radiation worker).
- A. A 20 year old worker receives a TEDE exposure of 1 rem during work inside an OTSG which brings his total lifetime TEDE exposure to 22 rem.
 - B. A 40 year old worker receives a TEDE exposure of 1.8 rem during the week while completing a reactor vessel ISI. This brings his lifetime exposure to 25 rem.
 - C. A 45 year old worker receives a SDE-WB exposure of 25 rem after cutting open a reactor coolant system pipe to complete a maintenance work order.
 - D. A 35 year old chemist receives a LDE exposure of 5 rem while sampling the reactor coolant system for indication of failed fuel.

73. The following plant conditions exist:

- The plant is at 30% power.
- Turbine vibration on bearing #7 is 10 mils.
- Hydrogen Cooler outlet temperature is 60° C.

Based on the above conditions which of the following action(s) should be taken?

- A. Enter AP-510, Rapid Power Reduction, and perform a plant shutdown.
- B. Enter OP-204, Power Operations, and perform a plant shutdown.
- C. Enter EOP-02, Vital System Status Verification, and trip the reactor.
- D. Enter AP-660, Turbine Trip, and trip the turbine.

74. The following plant conditions exist:

- The plant is in Mode 3 with RCS pressure at 2150 psig.
- AP-990, Shutdown from Outside the Control Room, has been entered and transfer to the Remote Shutdown Panel is complete.
- MUV-31 has failed.
- The CRS directs that PZR level be maintained at an *indicated* \approx 100 inches.

Which of the following actions should be taken and what would be the approximate *actual* PZR level for these conditions?

- A. Open MUV-27 and direct the PPO to open MUV-30, bypass around MUV-31; \approx 160 inches.
- B. Use an available HPI valve; \approx 160 inches.
- C. Open MUV-27 and direct the PPO to open MUV-30, bypass around MUV-31; \approx 40 inches.
- D. Use an available HPI valve; \approx 40 inches.

75. AP-990, Shutdown from Outside the Control Room, has been entered. After control has been transferred to the RSP a followup step directs the RO to ensure BSP-1A is tripped by opening the DC knife switch and depressing the manual trip pushbutton.

Which of the following describes where this action is performed and its purpose?

- A. The "A" ES 4160V switchgear room; to protect the pump from loss of essential support functions.
- B. The "A" ES 480V switchgear room; to protect the pump from loss of essential support functions.
- C. The "A" ES 4160V switchgear room; to ensure RCS inventory control problems are not created by component failures.
- D. The "A" ES 480V switchgear room; to ensure RCS inventory control problems are not created by component failures.