

APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION  
REGION IV

Operator Licensing Exam Report: 50-313/OL88-01 Operating License: DPR-51

Docket No: 50-313

Licensee: Arkansas Power & Light Company  
P.O. Box 551  
Little Rock, Arkansas 72203

Facility Name: Arkansas Nuclear One, Unit 1 (AN01)

Examination at: AN01

Chief Examiner: J. E. Whittemore 5/13/88  
J. E. Whittemore, Examiner, Date  
Operator Licensing Section,  
Division of Reactor Safety

Approved by John L. Pellet 5/13/88  
J. L. Pellet, Chief Date  
Operator Licensing Section,  
Division of Reactor Safety

Summary

NRC Administered Examinations Conducted During the Week of April 18, 1988  
Report 50-313/OL88-01

NRC administered examinations to 12 candidates. Eleven candidates passed all portions of the examination and will be issued the appropriate license.



8.08.b Memorizing the order in which a list of personnel appears in an administrative procedure is beyond the reasonable scope of required SRO knowledge. The procedure is used during the process doing temporary modifications therefore memorization of the preferred order is not required. We request Part b be deleted from the test.

Resp. Not accepted. Question solicits inherent knowledge about the procedure, mainly how specific personnel interface with the procedure under normal conditions. The SRO should be aware of desired personnel to perform verification duties. Successful candidates demonstrated greater than 80 percent performance on this question.

b. Site Visit Summary

- (1) At the end of the written examination administration, the facility licensee was provided a copy of the examination and answer key for the purpose of commenting on the examination content validity. It was explained to the facility licensee that regional policy was to have examinations finalized within 30 days. Thus, a timely response was desired to attain this goal.
- (2) At the conclusion of the site visit, the Chief Examiner met with facility representatives to discuss the visit. The following personnel were present:

NRC

J. E. Whittemore

FACILITY

K. W. Canitz  
A. Cox  
E. Force  
W. E. Perks  
J. D. Vandergriff

Mr. Whittemore opened the meeting by thanking those present for the cooperation received during the site visit. Those present were also informed that current guidelines do not allow disclosure of preliminary operating examination results. Other items discussed were as follows:

1. Mr. Whittemore stated that several problems had been noted informally to the simulator instructors concerning simulator performance, and these problems would be stated formally in the Simulation Facility Fidelity Report (included in this report).

2. Mr. Vandergrift inquired about the conduct and cooperativeness of the onshift control room staff during walkthrough examinations. Mr. Whittemore stated that the control room staff had been most cooperative while the examinations were ongoing, and that proper conduct had been observed at all times.
3. Mr. Force inquired if examiners would consent to use facility generated scenarios during the simulator portion of future examinations. Mr. Whittemore responded that this would be possible provided that the requirements of NUREG 1021 were met and that the scenario bank was large enough to provide an adequate number of scenarios (through sampling) to preclude compromise. Mr. Whittemore noted that he had used some of the one event scenarios submitted by ANO1 in the preparation of NUREG-1021, ES-302, Att. 4 forms for the current examination.
4. Mr. Canitz expressed appreciation of the attitude exhibited by the NRC examiners to overcome problems that arose during the simulator examinations due to either simulator discrepancies or instructor inexperience in the administration of initial examinations.

c. Generic Comments

One area of generic weakness was noted. Generally, SRO candidates were not sure how to ascertain that all requirements had been met to exit refueling shutdown conditions and enter cold shutdown or heatup conditions.

d. Master Examination and Answer Key

A copy of the final ANO1 written examination and answer key is attached. The valid facility licensee comments have been incorporated into the answer key.

e. Facility Examination Review Comments

The facility licensee comments regarding the ANO1 written examination are attached.

f. Simulation Facility Fidelity Report

All items on the attached Fidelity Report have been discussed with the facility simulator instructor personnel.

U. S. NUCLEAR REGULATORY COMMISSION  
 SENIOR REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: ARKANSAS NUCLEAR ONE-1  
 REACTOR TYPE: PWR-B&W1ZZ  
 DATE ADMINISTERED: 88/04/18  
 EXAMINER: WHITTEMORE, J.  
 CANDIDATE: \_\_\_\_\_

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up six (6) hours after the examination starts.

CATEGORY	% OF	CANDIDATE'S	% OF	CATEGORY
VALUE	TOTAL	SCORE	VALUE	
25.00	25.00	-----	-----	5. THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
25.00	25.00	-----	-----	6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
25.00	25.00	-----	-----	7. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
25.00	25.00	-----	-----	8. ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
100.00		-----	-----	Totals
		Final Grade	%	

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

-----  
 Candidate's Signature

QUESTION 5.01 (1.00)

Calculate the stable count rate for a reactor that has a source strength of 5 CPS and  $K_{eff}$  is 0.95. (1.0)

ANSWER 5.01 (1.00)

$$SCR = S / (1 - K_{eff}) \quad [0.5]$$

$$= 5 / 1 - 0.95 = 100 \text{ CPS} \quad [0.5] \quad (1.0)$$

REFERENCE

Unit 1 PSRT, P. 144  
192003K102 ... (KA'S)

QUESTION 5.02 (1.50)

Reactor power doubles in 1 min. 20 sec's. What was the reactor period for this power gain. Show all work. (1.5)

ANSWER 5.02 (1.50)

$$P = P_0 e^{(t/T)} \quad [0.5]$$

$$2 = \ln e^{(80/T)} \quad [0.25]$$

$$0.693 = 80/T \quad [0.25]$$

$$T = 115.4 \text{ seconds (accept 110 -120 seconds)} \quad [0.5] \quad (1.5)$$

REFERENCE

Unit 1 PSRT, P. 129  
192003K109 ... (KA'S)

QUESTION 5.03 (2.50)

True or False:

- a. It will take less time for the reactor to go from 2% to 4% power than from 25% to 50% power if the period is constant.
- b. Halving the period will double the Start Up Rate.
- c. If reactor power is increased from 1% at a stable SUR of 0.5 DPM, power will be 5% in one minute.
- d. If a positive reactivity addition to a just critical reactor results in a 100 sec. period, the same amount of negative reactivity addition will result in a 100 second negative period.
- e. If a shutdown reactor is started up from a 10 CPS count rate, criticality should be expected at a count rate between 2000 and 2500 CPS. (2.5)

ANSWER 5.03 (2.50)

- a. False
- b. True
- c. False
- d. False
- e. False [0.5 ea.] (2.5)

REFERENCE

Unit 1 PSRT, Pp. 129 - 148  
192003K110 ... (KA'S)

QUESTION 5.04 (1.50)

- a. Explain the mechanisms which could cause Shutdown Margin (SDM) to increase or decrease as a result of plant heatup. (1.0)
- b. Explain which control room instrument(s) would be used to detect a changing SDM and why the indication responds as it does (1.0)



ANSWER 5.04 (1.50)

- a. 1. Boron expanding out of the core adds positive reactivity, causing SDM to decrease.
2. Decreasing density results in loss of neutron moderation adding negative reactivity, causing SDM to increase.
3. Increasing fuel temperature provides negative doppler which will increase SDM. [Any 2, 0.5 ea.] (1.0)
- b. As SDM changes,  $K_{eff}$  changes and therefore subcritical multiplication will change. [0.25] CONCEPT This leads to a change in neutron population which is detectable on the source range. [0.25] (0.5)

REFERENCE

Facility Exam Question Bank  
192002K114 ... (KA'S)

QUESTION 5.05 (1.00)

Choose the correct answer.

For a reactor restart after shutdown with equilibrium Xenon, the decreased Xenon concentration reached due to burnout. (Assume constant power ramp rate.)

- a. Would be lower for a startup commenced 5 hours after shutdown.
- b. Would be lower for a startup commenced 10 hours after shutdown.
- c. Would be lower for a startup commenced 20 hours after shutdown.
- d. Would be approximately equal for any startup between 5 and 20 hours after shutdown. (1.0)

ANSWER 5.05 (1.00)

"c."

REFERENCE

Unit 1 PSRT, P. 203  
192006K107 192006K114 ... (KA'S)



QUESTION 5.06 (1.00)

Choose the correct response.

The preferred method for dampening a Xenon oscillation is to initially:

- a. Insert control rods into a low flux area.
- b. Withdraw control rods from a low flux area.
- c. Insert control rods into a high flux area.
- d. Withdraw control rods from a high flux area.

(1.0)

ANSWER 5.06 (1.00)

"c."

REFERENCE

Unit 1 PSRT, P. 205  
192006K114 ... (KA'S)

QUESTION 5.07 (1.00)

Concerning equilibrium Samarium-149 (Sm) reactivity, which of the following statements is correct? 50% equilibrium Sm reactivity is:

- a. one-quarter of 100% equilibrium Sm reactivity.
- b. one-half of 100% equilibrium Sm reactivity.
- c. three-quarters of 100% equilibrium Sm reactivity.
- d. equal to 100% equilibrium Sm reactivity.

ANSWER 5.07 (1.00)

"d"

REFERENCE

Unit 1 PSRT, P. 207  
192006K115 ... (KA'S)

QUESTION 5.08 (1.00)

Which one of the following statements most correctly describes the change in the Doppler and Moderator Temperature Coefficients (FTC and MTC) as a function of core life (BOL to EOL)?

- a. FTC becomes more negative and MTC becomes more negative.
- b. FTC becomes more negative and MTC becomes more positive.
- c. FTC becomes more positive and MTC becomes more negative.
- d. FTC becomes more positive and MTC becomes more positive.

ANSWER 5.08 (1.00)

"a"

(1.0)

REFERENCE

UNIT 1 PSRT, Pp. 175, 180  
192004K107 ... (KA'S)

QUESTION 5.09 (2.00)

- a. How will the reactor response differ to equal positive reactivity insertions as the reactor approaches criticality? (1.0)
- b. How much reactivity must be added to a critical reactor for it to be considered prompt critical? (Actual value is NOT required.) (0.5)
- c. Why are extrinsic neutron sources installed in the reactor core? (0.5)

ANSWER 5.09 (2.00)

- a. The neutron population increase is greater [0.25] and the time to stabilize is longer [0.75] as  $K_{eff}$  approaches 1. (1.0)
- b. Beta effective [or beta] (accept numbers). (0.5)
- c. Neutron sources are required to assure sufficient indication to control the startup. CONCEPT (0.5)

REFERENCE

AN01 PSRT, Pp. 140-145  
192003K101 192003K108 192003K111 ... (KA'S)

QUESTION 5.10 (2.00)

- a. Explain why the effect of the core delayed neutron fraction is numerically larger than the fraction itself. (1.0)
- b. Explain HOW the effect of the delayed neutron fraction is numerically different at the end of cycle compared to the beginning of cycle. WHY? (1.0)

ANSWER 5.10 (2.00)

- a. Delayed neutrons are created at a lower energy and therefore more likely to thermalize and cause fission. Also accept an explanation of how importance factors may actually decrease value of effective fraction. CONCEPT. (1.0)
- b. Numerically smaller. [0.5] (Accept explanation of quicker response.) Due to the buildup of fissionable isotopes (Pu-239 and Pu-241) which have smaller individual fractions compared to U-235. [0.5] (1.0)

REFERENCE

AN01 PSRT, Pp. 124-126  
192003K107 ... (KA'S)

QUESTION 5.11 (1.50)

For a centrifugal pump operating in a closed loop system, how will the available AND minimum Net Positive Suction Head vary as the pump speed is changed with other parameters constant. Explain your answer. (1.5)

ANSWER 5.11 (1.50)

As pump speed increases the potential for cavitation is greater so the minimum NPSH required increases. [0.5] With increasing flow, there are increasing head losses at the pump suction, [0.5] so the available NPSH decreases. [0.5] (1.5)

REFERENCE  
AND HTT&F HDBK, P.83  
191004K113 ...[KA'S]

QUESTION 5.12 (1.50)

What steam generator pressure is required to maintain 200 deg's F subcooling margin in the RCS when RCS pressure is 595 psig. Show all work. (1.5)

ANSWER 5.12 (1.50)

1. Add 15 psi to 595 psig = 610 psia (0.25)
2. Using steam tables, @ 610 psia,  $T_{sat} = 488 \pm 2$  deg's F (0.5)
3.  $T_{sat}$  in S/G =  $T_{rcs} - T_{subcooling} = 488 - 200 = 288 \pm 2$  deg's F (0.25)
4. Using steam tables,  $P_{sat}$  @  $T_{sat} = 288$  deg's F =  $56 \pm 4$  psia or  $41 \pm 4$  psig. (0.5)

REFERENCE  
Steam Tables  
002000K515 ...[KA'S]

QUESTION 5.13 (2.50)

Concerning the Once-Through Steam Generators:

- a. In what heat transfer region(s) does the secondary side temperature change the least? Why? (1.0)
- b. In what region(s) does the primary side temperature change the least? Why? (1.0)
- c. If full power RCS core  $\Delta T$  is 48 deg's F., what is  $\Delta T$  at 40% with 1 RCP stopped? (0.5)

ANSWER 5.13 (2.50)

- a. In the nucleate (and film) boiling regions, [0.5] because all thermal energy is being used to cause the phase change. [0.5] (1.0)
- b. In the superheat region, [0.5] due to poor heat transfer characteristics of dry steam. [0.5] (1.0)
- c. 25.6 oF. (Accept 25 -26 oF.) (0.5)

REFERENCE

ANO HTT&F HDBK. Pp. 140, 141  
193008K126 ... (KA'S)

QUESTION 5.14 (1.00)

Which one of the following actions, carried to extreme, should not hinder, natural circulation and subsequent core cooling?

- a. Lowering S/G level
- b. Lowering RCS pressure
- c. Increasing RCS temperature
- d. Increasing PZR level

ANSWER 5.14 (1.00)

"d."

REFERENCE

ANO HTT&F HDBK. Pp. 144 - 146  
193008123 ... (KA'S)

QUESTION 5.15 (1.50)

What are the three limits (or concerns) of flux peaking for the Unit 1 Reactor Core? (1.5)

ANSWER 5.15 (1.50)

Power imbalance, Quadrant power tilt, and Linear heat rate. [0.5 ea] (1.5)

REFERENCE

ANO1 PSRT, P.114  
193009K107 ... (KA'S)

QUESTION 5.16 (1.50)

State the axial core locations (mid-plane, upper half, or lower half) where you would expect to see maximum clad temperature and maximum heat flux at full power for beginning of life conditions. Explain your reasoning. (1.5)

ANSWER 5.16 (1.50)

Max. clad temp. would occur in the upper half of the core. [0.5] Max. heat flux occurs about core mid-plane. [0.5]. Max heat flux is where max power is produced, and temperature is dependent upon heat flux and coolant temperature. [0.5] (1.5)

REFERENCE

ANO HTT&F HDBK. Pp. 124, 125  
193008K129 ... (KA'S)

QUESTION 5.17 (1.00)

TRUE OR FALSE

- a. The thermal conductivity within a fuel pellet tends to decrease over core life.
- b. Initial fuel to clad gap thermal conductivity decreases during initial power operation. (1.0)

ANSWER 5.17 (1.00)

- a. TRUE
- b. TRUE [0.5 ea.] (1.0)

REFERENCE

ANO HTT&F HDBK., Pp. 118,119  
193008K116 ... (KA'S)



## QUESTION 6.01 (2.00)

- a. How does ICS prevent OTSG water inventory from dropping below that corresponding to 15% load during low power operations? (1.0)
- b. How does the ICS act to prevent flooding of the aspirating ports in the OTSG? (1.0)

## ANSWER 6.01 (2.00)

- a. When level drops, control of feedwater switches to low level limits to maintain the minimum dp. (CONCEPT) (1.0)
- b. When level increases above maximum permitted value, control of feedwater switches to the high level limit control circuit, which limits OTSG level. (CONCEPT) (1.0)

## REFERENCE

ANO1 STM 1-15, p. 4, 5  
035010A301 ... (KA'S)

## QUESTION 6.02 (2.00)

- a. Explain the function of the CRA Torque Tube Assembly. (0.5)
- b. What is the purpose of the synchronizing bearing in the control rod drive mechanism? (0.5)
- c. Explain in detail why an APSR, when de-energized, will not trip. (1.0)

## ANSWER 6.02 (2.00)

- a. Prevents rotation of the lead screw. OR, Transmits rotating motion of CRDM to vertical motion of lead screw. (0.5)
- b. Ensures both segment arms move together. (0.5)
- c. Located on the segment arms is a button [0.5] which will strike the motor tube to prevent the segment arm from moving outward. [0.5] (1.0)

## REFERENCE

Facility Exam Bank

0010006007 001000K601 ... (KA'S)

## QUESTION 6.03 (2.50)

Assume an ES signal has occurred due to low RCS pressure and answer the following TRUE or FALSE.

- a. Upon ES actuation, the MUT outlet valve shuts.
- b. The 5 psig oil pressure interlock is bypassed for MU pump start due to an ES signal.
- c. During high pressure injection the make up pump recirc isolation valves remain open to preclude pump damage.
- d. The RCP seal return valves and the seal return isolation valve both receive a close signal upon ES actuation.
- e. All 3 HPI pumps receive an ES start signal from both ES channels 1 and 2. (2.5)

## ANSWER 6.03 (2.50)

- a. False
- b. True
- c. False
- d. True
- e. False

## REFERENCE

STM 1-4, Pp. 9, 11, 13, 27

006000A303 006000K406 006020K401 ... (KA'S)

## QUESTION 6.04 (2.00)

- a. What are 3 uses or purposes of the Reactor Coolant Quench Tank? (1.5)
- b. How is the Quench Tank cooled? (0.5)

ANSWER 6.04 (2.00)

- a. 1. Collect effluent from pwr. safeties and electric relief.  
 2. Alternate flow path for seal return.  
 3. Act as a water trap for RB vent hdr.  
 4. Collects RCP seal leakage. [Any 3, 0.5 ea.] (1.5)
- b. By dilution with condensate. (0.5)

## REFERENCE

STM 1-3, P. 8

002000K104 ... (KA'S)

QUESTION 6.05 (3.00)

For the components numbered 1 - 6 on the attached fig. 6-1, state their position or condition (open, closed, running, stopped) for the control room ventilation system operating:

- a. Normally. (0.6)
- b. Due to initiation from area high radiation. (1.2)
- c. Due to initiation by smoke detector. (1.2)

ANSWER 6.05 (3.00)

Require column "c" if exhaust detector is assumed or "d" if supply smoke detector is assumed.

- |               |               |               |               |
|---------------|---------------|---------------|---------------|
| a. 1. Stopped | b. 1. Running | c. 1. Stopped | d. 1. Stopped |
| 2. Shut       | 2. Shut       | 2. Open       | 2. No Effect  |
| 3. Open       | 3. Open       | 3. Shut       | 3. No Effect  |
| 4. Shut       | 4. Shut       | 4. Open       | 4. No Effect  |
| 5. Running    | 5. Stopped    | 5. Running    | 5. Stopped    |
| 6. Open       | 6. Shut       | 6. Open       | 6. Shut       |

[0.1 ea. for a, 0.2 ea. for b, c, or d] (3.0)

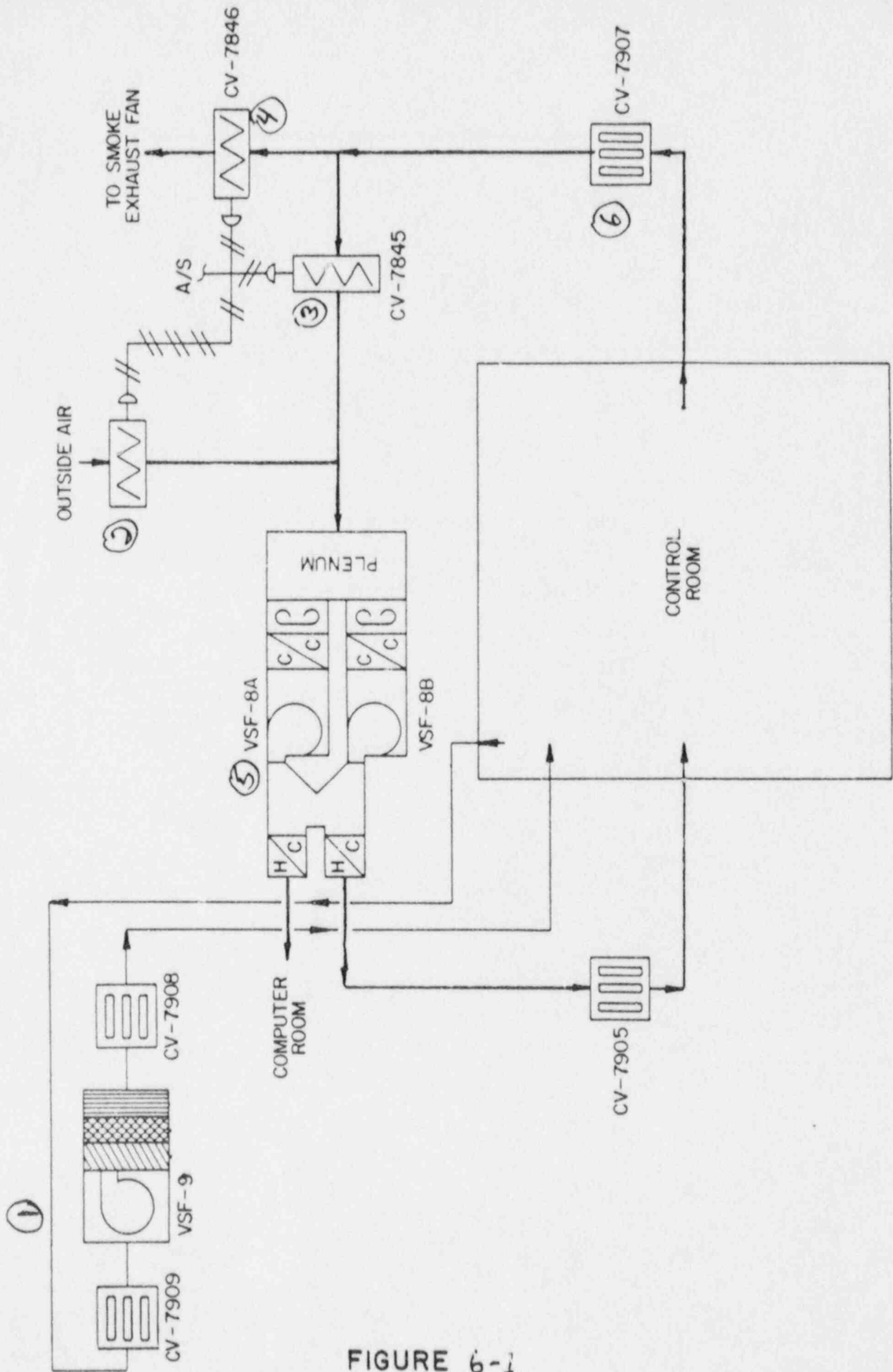


FIGURE 6-1

## REFERENCE

STM 1-47, Pp. 14, 15, 24, 25, 26  
000060A102 ...[KA'S]

## QUESTION 6.06 (2.00)

For the following components, explain how RCS temperature and pressurizer level may be IMMEDIATELY affected by loss of instrument air to the components.

- a. Main Steam Atmospheric Dump Valves, with the valve open.
- b. Turbine Bypass Valves, that are open.
- c. Letdown Orifice Isolation Valve, that is open.

## ANSWER 6.06 (2.00)

- a. No effect [0.25] as valves may operate from MSIV accumulator system. [0.5] (0.75)
- b. Temperature and level may increase [0.25] as emergency accumulators will act to close valves. [0.5] (0.75)
- c. Pzr level will increase due to valve closure. (0.5)

## REFERENCE

STM 1-15, Pp. 12, 15 STM 1-4, P.  
078000K302 ...[KA'S]

## QUESTION 6.07 (2.00)

- a. If both start up transformers are available, what determines which will be utilized if a fast transfer of 6.9 KV power to backup source becomes necessary due to loss of unit auxiliary transformer? (0.5)
- b. What will happen if the fast transfer as predicted in "a" above does not occur? (0.5)
- c. If both 6.9 KV buses are auto transferred to Startup Transformer #2, what additional automatic action will occur? Why? Consider only the electrical distribution system and assume full power conditions. (1.0)

ANSWER 6.07 (2.00)

- a. Whichever has been selected by the operator on the preferred standby switch in the control room. (0.5)
- b. Automatically transfer to the other standby transformer. (0.5)
- c. Auto load shedding will occur [0.5] to shed 1 Reactor Coolant Pump from each bus, [0.25] to prevent XFMR overload. [0.25] (1.0)

REFERENCE

STM 1-32, Pp.19, 20  
062000K403 ... (KA'S)

QUESTION 6.08 (1.00)

Choose the correct statement below:

- a. The emergency diesel generators can be started by signals from 480V and 4160V undervoltage relays.
- b. It is not possible to feed buses A3 and A4 from one emergency diesel generator.
- c. The undervoltage relay on a vital 4160V bus has no effect on the individual component feeder breakers on that bus.
- d. Interlocks to prevent paralleling buses A3 and A4 are strictly mechanical. (1.0)

ANSWER 6.08 (1.00)

"a."

REFERENCE

STM 1-32, Pp.25, 26  
064000A301 ... (KA'S)

QUESTION 6.09 (1.00)

Which of the following conditions would act to increase the calculated loop BTU limit?

- a. Feedwater Temperature decreasing
- b. OTSG pressure decreasing.
- c. Loop RCS flow decreasing.
- d. Selected Th decreasing.

(1.0)

ANSWER 6.09 (1.00)

"b."

## REFERENCE

STM 1-64, P.9

059000A410 ... (KA'S)

QUESTION 6.10 (1.00)

Choose the correct statement:

- a. The power to the CRDM windings is AC.
- b. If one set of programmer lamps is de-energized, the rods for that group will not drop.
- c. If a programmer stops with 3 phases to it's CRDM's energized, it will automatically continue to move in the same direction until only 2 phases are energized.
- d. The "Asymmetric Rod" alarm (amber light) on the diamond panel receives it's inputs from relative position indicators and the absolute average position indicator.

(1.0)

ANSWER 6.10 (1.00)

"b."



## REFERENCE

Facility Exam Bank & STM 1-02, P. 12  
001000G004 ... (KA'S)

## QUESTION 6.11 (2.00)

- a. How does an ESAS analog channel INHIBIT BISTABLE function to allow plant cooldown/depressurization? (1.0)
- b. What is the purpose of the Removal/Test Relays within the Logic Buffer modules of the ESAS Analog system? (1.0)

## ANSWER 6.11 (2.00)

- a. Blocks HP and LP injection [0.5] by inserting a false RCS pressure signal to prevent actuation. [0.5] (1.0)
- b. To provide protection for removal of a module [0.5] by passing a trip signal to the digital system. [0.5] (1.0)

## REFERENCE

STM 1-65, Pp. 3, 4  
013000K101 013000K412 ... (KA'S)

## QUESTION 6.12 (2.50)

Indicate on which panel(s) (C116, R33, or R08) the following Remote Shutdown Indication may be found:

- a. S/G "B" Start Up Range Level
- b. DELETED
- c. Compensated Pressurizer Level
- d. Make Up Tank Level
- e. Source Range Power
- f. Reactor Coolant Loop "A" inlet temperature
- g. RCS Loop "B" Th (2.5)

ANSWER 6.12 (2.50)

- a. C116, R33
- b. DELETED
- c. C116, R08, R33
- d. C116, R08
- e. C116
- f. C116
- g. R33 [0.25 for ea. location] (2.5)
- NOTE. Accept the following descriptions or locations of the panels:
- R08 - Outside MUT Room
- R33 - Orange door/ E1 Heater deck
- C116- Dasey Panel or Unit 1 computer room

## REFERENCE

STM 1-70, Pp. 1-3

000068K201 ... (KA'S)

QUESTION 6.13 (2.00)

- a. What occurs within a Reactor Protection System (RPS) Channel when the following are placed in bypass: Ignore setpoints.
1. Channel By-Pass Keyswitch
  2. Shutdown By-pass Keyswitch (1.5)
- b. Is it possible to place 2 channels in bypass simultaneously for each of the system features above, with the plant at full power? (0.5)

ANSWER 6.13 (2.00)

- a. 1. By-passes all channel trips. [0.3]
2. Bypasses Low press. trip, Var. press. trip, Power/Pump trip, and Power/Flow/Imbalance trip. [0.2 for ea. trip]
- Imposes Shutdown High Flux Trip, and Shutdown High Pressure trip. [0.2 for ea. trip] (1.5)
- b. Channel By-pass. -----NO
- Shutdown By-Pass. -----YES [0.25 ea.] (0.5)

REFERENCE

STM 1-63, P. 25

012000K406 012000K604 ... (KA'S)

QUESTION 7.01 (2.50)

- a. According to the radiation protection manual, what are the weekly exposure limits for an escorted visitor? State the conditions associated with each of the two limits. (1.0)
- b. For ANO personnel, what is the MAXIMUM weekly limit if there is a demonstrated need and all necessary approvals are obtained? (0.5)
- c. Who is authorized to approve emergency exposure that is likely to be greater than 5 rem? (0.5)
- d. Why does ANO have external radiation exposure limits and guidelines that appear to be more restrictive than the federal limits already in place. (0.5)

ANSWER 7.01 (2.50)

- a. 1. 100 mrem/week [0.25] without completed exposure history (NRC Form 4) [0.25]  
2. 300 mrem/week [0.25] with completed history. [0.25]
- b. The quarterly limit. (Accept 1.25, 2.5, or, 3.0 Rem with explanation of limit.) [0.5]
- c. Any one of the following: Emergency Coordinator, Emergency Ops Facility Director, Shift Supervisor, or, VP Nuc. Ops. [0.5]
- d. ALARA, or prevent or minimize unwarranted exposure. OR, Prevent violating federal rules/regulations. [0.5]

REFERENCE

ANO 1000.31, Pp. 30, 37, 38, 39  
194001K103 ...[KA'S]

QUESTION 7.02 (2.50)

- a. During refueling operations, a boron sample reveals that boron concentration in the canal and Spent Fuel Pool has unexpectedly dropped to 1865 PPM. Describe the boration flow path that should be used to restore concentration. (0.75)
- b. What are the conditions and restrictions for non-licensed operators to operate fuel handling bridges? (0.75)
- c. If a fuel handling accident occurs in the Reactor Building (RB), what two additional actions should be immediately ordered in conjunction with or after plant notification and RB evacuation? (1.0)

ANSWER 7.02 (2.50)

- a. (BAA Tk. or BA Pump.) [0.25] > (SFP Cooling or Recirc System) [0.25]  
> Suct. of DHR Pump. [0.25]
- b. May not handle nuclear fuel [0.5] unless directly supervised by a licensed operator. [0.25]
- c. 1. Shutdown RB purge system.  
2. Isolate th RB.  
3. Place plant in safe condition/take action to mitigate problem.  
4. Order ops personnel to control room.  
[Any 2, 0.5 ea.]

REFERENCE

ANO 1502.04 Pp. 4, 5, 83

033000K405 034000A201 034000G006 ... (KA'S)

QUESTION 7.03 (2.50)

- a. When performing Category "E" valve position verification for "Plant Preheatup and Precritical checklist, what does the asterisk (\*) in the POSITION column denote to the verifier? (0.75)
- b. What does an asterisk adjacent to a step in the plant startup procedure denote to the operator? (0.5)
- c. What is required to be plotted during RCS heatup? (0.75)
- d. Why should RCP operation below 400 psig be minimized? (0.5)

ANSWER 7.03 (2.50)

- a. The specified valve position may be reversed to facilitate component operation from a redundant loop. CONCEPT
- b. The step must be performed in the listed sequence. [0.5]
- c.
  1. RCS pressure vs. temperature
  2. RCS temperature (vs. time)
  3. Pzr. temperature (vs. time) [0.25 ea.]
- d. To prevent excessive seal wear. [0.5]

REFERENCE

ANO 1102.01 P. 27 ANO 1102.02, Pp. 3, 9, 10  
0020006013 0030006001 194001K101 ... (KA'S)

QUESTION 7.04 (3.00)

- a. What is the primary, backup, and third or alternate backup means of communications within the plant during the performance of Alternate Shutdown? (0.75)
- b. ANO 1203.02 (Alternate Shutdown) states that the Service Water System is a major safe shutdown system utilized by the procedure. State why this system is important to safe shutdown. (0.75)
- c. Choose the correct answer.

If Alternate shutdown of unit 2 must be performed due to a fire in the unit 2 control room, then unit 1 must:

1. Commence shutdown at normal rate.
  2. Trip and go to hot shutdown.
  3. Commence shutdown at maximum safe rate.
  4. Maintain stable plant conditions. (1.0)
- d. True or False.

If the unit 1 control must be evacuated due to toxic fumes from a fire in the unit 2 control room, then unit 1 must also perform Alternate Shutdown in accordance with ANO 1203.02. (Alternate Shutdown) (0.5)

ANSWER 7.04 (3.00)

- a. Portable radios and alternate SD radio cabinet, Dial telephone (PAX), and Gaitronics. [0.25 ea.]
- b. Service water is required to sustain EDG, makeup pump, and possibly EFW systems operation. Accept required to support other safe shutdown systems. [0.75]
- c. "3."
- d. False

REFERENCE

ANO 1203.02 Pp. 1-4  
000068G010 ... (KA'S)

QUESTION 7.05 (2.00)

- a. For an indicated Asymmetric Rod condition, what are 2 methods of determining if the problem is due to faulty instrumentation? (1.0)
- b. If a group of rods are moving due to a programmer lamp fault, how can the rod motion be stopped? (0.5)
- c. If rods cannot be driven after verifying that Reactor Demand and Diamond Stations are in manual, what should be done next? (0.5)

ANSWER 7.05 (2.00)

- a.
  1. Utilize PI channel Bypasses to find and isolate a faulty string.
  2. Compare with a zone indicating switch.
  3. Use computer trending capabilities to determine rod behavior.
  4. Determine tilt or imbalance. [Any 2, 0.5 ea.]
- b. Remove the fuses in the (left) cabinet of the affected CRD power supply. [0.5]
- c. Transfer the affected group to the auxiliary power supply. [0.5]



REFERENCE

ANO 1203.03, Pp. 2, 4, 6  
001000A203      001000A407      ...{KA'S}

QUESTION 7.06      (1.50)

- a.    What are 2 abnormal indications or conditions that may arise if the unit is operated continually at full power without pressurizer bypass spray flow?      (1.0)
- b.    What mitigating action should the operator take?      (0.5)

ANSWER 7.06      (1.50)

- a.    1.    Low spray line temperature (alarm at 520 oF.) [0.5]  
      2.    Abnormal difference between Pzr. and RCS boron conc. [0.5]
- b.    Operate spray and heaters as necessary to maintain spray line temperature and equalize boron concentration. [0.5]

REFERENCE

ANO 1203.15, P. 5  
010000A202      ...{KA'S}

QUESTION 7.07      (1.50)

- a.    After a dilution problem has been found and corrected with the reactor critical, which method below should NOT be used to restore boron concentration?
1.    Utilize batch controller.
2.    Direct feed from boric acid addition tank to letdown line.
3.    Direct from BWST.
4.    Utilize boron feed line bypassing batch controller.      (1.0)
- b.    If a dilution is detected while the reactor is shutdown on DHR system, and the vessel head in place, what additional source of possible dilution beside normal makeup, should be secured?      (0.5)

ANSWER 7.07 (1.50)

- a. "2." [1.0]
- b. RCP seal supply [0.5]

REFERENCE

ANO 1103.04 Pp. 5.6 & ANO 1207.17, P.4  
004000A206 ...[KA'S]

QUESTION 7.08 (2.50)

- a. For a simultaneous loss of RCP seal injection and seal cooling resulting in Reactor trip and stopping of all pumps, which should you attempt to restore first (cooling or injection)? (0.5)
- b. What special precaution(s) should the operator observe in the restoration of seal injection flow? Why? (0.75)
- c. The procedure for a sheared RCP shaft tells the operator to immediately trip the affected pump. What are 3 parameters or indications that may be used to determine the affected pump? (0.75)
- d. After stopping a RC Pump at power due to abnormal vibration, indication of reverse rotation is noted. What action should be taken immediately? (0.5)

ANSWER 7.08 (2.50)

- a. Injection [0.5]
- b. Restore slowly [0.5] to avoid thermal shock and the subsequent damage of seal parts. [0.26] CONCEPT
- c. Vibration monitor, Pump motor current, or SPDS. [0.25 ea.]
- d. Manually trip the reactor, [0.25] and stop all pumps. [0.25]

REFERENCE

ANO 1203.31, Pp. 3,4,9  
003000A101 003000A202 003000G001 ...[KA'S]

QUESTION 7.09 (2.50)

When subcooling margin has been lost, the operator is allowed to bump an RC Pump to regain natural circulation.

- a. Why is the operator required to decrease steam generator pressure to a saturation temperature below CET average temperature? (0.5)
- b. What is the criteria for selecting the pump to be bumped? (0.5)
- c. How and where are the pump start interlocks bypassed for bumping the pump? (1.0)
- d. If RC Pumps can not be bumped, what is the next manipulation the operator should perform to start natural circulation flow? (0.5)

ANSWER 7.09 (2.50)

- a. To establish the steam generator as a heat sink. [0.5]
- b. Select a pump in the loop with the smallest void. [0.5]
- c. Manually close the RC Pump breaker [0.5] locally. [0.5]
- d. Open Hot leg high point vents. [0.5]

REFERENCE

ANO 1202.01, Pp. 49, 50  
003000G001 003000K507 ...[KA'S]

QUESTION 7.10 (2.50)

According to the Emergency Procedure for Steam Generator Tube Rupture (SGTR):

- a. When can the emergency cooldown rate be used? (0.5)
- b. What action may be required of the operator do to obtain EFW for RCS cooldown and why is this action necessary? (1.0)
- c. Why is it preferred to reduce reactor power at 5%/ min. rather than trip during SGTR? (0.5)
- d. What are 2 components or systems that should be isolated from the affected S/G during initial power decrease to minimize secondary contamination? (0.5)

ANSWER 7.10 (2.50)

- a. (Greater than 500 oF.) when leak rate is greater than HPI capacity. (Also accept: non-isolable steam leak on affected S/G outside RB. [0.5])
- b. Override the vector close signal. [0.5] The EFIC is designed to feed the steam generator with the highest pressure and may have locked out the unaffected steam generator. [0.5] CONCEPT
- c. To prevent a release due to lifting of main steam safeties. [0.5]
- d. EFW P-7 steam supply, Steam to MSR's, and Steam line drains. [Any 2, 0.25 ea.]

REFERENCE

ANO 1202.01, Pp. 84-100  
000038A136 000038K306 ...{KA'S}

QUESTION 7.11 (2.00)

- a. When recovering from degraded power conditions, which non-vital 4160 VAC bus would you recover first? Why? (1.0)
- b. Why is loss of NNI "X" power considered more severe than loss of NNI "Y" power? (0.5)
- c. Why does the procedure for BLACKOUT require the operator to remain at Hot Shutdown instead performing a natural circulation cooldown? (0.5)

ANSWER 7.11 (2.00)

- a. Bus A-2. [0.5] To provide cooling water to instrument and breathing air compressors [0.25] and provide an additional bank of pressurizer heaters. [0.25]
- b. "X" power supplies (buffer amplifiers which) drive indicators. [0.5]
- c. No means to improve SDM [0.25] or make up for RCS leakage/shrinkage. [0.25]

REFERENCE

ANO 1202.01 Pp. 119, 137, 147

000055E102      000055G003      000057K301      ... (KA'S)

## QUESTION 8.01 (3.00)

- a. What action must be taken, and in what time frame, if the unit is operating with the minimum shift crew composition and one of the Reactor Operators becomes ill? (0.5)
- b. How long may the shift crew remain below the minimum composition and what action must be taken if this time is exceeded? (1.5)
- c. Fifteen minutes before the scheduled arrival of the on-coming shift, one of the three on-coming RO's calls in sick and says he will not be coming in. The Shift Supervisor decides to call in another operator due to the overtime status of his own shift. He also decides that since the relief operator should arrive shortly after shift change (approximately 30 minutes) that his shift can go home and let the on-coming shift start with two RO's. Were his decisions correct? JUSTIFY your answer. Assume the plant is operating in Mode 1. (1.0)

## ANSWER 8.01 (3.00)

- a. Immediately [0.25] attempt to restore minimum crew composition [0.25] such as call in replacement operators.
- b. 2 hours [0.5]. Place the plant in a mode where the minimum crew composition is met [1.0].
- c. Decisions were correct [0.5]. Minimum crew composition was met without calling in the additional operator [0.5].

## REFERENCE

AN01 Technical Specification, Table 6.2-1  
194001A103 2.5/3.4  
194001A103 ... (KA'S)

QUESTION 8.02 (2.00)

The plant is in Hot Standby, when the following information is turned over to the on-coming Shift Supervisor:

- 1.8 gpm - leakage past check valves from RCS to both Core Flood Tanks (0.9 GPM ea.)
- 1.2 gpm - Primary to secondary leakage (total) with RCS activity of 0.2 uCi/gm of I-131.
- 4.8 gpm - Total RCS leakage

Indicate whether any RCS leakage or other limits are exceeded, including the limit that was exceeded. (2.0)

ANSWER 8.02 (2.00)

The leakage limits for unidentified leakage [1.0] of greater than 1 GPM [1.0] is being exceeded.

REFERENCE

AN02 Technical Specification 3.1.6 & 3.10  
002020G011 3.3/4.0  
002020G011 ... (KA'S)

QUESTION 8.03 (2.00)

The AN01 Technical Specifications require that the the Core Flood Tanks be operable when RCS pressure is above 800 psig. What are four (4) conditions required to be verified to satisfy this requirement? VALUES ARE NOT REQUIRED, only the parameter need be listed. (2.0)

ANSWER 8.03 (2.00)

- Isolation valves open
- Water volume
- Boron concentration
- Cover pressure
- Pressure and level instrumentation operable [any 4, 0.5 each]

REFERENCE

AN01 Technical Specification 3.3.3  
006020G005 3.5/4.2\*  
006020G005 ... (KA'S)



QUESTION 8.04 (1.00)

Per 10 CFR 55, "Operators' Licenses", what must be done by a licensed operator to maintain his/her license in an "active" status?" (1.0)

ANSWER 8.04 (1.00)

The operator shall actively perform the functions of the appropriately licensed operator [0.25] on a minimum of seven 8 hour shifts [0.25] or five 12 hour shifts [0.25] per calendar quarter [0.25].

REFERENCE

10 CFR 55.53(e)  
194001A103 2.5/3.4  
194001A103 ...[KA'S]

QUESTION 8.05 (2.50)

TRUE or FALSE:

- a. A 10 CFR 50.59, "Changes, Tests, and Experiments", review is required for changes to non-safety related procedures as well as safety related procedures.
- b. A Senior Reactor Operator is a "certified 10 CFR 50.59 reviewer" due to having an active SRO license.
- c. A procedure change that expands the acceptance criteria of a surveillance does not constitute a change of intent of the procedure.
- d. The Interim Procedure Approval Process may be used to implement a procedure change that changes the intent of a procedure as long as it does not involve an unresolved safety question.
- e. Following interim approval of a procedure change applicable to BOTH units, the change form will be placed in the procedure change update manual binder in the Unit 1 Control Room. (2.5)

ANSWER 8.05 (2.50)

- a. true
- b. false
- c. false
- d. false
- e. true [0.5 each]

REFERENCE

ANO 1000.06, Procedure Review, Approval, and Revision Control, Rev 27,  
pg 3, 9, 15  
194001A101 3.3/3.4  
194001A101 ... (KA'S)

QUESTION 8.06 (2.00)

- a. List, in order of preference, the three (3) means of communication to be used for IMMEDIATE NOTIFICATIONS to the NRC. (1.5)
- b. WHO, by title, is normally designated to make this notification? (0.5)

ANSWER 8.06 (2.00)

- a. 1. ENS  
2. Commercial  
3. HPN [0.4 for each line, 0.1 for each preference]
- b. Shift Administrative Assistant [0.5]

REFERENCE

ANO 1000.08, NRC Reporting and Communications, Rev 24, pg 10 - 12  
194001A104 3.0/3.2  
194001A104 ... (KA'S)

## QUESTION 8.07 (3.00)

- a. What two (2) persons, by title, may sign for authorizing the placement of Hold Cards? (0.5)
- b. What two persons, by title, are required to review the tagout for adequate boundary isolation? (0.5)
- c. What two (2) persons, by title, may authorize intentionally entering an Action Statement of Tech Specs due to tagging? (1.0)
- d. List the order of placing and removing contractor tags and ANO Hold Cards when being used on the same component (which tags should be hung first, removed first, etc.). (1.0)

## ANSWER 8.07 (3.00)

- a. SS or CRS [0.25 each] on the affected unit
- b. Licensed Operator and Lead Craftsman [0.25 each]
- c. Affected Unit's Operations Superintendent or Operations Manager [0.5 each]
- d. Install ANO Hold Card, then contractor tag. Remove contractor tag, then ANO Hold Card [1.0].

## REFERENCE

ANO 1000.27, Hold and Caution Card Control, Rev 10, pg 12-14, 23  
194001K102 3.7/4.1  
194001K102 ...[KA'S]

## QUESTION 8.08 (3.00)

- a. List five (5) examples of temporary modifications. (2.0)
- b. Arrange the following list of personnel in order of preference for performing the independent verification of a temporary modification installation. STATE WHICH ORDER THE LIST IS IN, i. e. most to least preferred. (1.0)
  - 1. Cognizant engineer
  - 2. Another lead craftsman of the same discipline
  - 3. Responsible supervisor
  - 4. Cognizant SRO on the affected unit

ANSWER 8.08 (3.00)

- a. - Lifted leads for the purpose of altering a function  
- Electrical jumpers  
- Pulled circuit cards  
- Intentionally disabled annunciator alarms  
- Mechanical jumpers  
- Blank flanges  
- Disabled relief or safety valves  
- Temporary power supplies [5 required at 0.4 each]  
- Blocked relays
- b. \*3, 2, 1, 4 [Subtract 0.33 for each manipulation to put in the correct order] \* Most Preferred.

## REFERENCE

ANO 1000.28, Temporary Modification Control, Rev 8, pgs 4, 19  
194001A103 2.5/3.4  
194001A103 ... (KA'S)

QUESTION 8.09 (2.50)

- a. When an event occurs that is common to both units such as a security alert, fire in a common building, etc., which Shift Supervisor is responsible for responding to the event? (0.5)
- b. Key shift personnel shall not enter areas from which they cannot respond to the control room within 10 minutes. Name TWO (2) positions which fall under "key shift personnel." (1.0)
- c. List two (2) areas from which returning to the control room may take more than 10 minutes. (1.0)

ANSWER 8.09 (2.50)

- a. The SS receiving the notification [0.5] is responsible for incident response.
- b. Shift Supervisor and STA [0.5 each]
- c. - cooling tower area  
- containment  
- emergency cooling pond area [ 2 at 0.5 each]

## REFERENCE

ANO 1015.01, Conduct of Operation, Rev 32, pg 10, 25  
194001A103 2.5/3.4  
194001A103 ...[KA'S]

QUESTION 8.10 (1.00)

TRUE or FALSE:

- a. Non-licensed operators may manipulate the reactor reactivity controls if directly supervised by a licensed operator and the trainee is enrolled in a license training program. (0.5)
- b. Non-licensed operators may operate indirect controls of reactivity such as steam generator pressure or feed flow with the knowledge and consent of a licensed control room operator (direct supervision is not required). (0.5)

ANSWER 8.10 (1.00)

- a. true [0.5]
- b. true [0.5]

## REFERENCE

ANO 1015.01, Conduct of Operation, Rev 32, pg 17, 18  
194001A111 2.8/4.1\*  
194001A111 ...[KA'S]

QUESTION 8.11 (3.00)

- a. Define a Category "E" valve? (1.0)
- b. What physically ensures that their position remains as intended?(0.5)
- c. Who may waive the independent verification on Category "E" valve operations (non-emergency)? (0.5)
- d. TRUE or FALSE. When an independent verification is performed on a Category "E" valve, it is not necessary to actually reposition the valve. (0.5)
- e. TRUE or FALSE. Independent verification of throttle valve position may be accomplished by observing the first operator throttling the valve. (0.5)

ANSWER 8.11 (3.00)

- a. Valves in the flow path of a safety related system [0.33] required to be in a specified position for the system to perform its safety function [0.33] and whose mispositioning could go undetected from the control room [0.34].
- b. All category "E" valves are locked [0.5].
- c. Operations Superintendent [0.5]
- d. True [0.5]
- e. True [0.5]

REFERENCE

ANO 1015.01, Conduct of Operation, Rev 32, pgs 40-41  
194001K101 3.6/3.7  
194001K101 ...[KA'S]

## NRC LICENSE EXAMINATION HANDOUT

### EQUATIONS, CONSTANTS, AND CONVERSIONS

$$\dot{Q} = \dot{m} \cdot C_p \cdot \Delta T$$

$$\dot{Q} = U \cdot A \cdot \Delta T$$

$$P = P_0 \cdot 10^{\text{SUR} \cdot (t)}$$

$$P = P_c \cdot e^{t/T}$$

$$\text{SUR} = 26/T$$

$$T = I^*/p + (\beta - p)/\bar{\lambda} p$$

$$T = 1/(p - \beta)$$

$$T = (\beta - p)/\bar{\lambda} p$$

$$p = (K_{\text{eff}} - 1)/K_{\text{eff}} = \Delta K_{\text{eff}}/K_{\text{eff}} \quad p = I^*/TK_{\text{eff}} + \bar{p}_{\text{eff}}/(1 + \bar{\lambda} T)$$

$$\lambda = \ln 2/t_{1/2} = 0.693/t_{1/2}$$

$$\bar{\lambda} = 0.1 \text{ seconds}^{-1}$$

$$I = I_0 \cdot e^{-u x}$$

$$\text{CR} = S/(1 - K_{\text{eff}})$$

$$R/\text{hr} = 6 \cdot \text{CE}/d^2 \text{ feet}$$

#### Water Parameters

$$1 \text{ gallon} = 8.345 \text{ lb}_m = 3.87 \text{ liters}$$

$$1 \text{ ft}^3 = 7.48 \text{ gallons}$$

$$\text{Density @ STP} = 62.4 \text{ lb}_m/\text{ft}^3 = 1 \text{ gm/cm}^3$$

$$\text{Heat of vaporization} = 970 \text{ Btu/lb}_m$$

$$\text{Heat of fusion} = 144 \text{ Btu/lb}_m$$

$$1 \text{ atmosphere} = 14.7 \text{ psia} = 29.9 \text{ inches Hg.}$$

#### Miscellaneous Conversions

$$1 \text{ curie} = 3.7 \times 10^{10} \text{ disintegrations per second}$$

$$1 \text{ kilogram} = 2.21 \text{ lb}_m$$

$$1 \text{ horsepower} = 2.54 \times 10^3 \text{ Btu/hr}$$

$$1 \text{ mw} = 3.41 \times 10^6 \text{ Btu/hr}$$

$$1 \text{ inch} = 2.54 \text{ centimeters}$$

$$\text{degrees F} = 9/5 \text{ degrees C} + 32$$

$$\text{degrees C} = 5/9 (\text{degrees F} - 32)$$

$$1 \text{ Btu} = 778 \text{ ft-lb}_f$$