ENCLOSURE 1

EXAMINATION REPORT - 50-327/OL-84-01

Facility Licensee: Tennessee Valley Authority
500A Chestnut Street
Chattanooga, TN 37401

Facility Name: Sequoyah

Facility Docket No. 50-327

Written and oral examinations were administered at Sequoyah near Soddy-Daisy, TN

Chief Examiner: W G Douglas — 19 DEC 84
W. G. Douglas — Date Signed

Approved by: for Bruce E. Bonderman — 12/27/84
Bruce A. Wilson, Section Chief — Date Signed

Summary:

Examinations on November 13-16, 1984

Oral and written examinations were administered to nine candidates, seven of whom passed. One candidate was administered a written re-examination of four categories, which he passed. One candidate was administered a written examination of one category, which he passed. One candidate was administered an oral re-examination, which he did not pass.

REPORT DETAILS

1. Persons Examined

SRO Candidates:

Childers, S. M.
Gass, D. W.
McDonald, W. H.
Sanders, G. I.
Van Huis, T. J.
Vanosdale, W. A.

RO Candidates:

Kell, J. H.
Hyden, E. L.
Williams, R. H.
Hardin, L. F.
Johnson, S. R.
Brackin, C.

Other Facility Employees Contacted:

*Benton, C. T., Unit Supervisor
*Anthony, J. M., Operations Supervisor
*Noe, C. H., Supervisor, Operator Training
*Arnold, H. A., Section Supevisor
*Wallace, P. R., Plant Manager
*Nobles, L. M., Superintendent, O&E
*Lake, B. C., Training Shift Engineer
*Ford, E. J., Senior Resident Inspector
*Brewer, C. O., Training Manager

*Attended Exit Meeting

2. Examiners:

Cook, E. A
*Douglas, W. G.
Sailor, B. L.
Vinnola, A. J.

*Chief Examiner

3. Examination Review Meeting

At the conclusion of the written examinations, the examiners met with V. E. Keyser, C. O. Brewer, C. T. Benton, W. G. Payne, and M. J. Lorek to review the written examination and answer key. The following comments were made by the facility reviewers:

a. SRO Exam

(1) Question 5.15

Facility Comment:

The wor'ing of the questions could lead to two interpretations. The valve is being partially closed or is in a particularly closed position. Based on the interpretation, there could be three correct answers: a, c, and d.

If it is assumed that the valve is being throttled closed, then c and d are correct.

If it is assumed that the valve is initially in a partially closed position and the system is being changed based on the four answers, then a, c, and d are correct.

NRC Resolution:

Comment accepted. Question 5.15 deleted from exam.

(2) Question 8.05

Facility Comment:

The answer is based on Section 6.9.1.12, Administrative Controls, which is attached.

Section 6.9.1.12d is one of 11 conditions that require prompt notification. Section 6.9.1.12d lists five events that require prompt notification. A reactivity anomaly is one of the five events, the other events as listed are a calculated reactivity balance indicating a shutdown margin less conservative than specified in the T.S.; short-term reactivity increases that correspond to a reactor period of less than 5 seconds or, if subcritical, an unplanned reactivity insertion of more than .5 K/K; or occurrence of any unplanned criticality.

Based on wording of the question, the training staff interprets the question to be asking for conditions that will cause a reactivity anomaly, not conditions that require a prompt notification.

Based on T.S. Section 3/4.1, Reactivity Control System, attached, consideration should be given for items mentioned in Section 4.1.1.1.2.

NRC Resolution:

The NRC believes that all five events listed in Section 6.9.1.12d are reactivity anomalies. Therefore, the items mentioned in Section 4.1.1.2 will not be given consideration for partial credit. However, Revision 33 of AI-18, File Package No. 18, states that "Section 6.9.1.12 and 6.9.1.13 of the technical specifications are no longer applicable after January 1, 1984, and should not be used for determining reportability." This revision gives new notification and Licensee Event Report requirements. These requirements do not use the term reactivity anomaly. The events that constitute a reactivity anomaly are incorporated into other reporting requirements. Based on this fact, the NRC does not believe that defining the events that constitute a reactivity anomaly at Sequoyah is necessary Senior Operator knowledge and Question 8.05 was deleted.

4. Exit Meeting

At the conclusion of the site visit the examiners met with representatives of the plant staff to discuss the results of the examination. Those individuals who clearly passed the oral examination were identified. There was one area of generic weakness noted during the oral examinations. This was in the use of and adherence to emergency procedures. Examinees either did not use the procedures or only did some of the steps while skipping others. They were not aware of any requirements to perform all steps, whether the steps had to be performed in order, or whether they could only do certain steps. In some cases, the emergency procedures were not referred to by the Lead Operator nor the Balance of Plant Operator. This resulted in improper actions being taken during the emergencies. Even after the emergency was under control, the operators did not refer to the procedures to verify their actions. These incidents of misuse of procedures were brought to the attention of the plant staff at the exit interview.

Enclosure 3
(1 of 2)

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

REVIEWED BY:

Clyde T. Benton
William G. Payne
Michael J. Lorek
V.E. Keyser, Jr.

FACILITY: SEQUOYAH 1&2
REACTOR TYPE: PWR-WEC4
DATE ADMINISTERED: 84/11/13
EXAMINER: SAILOR, B.
APPLICANT: MASTER

INSTRUCTIONS TO APPLICANT:

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 VALUE	% OF TOTAL	APPLICANT'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	25.00			1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	25.00			2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
25.00	25.00			3. INSTRUMENTS AND CONTROLS
25.00	25.00			4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
100.00	100.00			TOTALS

FINAL GRADE _____%

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

_____
APPLICANT'S SIGNATURE

1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW

QUESTION 1.01 (1.50)

How will changing the following factors affect the Moderator Temperature Coefficient? (Limit your answer to becomes MORE NEGATIVE, LESS NEGATIVE or DOES NOT CHANGE the MTC.)

a. The BIT is inadvertantly injected into the RCS.

b. The core ages from BOL to EOL.

c. The RCS is cooled down from 550 F to 450 F. (1.5)

QUESTION 1.02 (2.50)

In Mode 5, the SHUTDOWN MARGIN must be determined at least once per 24 hours by considering six reactivity factors. Provide FIVE of these factors. (2.5)

QUESTION 1.03 (3.00)

a. IDENTIFY and BRIEFLY EXPLAIN THREE factors that cause Fuel Temperature Coefficient (FTC) to change from BOL to EOL. (2.25)

b. Does FTC (pcm/%power) become MORE or LESS NEGATIVE at EOL? (0.75)

QUESTION 1.04 (2.50)

a. State TWO reasons why equilibrium Xenon has significantly more negative worth than does equilibrium Samarium in an operating reactor. (1.5)

b. State the approximate Xenon values (in pcm) for the present core cycle.

1) Steady state equilibrium Xenon at 100% power. (0.5)
2) Peak Xenon following a reactor trip from 100% power. (0.5)

QUESTION 1.05 (1.00)

It is the ultimate responsibility of the reactor operator to ensure that the core power distribution limits are maintained at all times. Operation within these limits is reasonably assured when four conditions are met. Which of the following is/are NOT included as one of these four conditions?

a. All control rods in a single group are moved together with no single rod in the group differing by more than 12 steps from the group position.

b. Axial power distribution is maintained within the limits of AFD requirements.

c. Control rod groups are sequenced with proper bank overlap.

d. A negative Moderator Temperature Coefficient (MTC) is maintained.

e. The reactor does not remain at power (>10%) with less than four loop operation. (1.0)

QUESTION 1.06 (3.00)

a. Provide the THREE conditions necessary for Brittle Fracture of a carbon steel pressure vessel to occur. (1.5)

b. Define RT NDT (Nil-Ductility Reference Temperature). (0.5)

c. How does RT NDT change as the reactor vessel ages? BRIEFLY EXPLAIN your answer. (1.0)

QUESTION 1.07 (1.50)

True or False?

a. One of the pump laws for centrifugal pumps states that the volume flow rate is proportional to the speed of the pump. (0.5)

b. As VCT temperature decreases, volume flow rate from the positive displacement (PD) pump increases. (0.5)

c. Pump runout is the term used to describe the condition of a centrifugal pump running with no volume flow rate. (0.5)

QUESTION 1.08 (2.50)

Indicate how the following will affect Unit efficiency (increase, decrease, no change) at a steady state power level: (Consider each case separately.)

a. Absolute condenser pressure changes from 1 psi to 1.25 psi.

b. Total S/G blowdown is changed from 35 gpm to 40 gpm.

c. Condenser hotwell temperature changes from 125 F to 130 F. (Assume no change in condenser pressure.)

d. Steam quality changes from 99.6% to 99.7%.

e. Level increases to higher than normal in a feedwater heater. (2.5)

QUESTION 1.09 (1.50)

The following statements concern subcritical multiplication. Choose the one [bracketed] word that will make the statements correct.

a. As Keff approaches unity, a [larger/smaller] change in neutron level results from a given change in Keff. (0.75)

b. As Keff approaches unity, a [shorter/longer] period of time is required to reach the equilibrium neutron level for a given change in Keff. (0.75)

QUESTION 1.10 (.50)

True or False?

A Primary neutron source is necessary to provide sufficient neutrons to start the initial chain reaction in a new core. (0.5)

QUESTION 1.11 (1.50)

Provide TWO of the three evolutions for which a 1/M plot is utilized in a Westinghouse PWR. (1.5)

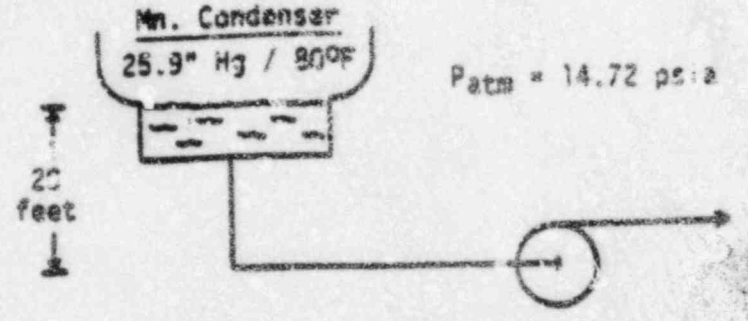
QUESTION 1.12 (2.00)

a. Define CRITICAL HEAT FLUX (CHF). (1.0)

b. Define DdepartURE FROM NUCLEATE BOILING RATIO (DNBR). (1.0)

QUESTION 1.13 (2.00)

Calculate the NPSH for the following pump. Assume a 3 psi line loss in the suction header at rated flow. Show all calculations.



(2.0)

QUESTION 2.01 (2.75)

Place an "X" in the appropriate boxes of the table on Attachment 1 to indicate where the "systems" connect to the RCS. (Please include this Attachment 1 with your ANSWER sheets.) (2.75)

QUESTION 2.02 (2.75)

a. BRIEFLY EXPLAIN the reasons for the upward and downward thrusts (conditions) that the RCP thrust bearing must compensate for. (One reason each for both upward and downward thrust.) (1.0)

b. What is the purpose of the RCP Oil Lift System? (0.75)

c. How does the RCP Oil Lift System interface (interlock) with the RCP starting circuitry? (1.0)

QUESTION 2.03 (1.50)

Which chemical is used to accomplish the following method of RCS corrosion control at Sequoyah?

a. Control pH during startup.

b. Scavenge oxygen during a startup from cold conditions.

c. Control oxygen. (1.5)

QUESTION 2.04 (2.00)

a. What forces are used for Main Steam Isolation Valve...

1) Opening?
2) Fast closing? (1.5)

b. What component prevents MSIV damage on fast closure? (0.5)

QUESTION 2.05 (3.00)

a. Which containment (PRIMARY or SECONDARY) provides the majority of the following radiation protection?

1) Radiation shielding.
2) Fission Product retention. (1.0)

b. Provide both the chemical used and TWO reasons for using this chemical as an additive to the ice in the Ice Condenser. (2.0)

QUESTION 2.06 (3.00)

a. Provide the THREE suction supplies of water to the Turbine Driven Auxiliary Feedwater Pump (TDAFWP). (1.5)

b. How is backup suction water automatically supplied to the TDAFWP if the primary source is inadvertently isolated? (Include setpoints). (1.0)

c. Which S/G steam lines supply steam to the TDAFWP? (0.5)

QUESTION 2.07 (2.50)

a. Provide TWO reasons for having a 30 second time delay on the Main Generator Power Circuit Breaker Trip subsequent to a Unit Trip? (1.5)

b. What are the TWO exceptions to the 30 second time delay on the Breaker trip? (1.0)

QUESTION 2.08 (3.00)

Give a description or provide a one-line sketch to show how power is supplied to Component Cooling Water Pump 1A-A during the following conditions. (Include major Busses, Transformers and the Site power source. Identify all major components by name and/or voltage. Breakers are NOT required for full credit.)

a. Normal 100% power lineup.
b. Normal Cold Shutdown lineup. (3.0)

QUESTION 2.09 (3.00)

The following concern the Component Cooling Water System.

a. Name THREE CCW system alarms that could indicate a RCS to CCW leak. (1.5)

b. Describe, in detail, how the CCW system is protected against an overpressure condition if a RCS to CCW rupture occurred in the RCP Thermal Barrier. (1.5)

QUESTION 2.10 (1.50)

a. EXPLAIN WHY the Diesel Generator Lube Oil "Soakback" Pumps are necessary for reliable EDG operation. (1.0)

b. Which of the following EDG protective relays will shutdown the EDG in ALL modes of operation?

1) Phase Balance Relay
2) Generator Differential Relay
3) Loss of Field Relay (0.5)

QUESTION 3.01 (2.00)

Provide FOUR uses for the Auctioneered High Tave signal. (2.0)

QUESTION 3.02 (2.50)

a. In what position(s) of the Rod Control Bank Selector Switch is "Bank Overlap" in service? (0.5)

b. Why is "Bank Overlap" desired? (0.75)

c. At what BANK C POSITION should Bank D rods begin to withdraw? (0.5)

d. BRIEFLY EXPLAIN why the Rod Control Startup Reset Switch is not used when recovering from a dropped control rod at power. (0.75)

QUESTION 3.03 (2.50)

a. What associated manual operator action would be required during plant shutdown if an Intermediate Range Nuclear Instrumentation channel was grossly undercompensated? (1.0)

b. What CONTROL or PROTECTION functions are provided by the IRNI? (Include setpoints and logics.) (1.5)

QUESTION 3.04 (1.50)

Indicate which of the Excore Nuclear Instrumentation Ranges (SOURCE, INTERMEDIATE, or POWER), will correctly match with the following statements. (May be all, none or any combination of the ranges.)

a. Provides a direct input to the Rod Control System. (Not Rx Trips)

b. Has a reactor trip function that is blocked at some time between startup and full power operation.

c. Operates in the "Ion Chamber" region of the "Gas Filled Detector Characteristic Curve". (1.5)

QUESTION 3.05 (3.00)

Show what happens to the Rod Control System (RODS IN, RODS OUT or NO CHANGE) and BRIEFLY EXPLAIN why the change will or will not occur for the following instrument failures. Assume that the plant is at 50% load with all systems controlling in automatic.

a. Loop B(2) Cold Leg RTD fails LOW.

b. Turbine Impulse Pressure (controlling) fails LOW.

c. Power Range lower detector (NI-44) fails HIGH. (3.0)

QUESTION 3.06 (3.00)

a. What circuitry conditions must be present in order to have the "CONDENSER AVAILABLE" (C-9 Permissive) indicated on the Control Board? (Include setpoints and logic as applicable.) (0.8)

b. Besides the C-9 permissive, what THREE circuitry conditions must be present to permit the cooldown valves to open below P-12 (540 F)? (1.2)

c. What TWO ways is Turbine Impulse Pressure utilized by the Steam Dump Control System? (1.0)

QUESTION 3.07 (3.00)

How will the S/G feedwater control valves INITIALLY respond to each of the following events? Consider each independently and BRIEFLY EXPLAIN your answer. Assume 75% initial unit load.

a. HIGH failure of the controlling S/G pressure transmitter.

b. HIGH failure of the Main Steam Manifold pressure transmitter.

c. HIGH failure of the controlling Turbine Impulse pressure. (3.0)

QUESTION 3.08 (3.50)

List the FIVE different Safety Injection initiation signals/ conditions. (Include setpoints and logic if applicable.) (3.5)

QUESTION 3.09 (2.50)

a. The general basis for the pressurizer level program used at Sequoyah is to maintain a constant mass in the Rx Coolant System. What are the bases for the high (60%) and low (24.7%) pressurizer level program SETPOINTS? (1.0)

b. BRIEFLY DESCRIBE the sequence of events that lead to a reactor trip after a LOW failure of the controlling pressurizer LEVEL channel. (Include which Rx trip is responsible and assume no corrective operator action is taken.) (1.5)

QUESTION 3.10 (1.50)

The plant is operating at 50% power with all systems in automatic. How does a HIGH failure of Power Range channel N-44 LOWER detector affect the following indications? (Limit your answer to INCREASE, DECREASE, MORE NEGATIVE, LESS NEGATIVE, etc.)

a. Lower Quadrant Power Tilt Ratio (QPTR)

b. Delta Flux (Axial Flux) indication (Channel 4)

c. S/G Feed Flow (Initially) (1.5)

4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL

QUESTION 4.01 (3.00)

EXPLAIN the reasons for the following precautions provided in Unit Heatup from Cold Shutdown to Hot Standby (GOI-1).

a. Continuous flow should be maintained in the PZR spray lines.

b. Boron concentration difference between the pressurizer and RCS should be <50 ppm.

c. When the Rx trip breakers are closed and any control or shutdown rod is not withdrawn at least 5 steps, avoid RCS temperature changes >50 F.

d. If all RCPs are stopped and the RCS is being cooled down by the RHR system, do NOT restart an RCP unless a PZR bubble exists. (3.0)

QUESTION 4.02 (3.00)

The following questions concern information found in Plant Startup from Hot Standby to Minimum Load (GOI-2).

a. While performing a planned dilution operation prior to commencing a Rx startup, you notice that both Source Range channels have increased from 10 cps to 22 cps. What action must you take? (1.0)

b. What is the maximum steady state startup rate permitted? (0.5)

c. Why must the Chem Lab be notified to perform SI-407 and 415 (RCS activity determinations) when Rx power changes >15% of Rated Thermal Power? (1.0)

d. True or False?

While in the source range, reactivity may be added by rod withdrawl and dilution simultaneously if the Shutdown banks are fully withdrawn and the reactor core is in a Xenon free condition. (0.5)

4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL

QUESTION 4.03 (1.50)

Answer the following questions by utilizing information found in Unit Startup from Minimum Load to Full Power (GOI-5A).

a. What action must you take if the "Rod Control Bank Lo-Lo" alarm is received? (1.0)

b. With the reactor power at 95% power AND control bank D height at 210 steps, should control rods be in AUTOMATIC or MANUAL control? (0.5)

QUESTION 4.04 (3.00)

AFD is being logged every 30 minutes because of an inoperable AFD Monitor Alarm.

a. At 1200, the reading is found as in point "A" of the attached Figure 4-1. How many penalty minutes have been accumulated? (Assume that none were present previously and that AFD was in band when logged at 1130.) (0.5)

b. Would BORATING or DILUTING be required to correct this problem? BRIEFLY EXPLAIN your answer. (1.5)

c. How much time does Technical Specifications allow for you to reduce power to <50% if you find the AFD as it is shown on Figure 4-1? (0.5)

d. True or False?

Axial Flux Difference (Delta I) becomes more negative as the core ages. (Assume a Cycle 1 fuel load.) (0.5)

QUESTION 4.05 (3.50)

a. In order for the Boric Acid Storage System to be considered OPERABLE, three associated parameters must be verified. What are these THREE parameters? (No setpoints required.) (1.5)

b. Provide the value for each of the following Technical Specification temperature limits.

1) Pressurizer heatup rate.
2) Pressurizer cooldown rate.
3) Pressurizer - spray water differential temperature.
4) RCS minimum temperature for criticality. (2.0)

QUESTION 4.06 (2.75)

The following concern Waste Disposal System Gas Decay Tanks Release Procedure.

a. Why must a GDT have been purged with Nitrogen and have an Oxygen concentration of <2% prior to placing in service? (0.75)

b. If a GDT is overpressurized, where will it normally relieve to? (0.5)

c. Whenever possible, which tank is chosen for:

1) Discharge?
2) Cover gas? (1.0)

d. Why shall all GDTs be released between the hours of 0900 and 1600? (0.5)

QUESTION 4.07 (3.00)

According to Response to Nuclear Power Generation/ATWS (FR-S.1), what ~~five~~ four actions are required to be initiated if the reactor trip breakers do not open when manually tripped from the Control Room? (Be Specific.) (3.0)

QUESTION 4.08 (3.50)

Answer the following in accordance with Reactor Trip or Safety Injection (E-0).

a. What FOUR conditions must be checked in order to verify Main Feedwater Isolation? (2.0)

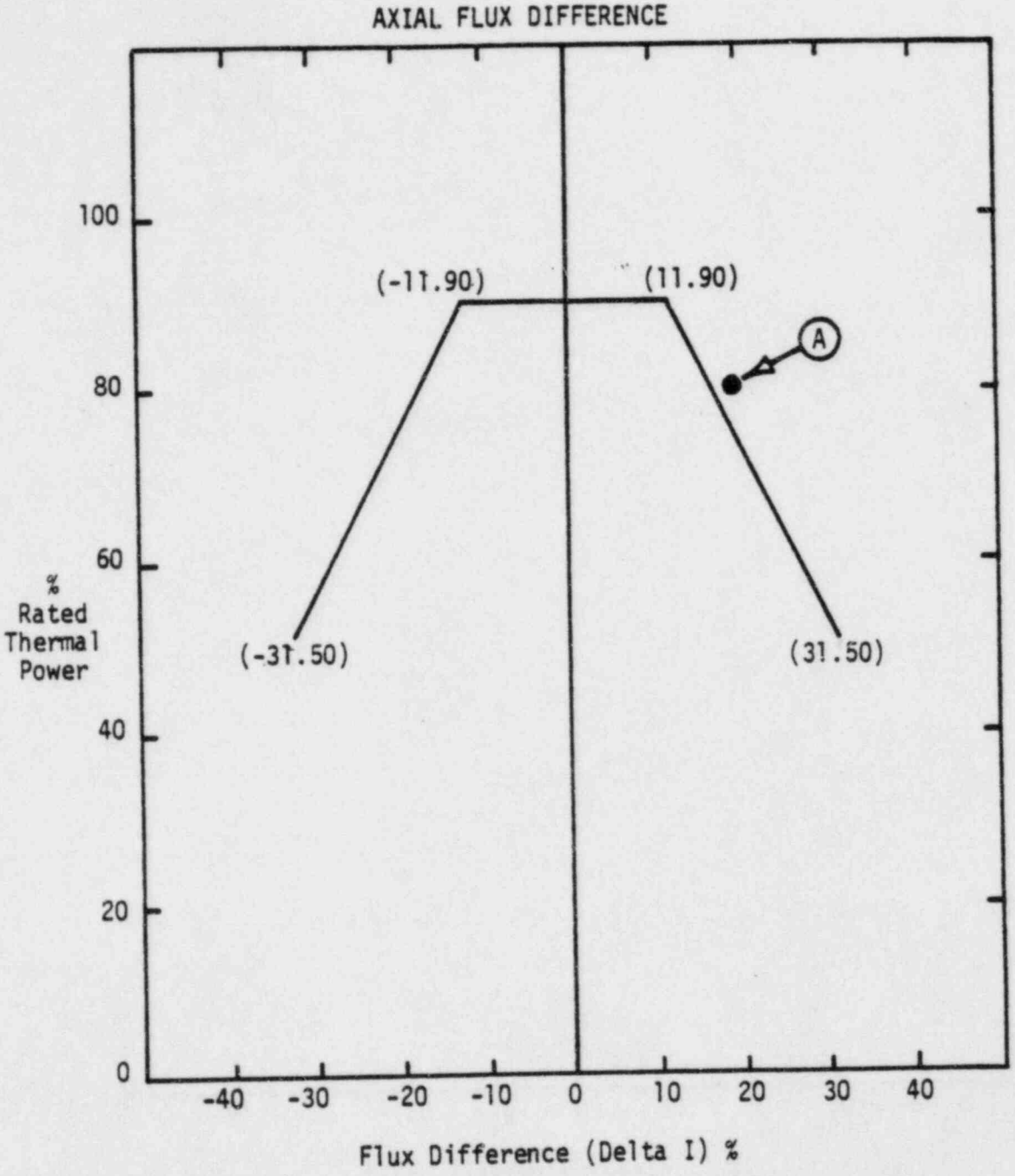
b. Provide FOUR of the five conditions that are used to verify Natural Circulation. (1.5)

QUESTION 4.09 (1.75)

Answer the following questions in accordance with Radiological Hygiene Program (RCI-1).

a. What is your maximum allowable dose per quarter? (Assume that a TVA 17086/NRC-4 Form has NOT been completed.) (0.75)

b. When entering a Regulated Area, what is the minimum required personnel dosimetry? (1.0)



(Also T.S. Figure 3.2-1)

FIGURE 4-1

EQUATION SHEET

$f = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgn$

$V_f = V_o + at$

$W = v\ \Delta P$

$\Delta E = 931\ \Delta m$

$\dot{Q} = \dot{m}C_p\Delta t$

$\dot{Q} = UA\Delta T$

$Pwr = W_f\Delta h$

$P = P_o 10^{sur(t)}$

$P = P_o e^{t/T}$

$SUR = 26.06/T$

$SUR = 26\rho/\ell^* + (\beta - \rho)T$

$T = (\ell^*/\rho) + [(\beta - \rho)/\bar{\lambda}\rho]$

$T = \ell/(\rho - \beta)$

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

$\rho = (K_{eff} - 1)/K_{eff} = \Delta K_{eff}/K_{eff}$

$\rho = [(\ell^*/(T\ K_{eff})] + [\bar{\beta}_{eff}/(1 + \bar{\lambda}T)]$

$P = (\Sigma\phi V)/(3 \times 10^{10})$

$\Sigma = \sigma N$

$v = s/t$

$s = V_o t + 1/2\ at^2$

$a = (V_f - V_o)/t$

$w = \theta/t$

$A = \frac{\pi D^2}{4}$

$\dot{m} = V_{av}A\rho$

Cycle efficiency = (Net work out)/(Energy in)

$A = \lambda N \qquad A = A_o e^{-\lambda t}$

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

$t_{1/2}^{eff} = \frac{[(t_{1/2})(t_b)]}{[(t_{1/2}) + (t_b)]}$

$I = I_o e^{-\Sigma x}$

$I = I_o e^{-\mu x}$

$I = I_o\ 10^{-x/TVL}$

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

$SCR = S/(1 - K_{eff})$

$CR_x = S/(1 - K_{effx})$

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$M = 1/(1 - K_{eff}) = CR_1/CR_o$

$M = (1 - K_{effo})/(1 - K_{eff1})$

$SDM = (1 - K_{eff})/K_{eff}$

$\ell^* = 10^{-4}$ seconds

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

$I_1 d_1 = I_2 d_2$

$I_1 d_1^{\ 2} = I_2 d_2^{\ 2}$

$R/hr = (0.5\ CE)/d^2$(meters)

$R/hr = 6\ CE/d^2$ (feet)

Water Parameters

1 gal. = 8.345 lbm.
1 gal. = 3.78 liters
1 ft^3 = 7.48 gal.
Density = 62.4 lbm/ft^3
Density = 1 gm/cm^3
Heat of vaporization = 970 Btu/lbm
Heat of fusion = 144 Btu/lbm
1 Atm = 14.7 psi = 29.9 in. Hg.
1 ft. H_2O = 0.4335 lbf/in.

Miscellaneous Conversions

1 curie = 3.7×10^{10} dps
1 kg = 2.21 lbm
1 hp = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf

NAME _____

SYSTEM	Loop 1		Loop 2		Loop 3		Loop 4	
	Hot Leg	Cold Leg	Hot Leg	Cold Leg	Hot Leg	Cold Leg	Hot Leg	Cold Leg
Normal Charging								
Alternate Charging								
Normal Letdown								
Excess Letdown								
Pressurizer Spray								
Pressurizer Surge								
RHR Cooldown Supply								
RCS Loop Sample								

ATTACHMENT 1

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 1.01 (1.50)

a. LESS NEGATIVE
b. MORE NEGATIVE
c. LESS NEGATIVE [0.5 each] (1.5)

REFERENCE
WNTO Station Nuc Eng Text, 1-5.9 through 15

ANSWER 1.02 (2.50)

- RCS boron concentration
- Control rod position
- RCS Tavg
- Fuel burnup
- Xenon concentration
- Samarium concentration [0.5 each, any 5] (2.5)

REFERENCE
SQTS; 3/4 1-3

ANSWER 1.03 (3.00)

a. - Clad creep [0.25] better heat transfer results in lower fuel temperature at EOL. [0.5]

- F.P. contamination of gap [0.25] reduction in the He conc. results in less heat transfer and higher fuel temperatures [0.5]

- Pellet swell [0.25] better heat transfer results in lower fuel temp at EOL [0.5]

- Pellet densification [0.25] results in initial higher fuel temp at BOL [0.5]

- Pu buildup [0.25] higher thermal neutron capture of Pu results in a higher FTC contribution [0.5] [0.75 each; any 3] (2.25)

- *Core flux spectrum hardening is not incorrect*

b. LESS NEGATIVE (0.75)

REFERENCE
WNTO Station Nuc Eng Text; I.5-22

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 1.04 (2.50)

a. - The amount of Xe produced from fission/decay is greater. (0.75)
- The absorption cross section for Xe is much higher. (0.75)

b. 1) 2900 pcm ±200
2) 2900 pcm (or 2000 + 2900 = 4900 pcm ±300) (CAF) [0.5 each] (1.0)

REFERENCE
SNP TI-~~20~~ 22 (CAF)
, Appendix I, pages 3 through 8

ANSWER 1.05 (1.00)

D and E (1.0)

REFERENCE
WNTC Rx Core Control, 8-32
SQTS; B 3/4 2-2 through 2-4

ANSWER 1.06 (3.00)

a. - Low temperature
- Vessel stress
- Pre-existing material flaw [0.5 each] (1.5)

b. (RT NDT) is that temperature at which non-ductile failure will no longer occur. (0.5)

c. Increases [0.5] because of metal changes due to (fast) neutron irradiation.[0.5] (1.0)

REFERENCE
SQTS; B 3/4 4-7 through 17

ANSWER 1.07 (1.50)

a. True
b. False
c. False [0.5 each] (1.5)

REFERENCE
WBLP; HTFF, pages 16, 17 and 19

1a__PRINCIPLES_OF_NUCLEAR_POWER_PLANT_OPERATION,
THERMODYNAMICS,_HEAT_TRANSFER_AND_FLUID_FLOW

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 1.08 (2.50)

a. Decrease

b. Decrease

c. Increase

d. Decrease

e. Decrease (2.5)

REFERENCE
WBLP; HTFF, page 15

ANSWER 1.09 (1.50)

a. LARGER (0.75)
b. LONGER (0.75)

REFERENCE
WNTO Station Nuc Eng Text; 1-3.13 through 19

ANSWER 1.10 (.50)

FALSE (0.5)

REFERENCE
WNTC Rx Core Control; page 1-37

ANSWER 1.11 (1.50)

- Fuel loading
- Control rod startup
- Boron dilution
- Cooldown
- Xenon decay [0.75 each; 2 required] (1.5)

REFERENCE
WNTO Station Nuc Eng Text; I-4.18 and 19

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 1.12 (2.00)

a. The heat flux at which DNB occurs. (1.0)

b. The ratio of CHF to the actual heat flux. (1.0)

REFERENCE
WBLP; HTFF, page 22

ANSWER 1.13 (2.00)

Press. due to head of water = (20 ft) (.43 psi/ft) = 8.6 psi [0.4]
Press. due to press. in cond. = 14.72 psia - (25.9"Hg)(.491 psi/"Hg)
= 14.72 - 12.72
= 2 psia [0.4]
Pact = 8.6 + 2 - 3 = 7.6 [0.4]
Psat = 0.5 psia (for 80 F) [0.4]
NPSH = 7.6 - 0.5 = 7.1 psi [0.4] (2.0)

REFERENCE
WBLP; HTFF, page 18

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 2.01 (2.75)

SYSTEM	Loop 1		Loop 2		Loop 3		Loop 4	
	Hot Leg	Cold Leg	Hot Leg	Cold Leg	Hot Leg	Cold Leg	Hot Leg	Cold Leg
Normal Charging		X						
Alternate Charging								X
Normal Letdown						X		
Excess Letdown						X		
Pressurizer Spray		X		X				
Pressurizer Surge			X					
RHR Cooldown Supply							X	
RCS Loop Sample	X				X			

(Pzr spray 0.375 each; all others 0.25 each)

(2.75)

REFERENCE
WBLP; RCS, pages 6 and 7

ANSWER 2.02 (2.75)

a. (UPWARD) - Idle pump high RCS pressure (>400 psig) -OR-
- Running pump high RCS pressure (>1500 psig) (0.5)

(DOWNWARD) - Idle pump weight at low RCS pressure (<400 psig) -OR-
- Running pump screwdown at low RCS pressure (<1500 psig) (0.5)

b. Reduces motor starting current (thus reducing switchgear size). (0.75)
(Partial Credit for only talking about thruse bearing considerations)[0.5]

c. Lift pump must be running with adequate pressure (700 psig) for 2 minutes prior to start. [0.33 each] (1.0)

REFERENCE
WBLP; RCS, pages 18 and 19
Dwg 47W611-68-1

ANSWER 2.03 (1.50)

a. Lithium (Hydroxide).

b. Hydrazine.

c. Hydrogen. [0.5 each] (1.5)

WBLP; CVCS, page 6

ANSWER 2.04 (2.00)

a.1) Air [0.5]
2) A spring and steam flow [1.0] (1.5)

b. Air accumulator (slows valve speed to prevent slamming). (0.5)

REFERENCE
WBLP; Mn Stm, pages 7 and 8

ANSWER 2.05 (3.00)

a.1) SECONDARY
2) PRIMARY [0.5 each] (1.0)

b.1) Sodium Tetraborate (0.5)

2) - Maintain alkaline pH (to enhance Iodine retention). (0.75)
- Maintain boron concentration (to maintain SDM control). (0.75)

REFERENCE
WBLP; Containment Systems, pages 4 through 6

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 2.06 (3.00)

a.1) CST
2) ERCW A
3) ERCW B [0.5 each] (1.5)

b. ERCW supply valve opens if CST header pressure is less than 11.5 psig for 2 seconds. (CAF) (1.0)
[Setpoints = 0.1] ["Time delay" = 0.1]

c. 1 and 4 (0.5)

REFERENCE
WBLP; AFW, pages 4 and 5
SQN SOI-3.2; page 2

ANSWER 2.07 (2.50)

a. - Provides power to the RCPs (for 30 sec after 80).
- Prevents overspeed of turbine. (1.5)

b. - Trips due to electrical fault.
- Thrust bearing trip. (1.0)

REFERENCE
WBLP; Turbine Control, pages 18 and 19

ANSWER 2.08 (3.00)

a. Main Generator -> 22.5/6.9 KV Unit Station Service Xfmr ->
6.9 KV Unit Board 1B -> 6.9 KV Shutdown Board 1B -> 6.9/480V
Xfmr 1A1-A -> 480 V Shutdown Board 1A1-A -> (Pump) (1.5)

b. 161 KV Switchyard -> 161/6.9 KV Common Station Service Xfmr ->
6.9 KV Unit Board 1B -> 6.9 KV Shutdown Board 1A -> 6.9/480V
Xfmr 1A1-A -> 480 V Shutdown Board 1A1-A -> (Pump) (1.5)
(Site Source [0.5]; Others @ [0.2] each)

REFERENCE
SQ Dwg. 15N500

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 2.09 (3.00)

a. - CCW surge tank high level.
   - CCW RMS.
   - Thermal Barrier High Differential Flow.
   - Thermal Barrier Outlet Low Flow.
   - (CAF) [0.5 each. 3 required] (1.5)

b. - Inlet/outlet flow mismatch closes return isolation valve.
   - Check valve isolates on reverse flow.
   - Relief valve (~2500 psig) Protects from overpressure. [0.5 each](1.5)

REFERENCE
WB PID; 47W611-70-3
(CAF)

ANSWER 2.10 (1.50)

a. They keep engine parts lubricated when, after (1/4 to 3 hours) running periods, the engine oil may not be viscous enough to provide lubrication during subsequent starting periods. (1.0)
(Turbo charger bearings are the limiting component and the reason for installing the
b. (2) Generator Differential (CAF) Soakback pumps) (0.5)

REFERENCE
WBLP; EDG, pages 5-0 and 12-41

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 3.01 (2.00)

- Rod control
- Tavg/Tref (Meter and Alarm)
- Pressurizer level control
- Steam dump
- RIL computer [any 4; 0.5 each] (2.0)

REFERENCE
WB Question Bank; 3-12

ANSWER 3.02 (2.50)

a. - AUTOMATIC
   - MANUAL [0.25 each] (0.5)

b. Maintains an even /smooth rod worth. (0.75)

c. 128 steps. (0.5)

d. Only one group of rods needs to be reset. The Startup Reset Switch will reset all control rod groups. (0.75)

REFERENCE
WB Question Bank; 3-14
AOI-2D; page 10

ANSWER 3.03 (2.50)

a. Operator would be required to manually reset power to the Source Range Instruments. (1.0)

b. - Input to P-6 [0.3] 10-10 amps [0.1] 1/2 [0.1]
   - High flux rod stop [0.3] Ieq 20% [0.1] 1/2 [0.1]
   - High flux Rx trip [0.3] Ieq 25% [0.1] 1/2 [0.1] (1.5)

REFERENCE
WBLP; Excore Instr, pages 12 and 13
PWR Systems Manual; 11.5-37

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 3.04 (1.50)

a. INTERMEDIATE and POWER
b. SOURCE, INTERMEDIATE and POWER
c. INTERMEDIATE and POWER [0.5 each] (1.5)

REFERENCE
WBLP; Excore Instr., Various

ANSWER 3.05 (3.00)

a. NO CHANGE; Results in a low loop Tavg, Rod Control utilizes a Auctioneered High Tavg. (1.0)

b. RODS IN; Pimp will generate a minimum Tref, a large temperature error will cause rods to insert. (OR because NI power appears high and power mismatch inserts rods.) (1.0)

c. RODS IN; Nuclear power > turbine power (mismatch), rods in to compensate for anticipated high Tavg. (1.0)

REFERENCE
WBLP; Rod Control, page 7,8 and 14

ANSWER 3.06 (3.00)

a. - 2/2 condenser vacuum >17" Hg
   - One circwater pump breaker closed [0.4 each] (0.8)

b. - Both SD Bypass Intlk Switches to "Bypass Interlock"
   - SD Selector Switch to "PRESSURE"
   - Pressure deviation (between Pset and Pactual) [0.~~5~~ 4 each] (1.2)

c. - Generate Tref
   - Load Rejection Arming [0.5 each] (1.0)

REFERENCE
WBLP; Stm Dump, pages 4 and 5

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 3.07 (3.00)

a. OPENS [0.25] Causes steam flow to appear high [0.375] Mismatch results in FRVs opening [0.375] (1.0)

b. CLOSES [0.25] Causes MFP speed (and discharge pressure) go to maximum [0.375] FRVs close to reduce actual feed flow [0.375] (1.0)

c. NO CHANGE ~~OPENS [0.25] Reference level increases [0.375] flow must increase to compensate [0.375].~~ Reference level is already at its maximum value (of 44%) so level will remain unchanged. (1.0)

REFERENCE
WBLP; SG&LC, page 3 and 8 through 11
WBLP; Feed & Cond, page 7

ANSWER 3.08 (3.50)

- Low Pzr pressure [0.4] 1870# [0.1] 2/3 [0.1]
- High containment pressure [0.4] 1.54 psid [0.1] 2/3 [0.1]
- Low steamline D/P [0.4] 100 psid [0.1] 2/3 < 2/3 other stmlines [0.1]
- High steam flow [0.4] Variable [0.1] 1/2 in 2/4 loops [0.1] AND
  - Low steam pressure [0.2] 600 psig [0.1] 2/4 [0.1]
  - Lo-lo Tavg [0.2] 540 F [0.1] 2/4 [0.1]
- Manual [0.3] (1/2 switches) (3.5)

REFERENCE
SQLP; ECCS, page 4
SQ Precautions, Limitations and Setpoints

ANSWER 3.09 (2.50)

a. (HIGH) Prevent lifting PORVs or Safeties on insurge from load rejection. (CAF)
(LOW) Prevent emptying pressurizer after trip. [0.5 each] (1.0)

b. - Letdown isolation and charging to maximum.
- Level increases.
- High level reactor trip. [0.5 each] (1.5)

REFERENCE
WBLP; Pzr Lvl Contr, page 3

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 3.10 (1.50)

a. INCREASE

b. MORE NEGATIVE

c. ~~INCREASES~~ NO CHANGE [0.5 each] (1.5)

REFERENCE
WBLP; Excore NI, pages 16 and 17
SGWLC, page 3

4a. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 4.01 (3.00)

a. - Protect spray lines from thermal shock.
   - Help maintain uniform water chemistry. [0.6 each] (1.2)

b. Minimize significant reactivity changes due to Pzr outsurge. (0.6)

c. Limits the possibility of rod "thermal lockup" (binding). (0.6)

d. (A non-uniform temperature distribution) may cause a RCS pressure transient. (0.6)

REFERENCE
GOI-1; pages 2 through 5

ANSWER 4.02 (3.00)

a. Suspend the dilution operation immediately. (1.0)

b. 1 dpm. (0.5)

c. Helps to identify fuel pin defects (due to combination of thermal stress and internal pressure buildup that would release gases). (1.0)

d. FALSE (0.5)

REFERENCE
GOI-2; pages 1 through 5

ANSWER 4.03 (1.50)

a. Immediately Borate (1.0)

b. MANUAL (0.5)

REFERENCE
GOI-5A; pages 2 and 3

4a. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 4.04 (3.00)

a. 30 minutes (0.5)

b. DILUTING [0.5] Raises Tavg which will require rods to move into the core [0.5] this will suppress the flux high in the core and cause AFD to become less positive. [0.5] (1.5)

c. 30 minutes (0.5)

d. FALSE (0.5)

REFERENCE
SQTS; 3/4 2-1 through 2-4

ANSWER 4.05 (3.50)

a. - Tank volume (level)
- Boron concentration
- Fluid temperature [0.5 each] (1.5)

b. 1) 100 F/Hr
2) 200 F/Hr
3) 320 F
4) 541 F [0.5 each] (2.0)

REFERENCE
SQTS; 3/4 1-13 and 1-6

ANSWER 4.06 (2.75)

a. Prevents the possibility of an explosive mixture of H2 and O2. (0.75)

b. Plant vent (shield bldg. vent) (0.5)

c. 1) Oldest tank collected.
2) Most recent tank collected [0.5 each] (1.0)

d. Minimize (individual) population dose rate (exposure). (0.5)

REFERENCE
(CAF)

ANSWERS -- SEQUOYAH 1&2 -84/11/13-SAILOR, B.

ANSWER 4.07 (3.00)

- Reduce turbine load.
- Verify auto rod insertion or manually insert to match Tavg/Tref.
- Open RTBs at MG Set Room (Aux Bldg 759).
- Open MG Set breakers at 480 Unit Bds A and B.
- (Have P-4 contact closed.) [0.75 ~~0.6~~ each] (3.0)

Additional subsequent answers in FR-S.1 that are included are not incorrect.

REFERENCE
FR-S.1; page 2

ANSWER 4.08 (3.50)

a. - MFW isolation valves closed
   - MFW regulating valves closed
   - MFW bypass valves closed
   - MFW pumps tripped [0.5 each] (2.0)

b. - RCS subcooling
   - S/G pressure stable or decreasing
   - Thot stable or decreasing
   - Core exit T/Cs stable or decreasing
   - Tcold at saturation for S/G pressure [any 4; 0.375 each] (1.5)

REFERENCE
E-0; pages 4 and 7

ANSWER 4.09 (1.75)

a. 1.25 Rem/quarter (0.75)

b. TLD badge AND dosimeter [0.5 each] (1.0)

REFERENCE
RCI-1; pages 3 and 7

Enclosure 3
(2 of 2)

MASTER

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

Facility: Sequoyah
Reactor Type: Westinghouse (PWR)
Date Administered: 13 Nov 84
Examiner: W. G. Douglas
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 Value	% of Total	Candidate's Score	% of Category Value	Category
24 ~~25~~.0	25			5. Theory of Nuclear Power Plant Operation, Fluids, and Thermodynamics
25.0	25			6. Plant Systems Design, Control, and Instrumentation
25.0	25			7. Procedures - Normal, Abnormal, Emergency, and Radiological Control
23 ~~25~~.0	25			8. Administrative Procedures, Conditions, and Limitations
97 ~~100~~.0				Totals

Final Grade

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

_____
Candidate's Signature

SECTION 5 - THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS

QUESTION 5.01
For the following definitions, give the term that is defined.

a. The amount of reactivity that is required to go from hot zero power to hot full power. (0.5)
b. A measure of the departure from criticality. (0.5)
c. The amount of heat supplied to change a liquid into a vapor without changing its temperature. (0.5)
d. The maximum upper excore detector current divided by the average upper excore detector current. (0.5)
e. Heat transfer due to motion between two bodies. (0.5)

QUESTION 5.02
5 minutes after a Rx trip the IR channel reads 10^{-8} amps. What should it read in an additional 5 minutes? (1.0)

QUESTION 5.03
The decrease in the effective delayed neutron fraction over core life is due to: (1.0)

a. The reduction in boron concentreation.
b. The buildup of Pu-239.
c. The half-life of U-235.
d. The more negative MTC.

QUESTION 5.04
Which components of the six-factor formula are most affected by a moderator temperature change? (1.0)

a. Thermal Utilization and Fast Fission
b. Resonance Escape and Reproduction
c. Reproduction and Fast Fission
d. Resonance Escape and Thermal Utilization

QUESTION 5.05
Concerning the behavior of Samarium (Sm), answer TRUE or FALSE to each of the following. (1.0)

a. Once equilibrium Sm is established, Sm reactivity does not change regardless of power level changes.
b. 50 % equilibrium Sm reactivity is equal to 100 % equilibrium Sm reactivity.
c. Sm is removed by radioactive decay only.
d. Sm is produced by the decay of Iodine.

QUESTION 5.06

Frequent mention is made in the Technical Specifications and elsewhere that limits are placed on the Departure from Nucleate Boiling Ratio (DNBR).

a. Define DNBR. (0.5)
b. What is the limit on DNBR? (0.5)
c. What will happen if the DNBR is violated? (DNBR still > 1.0) (0.5)
d. Since DNB is not a directly observable parameter, what FOUR parameters may the operator monitor and/or contol to ensure that DNB is not reached? (1.0)

QUESTION 5.07

During a reactor startup, equal increments of reactivity are added and the count rate is allowed to reach equilibrium each time. Choose the bracketed ([ ]) word(s) that describe what is observed on the Source Range recorder and/or SUR meter.

a. The change in equilibrium count rate is [larger] [the same] [smaller] each time. (0.5)
b. The time required to reach equilibrium is [longer] [the same] [shorter] each time. (0.5)
c. The point of supercriticality can be identified by a(n) [increasing] [constant] [decreasing] positive SUR twenty seconds after the reactivity addition is terminated. (0.5)

QUESTION 5.08

The reactor is producing 100 % rated thermal power at a core delta T of 60 degrees and a mass flow rate of 100 % when a blackout occurs. Natural circulation is established and core delta T goes to 40 degrees. If decay heat is 2 %, what is the core mass flow rate (in %)? (1.0)

QUESTION 5.09

A variable speed centrifugal pump is operating at 1800 rpm with a capacity of 400 gpm at a discharge head of 20 psi which requires a power of 40 kW. Determine the pump capacity, discharge head, and power requirements if the pump speed is increased to 2000 rpm. (1.5)

QUESTION 5.10 (1.0)

Which of the following do NOT provide assurance that the heat flux hot channel limits are not violated?

a. Axial power distribution is maintained within limits.
b. Control rod groups are sequenced with proper overlap.
c. Control rod insertion limits are maintained.
d. The MTC is within its analyzed temperature range.

QUESTION 5.11 (1.0)

The reactor is operating at 50 % power with the rod control system in automatic when a single Group A rod drops into the core. Assuming no reactor trip or operator actions occur, choose the answer below that best describes the final steady state conditions. Assume the rods have enough reactivity to provide any necessary reactivity requirements.

a. Final power < initial power, final Tavg = initial Tavg
b. Final power = initial power, final Tavg = initial Tavg
c. Final power > initial power, final Tavg = initial Tavg
d. Final power = initial power, final Tavg > initial Tavg

QUESTION 5.12 (1.5)

Why does the efficiency of a feedwater heater decrease when the level goes outside its normal band? Discuss both high and low level.

QUESTION 5.13 (1.0)

A decrease in the boron concentration makes the differential boron worth more negative. If this is so (it is), why does boron worth per ppm become less negative over core life?

initially

QUESTION 5.14 (1.0)

Which of the following cause the MTC to become more negative?

a. Increasing boron concentration
b. Decreasing moderator temperature
c. Insertion of control rods
d. Flux moving toward center of core

QUESTION 5.15 (1.0)

Which of the following statements is TRUE if the discharge valve from a centrifugal pump is partially closed?

a. Volume flow rate increases as head loss decreases.
b. Pump head decreases as volume flow rate decreases.
c. Pump head increases as head loss increases.
d. Volume flow rate decreases as pump head increases.

QUESTION 5.16

a. Match Column A to the proper core location in Column B. (1.0)

COLUMN A	COLUMN B
1. Maximum actual heat flux	a. Bottom
2. Minimum critical heat flux	b. Middle
	c. Top

b. What are the units of heat flux? (0.5)

QUESTION 5.17

a. When in MODE 2 with keff < 1, the Shutdown Margin must be verfied within 4 hours prior to criticality. What calculation is required and what must be its result for this verfication? (1.0)
b. What is the Shutdown margin limit with Tavg greater than 200 degrees? (0.5)
c. Name FIVE factors that go into a Shutdown Margin calculation. (1.0)

QUESTION 5.18 (1.5)

From the following list, identify ALL of the events that cause the Fuel Temperature Coefficient to become less negative over core life.

a. Buildup of Pu-240
b. Clad creep
c. Pellet swell
d. Lower effective fuel temperature

WRITE END OF SECTION FIVE ON ANSWER SHEET

SECTION 6 - PLANT SYSTEMS, DESIGN, CONTROL, AND INSTRUMENTATION

QUESTION 6.01 (1.0)

Which of the following is NOT an interlock associated with opening the letdown orifice isolation valves?

a. Pressurizer Level > 17%
b. Letdown Isolation Valves (FCV-62-69 & -70) closed
c. Phase A reset
d. Charging Pump running

QUESTION 6.02 (1.0)

The minimum charging flow for the positive displacement (PD) charging pump is 32 gpm. How is this minimum flow rate obtained?

a. Flow orifice on discharge of PD pump.
b. Flow sensing recirculation lines back to VCT.
c. Variable supply voltage to PD pump motor.
d. Mechanical stop on PD pump hydraulic speed changer.

QUESTION 6.03

The following questions concern the RHRS inlet isolation valves (74-1 & -2).

a. What position will they fail upon loss of power? (0.5)
b. What TWO interlocks are associated with their operation? (1.0)

QUESTION 6.04 (1.5)

Match Column A to the RCS penetration in Column B.

COLUMN A	COLUMN B
1. Pzr Surge Line	a. Loop 3 Intermediate Leg
2. Letdown Line	b. Loop 1 Cold Leg
3. Excess Letdown Line	c. Loop 2 Hot Leg
4. Normal Charging	d. Loop 4 Hot Leg
5. RHRS Cooldown Suction	e. Loop 3 Cold Leg
	f. Loop 4 Cold Leg

QUESTION 6.05 (1.0)

List FIVE components cooled by component cooling water which, if leaking, would cause the surge tank level to rise and the surge tank vent to automatically shut.

QUESTION 6.06
The following questions concern the Reactor Control Unit of the Rod Control System.

a. What are the TWO input signals to the power mismatch channel? (0.4)
b. Why is the power mismatch error signal processed through a variable gain unit prior to being compared to the temperature error signal? (0.3)
c. What TWO signals are compared to give the temperature error signal? (0.4)
d. How big must the total error signal be to produce rod motion at the minimum rod speed? (0.2)
e. How big must the total error signal be to produce rod motion at the maximum rod speed? (0.2)

QUESTION 6.07
The condenser steam dumps will not open unless certain interlocks are met, arming signals are present, and there is a demand signal.

a. What THREE interlocks must be met? (0.6)
b. How is the Load Rejection arming signal reset? (0.3)
c. What determines the magnitude of the demand signal when in the Reactor Trip Mode? (0.3)
d. What determines the magnitude of the demand signal when in the Steam Pressure Mode? (0.3)

QUESTION 6.08
Which ONE of the following Reactor Trip signals provide protection against having a low DNBR? (1.0)

a. Turbine Trip / Reactor Trip
b. Overpower Delta T Reactor Trip
c. Pzr Pressure High Reactor Trip
d. Source Range High Flux Reactor Trip

QUESTION 6.09
For the following, indicate how (high, low, as is) the indication will change for the given failure. No explanation is required.

a. Tc RTD opens. (0.4)
b. IRM compensation voltage fails high while in the Power Range at 100% power. (0.4)
c. Pulse height discriminator setting fails low while in the Source Range. (0.4)
d. Thermocouple junction opens. (0.4)
e. Pressurizer level bellows ruptured (0 delta P). (0.4)

QUESTION 6.10 (1.5)

For a LOCA resulting in a slow, steady depressurization, list the ECCS components (in order of injection) that will inject into the RCS. Include the pressure at which each will inject.

QUESTION 6.11 (2.0)

List FIVE different ways to emergency borate.

QUESTION 6.12 (1.0)

Which of the following is NOT a basis for the RWST minimum volume and boron concentration limits?

a. Sufficient water is available for recirculation cooling flow to core following a LOCA.
b. RCS temperature will be < 350 degrees before the RWST empties following a LOCA.
c. Reactor will remain subcritical following mixing of RWST and RCS water volumes following a LOCA.
d. The solution recirculated within containment following a LOCA will have a pH valve between 8.5 and 11.0.

QUESTION 6.13

a. List the automatic start signals for the emergency diesels. (0.5)
b. List the signals that will trip the emergency diesels following an emergency start. (0.5)
c. TRUE or FALSE (0.5)
Never isolate a diesel on a shutdown board during surveillance.

QUESTION 6.14

List (by Board) the NORMAL and ALTERNATE power supplies to the following:

a. 125V Battery Charger I (0.5)
b. Component Cooling System Pump C-S (0.5)

SECTION 6 CONTINUED ON NEXT PAGE

QUESTION 6.15
Which of the following is NOT a precaution concerning the Nuclear Instrumentation System? (1.0)

a. Set the Source Range detector high voltage at 30% of the plateau length above the plateau knee voltage.
b. Do not reset the Source Range Reset-Block switches above 4×10^{-10} amps.
c. An interlock between the Level Trip and Operation Selector switches on the Intermediate Range requires that the Level Trip switch be in the BYPASS position before testing can be preformed on the associated channel.
d. A monthly surveillance test of the Power Range shall be performed if reactor power is before P-10 for > 8 hours.

QUESTION 6.16
a. How is RCS pH increased? (0.5)
b. How is RCS pH decreased? (0.5)

QUESTION 6.17
a. What THREE signals will cause Feedwater Isolation? (0.6)
b. List ALL automatic actions that occur on a Feedwater Isolation? (1.0)
c. How is Feedwater Isolation reset? (0.4)

QUESTION 6.18
For the following permissives, give their function and setpoints.

a. P-6 (0.5)
b. P-9 (0.5)
c. P-11 (0.5)
d. P-12 (0.5)

WRITE END OF SECTION 6 ON ANSWER SHEET

SECTION 7 - PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL

QUESTION 7.01

Assuming the plant is in a solid water operation condition, indicate whether the following precautions are TRUE or FALSE.

a. With letdown from RHR and RCS pressure maintained with the low pressure letdown control valve, all three letdown orifices must be closed. (0.5)

b. Whenever RCS temperature is above 160 degrees, at least one RCP must be in operation. (0.5)

c. When RCS pressure is below 500 psig, the reciprocating charging pump shall be used. (0.5)

QUESTION 7.02

A NOTE in GOI-2, "Plant Startup from Hot Standby To Minimum Load", states that if control rods were withdrawn 5 steps during heatup, the control rods must be fully inserted prior to withdrawing rods.

a. Why are the rods withdrawn 5 steps during heatup? (0.5)

b. Why must they be inserted prior to withdrawal? (0.5)

QUESTION 7.03

Match the evolutions performed during a power increase in Column A with the power it is normally performed in Column B. Column B answers may be used more than once.

COLUMN A	COLUMN B	
a. Verify chemistry within limits	1. 35%	(0.4)
b. Place MSR in service.	2. 90%	(0.4)
c. Load second MFPT.	3. 50%	(0.4)
d. Perform calorimetric calculation.	4. 30%	(0.4)
e. Verify P-8 light goes out.	5. 40%	(0.4)

QUESTION 7.04

The Sequoyah maximum contamination limit on personal clothing and skin surfaces for Beta-Gamma using a direct survey is _____(1)_____ mrad/hr which is equivalent to _____(2)_____ cpm as measured at approximately one centimeter from the surface with a thin window pancake probe. (1.0)

QUESTION 7.05

a. Give the Sequoyah normal quarterly whole body dose limits for the following:
   1. TVA personnel (0.5)
   2. Non-TVA personnel (without present quarterly records) (0.5)
   3. Non-TVA personnel (with present quarterly records) (0.5)

b. Whose consent is required before the emergency exposure guidelines can be used? (0.5)

QUESTION 7.06

Following a reactor trip without a SI, what is the expected condition of the following?

a. RCS Tavg (0.4)
b. RCS Pressure (0.4)
c. AFW Pumps (0.4)
d. Pzr Level (0.4)
e. Shutdown Boards (0.4)

QUESTION 7.07

Which of the following is a requirement of the Natural Circulation Cooldown Procedure? (1.0)

a. The maximum cooldown rate is 100 degrees / hour.
b. The preferred method of depressurization is using a pressurizer PORV.
c. If less than three CRDM fans are running, maintain > 100 degrees subcooling.
d. Secure RCP seal injection flow 15 minutes after the loss of RCPs.

QUESTION 7.08

What are the Immediate Operator Actions for a continuous insertion of a control rod bank? (1.0)

QUESTION 7.09

a. List FIVE probable alarms that could occur as a result of an inadvertent opening of a pressurizer PORV. Only list alarms that could occur if the pressurizer pressure remains above 2000 psig. Do NOT include setpoints. (1.5)
b. List the TWO automatic reactor trips that are most likely to occur if the PORV remains open. Do not include SI/Rx Trip. (1.0)

QUESTION 7.10
Following a LOCA, what are the FOUR SI Termination Criteria if containment conditions are adverse? (2.0)

QUESTION 7.11
The following questions concern the Steam Generator Tube Rupture Procedure.

a. What are FIVE ways in which the ruptured S/G can be identified? (1.5)
b. Do not proceed with cooldown until the ruptured S/G is identified. TRUE or FALSE? (0.5)
c. All RCP trip criteria still apply during the RCS depressurization. TRUE or FALSE? (0.5)
d. RCS depressurization may begin during cooldown provided RCS subcooling is maintained. TRUE OR FALSE? (0.5)

QUESTION 7.12
Following a reactor trip signal in which the reactor and turbine did not trip and the reactor trip breakers can not be opened from Control Room Pnl M-4 or M-6, what are the FOUR Immediate Actions that are required to be preformed? (2.0)

QUESTION 7.13
According to FR-C.1, what are the symptons of inadequate core cooling? (1.0)

QUESTION 7.14
According to FR-H.1, "Response to Loss of Secondary Heat Sink", what method of cooling the RCS is available if the secondary heat sink can not be restored? (1.5)

QUESTION 7.15
An irradiated fuel assembly is being moved from the reactor vessel to the upender when it drops to the bottom of the refueling canal.

a. What are the SRO's immediate actions if radiation monitors indicate increasing levels, in accordance with AOI-29? (1.0)
b. What is the type (source) of radiation activity released? (0.5)

WRITE END OF SECTION 7 ON ANSWER SHEET

SECTION 8 - ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS

QUESTION 8.01

a. List the FOUR emergency classifications in order of increasing severity. (1.0)

b. Who is responsible for declaring the emergency and providing the initial activation of the emergency plan? (0.5)

c. Within how long after declaration of an emergency must the Operations Duty Specialist be notified? (0.5)

d. Which emergency classifications require activation of the Technical Support Center? (0.5)

QUESTION 8.02

Which of the following correctly describes the requirements of an Operating Permit (form TVA 6271)? (1.0)

a. The person holding an operating permit is authorized to perform maintenance on the equipment.

b. The operating permit does not authorize anyone to operate equipment from a control board except its normal operators.

c. More than one person can hold the same operating permit.

d. When an operating permit is used in conjunction with a hold order, a person other than the one holding the operating permit can hold the hold order.

QUESTION 8.03

In the event a yellow controlled copy of a procedure is not available, a controlled copy can be obtained by reproducing the shift engineer office copy. What are the requirements for documenting this copy? (1.0)

QUESTION 8.04

SOIs are categorized as Category A or Category B.

a. What does being classified Category A require? (0.5)

b. How does the operator tell if a SOI is Category A or B? (0.5)

QUESTION 8.05

The Technical Specifications require prompt (within 24 hours) notification to the NRC in the event of a reactivity anomaly. Give FOUR conditions that constitute a reactivity anomaly. (2.0)

QUESTION 8.06
Give the bases for the following Technical Specification RCS leakage limits:

a. 40 gpm Controlled Leakage (1.0)
b. 500 gpd from one S/G (1.0)

QUESTION 8.07
a. What is the minimum temperature for criticality? (0.5)
b. When must the RCS temperature be determined to be above the minimum temperature for criticality:
   1. Prior to achieving criticality? (0.5)
   2. If reactor is critical and RCS temperature is < 551 degrees with the Tavg-Tref deviation alarm not reset? (0.5)

QUESTION 8.08
Indicate whether or not the following conditions REQUIRE that the plant be in Hot Standby within one hour.

a. In Mode 1 with cold leg accumulator isolation valve failed in the closed position. (0.5)
b. In Mode 1 with the BIT boron concentration found to be 19,000 ppm. (0.5)
c. In Mode 2 with two auxiliary feedwater pumps found to be inoperable. (0.5)
d. In Mode 1 without primary containment integrity. (0.5)

QUESTION 8.09
a. A specific color code system has been established for use on instruments. List the colors used and what each specifies. (1.0)
b. A color code system is also used on controls that are in a common area. What color codes are used and what do they indicate? (1.0)

QUESTION 8.10
A CAUTION in ES-3.3, "Post SGTR Cooldown by Ruptured S/G Depressurization", states that this instruction should not be used unless ES-3.2, "Post SGTR Cooldown Using Backfill", is inadequate.

a. What is the bases for this CAUTION? (1.0)
b. What TWO requirements must be met before performing ES-3.3? (1.0)

QUESTION 8.11
Concerning the Critical Safety Function (CSF) status trees:

a. List the different CSFs that are monitored. (1.0)
b. Who is responsible for monitoring the CSF status trees? (0.5)
c. When are the CSF status trees monitored? (0.5)

QUESTION 8.12
Concerning temporary changes to procedures:

a. Who may originate a temporary change? (0.5)
b. What approval is required before a non-intent temporary change can be implemented? (0.5)
c. What approval is required after a non-intent temporary change is implemented? (0.5)
d. What is the maximum time a non-intent temporary change is effective? (0.5)

QUESTION 8.13
a. According to GOI-5A, "Normal Plant Operation", what condition is necessary for automatic rod control above 90% power? (0.5)
b. Why is this requirement necessary? (0.5)

QUESTION 8.14
Answer TRUE or FALSE to the following questions that are concerned with fuel handling operations.

a. During fuel handling operations a maximum of five fuel assemblies shall be allowed out of approved storage locations at any one time. (0.5)
b. Manipulator crane interlocks shall only be bypassed by approval of and under direct supervision of the fuel handling SRO. (0.5)
c. Hard hats and safety glasses are not to be worn in upper containment during fuel shuffle. (0.5)

QUESTION 8.15
The Technical Specifications require that at least one RHR loop be in operation during refueling operation.

a. What conditions define refueling operations? (1.0)
b. The above requirement does not have to be met for up to one hour per eight hour period if what evolution is being performed? (0.5)

WRITE END OF SECTION 8 ON ANSWER SHEET

$f = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgh$

$V_f = V_o + at$

$W = v\ \Delta P$

$\Delta E = 931\ \Delta m$

$\dot{Q} = \dot{m}\Delta h$

$\dot{Q} = \dot{m}C_p\Delta t$

$\dot{Q} = UA\Delta T$

$Pwr = W_f\Delta h$

$P = P_o 10^{sur(t)}$

$P = P_o e^{t/T}$

$SUR = 26.06/T$

$SUR = 26\rho/\ell^* + (\beta - \rho)T$

$T = (\ell^*/\rho) + [(\beta - \rho)/\bar{\lambda}\rho]$

$T = \ell/(\rho - \beta)$

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

$\rho = (K_{eff}-1)/K_{eff} = \Delta K_{eff}/K_{eff}$

$\rho = [(\ell^*/(T K_{eff})] + [\bar{\beta}_{eff}/(1 + \bar{\lambda}T)]$

$P = (\Sigma\phi V)/(3 \times 10^{10})$

$\Sigma = \sigma N$

$v = s/t$

$s = V_o t + 1/2\ at^2$

$a = (V_f - V_o)/t$

$w = \theta/t$

$A = \frac{\pi D^2}{4}$

$\dot{m} = V_{av}A\rho$

Cycle efficiency = (Net work out)/(Energy in)

$A = \lambda N \qquad A = A_o e^{-\lambda t}$

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

$t_{1/2}^{eff} = \frac{[(t_{1/2})(t_b)]}{[(t_{1/2}) + (t_b)]}$

$I = I_o e^{-\Sigma x}$

$I = I_o e^{-\mu x}$

$I = I_o 10^{-x/TVL}$

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

$SCR = S/(1 - K_{eff})$

$CR_x = S/(1 - K_{effx})$

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$M = 1/(1 - K_{eff}) = CR_1/CR_o$

$M = (1 - K_{effo})/(1 - K_{eff1})$

$SDM = (1 - K_{eff})/K_{eff}$

$\ell^* = 10^{-4}$ seconds

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

$I_1 d_1 = I_2 d_2$

$I_1 d_1^{\ 2} = I_2 d_2^{\ 2}$

$R/hr = (0.5\ CE)/d^2$(meters)

$R/hr = 6\ CE/d^2$ (feet)

Water Parameters

1 gal. = 8.345 lbm.
1 gal. = 3.78 liters
1 ft^3 = 7.48 gal.
Density = 62.4 lbm/ft^3
Density = 1 gm/cm^3
Heat of vaporization = 970 Btu/lbm
Heat of fusion = 144 Btu/lbm
1 Atm = 14.7 psi = 29.9 in. Hg.
1 ft. H_2O = 0.4335 lbf/in.

Miscellaneous Conversions

1 curie = 3.7×10^{10} dps
1 kg = 2.21 lbm
1 hp = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf
e = 2.718

MASTER

ANSWER KEY

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

Facility: Sequoyah
Reactor Type: Westinghouse (PWR)
Date Administered: 13 Nov 84
Examiner: W. G. Douglas
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 Value	% of Total	Candidate's Score	% of Category Value	Category
~~25~~ 24.0	25			5. Theory of Nuclear Power Plant Operation, Fluids, and Thermodynamics
25.0	25			6. Plant Systems Design, Control, and Instrumentation
25.0	25			7. Procedures - Normal, Abnormal, Emergency, and Radiological Control
~~25~~ 23.0	25			8. Administrative Procedures, Conditions, and Limitations
~~100~~ 97.0				Totals

Final Grade

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

_____
Candidate's Signature

SECTION 5 ANSWER KEY

ANSWER 5.01

a. Power Defect (1/2 credit for power coefficient) (0.5)
b. Reactivity (0.5)
c. Latent Heat of Vaporization (0.5)
d. Quadrant Power Tilt Ratio (0.5)
e. Convection, **Also except Conduction** (0.5)

REFERENCE:
SQN, Review of Reactivity Coefficients, p. 9
SQN, Review of Neutron Kinetics, p. 3
General Physics, HT & FF, pp. 38 & 99
SQN, TS, p. 1-5

ANSWER 5.02

Use exponential power equation (0.2 pts)
Assume - 1/3 DPM (0.6 pts)
2.24×10^{-10} amps (0.2 pts)

REFERENCE:
Westinghouse Reactor Physics, pp. I-3.15 & 19
SQN, Review of Neutron Kinetics, pp. 8 & 9

ANSWER 5.03

b (1.0)

REFERENCE:
SQN, Review of Neutron Kinetics, p. 6

ANSWER 5.04

d (1.0)

REFERENCE:
SQN, Review of Reactivity Coefficients, pp. 3 & 4

ANSWER 5.05

(0.25 pts each)
a. FALSE
b. TRUE
c. FALSE
d. FALSE

REFERENCE:
Westinghouse Reactor Physics, pp. I-5.77-79
SQN, Review of Core Poisons

ANSWER 5.06

a. DNBR = (power to cause DNB) / actual power (0.5)
b. > 1.3 (0.5)
c. Probably nothing, but your safety margin to DNB is less. (Confidence limit that DNB will not occur is less) (1/2 credit for core damage) (0.5)
d. 1. RCS pressure (1.0)
2. RCS temperature
3. RCS flow
4. Reactor power

REFERENCE:
SQN, Question and Answer Bank, Sec 5, p. 7

ANSWER 5.07

a. Larger (0.5)
b. Longer (0.5)
c. Constant (0.5)

REFERENCE:
Westinghouse Reactor Physics, Section I-4
SQN, Question and Answer Bank, Sec 1. p.12

ANSWER 5.08

$Q(1)\ m(2)\ dT(2) = Q(2)\ m(1)\ dT(1)$ (0.5 pts)
$100\ (m(2))\ (40) = 2\ (100)\ (60)$ (0.3 pts)
$m(2) = 3\ \%$ (0.2 pts)

REFERENCE:
General Physics, HT & FF, Section 3.2
SQN, Question and Anwer Bank, Sec 5, p. 19

ANSWER 5.09

Capacity = 444 gpm (linear) (0.5)
Head = 25 psi (square) (0.5)
Power = 55 kW (cube) (0.5)

REFERENCE:
General Physics, HT & FF, p.323

ANSWER 5.10

d (1.0)

REFERENCE:
SQN, TS, p. B 3/4 2-2

ANSWER 5.11
b (1.0)

REFERENCE:
SQN, Rod Control System Description

ANSWER 5.12
(0.75 pts each)
High - water covers tubes inside FW heater which reduces heat transfer surface area.
Low - steam passes through heater without giving up its latent heat of vaporization.

REFERENCE:
SQN, Question and Answer Bank, Sec 5, p. 22

ANSWER 5.13
Fission product buildup (0.5 pts) over core life results in more competition (0.5 pts) for the neutrons. (This is true for Cycle 1, for other cycles may not become less negative - Full credit if they state only this.)

REFERENCE:
Westinghouse Reactor Physics, p. I-5.31
SQN, Review of Core Poisons, p.4

ANSWER 5.14
c (1.0)

REFERENCE:
SQN, Review of Reactivity Coefficients, pp. 4 & 5

ANSWER 5.15 QUESTION DELETED (1.0)
c

REFERENCE:
General Physics, HT & FF, p. 328

ANSWER 5.16
a. 1. b (0.5)
2. c (0.5)
b. BTU /(hr square ft) (0.5)

REFERENCE:
General Physics, HT & FF , p. 229

ANSWER 5.17

a. Predicited critical control rod position (0.5 pts) is within control rod insertion limits (0.5 pts).

b. 1600 pcm (0.5)

c. (any 5 of at 0.2 pts each)

1. RCS boron concentration
2. Control rod position
3. RCS Tavg
4. Fuel burnup
5. Xenon concentration
6. Samarium concentration
7. Nuclear power level

REFERENCE:
SQN, TS, pp. 3/4 1-1 & 1-2

ANSWER 5.18

b, c, d (0.5 pts each)

REFERENCE:
SQN, Review of Reactivity Coefficients, p. 8

SECTION 6 ANSWER KEY

ANSWER 6.01

b (1.0)

REFERENCE:
SQN, CVCS SD, p. 10

ANSWER 6.02

d (1.0)

REFERENCE:
SQN, CVCS SD, p. 16

ANSWER 6.03

a. As Is (0.5)
b. 1. Can not open if RCS pressure > 380 psig (0.5)
2. Close automatically if RCS pressure > 700 psig (0.5)

REFERENCE:
SQN, RHRS SD, p. 5

ANSWER 6.04

1. c (0.3)
2. a (0.3)
3. e (0.3)
4. b (0.3)
5. d (0.3)

REFERENCE:
SQN, RCS SD, pp. 6 & 7

ANSWER 6.05

(Any five of at 0.2 pts each)

1. L/D Hx
2. Seal Water Hx
3. Excess L/D Hx
4. RHR Hx
5. RHR Pump Seal Hx
6. GFFD
7. Thermal Barrier Hx
8. Spent Fuel Pool Hx

REFERENCE:
SQN, Question and Answer Bank, Sec 6, p.3

ANSWER 6.06

a.	1. Autioneered high nuclear power	(0.2)
	2. Pimp	(0.2)
b.	The effect of rod motion (on power level) is different at different power levels (greater at high power).	(0.3)
c.	1. Auctioneered High Tavg	(0.2)
	2. Tref (from Pimp)	(0.2)
d.	1.5 degrees	(0.2)
e.	5.0 degrees	(0.2)

REFERENCE:
SQN, Rod Control System SD, pp. 5-7

ANSWER 6.07

a.	1. 17" Hg vacuum in condenser (C-9)	(0.2)
	2. 1 CCWP running (bkr closed)	(0.2)
	3. No Lo-Lo Tavg (>540 Degrees)	(0.2)
b.	By taking the Steam Dump Mode Selector Switch momentarily to "Reset"	(0.3)
c.	Difference between High Auctioneered Tavg and Tno load (547 degrees)	(0.3)
d.	Difference between steam header pressure and pressure setpoint.	(0.3)

REFERENCE:
SQN, Steam Dump Control System SD, pp. 4-8

ANSWER 6.08

a		(1.0)

REFERENCE:
SQN, Reactor Protection SD, pp. 9 & 10

ANSWER 6.09

a.	High	(0.4)
b.	As Is	(0.4)
c.	High	(0.4)
d.	Low	(0.4)
e.	High	(0.4)

REFERENCE:
SQN, Individual System Descriptions

ANSWER 6.10
(0.1 for component, 0.1 for order, 0.1 for pressure)

1. CCP (2700 psig (Anything > NOP)
2. SI 1500 psig (1450 - 1550)
3. UHI 1250 psig (1200 - 1300)
4. CLA 425 psig (400 - 450)
5. RHR 180 psig (160 - 200)

REFERENCE:
SQN, Question and Answer Bank, Sec 6, p. 4

ANSWER 6.11

1. Emergency boration valve on main control panel (0.4)
2. Emergency boration manual valve (local) (0.4)
3. Blender to charging pump suction (0.4)
4. Charging pump suction to RWST (0.4)
5. Manually inject BIT from main control panel (0.4)

REFERENCE:
SQN, Question and Answer Bank, Sec 6, p.11

ANSWER 6.12

b (1.0)

REFERENCE:
SQN, TS, p. B 3/4 5-3

ANSWER 6.13

a. 1. SI (on either unit) (0.5)
   2. UV on any 6.9 KV shutdown board (1.5 seconds)
   3. Loss of vital battery board (not required)
b. 1. Overspeed (0.5)
   2. Generator differential (87)
c. TRUE (0.5)

REFERENCE:
SQN, Diesel Description, pp. 7-9

ANSWER 6.14

a. Normal = SD Bd 1A1-A (0.5)
   Alter = SD Bd 1B1-B
b. Normal = SD Bd 2B2-B (0.5)
   Alter = SD Bd 1A2-A

REFERENCE:
SQN, Review of Electrical Distribution, p. 5-43

ANSWER 6.15

d (1.0)

REFERENCE:
SQN, PLS, pp. 37 & 38

ANSWER 6.16

a. Adding LiOH (0.5)
b. Using Cation bed (0.5)

REFERENCE:
SQN, SOI 62.3C, p.1

ANSWER 6.17

a. 1. Hi-Hi S/G Level (75%) in any S/G (0.2)
   2. SIS (0.2)
   3. Rx Trip with low Tavg (554 degrees) (0.2)
b. (0.25 pts each) (1.0)
   1. Both MFPs trip
   2. Feed Reg valves close
   3. Feed Reg bypass valves close
   4. Feed Isolation valves close
c. Train A and B switches on main control board (M-3) (0.4)

REFERENCE:
SQN, Feed and Condensate SD

ANSWER 6.18

(0.25 for function, 0.25 for setpoint)

a. IRM = 10^{-10} amps - Allows manual block of SRM High Flux Rx Trip
b. PRM = 50% - Below blocks Rx Trip due to Turbine Trip
c. Pzr Pressure = 1970 psig - Allows manual block of Low Pzr Pressure SI
d. Tavg = 540 Degrees - Allows manual block of High Steam Flow SI and blocks steam dump operation

REFERENCE:
SQN, Reactor Protection SD, p. 10 & 11

SECTION 7 ANSWER KEY

ANSWER 7.01

a. FALSE (0.5)
b. TRUE (0.5)
c. FALSE (0.5)

REFERENCE:
SQN, GOI-1, pp. 3 & 4

ANSWER 7.02

a. To prevent thermal lock-up (0.5)
b. To prevent bank overlap malfunction (0.5)

REFERENCE:
SQN, GOI-2, p.9

ANSWER 7.03

a. 4 (0.4)
b. 1 (0.4)
c. 5 (0.4)
d. 2 (0.4)
e. 1 (0.4)

REFERENCE:
SQN, GOI-5A, pp. 5-9

ANSWER 7.04

1. 0.05 (0.5)
2. 300 (0.5)

REFERENCE:
SQN, RCI-1, pp. 12 & 13

ANSWER 7.05

a. 1. 3 Rem (0.5)
   2. 300 mRem (0.5)
   3. 1250 mRem (0.5)
b. Plant Superintendent (or authorized representative) (0.5)

REFERENCE:
SQN, RCI-1, pp. 7 & 8

ANSWER 7.06

a. < 547 degrees (and stable and controlled) (0.4)
b. Trending to 2235 psig (0.4)
c. Running (0.4)
d. Trending to 25% (0.4)
e. Energized (by offsite power) (0.4)

REFERENCE:
SQN, ES-0.1

ANSWER 7.07

c (1.0)

REFERENCE:
SQN, ES-0.3, p. 3

ANSWER 7.08

1. Rod control in manual (or individual bank select) and restore Tavg. (0.5)
2. If unable to stop rod insertion, trip reactor. (0.5)

REFERENCE:
SQN, AOI-2B, p. 1

ANSWER 7.09

a. (Any five of at 0.3 pts each)
   1. Relief line high temperature
   2. Pzr pressure low, backup heaters on
   3. PRT high pressure
   4. PRT high temperature
   5. PRT high-low level
   6. Pzr level high, backup heaters on
   7. Acoustic monitoring system
b. 1. Overtemperature Delta T (0.5)
   2. Low Pzr Pressure (0.5)

REFERENCE:
SQN, AOI-18A, p. 1

ANSWER 7.10

1. RCS subcooling > 40 degrees (0.5)
2. RCS pressure stable are increasing (0.5)
3. AFW to intact S/G > 440 gpm (0.25 pts) or narrow range in one S/G > 25% (0.25 pts) (0.5)
4. Pzr level >50% (0.5)

REFERENCE:
SQN, Foldout Page

ANSWER 7.11

a. 1. Unexpected rise in S/G level (1.5)
2. S/G blowdown monitors
3. HP survey of main steam lines
4. HP survey of blowdown lines
5. Chem lab samples of S/G
6. Steam flow > feed flow (Not required, but accepted)

b. True (0.5)

c. False (0.5)

d. True (0.5)

REFERENCE:
SQN, E-3

ANSWER 7.12

1. Decrease turbine load (0.5)
2. Verify auto rod insertion or manually insert rods (to maintain Tavg at Tref) (0.5)
3. Locally open reactor trip breakers (at MG Set Rm) (0.5)
4. Open control rod MG set breakers (at 480V Unit Boards A & B) (0.5)

REFERENCE:
SQN, FR-S.1, p. 2

ANSWER 7.13

1. Core exit T/Cs > 700 degrees (0.5)
2. RCS at saturation (0.25 pts) and low reactor vessel level (0.25 pts) (0.5)

REFERENCE:
SQN, FR-C.1, p. 11

ANSWER 7.14

With at least one CCP or SI pump running (0.6 pts) open (both) PORV (0.6 pts) and feed and bleed the RCS (0.3 pts).

REFERENCE:
SQN, FR-H.1, p. 10

ANSWER 7.15

a. 1. Announce radiation abnormal in reactor bldg (0.5)
2. Announce over PA for all personnel to evacuate the containment building (0.5)

b. Airborne gases (I, Kr, etc) (0.5)

REFERENCE:
SQN, AOI-29, p.2

SECTION 8 ANSWER KEY

ANSWER 8.01

a. (0.25 pts each, 0.1 pts for order) (1.0)
   1. Unusual Event
   2. Alert
   3. Site (Area) Emergency
   4. General Emergency

b. Shift Engineer (0.5)

c. 5 minutes (0.5)

d. All but Unusual Event (0.16 pts each) (0.5)

REFERENCE:
SQN, IPD, IP-1 - IP-6

ANSWER 8.02

b (1.0)

REFERENCE:
SQN, AI-3, p. 4

ANSWER 8.03 (1.0)

1. SRO will review each page
2. Stamp or write "Controlled Copy" on each page
3. SRO will sign and date the front page

REFERENCE:
SQN, AI-4, p. 10

ANSWER 8.04

a. Instruction (procedure) shall be present during task performance. (0.5)

b. Cover sheet (and individual sections) identified by stamp. (0.5)

REFERENCE:
SQN, AI-4, p. 11

ANSWER 8.05 QUESTION DELETED

(any four of at 0.5 pts each)

1. If steady state, disagreement with predicted value or reactivity balance > 1000 pcm.
2. SDM less conservative than specified in Tech Specs.
3. Reactor period of < 5 seconds.
4. If subcritical, unplanned reactivty insertion of > 500 pcm.
5. Unplanned criticality.

REFERENCE:
SQN, TS, p. 6-20

ANSWER 8.06

a. In the event of a LOCA, the SI flow will not be less than assumed in the accident analysis. (1.0)

b. Ensures S/G tube integrity is maintained in the event of a LOCA or main steam line rupture. (1.0)

REFERENCE:
SQN, TS, p. B 3/4 4-4

ANSWER 8.07

a. 541 degrees (0.5)

b. 1. Within 15 minutes (0.5)
2. At least once per 30 minutes (0.5)

REFERENCE:
SQN, TS, p. 3/4 1-6

ANSWER 8.08

1. Yes (0.5)
2. No (0.5)
3. No (0.5)
4. No (0.5)

REFERENCE:
SQN, TS, pp. 3/4 5-1, 5-11, 7-5, & 6-1

ANSWER 8.09

(0.15 pts for color, 0.18 pts for specification)

a. 1. Green - operating band
2. Yellow - alarm point
3. Red - trip point

b. 1. Yellow - Unit 1
2. Orange - Unit 2
3. (Bright) Red - Unit 0

REFERENCE:
SQN, Question and Answer Bank, Sec 8, p. 6 and AI-2, p. 9

ANSWER 8.10

a. S/G is depressurized to secondary system (or atmosphere) which may (will) result in radiation releases. (1.0)

b. 1. Management approval (0.5)
2. Offsite Dose evaluation (0.5)

REFERENCE:
SQN, ES-3.1, p. 10 and ES-3.3, p. 1

ANSWER 8.11

a. 1. Subcriticality (1.0)
2. Core Cooling
3. Heat Sink
4. Containment

b. STA (0.5)

c. As directed by the E and/or ES procedures (SI) (0.5)

REFERENCE:
SQN, CSF Status Trees

ANSWER 8.12

a. Any person (0.5)

b. Approval of SE and plant supervisor or person in an active position requiring an SRO license. (0.5)

c. Plant Superintendent (0.5)

d. 45 days (0.5)

REFERENCE:
SQN, AI-4, pp. 14 - 16

ANSWER 8.13

a. Control Bank D > 215 steps withdrawn (0.5)

b. Prevent control rod drop yielding less conservative DNBRs than stated in FSAR. (0.5)

REFERENCE:
SQN, GOI-5A, p. 3

ANSWER 8.14

a. FALSE (0.5)

b. TRUE (0.5)

c. TRUE (0.5)

REFERENCE:
SQN, FHI-7, pp. 1, 2, & 4

ANSWER 8.15

a. 1. keff < 0.95 (1.0)
2. Tavg < 140 degrees
3. Fuel in reactor vessel with closure bolts less than fully tensioned or with head withdrawn.

b. Core alterations in vicinity of hot legs. (0.5)

REFERENCE:
SQN, TS, pp. 1-7 and 3/4 9-8