U. S. NUCLEAR REGULATORY COMMISSION REGION I
OPERATOR LICENSING EXAMINATION REPORT

EXAMINATION REPORT NO. 84-18

FACILITY DOCKET NOS. 50-272 Salem I
50-311 Salem II

FACILITY LICENSE NOS. DPR-70 Salem I
DPR-70 Salem II

LICENSEE: Public Service Electric and Gas Co.
P. O. Box 236
Hancock's Bridge, New Jersey 08038

FACILITIES: Salem Units 1 and 2

DATES: May 14-18, 1984

CHIEF EXAMINER: D F Johnson
D. F. Johnson, Chief Examiner — Date 6/28/84

APPROVED BY: Ron Kelly
Chief, Project Section 1D — Date 6/26/84

SUMMARY: Written, oral and simulator examinations were administered to eight SROs and two instructor candidates. One SRO failed the oral and simulator examination. All other candidates passed the examinations.

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01/31/84

REPORT DETAILS

TYPE OF EXAMS: Initial ___ Replacement X Requalification ___

EXAM RESULTS:

	RO Pass/Fail	SRO Pass/Fail	Inst. Cert Pass/Fail	Fuel Handler Pass/Fail
Written Exam	/	8/0	2/0	/
Oral Exam	/	*6/1	2/0	/
Simulator Exam	/	*6/1	2/0	/
Overall	/	7/1	2/0	/

*the oral and simulator exams were waived for one candidate who successfully passed a previously administered oral examination.

1. CHIEF EXAMINER AT SITE: D. F. Johnson, NRC

2. OTHER EXAMINERS: R. Sailor, EG&G, Idaho, Inc.
B. Picker, EG&G, Idaho, Inc.

3. PERSONS EXAMINED

SRO
D'Antonio, Joseph M
House, Alex J.
Maier, William A.
Massa, Jeffrey P.
Ott, Peter J.
Roggio, Glenn A.
Varga, Joseph S.
Villar, Enrique H.

INSTRUCTOR CERTIFICATION
Best, Richard L.
Foenner, Albert

1. Summary of generic strengths or deficiencies noted on oral exams:

   Examiners noted a general weakness in the following areas:

   a. Sources of radiation
   b. Portable radiation detectors
   c. Chemistry control
   d. Remote shutdown panel controls and indication
   e. Charging pump speed control

2. Summary of generic strengths or deficiencies noted from grading of written exams:

   No generic weaknesses noted. Overall grades were good.

3. Comments on availability and candidate familiarization with plant reference material:

   Both availability and candidate familiarization were good.

4. Comments on availability and candidate familiarization with plant design, procedure, T. S. changes and LERs:

   Some minor weaknesses were noted in the candidates inability to readily determine conditions requiring entry into LCO's.

5. Comments on interface effectiveness with plant training staff and plant operations staff during exam period.

   The plant staff was very cooperative during all phases of the examination process.

6. Improvements noted in training programs as a result of prior operator licensing examinations/suggestions, etc:

   None noted.

7. Personnel Present at Exit Meeting:

NRC Personnel

D. F. Johnson, Chief Examiner
R. J. Summers, Resident Inspector

NRC Contractor Personnel

R. Sailor, EG&G Idaho, Inc.
B. Picker, EG&G Idaho, Inc.

Facility Personnel

J. Lloyd, Principal Training Supervisor, Salem Operations
P. Landers, Principal Training Supervisor, Salem Simulator
R. Schaefer, Principal Training Supervisor, Operations

8. Summary of NRC Comments made at exit interview:

At the conclusion of the site visit, the examiners met with representatives of the plant staff to discuss results of the examinations. They were informed that one candidate appeared marginal on the operating portion of the exam. Generic weaknesses noted in item 1 above were discussed in detail. The examiners felt that the candidates were generally well prepared for the exam.

9. Summary of facility comments and commitments made at exit interview:

The licensee is to provide plant specific 1/M plots to be used for evaluation of the answer to question 5.04a.

10. CHANGES MADE TO WRITTEN EXAM

At the conclusion of the written examinations, the examiners met with J. Lloyd, K. Moore, W. Grau and P. Casey to review the written examinations and answer keys. The facility's comments and our resolution of these comments are enclosed.

Attachment:
Written Examination and Answer Key

ENCLOSURE 2

FACILITY COMMENTS TO EXAM

The following is a list of comments noted during the review of the SRO examination and our resolution of these comments.

QUESTION	RESPONSE
5.01.b	The licensee was asked to provide a plant specific answer to the question. The following statement was reviewed and accepted by the examiners and placed in the answer key. "Under stable conditions, SDM is always >5% with boron >2000 ppm."
5.04.a	The licensee stated that the provided graphs were not accurate for actual plant specific conditions and that they would supply actual 1/M plots. The 1/M plots were evaluated and the exam answer key was modified accordingly. It should be noted, however, that these plots differ significantly from those illustrated in the plant theory text supplied to the examiner and consideration should be given to including these actual plant plots in the theory manual.
6.01.d,c	Answer key was modified to delete reference to the manual makeup mode that is not used at Salem.
6.02.c	Answer key was modified to delete an incorrect response relative to plant specific design.
6.09.b	Answer key modified to include additional plausible responses in accordance with plant specific design.
6.08.e	The licensee considered the answer key was requiring additional information not asked by the question as stated. The examiners, after review of the answer key, stated that the question does not solicit the specific levels of plant actions but rather asks for "actions that occur when the following RMS channels reach their alarm setpoints." The "SG Blowdown Warning Alarm" is also considered an alarm by the examiner. Therefore, the answer key remains unchanged.

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

REVIEWERS
J. Lloyd
K. Moore
W. Grau
P. Casey

FACILITY: SALEM 1&2
REACTOR TYPE: PWR
DATE ADMINISTERED: 84/05/14
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			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	100.00			TOTALS

FINAL GRADE _____%

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

_____
APPLICANT'S SIGNATURE

QUESTION 5.01 (2.00)

a. Is it possible to have a positive isothermal temperature coefficient (or MTC) at EOL with Hot Zero Power (HZP) conditions? Briefly explain your answer. (1.0)

50

b. Why may Shutdown Margin calculations be suspended if RCS boron concentration is >2000 ppm. (0.5)

5

c. TRUE or FALSE?

Maintaining adequate Shutdown Margin ensures that the reactor remains subcritical. (0.5)

25

QUESTION 5.02 (2.50)

Compare the CALCULATED Estimated Critical Position (ECP) for a startup to be performed 4 hours after a trip from 100% power, to the ACTUAL control rod position if the following events/conditions occurred. Consider each independently. Limit your answer to HIGHER than, LOWER than, or SAME as the ECP.

5

a. One reactor coolant pump is stopped two minutes prior to criticality. (0.5)

b. The startup is delayed until 8 hours after the trip. (0.5)

c. The steam dump pressure setpoint is increased to a value just below the Steam Generator PORV setpoint. (0.5)

d. Condenser vacuum is reduced by 4 inches of Mercury. (0.5)

e. All Steam Generator levels are being raised by 5% as the ECP is reached. (0.5)

QUESTION 5.03 (2.50)

a. Provide the full power equilibrium PCM values for the following poisons:

20

1. Xenon (0.25)

2. Samarium (0.25)

b. Provide TWO reasons for Xenon contributing more negative reactivity at full power than does Samarium. (2.0)

23

QUESTION 5.04 (2.50)

a. Match the list of reactivity changing evolutions with the Inverse Count Rate Ratio (1/M) plots that most clearly represent them.

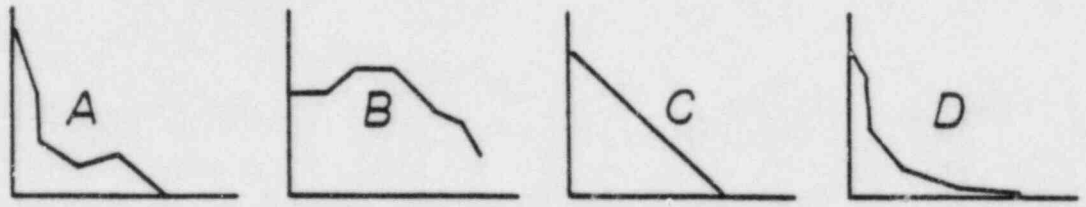
1) Boron dilution.

2) Control Rod withdrawl.

5

3) Fuel shuffle.

4) Initial fuel load.



(1.0)

b. During a routine startup, the reactor is subcritical with the shutdown banks withdrawn (to a Keff=0.95) and a stable count rate of 200 cps on both source range instruments. The operator withdraws the control banks until the stable count rate is 400 cps then stops rod motion. What is the new Keff? (Show all work.) (1.0)

0

c. Calculate the Inverse Count Rate Ratio for the Keff that you determined in part "b" above. (Show all work.) (0.5)

70

QUESTION 5.05 (3.50)

a. In addition to the amount of heat produced by the reactor/steam generators, name THREE other heat gains or losses considered by the Calorimetric Calculation (REM, Part 2). (1.5)

20

b. A precaution in the Calorimetric Calculation states that it is important to maintain Tave within .5 degrees of Tref. Explain why it is an important concern in the calculation. (0.5)

10

c. State the relationship between Reactor Power, RCS Delta temperature, and RCS Delta enthalpy. Discuss the validity of this relationship if hot leg temperature is at saturation temperature. (1.5)

0

QUESTION 5.06 (3.00)

a. Explain why a newly installed fuel assembly will exhibit a Doppler-only coefficient that becomes MORE negative EARLY in core life. (1.0)

50

b. Explain why the same fuel assembly will exhibit a Doppler-only coefficient that becomes LESS negative at the END of its core life. (1.0)

0

c. Is Doppler-only coefficient more negative at 350 F or 550 F RCS temperature? Explain your answer. (1.0)

78

QUESTION 5.07 (2.00)

While at 30% power, a Reactor Coolant Pump trips without causing a reactor protective system actuation or a change in turbine load. Indicate whether the following parameters will increase, decrease, or remain the same. (No explanation is required)

18

a. Flow in the operating coolant loops

b. Reactor vessel Delta P

c. Core Delta T

d. An operating loop steam generator pressure (2.0)

QUESTION 5.08 (2.00)

Regulatory action has limited your reactor power to 75%. In an attempt to extract the maximum megawatts from the main generator, steam to the high pressure feed heaters is secured.

0 a. Will this action provide a continuous, increased generator megawatts? (0.5)

0 b. Briefly explain your answer. (1.5)

QUESTION 5.09 (3.00)

a. Hot channel factors are measurable and their Technical Specification surveillance frequency requirements are relatively low provided FOUR items are monitored and verified to be within their limits. What are these FOUR items? (2.0)
3

b. What concern do we have if Hot Channel Factors are exceeded? (0.5)
0

c. What piece of plant equipment is used to perform the Hot Channel Factor measurement? (0.5)
0

QUESTION 5.10 (2.00)

a. Brittle fracture of any carbon steel pressure vessel can occur at stresses well below yield stress if TWO other conditions are present. What are these TWO conditions? (1.0)
19

b. Why does the concern about brittle fracture of the reactor pressure vessel increase as the Salem plant ages? Include in your answer the specific material property that is affected. (1.0)
0

QUESTION 6.01 (4.50)

Utilizing the attached CVCS drawing (Figure 6.1), answer the following questions.

0 a. Where does this relief valve discharge to? (0.25)

35 b. What are the TWO purposes of this valve? (1.0)

0 c. What is the purpose of this valve? (0.5)

22 d. In which positions on the Reactor Control Makeup Switch is this valve (CV-181) enabled to open? (0.75)

17 e. In which positions on the Reactor Control Makeup ~~Switch~~ Bezel/Controller is this valve (CV-185) enabled to open? (1.0)

5 f. What TWO signals will result in automatic closure of these valves (CV-40 and 41)? (No setpoints required). (0.5)

0 g. From what component(s) does this piping line originate? (0.25)

20 h. Where does this valve divert to? (0.25)

QUESTION 6.02 (3.00)

a. 5 Describe the various methods the Reactor Protection System uses to sense a loss or impending loss of coolant flow. (No setpoints required.) (1.0)

b. 9 Describe the permissive circuits that are associated with the loss of flow circuits. Setpoints and logics ARE required here. (1.0)

c. 28 Which loss of flow circuits result in another automatic action in addition to reactor trip? List BOTH the SENSING CIRCUITS and the AUTOMATIC ACTION they provide. (1.0)

QUESTION 6.03 (3.00)

The following questions concern the Salem Steam Generators.

0 a. What is the purpose of the J-tubes used on the feedring? (include how they accomplish this purpose.) (1.0)

10 b. Provide THREE of the four functions of the steam flow restrictor. (1.0)

23 c. TWO chemicals are utilized for S/G chemistry control.

1. What are these TWO chemicals. (0.5)

2. What specific function does each do to reduce corrosion? (0.5)

QUESTION 6.04 (1.50)

Briefly describe the THREE methods utilized to prevent
33 crystallization of boron in the boron injection tank (BIT) during normal plant operation. (1.5)

QUESTION 6.05 (1.50)

0 a. Briefly describe the interlock between the Safety Injection pump miniflow isolation valves (2SJ67 and 2SJ68) and the RHR to Safety Injection pump suction isolation valve (21SJ45). (0.75)

60 b. Why is this interlock necessary? (0.75)

QUESTION 6.06 (3.50)

28 a. What is the volume design basis for the Auxiliary Feedwater (AFW) Storage Tank? (1.0)

1 b. List, in order of preference, the THREE alternate sources of AFW suction supply. (0.75)

0 c. How is runout of the Motor-Driven AFW pumps prevented? (Setpoints are NOT required.) (0.75)

25 d. What TWO automatic start signals are in effect when the Turbine-Driven AFW pump is in "LOCAL" control? (1.0)

QUESTION 6.07 (3.50)

The following questions concern various containment systems.

a. Explain the interlock associated with the containment
0 personnel access hatch doors. (0.5)

b. List the THREE sets of valves (6 valves total) that should
0 close on a Phase B Containment Isolation Signal. (Either noun names or valve numbers are acceptable.) (1.0)

c. How do the fan cooling system FANS respond to a safety
0 injection signal? (1.5)

d. How many fan cooling units are required to keep containment
20 pressure below its design value if no containment spray is available? (0.5)

QUESTION 6.08 (2.00)

Briefly describe the AUTOMATIC actions that occur when the following Radiation Monitoring System channels reach their alarm setpoints.

60 a. Unit 2 Containment (2R2)

0 b. Unit 1 Control Room (1R1A)

25 c. Unit 1 Fuel Storage Area (1R9)

10 d. Condenser Air Ejector (2R15)

15 e. No. 23 Steam Generator Blowdown (2R19C) (2.0)

QUESTION 6.09 (2.50)

0 a. List FIVE circuit problems, from either the Logic or Power Cabinet, that can actuate the "Rod Control Urgent Failure" annunicator. (1.5)

0 b. Provide the TWO Rod Control System AUTOMATIC WITHDRAWAL blocks and their setpoints. (ones that block automatic withdrawal only) (1.0)

QUESTION 7.01 (4.00)

The following questions relate to information found in the "Reactor Trip" (EI-I-4.3) procedure.

a. What FIVE immediate manual actions must be taken if a Reactor Trip has been demanded but has not been confirmed? (3.0)

b. You are required to RAPID BORATE 150 PPM for each rod not fully inserted. What TWO steps must be preformed to initiate Rapid Boration flow? (1.0)

QUESTION 7.02 (3.00)

The following questions relate to steps found in "Steam Generator Tube Failure" (EI-I-4.7).

a. Why might a S/G Blowdown sample monitor not show any increase in radiation levels following a S/G tube rupture, even though it is working properly? (0.75)

b. Why must a channel of the Main Steam Line Radiation Monitor (R46 A-E) be isolated if it is discovered to have a higher reading than the others? (0.75)

c. What must be done with a Diesel Generator if CO2 actuation occurs while it is operating? Why is this action necessary? (1.5)

QUESTION 7.03 (3.00)

According to the "Loss of Secondary Coolant" procedure (EI-I-4.6);

a. If Containment pressure reaches the Hi-Hi setpoint of 23.5 psig, THREE actions must be verified on RP-4. What are the THREE actions that must be verified? (2.25)

b. If the RCS pressure is less than 1500 psig, what action must be taken with the charging pumps? (0.75)

QUESTION 7.04 (3.50)

a. 7 According to Control Room Evacuation Procedure (I-4.10A), upon evacuation, the Shift Supervisor must assign an operator to Panel 213 (Hot Shutdown Panel) to verify that pressurizer level is controlling automatically at approximately 22%. If pressurizer level is NOT controlling at 22%, WHAT FIVE action STEPS must be taken? (2.0)

b. 3 Besides pressurizer level controlling at 22%, what are the other THREE PARAMETERS and their DESIRED VALUES to be verified? (1.5)

QUESTION 7.05 (3.00)

The following questions pertain to the precautions, initial conditions, and procedure found in Operating Instruction II-1.3.1 (Reactor Coolant Pump Operation).

a. 0 Prior to starting a RCP, why is the Volume Control Tank pressure maintained at least at 15 psig? (0.75)

b. 7 Why must a delta P of at least 200 psid be maintained across #1 seal during startup and operation? (0.75)

c. 10 Why must starting frequency/duty limitations be placed on the RCP's? (0.75)

d. 3 Why must the RCP oil lift pump be started prior to starting a RCP? (Assume permissive is met.) (0.75)

QUESTION 7.06 (2.50)

a. 18 Check Off Sheet 1 - "Requirements to Enter Mode 2", is normally required to be completed prior to commencing a reactor startup to recover from a reactor trip. It is not required, however, if THREE conditions are met. List these THREE conditions. (1.5)

b. 0 Whose permission must the Senior Shift Supervisor obtain prior to commencing a reactor startup? (1.0)

QUESTION 7.07 (2.50)

Complete the following precautions from Plant Operating Procedures "Plant Heatup from Cold Shutdown to Hot Standby" (IOP-2) and "Hot Standby to Minimum Load" (IOP-3). (Please place the answers on your answer sheets.)

a. An Inverse Count Rate Ratio (ICRR) Plot shall be maintained during
5 Control Rod withdrawl on a reactor startup when the estimated critical configuration differs from a known critical configuration by more than ___(1)___ PCM due to rods or ___(2)___ due to Xenon.

b. Manually initiate spray flow if necessary to maintain less
0 than _____ ppm difference in boron concentration between the pressurizer liquid and the primary coolant.

c. The pressurizer spray must not be used if the temperature
0 difference between the pressurizer and the spray fluid is greater than _____ F.

d. The letdown demineralizers should be bypassed anytime _____
0 is added to the primary system. (2.5)

QUESTION 7.08 (2.00)

a. According to Emergency Procedure EPI-1, (Notification of
18 Unusual Event/Significant Event, you are directed to notify four specified organizations or persons within 15 minutes of the declaration. List THREE of these. (1.2)

b. List Four of the six locations of the ENS Network (RED)
5 phones associated with the Salem facility. (0.8)

QUESTION 7.09 (1.50)

You have been working in a radiation area for a period of five minutes. On checking your pocket dosimeter, you note it is off
3 scale. What action must you take? (Include any limitations placed on your ability to return to work.) (1.5)

QUESTION 8.01 (2.25)

22 What are the THREE provisions that must be met, according to Technical Specifications, before a temporary change can be made to an operating procedure? (2.25)

QUESTION 8.02 (2.50)

Reactor Coolant System pressure has just exceeded 2735 psig.

15 a. If in Mode 1, what action must be taken? (1.25)

24 b. If in Mode 3, what action must be taken? (1.25)

QUESTION 8.03 (2.25)

The unit is operating at 50% load when the main generator governor valve #3 fails open and the remaining three valves reposition to maintain load at 50%.

35 a. What TWO possible actions may be taken to keep the turbine in an operable status? (1.25)

40 b. What is the Technical Specification basis for the action required for a loss of turbine overspeed protection? (1.0)

QUESTION 8.04 (3.00)

For each of the following leak locations give the maximum allowable leak rate AND the basis for each.

20 a. Unknown location.

7 b. Through a pressurizer code safety valve to the Pressurizer Relief Tank.

3 c. Through the wall of the line between the pressurizer relief valves and the pressurizer.

0 d. Total flow to Reactor Coolant Pump seals.

0 e. TOTAL Steam Generator tube leakage. (3.0)

QUESTION 8.05 (3.50)

8 a. Preparations are being made to parallel the main generator to the grid when the Control Board Operator (RO) reports that Tavg is 539 F. What actions are required by the Salem Technical Specifications? (1.5)

4 b. What are the FIVE bases for the minimum temperature for criticality? (2.0)

QUESTION 8.06 (2.50)

21 Fuel is being unloaded from the Unit 2 reactor vessel when the chemist reports that his latest boron sample of the RCS indicates 1925 ppm. What action is required? (Be specific.) (2.5)

QUESTION 8.07 (2.00)

0 a. What are the Steady State and Transient Technical Specification limits for the RCS chemistry limits listed below?

1) Dissolved Oxygen (>250 F)
2) Chloride
3) Floride (0.6)

60 b. Why are the above Transient limits different than the Steady State limits? (0.8)

5 c. Why must RCS pressure be reduced below 500 psig if RCS chloride concentration exceeds the steady state limit for greater than 24 hours? (0.6)

QUESTION 8.08 (1.50)

10 If specific activity of the RCS is >1.0 uCi/gram dose equivalent I-131 for more than 48 hours during one continuous time interval, the plant must be placed in at least hot standby with RCS Tavg <500 F. What is the basis for reducing RCS temperature to less than 500 F? (1.5)

QUESTION 8.09 (3.00)

The following Questions concern information found in "Operating Practices Program" (AP-5).

a. The licensed operators on duty shall have the authority and responsibility t shutdown the reactor when they determine that any of three situations exist. List these THREE general situations/conditions. (2.25)
7

b. Define "CONTROL ROOM" (Reactor Operator definition) (0.75)
0

QUESTION 8.10 (2.50)

a. The whole body exposure limit provided is 1.25 Rem/Quarter. Under what THREE non-emergency conditions/criteria may this limit be exceeded? (AP-24 or 10 CFR 20) (1.5)
17

b. A "High Radiation Area" in which the intensity of radiation is >100 mRem/hour but <1000 mRem/hour has three special requirements associated with its access control. Provide TWO of these special requirements. (AP-24) (1.0)
10

EQUATION SHEET

$F = ma$

$v = s/t$

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

$w = mg$

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

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

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

$PE = mgn$

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

$V_f = V_o + at$

$w = \theta/t$

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

$W = v\ \Delta P$

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

$\Delta E = 931\ \Delta m$

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

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

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

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

$Pwr = W_f \Delta h$

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$I_1 d_1 = I_2 d_2$

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

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

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

$\Sigma = \sigma N$

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

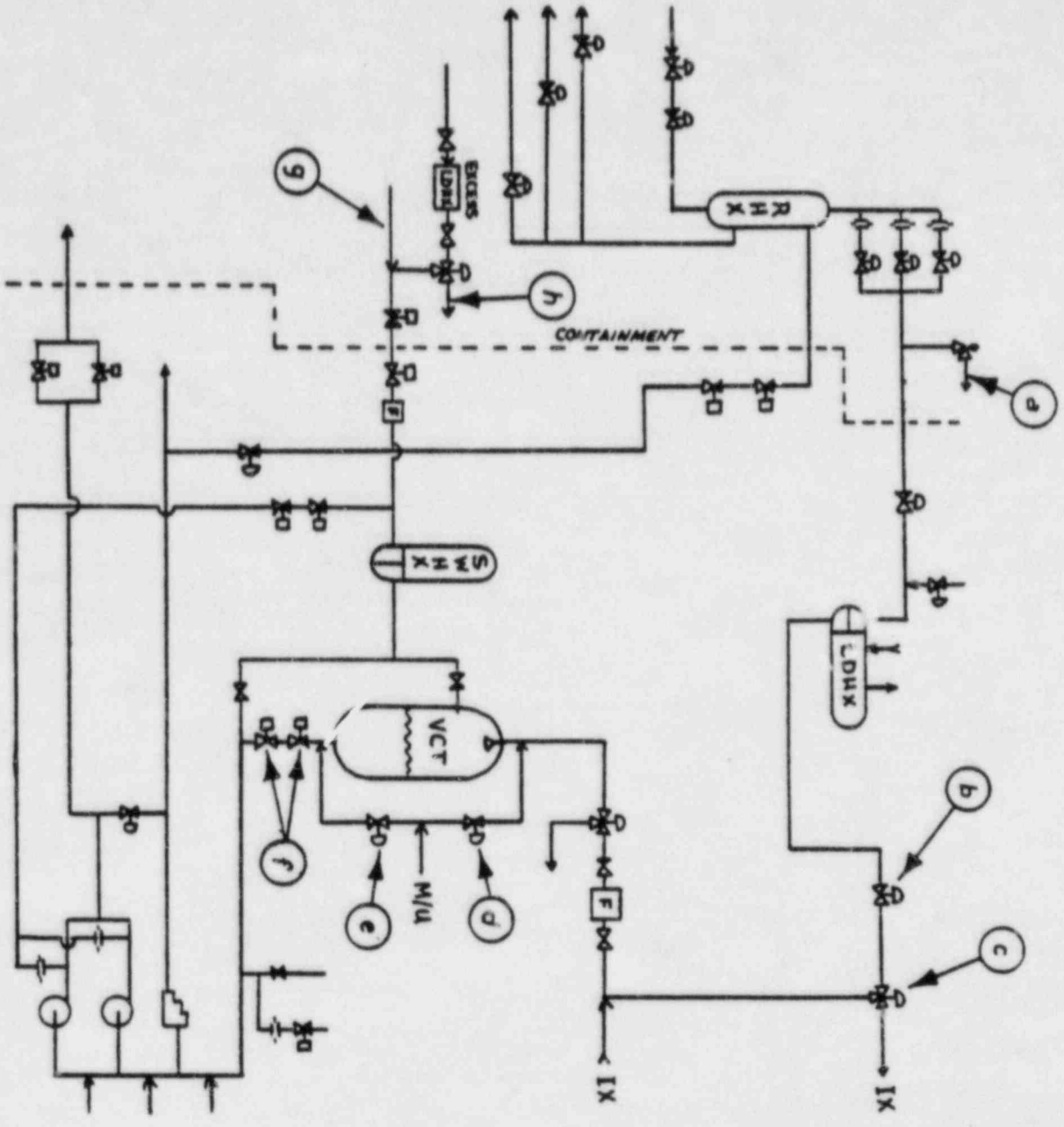

g
EXCESS
LETDN
h
CONTAINMENT
XIX
a
XIII
LDHX
VCT
b
f
e
M/U
d
F
c
IX
IX

Figure 6.1

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

ANSWER 5.01 (2.00)

a. NO [0.25] With HZP and EOL conditions, boron is sufficiently low enough to prevent a positive MTC [0.75]. (1.0)

b. (CAF) Under stable conditions, SDM is always > 5% with boron > 2000 ppm. (This is also shown in the "boron conc. - core exposure - Keff" curve in the R.E.M.) (0.5)

c. FALSE (0.5)

REFERENCE
General Physics Reactor Theory Student Handout (GPRTSH), pp 181-183
Reactor Engineering Manual (REM), Part 3, p 1

ANSWER 5.02 (2.50)

a. SAME

b. HIGHER

c. HIGHER

d. SAME

e. LOWER [0.5 each] (2.5)

REFERENCE
GPRTSH, pp 146-148

ANSWER 5.03 (2.50)

a. 1. 2700 to 3125 pcm [0.25] (.15 credit for reasonably close answers)

2. 540 to 640 pcm [0.25] (0.5)

b. 1. Higher fission yield of Xenon precursor [1.0]

2. Higher (thermal) absorption cross section for Xenon [1.0] (2.0)

REFERENCE
GPRTSH, pp 219-231
REM, Figure 6

ANSWER 5.04 (2.50)

a. 1) C

2) A, B, or D

3) B or A

4) D, B or A [0.25 each] (1.0)

b. CR1/CR2 = 1-Keff2/1-Keff1

(200/400) (1-.95) = 1-Keff2

.025 = 1-Keff2

.975 = Keff2 (1.0)

c. M = 1/1-Keff = 1/1-0.975 = 40

1/M = 1/40 = 0.025 (0.5)

REFERENCE
GPRTSH, pp 250-257 and 266-270
REM, Part 4

ANSWER 5.05 (3.50)

a. - Radiant (ambient) heat losses.

- Blowdown heat loss.

- Letdown heat loss.

- RCP heat gain. [three required @ 0.5 each] (1.5)

b. Significant RCS temperature changes will affect excore power indication (due to coolant density changes). (0.5)

c. Q Reactor = Delta T = Delta h (or equivalent) [0.5] If Thot is at saturation, the latent heat of vaporization would not be accounted for and reactor power could increase with no corresponding increase in reactor core Delta T. [1.0] (1.5)

REFERENCE
REM, Part 2, pp 1 and 2
General Physics Heat Transfer and Fluid Flow (GPHTFF), p 341

ANSWER 5.06 (3.00)

a. Its fuel pellets will become denser, causing the pellet to clad gap to increase. The decreased heat transfer results in an increased fuel temperature for a given percent power (making Doppler coefficient more negative). (1.0)

b. The pellet to clad gap is reduced by fuel pellet swell (due to the buildup of fission product gasses) and clad creep. This will result in lower fuel temperatures. (1.0)

c. 550 F [0.25] At higher temperatures, decreased moderator density results in an increase in neutron slowing down length. Neutrons will travel a longer distance at resonant energies. [0.75] (1.0)

REFERENCE
GPHTFF, pp 169-170

ANSWER 5.07 (2.00)

a. Increase
b. Decrease
c. Increase
d. Decrease [0.5 each] (2.0)

REFERENCE
GPHTFF, pp 287-329

ANSWER 5.08 (2.00)

a. NO (0.5)

b. Plant efficiency decreases because HP feed heaters are no longer providing an increase in feedwater temperature [0.5]. Reactor power must increase to make up for the lower feedwater enthalpy [0.5]. When steam flow is reduced to maintain reactor power less than 75%, actual megawatt output will be less than or equal to the original value [0.5]. (1.5)

REFERENCE
GPHTFF, pp 143-160

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

ANSWER 5.09 (3.00)

a. -Rod to group alignment. [0.5]
-Groups sequenced and overlapped. [0.5]
-Rod Insertion Limits maintained. [0.5]
-Axial Flux Difference limits maintained. [0.5] (2.0)

b. Fuel overheating or damage may occur. (0.5)

c. Incore Nuclear Instrumentation System. (0.5)

REFERENCE
Salem Technical Specifications, B 3/4 p 2-4

ANSWER 5.10 (2.00)

a. 1) Presence of a flaw (or crack of sufficient size). [0.5]
2) Low temperature [0.5]. (1.0)

b. Neutron exposure (integrated) [0.5] makes the material more brittle (raises NDT) [0.5]. (1.0)

REFERENCE
WNTC Thermodynamics, Volume II, Chapter 13, pp 58-68.
(CAF)

ANSWER 6.01 (4.50)

a. PRT (0.25)

b. -Control RCS pressure (while in solid plant control) [0.5]
-Maintain backpressure (to prevent flashing in orifices) [0.5] (1.0)

c. Prevent damage to resin (by bypassing IX on high temperature) (0.5)

d. ~~-Manual [0.25]~~
-Dilute ~~[0.25]~~ [0.375]
-Alternate Dilute ~~[0.25]~~[0.375] (0.75)

e. -Auto ~~[0.25]~~ [0.33]
~~-Manual [0.25]~~
-Borate ~~[0.25]~~[0.33]
-Alternate Dilute ~~[0.25]~~ [0.33] (1.0)

f. -When RWST suction valves (2SJ1/2) open [0.25] (and/or shut VCT outlet valves)
-SI signal [0.25] (0.5)

g. RCP seals (all pumps) (0.25)

n. RCDT (including VCT as additional answer is not incorrect) (0.25)

REFERENCE
Salem Study Guides, Chapter 6, pp 12,19, and 33-34, Drawings CV-4 and 8
(changes to "d-e" were made after verification of control boards at plant and simulator)

ANSWER 6.02 (3.00)

a. 1. RCP bus undervoltage
2. RCP bus underfrequency
3. RCP breakers open
4. Measured low flow in a loop [0.25 each] (1.0)

b. 1. The P-7 CIRCUIT [0.125] is in effect ABOVE 10% POWER [0.125] to ensure a reactor trip if 2/4 LOOP FLOWS are lost [0.125] for ALL OF THE ABOVE CIRCUITS [0.125]. (0.5)

2. The P-8 CIRCUIT [0.125] will cause a trip for LOW FLOW AND BREAKER OPEN TRIPS [0.125] above 36% power [0.125] for 1/4 LOOPS [0.125]. (0.5)

c. 1. UNDERVOLTAGE causes AUXILIARY FEED PUMPS TO START [0.~~33~~ 5]

2. UNDERFREQUENCY causes ALL RCP BREAKERS TO OPEN [0.~~33~~ 5]

~~3. UNIT ISOLATION TRIP causes GROUP BUS TRANSFER [0.33]~~ (1.0)

REFERENCE
Salem P&ID's, 221054-8-9545-2, sheet 5.

ANSWER 6.03 (3.00)

a. They keep the feedring from draining when flow is stopped, which prevents waterhammer when flow is reinitiated. (1.0)

b. - Provide a method of measuring steam flow.
- Reduce pipe whip during a steamline break.
- Minimize RCS cooldown rate during a steamline break.
- Reduce the mass flow of steam which the stop valve must overcome during a pipe rupture.
[three required 0.33 each] (1.0)

c. - Ammonium hydroxide [0.25] - pH control [0.25]
- Hydrazine [0.25] - Oxygen control [0.25] (1.0)

REFERENCE
Salem Study Guides, Chapter 5, pp 23 and Key 2-3.

ANSWER 6.04 (1.50)

- Electrical heat tracing to keep temperature elevated (> 145 F) [0.5].
- Recirc flow to and from the BAT's (no stagnant fluid) [0.5]
- BIT inlet sparger to promote uniform temperature and boron concentration in the BIT [0.5]. (1.5)

REFERENCE
Salem Study Guides, Chapter 10, K-7.

ANSWER 6.05 (1.50)

a. SI miniflow isolation valve (2SJ67 or 2SJ68) must be closed before the SI pump suction valve (21SJ45) can be open (and vice versa). (0.75)

b. This will prevent radioactive water from the containment sump from recircing to the RWST. This prevents a release to the atmosphere through the RWST vent. (0.75)

REFERENCE
Salem Study Guide, Chapter 10, p. K-4.

ANSWER 6.06 (3.50)

a. Maintain the plant at HSBY after a trip from full load for 8 hours. (with steam discharging to atmosphere concurrent with a loss of offsite power.) (1.0)

b. 1. Demineralized water storage tank.
2. Fresh water and Fire Protection water storage tank.
3. Service water system. (0.75)

c. The S/G inlet control valves (AF-21) close down to maintain a discharge head against which the pump must work. (0.75)

d. - Loss of 125 VDC [0.5]
- Loss of (35 psig) control air [0.5] (1.0)

REFERENCE
Salem Study Guide, Chapter 11, K-2 through 5.

ANSWER 6.07 (3.50)

a. One door must be closed before the other door may be opened. (This prevents both from being opened simultaneously.) (0.5)

b. - CCW Supply to RCP's CIS valves (2CC117 and 118) [0.33]
- RCP's Motor Bearing Cooling Hdr. CIS valves (2CC136 and 187) [0.33]
- RCP's Thermal Barrier Hx outlet CIS valves (2CC131 and 190) [0.33] (1.0)

c. All fans are tripped. They are sequentially started in slow speed. (1.5)

d. All FIVE (0.5)

REFERENCE
Salem Study Guide, Chapter 12, pp K-2-4.

ANSWER 6.08 (2.00)

a. High Radiation signs are actuated at hatches. (0.3)
b. Control Room intake duct isolation. (0.3)
c. - Fuel Handling Area Hi-Rad Evac Alarm.
- Fuel Handling Area Vent Exhaust Filter Units Shift (CAF) (0.6)
d. NONE (0.2)
e. - Blowdown Tank inlet values close (warning)
- Isolates #23 S/G blowdown (high) (0.6)

REFERENCE
Salem Study Guides, Chapter 17, pp 20-47.

ANSWER 6.09 (2.50)

a. (Logic Cabinet) - Oscillator failure
- Slave cycler failure
- Loose circuit card

(Power Cabinet) - Regulator failure
- Phase failure
- Logic error
- Multiplex error
- Loose circuit card [ANY 5, 0.3 each] (1.5)

b. Turbine First Stage Pressure, < 15% [0.5]
Bank D Withdrawal Limit, 228 Steps [0.5] (Any 2 @ 0.5 each) (1.0)

REFERENCE
Salem Study Guide, Chapter 22, pp 71 and K-3.

OTΔT @ 3% < STPT
OPΔT @ 3% < STPT
Hi Flux @ 103% (PRNI)
Hi Flux @ 20% (IRNI)

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

ANSWER 7.01 (4.00)

a. - Manually INITIATE a REACTOR TRIP (with the other trip handle on the control console). [0.6]

- OPEN the REACTOR TRIP BREAKERS manually (by depressing the trip pushbuttons on both Reactor Trip Breakers A and B). [0.6]

- TRIP the TURBINE (by using the trip handle on the control console). [0.6]

- OPEN 4Kv BREAKERS (2E6D and 2G6D) to de-energize the Rod Drive MG sets. [0.6]

- Manually INITIATE SI (and go to "SI Initiation"). [0.6] (3.0)

b. - START BOTH Boric Acid Transfer Pumps in FAST. [0.5]

- OPEN Rapid Boration stop valve (2CV175). [0.5] (1.0)

REFERENCE
Salem Procedures, EI-I-4.3, pp 4 and 5.

ANSWER 7.02 (3.00)

a. Sample supply may be isolated by a Phase A CIS signal. (0.75)

b. Isolation of the monitor prevents an uncontrolled radioactive release via the monitor. (0.75)

c. Immediate shutdown [0.5] because DG cooling will be secured by the CO2 initiation [1.0]. (and CO_2 is a poor cooling medium) (1.5)

REFERENCE
Salem Procedures, EI-I-4.7, pp 5-6.

ANSWER 7.03 (3.00)

a. - Containment Spray Actuation.
- Containment Phase "B" Isolation.
- Main Steam Isolation. [0.75 each] (2.25)

b. The Recirc Stop Valves (CV-139 & 140) must be shut. (0.75)

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

REFERENCE
Salem Procedures, EI-I-4.6

ANSWER 7.04 (3.50)

a. 1. Station operator at Panel 216 (Charging Sys. Panel) [0.4]
2. Establish COMMUNICATION between panels 213 (Hot S/D Panel) and 216. [0.4]
3. At 216, take LOCAL-MANUAL CONTROL of the CHARGING FLOW CONTROL VALVE (CVCS), and MAINTAIN PZR. LEVEL AT 22%. [0.4]
4. Start ONE CENTRIFUGAL CHARGING PUMP in LOCAL CONTROL at 213. [0.4]
5. REMOVE #13 CHARGING PUMP FROM SERVICE by opening the BREAKER ON 2A-4160v VITAL BUS on Aux. Bldg. Elev. 84'. [0.4] (2.0)

b. 1. Verify PRESSURIZER PRESSURE auto controlling at about 2235 psig. [0.5]
2. Verify Tavg less than/equal to 547 F by steam dump or atmos. reliefs. [0.5]
3. Verify S/G level controlling at 60% W.R. (33% N.R.) [0.5] (1.5)

REFERENCE
Salem Emergency Instructions, I-4.10, pp 2-3.

ANSWER 7.05 (3.00)

a. Ensures enough backpressure to provide adequate #2 seal flow. (0.75)

b. With delta P less than 200 psid, the #1 seal may make contact, resulting in excessive wear/damage to the seating surface. (0.75)

c. RCP motors are not designed to dissapate the heat from frequent starts. These limits protect the motor windings from heat damage. (0.75)

d. The lift pump supplies hydraulic and lubrication oil to separate the bearing surfaces and thus prevent thrust bearing wear/damage on startup. (0.75)

REFERENCE
General Operating Procedure II-1.3.1, pp 1-5

ANSWER 7.06 (2.50)

a. - Control rod withdrawl started within 24 hours of the trip.

- RCS temperature has not decreased below 500 F since the trip occured.

- The cause of the trip is known and corrected. (AD-16 Completed) (1.5)

b. Operations Manager (1.0)

REFERENCE
IOP-3, pp 4 and 5

ANSWER 7.07 (2.50)

a. 1) 650

2) 1000

b. 50

c. 320

d. hydrazine [0.5 each] (2.5)

REFERENCE
IOP-2 and 3

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

ANSWER 7.08 (2.00)

a. - New Jersey State Police (NJSP)

- Delaware State Police (DSP)

- ~~NRC Operations Center (NRC)~~ Primary EDO

- ~~Emergency Duty Officer (EDO)~~ Secondary EDO [0.4 each, any three] (1.2)

b. - Senior Shift Supervisor Office

- Control Room 1

- Control Room 2

- Resident NRC Office

- Technical Support Center (TSC)

- Emergency Operations Facility (EOF) [0.2 each, any four] (0.8)

REFERENCE
Emergency Plan, EP-I-1, p 1; and EP-I-11, p 1; EP I-1 Att.4.

ANSWER 7.09 (1.50)

- Leave the area immediately. [0.5]

- Report to Radiation Protection. [0.5]

- You may not work in any radiation area until your exposure has been determined. [0.5] (1.5)

REFERENCE
AP-24, 5.5.2 and (CAF)

ANSWER 8.01 (2.25)

1. The intent of the procedure is not altered.
2. Must be approved by two members [.5] of the plant management staff, at least one of whom holds an SRO license at the Salem Facility. [.25]
3. Change is documented, reviewed (by SORC) [.25], and approved by the Station Manager [.25] within 14 days of implementation. [.25] (2.25)

REFERENCE
Salem Technical Specifications (TS), p. 6-12a

ANSWER 8.02 (2.50)

a. Be in Hot Standby [.5] within 1 hour. [.5] Notify NRC Operations Center (Bethesda) immediately (within 1 hour). (1.25)

b. Reduce pressure [.5] (to less than 2735) within 5 minutes. [.5] Notify NRC Operations Center (Bethesda) immediately (within 1 hour). (1.25)

REFERENCE
TS, pp. 2-1 and 6-12
10 CFR 50, 50.72, pp 50-34 and 34a

ANSWER 8.03 (2.25)

a. 1. Return the governor valve to operable status [0.625]
2. Close at least one valve in the affected steam lead [0.625] (1.25)

b. Prevent missile damage to vital equipment. (1.0)

REFERENCE
TS, p. 3/4 3-53 and B 3/4 3.3

ANSWER 8.04 (3.00)

a. 1 gpm [0.2]--it is sufficiently low to allow for early detection of additional leakage [0.4].

b. 10 gpm [0.2]--allowance for leakage from known sources which would not interfere with detection of unidentified leakage [0.4]

c. 0 gpm [0.2]--may be indicative of an impending gross failure [0.4]

d. 40 gpm (at 2230 psig) [0.2]-- that SI flow will not be less than assumed in accident analysis in event of a LOCA [0.4].

e. 1 gpm [0.2]-- ensures the dosage contribution from tube leakage will be a small fraction of Part 100 limits in event of a SGTR or Steam Line Break [0.4]. (3.0)

REFERENCE
TS, p. B 3/4 4.4

ANSWER 8.05 (3.50)

a. - Restore Tavg to 541 F or greater within 15 minutes OR

- Be in hot standby within the next 15 minutes. [.375] [.375] (1.5)

b. - MTC within analyzed range.

- Protective instrumentation within operating range.

- P-12 interlock above setpoint.

- Pressurizer in operable status with a bubble.

- Rx vessel temperature above minimum RT NDT. [0.4 each] (2.0)

REFERENCE
TS, pp 3/4 1-18 and B 3/4 1-2

ANSWER 8.06 (2.50)

- Immediately suspend core alterations (unloading fuel) [0.5] AND
- Commence boration at 10 gpm of 20K ppm boron solution* [0.5] UNTIL
  - Keff less than or equal to 0.95 [0.5] OR
  - Boron greater than or equal to 2000 ppm [0.5]
  - whichever is most restrictive [0.5] (2.5)

*Rapid or Emergency boration will meet this requirement

REFERENCE
TS, p 3/4 9-1

ANSWER 8.07 (2.00)

	Steady State	Transient
a. 1) Dissolved Oxygen	0.1 ppm	1.0 ppm
2) Chloride	0.15 ppm	1.5 ppm
3) Floride	0.15 ppm	1.5 ppm

(All values are less than or equal to) (0.6)

b. Since (stress) corrosion is time and temperature dependent, time (24 hours) is allowed to restore chemistry parameters prior to taking action. (0.8)

c. Reduce the effects of (stress) corrosion in the RCS. (0.6)

REFERENCE
TS, 3/4 4-20/21 and Bases

ANSWER 8.08 (1.50)

If a tube rupture were to occur, a release will be prevented, since the S/G atmospheric relief setpoint will be below the corresponding saturation pressure for 500 F. (1.5)

REFERENCE
TS, 3/4 4-23 and B 3/4 4-6

ANSWER 8.09 (3.00)

a. - The safety of the reactor is in jeopardy.

- A safety limit has been exceeded.

- Operating parameters exceed any of the RPS setpoints and automatic shutdown does not occur.

[0.75 each] (2.25)

b. Control Room - Unit Control Room, Process and Protection Equipment Rack Room, and Computer Room. (0.75)

REFERENCE
AP-5, pp 2 and 7

ANSWER 8.10 (2.50)

a. -3 Rem/Quarter is NOT exceeded. [0.5]
-Total accumulated dose does not exceed 5(N-18). [0.5]
-Accumulated exposure on record (NRC-4). [0.5] (1.5)

b. - Barricaded and posted as a High Radiation Area.
- Entrance controlled by Radiation Exposure Permit (REP).
- Continuous rate indicating radiation monitoring device. (1.0)
- will accept barricaded & posted above as two answers

REFERENCE
A-24, 6.7.1 and 6.2.4

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

ANSWER 5.01 (2.00)

a. NO [0.25] With HZP and EOL conditions, boron is sufficiently low enough to prevent a positive MTC [0.75]. (1.0)

b. (CAF) (0.5)

c. FALSE (0.5)

REFERENCE
General Physics Reactor Theory Student Handout (GPRTSH), pp 181-183
Reactor Engineering Manual (REM), Part 3, p 1

ANSWER 5.02 (2.50)

a. SAME

b. HIGHER

c. HIGHER

d. SAME

e. LOWER [0.5 each] (2.5)

REFERENCE
GPRTSH, pp 146-148

ANSWER 5.03 (2.50)

a. 1. 2700 to 3125 pcm [0.25]

2. 540 to 640 pcm [0.25] (0.5)

b. 1. Higher fission yield of Xenon precursor [1.0]

2. Higher (thermal) absorption cross section for Xenon [1.0] (2.0)

REFERENCE
GPRTSH, pp 219-231
REM, Figure 6

ANSWER 5.04 (2.50)

a. 1) C Seaman will provide graphs

2) A

3) B

4) D [0.25 each] (1.0)

b. CR1/CR2 = 1-Keff2/1-Keff1

(200/400) (1-.95) = 1-Keff2

.025 = 1-Keff2

.975 = Keff2 (1.0)

c. M = 1/1-Keff = 1/1-0.975 = 40

1/M = 1/40 = 0.025 (0.5)

REFERENCE
GPRTSH, pp 250-257 and 266-270
REM, Part 4

ANSWER 5.05 (3.50)

a. - Radiant (ambient) heat losses.

- Blowdown heat loss.

- Letdown heat loss.

- RCP heat gain. [three required @ 0.5 each] (1.5)

b. Significant RCS temperature changes will affect excore power indication (due to coolant density changes). (0.5)

c. Q Reactor = Delta T = Delta h (or equivalent) [0.5] If Thot is at saturation, the latent heat of vaporization would not be accounted for and reactor power could increase with no corresponding increase in reactor core Delta T. [1.0] (1.5)

REFERENCE
REM, Part 2, pp 1 and 2
General Physics Heat Transfer and Fluid Flow (GPHTFF), p 341

ANSWER 5.06 (3.00)

a. Its fuel pellets will become denser, causing the pellet to clad gap to increase. The decreased heat transfer results in an increased fuel temperature for a given percent power (making Doppler coefficient more negative). (1.0)

b. The pellet to clad gap is reduced by fuel pellet swell (due to the buildup of fission product gasses) and clad creep. This will result in lower fuel temperatures. (1.0)

c. 550 F [0.25] At higher temperatures, decreased moderator density results in an increase in neutron slowing down length. Neutrons will travel a longer distance at resonant energies. [0.75] (1.0)

REFERENCE
GPHTFF, pp 169-170

ANSWER 5.07 (2.00)

a. Increase
b. Decrease
c. Increase
d. Decrease [0.5 each] (2.0)

REFERENCE
GPHTFF, pp 287-329

ANSWER 5.08 (2.00)

a. NO (0.5)

b. Plant efficiency decreases because HP feed heaters are no longer providing an increase in feedwater temperature [0.5]. Reactor power must increase to make up for the lower feedwater enthalpy [0.5]. When steam flow is reduced to maintain reactor power less than 75%, actual megawatt output will be less than or equal to the original value [0.5]. (1.5)

REFERENCE
GPHTFF, pp 143-160

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

ANSWER 5.09 (3.00)

a. -Rod to group alignment. [0.5]
-Groups sequenced and overlapped. [0.5]
-Rod Insertion Limits maintained. [0.5]
-Axial Flux Difference limits maintained. [0.5] (2.0)

b. Fuel overheating or damage may occur. (0.5)

c. Incore Nuclear Instrumentation System. (0.5)

REFERENCE
Salem Technical Specifications, B 3/4 p 2-4

ANSWER 5.10 (2.00)

a. 1) Presence of a flaw (or crack of sufficient size). [0.5]
2) Low temperature [0.5]. (1.0)

b. Neutron exposure (integrated) [0.5] makes the material more brittle (raises NDT) [0.5]. (1.0)

REFERENCE
WNTC Thermodynamics, Volume II, Chapter 13, pp 58-68.
(CAF)

ANSWER 6.01 (4.50)

a. PRT (0.25)

b. -Control RCS pressure (while in solid plant control) [0.5]
-Maintain backpressure (to prevent flashing in orifices) [0.5] (1.0)

c. Prevent damage to resin (by bypassing IX on high temperature) (0.5)

d. -Manual [0.25]
-Dilute [0.25]
-Alternate Dilute [0.25] (0.75)

.375

will delet reference to manual mode

e. -Auto [0.25]
-Manual [0.25]
-Borate [0.25]
-Alternate Dilute [0.25] (1.0)

.53

f. -When RWST suction valves (2SJ1/2) open [0.25]
-SI signal [0.25] (0.5)

g. RCP seals (all pumps) (0.25)

n. RCDT (0.25)

REFERENCE
Salem Study Guides, Chapter 6, pp 12,19, and 33-34, Drawings CV-4 and 8

ANSWER 6.02 (3.00)

a. 1. RCP bus undervoltage
2. RCP bus underfrequency
3. RCP breakers open
4. Measured low flow in a loop [0.25 each] (1.0)

b. 1. The P-7 CIRCUIT [0.125] is in effect ABOVE 10% POWER [0.125] to ensure a reactor trip if 2/4 LOOP FLOWS are lost [0.125] for ALL OF THE ABOVE CIRCUITS [0.125]. (0.5)

2. The P-8 CIRCUIT [0.125] will cause a trip for LOW FLOW AND BREAKER OPEN TRIPS [0.125] above 36% power [0.125] for 1/4 LOOPS [0.125]. (0.5)

c. 1. UNDERVOLTAGE causes AUXILIARY FEED PUMPS TO START [0.33] .5

2. UNDERFREQUENCY causes ALL RCP BREAKERS TO OPEN [0.33] .5

3. UNIT ISOLATION TRIP causes GROUP BUS TRANSFER [0.33] (1.0)

delet item # 3

REFERENCE
Salem P&ID's, 221054-B-9545-2, sheet 5.

ANSWER 6.03 (3.00)

a. They keep the feedring from draining when flow is stopped, which prevents waterhammer when flow is reinitiated. (1.0)

b. - Provide a method of measuring steam flow.
- Reduce pipe whip during a steamline break.
- Minimize RCS cooldown rate during a steamline break.
- Reduce the mass flow of steam which the stop valve must overcome during a pipe rupture.
[three required 0.33 each] (1.0)

c. - Ammonium hydroxide [0.25] - pH control [0.25]
- Hydrazine [0.25] - Oxygen control [0.25] (1.0)

REFERENCE
Salem Study Guides, Chapter 5, pp 23 and Key 2-3.

ANSWER 6.04 (1.50)

- Electrical heat tracing to keep temperature elevated (> 145 F) [0.5].
- Recirc flow to and from the BAT's (no stagnant fluid) [0.5]
- BIT inlet sparger to promote uniform temperature and boron concentration in the BIT [0.5]. (1.5)

REFERENCE
Salem Study Guides, Chapter 10, K-7.

ANSWER 6.05 (1.50)

a. SI miniflow isolation valve (2SJ67 or 2SJ68) must be closed before the SI pump suction valve (21SJ45) can be open (and vice versa). (0.75)

b. This will prevent radioactive water from the containment sump from recircing to the RWST. This prevents a release to the atmosphere through the RWST vent. (0.75)

REFERENCE
Salem Study Guide, Chapter 10, p. K-4.

ANSWER 6.06 (3.50)

a. Maintain the plant at HSBY after a trip from full load for 8 hours. (with steam discharging to atmosphere concurrent with a loss of offsite power.) (1.0)

b. 1. Demineralized water storage tank.
2. Fresh water and Fire Protection water storage tank.
3. Service water system. (0.75)

c. The S/G inlet control valves (AF-21) close down to maintain a discharge head against which the pump must work. (0.75)

d. - Loss of 125 VDC [0.5]
- Loss of 35 psig control air [0.5] (1.0)

REFERENCE
Salem Study Guide, Chapter 11, K-2 through 5.

ANSWER 6.07 (3.50)

a. One door must be closed before the other door may be opened. (This prevents both from being opened simultaneously.) (0.5)

b. - CCW Supply to RCP's CIS valves (2CC117 and 118) [0.33]
- RCP's Motor Bearing Cooling Hdr. CIS valves (2CC136 and 187) [0.33]
- RCP's Thermal Barrier Hx outlet CIS valves (2CC131 and 190) [0.33] (1.0)

c. All fans are tripped. They are sequentially started in slow speed. (1.5)

d. All FIVE (0.5)

REFERENCE
Salem Study Guide, Chapter 12, pp K-2-4.

ANSWER 6.08 (2.00)

a. High Radiation signs are actuated at hatches. (0.3)
b. Control Room intake duct isolation. (0.3)
c. - Fuel Handling Area Hi-Rad Evac Alarm.
- Fuel Handling Area Vent Exhaust Filter Units Shift (CAF) (0.6)
d. NONE (0.2)
e. - Blowdown Tank inlet values close (warning)
- Isolates #23 S/G blowdown (high) (0.6)

REFERENCE
Salem Study Guides, Chapter 17, pp 20-47.

ANSWER 6.09 (2.50)

a. (Logic Cabinet) - Oscillator failure
- Slave cycler failure
- Loose circuit card

(Power Cabinet) - Regulator failure
- Phase failure
- Logic error
- Multiplex error
- Loose circuit card [ANY 5, 0.3 each] (1.5)

b. Turbine First Stage Pressure, < 15% [0.5]
Bank D Withdrawal Limit, 228 Steps [0.5] (1.0)

REFERENCE
Salem Study Guide, Chapter 22, pp 71 and K-3.

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

ANSWER 7.01 (4.00)

a. - Manually INITIATE a REACTOR TRIP (with the other trip handle on the control console). [0.6]

- OPEN the REACTOR TRIP BREAKERS manually (by depressing the trip pushbuttons on both Reactor Trip Breakers A and B). [0.6]

- TRIP the TURBINE (by using the trip handle on the control console). [0.6]

- OPEN 4Kv BREAKERS (2E6D and 2G6D) to de-energize the Rod Drive MG sets. [0.6]

- Manually INITIATE SI (and go to "SI Initiation"). [0.6] (3.0)

b. - START BOTH Boric Acid Transfer Pumps in FAST. [0.5]

- OPEN Rapid Boration stop valve (2CV175). [0.5] (1.0)

REFERENCE
Salem Procedures, EI-I-4.3, pp 4 and 5.

ANSWER 7.02 (3.00)

a. Sample supply may be isolated by a Phase A CIS signal. (0.75)

b. Isolation of the monitor prevents an uncontrolled radioactive release via the monitor. (0.75)

c. Immediate shutdown [0.5] because DG cooling will be secured by the CO2 initiation [1.0]. (1.5)

REFERENCE
Salem Procedures, EI-I-4.7, pp 5-6.

ANSWER 7.03 (3.00)

a. - Containment Spray Actuation.
- Containment Phase "B" Isolation.
- Main Steam Isolation. [0.75 each] (2.25)

b. The Recirc Stop Valves (CV-139 & 140) must be shut. (0.75)

ANSWERS -- SALEM 1&2 -84/05/14-SAILOR, B.

REFERENCE
Salem Procedures, EI-I-4.6

ANSWER 7.04 (3.50)

a. 1. Station operator at Panel 216 (Charging Sys. Panel) [0.4]
2. Establish COMMUNICATION between panels 213 (Hot S/D Panel) and 216. [0.4]
3. At 216, take LOCAL-MANUAL CONTROL of the CHARGING FLOW CONTROL VALVE (CV55), and MAINTAIN PZR. LEVEL AT 22%. [0.4]
4. Start ONE CENTRIFUGAL CHARGING PUMP in LOCAL CONTROL at 213. [0.4]
5. REMOVE #13 CHARGING PUMP FROM SERVICE by opening the BREAKER ON 2A-4160v VITAL BUS on Aux. Bldg. Elev. 84'. [0.4] (2.0)

b. 1. Verify PRESSURIZER PRESSURE auto controlling at about 2235 psig. [0.5]
2. Verify Tavg less than/equal to 547 F by steam dump or atmos. reliefs. [0.5]
3. Verify S/G level controlling at 60% W.R. (33% N.R.) [0.5] (1.5)

REFERENCE
Salem Emergency Instructions, I-4.10, pp 2-3.

ANSWER 7.05 (3.00)

a. Ensures enough backpressure to provide adequate #2 seal flow. (0.75)

b. With delta P less than 200 psid, the #1 seal may make contact, resulting in excessive wear/damage to the seating surface. (0.75)

c. RCP motors are not designed to dissapate the heat from frequent starts. These limits protect the motor windings from heat damage. (0.75)

d. The lift pump supplies hydraulic and lubrication oil to separate the bearing surfaces and thus prevent thrust bearing wear/damage on startup. (0.75)

REFERENCE
General Operating Procedure II-1.3.1, pp 1-5

ANSWER 7.06 (2.50)

a. - Control rod withdrawl started within 24 hours of the trip.

- RCS temperature has not decreased below 500 F since the trip occured.

- The cause of the trip is known and corrected. (1.5)

b. Operations Manager (1.0)

REFERENCE
IOP-3, pp 4 and 5

ANSWER 7.07 (2.50)

a. 1) 650

2) 1000

b. 50

c. 320

d. hydrazine [0.5 each] (2.5)

REFERENCE
IOP-2 and 3

ANSWER 7.08 (2.00)

a. - New Jersey State Police (NJSP)

- Delaware State Police (DSP)

- NRC Opertions Center (NRC)

- Emergency Duty Officer (EDO) [0.4 each, any three] (1.2)

b. - Senior Shift Supervisor Office

- Control Room 1

- Control Room 2

- Resident NRC Office

- Technical Support Center (TSC)

- Emergency Operations Facility (EOF) [0.2 each, any four] (0.8)

REFERENCE
Emergency Plan, EP-I-1, p 1; and EP-I-11, p 1

ANSWER 7.09 (1.50)

- Leave the area immediately. [0.5]

- Report to Radiation Protection. [0.5]

- You may not work in any radiation area until your exposure has been determined. [0.5] (1.5)

REFERENCE
AP-24, 5.5.2 and (CAF)

ANSWER 8.01 (2.25)

1. The intent of the procedure is not altered.

2. Must be approved by two members of the plant management staff, at least one of whom holds an SRO license at the Salem Facility.

3. Change is documented, reviewed (by SORC), and approved by the Station Manager in 14 days of implementation. (2.25)

REFERENCE
Salem Technical Specifications (TS), p. 6-12a

ANSWER 8.02 (2.50)

a. Be in Hot Standby within 1 hour. Notify NRC Operations Center (Bethesda) immediately (within 1 hour). (1.25)

b. Reduce pressure to less than 2735 within 5 minutes. Notify NRC Operations Center (Bethesda) immediately (within 1 hour). (1.25)

REFERENCE
TS, pp. 2-1 and 6-12
10 CFR 50, 50.72, pp 50-34 and 34a

ANSWER 8.03 (2.25)

a. 1. Return the governor valve to operable status [0.625]
2. Close at least one valve in the affected steam lead [0.625] (1.25)

b. Prevent missile damage to vital equipment. (1.0)

REFERENCE
TS, p. 3/4 3-53 and B 3/4 3.3

ANSWER 8.04 (3.00)

a. 1 gpm [0.2]--it is sufficiently low to allow for early detection of additional leakage [0.4].

b. 10 gpm [0.2]--allowance for leakage from known sources which would not interfere with detection of unidentified leakage [0.4]

c. 0 gpm [0.2]--may be indicative of an impending gross failure [0.4]

d. 40 gpm (at 2230 psig) [0.2]-- that SI flow will not be less than assumed in accident analysis in event of a LOCA [0.4].

e. 1 gpm [0.2]-- ensures the dosage contribution from tube leakage will be a small fraction of Part 100 limits in event of a SGTR or Steam Line Break [0.4]. (3.0)

REFERENCE
TS, p. B 3/4 4.4

ANSWER 8.05 (3.50)

a. - Restore Tavg to 541 F or greater within 15 minutes OR

- Be in hot standby within the next 15 minutes. (1.5)

b. - MTC within analyzed range.

- Protective instrumentation within operating range.

- P-12 interlock above setpoint.

- Pressurizer in operable status with a bubble.

- Rx vessel temperature above minimum RT NDT. [0.4 each] (2.0)

REFERENCE
TS, pp 3/4 1-18 and B 3/4 1-2

ANSWER 8.06 (2.50)

- Immediately suspend core alterations (unloading fuel) [0.5] AND
- Commence boration at 10 gpm of 20K ppm boron solution [0.5] UNTIL
  - Keff less than or equal to 0.95 [0.5] OR
  - Boron greater than or equal to 2000 ppm [0.5]
  - Whichever is most restrictive [0.5] (2.5)

REFERENCE
TS, p 3/4 9-1

ANSWER 8.07 (2.00)

	Steady State	Transient
a. 1) Dissolved Oxygen	0.1 ppm	1.0 ppm
2) Chloride	0.15 ppm	1.5 ppm
3) Floride	0.15 ppm	1.5 ppm

(All values are less than or equal to) (0.6)

b. Since (stress) corrosion is time and temperature dependent, time (24 hours) is allowed to restore chemistry parameters prior to taking action. (0.8)

c. Reduce the effects of (stress) corrosion in the RCS. (0.6)

REFERENCE
TS, 3/4 4-20/21 and Bases

ANSWER 8.08 (1.50)

If a tube rupture were to occur, a release will be prevented, since the S/G atmospheric relief setpoint will be below the corresponding saturation pressure for 500 F. (1.5)

REFERENCE
TS, 3/4 4-23 and B 3/4 4-6

ANSWER 8.09 (3.00)

a. - The safety of the reactor is in jeopardy.

- A safety limit has been exceeded.

- Operating parameters exceed any of the RPS setpoints and automatic shutdown does not occur.

[0.75 each] (2.25)

b. Control Room - Unit Control Room, Process and Protection Equipment Rack Room, and Computer Room. (0.75)

REFERENCE
AP-5, pp 2 and 7

ANSWER 8.10 (2.50)

a. -3 Rem/Quarter is NOT exceeded. [0.5]
-Total accumulated dose does not exceed 5(N-18). [0.5]
-Accumulated exposure on record (NRC-4). [0.5] (1.5)

b. - Barricaded and posted as a High Radiation Area.
- Entrance controlled by Radiation Exposure Permit (REP).
- Continuous rate indicating radiation monitoring device. (1.0)

REFERENCE
A-24, 6.7.1 and 6.2.4