U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No. 50-454 License No. CPPR-130

Licensee: Commonwealth Edison Company
Post Office Box 767
Chicago, IL 60690

Facility Name: Byron Nuclear Power Station

Examination Administered At: Byron Nuclear Power Station

Examination Conducted: July 16, 1984

Examiners: T. D. Reidinger — 9/6/84 Date

T. Burdick — 9/6/84 Date

D. Schreiber (J. I. McMillen for) — 9/6/84 Date

Approved By: J. I. McMillen, Chief
Operating Licensing Section — 9/6/84 Date

Examination Summary

Examination administered on July 16, 1984.
The applicants consisted of six RO and eight SRO candidates.
Results: All RO candidates passed and five SRO candidate passed.

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REPORT DETAILS

1. Examiners

   *T. D. Reidinger
   T. Burdick
   D. Schreiber

   *Chief Examiner

2. Examination Review Meeting

   The examination review was conducted by the examiners and facility representatives as follows:

   RO/SRO

   *T. Higgins
   A. Snow
   T. Tulander
   M. Snow

   *Facility Training Manager

   Resolution of Comments on Byron RO Examination

Question	Resolution
1.3.a	The use of a ratio is acceptable in lieu of a word definition. The answer key was changed to accommodate this.
1.5.a	The use of an approximate value in lieu of a word definition is acceptable. The answer key was changed to accommodate this.
2.4.a	The licensee stated that an acceptable answer would be "to isolate excess leakage". The examiner rejects this since the statement is made in the premise. No changes were made to the answer key.
2.12.a	The licensee identified a recent change to procedure altering the correct answer to "through the heat exchanger". The examiner changed the answer key.
3.8.a	The licensee stated that the answer key included responses to Phase A as well as Safety Injection. The examiner stated that he verbally clarified with the examinees that responses to Phase A were also part of the answer. The examiner later entered an additional acceptable answer to the key.

3.11.b The licensee stated that P-7 is initiated by P-13 as well as P-10. The examiner agreed and the answer key was corrected.

3.11.c The licensee stated that C-16 is no longer used. The examiner let the question stand and no changes were made to the answer key.

3.12.a The licensee stated that Phase A can also be initiated manually. The examiner agreed and corrected the answer key.

3.12.b The licensee stated that Main Feedwater does not isolate on Phase A. The examiner agreed and corrected the answer key.

The licensee also stated that the Component Cooling Water pump crosstie does not close on Phase A but the isolation for CCW to the excess letdown heat exchanger does. The examiner agreed and corrected the answer key.

3.12.c The licensee stated Phase B is also manually actuated. The examiner agreed and corrected the answer key.

3.12.d The licensee stated that main steam does not isolate on Phase B. The examiner agreed and corrected the answer key.

3.13.b The licensee stated the correct setpoint is 540 psig. The examiner agreed and corrected the answer key.

Note: Questions in Section 4 were based upon the available references at the time of writing. The licensee provided revised material after the examination was written.

4.2 The licensee stated that the first part of the answer was not applicable as a precaution. The examiner agreed and corrected the answer key.

4.3 The licensee stated the zero power rod insertion limit was incorrect on the answer key. The examiner agreed and corrected the answer key.

4.4 The licensee stated that this precaution is no longer in the procedure due to revision. The examiner let it stand as is.

4.8 The licensee offered a more detailed answer. The examiner did not require this level of answer. No changes were made to the answer key.

4.12 The licensee stated that another possible answer would include hot channel factors. The examiner agreed and corrected the answer key.

Resolution of Comments on Byron SRO Examination

Question	Resolution
5.1	The utility commented that the answer key reference to mass flow rate is not really required for the complete answer. The examiner agreed that secondary mass flow rate is not essential for answer.
5.7.a	The utility commented that the answer key could reference an alternative discussion relating to the temperature difference. The examiner agreed.
6.1.b	The utility provided valves in addition to valve descriptions. The examiner accepted the additional data.
6.7.[illegible]	The utility pointed out that the answer key listed the two modes of control, load control and speed control. Each mode has two conditions which could cause a bumpless transfer. The examiner will accept either mode with the required conditions.
6.8.c	The utility stated that Revision AD of P1D M-64 sheet 5 states valve 1CV131 fails open vice closed. The examiner accepted the revision.
6.8.d	The utility pointed out that there are two valves in the line. One valve has a motor operated valve and fails "as-is" and the other valve is air operated which fails open. The examiner will accept either valve position.
6.8.b	The utility identified that an alternative but similar answer to "failed as is" is "closed" since this is the position the valve would have failed to on the loss of power. The examiner agreed.
6.10	The utility stated that the candidate might provide the location of the switch on the main control board (1PM05J Rx control panel) and 1PM06J (Safeguards panel). The examiner will accept either location.
6.12	The utility identified that the bank position is compared against the rod insert limit versus establishing the bank position. The examiner deleted bank position from answer key.
6.14	The utility stated that the answer key is incorrect. That in fact the SX makeup pumps automatically start on a low level signal. The examiner disagreed. P1D drawing 40[illegible]SX30 reflects that it requires a low-low level for pumps to turn on.

6.16 The utility mentioned that the answer key was too lengthy and detailed. They wished to include additional responses of; (1) CRDM fans running to cool vessel head. The utility also indicated that the steam dump system is normally in steam pressure mode on a trip in addition to aux feed system being controlled in automatic. The examiner disagreed. The systems indicated are directly referenced from the Westinghouse Thermal Hydraulic. In addition BGP 100-1 paragraph 5.b states, "to maintain CRDM fans on whenever RCS temperature exceeds 350°F," so natural circulation initiated from a loss of all AC would preclude use of CRDM fans as the Power supply is non-ESF power supply. The examiner did not accept any of the premises from the utility. Telephone conversation with utility in August reveals that they wish to delete the additional response.

7.3 The utility stated that the answer key should not list "containment conditions normal" as 1BEP-0 lists only four conditions. The examiner disagreed. 1BEP-0 foldout lists "containment conditions normal" as a specific criteria in stopping a safety injection, also Byron lesson plans reflect this same criteria. The examiner will accept the objection due to the fact it is an implied assumption and the emergency procedure itself does not list "containment conditions normal" as a requirement.

7.4 The utility stated that the candidates may not see or recognize that this controller is a PID type. The examiner noted this comment and will amend the answer key to reflect only what is actually required for the answer.

7.6 The utility commented that additional responses could be elicited from the candidate and the responses received will not be "word for word". The examiner noted the comment.

7.10 The utility wished to add another answer; (1) start another feedwater pump. The examiner amended the answer key to reflect the additional answer.

7.13 The utility provided data reflecting the basis for specific steps and cautions in BCA-1 with the intent that S/G water level is the controlling factor for placing steam dump to the off position during a ATWAS. The examiner will accept this answer also and amend the answer key.

7.14 The utility pointed out typographical errors in answer key. The answer key was amended.

7.15 The utility pointed out that the answer would be false if the candidate lists the assumption that BCA-2 tells the operator to monitor the status for information only. The examiner will accept this as an alternative answer if the candidate states the assumption that procedure BCA-2 is the only exception to the requirement.

8.1 The utility objected to the answer key listing only three answers. The utility wishes to include all trips and safeguard actuation systems in Technical Specification Section 3/4-3. The examiner will not accept answers outside the Byron technical manual - Precautions, Limitations and Safety Setting, which lists only three trips that can be bypassed administratively for maintenance on a single channel.

8.10.b The utility provided revised data that Tavg must be $\geq$ 550°F vice $\geq$ 540°F. The examiner amended the answer key.

8.13 The utility pointed out that BAP 300-26 has been cancelled and replaced with BAP 1400-10. This procedure no longer reflects the Shift Engineer's Surveillance Board. This question was deleted.

3. Exit Meeting

The facility representatives from training, operations and plant management, the NRC resident inspector and the examiner met to summarize the results of the oral and simulator examinations. The examiner indicated those that clearly passed. The balance of the results of the oral and simulator examinations conducted by the NRC contractor examiner were to be transmitted to the utility upon the Chief Examiner being notified by the consultant.

U.S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: Byron
REACTOR TYPE: Westinghouse PWR
DATE ADMINISTERED: 7-16-84
EXAMINER: T. Burdick
APPLICANT: ____________________

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 Cat. Value	Category
25	25	_____	_____	1. Principles of Nuclear Power Plant Operation and Fundamentals of Thermodynamics, Heat Transfer, and Fluid Flow
25	25	_____	_____	2. Plant Design Including Safety and Emergency Systems
25	25	_____	_____	3. Instruments and Controls
25	25	_____	_____	4. Procedures - Normal, Abnormal, Emergency and Radiological Control
100	_____	_____	_____	Total

FINAL GRADE: _____%

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

____
Applicant's Signature

MASTER COPY

1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION AND FUNDAMENTALS OF THERMODYNAMICS HEAT TRANSFER AND FLUID FLOW (25)

1.1 Refer to figure 1.1 and answer the following questions:

a. Is the startup rate constant? Explain your answer. (1.0)

b. Would you expect a similar indication on you NI recorder during a startup? Explain. (1.0)

1.2 In preparation for reactor startup, you are directed to dilute the RCS with 400 gallons of water in 100 gallon increments. After completing the first 100 gallon addition, you observe the source range instruments have doubled their count rate. Would you proceed as directed to dilute the plant with a second 100 gallon addition? Explain. (2.0)

1.3 Consider a situation where you and another RO are assigned to perform a 1/M plot during a startup. The rods are pulled out in 50 step increments. After each pull, a 1/M plot is taken by each RO. One individual waits 1 minute while the other waits 2 minutes before determining the plot.

a. How is a 1/M determined? (0.5)

b. How will the two plots differ? Explain why? (1.5)

1.4 Your core is loaded with a significant amount of K excess.

a. What is K excess? (.25)

b. List four (4) reasons for loading K excess. (1.0)

c. Give two (2) methods of suppressing K excess. (0.5)

d. How is the K excess inventory measured over core life? (.25)

1.5 a. How much reactivity is needed to cause prompt criticality in your core? (0.5)

b. Explain why you can or cannot achieve prompt criticality in your core, barring accidents. (1.0)

1.6 Byron Unit 1 has been operating at full power for one month when your crew is directed to backdown to 50% for maintenance work.

a. What inherent reactivity changes will occur? (1.0)

b. Would it be good operating practice to use control rods alone to offset these changes? Explain your answer. (1.0)

1.7 Consider a cooldown of the RCS using Residual Heat Removal. Assuming a constant decay heat rate, will RHR flow through the heat exchanger have to be adjusted to maintain a constant cooldown rate from 350°F to 150°F? Explain your answer. (2.0)

1.8 The Byron core safety limit is established such that at low power the enthalpy of coolant exiting the core will be less than the value for saturated liquid. Why must the enthalpy be maintained below that of saturated liquid? (2.0)

1.9 The Byron Unit 1 is in hot standby mode. As the RO you are directed to stop all but one reactor coolant pump. After completing this task, you notice the remaining pump motor amps have increased somewhat. Give two reasons for this increase in motor current. (2.0)

1.10 a. How does the <u>required</u> suction pressure for the main feedwater pumps change with increasing power? Explain. (1.0)

b. How does the <u>available</u> suction pressure for the main feedwater pumps change with increasing power? Explain. (1.0)

(Assume all necessary pumps are running for full power operation for both questions above.)

1.11 Reproduce typical graphs with labeled axis for:

a. differential rod worth vs. core height (0.5)

b. integral rod worth vs. core height (0.5)

c. critical boron concentration vs. core age (0.5)

d. axial flux vs. core height at full power EOL (0.5)

1.12 In reference to Xenon oscillations:

a. How are they initiated? (two ways) (0.5)

b. What is their adverse affect on the reactor? (0.5)

c. How are they terminated? (two ways) (0.5)

1.13 In the steam cycle:

a. Where does the largest single enthalpy change occur? (0.5)

b. Where does the largest single temperature change occur? (0.5)

c. Does locating feedwater heaters in the condenser improve thermal efficiency? (0.5)

d. Can the steam quality be improved while reducing its BTU content? (0.5)

2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS (25)

2.1 The Byron license operator lesson plans for emergency core cooling specifies SI pump runout flow and head.

a. How are the runout conditions limited by design? (1.0)

b. If these pumps were operated under runout conditions, what effect would this have on them? Give two examples. (1.0)

2.2 Refer to figure 2-2 and determine eight (8) errors in the diagram. Do not consider any omissions as errors. (2.0)

2.3 Match the following with the descriptive statements. Use each statement only once. (2.0)

a. Seal injection flow
b. Letdown flow
c. Spray flow
d. Surge line flow
e. Thermal barrier CCW flow
f. Charging flow
g. RTD bypass flow
h. Pressurizer relief line flow
i. Number 1 seal flow
j. Number 2 seal flow

1. Varies inversely with pressurizer level.
2. Must not be initiated without charging flow.
3. Part of the reactor protection and control system.
4. Dependent upon VCT pressure.
5. May not be sufficient, due to low RCS pressure, to support Reactor Coolant Pump operation.
6. Under normal conditions is zero.
7. Must be available upon loss of seal injection flow.
8. Moves in either direction.
9. Proportional to the RCP labyrinth seal differential pressure.
10. Helps minimize relief valve actuation during transients.

2.4 It becomes necessary to isolate a segment of high pressure letdown piping due to excess leakage.

a. State how and why an alternative path can be/must be established. (1.0)

b. What limits long term operation under these conditions? Two examples required. (1.0)

2.5 The CVCS system incorporates two (2) diversion valves in the letdown stream.

a. Name both of them. (0.5)

b. State the condition under which each will divert automatically. (Setpoint required.) (0.5)

c. State when each must be diverted manually other than for the conditions stated for part b and explain why. (1.0)

2.6 In 1975 the Zion Unit 1 underwent an inadvertent RCS pressure surge while in cold shutdown. The reactor operator isolated RHR from the RCS while leaving a centrifugal charging pump in operation. The RCS pressure increased from 100 to 1100 psig in 10 minutes.

a. How is the Byron Unit 1 protected from overpressurization during cold shutdown conditions? Provide two (2) methods. (1.0)

b. What operating procedure precautions per BGP 100-5 are taken to ensure the protection is afforded in part a above for both methods used? Three required. (1.5)

2.7 a. How is a minimum amount of aux feedwater flow to each steam generator ensured by system design? (1.0)

b. Why is such a design feature necessary? (1.0)

2.8 Describe the normal and two (2) alternate paths of power to an instrument bus from the respective SAT or battery. Include all major components in the flow path except breakers and fuses. (2.0)

2.9 a. Your turbine and diesel generators are distinctly different in many ways. Explain their difference in regards to the following:

1. Field excitation (.25)

2. Generator cooling (.25)

3. Synchronous speed (.25)

4. Load ratings (.25)

b. Can the diesel generators be started without service water cooling? Explain. (1.0)

2.10 How would the loss of a Byron 125 VDC bus affect the plant AC power distribution? (2.0)

2.11 Name the three (3) electrical circuit components designed to automatically interrupt overcurrent. (1.5)

2.12 a. Describe the at-power RHR system flow path. (1.5)

b. When is the RHR/hot leg connection used? (0.5)

2.13 State 2 noncooling functions of the SX system. (1.0)

3. INSTRUMENTS AND CONTROLS

3.1 According to Byron Technical Specifications, the Power Range Nuclear Instrumentation is only required in Modes 1 and 2. In spite of this fact, no more than one channel can ever be removed from service during Modes 3, 4, and 5. Explain Why. (2.0)

3.2 To help provide consistent control affects at all power levels, the rod control system employs a: (1.0)

Choose the correct answer.

a. Linear gain unit

b. Nonlinear gain unit

c. Variable gain unit

d. Proportional gain unit

3.3 The RPS system is reliable due to design. State four (4) design features that help achieve a reliable system. (2.0)

3.4 Concerning digital rod position indication:

a. What stack coil design feature improves the system reliability? (1.0)

b. How, basically, do stack coils work to indicate rod position? (1.0)

3.5 In reference to the incore thermocouples:

a. Why don't they require external power? (1.0)

b. Why must the reference junction temperature be constant? (1.0)

3.6 Explain in detail why there is a need for both hot and cold pressurizer level channels. (2.0)

3.7 State 5 functions provided by each of the two (2) VCT level channels. Setpoints are not required. (2.0)

3.8 a. State the CVCS system actuations caused by a Safety Injection Signal. Six are required. Include phase "A" (1.5)

b. State the two (2) methods used to modulate charging flow. (0.5)

3.9 The steam dump system has three controllers.

a. How do the two (2) temperature controllers differ? Provide four (4) examples. (1.6)

b. Why are neither of these temperature controllers used to maintain T average while the unit is not at power? (0.4)

3.10 If the Main Feedwater Pump net positive suction head is not maintained pump damage results.

a. Name the three (3) inputs to the NPSH circuit. (.75)

b. What parameter is used to determine the NPSH setpoint. (.25)

c. State the four (4) automatic actions that occur when the MNPSH setpoint is reached. (1.0)

3.11 Indicate all the automatic control and/or protection action(s) that occur at the following setpoints.

a. 10^{-10} ion chamber amps increasing (0.4)

b. 10% power increasing (0.4)

c. 553°F T average decreasing (0.4)

d. 564°F T average decreasing (0.4)

e. 82% SG level increasing (0.4)

3.12 a. What signal initiates phase "A" containment isolation? (.25)

b. Which flow paths are affected by phase "A" isolation? (10 required) (1.3)

c. What signal initiates phase "B" containment isolation? (.25)

d. Which flow paths are affected by phase "B" containment isolation? (Two required.) (0.2)

3.13 a. List the signal(s) that actuate the main turbine speed limiter. Include setpoints. (Three required.) (1.2)

b. List the signals that initiate a turbine/reactor trip. Include setpoints. (Two required.) (0.8)

4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL (25)

4.1 The Byron operating procedure BGP 100-3 required the rod control system to be in manual or rods to be greater than 215 steps when at or greater than 90% power. Explain the reason for this requirement. (2.0)

4.2 List the three (3) precautions per BGP 100-5 that should be taken to ensure RCS pressure can be controlled using PCV 131 during solid plant conditions. (1.5)

4.3 In accordance with BGP 100-2, what are the minimum and maximum critical rod heights? (1.0)

4.4 BGP 100-2 cautions the operator to immediately close the feedwater isolation bypass valves should a rapid decrease of 50 psig or greater occur in steam pressure. What are the reasons for this precaution? (Two required.) (1.0)

4.5 The Byron procedure for alternate dilution, BOP CV-6, states that operation of the reactor makeup system in the alternate dilute mode should be limited to one hour. Explain why this limitation is necessary. (2.0)

4.6 In regards to the identification (posting) of radiation areas under what conditions shall the following terms be used?

a. "Danger" (0.5)

b. "Caution" (0.5)

4.7 Following termination, SI may require reinitiation based on three criteria. Name those criteria. Values are not required. (1.5)

4.8 RCP trip criteria is stipulated in the foldout for BEP-0, Reactor Trip or Safety Injection. Name the three (3) criteria. (1.5)

4.9 The required operator action for a tube rupture includes verifying secondary system integrity. List the two (2) criteria as stipulated in BEP-3. (1.0)

4.10 Based upon the priority established through the Byron administrative procedure 300-11, rank the following according to their importance in numerical order from 1 to 5. (1.5)

a. Subcriticality - green

b. RCS inventory - red

c. Heat sink - red

d. Containment - orange

e. Core cooling - yellow

4.11 Concerning Radiation Work Permits.

a. What must each person assigned to perform work requiring an RWP do? (Three requirements.) (.75)

b. Who approves RWP's? (Three required.) (.75)

c. How long are regular and extended RWPs good for? (0.5)

4.12 a. List four (4) symptoms for a dropped rod per BOA ROD-4. (1.0)

b. Why must turbine power be reduced to less than 70% for the dropped rod recovery? (2.0)

4.13 a. For what reason would the refueling foreman request that RH flow be reduced or secured during fuel loading operations? (1.0)

b. What are the restrictions per BAP-300-28 concerning part a above? (Two required.) (1.0)

c. List four (4) alternative cooling methods on a loss of RH per refueling procedure BOA Refuel-4. (1.0)

4.14 a. List eight (8) items to be recorded in the control room log book (per BAP 300-4). (1.0)

b. What is the purpose of blue light lenses? (1.0)

c. When do operators have authority to depart from approved procedures? (per BAP 300-22) Two required. (1.0)

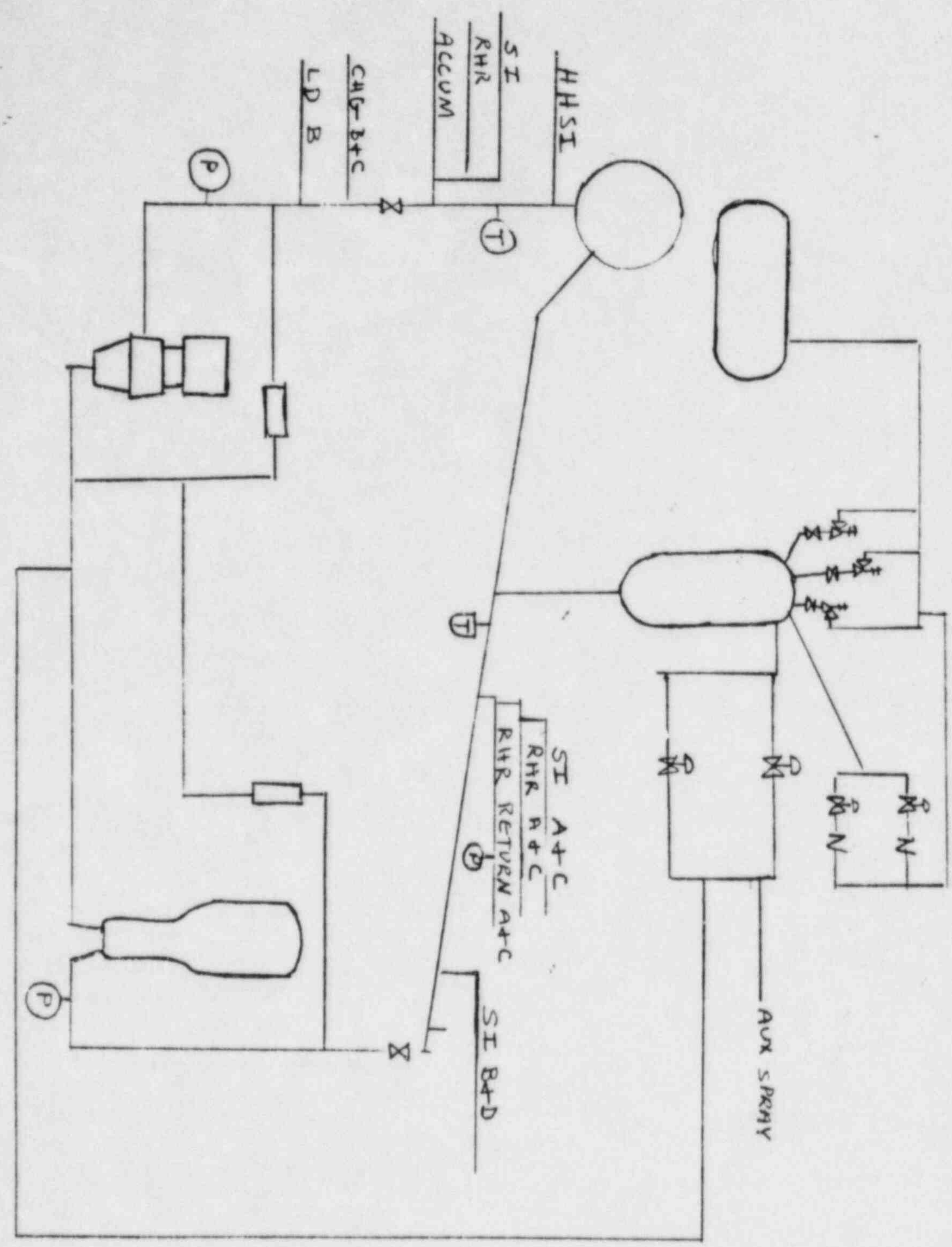

HHSI
SI
RHR
ACCUM
CHG B+C
LP B
SI A+C
RHR A+C
RHR RETURN A+C
SI B+D
AUX SPRAY

Fig 2-2

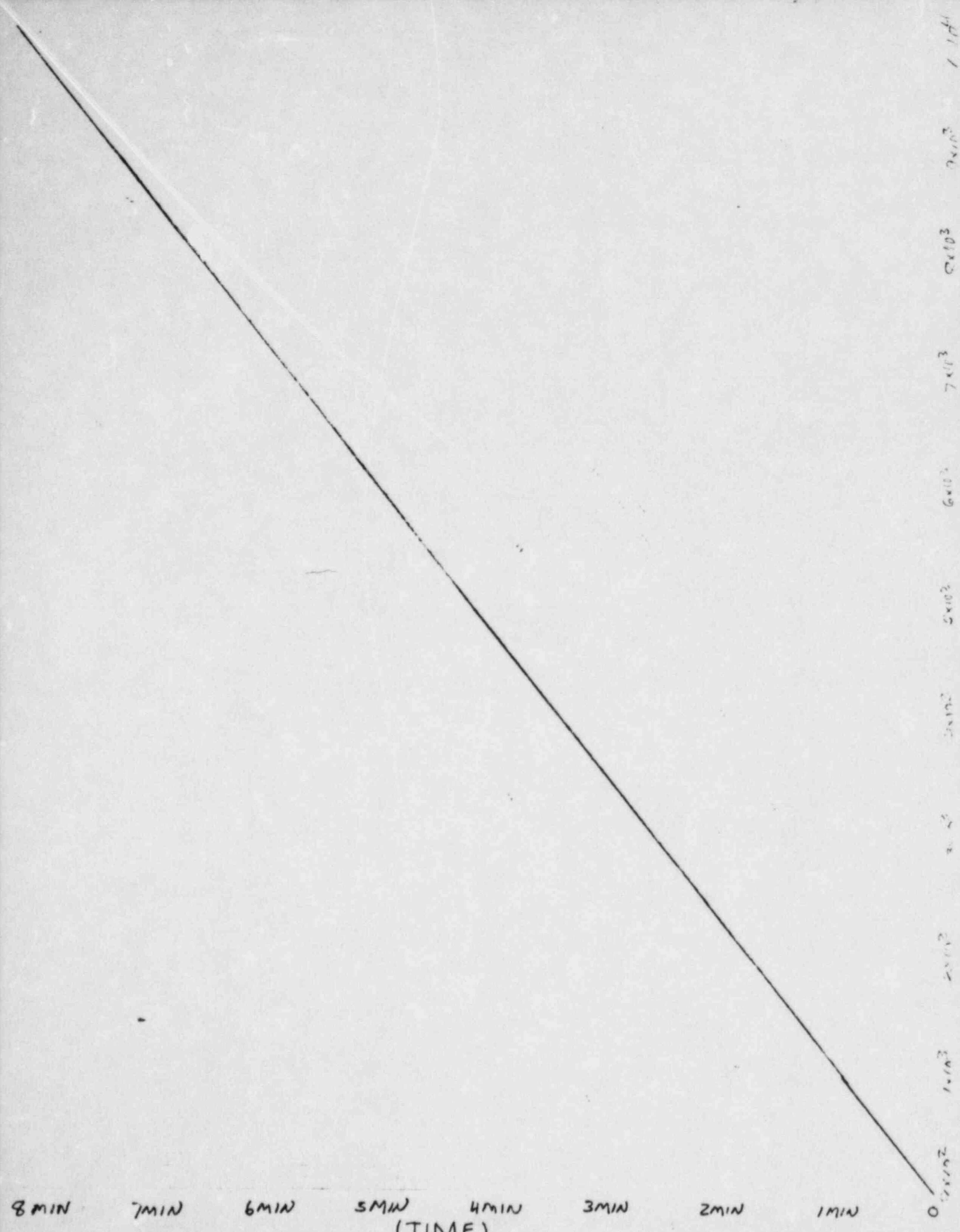

8 MIN
7MIN
6MIN
5MIN
4MIN
3MIN
2MIN
1MIN
0
(TIME)
7x10^3
6x10^3
5x10^3
1x10^3

FIG. 1.1

EQUATION SHEET

$f = ma$

$v = s/t$

Cycle efficiency = (Network out)/(Energy in)

$w = mg$

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

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

$A = \lambda N$

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

$PE = mgh$

$V_f = V_o + at$

$w = \theta/t$

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

$W = v\ \Delta P$

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

$\Delta E = 931\ \Delta m$

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

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

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

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

$Pwr = W_f \Delta h$

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

$TVL = 1.3/\mu$

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

$HVL = -0.693/\mu$

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

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

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

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

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

$\ell^* = 10^{-5}$ seconds

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

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

$I_1 d_1 = I_2 d_2$

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

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

$\Sigma = \sigma N$

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

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

<u>Water Parameters</u>

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 $lbf/in.^2$

<u>Miscellaneous Conversions</u>

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

ANSWERS

BYRON - RO

1.1 a. No. Startup rate is not constant. It is decreasing since it is a logarithmic function. The trace represents a linear rate of rise only. (1.0)

b. No. The NI recorder plots in semi log format with a log power scale. Also SUR would be constant at this level (1.0)
"Yes, shape is similar" is acceptable also

Reference: Westinghouse Reactor Theory

1.2 No. Based upon the inverse linear relationship between SD margin and counts, it appears that the 100 gallon dilution reduced the SDM by 50% since counts have doubled. To proceed would be contrary to good judgement since the second addition would take the reactor supercritical. (2.0)

Reference: Westinghouse Reactor Theory

1.3 a. The ratio of initial counts over final counts versus rod height. (C_o/C_i) (0.5)

b. The two plots were based on different waiting periods. The longer waiting period will result in higher counts. With a higher count rate the 1/M is smaller. The RO who waits longer will predict a critical rod height lower than the other RO does. (1.5)

Reference: Westinghouse Reactor Theory

1.4 a. K-1 = K excess (reactivity). (.25)

b. Fuel temperature affects (1.0)
Fission product poisons
Xenon peaks
Fuel burnup
Moderator temperature affects
(any four)

c. Control rods (0.5)
Burnable poison rods
Soluble boron
(any 2)

d. Equilibrium boron concentration (.25)

Reference: Westinghouse Reactor Theory

1.5 a. A reactivity insertion equal to beta. (0.5)

b. No way of adding reactivity fast enough to achieve prompt critical through design. (1.0)

Reference: Westinghouse Reactor Theory

1.6 a. The xenon will peak and then burn out to the new equilibrium for 50%, adding a net positive reactivity. (0.5)

The power defect will decrease proportionately to the new 50% value, adding positive reactivity. (0.5)

b. No, due to delta flux and rod insertion limits. Boron concentration will have to be adjusted. (1.0)

Reference: Westinghouse Core Physics

1.7 Yes. As the RCS temperature drops, the temperature difference across the RHR heat exchanger also drops. The cooldown rate will be lower as a result. The flow through the HX must be increased to maintain the same heat removal rate. (2.0)

Reference: Westinghouse HTFF

1.8 According to Byron lesson notes this is to ensure the core's actual power output measured by differential temperature is always being accurately measured. If liquid exiting the core were at saturation, then the outlet temperature would not necessarily reflect actual energy content of the liquid or core power based on delta-T. (2.0)

Reference: Byron Lesson Notes

1.9 Stopping the other three (3) pumps has reduced the head against which the remaining pump must work. The result is a higher pump flow thereby requiring a higher motor current. Reverse flow through the idle loop will also contribute to this affect. (2.0)

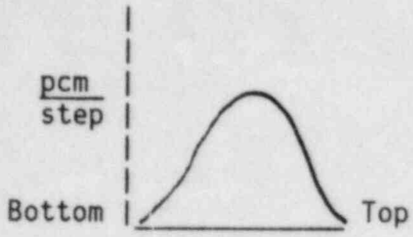
Reference: Westinghouse HTFF

1.10 a. As power increases, the extraction steam to the feed heaters increases in temperature. This causes higher condensate temperature thereby requiring higher suction pressure. (1.0)

b. As power increases the condensate and feedwater system flow increases and pressure at the feed pump suction drops due to increased system headlosses, so available suction pressure decreases. (1.0)

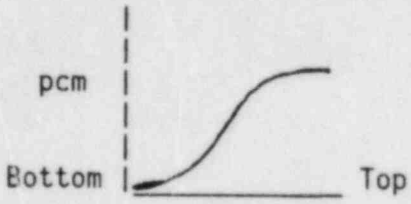
Reference: Byron Lesson Notes

1.11 a.



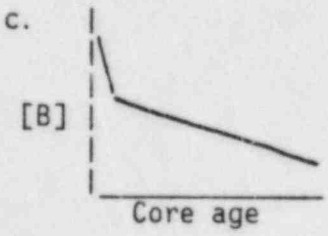
(0.5)

b.



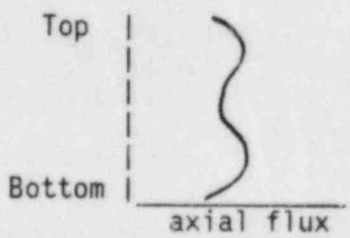
(0.5)

c.



(0.5)

d.



(0.5)

Reference: Westinghouse Core Physics

1.12 a. By a localized regional core flux change induced by rods or temperature redistribution. (0.5)

b. Excessive localized flux peaking. (0.5)

c. Self dampening or the use of control rods. (0.5)

Reference: Westinghouse core physics

1.13 a. In the condenser. (0.5)

b. In the turbine. (0.5)

c. No. (0.5)

d. Yes. (0.5)

Reference: Westinghouse HTFF

<u>Section 2 Answers</u>

2.1 a. Installed orifices are sized to limit runout conditions. (1.0)

Reference: M-61 drawing

b. Pumps cavitation <u>and</u> excessive motor current overheating windings. (1.0)

Reference: Westinghouse HTFF

2.2 1. Pressurizer safeties do not have isolation valves. (2.0)
2. Check valves instead of power operated relief isolation motor valves on pressurizer.
3. Spray from wrong place on RCS loop.
4. Aux spray and loop spray do not tie together before spray valves.
5. RHR return should be RHR suction.
6. RCS hot leg temperature element in wrong place.
7. RCS cold leg temperature element in wrong place.
8. Charging line on wrong side of isolation valve.
9. Charging line A and B, not B and C.
10. Letdown on wrong side of isolation valve.
11. Letdown on Loop C not B.
12. No pressure element on cold leg after RCS pump.

2.3 1. f (2.0)
2. b
3. g
4. j
5. i
6. h
7. e
8. d
9. a
10. c

Reference: Byron Drawing M-60

2.4 a. Place excess letdown in service and reduce charging line flow accordingly. (0.5)

To offset seal injection flow. (0.5)

b. Long term operations are limited by the lack of cleanup abilities in this mode. Possible problems with high coolant activity may result. <u>Also</u>, hydrogen concentration reduced due to bypassing VCT. (1.0)

Reference: BOP CV-9, p. 1

2.5 a. Ion exchanger high temperature diversion (.25)
Volume control tank high level diversion (.25)

b. The high temp diverts at 138°F. (.25)
The high level diverts at 73% level. (.25)

c. The ion exchanger divert valve must be diverted manually when ammonia exceeds 1 ppm to prevent chlorides from leaching out of the beds as ammonia from hydrazine additions is collected by the beds. (0.5)
The level diversion valve must be in divert when a new ion exchange bed is placed in service to prevent diluting the RCS as the new bed borates. (0.5)

Reference: BGP 100-1, p. 18

2.6 a. PORV low temperature setpoint <u>and</u> RHR suction reliefs. (1.0)

b. 1 (PORV isolation valves must be open) <u>and</u> 2 (RHR loop isolations open with breakers open.) 3 ("PORV armed and isolation valve shut" alarm is checked operable.) (1.5)
Also accept placing SI + CCP in pull-to-lock

Reference: Lesson Plan 3 and BGP 100-5

2.7 a. Each feed line to the four steam generators contains an orifice to balance flow thus ensuring a minimum to each generator. (1.0)

Reference: Condensed Notes 14, p. 2

b. To minimize the affect of a failed steam or feed line on one steam generator which would tend to be the path of least resistance for aux feed flow. (1.0)

2.8 (2.0)

	<u>Normal</u>	<u>Alternate 2</u>	<u>Alternate 1</u>
1.	SAT	SAT	125V Battery
2.	SFGD's 4160 Bus (.2)	SFGD's 4160 Bus (.2)	125V dc Bus (.2)
3.	SFGD's 480 Bus (.2)	SFGD's 480 Bus (.2)	Inverter (.2)
4.	SFGD's 480 MCC (.2)	SFGD's 480 MCC (.2)	Instrument Bus
5.	Inverter (.2)	Transformer (.2)	
6.	Instrument Bus	Instrument Bus	

Reference: Byron Lesson Plan and condensed notes

2.9 a. 1. The main generator is excited by a permanent magnet generator whereas the diesel generator is initially flashed by the battery and then provides its own excitation. (.25)

2. Main generator cooling is by way of hydrogen gas and stator cooling water whereas the diesel generator is cooled by air. (.25)

3. The synchronous speed of the turbine is 1800 rpm whereas that of the diesel is 600 (.25)

4. The turbine load rating is 1175/1120 MWe whereas the diesel is rated for 5500 KW continuous and 6050 KW for 2 hours. (.25)

b. Yes it can. (.25) The diesel generator may be required to start without service water cooling since it is an emergency power source for the service water pumps. (.75)

Reference: Byron Lesson Notes

2.10 Loss of 125VDC power renders AC power distribution partially inoperable and unprotected since DC is used to remotely control and cause protective action tripping of major AC circuit breakers. (2.0)

Reference: Byron procedure for loss of dc bus.

2.11 1. breaker (0.5)
2. fuse (0.5)
3. motor controller (thermal overloads) (0.5)

Reference: Byron drawings

2.12 a. 1. From RWST and through the pump (0.5)
2. Around RHR HX (0.5)
3. Through cold leg valves (0.5)

b. 18 hours after the recirc phase begins following an accident. (0.5)

Reference: RHR Lesson Notes, page 11 of 21

2.13 1. Aux feedwater emergency makeup. (0.5)
2. Fire protection emergency makeup. (0.5)

Reference: Byron Lesson Notes, page 11

Section 3 Answers

3.1 If more than one PRNI channel is deenergized, P10 will block source range high voltage causing a loss of source range. Source range is required in modes 3, 4, and 5. (2.0)

Reference: Byron BOA Inst-1, App. A, p. 5

3.2 c (1.0)

Reference: Byron Lesson Notes

3.3
1. Redundant
2. Independent
3. Diverse
4. Fail Safe
5. Testable (4 @ .5 each)

Reference: Byron Lesson Notes page 5

3.4 a. Every other coil is part of a redundant circuit. (1.0)

b. The coils are like a movable core transformer and the rod serves as the core. As the rod moves the transformer output voltage changes. (1.0)

Reference: Byron Lesson Notes pages 9 & 12

3.5 a. An EMF is generated in the TC circuit. (1.0)

b. The accuracy of the TC is dependent upon a constant reference junction temperature. (1.0)

Reference: Byron Lesson Notes page 131, 133

3.6 The pressurizer water volume is proportional to its temperature. (0.5)

The level detectors are differential pressure sensors. (0.5)

They are not sensitive to varying level due to temperature changes in the pressurizer. (0.5)

Therefore, it is necessary to calibrate channels to operate accurately in specific temperature ranges. (0.5)

Reference: Byron Lesson Notes, page 31

3.7 LT-112

1. Indication-MCB
2. Hi level alarm
3. Divert valve modulation
4. Auto makeup start
5. Auto makeup stop
6. Low level alarm
7. Emergency makeup-RWST 2/2
8. Control not in automatic alarm 2/2

LT-185

1. RSD indication
2. Full divert
3. Hi level alarm
4. Low level alarm
5. Emergency makeup-RWST 2/2
6. Control not in automatic alarm 2/2 (10 @ .2 each)

Reference: Byron Lesson Notes pages 21-23

3.8 a. 1. Both CCP's start (.25)
2. VCT outlet valves close (.25)
3. RWST suction valves open (.25)
4. Letdown isolation valves close (.25)
5. Charging isolation valves close (.25)
6. High head SI isolation valves open (.25)
7. [illegible]

Reference: Byron Lesson Notes, page 31

b. 1. PDP speed control (.25)
2. FCV 121 position control (.25)

3.9 a. 1. The load rejection controller is armed by C9 and C7 whereas the trip controller is armed by C9 and C8. (0.4)

2. The load rejection controller compares T-average to T-reference whereas the trip controller compares T-average to T-no load. (0.4)

3. The load rejection controller has a 5°F deadband to allow control rod action. (0.4)

4. The controllers have different gain and setpoints for valve positioning. (0.4)

b. Neither temperature controller is capable of maintaining a setpoint because they are proportional only controllers. (0.4)

Reference: Byron Lesson Notes, page 9

3.10 a. 1. Total FW flow on discharge (.25)
2. FW pump suction pressure (.25)
3. FW pump suction temperature (.25)

b. FW flow (.25)

c. 1. STBY CD/CB pump starts (.25)
2. CD pump recirc valve shuts (.25)
3. GSC bypass valve opens (.25)
4. HD pump FC valves open fully (.25)

Reference: Byron Lesson Notes

3.11 a. P6 - Source Range block permissive. (0.4)

b. P7 - at power trips enabled (0.2)
P10 - SR high voltage blocked (0.2)
- IR and PR trip block permissive
P13 - turbine power

c. C-16, turbine loading stop (0.4)

d. Feedwater isolation after a reactor trip (0.4)

e. P-14, Hi-Hi SG level override (0.4)

Reference: Byron Lesson Notes

3.12 a. Safety Injection actuation. ~~[illegible]~~ or manual (.25)

b.
1. RCP seal leakoff
2. Letdown
3. RCFC chill water
4. ~~CCW pump cross tie~~ CCW excess let down Hx
5. Containment fire protection
6. Containment instrument air
7. Off gas (CAF)
8. Process radiation monitors (CAF)
9. Primary sampling (CAF)
10. Reactor and containment drains
11. Pressurizer nitrogen and gas analyzer
12. Pressure relief tank makeup and gas analyzer
13. Accumulator nitrogen and fill headers
14. Test line to RWST
15. Service air to containment
16. SG blowdown and sampling
17. Waste disposal (CAF)
18. ~~Main feedwater to SG~~'s
19. Containment vent and purge

(~~13~~ 10 @ 0.1 each) .13

c. Containment spray actuation or Hi Hi containment pressure (.25)
~~[illegible]~~ and manual

d. 1. CCW for RCP's (0.2)
2. ~~Main steam~~ ~~(0.1)~~

Reference: T.S., BOP's

3.13 a. 1. Turbine overspeed at 103% (0.4)
2. Generator output breakers open with LP inlet pressure greater than 30%. (0.4)
3. LP inlet pressure 30% greater than generator megawatt output. (0.4)

b. 1. 2/3 ~~1000~~ 540 psig EH pressure (0.4)
2. 4/4 stop valves not fully open (0.4)

Reference: Byron Notes

Section 4 Answers

4.1 In the event of a dropped rod without a scram, the rods would step out in automatic to restore temperature. The risk of exceeding peaking factors at power levels equal to or greater than 90% are high. Therefore, the rods must be out of the core (> 215) or in manual to operate at or above 90%. (2.0)

Reference: BGP 100-3

4.2 1. ~~Open all letdown orifice isolation valves and orifice bypass valve.~~
2. Keep HCS 128 full open.
3. Place 131 in manual before starting or stopping an RHR pump. (1.5)

Reference: Byron Lesson Notes (RCS p. 48) and BGP 100-5, p. 2, 15

4.3 The minimum height is the zero power low rod insertion limit while the upper limit is 228 steps on Bank D. Also low limit = ~~175 to 195~~ on C. *acceptable* [illegible] (1.0)

Reference: Data Book 2.1 and BGP 100-2

4.4 To avoid a high rate steam line isolation or cooldown. (1.0)

4.5 Alternate dilute introduces makeup water to the charging pump suction as well as to the VCT. The water entering the charging pump suction does not absorb hydrogen and therefore the RCS hydrogen concentration may be depleted. (2.0)

Reference: BOP CV-6, E.5

4.6 a. The use of the word "Danger" shall be limited to high radiation areas only. (0.5)

b. The word "Caution" is to be used on all other radiological signs and labels. (0.5)

Reference: BRP 1000-A1 page 10

4.7 1. RCS pressure (0.5)
2. Pressurizer level (0.5)
3. RCS subcooling (0.5)

Reference: IBEP ES-0.3 page 2

4.8 1. Trip any pump which has lost component cooling water flow.
2. Trip all pumps if phase B isolation has initiated.
3. Trip all pumps if ECCS flow equals or exceeds (specified limits) and RCS pressure equals or is less than (specified limits). (1.5)

Reference: Foldout, line 1, BEP-0

4.9 1. Hot leg temperatures all greater than specified limits. (>520)
2. All steam generator pressures greater than specified limits. (>700) (1.0)

4.10 1.	c		a.	5
2.	b		b.	2
3.	d	or	c.	1
4.	e		d.	3
5.	a		e.	4 (1.5)

Reference: BAP 300-11, p. 6

4.11 a. 1. Read and understand the RWP prior to CA entry. (.25)
2. Print his name and initial the original copy prior to CA entry. (.25)
3. Comply with the recommendations of the permit in all respects. (.25)

b. 1. Respective group supervisor (.25)
2. Rad-chem representatives (.25)
3. Shift Engineer or affected SS on duty at time work is performed. (.25)

c. 1. Regular - 24 hours (.25)
2. Extended - 7 days (.25)

Reference: BAP 1000-A1, page 12

4.12 a. 1. Rod bottom lights
2. Rod at bottom alarm
3. Computer alarm
4. Power range channel deviation alarm
5. Bank D withdrawal limit rod stop alarm (1.0)
(Any four)

b. To reduce effects of tilt and allow for power increases as rod is returned to group position. Also to restore temperature. Also to ensure HCF are satisfied. (2.0)

4.13 a. The fuel handling may become difficult due to currents in the vessel caused by RHR. (1.0)

b. Flow may be reduced as long as flow indication is positive. (0.5)
Flow may be secured for 1 hour out of 8. (0.5)

c. 1. Drain and charge (.25)
2. Cavity to fuel pool cooling (.25)
3. SI pump injection (.25)
4. Accumulator injection (.25)

Reference: BOA Refuel-4

4.14 a.
1. mode changes
2. load changes
3. reactivity changes
4. equipment status changes
5. surveillance tests performed
6. reportable occurrences
7. safety related maintenance in progress
8. TS action statement, enter
9. TS action statement, leave
10. GSEP
11. start and stop of RA release
12. pertinent miscellaneous information (any 8 @ .125 each)

Reference: BAP 300-4

b. To indicate the "off" condition for standby redundant equipment. (1.0)

Reference: BAP 399-4

c. Where necessary to prevent or reduce personnel injury including the public or damage to the facility. (1.0)

Reference: BAP 300-22

MASTER

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

FACILITY: Byron
REACTOR TYPE: Westinghouse
DATE ADMINISTERED: July 16, 1984
EXAMINER: T. Reidinger
APPLICANT:

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%.

Category Value	% Of Total	Applicant's Score	% Of Category Value	Category
25	____	____	____	5. Theory of Nuclear Power Plant Operation, Fluids, and Thermodynamics
25	____	____	____	6. Plant Systems Design, Control, and Instrumentation
25	____	____	____	7. Procedures - Normal, Abnormal, Emergency, and Radiological Control
25	____	____	____	8. Administrative Procedures, Conditions, and Limitations
100	____	____	____	TOTALS

Final Grade ________%

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

____
Applicant's Signature

Section 5 - Theory of Nuclear Power Plant Operation, Fluids and Thermodynamics

5.1 Describe how the Δh (enthalpy) changes across the steam generators as reactor power increases from 75% to 100% power. (2.0)

5.2 What is the highest value of the Quadrant Power Tilt Ratio for which no corrective action is required? (0.5)

5.3 Byron Nuclear Station conducted an initial clean core startup to 25% power. A similar Westinghouse nuclear plant conducted the similar startup except that they went to 100% nuclear power. They both maintained their respective power levels constant.

Describe why both plants have equivalent samarium inventories at their respective power levels after 30 days constant power level. (2.0)

5.4 Fuel damage from a loss of coolant accident is strongly core height dependent therefore the F(Q) (total peaking factor) have different limits for each core elevation per Figure 1.

Compare the basis for curve (a) against curve (b). (2.0)

5.5 What would be the major radioactive isotopes released to the reactor coolant system for a fuel rupture accident? (0.5)

5.6 Void formation can occur in the RCS during certain accident conditions while on natural circulation resulting in a phenomenon called "reflux boiling". Explain how reflux boiling cools the reactor core. (2.0)

5.7 A secondary system heat balance is performed to verify the accuracy of the power range instruments. Suppose that after the NI's were adjusted to read 100%, a number of errors were discovered to have been made during the performance of the heat balance. Consider each of the following errors, and explain whether indicated NI power will read greater than, less than, or equal to actual power:

a. Feedwater temperature was improperly recorded as 400°F vice its actual 440°F. (1.0)

b. Actual steam quality is 98% vice its assumed 99.75% because of steam generator moisture separator damage. (1.0)

5.8 As moderator temperature increases from cold shutdown to hot shutdown conditions, describe and explain the effects, if any, on the following:

a. differential boron worth (.75)
b. control rod worth (.75)
c. fuel temperature coefficient (.75)
d. source range channel indication (.75)

5.9 Indicate on your answer sheet whether the following statements are True or False. No explanation is required.

a. For normal Pressurized Water Reactor operation no bulk boiling (saturated nucleate boiling) occurs in the reactor vessel. (.75)

b. As RCS pressure increases, a smaller heat transfer rate (BTU/hr ft^2) occurs with a constant temperature differences (Twall-Tsat). (.75)

c. The point at which the heat transfer coefficient is at its maximum value is called the departure from nucleate boiling. (.75)

d. During normal PWR operation, only the secondary side of the steam generator operates with saturated nucleate boiling. (.75)

5.10 Indicate whether the overtemperature delta-T (OTΔT) <u>and</u> overpower delta-T (OPΔT) <u>setpoints</u> will: <u>increase</u>; <u>decrease</u>; or <u>remain the same</u> if the following operating parameter changes occur. <u>Consider each change independently</u>. STAY the SAME

a. Pressurizer pressure decreases 100 psig. (.75)

b. N-41 lower detector fails high. (.75)

c. Overdilution of the RCS, which causes control rods to insert while maintaining constant turbine generator output. (.75)

d. A loop cold leg bypass (narrow range) RTD fails low with plant at 50% power. (.75)

5.11 a. What is Byron's spontaneous primary fission source? (0.5)

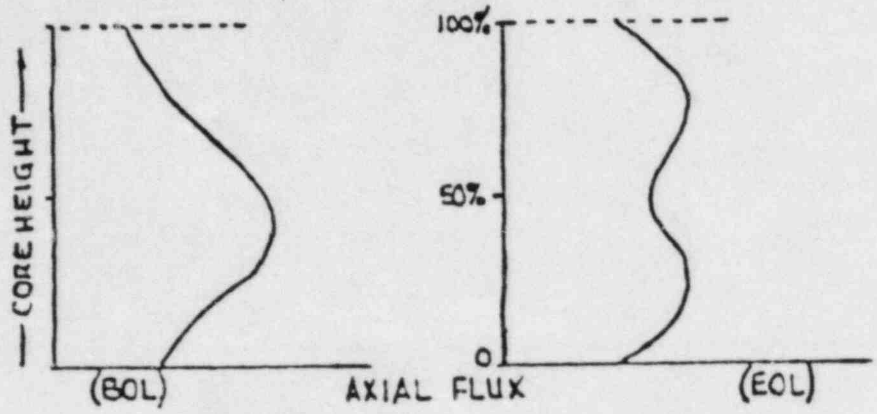
b. What is Byron's Secondary fission source? (0.5)

5.12 Axial xenon oscillations may result in unacceptable power distributions. Explain how axial xenon oscillations are initiated by the combination of boron dilution and an inward rod motion at 100% power. (reactor power remains constant.) (2.0)

5.13 Shown below are typical axial 100% power thermal flux profiles of BOL and EOL conditions.

a. Why does the flux <u>peak</u> shift from the centerline to below the centerline when power is raised from 0% to 100% at BOL? (1.0)

b. Explain the reason for each "FLUX PEAK' on the curve for EOL. (1.0)



STOP!

END OF SECTION 5

CHECK ALL QUESTIONS ARE ANSWERED.

NOW PROCEED TO SECTION 6.

Section 6 - Plant Systems Design, Control, and Instrumentation

6.1 Group 6 monitor light provide usual indications of status of pumps and valves that are actuated in an accident condition.

a. What safety signal/s would cause the Group 6 monitor lights to be actuated (lighted)? (1.0)

b. What components are monitored on Group 6 monitor lights? (2.0)

6.2 Of the following systems, identify whether they are safety related (SR) or non safety related systems (NS).

a. Steam dump control system (.25)
b. Incore instrumentation (thermocouples) (.25)
c. Rod control system (.25)
d. Pressurizer water level control system (.25)
e. RHR system (.25)
f. Diesel fuel oil system (.25)
g. Auxiliary feedwater system (.25)
h. ~~Component~~ CONTAINMENT spray system (.25)

6.3 The 48-inch containment shutdown purge supply and exhaust isolation valves can be used in mode 4 for control of containment pressure. True/False (.75)

6.4 What are the two (2) possible locations where RCP seal return can be sent during an ESF actuation? (1.0)

6.5 What is the only automatic engine shutdown to stop a "runaway" overspeeding diesel? (.75)

6.6 List the protective functions that would only trip the diesel output breaker and not trip the diesel engine during a diesel test or surveillance. (2.0)

6.7 What are two (2) conditions which would cause an automatic bumpless transfer of the main turbine from automatic control to manual control? (2.0)

6.8 List the failed positions of the following valves.

a. Feedwater isolation valve (.75)

b. Steam Generator PORV's (First 60 seconds following restoration of 480 volt ESF power) (.75)

c. Back pressure regulating valve (CV 131) (.75)

d. HP second stage reheat valve to moisture separator reheater (.75)

6.9 2/2 coincidence is required from both level channels LT-112 and LT-185 on the VCT to transfer charging pump suctions to the RWST. True/False. (.75)

6.10 Where can the RO manually initiate "phase B" actuation? (1.0)

6.11 What is the capacity (flow rate) emergency manual boration valve? (.75)

6.12 What inputs (parameters) determine the rod insertion limit? (2.0)

6.13 P-7 - the "AT Power Permissive" can unblock seven reactor trips at 10% power. List 5 of the reactor trips which are unblocked. (2.0)

6.14 SX makeup pump (diesel powered) will automatically makeup to the SX mechanical draft cooling basin on a low level in the basin. True/False. (1.0)

6.15 In what system in the primary plant does the largest observable pressure drop occur? gage or computer anywhere.? (1.0)

6.16 Which systems in the plant must be operated differently than normal during natural circulation? Discuss why it must be operated differently? (2.0)

STOP!

END OF SECTION 6

CHECK ALL QUESTIONS ARE ANSWERED.

NOW PROCEED TO SECTION 7.

Section 7 - Procedures - Normal, Abnormal, Emergency, and Radiological Control

7.1 During recovery from a Steam Generator Tube Rupture in BEP-3 the operator is instructed to isolate AF flow to the ruptured S/G once its' level is in the narrow range.

Why must AF flow be maintained to the ruptured S/G until the U-tubes are covered? (1.0)

7.2 a. List five Technical Specifications that would require a responsive action (hot standby, restorative action, etc.) within one hour. (1.0)

b. List five Technical Specifications if exceeded that would require a responsive action immediately. (1.0)

c. List three Technical Specifications if exceeded that would require a response action in 15 minutes. (1.5)

7.3 List the five (5) termination criteria for stopping a SI. (1.5)

7.4 A precaution in BGP 100-1 states "Starting a RH pump while using RH letdown with RCS solid will cause an inadvertent RCS pressure reduction if PCV-131 is in auto."

Please describe how this pressure reduction occurs? (1.5)

7.5 According to procedure BGP 100-5 the pressurizer PORV's should be placed in the <u>Arm</u> <u>Low</u> <u>Temp</u> mode before decreasing below what RCS temperature? (1.0)

7.6 According to procedure BGP 100-A13 the first out annunciator should be illuminated after a reactor trip.

List 3 causes or possibilities why the first out annunciator won't be illuminated after a reactor trip? (2.0)

7.7 Whose permission/s is required to restart the reactor <u>if</u> the root cause of a reactor trip has not been determined? (1.0)

7.8 Match the following casualties, abnormal conditions and malfunctions to the applicable procedure or guideline. (Answers can be used twice)

___ 1. Loss of Instrument Bus (.35)

___ 2. Natural Circulation Cooldown (no accident) (.35)

___ 3. Void in Reactor Vessel (.35)

___ 4. Loss of all AC power (.35)

___ 5. Anticipated Transient Without Scram (.35)

a. Byron Emergency Procedure
b. Byron Contingency Actions
c. Byron Functional Restoration
d. Byron Operating Abnormal Procedure
e. Byron Emergency Procedure
f Byron Operating Procedure
g. Byron Emergency Procedure Events Specific
h. Byron (BZP)

7.9 List six out of seven conditions which would require emergency boration of the RCS? (2.0)

7.10 Describe the operator actions for a main feedwater pump trip with the plant at 100% power per BOA SEC-1? (2 0)

7.11 During natural circulation with a pure steam bubble in the reactor vessel head, would you advise the RO to open the vents on the head to purge the steam bubble? Yes/No? (0.5) Justify your answer! (1.0)

7.12 a. What is the temperature required for core cooling red path? (1.0)

b. What is the flow rate for heat sink red path? (1.0)

7.13 One of the BCA-1 immediate actions for Anticipated Transient Without Scram is to "place steam dumps in off" after tripping the reactor and turbine but in BEP-0, Rx trip, immediate actions, there are no requirements in placing the steam dumps in off after the Rx trip and turbine trip.

Explain why steam dumps are placed in off position in the ATWAS procedure? (1.5)

7.14 Upon resetting safety injection following verification of a spurious safety injection signal

a. What protective feature(s) is/are lost? (.75)

b. What condition(s) would require operator action (reinitiation) in this situation? (2.0)

7.15 Actions which are required by a red-path BFR will take precedence actions in any BEP, BEP-ESS, BCA procedures. True/False (0.5)

STOP!

END OF SECTION 7

CHECK ALL QUESTIONS ARE ANSWERED.

NOW PROCEED TO SECTION 8.

Section 8 - Administrative Procedures, Conditions and Limitations

8.1 What reactor trip and safeguards actuation circuits can be administratively bypassed for maintenance on a single channel? (1.5)

8.2 a. What is the maximum planned radiation doses in an emergency situation that require personnel to search for and remove injured persons in a high radiation area? (1.0)

b. What is the maximum radiation doses in which to enter a hazardous area to protect valuable equipment? (1.0)

8.3 During the past few months there have been tornados sighted in different areas of Illinois and Wisconsin.

What are the SROs general responsibilities if a tornado warning is in effect? (1.0)

8.4 a. Define radiation area. (1.0)

b. Define High Radiation Area. (1.0)

8.5 List five out of eight reasons for ~~learning~~ leaving a radiation controlled area as quickly as possible. (1.0)

8.6 What emergency action levels automatically require activation of the Technical Support Center. (1.0)

8.7 MR Goodwrench is planning a routine two day repair to an instrument sensing line in containment where the expected whole body dose equivalent will be 97 mrem.

What RWP would you expect him to have? (1.0)

8.8 a. During a Loss of All AC Power, what is the major problem that endangers the safety of the plant? (1.0)

b. What plant system(s)/equipment is available and how is it used to mitigate the consequences of the Loss of all AC Power? (2.0)

8.9 Unit 1 is at 50% load and you are the Control Room Supervisor. The main turbine generator governor valve #3 fails open and the remaining three valves reposition to maintain load at 50%.

a. What two possible actions may be taken to keep the turbine in an operable status? (1.5)

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

8.10 While you are preparing the Main Turbine for parallel to the grid, the NSO informs you that Tavg is 537°F.

a. What options do the Technical Specifications allow you to carry out? (Include any applicable time limits). (1.0)

b. What is the Technical Specification lower temperature limit for operation? (0.5)

c. What is the basis for concern if the reactor is critical and Tavg is 537°F? (Provide <u>three</u> of four possible bases.) (1.5)

8.11 The Quadrant Power Tilt Ratio (QPTR) shall be determined to be within the limit above 50% power by calculating the ratio at least once per 7 days when the alarm is operable. The ratio was calculated under the following schedule:

May 1 - May 8 - May 16 - May 24 - May 31

a. <u>Explain</u> why or why not surveillance time interval requirements were exceeded on May 16. (1.5)

b. <u>Explain</u> why or why not surveillance time interval requirements were exceeded on May 24. (1.5)

8.12 a. Which CSF has the top priority? (1.0)

b. What is the purpose of a BFR? (1.0)

8.13 Who besides the Shift Engineer is permitted to use the Shift Engineer's Surveillance Board? (1.0)

8.14 How many Fire Brigade personnel must be maintained onsite at all times? (1.0)

END OF SECTION 8

REVIEW ENTIRE TEST FOR COMPLETE ANSWERS.

HAND IN EXAMINATION TO EXAMINER

WHEN TIME IS EXPIRED!

MASTER

Answers - Section 5

5.1 Although the saturation temperature of the steam exiting the steam generator decreases slightly as power increases, the temperature of the feedwater increases with power because of the improved effectiveness of the low and high pressure feedwater heaters. Since the feedwater temperature increases, the enthalpy change across the steam generator decreases with power recalling that

$$Q_{S/G} = \dot{m}\,\Delta h$$

a decrease in Δh requires an increase in $\dot{m}$ in order to increase $Q_{S/G}$. As power increases, therefore, the secondary mass flow rate increases. Although, the change in mass flow rate of the secondary system is not completely linear with respect to power, linear approximations are often used for determining flow rates at various power levels.

Ref: p. 13, Chap 12 Thermal-hydraulic Principles and Application to PWR - Westinghouse

5.2 1.02

Ref: T.S.

5.3 The equilibrium Sm-149 inventory is independent of flux or power. The reason why equilibrium inventory of Sm-149 is not dependent upon power level results from the fact that Sm-149 is a stable isotope. The time required for samarium to build up to its equil. value is determined by the power level at which the reactor is operated. If power doubles, the equil. production rate doubles but the equil. removal rate also doubles without requiring any change in samarium concentration. Changes in samarium inventory occur more gradually because of the longer half-life of its precursor. The time required for samarium to build up to its equilibrium value would be on the order of a month. Both plants would have equivalent samarium inventories generally.

Ref: W

5.4 For higher elevations in the core section (b), the correction term K(Z) varies with core height. Between 6 ft and 10 ft the term is reduced to a .94. This reduction accounts for a large LOCA which would uncover the upper half of the core first and reflood it last. A combination of an unward power tilt and a subsequent LOCA could exceed the fuel damage limits. F(Q)(Z) therefore has a reduction or penalty imposed to preclude operating the core with power tilted to the top. In section (a) the highly restrictive values of K(Z) is to preclude high power levels in the last 10"-13" or so in the core. In this area the small break LOCA (3"-4") requires limitation to account for the damage resulting from back pressure increases which could oppose the reflood rate. This restriction could occur if the break size were large enough to cause a blow down of the core area but not large enough to allow the displacement of steam out the break when ECCS starts reflooding the core. This impeding of the reflood water results in additional core damage in the last 10"-13" of the core. These operating limits ensures acceptable power distribution at the start of the accident to ensure that the accident does not cause fuel damage in excess of what the ECCS design criteria stipulated.

Ref: W - Rx Theory

5.5 Xenons, kryptons, iodines, cesiums

Ref: BZP 380-A8

5.6 Reflux boiling is the phenomenon of two phase flow in the RCS where steam entering the S/G U-tubes is condensed and then backflows into the reactor via the hot leg where it picks up additional heat and the process repeats itself.

Ref: QA - Byron 4/26/84

5.7 a. This would cause the enthalpy used in the calculation to be in error low.

Simply = >Q = ṁ h in - h out → recorded h in would be lower thus Δh greater so Q would be higher than actual.

Thus indicated NI power would be higher than actual.

b. h out = $h_F + (h_{Fg})(x)$
if x is less then h out is less therefore Q actual will be lower (Q = ṁ (h in - h out) so indicated power will be greater than actual power.

Ref: Thermal-Hydraulic W

5.8 a. differential boron worth decreases
As temperature increases, water and thus boron density decreases. Boron being displaced out of the core due to water expansion is no longer available for neutron absorption, therefore less neutrons absorbed (less -ρ) with the same ppm concentration.

b. control rod worth increases
As temperature increases, neutrons travel further essentially increasing neutron density. As the neutron population increases in the area of the rod, the rod's effective worth increases.

c. fuel temperature coefficient becomes less negative
As fuel temperature increases, the doppler broadening and self-shielding effects are reduced due to availability of more fuel for neutron absorption. Although the effects of this coefficient are evident mainly after the POAH the coefficient will vary as temperature varies above absolute zero.

d. source range channel indication increases
As temperature increases, neutron leakage from the core causes a higher indicated neutron level. Keff decreases as a result of reactivity changes causing level to decrease, however, the increased leakage predominates.

Ref: Byron Lesson Notes

5.9 a. True
b. False
c. True
d. True

Ref: Chap 4, 13 thermo-hydraulic - PWR

5.10

	OPΔT	OTΔT
a.	→	↓
b.	↓ (or not effect)	↓
c.	↓	↓
d.	→	↑

Ref: Chapter 12 - Thermo-hydraulic PWR

5.11 a. califorium-252
b. antimony - beryllium

Ref: W Rx Theory

5.12 Full power with all rods essentially withdrawn. The operator initiates a boron dilution and allows rods to drive in to compensate for the chemical shim removal to maintain constant reactor power. This skews the power distribution toward the bottom of the core.

High flux in bottom results in xenon burnout and reduced flux in top results in xenon buildup (B).

High flux peak in the bottom of core will eventually result in xenon distribution shifting to bottom of core which drives flux to the top of core (c).

Ref: W - Reactor Theory

5.13 a. This is caused by the axial change in moderator density [more dense (cooler) in bottom, more thermalization] as the moderator is heated from 0% power to 100% power. greater fuel density on top at EOL

b. The peak in the upper portion is a result of fuel depletion in the bottom. The peak in the lower portion is due to higher moderator density.

Ref: B-3, pp. 65-75 (Rx Theory)
B-I-5.54

Section 6 - Answers

containment phase B & containment spray

6.1 a. Group 6 monitors those components which actuate on a high-high or a high-high-high containment pressure signal.

b. The containment spray system components, Containment Isolation Phase B components, and the main steam isolation valves.

Ref: FSAR Chap 7.5 / page 23 of 43 (00801) ECC / page 85 of 88 (00921) R.P. see table 1 on back page of this page

6.2 a. NS
b. NS
c. NS
d. NS
e. SR
f. SR
g. SR
h. SR

Ref: Byron FSAR 7.7 chap - ix page

6.3 False - 48" shutdown purge supply and exhaust isolation valve shall be closed and sealed closed in mode 4

- 8" purge/exhaust system may be used for pressure control

Ref: TS B 3/4 6.3

6.4 RCDT or pressurizer relief tank relief is set at 150#.

Ref: M-64 P&ID drawing

6.5 The auto engine shutdown to stop a "runaway" diesel is the use of the emergency shutdown butterfly valve which shuts off air supply by the overspeed trip governor. (The diesel is running on lube oil leaking past the piston rings.)

Ref: 6 of 44 Vol. 1 Lesson Plan - Diesel

6.6 Generator ground fault
Generator overcurrent
SI DURING DIESEL SURVEILLANCE

Ref: Diesel Lesson Plans p. 37 of 44

6.7 1. load control

a. loss of vital power supply
b. error detected by computer that would hinder auto control

TABLE VI - PHASE B ISOLATION ("P" Signal) - (Continued)

(Initiates Cont Vent Isol)

SYSTEM	COMPONENT	ACTION	NUMBER
CC	Comp Cool to RCP's Cont Isol Vlvs	Close	CC9413A, B
CC	Comp Cool from RCP's Motor Brgs & Pene Cool Cont Isol Vlvs	Close	CC9414, CC9416
CC	Comp Cool from RCP's Thermal Barrier Cont Isol Vlvs	Close	CC685, CC9438
	CONTAINMENT SPRAY ACTUATION (CSAS)		
CS	Containment Spray Pumps	Start	A, B
CS	Cont Spray Discharge Vlvs	Open	CS007A, B
CS	Cont Spray Recirc to Eductor Isol Vlvs	Open	CS010A, B
CS	NaOH Tank to Eductor Isol Vlvs	Open	CS019A, B
CS	Cont Spray from RWST, Sump Isol Vlvs	Open	CS009A, B
	CONTAINMENT VENTILATION ISOLATION		
	(Also received on SI, Manual phase A or B, or Hi Cnmt. Radiation)		
VQ	Cont Purge Supply Isol Vlvs	Close	VQ001A, B
VQ	Cont Purge Exhaust Isol Vlvs	Close	VQ002A, B
VQ	Cont Mini-Flow Purge HVAC Supply Isol Vlvs	Close	VQ004A, B
VQ	Cont Mini-Flow Purge HVAC Exhaust Isol Vlvs	Close	VQ005A, B, C
VQ	Cont Post LOCA Purge Exhaust Isol Vlvs	Close	VQ003

SX	Essential Service Water Pumps	Start	A, B
SX	SX Lube Oil Pumps	Start	A, B
SX	SX to RCFC Chillers Isol Vlvs	Close	SX112A, B
SX	SX from RCFC Chiller Isol Vlvs	Close	SX114A, B
SX	SX Bypass around RCFC Chlrs Isol Vlvs	Open	SX147A, B
SX	SX to RCFC Isol Vlvs	Open	SX016A, B
VP	RCFC Fans	To Slow Speed	

PHASE A INITIATION

	INITIATION	COINCIDENCE	SETPOINT
1.	Manual	1/2	
2.	Any SI		

PHASE B INITIATION
(Initiates Cont. Spray Actuation)

1.	Manual	2/4 *	
2.	Cont Press Hi-3	2/4	20 psig

* Manual actuation is accomplished by actuating either of two sets of switches (2 switches per set). Both switches in a set must be actuated to obtain a manual Phase B isolation.

Page 85 of 88

(0092I)

2. speed control

   a. loss of vital power supply
   b. error detected by computer etc.
   c. loss of 2 speed channels

   Ref: p. 29 of 43 Turbine 7 MSR; p. 21 of 31 EHC

6.8 a. loss of power - failed closed
    b. fail as is - Ref BFR H.5 - precaution (maybe get closed)
    c. ~~closed~~ - Ref DW M-64 (open)
    d. fail open - DWG M-35

    Ref: p. 22 of 47 CD/CB/FW

6.9 True - 5% both levels LT-112 and LT-185 required

    Ref: TP #8 CVCS Lesson Plans

6.10 containment spray/pump switch

    Ref: Lesson Plans

6.11 Manual boration valve 1CV8439 will deliver 10 gpm <u>or less</u> of boration flow.

    Ref: BOA-PRI-2

6.12 a. Inputs 1. ΔT, Dt (auct. high)
     b. ~~2. PA converter - Bank position~~
        3. Tave (auct. high)

    Ref: XP - Rod Insertion Monitor

6.13 1. Low Primary Coolant Flow Trip (2 loop)
     2. RCP Bus undervoltage trip
     3. RCP Bus underfrequency trip
     4. Pressurizer low pressure trip
     5. Pressurizer high water level trip
     6. Turbine trip
     7. RCP breaker trip

    Ref: P. 79 of 88 - 00921 - lesson plans

6.14 ~~False, will make up to basin till fuel is exhausted, no level controller on pump~~ False - it takes lo-lo level [illegible]

    Ref: p. 5 of 25 (00791) SX Chapter

6.15 D/P in CVCS - RCP seals

    Ref: Lesson Plans

6.16 One of these systems is the Pressurizing System. Normally spray comes from one of the reactor coolant loops. In natural circulation, however, there will not be enough driving head for this spray to work. In this case, auxiliary spray from the Chemical and Volume Control System will have to be used. The operator will have to control spray very carefully manually to control pressurizer pressure. During natural circulation it is imperative to make changes to reactor coolant loop temperatures and pressures in a slow manner. Otherwise, the thermal driving head can be upset and natural circulation will stop. If the operator does not control pressurizer pressure correctly, the subcooling temperature may be lost and a bubble or steam void may be formed in the reactor vessel or loops. The operator must prevent pressure from rising to the power operated relief valves opening setpoint. These valves have been known to fail to reseat. A sudden drop in pressure due to a stuck open relief valve could cause flashing in the reactor coolant loop hot leg and a loss of natural circulation. As mentioned, the operator must control pressurizer pressure by controlling auxiliary spray and heaters.
(.5) (.5)

Another system that will have to be controlled differently is the Steam Dump Control System. The reactor coolant average temperature controller will not be functioning properly because of insufficient RTD bypass manifold flow. Therefore, the steam dumps will have to be controlled in the STEAM PRESSURE mode of control. The operator will have to manually make all changes to the system control parameters. Once again, all changes should be made slowly or natural circulation flow may be disrupted.
(.5)

The Auxiliary Feedwater System flow will also have to be controlled manually by the operator. Flow should be controlled so as to maintain a fairly constant level in the steam generators. Overfeeding can cause a rapid cooling down of the steam generator and a disruption to the natural circulation flow int he RCS. As small changes are made to the Steam Dump Control System, small changes should be made to the flow in the Auxiliary Feedwater System. These two systems should be adjusted slowly to provide a slow, steady cooldown rate of the Reactor Coolant System. (.5)

Ref: W thermal-hydraulic

Section 7 - Answers

7.1 To minimize steam condensation from occuring as the rising steam would condense on the U-tube, this would lower pressure in the S/G. As S/G pressure decreases, the break flow rate through the ruptured S/G would increase as the DP between the RCS S/G increased.

7.2 a. Ref. p. 2-1 T/S (1 hour responses)

1 hour

1. T/S 2.1 — Thermal power, pressurizer pressure, Tave exceed specified limit (SAFETY LIMITS)
2. T/S 2.1.2 — RCS pressure > 2735 psig
3. T/S 3.1.3.5 — Shutdown rods not fully withdrawn
4. T/S 3.2.4 — Quadrant power tilt > 1.02 < 1.09
5. T/S 3.3.1 — Power Range - hi/lo setpoint - inoperable (one inoperable rate channel less than total number)
6. T/S 3.3.1 — Source range instrument - shutdown (one channel less than minimum)
7. T/S 3.3.1 — OTΔT
   OPΔT
   Pressurizer Pressure low/high
   S/G level lo/lo
   RCP under volt/under freq.

   See Table 3.3-1 T/S
   3.3-3
   3.3-6
8. T/S 3.3.3.7 — Fire detection instrument - establish a fire watch
9. T/S 3.5.1 — Accumulator inoperable
10. T/S 3.5.3 — One ECCS subsystem inoperable - Mode 4
    3.5.4 — RWST inoperable
11. T/S 3.6.1.1 — Primary containment integrity loss
12. T/S 3.6.1.4 — Primary containment internal pressure outside limits
13. T/S 3.7.10.2 — Foam systems in diesel generator tank room inoperable
14. T/S 3.7.10.3 — Low pressure CO_2 system inoperable
15. T/S 3.7.10.4 — Halon systems in cable room inoperable
16. T/S 3.8.1.1 — AC power sources inoperable mode 1, 2, 3, 4

b. Ref: p. 3/4 1-1 T/S (immediate response)

Immediate -

1. Shutdown margin < 1.3% mode 1, 2, 3, 4 T/S 3.1.1.1
   < 1.0% mode 5
2. Boron injection flow path inoperable - Mode 5/6
3. Borated water source inoperable
4. Digital rod position indicator inoperable Mode 3, 4, 5, with Rx trip breakers closed T/S 3.1.3.2
5. Source range instrument - Startup inoperable (one channel less than minimum)

IMMEDIATE Response

6. Radioactive liquid/gaseous effluent monitoring channel inoperable
7. No RC loop/RHR loop in operation involving a boron reduction
8. AC electrical power source inoperable - Mode 5/6
9. DC bus/charger inoperable - Mode 5/6
10. AC busses inoperable
11. Boron concentration - Keff .95 - Mode 6
12. Source range monitor - Mode 6
13. Containment building penetrations
14. Direct communications during core alterations
15. RHR loop inoperable Mode 6 > 23 ft
16. RHR loop inoperable Mode 6 < 23 ft
17. < 23 feet top of Reactor Vessel
18. < 23 feet top of fuel racks
19. Fuel Handling Building Exhaust Ventilation System
20. Accumulator discharge valve closed

15 Minute Response

c. Ref: p. 3.4 1-6 T/S

1. RCS loop temp (Tavg) < 550°F - Mode 1
2. AFD outside band when thermal power ≥ 90% power
3. FQ(Z) exceeding limits T/S 3, 2, 2
4. One pressurizer code safety inoperable (1-2-3 modes) T/S 3. 4. 2. 1
5. PORV/blocks valves inoperable

7.3 1. Containment conditions normal and
2. RCS pressure > 2000 psig and
3. RCS subcooling > 26°F and
4. Pressurizer level > 25% and
5. Any S/G level > 4%.

Ref: p. 28 of 43 - Vol. 1 Lesson Plans

7.4 PCV-131 uses a PID controller, the differential portion of which will see the starting pressure surge of the RH pump as a major transient, and open PCV-131 too far to stop it, causing a pressure drop.

Ref: BGP 100-1, p. 26 of 43 of Lesson Plans - RH precautions para. 3.c

7.5 380°F

Ref: BGP 100-5 para 34

7.6 1. Reactor Protection Spurious reactor trip
2. Failure of the associated First out Annunciator
3. Reset before being confirmed
4. Rod drive system malfunction (including breakers)
5. Manual trip

Ref: BGP 100-A13 para f.

7.7 Station Superintendent plus one of the following: ~~Operations Manager~~, Operating Manager, Division Vice President or Vice President.

Ref: BGP 100-A13 Section G

7.8 1. d BOA
2. g BEP
3. c BFR
4. b BCA
5. b BCA

Ref: BOA

7.9 1. Control rod bank height < low-low-Rx critical
2. Failure of > 1 RCCA to insert after Rx trip or shutdown
3. Unexplained or uncontrolled reactivity increase
4. Failure of reactor makeup control system
5. Uncontrolled cooldown
6. Insufficient shutdown margin
7. Keff ≥ .95 or less or boron conc. ≤ 2000 ppm during <u>refueling</u>

Ref: BOA PRI-2

7.10 1. Reduce load to less than 560 MW using Fast Action GV lower
2. Verify rods moving in (automatic)
3. Place S/G level controllers in manual if necessary to prevent overfeeding.
4. START AUXILIARY FEED PUMP (WITH CONTROLLERS AND PLACE IN AUTO) EXTRA

Ref: BOA SEC-1

7.11 No! Venting procedure assumes the bubble in head is a hard bubble of noncondensible gases which can be vented.

If steam bubble was vented, the size of the bubble would increase due to pressure decrease and saturation conditions in the upper head.

Ref: 1BFR 1.3 Step 6

7.12 a. > 1200°F - core exit TCs

b. < 485 gpm total AF flow available

Ref: BEP-0

7.13 Steam dumps placed in off to avoid adding positive reactivity during cooldown during the evolutions required to manually trip the reactor and turbine. OR TO MAINTAIN S/G WATER LEVELS

Ref: BCA-1

7.14 a. Auto SI initiation is lost
b. (1) RCS pressure < 1830#
(2) RCS subcooling < 20 | pressurizer level < 10%

Ref: BEP-0, ES-0.3

7.15 True, ACCEPT FALSE IF ASSUMPTION MADE TO REFERENCE BCA-? WHERE CAUTION STATES TO ACQUIRE FOR INFORMATION ONLY.

Ref: BAP 300-11

Section 8 - Answers

8.1 1. Source range high neutron flux trip
2. Intermediate range high neutron trip
3. Containment - hi/hi spray actuation

Ref: Precautions, limitations and setpoint p. 7

8.2 a. 75 rem whole body
200 rem - extremities

b. 25 rem - while body
100 rem - extremities

Ref: B2P 380-1

8.3 (1.) Alert plant personnel
(2.) Start Diesel Generators and run unloaded
(3.) Stop any surveillances that would make any ES equipment inoperable
(4.) Stop fuel handling and (5) processing of radioactive material

Ref: BOA ENV-1

8.4 a. Any area accessible to personnel in which body could receive in hour a dose > 5 mr or in any 5 consecutive days a dose > 100 mr.

b. Area in which body could receive in any one hour a dose > 100 mr.

Ref: BRP 1000-A

8.5 A worker should leave the controlled area as quickly as possible, consistent with safety, for any of the following reasons:

a. When instructed or signaled to do so by the Radiation-Chemistry department.

b. Failure or suspected failure of personal protective equipment.

c. Unexpected deterioration of radiological conditions.

d. In the event that the worker's current accumulated dose equivalent status becomes uncertain for any reason or dose equivalent is equal to the exposure authorized for the job.

e. "Assembly" sirens sound - practice or actual.

f. Completion of work assignment.

g. Injury

h. Unexpected area radiation monitor alarm and the area dose rate is unknown.

Ref: BRP 1000-A1

8.6 1. Alert
2. Site Emergency
3. General Emergency

Ref: BZP 400-1

8.7 The regular RWP. The extended RWP is for > 50 + < 100 for > 2 days.

Ref. BRP 1000-A1

8.8 a. -loss of inventory through the RCP seals
-no means of makeup to the RCS

b. -the AF pump diesel is available to supply AF flow to the Steam Generators

-it is used to cooldown and depressurize the RCS
- S/G PORV relieve pressure ; natural circulation due to elev. design of loop ...

Ref: BCA-2

8.9 a. 1. Return the governor valve to operable status (within 72 hours)

2. Shut the throttle valve associated with #3 governor valve
3. Isolate turbine from stm supply within 6 HRS

b. Missile damage to vital equipment may result from a severe overspeed condition.

Ref: T/S, 3/4.3.4 and Basis

8.10 a. Restore Tave to its limit within 15 minutes or be in Hot Standby within the next 15 minutes.

b. Tavg must be ≥ ~~540~~°F 550°F

c. 1. MTC within analyzed temperature range.
2. Protective instrumentation within normal operating range.
3. Pressurizer operable with steam bubble.
4. Rx pressure vessel above minimum RT NDT temperature.

Ref: T/S 3/4.1.1.4 and Basis

8.11 a. Interval requirements were not exceeded. The time interval of 8 days does not exceed 25% of the specified interval of 7 days.

b. Interval requirements were exceeded. The last 3 consecutive intervals exceed 3.25 times the specified interval.

8.12 a. Subcriticality

Ref: BAP 300-11

b. Direct operator action to recover/restore the degraded safety function dependent on which CSF is challenged and the extent of degradation.

Ref: BAP 300-11

8.13 Operating Surveillance Coordinator or his designee.

Ref: BAP 300-26

8.14 5

Ref: T/S p. 6-1