UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W
ATLANTA, GEORGIA 30303

ENCLOSURE 1

EXAMINATION REPORT

Facility Licensee: Alabama Power Company
P. O. Box 2641
Birmingham, AL 35291

Facility Name: J. M. Farley

Facility Docket Nos. 50-348 and 50-364

Written, simulator and oral examinations were administered at J. M. Farley Nuclear Plant near Ashford, Alabama.

Chief Examiner: Thomas Rogers — Date Signed: 8/24/84

Approved by: Bruce A. Wilson, Section Chief — Date Signed: 8/24/84

Summary:

Examinations on July 10-12, 1984

Oral examinations were administered to ten candidates all of whom passed. Ten candidates were administered written examinations of which nine candidates passed and ten candidates were administered simulator examinations of which nine candidates passed.

REPORT DETAILS

1. Persons Examined

SRO Candidates:

Jessup, Francis M.,
Johnson, John R.
*Lee, Walter H.
Lero, Forest K.
McCoy, David E
Patterson, Raymond L.
Poole, Edmon S.
Ryan, James P.

RO Candidates:

Danberry, Kenneth D.
Long, Ervin B.

*Instructor Certification

Other Facility Employees Contacted:

**J. D. Woodard, Plant Manager
**Lee S. Williams, Training Director
**Richard D. Hill, Operations Superintendent
**Bill Shipman, Assistant Plant Manager

Resident Inspector Contacted:

**W. H. Ruland

2. Examiners:

**#T. Rogers
**J. Whittemore
**G. Jeffries
**L. D. Brooks

#Chief Examiner
**Attended Exit Meeting

3. Examination Review Meeting

At the conclusion of the written examinations, the examiners met with Lee Williams, Thomas Horne, Bob Vanderbye and Chris McLean to review the written examination and answer key. The following comments were made by the facility reviewers:

a. SRO Exam

1. Question 5.09.c

Facility Comment: Candidate may respond 65±3 °F.

NRC Resolution: 65±3 °F is acceptable for full credit. The answer key has been changed to reflect this.

2. Question 6.01.d

Facility Comment: Loop C is excess letdown, not normal letdown.

NRC Resolution: Loop C has been deleted as part of the required response on the answer key.

3. Question 6.08.a

Facility Comment: High-High Radiation should be High Radiation. Supporting reference material was provided during the review.

NRC Resolution: The answer key has been changed to high radiation.

4. Question 6.10.a

Facility Comment: Candidates may respond PT 402 and PT 403 for the loop pressure transmitters.

NRC Resolution: PT 402 and PT 403 is an acceptable response. The answer key has been changed to reflect this.

5. Question 7.02.a

Facility Comment: Candidates may respond 425 psig since it is a limitation. Supporting reference material was provided during the review meeting.

NRC Resolution: The answer key has been changed to accept 400, 400-0 +25 or 402.5 psig for full credit.

b. RO Exam

1. Question 1.06.b

Facility Comment: The answer key should read either:

a. increase or
b. increasing at a lower rate.

NRC Resolution: The answer key has been changed to accept "increase".

2. Question 2.04.c

Facility Comment: The answer key should be changed to "none (75 psig)". Supporting reference material was provided during the review meeting.

NRC Resolution: The answer key has been changed to accept "none (75 psig)".

3. Question 2.08.c

Facility Comment: The answer to the second part of the question should be "none". Supporting reference material was provided during the exam review meeting.

NRC Resolution: The answer key has been changed to "no auto actions".

4. Question 4.04.a

Facility Comment: The answer key should be changed to read "(RHR Pumps may be stopped anytime after the sequencer signal has cleared). The reset is to allow valve operations for (s) signal valves. Supporting reference material was provided during the review meeting.

NRC Resolution: The answer key has been changed to "allow operation of valves affected by (s) signal".

4. NRC Post Grading Review

The following changes have been incorporated to the answer keys to reflect acceptable responses not identified during the facility exam review meeting.

a. SRO Exam

1. Question 5.04.c - "Because of ROD shadowing effect if rod is inserted" was accepted for full credit.

2. Question 5.06.b - "Reduced ΔT across the reactor vessel wall reduces total/thermal/tensile stresses" was accepted for full credit.

3. Question 5.06.b - "Reduced ductility" was accepted for full credit.

4. Question 5.09.b - "Unexplained pressurizer level increase" was accepted for credit.

5. Question 6.01.c - "Loop A" was deleted since it is an alternate changing line, not the normal charging line.

6. Question 6.03.a - "To protect the letdown heat exchanger" was accepted.

7. Question 6.05.a - "LOSP" for UV and "ESS" for SI was accepted.

8. Question 7.04.a - "Trip the reactor if valve operation becomes erratic" was required for full credit.

9. Question 7.10.a - "Yes" was accepted for half credit if the stay time was calculated to verify that five minutes is correct.

b. RO Exam

1. Question 1.11.b - "Worth of most reactive rod" was accepted as one correct answer.

2. Question 2.02.b - "To prevent seal damage was accepted for full credit.

3. Question 2.09 - "Surge tank volume reduces pressure increase from inflow at thermal barrier" was accepted as one correct answer.

4. Question 3.03.b - "P-4" was accepted as one correct answer.

5. Question 4.04.d - "RCS subcooling less than 26°F" was accepted for partial credit.

5. Exit Meeting

At the conclusion of the site visit the examiners met with representatives of the plant staff to discuss the results of the examination. Those individuals who clearly passed the oral and simulator examination were identified.

There were no generic weakness (greater than 75 percent of candidates giving incorrect answers to one examination topic) noted during the oral examination. The cooperation given to the examiners and the effort to ensure an atmosphere in the control room conducive to oral examinations was also noted and appreciated.

ENCLOSURE 3
(1 of 2)

MASTER COPY

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

Reviewed by Utility Reviewers:
1. Lee S. Williams
2. Thomas E. Horne

FACILITY: EARLEY 1&2

REACTOR TYPE: PWR-WEC3

DATE ADMINISTERED: 84/07/10

EXAMINER: JEEBIES, G.

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

FINAL GRADE _____%

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

_____
APPLICANT'S SIGNATURE

QUESTION 1.01 (2.50)

During 100% power operation, it is decided to reduce power by 20% using control rods only for reactivity control.

73 a. Explain HOW AND WHY the axial flux shape will change for the first hour after the power reduction. (1.0)

33 b. Explain HOW AND WHY the flux shape will change over the next 24 hours. Include the effects of control rod movement to maintain power stable. (1.5)

QUESTION 1.02 (3.00)

During a startup the reactor is subcritical at 3000 CPS on the Source Range Instruments when a steam dump valve fails open.

17 a. EXPLAIN what happens to reactor power and Tave until stable conditions are reached with no operator action. (Assume the reactor is undermoderated, at BOL and no reactor trip occurs). (1.5)

58 b. Assume the same transient as above occurs at EOL. EXPLAIN any differences in the power/Tave response and final stable conditions as a result of the increased burnup. (1.5)

QUESTION 1.03 (2.00)

For the following separate conditions, indicate whether rod worth will increase, decrease, or remain the same. Briefly justify your answer.

0 a. Boron concentration is reduced from 1000 ppm to 800 ppm. (1.0)

0 b. Tave is decreased from 547 F to 350 F. (1.0)

QUESTION 1.04 (2.40)

13 Indicate how the following changes in plant conditions would individually affect DNBR (increase, decrease, or have no effect).

a. Pressurizer pressure decreases
b. Cold leg temperature (Tc) decreases
c. Reactor power decreases
d. RCS flow decreases (2.4)

QUESTION 1.05 (2.00)

For the following statements choose the most correct answer:

0 a. The reactivity worth of SAMARIUM at 25% equilibrium power is (greater than/less than/or equal to) the reactivity worth at 100% equilibrium power. (1.0)

0 b. The TOTAL POWER COEFFICIENT (pcm/%power) at BOL is (more negative than/less negative than/or equal to) the power coefficient at EOL. (1.0)

QUESTION 1.06 (3.50)

0 a. Although the U238 resonance capture peaks broaden and flatten with increased fuel temperature, the area under the peak remains the same. Why then is there an increase in neutron capture as the fuel temperature is increased? (1.0)

50 b. Does the fuel temperature coefficient (PCM/F) INCREASE or DECREASE as fuel temperature is increased? (0.5)

38 c. HOW AND WHY does the moderator temperature coefficient (MTC) change (more or less negative) as temperature is increased at a constant boron concentration, in an undermoderated core? (1.0)

0 d. HOW AND WHY does the MTC change as boron concentration is increased at a constant temperature, in an undermoderated core? (1.0)

QUESTION 1.07 (1.00)

0 Why is temperature change not always a good measure of heat added to a fluid such as water? (1.0)

QUESTION 1.08 (1.00)

13 Explain how the starting of a Reactor Coolant Pump in a water-solid plant can cause a pressure transient. (1.0)

QUESTION 1.09 (2.00)

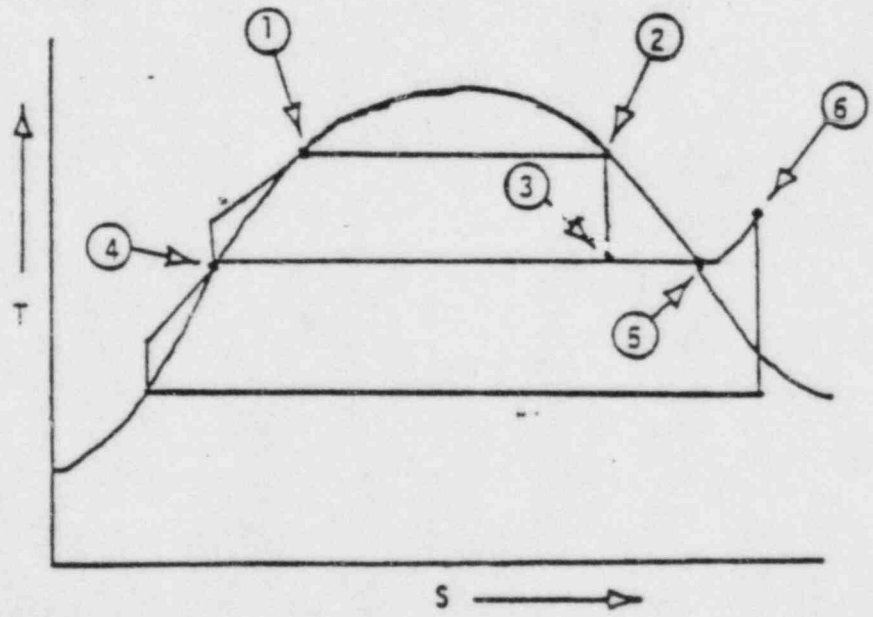
Below is a T-S diagram which closely approximates the steam cycle for your plant. Using the diagram, answer the following questions.

A. What name is given to the energy (enthalpy) GAINED between Points 1 and 2? (0.5)

B. What plant process occurs between Points 3 and 4? (0.5)

C. Why is there a GAIN in STEAM QUALITY between Points 3 and 5? (0.5)

D. What does the line between Points 5 and 6 represent? (0.5)



QUESTION 1.10 (1.50)

Indicate on your answer sheet whether the following statements are TRUE or FALSE. (No explanation is required.)

A. The faster a centrifugal pump rotates, the greater the NPSH required to prevent cavitation. (0.5)

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

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

QUESTION 1.11 (2.50)

a. Explain the effect on SHUTDOWN MARGIN of a 25 ppm boron addition while operating at 50% power and all control systems in automatic. (1.0)

b. List THREE factors other than RCS boron concentration which affect Shutdown Margin and are used to make Shutdown Margin calculations. (1.5)

QUESTION 1.12 (1.60)

What effect does nucleate boiling have on heat transfer in the core (increase, decrease or no effect)? Explain the mechanism of this effect. (1.6)

QUESTION 2.01 (3.00)

a. At what point does each of the three pressurizer spray lines originate? (0.75)

b. What provides the driving force to supply adequate flow through the normal spray line when the spray valves are opened after a load reduction? (1.0)

c. List two reasons for maintaining a small continuous spray flow through the pressurizer spray line. (1.0)

d. Do the pressurizer spray valve closed indicating lights LI-444C & D) indicate actual valve position or controller demand position? (0.25)

QUESTION 2.02 (3.50)

a. What is the purpose of the Reactor Coolant Pump (RCP) No. 1 seal bypass line? (0.5)

b. What are the RCS PRESSURE LIMITATIONS associated with opening the No. 1 seal bypass line valve AND what are the CONSEQUENCES of opening this valve if RCS pressure is not within limits? (1.5)

c. Describe the normal flowpath of No. 3 seal injection water through the RCP. Include supply sources, approximate flowrates through each path and discharge collection points. (1.5)

QUESTION 2.03 (3.00)

a. How is moisture separated from the steam in the steam generators? (Explain how the mechanisms work.) (1.0)

b. What FUNCTION does the inverted J-shaped tubes welded to the feed ring perforations provide AND WHY? (1.0)

c. What are two independent functions of the steam generator steam line exit nozzle flow restrictors? (1.0)

QUESTION 2.04 (2.50)

The relief valves located as noted below protect the charging and letdown portions of the Chemical and Volume Control System. Match the relief valves with its respective tank and setpoints. (Place answers on answer sheet, e. g., f - F,6)

LOCATION	SETPOINT	RELIEVES TO
a. Letdown line downstream of letdown orifices	A. 300 psig	1. Reactor Coolant Drain Tank
b. Letdown line downstream of pressure control valve (PCV-145)	B. 300 psig	2. Pressurizer Relief Tank
c. Volume Control Tank	C. 220 psig	3. Volume Control Tank
d. RCP seal water return line (inside containment)	D. 600 psig	4. Recycle Holdup Tank
e. Charging pump suction line	E. 150 psig	5. Waste Gas Tank

(2.5)

QUESTION 2.05 (3.50)

a. What TWO conditions are necessary to cause Unit 1 Air Compressor A to automatically start with its control switch selected to AUTO? (Assume power to the compressor breaker is available) (0.5)

b. What THREE conditions will cause automatic shutdown of the above air compressor (other than electrical faults) after an Auto start? (0.75)

c. After Auto start of the above air compressor, what conditions cause the compressor to load and to unload? (Consider all positions of the pressure control selector switch and assume no automatic shutdown.) (1.5)

d. What is the backup air supply to the main steam atmospheric relief valves AND WHAT OTHER VALVES are also supplied by this backup system? (0.75)

QUESTION 2.06 (3.00)

23 What are the NORMAL, BACKUP, AND ALTERNATE power supply paths from the 600V LC's to the 120 vital AC instrument distribution panel 1A? Circuit breaker numbers are not necessary. (3.0)

QUESTION 2.07 (2.50)

40 List FIVE independent features that protect the RHR System against overpressure. Include applicable setpoints in your answer. (2.5)

QUESTION 2.08 (2.00)

o a. What are two independent functions of the containment spray system during a major Loss-of-Coolant accident? (0.75)

60 b. What valve position changes occur in the containment spray system when a containment spray actuation signal is received? (Valve numbers not necessary, just valve location or functional description) (0.5)

33 c. What is the cover gas in the spray additive tank and how is this gas prevented from gas binding the spray pumps when the spray additive tank contents are depleted with no operator action? (0.75)

QUESTION 2.09 (2.00)

19 List FOUR independent features that protect the component cooling water system from overpressure if a reactor coolant pump thermal barrier ruptures. (2.0)

QUESTION 3.01 (3.00)

5 a. What TWO automatic actions occur in the condensate/main feedwater system as main feed pump suction pressure decreases to 300 psig? (1.0)

5° b. What conditions cause automatic closure of the steam generator Main Feedwater Stop (Isolation) Valves (3232A,B,C)? (0.5)

17 c. If the steam generator Feed Regulating valves are closed by a protection signal (SSPS), the signal must be cleared to reopen the valves. What are the THREE protection signals that close the valves AND HOW is each cleared? (1.5)

QUESTION 3.02 (2.40)

2 List all EIGHT power range channel N-41 output bistables that are actuated by a signal from the summing amplifier. Include the associated trip setpoints. (2.4)

QUESTION 3.03 (2.80)

13 a. What are the FOUR permissives, by number, that allow MANUAL blocking of a Safeguards Protection signals? (1.6)

0 b. What are the THREE permissives, by number, that AUTOMATICALLY block Safeguard Protection signals? (1.2)

QUESTION 3.04 (2.50)

12 What are the AUTOMATIC ACTIONS that occur on detection of high rediation by the following radiation monitors?

a. Steam Generator Blowdown Purification Outlet Radiation Monitor (RE-23A)

b. Plant Vent Stack Gas Radiation Monitor (RE-14)

c. Containment Purge Exhaust Radiation Monitor (RE-24A & B)

d. Spent Fuel Pool Exhaust Gas Radiation Monitors (RE-25A & B) (2.5)

QUESTION 3.05 (3.00)

Assume three Containment Fan Coolers are operating with all switches lined up for normal power operation when a Loss of Coolant accident occurs and a Safety Injection is actuated.

0 a. What are the automatic actions that affect the fan motor power supply AND WHY are these actions necessary? (1.0)

0 b. What are the automatic actions that affect the Containment Fan Coolers cooling water flow AND WHY are these actions necessary? (1.0)

50 c. What causes the dropout plate on the duct between each fan cooler and its damper to be released AND WHY is this dropout plate removed? (1.0)

QUESTION 3.06 (3.00)

Unit 1 is operating at 75% power with all systems in automatic control. For the following manfunctions, what reactor protective signals will cause the reactor to trip? Provide a BRIEF EXPLANATION why the trip occurs. Assume no operator action and consider each failure independently.

25 a. The controlling pressurizer level channel fails high. (1.5)

42 b. A controlling cold leg temperature detector fails high. (1.5)

QUESTION 3.07 (3.00)

Unit 1 is operating at 45% power with all systems in automatic control. For each of the following conditions, give the direction of inital rod motion AND EXPLAIN why there is rod motion.

0 a. A steam generator Atmospheric Relief Valve fails open. (1.0)

50 b. A feedwater heater string becomes isolated. (1.0)

0 c. The lower detector of the power range channel N-44 fails high. (1.0)

QUESTION 3.08 (3.20)

50 a. Describe the sequence of events that occur to trip the main turbine if a turbine overspeed event occurs over a one minute (slow) interval from 100% (1800 rpm) to 111%. (1.6)

0 b. What are TWO INDEPENDENT reasons for delaying a main generator TRIP AFTER a main turbine trip? (0.8)

13 c. Which main turbine trip does not result in a delayed main generator trip AND WHY? (Assume turbine trip DOES NOT come from from generator trip.) (0.8)

QUESTION 3.09 (2.10)

46 What are the CONDITIONS that will cause AUTOMATIC start of the motor driven auxiliary feedwater pumps? Include INTERLOCK AND SWITCH positions that are necessary for auto start. Setpoints/logics not required for auto start signals. (2.1)

QUESTION 4.01 (2.30)

50 a. If one control rod dropped into the core at 100% power, with rod control in automatic, what would be the proper operator response to stabilize the plant in accordance with AOP 19, Malfunction of a Control Rod? (1.0)

o b. After stabilizing the plant and correcting the cause of the rod drop, prior to recovery of the rod, turbine load is to be reduced in accordance with AOP 19.0. WHY? (0.5)

19 c. Why does an Urgent Failure Alarm occur as the dropped control rod is withdrawn during rod recovery AND HOW is this alarm reset? (0.8)

QUESTION 4.02 (3.00)

Match the trends from Column B that would be indicative of conditions for Column A malfunctions prior to any protective function actuations. There may be more than one Column B item for each Column A item. Place answers on answer sheet (e.g., c-7,8,9).

COLUMN A	COLUMN B
o a. Small Break LOCA Inside Containment	1. Decreasing Pressurizer Level
	2. Decreasing Steam Pressure
10 b. Large Steam Leak Inside Containment	3. Increasing Containment Pressure
	4. Decreasing Tave
	5. Increasing Containment Radiation
	6. Decreasing Pressurrizer Pressure
	7. Near Normal Steam Pressure (3.0)

QUESTION 4.03 (3.50)

0 a. Prior to increasing Tave from Mode 5, your heatup procedure (UOP-1.1) gives you the option NOT to withdraw shutdown banks. What condition must exist prior to taking this option? (0.5)

5° b. If the heatup began with a solid Reactor Coolant System (RCS) condition, at approximately what PRESSURE will a steam bubble be formed in the pressurizer? (0.5)

0 c. What are the maximum allowable pressurizer HEATUP AND COOLDOWN rates? (1.0)

0 d. After the steam bubble is formed in the pressurizer in Mode 5, and prior to further RCS heatup, will the hot calibrated pressurizer level channels indicate HIGHER OR LOWER than actual level? EXPLAIN. (1.0)

2.5 e. Prior to boron dilution operations after the steam bubble is formed in the pressurizer, what operator action should be taken to maintain RCS and pressurizer boron concentration equalized? (0.5)

QUESTION 4.04 (4.00)

The following questions pertain to Procedure EOP-2.0, Loss of Secondary Coolant.

5° a. If RCS pressure stabilizes above 130 psig, Safety Injection is reset. Why? (0.5)

5° b. What are TWO conditions, either of which require shutdown of the Reactor Coolant Pumps? (1.5)

1.3 c. The minimum pressurizer level required to terminate Safety Injection is not the same if containment conditions are abnormal compared to normal. Which condition requires the higher level (abnormal or normal)? WHY? (1.0)

10° d. What conditions are specified for manually re-initiating Safety Injection once it has be initially terminated. (1.0)

QUESTION 4.05 (3.00)

0 a. After a Residual Heat Removal (RHR) pump is started for plant cooldown, but before placing the train in service, the pump is operated on miniflow recirculation for a minimum of 10 min. WHY? (0.5)

63 b. How is a low boron concentration (in an RHR train to be placed in service) corrected? (1.0)

50 c. Would starting an RHR pump, with the CVCS letdown pressure control valve (PCV-145) in automatic, result in a pressure INCREASE OR DECREASE in the Reactor Coolant System (RCS) during solid plant operation? (0.5)

50 d. When establishing a bubble in the pressurizer, WHY must both RHR trains be valved into their respective RCS hot legs? (1.0)

QUESTION 4.06 (3.20)

The following questions refer to immediate actions required by procedure EOP 15.0, Anticipated Transients Without Trip (ATWT).

38 a. What are all the Immediate Operator Actions if a reactor trip does not occur when a trip should have occured? (1.6)

50 b. What are all the Immediate Operator Actions if a turbine trip does not occur following a turbine trip signal? (1.6)

QUESTION 4.07 (2.50)

0 a. WHY is a 30 minute idle period specified after a running Reactor Coolant Pump (RCP) is shutdown prior to a restart? (0.5)

50 b. How is the minimum backpressure of 15 psig maintained on the RCP No. 1 seals AND WHY is 15 psig backpressure necessary? (1.0)

0 c. What CONDITION requires isolation of the RCP No. 1 seal leakoff within 5 minutes? (0.5)

50 d. If the RCP No. 1 seal leakoff is isolated, what further OPERATOR ACTION is necessary if the reactor is at power? (0.5)

QUESTION 4.08 (1.00)

25 a. The Systems Operator is making his rounds on shift and notices that the identification tag is missing from a valve. What should he do (or assure has been done) to correct this condition? (0.5)

5° b. What criteria is used to determine if a "Hold Tag" or a "Caution Tag" should be used on a component? (0.5)

QUESTION 4.09 (2.50)

25 a. What are the Farley Nuclear Plant WEEKLY AND QUARTERLY Administrative External Whole Body Exposure Limits for normal operation without special approvals? (0.8)

5° b. List THREE independent conditions that require a Special Radiation Work Permit. (1.2)

0 c. During a radiological emergency, which Gai-tronics line (channel) is to be used for EMERGENCY messages? (0.5)

$f = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgh$

$V_f = V_o + at$

$W = v\ \Delta P$

$\Delta E = 931\ \Delta m$

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

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

$Pwr = W_f \Delta h$

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

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

$\Sigma = \sigma N$

$v = s/t$

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

$a = (V_f - V_o)/t$

$w = \theta/t$

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

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

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

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

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

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

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

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

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

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

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

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

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

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

$I_1 d_1 = I_2 d_2$

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

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

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

Water Parameters

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

Miscellaneous Conversions

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

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 1.01 (2.50)

a. Flux will be depressed toward the bottom of the core [0.5] due to:
1. Lower control rod level [0.25] and
2. Xenon buildup in top of core [0.25] (1.0)

b. Flux continues to be depressed more and more towards the bottom as Xenon builds in top, then reverses as it decays off [0.75]. Control rod movement to compensate for Xenon changes reduces the flux shift [0.75]. (1.5)

REFERENCE
Farley Reactor Theory Manual, pp I-3.15,3.16,2.10 GLJ 126

ANSWER 1.02 (3.00)

a. The excess steam flow causes Tave to decrease and insert positive reactivity [0.5]. Power rises at increasing rate. At the POAH, negative reactivity from FTC [0.5] and Tave decrease slows [0.2]. Power rise and cooldown continues until reactor power equals steam demand [0.3]. (1.5)

b. Power rise rate higher and time to reach POAH shorter [0.5] due to smaller beta-bar and more negative MTC [0.5]. Final power is the same but temperature will be higher (still below no-load Tave) [0.5] (1.5)

REFERENCE
Farley Reactor Theory Manual, pp I-1.12,1.23, & H-3-7 to 3-10 GLJ 127

ANSWER 1.03 (2.00)

a. Increase [0.5]; less competition [0.5] (1.0)

b. Decrease [0.5]; decreased migration length [0.5] (and increased moderator competition) (1.0)

REFERENCE
Farley Reactor Theory Manual p I-2.13 GLJ 128

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 1.04 (2.40)

a. Decrease
b. Increase
c. Increase
d. Decrease [0.6 each] (2.4)

REFERENCE
Farley Thermodynamics Manual, Fig. 3 GLJ 129

ANSWER 1.05 (2.00)

a. Equal to (1.0)

b. Less negative than (1.0)

REFERENCE
Farley Reactor Theory Manual, pp I-1.28,3.18 GLJ 130

ANSWER 1.06 (3.50)

a. The neutron sees a significant absorption cross section over a wider range of energies (decrease in the fuel self shielding). (1.0)

b. ~~Decrease~~ Increase (at a lower rate) (less negative). (0.5)

c. MTC becomes more negative [0.5] because the density change per F is greater at higher temperatures [0.5]. (1/2 credit given for discussion of expansion/removal of B and mod. as temp. inc.) (1.0)

d. MTC becomes less negative (decreases) [0.5] because the number of boron atoms (poison) in the core decreases more per F change at higher boron concentrations. [0.5] (Also accept relevant discussion of thermal utilization) (1.0)

REFERENCE
Farley Reactor Theory Manual, pp I-1.7 to 1.9 & I-1.17 to 1.23 GLJ 131

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 1.07 (1.00)

If the fluid changes phase, the heat added can increase but the temperature remains constant. (1.0)

REFERENCE
Farley Thermocynamics Manual, Chapter 8, pp 10 GLJ 132

ANSWER 1.08 (1.00)

The idle RCP can develop temperatures in the seal area that are less than steam generator temperatures [0.5]. When the cold slug goes through the steam generators it picks up heat and expands. The thermal expansion in a solid plant causes a pressure increase [0.5]. (1.0)

REFERENCE
AOP-24 GLJ 133

ANSWER 1.09 (2.00)

A. Latent heat of vaporization. (0.5)
B. The removal of EXTRACTION STEAM for feedwater pre-heating. (0.5)
C. Water is removed, making the REMAINING STEAM DRYER and/or results of MSR action and reheating taking place. (0.5)
D. Steam re-heaters adding energy (superheat) to the steam (0.5)

REFERENCE
Farley Thermodynamics Manual, Chapter 2, p 34 GLJ 134

ANSWER 1.10 (1.50)

A. True
B. False
C. False [3 @ 0.5 each] (1.5)

REFERENCE
WEC Thermal Hydraulic Principles and Applications to the Pressurized Water Reactor, Chapter 10, pp 32,38,49, Chapter 11, p 27 GLJ 135

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 1.11 (2.50)

a. SDM is increased [0.5], with power remaining constant, rod position will be higher (and boron concentration will increase). [0.5] (Since SDM is the instantaneous amount of reactivity by which the reactor is, or would be subcritical from its present condition). (1.0)

b. Control Rod Position — Tave
Fuel Burnup (Diff Worth) — Power Level
Xenon — Samarium [Any 3, 0.5 each] (1.5)
(also accept Worth of most reactive rod)

REFERENCE
Farley Reactor Theory Manual, p I-2, Farley Technical Specifications p 1-6 & STP-29.1 GLJ 136

ANSWER 1.12 (1.60)

Increases heat transfer [0.4]. Bubble formation/removal breaks up laminar layer allowing cooler fluid to get to the clad [0.8]. Also, the bubbles carry away latent heat of vaporization which is released in the bulk coolant when the bubbles collapse [0.4]. (1.6)

REFERENCE
Farley Thermodynamics Manual, Chapter 4, p 9, Chapter 5, p 10 & Fig V-1 GLJ 137

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 2.01 (3.00)

a. Loop A cold leg [0.25], Loop B cold leg [0.25] & RCS charging line [0.25]. (0.75)

b. Differential pressure between hot leg and cold leg [0.5] and the velocity head of the loop flow (via scoops that extend into the loop piping) [0.5]. (1.0)

c. 1. Maintain the spray lines warm to decrease thermal shock when the spray valves open [0.5].
2. Maintain uniform chemistry (and temperature) in the pressurizer [0.5]. (1.0)

d. Actual valve position. (0.25)

REFERENCE
Farley Lesson Plans Volume 1, Tab 2 pp 18,19,T-4a, & Fig 14 GLJ 138

ANSWER 2.02 (3.50)

a. To provide additional seal injection flow to cool the pump bearing at low RCS pressure. (0.5)

b. Must be > 100 psig [0.25] to prevent cocking (or unseating) the No. 1 seal [0.5]. Also accept to prevent seal damage
Must be < 1000 psig [0.25] to prevent slamming the No. 1 seal ring against its seat [0.5]. Also accept to prevent seal damage (1.5)

c. -Reactor makeup water (standpipe) supplies 2000 (+/- 400) cc/hr to the No. 3 seal (double dam) [0.5]
-1000 (+/- 200) cc/hr flows through the No. 3 seal to the No. 2 seal leakoff line (to the RCDT) [0.5]
-1000 (+/- 200) cc/hr flow through the No. 3 seal to the normal containment sump [0.5] (1.5)

REFERENCE
Farley Lesson Plans Volume 1, Tab 5, pp 27 to 29 GLJ 139

ANSWERS -- FARLEY 162 -84/07/10-JEFFRIES, G.

ANSWER 2.03 (3.00)

a. Swirl vane separators force the heavier water droplets outward to the barrel surface, where they collect & are routed to the downcomer [0.5]. Chevron separators change the direction of wet steam flow forcing the heavier water droplets to collect on the contour of the separators which then drain to the downcomer [0.5]. (1.0)

b. They maintain water in the feed ring [0.5] to limit thermal shock on the feed ring when initiating flow in a steam generator at high temperature [0.5]. (1.0)

c. Limits steam flow on a steam line rupture event to prevent excessive cooldown of the RCS/reactivity addition [0.5]. Provides a delta-p for steamline flow measurement signal [0.5] (1.0)

REFERENCE
Farley Lesson Plans Volume 1, Tab 4 pp 7 to 10 GLJ 140

ANSWER 2.04 (2.50)

a. D,2

b. ~~B or~~ A,3

c. ~~B,4~~ None (75 psig)

d. E,2

e. C,2 (2.5)

REFERENCE
Farley Lisson Plans Volume 1, Tab 7, pp 16,20,27,33,42 GLJ 141

ANSWER 2.05 (3.50)

a. Remote/Local switch in the Remote position [0.25] and pressure in its respective air receiver reduced to 70 psig [0.25] (0.5)

b. 1. Low oil pressure (<15 psig)
2. High service water temp (>150 F)
3. High air temp (>325 F) [0.25 each] (0.75)

c. To load, the pressure control switch must not be in the Off position [0.25] and then it will load in 15 sec after starting [0.25]. To unload, with the pressure control switch in Air Receiver position [0.25], its air receiver pressure must be raised to > 95 psig [0.25] To unload, with the pressure control switch in the Air Header position [0.25], the air header pressure must be raised to > 100 psig [0.25]. (1.5)

d. Two emergency air compressors provide a backup air supply to the atmospheric relief valves [0.5] and to the TDAFWP steam supply valves [0.25]. (0.75)

REFERENCE
Farley Lesson Plans Volume 6, Tab 3, Fig. 6 and Fig. 10 GLJ 142

ANSWER 2.06 (3.00)

Normal - Emergency 600V LC-1D to 600V MCC-1A to Inverter 1A which supplies 120V to Vital AC-1A instrument distribution panel
Backup - Emergency 600V LC-1D to Battery Charger 1A (or 1C) which supplies 125 V to DC bus 1A to Inverter 1A (and as above)
Alternate - Emergency 600V LC-1D to 600V MCC1B to 600V/208V transformer to SOLA 1A which supplies 120V to Reg AC-1A to Vital AC-1A instrument distribution panel
[1.0 each] (3.0)

REFERENCE
Farley Lesson Plans Volume 4, Tab 1, Fig. 2 & Tab 3 Fig. 2 GLJ 143

ANSWER 2.07 (2.50)

- Each RHRS inlet line has a relief valve that opens at 450 psig [0.5]
- Each RHRS discharge line has a relief valve that opens at 600 psig[0.5]
- Each RHRS inlet line from the RCS hot legs has two isolation valves in series (8701A & B, 8702A & B) that will not open unless RCS pressure is less than 402.5 psig [0.5], and pressurizer vapor space temperature is less than 475 F for one of the valves in each set [0.5]. These valves will automatically close if RCS pressure increases to 700 psig [0.5]. (2.5)

REFERENCE
Farley Lesson Plans Volume 2, Tab 5, pp 5,6,8,9,15 GLJ 144

ANSWER 2.08 (2.00)

a. 1. Reducing containment pressure rapidly following the accident [0.5]
   2. Removal of radionuclides from the containment atmosphere [0.25] (0.75)

b. Each spray pump discharge valve opens and the two parallel outlet valves from the spray additive tank open. (0.5)

c. Nitrogen [0.25]. No auto actions ~~The spray additive tank outlet valve closes on low tank level~~ [0.5]. (0.75)

REFERENCE
Farley Lesson Plan Volume 2, Tab 9, pp 1,2, Fig 6A GLJ 145

ANSWER 2.09 (2.00)

Accept any 4 of the following [0.5 each]
1. Valve (AOV-3184) on CCW return from the RCP thermal barriers closes on high pressure (75 psig) on any of the three RCP thermal barrier heat exchangers.
2. Valve (AOV-3085) on CCW return from the RCP thermal barriers closes on high combined flow (160 gpm) from all three RCP thermal barrier heat exchangers.
3. A check valve on the CCW supply to the thermal barriers prevents back flow/pressurization.
4. High design pressure (2500 psig) of piping between inlet/outlet containment isolation valves.
5. CCW surge tank relief valve sized for maximum leakage from rupture of a RCP thermal barrier. (2.0)
6. Surge tank reduces pressure increase from inflow at thermal barrier

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

REFERENCE
Farley Lesson Plans Volume 3, Tab 4 pp 8,11,17,18, & Fig. 3 GLJ 146

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 3.01 (3.00)

a. Low FWP suction pressure (300 psig) for 10 sec starts the standby condensate pump [0.5]. Low FWP suction pressure pressure (300 psig) for 30 sec causes FWP trip [0.5]. (1.0)

b. Valve auto closes on FWP trip signal from both pumps with control switch in AUTO. (0.5)

c. 1. Hi-Hi S/G level - cleared by closing reactor trip breakers
2. SI - cleared by closing reactor trip breakers
3. Lo Tave & P-4 - cleared by manual reset button (1/2) on the MCB to reset Lo Tave signal [0.5 each] (1.5)

REFERENCE
Farley Lesson Plans Volume 4, Tab 7, pp 28,29,36 & Volume 6, Tab 11, pp 18,19

GLJ 149

ANSWER 3.02 (2.40)

BISTABLES [0.2 each]	SETPOINTS [0.1 each]
1. Overpower Rod Stop	103%
2. Overpower Trip Low	25%
3. Overpower Trip High	109%
4. Positive Rate Trip	+5%/2 sec time constant
5. Negative Rate Trip	-5%/2 sec time constant
6. P-10	10 %
7. P-8	35%
8. P-9	35%

(2.4)

REFERENCE
Farley Lesson Plans, Volume 7, Tab 1, pp T-4A,T-5B,T-5C,T-6 & Fig 5

GLJ 150

ANSWER 3.03 (2.80)

a. P-6, P-10, P-11, P-12 (1.6)

b. P-7, P-8, P-9, P-4 [Any 3, 0.4 each] (1.2)

REFERENCE
Farley Leson Plans Volume 7, Tab 1, pp T-5,T-5A,T-5B,T-5C,T-5D GLJ 151

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 3.04 (2.50)

a. Blowdown inlet isolation valve (FCV-1152) closes [0.5]

b. Gas Waste Discharge valve (RCV-014) closes [0.5]

c. Containment Vent Isolation (Isolation valves close, inlet & outlet dampers close & supply/exhaust fans trip) [0.5]

d. Fuel Bldg Isolation (Fuel Building supply/exhaust fans trip, supply/exhaust dampers close) [0.5] and starts special exhaust/ filtration of spent fuel pool area (All four penetration room filtration/exhaust and recirculation fans start/dampers open with suction on spent fuel pool area) [0.5] (2.5)

REFERENCE
Farley Lesson Plans Volume 5, Tab 5, p 25, Tab 6, p 11, Tab 9, p T-2 & Fig. 2,4,5 GLJ 152

ANSWER 3.05 (3.00)

a. The operating CFC's fast speed breakers open on SI signal and all CFC slow speed breakers close on ESF Sequencer signal to reduce steam damage (blade erossion) to the fan (Also accept to prevent motor overload). (1.0)

b. Service water discharge valves (10") open in parallel with the normal discharge line (6"), increasing service water flow (from 800 to 2000 gpm) to provide additional cooling and depressurization of the containment atmosphere. (1.0)

c. A fusible link will melt (135 F) due to elevated containment temperature, releasing the dropout plate to reduce steam damage to the fan, increase air flow through the fan and prevent overheating of the motor. (1.0)

REFERENCE
Farley Lesson Plans Volume 2, Tab 9, pp 3,16,17,18 GLJ 153

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 3.06 (3.00)

a. Pressurizer level decreases (slowly) (backup heaters on) [0.25]
Letdown isolates (heaters off) on low level [0.5]
Pressurizer level increases (slowly) (heaters re-energize) [0.25]
High pressurizer level trip [0.5] (1.5)

b. Rods insert [0.5]
Tave decreases [0.25]
Pressurizer pressure (level) decreases [0.25]
Low pressurizer pressure trip [o.5] (1.5)

REFERENCE
FNP AOP-19, Farley Lesson Plans Volume 1, Tab 6, p 5, Volume 7, Tab 2, Fig. 3, Tab 5, pp 9,10,14,24,25,T-3 GLJ 154

ANSWER 3.07 (3.00)

a. Steam flow increases causing increased removal of heat from the RCS, reducing Tave. Tave - Tref deviation causes rod control circuit to withdraw rods to restore Tave. (1.0)

b. This causes reduced efficiency in the secondary plant cycle for the same turbine load output. Tave will decrease because of greater heat removal. Tave - Tref deviation causes rod control circuit to withdraw rods to restore Tave. (1.0)

c. This causes increased N-44 output which results in the power mismatch circuitry inserting rods to match turbine power with indicated nuclear power. (1.0)

REFERENCE
Farley Lesson Plans Volume 7, Tab 2, p 5,6 GLJ 155

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 3.08 (3.20)

a. -OPC solenoid valves trip open (103%) [0.4] causing intercept and governor valves to close [0.4].
-Auto Stop Oil system trips (111%) [0.4] causing interface valve to open which causes stop and reheat valves to close [0.4]. (1.6)

b. 1. Ensures RCP's will remain running for 30 sec prior to de-energizing the 4160V buses A,B, & C (ensures flow through the core to remove decay heat) [0.4].
2. Minimizes turbine overspeed by allowing steam pressure in the turbine to decay [0.4]. (0.8)

c. Any turbine trip if excessive turbine bearing wear is indicated (thrust bearing trip oil pressure > 60 psig) [0.4]. Removing load from the generator reduces thrust on the turbine [0.4] (0.8)

REFERENCE
Farley Lesson Plans Volume 4, Tab 10, pp 30,32,34,35,36, Volume 5, Tab 1, p 20, Tab 2, pp 32,33 GLJ 156

ANSWER 3.09 (2.10)

-Local/Remote switch in Remote (HSP) [0.1]
-Stop/Auto/Start switch in Auto [0.1]
-No Load Shed signal [0.1]
-No Overcurrent Protection signal [0.1]
-Loss of Feed (Both FWP's tripped) [0.3] with Auto/Defeat switch in Auto [0.1] and no LOSP [0.2]
-S/G Lo-Lo level [0.3] with no LOSP [0.2]
-LOSP Sequencer signal [0.3]
-ESF Sequencer signal [0.3] (2.1)

REFERENCE
Farley Lesson Plans Volume 3, Tab 5, Fig. 5 GLJ 157

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 4.01 (2.30)

a. Do not allow rods to withdraw to >85% reactor power [0.5]. Reduce turbine load to restore Tave to program value[0.5] (1.0)

b. So that subsequent withdrawal of the dropped rod can be accomplished without exceeding (95%) reactor power. (0.5)

c. Occurs because lift coils for other rods in the group have been disconnected [0.5]. Reset with Rod Control Urgent Failure Reset pushbutton [0.3]. (0.8)

REFERENCE
FNP AOP-19 GLJ 158

ANSWER 4.02 (3.00)

a. 1,3,5,6,7
b. 1,2,3,4,6 [0.3 each] (3.0)

REFERENCE
EOP-0 GLJ 160

ANSWER 4.03 (3.50)

a. RCS borated to at least the cold shutdown concentration (0.5)

b. 400 to 425 psig (0.5)

c. Heatup 100 F/hr; cooldown 200 F/hr (1.0)

d. High [0.5] due to measured leg density greater than when hot (1.0)

e. Pressurizer heaters manually turned on (to operate sprays) (0.5)

REFERENCE
FNP UOP 1.1 GLJ 161

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 4.04 (4.00)

a. ~~Allows shutdown of the RHR pumps (prevents RHR pump damage).~~ Allows operation of valves affected by (S) Signal. (0.5)

b. 1. RCS pressure <1300 psig [0.5] and high head SI pumps operation verified [0.5]
2. Phase B isolation (Loss of CCW to RCP motor bearings) [0.5] (1.5)

c. The level must be higher (50% vs 20%) if abnormal containment conditions exist [0.5] due to potential reference leg heatup causing erroneously higher level than actual [0.5]. (1.0)

d. RCS pressure decrease 200 psig below pressure at SI termination [.333] ~~[0.5]~~ or pressurizer level decrease 10% below level at SI termination ~~[0.5]~~ [.333]. OR RCS subcooling < 26°F (.333) (1.0)

REFERENCE
FNP EOP-2.0 GLJ 162

ANSWER 4.05 (3.00)

a. To mix water for sampling (0.5)

b. Flowpath aligned from RWST to CVCS letdown (without exceeeding 130 gpm thru LTDN HX) until boron concentration is equal to or greater than RCS boron concentration. (1.0)

c. Decrease (0.5)

d. RCS overpressure protection provided by RHR inlet relief valves. (1.0)

REFERENCE
FNP SOP 7.0 GLJ 163

ANSWER 4.06 (3.20)

a. Manual trip at MCB [0.4]
If no trip, open supply breakers for MG sets at MCB [0.4]
If no trip, emergency borate [0.4] and drive rods in [0.4] (1.6)

b. Manual trip at MCB [0.4]
If no trip, de-energize EH pmps (1A &1B) at MCB [0.4], start all AFWP's and throttle to maintain S/G level in narrow range [0.4]
If no trip, close MSIV's [0.4] (1.6)

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

REFERENCE
FNP EOP-15.0 GLJ 164

ANSWER 4.07 (2.50)

a. To prevent motor winding damage (overheating). (0.5)

b. By maintaining the VCT pressure higher (18 psig) [0.5] to assure adequate flow to the No. 2 seal [0.5]. (1.0)

c. No. 1 seal leakoff flowrate excessive (>5 gpm). (0.5)

d. Ramp down power and remove affected pump from service (within 30 minutes). (0.5)

REFERENCE
FNP SOP-1.1 GLJ 165

ANSWER 4.08 (1.00)

a. Submits request for identification (in accordance with AP-25) and affixes temporary identification to the valve (blank MWR deficiency tag with TPNS No. and Identification written on form). (0.5)

b. Hold tag used to protect personnel/equipment (do not operate) Caution tag used to give special instructions to Operator (Operate only in accordance with instructions on tag). (0.5)

REFERENCE
FNP SOP-0, AP-14 GLJ 166

ANSWERS -- FARLEY 1&2 -84/07/10-JEFFRIES, G.

ANSWER 4.09 (2.50)

a. Weekly - 100 mRem
Quarterly - 1100 mRem [0.4 each] (0.8)

b. 1. When area to be entered is posted as SRWP required
2. Entry into reactor containment
3. When whole body exposures are likely to exceed 100 mRem/day
4. When activity has potential for significant increase in radiation or contamination.
[3 required, 0.4 each] (1.2)

c. Channel 5 (0.5)

REFERENCE
Farley Health Physics Training For Hot License Class Manual, Tab 4, pp 8,19, Tab 6, p 18 GLJ 167

(2 OF 2)

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

FACILITY: EARLEY 1&2

REACTOR TYPE: PWR-WEC3

DATE ADMINISTERED: 84/07/10

EXAMINER: BROOKS, L.

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 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.

MASTER COPY

_____
APPLICANT'S SIGNATURE

QUESTION 5.01 (1.50)

From BOL to EOL, does the AVERAGE delayed neutron fraction increase, decrease, or remain the same? Explain why it changes. (1.5)

QUESTION 5.02 (3.00)

Briefly EXPLAIN how the addition of 0.5% positive reactivity to a subcritical reactor would affect the following: (No calculations are required.)

a. THE CHANGE IN THE COUNT RATE: (if the reactor was slightly subcritical [shutdown margin = 1%] as compared to greatly subcritical [shutdown margin = 5%]). (1.5)

b. THE TIME TO REACH A STABLE COUNT RATE: (for the different shutdown margin conditions in (a) above.) (1.5)

QUESTION 5.03 (3.00)

For both Xenon 135 and Samarium 149 in the reactor core:

a. State the production and removal mechanisms.

b. State the time required to reach equilibrium concentrations after a startup from a clean core condition.

c. State the time required to reach peak concentration after a shutdown from full power. (3.0)

QUESTION 5.04 (2.25)

For each of the following, choose the situation in which INDIVIDUAL rod worth will be greater. Briefly EXPLAIN your answer.

a. Tave equal to 150 F OR 500 F

b. At 180 steps OR 215 steps on bank D

c. For an assembly next to a rodded assembly in which the rod is withdrawn OR inserted (2.25)

QUESTION 5.05 (3.00)

The Heat Flux Hot Channel Factor (FQZ) and Nuclear Enthalpy Hot Channel Factor (FNDH) are both power distribution limits.

1. Which limit is calculated using a Rod Bow penalty based on the core region average burnup? (0.5)

2. Which limit is defined as "The ratio of the integral of linear power along the rod with the highest integrated power to the average power"? (0.5)

3. Technical Specification surveillance requirements using in-core detectors is infrequent provided that FOUR items are monitored and verified to be within their limits. What are these four items? (2.0)

QUESTION 5.06 (2.50)

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)

b. How do heatup/cooldown rate limits on the reactor coolant system reduce the probability of brittle fracture? (0.5)

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

QUESTION 5.07 (3.50)

a. What is the most significant type of heat transfer (conduction, convection, or radiation) taking place under each of the following conditions? Consider each condition separately.

1. Nucleate boiling.
2. Accident condition in which coolant is boiled and converted to steam in the reactor vessel.
3. Heat from fission through the fuel rod.
4. Decay heat removal by natural circulation. (2.0)

b. Indicate on your answer sheet whether the following statements are TRUE or FALSE. No explanation is required.

1. For normal Pressurized Water Reactor (PWR) operation, NO bulk boiling (saturated nucleate boiling) occurs in the reactor vessel.

2. The point at which the heat transfer COEFFICIENT is at its MAXIMUM value is called "Departure from Nucleate Boiling".

3. As RCS pressure increases, a smaller heat flux (BTU/hr-ft) occurs with a constant delta-T (Tclad wall - Tbulk coolant). (1.5)

QUESTION 5.08 (3.75)

Assume one Reactor Coolant Pump trips at 30% power, without a reactor protective system actuation or a change in turbine load. Indicate whether the following parameters will INCREASE, DECREASE or REMAIN THE SAME.

a. Flow in the OPERATING reactor coolant loops.

b. The ratio of the core flow compared to the total loop flow. (Core Flow/Total Loop Flow).

c. Reactor vessel Delta P.

d. Core Delta T

e. An OPERATING LOOP steam generator pressure (3.75)

QUESTION 5.09 (2.50)

a. If during a cooldown on natural circulation, the RCS pressure was 1200 psig, what would be the maximum steam generator pressure to assure adequate subcooling? (1.0)

b. During natural circulation cooldown, a steam bubble may form in the reactor vessel head area. What is the primary indication of this bubble formation? (0.5)

c. What is the maximum core Delta Temp. which would be indicative of PROPER natural recirculation flow following a full power trip AND what is the approximate loop transit time? (1.0)

QUESTION 6.01 (2.75)

For each of the following RCS loop penetrations, indicate which loop(s) (A,B, or C) AND which leg (Hot, Cold or Intermediate) the penetration is located in.

A. Pressurizer Surge Line.

B. Pressurizer Spray Line.

C. Normal CVCS charging line.

D. Normal CVCS letdown line. (2.75)

QUESTION 6.02 (2.50)

What is the design pressurizer spray valve leakage in gpm AND what are four reasons for maintaining this leakage? (2.5)

QUESTION 6.03 (2.00)

A. List the two automatic signals other than a "T" signal which will automatically close the CVCS letdown orifice isolation valves and explain the basis for each automatic closure. (1.0)

B. Why is hydrazine added to the RCS AND WHY should the CVCS be removed from service during addition? (0.5)

C. Which CVCS demineralizer (cation or mixed bed) would NORMALLY be valved in to remove Cesium or Yttrium fission products? (0.5)

QUESTION 6.04 (3.00)

A. The Component Cooling Water System (CCW) supplies cooling water to the RCP thermal barrier heat exchangers. What TWO automatic actions protect the low pressure CCW piping downstream of the thermal barrier heat exchanger from overpressure in the event of a thermal barrier heat exchanger rupture? (Briefly describe the type of sensor and the action the sensor initiates to protect the CCW system.) (1.0)

B. What are the NORMAL and ALTERNATE makeup water supply sources to the CCW system? (1.0)

C. Indicate whether the following components supplied by CCW isolate on a "S", "T" or "P" isolation signal. If none of the isolation signals isolate the component, indicate NONE.

1. Excess letdown heat exchanger.
2. Letdown heat exchanger.
3. Reactor coolant pump oil coolers.
4. Sample System heat exchangers. (1.0)

QUESTION 6.05 (4.50)

A. List the three automatic signals which will cause an AUTO START of the Emergency Diesel Generator 1C. Assume 1C is selected to Unit One. (1.5)

B. If a loss of off site power to both Nuclear Generating Units has occurred, which Unit will Diesel Generators 1-2A and C supply power to. Address the situation with AND without a safety Injection signal present. (1.5)

C. List THREE of the FOUR Essential Engine Protection Shutdown signals which will shutdown the Emergency Diesels under all conditions. (1.5)

QUESTION 6.06 (2.00)

Indicate whether the following statements are TRUE or False concerning the construction and operation of the POWER RANGE NUCLEAR INSTRUMENTATION detector. No explanation is required.

A. Has Boron-trifiouride (BF3) gas in the outer volume of the detector but not in the inner volume of the detector.

B. Has Boron-trifiouride (BF3) gas in both inner and outer volumes of the detector.

C. Operates in the proportional region of the gas amplification curve. (Detector voltage vs. current curve.)

D. Uses NO compensation circuitry to remove gamma current. (2.0)

QUESTION 6.07 (2.00)

The following concern the Turbine Feed Pump speed control for programmed feed header / steam header Delta-P.

A. Why is the feed pump speed varied to maintain a programmed pressure difference between the feed header and the steam header? (0.5)

B. State the NO LOAD and FULL LOAD Delta-P setpoints for Unit One AND Unit Two. (1.0)

C. What plant parameter(s) provide the PLANT LOAD signal for the programmed Delta-P? (0.5)

QUESTION 6.08 (1.50)

A. What automatic signal will automatically isolate the Spent Fuel Pool area ventilation system during a spent fuel handling accident? (Signal is in addition to a "P" signal.) (0.5)

B. Describe how the Spent Fuel Pool area atmosphere is automatically exhausted during a spent fuel handling accident. Include in your description the flow path from the Spent Fuel Pool area to the environment. (1.0)

QUESTION 6.09 (2.50)

Indicate whether the following statements are true for OTDT, OPDT, or both OTDT and OPDT protection instruments.

1. Protects the core from DNB.
2. Protects the core from overpower. (kw/ft.)
3. Backup for the high neutron flux trip.
4. Circuitry includes dynamic compensation for piping delays to the loop temperature detectors.
5. Requires pressure to be within the high and low pressure reactor trip setpoints to be valid. (2.5)

QUESTION 6.10 (2.25)

The following concern the Core Subcooling Monitoring Panel, (CSMP).

A. Three RCS pressure transmitters provide input to the CSMP. Where, within the RCS, is the pressure sensed? (0.75)

B. There are twelve plant temperature input signals to the CSMP which can be catagorized into three groups (plant parameters). What are the three groups? (0.75)

C. True or False: When reading TSAT/PSAT at the CSMP, TSAT is based on the lowest PRESSURE while PSAT is based on the highest TEMPERATURE. (0.50)

D. What function does the Set Point Selector switch for the Margin to Saturation ALARM perform? (0.25)

QUESTION 7.01 (2.75)

The following refer to information found in FNP-1-SOP-3.0, "Boron Thermal Regeneration System." (BTRS)

A. When using the BTRS for dilution following a BTRS demineralizer flush with reactor makeup water, the initial RCS dilution rate could be greater than normal. Briefly explain why. (0.5)

B. What is the maximum difference in Boron concentration between the RCS and the Pressurizer during normal operation? (0.5)

C. Following a change in Boron concentration, what action must be taken to assure the Boron concentration is equalized between the Pressurizer and the RCS? (1.0)

D. Precautions and Limitations requires the effect of changing RCS Boron concentration be observed. State the THREE methods for making this observation. (0.75)

QUESTION 7.02 (2.75)

The following refer to information found in FNP-SOP-7.0, "Residual Heat Removal System" (RHR), Precautions & Limitations.

A. What are the maximum RCS temperature, RCS pressure and Pressurizer vapor temperature during RHR operation? (1.5)

B. When any RCS cold leg is at OR below 310 F, certain RHR relief valve requirements must be met. What are these requirements? Be specific - include setpoints. (1.25)

QUESTION 7.03 (2.00)

The following refer to information found in FNP-1-SOP-22.0, "Auxiliary Feedwater System."

A. What is the maximum feedwater flow allowed:
   1. to a steam generator whose level is 20 % Narrow Range and increasing during a level recovery transient?
   2. from one motor driven AFW pump?
   3. from the turbine driven AFW pump? (1.5)

B. At what decreasing Condensate Storage Tank LEVEL must the AFW pump suction be shifted to the Service Water System during emergency conditions when Auxiliary feedwater must be maintained? (0.5)

QUESTION 7.04 (2.50)

The following concern FNP-AOP-6.0, "Loss of Instrument Air."

A. If the plant is operating at 50 % power and Instrument Air pressure decreases to less than 50 psig., what IMMEDIATE operator action in regard to the reactor is required? (0.5)

B. How is Pressurizer level maintained/controlled immediatly following a loss of Instrument Air AND why is this action necessary? (1.0)

C. How is Steam Generator level maintained AND the RCS cooldown rate maintained/controlled immediatly following a loss of Instrument Air at 50 % power? Assume ALL AFW pumps are running. (1.0)

QUESTION 7.05 (2.25)

The following refer to FNP-1-AOP-8.0, "Partial Loss of Condenser Vacuum."

A. List the five immediate operator action steps which should be performed to restore vacuum if it is decreasing rapidly. (2.0)

B. What is the Condenser backpressure turbine trip setpoint? (0.25)

QUESTION 7.06 (3.50)

The following concern FNP-1-EOP "Safety Injection" and FNP-1-EOP-3.0 "Steam Generator Tube Rupture."

A. List the FIVE KEY symptoms for a Steam Generator Tube Rupture during power operation. (2.0)

B. During the process of isolating a Steam Generator faulted by a tube rupture, the main steam isolation valve for that Steam Generator will not close.
   1. Briefly describe what operator action is required for:
      a. the non-faulted Steam Generators.
      b. the steam dumps to the condensor.
   2. Briefly describe what method is used to conduct a reactor cooldown. Assume cooldown required to remove decay heat. (1.5)

QUESTION 7.07 (3.25)

A. List five conditions that require Emergency Boration of the RCS. (2.25)

B. How is Emergency Boration initiated normally? (1.0)

QUESTION 7.08 (2.00)

During Refueling evolutions, the SRO in charge of fuel handling reports to the Control Room that a refueling accident has occurred in containment and he is evacuating the containment area. (Assume Containment area monitor R-2 is alarming.)

A. What plant alarm must be actuated AND what announcement must be passed over the public address system? (1.0)

B. What Immediate Operator Action must be taken with containment ventilation systems if fuel damage in containment has occurred? (0.5)

C. What Immediate Operator Action must be taken if a failure of a Steam Generator primary nozzle dam is suspected? (0.5)

QUESTION 7.09 (1.50)

A. Consider two point gamma sources, each with one curie strength. Source A gamma energy is 2 MEV and source B gamma energy is one MEV. If readings were taken at the same distance from unshielded source with a Geiger mueller (GM) type meter, HOW would the readings compare? Briefly explain. (1.0)

1 R/HR = 1 RAD/HR

B. If a worker was exposed to 1R/hr NEUTRON radiation field, would the biological damage be less than, greater than, or the same as if the 1 R/hr field was due to GAMMA radiation? (0.5)

QUESTION 7.10 (2.50)

Farley Nuclear Plant Event Report dated 11-22-82 outlines an incident in which two Assistant Plant Operators (APO's) exceeded administrative dose limits while working a tagging order in the Reactor Vessel Containment Sump.

A. Based on radiation readings in the sump, an HP Technician allowed a 5 minute stay time for the APO's based on 7 Rem/hr dose rates which he estimated would give approximately 600 M-Rem exposure. Was the HP Technician correct when allowing the APO's a five minute stay time? Explain your answer. (1.0)

B. What type of Radiation Work Permit should have been completed prior to entry into the sump? (0.5)

C. At this time, what two C&HP personnel (by title) can grant approval for personnel entry into an exclusion area? (1.0)

QUESTION 8.01 (2.90)

A. List the three PROCESS Radiation Monitors which must be operational during movement of irradiated fuel during refueling. (A process monitor with two channels counts as ONE process monitor.) (0.75)

B. During refueling operations involving core alterations:
1. What are the minimum neutron flux monitoring requirements as required by Technical Specifications? Include the monitoring locations and method of monitoring. (0.75)

2. What are the minimum Technical Specification requirements for:
a. Containment Building equipment door?

b. Containment Building airlocks?

c. Each Containment penetration providing access to the outside environment? (1.4)

QUESTION 8.02 (1.50)

The Technical Specifications for reactor trip system instrumentation channels specifies if one channel of Power Range Nuclear Instrumentation is inoperable, a Quadrant Power Tilt Ratio must be done at least once per 12 hours if power is at 100 %.

A. How is the Quadrant Power Tilt determined in this case? (0.5)

B. If the Quadrant Power Tilt Ratio is not determined within the allowable time, what must be done? (1.0)

QUESTION 8.03 (3.00)

The concentration of the boric acid solution in the RWST shall be verified once per seven days in accordance with Technical Specifications. The chemist sampled the RWST under the following schedule. (All samples taken at 1200 hours.)

January 1 -- January 8 -- January 16 -- January 24 --January 31

A. EXPLAIN why or why not surveillance time interval requirements were exceeded on January 16. (1.5)

B. Explain why or why not surveillance time interval requirements were exceeded on January 24. (1.5)

QUESTION 8.04 (4.00)

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

A. Unknown location.

B. Through a Pressurizer code safety valve to the Pressurizer Relief Tank.

C. Through the wall of the line between the Pressurizer relief valves and the Pressurizer.

D. Total flow to Reactor Coolant Pump seals.

E. Total Steam Generator tube leakage. (4.0)

QUESTION 8.05 (3.50)

The following concern procedures for checking MANUAL VALVES in their proper position during valve lineups in accordance with FNP-0-AP-16.

A. How does an operator:
1. verify a normally OPEN valve in the open position? (0.5)

2. verify a normally LOCKED OPEN valve? Be specific. Include any additional verification requirements NOT required in 1 above. (2.0)

3. verify a normally SHUT valve in the shut position? (0.5)

4. verify a LOCKED and THROTTLED valve? (0.5)

QUESTION 8.06 (2.00)

A. Who is responsible for filling out items 1 through 7 of an MWR when a plant equipment deficiency is discovered? (0.5)

B. What two individuals (by title) must approve the release of an MWR concerning PLANT EQUIPMENT? (1.0)

C. Who, by title, is NORMALLY responsible for performing a required INDEPENDENT VERIFICATION of a checklist used to return a piece of equipment to service? (Individual by title is in addition to "someone who is qualified on the system".) (0.5)

QUESTION 8.07 (1.50)

The following refer to "Emergency Plan Implementation Procedures", FNP-0-EIP's.

A. Who, by title, is responsible for the immediate and unilateral declaration of an emergency AND the initiation of emergency response during the initial phase of an energency? (0.5)

B. Who, by title, is the ONLY individual authorized to downgrade an emergency level once an emergency has been declared? (0.5)

C. Which channel number on the public address system is designated for use during emergencies? (0.5)

QUESTION 8.08 (3.00)

The following refer to the Meteorological Instrumentation.

A. Technical Specifications require meteorological instrumentation to be operable during ALL modes of plant operation. What are the TWO instruments which must be operable AND what is the basis for maintaining this minimum insrumentation? (1.0)

B. Delta-T (T200 ft. - T35 ft.) is provided to determine atmospheric stability. Indicate whether the following statements are TRUE for a NEGATIVE Delta-T OR a POSTIVE Delta-T. (Each statement must be answered indicating a + Delta T or a - Delta T.)

1. The atmospheric conditions are considered UNSTABLE.

2. Indicative of a THERMAL INVERSION.

3. The air close to the ground will remain close to the ground with little mixing.

4. The air is undergoing considerable mixing between the air at ground level and at higher elevations. (2.0)

QUESTION 8.09 (1.50)

What action must be taken if the RCS Pressure Safety Limit is exceeded, in accordance with Technical Specifications? Consider ALL modes. (1.5)

QUESTION 8.10 (2.10)

What are two provisions which must be met, according to Technical Specifications, before a temporary change can be made to an Operating Procedure? Be Specific. (2.1)

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

ANSWER 5.01 (1.50)

Decreases [0.5] (U235 decreases) Pu239 (and PU241) increases [1.0] (1.5)

REFERENCE
FNP Nuclear Plant Training Reactor Theory Manual p. H-3-7.

ANSWER 5.02 (3.00)

a. The slightly (greatly) subcritical reactor will have a larger (smaller) increase in count rate. (1.5)

b. The slightly (greatly) subcritical reactor will take a longer (shorter) time to reach a stable count rate. (1.5)

REFERENCE
FNP Training Reactor Theory Manual, pp. H-4-20, H-4-21.

ANSWER 5.03 (3.00)

	Xe 135	Sm 149
a.	Production directly fission AND decay Iodine. [0.6]	Production from decay of Promethium. [0.3]
	Removal by burnout AND decay [0.6]	Removal by burnout [0.3]
b.	40-60 hrs. [0.3]	30-40 days [0.3]
c.	5-15 hrs. [0.3]	14-18 days [0.3 ~~each~~] (3.0)

REFERENCE
FNP Training Reactor Theory Manual, pp. I3.1-3.5, 3.18-3.19.

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

ANSWER 5.04 (2.25)

a. At 500 F [0.25] At higher temperatures, the diffusion length is greater, allowing neutrons to reach the control rods from further away (and thus enhancing control rod effectiveness) OR (Moderator macroscopic absorption & scattering cross section decreases.)[0.5](0.75)

b. 180 steps [0.25] There is a higher flux at this lower core height. [0.5] (0.75)

c. Next to the withdrawn rod [0.25] The withdrawn rod results in a higher flux, making the rod in question more effective. [0.5] (0.75)
(will also accept "because of the rod shadowing effect if rod is inserted").

REFERENCE
FNP Training Reactor Theory Manual, pp. I-2.11-2.13.

ANSWER 5.05 (3.00)

1. FNDH. (0.5)
2. FNDH. (0.5)
3. Rods within a group are maintained within +/- 12 steps.
Control rod banks are sequenced and overlapped.
Rod insertion limits are maintained.
AFD limits are maintained. [0.5 ea.] (2.0)

REFERENCE
FNP T/S 3/4.2 and Basis.

ANSWER 5.06 (2.50)

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

b. Reduces the thermal stress. (will also accept that reduced ΔT across RV wall reduces total/thermal/tensile stress.) (0.5)

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

REFERENCE
WNTC Thermodynamics, Volume II, Chapter 13, pp 58-68.
JMF Nuclear Plant Technical specifications pp. B3/4 - 3/4 4-12.

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

ANSWER 5.07 (3.50)

a. 1. Convection
2. Radiation/convection (large Delta T)
3. Conduction
4. Convection (natural) (2.0)

b. 1. True
2. False
3. True (1.5)

REFERENCE
FNP Thermodynamics Manual, Chp. 3, pp. 3,7,8 & Chp. 9, pp. 2,12, & Figure V-2.

ANSWER 5.08 (3.75)

a. Increase
b. Decrease
c. Decrease
d. Increase
e. Decrease [0.75 each] (3.75)

REFERENCE
WTHP Chapter 12, p 15

ANSWER 5.09 (2.50)

a. Tsat for 1200 psig is 567 F (from steam tables).
567 - 50 = 517 F (subcooling of 50 F).
Psat for 517 F is about 800 psig. (1.0)

b. Erratic pressurizer level indication. (unexplained PER level increase) (0.5)

c. 65 F. ±3°F
10 minutes. (1.0)

REFERENCE
FNP EOP 7-1, pp.12 & EOP 7-2 pp. 8.

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

ANSWER 6.01 (2.75)

A. Loop B [0.~~25~~ 35] Hot leg. [0.25]
B. Loop A [0.~~25~~ 35] and B [0.35] Cold leg. [0.25]
C. ~~Loop A [0.25] and~~ B [0.35] Cold leg. [0.25] [NOTE: Loop A IS ALTERNATE]
D. Loop A [0.~~25~~ 35] ~~and C [0.25]~~ intermediate leg. [0.25] [NOTE: Loop C IS EXCESS LETDOWN] (2.75)

REFERENCE
FNP Lesson Plans, Vol. I, Chp. 2, pp. 11,12.

ANSWER 6.02 (2.50)

0.5 gpm. [0.5] (0.5)

Maintain the spray line at a warm temperature.
Decrease thermal shock to the spray (line) nozzle.
Decrease thermal stress to the spray (line) nozzle.
Maintain uniform chemistry in the pressurizer.
Maintain uniform temperature in the pressurizer. [4 @ ~~0.25~~ 0.5 ea.] (2.0)

REFERENCE
FNP Lesson Plans, Vol. I, Chp. 2, p.19.

ANSWER 6.03 (2.00)

A. 1. Pressurizer level < 15% [0.25] to prevent uncovering the Pressurizer heaters. [0.25]
2. Either letdown isolation valve (LCV 459/460) not fully open [0.25] to prevent the letdown fluid from flashing in the regenerative heat exchanger. [0.25] [To protect the letdown heat exchanger). (1.0)

B. To scavenge Oxygen at low temperatures [0.25]
The demineralizer will remove Hydrazine. [0.25] (0.5)

C. The Cation demineralizer. [0.50] (0.5)

REFERENCE
FNP Lesson Plan, Vol. I, Chp. 7, pp. 6,13,46.
FNP -1-SOP-2.1,p.3.

ANSWER 6.04 (3.00)

A. 1. Pressure sensors [0.25] shut the thermal barrier high pressure valve. (ADV-3184 A,B,or C @ 75 psig.) [0.25] (0.5)

2. Flow sensors [0.25] shut the thermal barrier high flow valve. (HV304 A,B,or C @ 160 gpm.) [0.25] (0.5)

B. Normal - Demineralizer Water System. [0.5]
Alternate - Reactor Makeup Water System. [0.5] (1.0)

C. 1. T
2. NONE
3. P
4. S [0.25 ea.] (1.0)

REFERENCE
FNP Lesson Plans, Vol. 3, Chp. 4, pp. 11, 14, 18 and fig. 2A & 3.

ANSWER 6.05 (4.50)

A. UV on Bus 1H. (LOSP)
Unit One SI. (ESS)
Service Water Pond low level. (1.5)

B. - 1-2A will go to the first Unit with an SI.
- If neither Unit has an SI, 1-2A will go to Unit One.
- 1C will go to the Unit that 1-2A does not supply. (1.5)

C. Generator Phase Differential.
Engine Fail To Start.
Engine Overspeed.
Low Lube Oil Pressure. [Any 3 @ 0.5 ea.] (1.5)

REFERENCE
FNP Lesson Plans, Vol. 3, Chp. &, pp. 25, 30.
Ref : VOL 3, chp. 10, pp. 1

ANSWER 6.06 (2.00)

A. False.
B. False.
C. False.
D. True. (2.0)

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

REFERENCE
FNP Lesson Plans, Vol. 7, Chp. 1, pp. 22, 23 and fig. 9.

ANSWER 6.07 (2.00)

A. To maintain the feed regulating valves in their optimum operating range. (0.5)

B. Unit I No load - 50 psid. Full load - 188 psid.
Unit II No load - 43 psid. Full load - 215 psid. All values ± 5psig. (1.0)

C. The sum of the three loop steam flow signals. (0.5)

REFERENCE
FNP Lesson Plans, Vol. 6, Chp. 11, pp. 12, 13.

ANSWER 6.08 (1.50)

A. High ~~high~~ (typo) Radiation. (RE-25A & B.)

B. The Penetration Room filtration system starts [0.5] and exhausts to the atmosphere through the Vent Stack. [0.5] (1.0)

REFERENCE
FNP Lesson Plans, Vol 5, Chp. 10, pp. 7.

ANSWER 6.09 (2.50)

1. OTDT.
2. OPDT.
3. OPDT.
4. Both.
5. OTDT. [0.5 ea.] (2.5)

REFERENCE
FNP Lesson Plans, Vol. 7, pp. 5 & 6.
FNP Technical Specifications, pp. B2-4 & B2-5.

ANSWER 6.10 (2.25)

A. -Two [0.25] Wide Range loop pressures loop A & C Hot legs. [0.25] (PT 462 & PT 403) (RHR Hot leg Suctions)
-Pressurizer pressure. [0.25] (0.75)

B. -Loop TH temp.
-Loop TC temp.
-Incore thermocouples. [0.25 ea.] (0.75)

C. True. (0.50)

D. Selects At Power setpoint OR the Shutdown Setpoint. (0.25)

REFERENCE
FNP Lesson Plans, Vol. 7, Chp. 7, pp. 4, 8, & 10.

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

ANSWER 7.01 (2.75)

A. Because the water in the BTRS system piping is essentially Boron free. (0.25 credit for New resin causing greater dilution rate.) (0.5)
B. 50 ppm. (0.5)
C. Initiate manual operation of the pressurizer heaters [0.5] to cause automatic Pressurizer spray initiation. [0.5] (1.0)
D. -Control Rod motion.
-Changes in Tave.
-S/R count rate. [0.25 ea.] (0.75)

REFERENCE
FNP-1-SOP 3.0, pp. 2 & 14.

ANSWER 7.02 (2.75)

A. RCS temp < 350 F.
RCS pressure < 402.5 psig. (400 psig) (400^{+25}_{-0})
PZR vapor space temp. < 475 F. [0.5 ea.] (1.5)
B. TWO RHR relief valves [0.5] with lift setpoints of < 450 psig. [0.25] (shall be operable) and their isolation valves open. [0.5] (1.25)

NOTE: RHR operations stipulates various pressure ranges depending upon the evolution; ie, 400psig prior to placing RHR in service; 400^{+25}_{-0} for drawing bubble in the PZR.

REFERENCE
FNP-1-SOP-7.0, p. 2., P-1, P-14.

ANSWER 7.03 (2.00)

A. 1. 150 gpm.
2. 350 gpm.
3. 700 gpm. [0.5 ea.] (1.5)
B. Four feet. (0.5)

REFERENCE
FNP-1-SOP-22.0 pp. 2, 3, 4.

ANSWER 7.04 (2.50)

A. Trip the reactor - IF Valve operation becomes erratic. (0.5)
B. The Coolant Charging pumps are started/stopped as required [0.5] as the Coolant Charging air controlled valves fail open on loss of air. [0.5] (1.0)
C. The motor driven AFW pumps are started/stopped as required [0.5] and the turbine driven AFW pump speed is varied as necessary. [0.5] (1.0)

REFERENCE
FNP-1-AOP-6.0 p. 1.
FNP Lesson Plans, Vol 1, pp. 36, 37.

ANSWER 7.05 (2.25)

A. -Start standby condensate pump.
-Reduce turbine load.
-Place standby SJAE in service.
-Start additional circulating water pumps.
-Start additional cooling tower fans. [5 @ 0.4 ea.] (2.0)
B. Approximately 9 in. Hg. OR
4.41 psia OR
21 in. vacuum. [one required] (0.25)

REFERENCE
FNP-1-AOP-8.0, pp.1, 2.

ANSWER 7.06 (3.50)

A. -Decreasing pressurizer level.
-Decreasing pressurizer pressure.
-Condensor air ejector radiation monitor alarm. (R-15)
-Steam Generator blowdown radiation monitor alarm, (R-19, R-23 A & B.)
-Increasing level in the affected Steam Generator.
[5 @ 0.4 ea.] (2.0)
B. The non-faulted Steam Generator steam isolation valves are shut [0.5], Steam dump to the condensor is terminated [0.5] and the PORV'S for the non-faulted Steam Generators are used to maintain no-load conditions. [0.5] (1.5)

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

REFERENCE
FNP-1-EOP-0, p.2.
FNP-1-EOP-3, p. 4/13.

ANSWER 7.07 (3.25)

A. 1. Control rod height below the insertion limit.
2. Failure of any full length rod to fully insert following a reactor trip.
3. Uncontrolled reactor cooldown following a reactor trip.
4. SDM less than requirements of Technical Specifications.
5. Unexplained or uncontrolled reactivity increase. [0.45 ea.] (2.25)

B. 1. Start boric acid transfer pump. (A or B) [0.5]
2. Open emergency borate to charging pump valve. [0.5] (CVC-MOV-8104) (1.0)

REFERENCE
FNP-1-EOP-6.0.

ANSWER 7.08 (2.00)

A. -Plant Emergency alarm.
-"All personnel report to designated assembly area." (1.0)
B. Stop containment purge supply and exhaust fans and dampers. (0.5)
C. Containment sump pumps are placed in "Pull to Lock." (0.5)

REFERENCE
FNP-1-EOP-10.0, pp. 1, 2.

ANSWER 7.09 (1.50)

A. The readings would be approximately the same [0.5]. GM meter readings are not dependent on energy level of source radiation (as each interaction results in complete ionization of the gas in the detector, giving a pulse.) [0.5] (1.0)
B. Greater than. (0.5)

REFERENCE
FNP Health Physics Training, Chp. 1, pp. 39, 40.

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

ANSWER 7.10 (2.50)

A. No. [0.5] The HP Technician cannot approve exposure exceeding 300 MR/yk. [0.5] (.5 CREDIT GIVEN IF CANDIDATE STATES YES AND CALCULATED THE STAY TIME AS 5 MINUTES) (1.0)
B. A Special ~~Safe~~ Radiation Work Permit. (0.5)
C. The HP Supervisor OR the HP Manager. (1.0)

REFERENCE
FNP Health Physics Training, PER NO. 82-044.

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

ANSWER 8.01 (2.90)

A. 1. Fuel Storage Pool area gaseous activity. (R25 A & B.)
2. Containment activity. (Purge and Exhaust isolation R24 A & B)
3. Control Room isolation. (R35 A & B.) [3 @ 0.25 ea.] (0.75)

B. 1. Two Source Range instruments [0.25], each with continuous visual indication in the Control Room [0.25] and one with audible indication in the Containment [0.25]. (0.75)
2. a. Held in place by a mimimum of 4 bolts. [0.3]
b. One door in each air lock closed. [0.3]
c. Closed by an isolation valve [0.2], flange [0.2] or manual valve [0.2] or be capable of bieng closed by an automatic Containment purge isolation valve [0.2]. (1.4)

REFERENCE
FNP Technical Specifications, pp. 3/4 3-39, 3/4 9-2, 3/4 9-4.

ANSWER 8.02 (1.50)

A. The QPTR is determined by using the incore moveable detectors. [0.25] (0.5)
→ remaining 3 power range channel [0.25]
confirmed by using.

B. Reactor power must be reduced (to less than 75 %) [0.5] and the Power Range high neutron flux trip setpoint must be reduced (to < 85 % within 4 hours.) [0.5] (1.0)

REFERENCE
FNP Technical Specifications, pp. 3/4 2-13, 3-6.

ANSWER 8.03 (3.00)

A. Interval requirement not exceeded [0.5]. Eight days does not exceed 1.25 times the specified interval [1.0]. (1.5)

B. Interval requirement exceeded [0.5]. The last 3 consecutive intervals exceed 3.25 times the specified interval [1.0]. (1.5)

REFERENCE
FNP Technical Specifications, pp. 3/4 0-2, 5-11.

ANSWER 8.04 (4.00)

A. 1 gpm [0.3] It is sufficiently low to allow for early detection of additional leakage. [0.5] (0.8)

B. 10 gpm. [0.3] Allowance for leakage from known sources which would not interfere with detection of unidentified leakage. [0.5] (0.8)

C. 0 gpm. [0.3] May be indicative of an impending gross failure. [0.5] (0.8)

D. 31 gpm. (at 2235 psig) [0.3] Assures that SI flow will not be less than assumed in accident analyses in event of a LOCA. [0.5] (0.8)

E. 1 gpm. [0.3] Assures the dosage contribution from tube leakage will be a small fraction of 10CFR100 limits in the event of a Steam Generator tube rupture OR steam line break. [0.5] (0.8)

REFERENCE
FNP Technical Specifications, pp. 3/4-17, B3/4 4-4.

ANSWER 8.05 (3.50)

A. 1. Move the valve handwheel in closed direction and return valve to original position. (0.5)

2. Remove the locking device [0.5] and move the valve in the closed direction, then return to original position. [0.5] Re-install the locking device. [0.5] A second person verification is required to verify proper installation of the locking device. [0.5] (2.0)

3. Attempt to close. (If valve is in the correct position, no motion will occur.) (0.5)

4. Verify locking device locked and visually verify valve is in the specified position. (0.5)

REFERENCE Appendix C, pp 17, 18
FNP-O-AP-16, ~~pp. 13, 14.~~

ANSWER 8.06 (2.00)

A. Each Farley Nuclear Plant employee. (The employee who finds the deficiency.) (0.5)

B. Shift Foreman Inspecting.
Shift Supervisor. (1.0)

C. Shift Foreman Inspecting. (0.5)

REFERENCE
FNP-0-AP-52, pp. 4, 17; App. III, p. 1.

ANSWER 8.07 (1.50)

A. Shift Supervisor.
B. Emergency Director.
C. Channel 5. [3 @ 0.5 ea.] (1.5)

REFERENCE
FNP-0-EIP 2, p.2; EIP 3, p.1, EIP 8, p. 1.

ANSWER 8.08 (3.00)

A. Wind Speed. [0.25]
Wind Direction. [0.25]
To allow estimation of doses to the public [0.25]
during radioactive material release. [0.25] (1.0)

B. 1. - DT.
2. + DT.
3. + DT.
4. - DT. [4 @ 0.5 ea.] (2.0)

REFERENCE
FNP Technical Specification, pp. 3/4 3-46, B3/4 3.3.7;
FNP Lesson Plans, Vol. 6, p. 7.

ANSWERS -- FARLEY 1&2 -84/07/10-BROOKS, L.

ANSWER 8.09 (1.50)

-Modes 1,2 Be in HSB with pressure within its limit (in one hour) [0.5] [0.1] [0.2] [0.2]

-Modes 3,4,5 Reduce pressure within its limit (within 5 minutes) [0.5] [0.1] [0.4]

-All Modes Notify the NRC Operations Center immediatly (within one hour.) OR (comply with Admin. T.S. 6.7.1. [0.5] [0.1] [0.4] (1.5)

REFERENCE
FNP Technical Specifications, pp. 2-1, 6-14.

ANSWER 8.10 (2.10)

1. The intent of the procedure is not altered. [0.7]

2. Must be approved by two members of the plant staff [0.7] at least one of whom holds a Senior Reactor Operators license. [0.7] (2.1)

REFERENCE
FNP Technical Specifications, Sect. 6, pp. 6-12, 6-13.

QUESTION	VALUE	REFERENCE
05.01	1.50	LOB0000074
05.02	3.00	LOB0000075
05.03	3.00	LOB0000076
05.04	2.25	LOB0000077
05.05	3.00	LOB0000078
05.06	2.50	LOB0000084
05.07	3.50	LOB0000087
05.08	3.75	LOB0000088
05.09	2.50	LOB0000089
	25.00	
06.01	2.75	LOB0000090
06.02	2.50	LOB0000091
06.03	2.00	LOB0000092
06.04	3.00	LOB0000093
06.05	4.50	LOB0000094
06.06	2.00	LOB0000096
06.07	2.00	LOB0000097
06.08	1.50	LOB0000098
06.09	2.50	LOB0000099
06.10	2.25	LOB0000100
	25.00	
07.01	2.75	LOB0000101
07.02	2.75	LOB0000102
07.03	2.00	LOB0000103
07.04	2.50	LOB0000104
07.05	2.25	LOB0000105
07.06	3.50	LOB0000106
07.07	3.25	LOB0000107
07.08	2.00	LOB0000108
07.09	1.50	LOB0000109
07.10	2.50	LOB0000110
	25.00	
08.01	2.90	LOB0000111
08.02	1.50	LOB0000112
08.03	3.00	LOB0000113
08.04	4.00	LOB0000114
08.05	3.50	LOB0000115
08.06	2.00	LOB0000116
08.07	1.50	LOB0000117
08.08	3.00	LOB0000118
08.09	1.50	LOB0000119
08.10	2.10	LOB0000120
	25.00	
	100.00	