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

EXAMINATION REPORT NO. 50-289/84-32

FACILITY DOCKET NO. 50-289

FACILITY LICENSE NO. DPR-50

LICENSEE: GPU Nuclear Corporation
P. O. Box 480
Middletown, Pennsylvania 17057

FACILITY: TMI-1

EXAMINATION DATES: October 22-24, 1984
November 12-16, 1984

CHIEF EXAMINER: Original Signed By: Noel Dudley — JAN 25 1985
Noel Dudley — Date
Reactor Engineer (Examiner)

REVIEWED BY: Original Signed By: RM Keller — JAN 25 1985
Chief, Projects Section 1C — Date

APPROVED BY: Original Signed By: HB Kister — JAN 31 1985
Chief, Project Branch No. 1 — Date

SUMMARY: Six candidates were examined and one SRO and four RO licenses were issued. Candidates were well prepared for the written and operational examinations. Generic weaknesses in understanding normal plant equipment responses are believed to result from the extended period (5½ years) of plant shutdown.

REPORT DETAILS

TYPE OF EXAMS: Initial ____ Replacement X Requalification ____

EXAM RESULTS:

	RO Pass/Fail	SRO Pass/Fail	Inst. Cert Pass/Fail	Fuel Handler Pass/Fail
Written Exam	5/0	/	/	/
Oral Exam	5/0	/	/	/
Simulator Exam	4/1	1/0	/	/
Overall	4/1	1/0	/	/

1. CHIEF EXAMINER AT SITE: N. Dudley

2. OTHER EXAMINERS: M. King, EG&G

3. PERSONS EXAMINED

   W. Atherholt
   D. May
   G. Herneisey
   D. Gorse
   J. Boltz
   W. McSorley

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

   Reactor operators relied on the Shift Supervisor or a Procedure Reader to provide all direction for console manipulations after immediate emergency actions were taken during the simulator portion of the examination. Candidates during the oral portion of the examination had difficulty describing how some equipment would actual respond during normal power operations.

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

   Areas of the written examination where a majority of candidates received less than 70% credit included:

   - Whether an LPI low flow alarm would be present if primary pressure was 1400 psig and decreasing.
   - The reason for RCP elevation in relation to the rest of the primary system.
   - The required action on loss of all offsite power if only one diesel generator starts.

3. Personnel Present at Exit Interview:

   NRC Personnel

   N. Dudley

   Facility Personnel

   M. Ross

4. Summary of NRC Comments made at exit interview:

   The names of the candidates who were definite passes on the simulator and oral portions of the examination were presented.

5. CHANGES MADE TO WRITTEN EXAM DURING EXAMINATION REVIEW:

Answer No.	Change	Reason
2.05	Add "Additional answers to be provided by Proc. 11.2.01.069."	Expands answer to include functions taught as part of Makeup and Purification lesson plan.
2.06b	Add "Note: river is acceptable".	Acknowledges fact that cooling towers are not always required for decay heat removal.
4.04	Change to "a does require a RWP".	Radiation limit has been reduced from 5mr/hr to 2.5 mr/hr.
4.04 Reference	Add "Proc. 1613, Radiological Controls Proc. Rev. 27".	Provides reference for changed radiation limit.

Attachments:

1. Written Examination(s) and Answer Key(s) (RO)

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: TMI-1

REACTOR TYPE: PWR-B&W177

DATE ADMINISTERED: 84/11/13

EXAMINER: KING, M.

APPLICANT: ____________________

MASTER COPY

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	[signature] 11/13/84		1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	25.00	[signature] 11/13/84 [signature] 11/13/84		2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
25.00	25.00	[signature] 11/13/84		3. INSTRUMENTS AND CONTROLS
25.00	25.00	[signature] 11/13/84		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 (1.00)

A reactor is operating in the nucleate boiling region. The reactor coolant system pressure begins to decrease. EXPLAIN what happens to the heat transfer rate as RCS pressure continues to fall. (1.0)

QUESTION 1.02 (3.00)

During a startup the reactor is subcritical at 10 E+3 CPS when an atmospheric dump fails open. (Isolation valve is open)

a. EXPLAIN what happens (INCLUDE WHY) to reactor power and Tave. (Assume the reactor is undermoderated, at BOL and no reactor trip occurs) (1.5)

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

QUESTION 1.03 (3.00)

Assume that your plant has experienced a degraded electrical power condition and that you are monitoring the plant's cooldown on natural circulation. Explain why you agree or disagree with the following statements:

a. A slow downward trend in indicated Tave is a good indication of well-established natural circulation flow. (1.0)

b. A difference between wide-range T h and wide-range T c of 65°F and slowly increasing indicates developing natural circulation flow. (1.0)

c. Natural circulation flow rate can be increased by rapidly increasing the steam flow rate. (

QUESTION 1.04 (2.00)

Describe HOW and WHY centrifugal pump discharge flow is affected by the following?

a. Suction pressure increase (0.7)
b. Throttling down the discharge valve. (0.7)
c. An increase in pump RPM's. (0.6)

QUESTION 1.05 (2.00)

Explain why you agree or disagree with each of the following statements:

a. Equilibrium Xenon at 100% power is about twice as much as equilibrium Xeon at 50% power. (0.70)

b. Equilibrium Samarium at 100% power is about twice as much as equilibrium Samarium at 50% power. (0.70)

c. The Doppler coefficient, as a function of a constant fuel temperature, decreases with core life. (0.60)

QUESTION 1.06 (1.80)

While operating, an operator should be concerned with condensate depression (CD).

a. What effect does CD have on plant efficiency and WHY ? (0.60)

b. What effect does CD have on the NPSH for the condensate pumps ? (0.60)

c. How will an increase in condenser vacuum (26" to 28") affect condensate depression ? (0.60)

QUESTION 1.07 (1.50)

List and explain three factors or conditions which can affect a rod's worth. (1.5)

QUESTION 1.08 (2.50)

During a routine startup the reactor is subcritical with a stable count rate of 200 cps on both source range instruments and the safety groups are fully withdrawn with a Keff of 0.95.

The operator withdraws control rods until the count rate is 400 cps then stops rod motion.(assume count rate stablizes at 400 cps)

a. What will be the new Keff? Show all work. (1.25)

b. What will happen if the same amount of reactivity is added again? Show all work. (1.25)

QUESTION 1.09 (3.00)

Two types of flux tilts can occur. (radial and axial)

a. What is axial flux tilt? (Core Power Imbalance) (0.5)

b. What is radial flux tilt? (Quadrant Power Tilt) (0.5)

c. Name three (3) possible causes for flux tilts. (1.0)

d. List two (2) means of detecting flux tilts. (1.0)

QUESTION 1.10 (2.20)

a. Does the magnitude of the source range counts (initially) affect the critical rod position? EXPLAIN. (1.1)

b. How would initial source range counts affect the power level (count rate) at which you will go critical? (1.1)

QUESTION 1.11 (3.00)

For each of the conditions below determine if they are subcooled, saturated, or superheated, by how many degrees, and where these conditions would exist in your plant.

a. 2150 psig and 604 F
b. 28" vacuum and 90 F
c. 895 psig and 580 F
d. 2165 psig and 648 F (12 @ 0.25 ea.)

QUESTION 2.01 (2.00)

What conditions must be met for the ICS to transfer Tave control to the Feedwater System? (2.0)

QUESTION 2.02 (3.00)

a. If the CFT's inject, what minimum portion of the core would be recovered ? (1.0)

b. Will the CFT's inject to the core during a LOCA if there is a loss of all AC electrical power ? EXPLAIN. (1.0)

c. If only one CFT injects into the core, is the design objective of the system met ? BRIEFLY EXPLAIN. (1.0)

QUESTION 2.03 (3.00)

"SINGLE FAILURE CRITERIA" concepts are:

1. NO single component failure will initiate unnecessary protective action.

2. NO single component failure will prevent the RPS from fulfilling its protective function.

a. If the channel A reactor coolant flow instrument fails high how are the above criteria insured ? (1.5)

b. If the same instrument fails low ? (1.5)

QUESTION 2.04 (2.50)

After an ES actuation RCS pressure is at 1400 psig, being maintained by HPI injection.

a. What is the status of the Low Pressure Injection (LPI) pumps? (1.5)

b. Would you see an LPI low flow alarm? Explain. (1.0)

QUESTION 2.05 (1.20)

List six functions performed by the makeup and purification system. (1.2)

QUESTION 2.06 (3.50)

a. List three major equipment items also serviced by the DHCC system and state what specific parts are cooled. (3 @ 0.4 ea.)

b. What is the ultimate heat sink for the DHCC system and how is the 'heat' transported there? (1.5)

c. If one DHCC pump fails, will the system be able to meet design loads during:
   (1) Normal operation? (0.4)
   (2) Emergency operation? (0.4)

QUESTION 2.07 (1.50)

What is the reason for the RCP's location (vertically/elevation) with respect to the reactor vessel inlet and outlet nozzles? Include in you answer the location of the RCP's with respect to the reactor vessel inlet and outlet nozzles. (1.5)

QUESTION 2.08 (2.50)

During a plant cooldown it is necessary to take action to ensure that High Pressure Injection (HPI) and Low Pressure Injection (LPI) are not actuated.

a. Specifically when is bypassing of the HPI and LPI actuation systems to be performed? (1.5)

b. What automatic function prevents premature bypassing of these systems? (1.0)

QUESTION 2.09 (2.80)

a. What is the function (purpose) of a thermal sleeve ? (1.00)

b. List the three locations in the RCS where thermal sleeves are used. (3 @ 0.6 ea.)

QUESTION 2.10 (3.00)

a. If Emergency Feedwater (EFW) pumps auto-start on loss of both feedwater pumps what level should be maintained automatically in the OTSGs? (0.5)

b. What is the preferred source of feedwater to the EFW pumps after the water in the condenser hotwell is expended? (1.0)

c. What system lineup, if any, can be established to assure prevention of cross contaminating condensate storage tanks if condensate storage tank A has high chlorides? (1.5)

QUESTION 3.01 (3.00)

With the plant at 95% power an operator sets the ICS minimum load to 85%. EXPLAIN in detail what happens on a loss of a feedpump. Take your discussion to a steady state condition. (Assume NO reactor trip.) (3.0)

QUESTION 3.02 (3.00)

a. IDENTIFY and DESCRIBE two seperate methods of rod position indication (RPI). (2.0)

b. With all control rods and both RPI systems operable, Explain WHEN and WHY will the two RPI systems NOT agree on rod position ? (1.0)

QUESTION 3.03 (3.00)

During power operation (50 %), a reactor coolant pump trips.

a. How does the ICS control dTc at "0" under these conditions? (2.0)

b. If required to shutdown, will this circuit (dTc) continue to control dTc at "0" ? EXPLAIN. (1.0)

QUESTION 3.04 (3.00)

Using figure 1 (source range countrate), explain the trace between points:

a. A and B (1.5)
b. C and D (1.5)

QUESTION 3.05 (3.00)

Concerning the control rod drive system:

a. The temperature of the CRD rotor is normally ~325 F. The RCS is 579 F. Explain why this temperature difference exists. (1.0)

b. What is used as the lubricant during normal rod withdrawal and insert process ? (1.0)

c. Why are the safety group's rod movements performed on an auxiliary power supply instead of the normal power supply ? (1.0)

QUESTION 3.06 (1.50)

Indicate weather each of the following control rod breaker trips WOULD or WOULD NOT result in a reactor trip. (5 @ 0.3 ea.)

a. B & C & E
b. A & B
c. C & D & E & F
d. A & C & E
e. A & D & F

QUESTION 3.07 (4.00)

One of the modules of the Reactor Protection System is the Function Generator.

a. EXPLAIN the purpose of the Function Generator (Include inputs and outputs.) (2.0)

b. Using Figure #2 IDENTIFY what input parameters limit operation in each of the five (5) areas. (1.5)

c. SKETCH the output curve of the function generator for three RCP's. (0.5)

QUESTION 3.08 (1.00)

Explain how the Rod Control System automatically ensures that no Control Rod Drive motors are left with three phases energized. (1.0)

QUESTION 3.09 (1.50)

How does a loss of Intermediate Range (IR) Nuclear Instrumentation (NI) compensating voltage affect the indicated reading at low AND high IR levels? Explain. (1.5)

QUESTION 3.10 (2.00)

Some of the safety limits of the reactor core are based on two parameters that are not directly observable. One of these is DNB.
What four observable parameters are used to determine the proximity to DNB ? (2.0)

QUESTION 4.01 (3.00)

What is an operator required to due if during a reactor startup:

a. the reactor goes critical prior to reaching the 0.5% dk/k below the ECP ? (1.5)

b. the reactor is not critical after the controls rods are pulled to the 0.5% dk/k position above the ECP ? (1.5)

QUESTION 4.02 (2.40)

Identify which conditions below, according to Proc. OP 1102-14, will close each of the purge exhaust and purge supply valves (X - will close)

	AH-V-1A	AH-V-1B	AH-V-1C	AH-V-1D
a. Fans AH-E-6A & 6B shutdown	--	--	--	--
b. Fans AH-E-7A & 7B shutdown	--	--	--	--
c. RM-A9 High Radiation	--	--	--	--
d. ESF Signal	--	--	--	--
e. Loss of Control Power	--	--	--	--
f. Loss of Instrument Air	--	--	--	--

(24 @ 0.1 ea.)

QUESTION 4.03 (1.00)

Who has the final responsibility for the radiation exposure of each individual at TMI? (1.0)

QUESTION 4.04 (1.00)

Indicate weather a radiation work permit is OR is not required for entry into each of the following areas:

a. 4 mrem/hr
b. 100 mrem/hr
c. 1290 DPM/100 CM sq Beta-Gamma
d. 387 DPM/100 CM sq Alpha (4 @ 0.25 ea.)

QUESTION 4.05 (2.00)

Explain the procedure to be followed by the operating shift upon discovery that a control room instrument indication is out of calibration and unreliable. (2.0)

QUESTION 4.06 (2.50)

Reactor Coolant Pumps are required to be tripped on a loss of subcooling margin. List the circumstances which would allow the RCP's to be restarted. (2.50)

QUESTION 4.07 (2.30)

a. No eating or smoking is allowed in radiation areas. If the radiation level is low enough to allow entry into the area, why are the above prohibitions imposed? (0.5)

b. Discuss the hazards of violating the above prohibitions. (1.8)

QUESTION 4.08 (3.00)

a. What is the purpose of the power level cutoff hold point? (1.0)

b. Give an example of how violating this hold point could result in undesirable consequences. (2.0)

QUESTION 4.09 (3.00)

a. List six logs and/or records that must be reviewed by the oncoming CRO. (1.8)

b. When may the responsible (on watch) CRO enter the shift supervisors office for consultation? (1.2)

QUESTION 4.10 (1.80)

What are the three reasons for an operator to be sent to the 'EF-V-30's' area on an EFW actuation ? (3 @ 0.6 ea.)

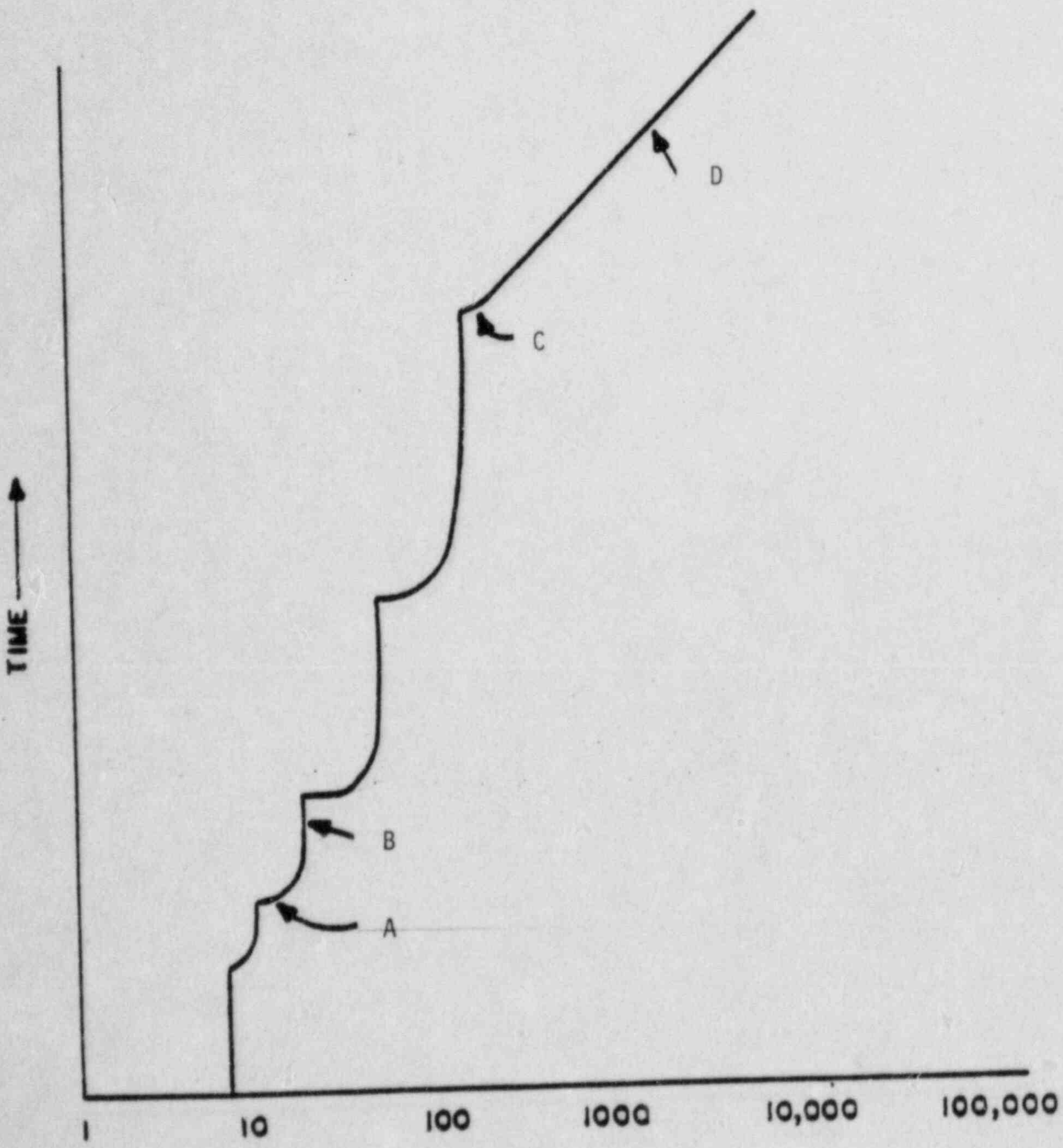
QUESTION 4.11 (3.00)

What actions, if any, should be taken after a Reactor/Turbine trip in each of the following situations. Consider each seperately.

a. Offsite power is lost and only one DG starts. (1.5)

b. Pressurizer level is being maintained at 120 inches and makeup tank level is 60 inches. (0.5)

c. Generator/field breaker remains closed. (1.0)



COUNTRATE (CPS)
FIGURE 3-11

Figure 1

Flux/Imbalance/Flow Trip Setpoint Function

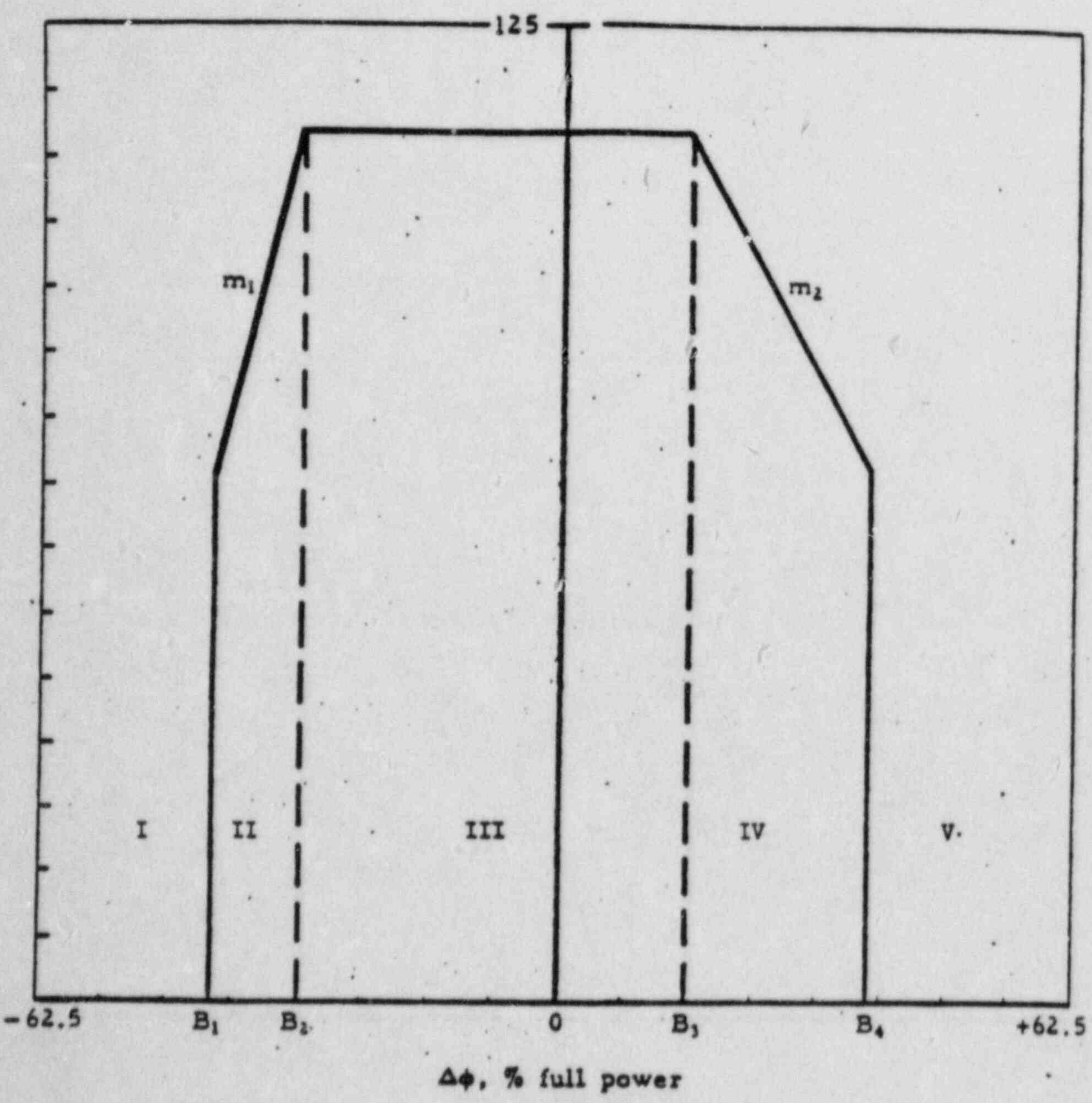


Figure 2

ANSWER 1.01 (1.00)

As RCS press. falls the heat transfer rate will (may) initially increase. When departure from nucleate boiling is reached, the dT required to maintain heat flux increases sharply to the point of 'fuel assembly degradation'. (1.0)

Use of DNB graph to answer this question is acceptable.

REFERENCE
TMI-1 OP Training Manual Vol III, Heat and Fluid Power, pg. 191

ANSWER 1.02 (3.00)

a. The excess steam flow causes Tave to decrease and insert positive reactivity [0.5]. The positive reactivity increase causes power to rise at an increasing rate. When the plant reaches the POAH [0.2], the fuel temperature rise will add negative reactivity via the doppler feedback [0.3] and add reactor heat to stop the temperature decrease. The power rise and cooldown will continue until reactor power equals steam demand.[0.5] (1.5)

b. The rate at which power rises will be much higher and the time to reach the POAH will be much shorter [0.5] because the Beff is smaller [0.2] and the rate at which reactivity is introduced is larger (more negative MTC)[0.3]. At the end, power will be the same but temperature will decrease less (more negative MTC) but still below no-load Tave [0.5]. (1.5)

REFERENCE
TMI-1 OP Training Manual Vol. II, Reactor Theory

ANSWER 1.03 (3.00)

a. Disagree - Tave is a calculated indication and one parameter decreasing will cause Tave to decrease giving a false indication. (Agree-If other indications are used in conjunction with Tave.) (1.0)
b. Disagree - Natural Circulation is indicated by Th stabilizing then tends to decrease. Tc tends to track OTSG sat. tem. (i.e. decrease). dT will decrease as decay heat load decreses. (1.0)
c. Agree - lowering steam pressure will lower saturation temp which will increase heat transfer across the tubes. (1.0)

ANSWERS -- TMI-1 -84/11/13-KING, M.

REFERENCE
TMI-1 OP Proc, RCS Natural Circ. Cooling, 1102-16, pg1-6

ANSWER 1.04 (2.00)

a. Flow increases due to pump discharge pressure increase (0.7)
b. Flow decreases as the system resistance increases. (0.7)
c. Flow increases since pump speed increases; pump laws. (0.6)

REFERENCE
TMI-1 OP Training Manual Vol V, Misc Procedures, Heat Transfer and Fluid Dymanics.

ANSWER 1.05 (2.00)

a. Disagree - Xenon has a non-linear flux dependance. Its production is flux dependent but removal depends on flux and decay. (0.7)

b. Disagree - Samarium is flux independent since its removal and production is totally flux dependent. Once it reaches equilibrium, the rate of production matches the rate of removal. (0.7)

c. Disagree - As the core ages, Plutonium 239 and 240 build-in. The Pu-240, with a very high peak (100,000 barns) tends to make the coefficient higher as the core ages. (0.6)

REFERENCE
TMI-1 OP Training Manual Vol II, Reactor Theory, sec 6

ANSWER 1.06 (1.80)

a. As condensate depression increases it lowers plant efficiency because of the heat removed has to be replaced by the reactor with no usable work out or visa-versa. (0.60)

b. By decreasing condensate depression the NPSH is decreased on the condensate pumps and visa-versa. (0.60)

c. Increasing condenser vacuum (ie 26" to 28") decreases condensate depression or visa-versa (0.60)

REFERENCE
Heat Transfer Fundamentals

ANSWER 1.07 (1.50)

(a) Temperature - neutrons travel further at higher temperatures and therefore more likely to be captured by a rod.
(b) Flux - The larger the neutron flux, the more neutrons can be captured.
(c) Boron - An increase in boron concentration will decrease rod worth due to more competition.
(d) Xenon - same as boron. (3 @ 0.5 ea)

Other answers as supported by plant training material are acceptable

REFERENCE
TMI-1 OP Training Manual Vol II, Reactor Theory, sec IV

ANSWER 1.08 (2.50)

a. C1(1-keff1)=C2(1-keff2)
200(1-.95) = 400(1-keff2)
10 = 400 - 400(keff2)
400(keff2) = 390
keff2 = 390/400 = .975 (1.25)

b. The same amount of reactivity added again will cause the reactor to be supercritical. (at least)

By equation: dK = (keff2-keff1)/(keff2)(keff1)

dK = .975 - .95/(.975)(.95)= .02699 dK

.02699 = (keff2) - .975/(keff2)(.975)

.02631(keff2) = keff2 - .975

.02631(keff2) - keff2 = -.975

keff2(.02631-1) = -.975

keff2(-.97369) = -.975

keff2 = 1.00134 (1.25)

REFERENCE
TMI-1 OP Training Manual Vol II, Reactor Theory, pg 129,130

ANSWER 1.09 (3.00)

a. Uneven flux distribution along vertical axis. (Power at top half minus power at bottom half) (0.5)
b. Uneven flux distribution along horizontal axis. (Quadrant Power Tilt % = 100 X [[Pwr in any quadrant/avg pwr of all quadrants]-1]) (0.5)
c. 1. Mispositioned rod
 2. Xenon
 3. Improper fuel loading (refueling)
 4. Flow shift, RCP's configuration (3 @ 0.33 ea)
 5. Uneven steaming of OTSG's
d. 1. Excore Det. monitoring
 2. Incore Det. monitoring
 3. Incore T. C.'s (2 @ 0.5 ea)

REFERENCE
TMI-1 OP Training Manual Vol V, Incore det. pg 9.

ANSWER 1.10 (2.20)

a. NO, the initial count rate will not affect critical rod position. (The reactor will be (approx.) critical after seven count doublings.) (1.1)
b. The higher the initial count rate, the higher in power the reactor will go critical. (1.1)

REFERENCE
TMI-1 OP Training Manual VOL II, Reactor Theory

ANSWER 1.11 (3.00)

a. subcooled, ~44 F, Th-leg
b. subcooled, ~9 F, condenser
c. superheated, ~50 F, OTSG (outlet steam)
d. saturated, ~0, pressurizer

(12 @ 0.25 ea.)

REFERENCE
TMI-1 OP Training Manual, Vol V, RCS and Main Steam sys desc.

ANSWER 2.01 (2.00)

Whenever the Reactor Control Station OR Diamond Control Station are in manual and the following do not exist. (0.5)
1. Both OTSG's on level control. (0.5)
2. Either OTSG on BTU limit. (0.5)
3. Both Feedwater loop Masters in manual. (0.5)

REFERENCE
TMI-1 OP Training Manual Vol VI, ICS, sec 5

ANSWER 2.02 (3.00)

a. 75% of active core area. (1.0)

b. YES[0.5], The CFT have 600 psig overpressure (N2)[0.3] and locked open isolation valves[0.2]. When RCS pressure decreases to <600 psig injection will start. (passive system) (1.0)

c. No, both CFT are required to inject to meet system objectives. (1.0)

REFERENCE
TMI-1 OP Training Manual, vol VI, Core Flood sys.

ANSWER 2.03 (3.00)

a. A high flow signal (failure) will not trip its channel or initiate any protective functive. The plant is still protected from a loss of flow by the remaining 3 flow channels (2 of 3). (1.5)

b. A low flow signal (failure) will trip its channel but will not initiate any protective function. Only one additional channel needs to trip to initiate protective functions of that channel. (1.5)

REFERENCE
TMI-1 OP Training Manual Vol VI, RPS.

ANSWERS -- TMI-1 -84/11/13-KING, M.

ANSWER 2.04 (2.50)

a. The LPI pumps are running (in a recirculation mode with the suction lined up to the to the BWST and the discharge valves open) (1.5)

b. No, the LPI flow alarms are not actuated until the LPI bistables trip at 500psig RCS pressure. (1.0)

REFERENCE
CAF (No ESFAS material supplied)

ANSWER 2.05 (1.20)

1. RCS inventory control
2. RC purification and recirculation
3. RCP seal injection
4. Core Flood tank makeup
5. HPI
6. chemistry control (6 @ 0.2 ea.)

REFERENCE
TMI-1 OP Training Manual Vol VI, Makeup and Purification, pg 3

ANSWER 2.06 (3.50)

a. Also cools: Bearings of DH pumps and DH motors; motors and bearings of RB spray pumps; motors,gear reduction and bearings of the MU pumps; and the DHCC pump bearing. (3 @ 0.4 ea.)

b. Atmosphere,[0.5] via decay heat service coolers to DHRW system, [0.5] through service water post cooling tower basin[0.5].

c. Yes; yes. (2 @ 0.4 ea.)

REFERENCE
TMI-1 OP Training Manual Vol. VI, DHCC system, pg 2,3 and DHRW system, pg 8,9

ANSWER 2.07 (1.50)

Pumps are a few feet above the horizontal plane of the reactor vessel penetrations for coolant flow. Prevents siphoning of coolant from RX during refueling or maintenance operations.

--OR--

Allows RCP pump maintenance without uncovering outlet to decay heat removal system. (1.5)

REFERENCE
TMI-1 OP Training Manual, Vol II, Reactor Coolant System.

ANSWER 2.08 (2.50)

a. Bypass HPI at <1750 psig & >1640 psig (with permission of SS or SF.)
   Bypass LPI at <900 psig & >540 psig (with permission of SS or SF.)
   (2 @ 0.75 ea.)

b. Bypass Bistables -(set at 1750 and 900 psig respectively.) (2 @ 0.5 ea.)

REFERENCE
TMI-1 Proc. OP 1102-11, pg 15

ANSWER 2.09 (2.80)

a. Thermal Sleeve prevent (limit) the stress developed due to rapid temperature changes. (1.00)

b. HPI injection points (0.6)
   PZR surge line (0.6)
   PZR spray line (0.6)

REFERENCE
TMI-1 OP Training Manual, Vol V. RCS, sec 5, pg 45

ANSWERS -- TMI-1 -84/11/13-KING, M.

ANSWER 2.10 (3.00)

a. 30 " on the startup range (0.5)
b. Million gal. demin water tank (and River Water) (1.0)
c. Condensate tank B [0.4] to one motor driven EFW pump [0.3] and the turbine driven EFW pump; [0.3] shut crossconnect valves (CO-V111A+D and EF V-1A) to isolate tank A but leave it available to met T.S. requirements. [0.3] (1.5)

REFERENCE
Emergency Feedwater System Lesson Plan p 7,11,32

ANSWERS -- TMI-1 -84/11/13-KING, M.

ANSWER 3.01 (3.00)

The loss of the feedpump will be detected by the ICS [0.4] and start a runback [0.4] to 60% elec. power at 50%/min. [0.5]. The loss of feedwater flow will also cause 'crosslimits' [0.4]. The crosslimits will place the unit in 'track' [0.4] which will bypass the 'minimum load' setpoint (85%) [0.5]. The runback will continue until the unit is at 60% elec. power and will stablize on one feedpump. [0.4] (3.0)

REFERENCE
TMI-1 OP Training Manual Vol VI, ICS, sec 1, 2, & 5

ANSWER 3.02 (3.00)

a. Absolute Position Indication [0.2] utilizes (45) equally spaced reed switches [0.2] mounted on the outside of the upper motor tube [0.2] which mark the position of the leadscrew by the magnetic field induced as the permanent magnet passes the immediate vicinity of the switch [0.2]. The indication is derived from the sequential opening and closing of the reed switches [0.1] which, in turn, are connected to a resistance network [0.1]. (1.0)
Relative Position Indication [0.2] receives its signal by monitoring the input pulses to the CRDM motor [0.3]. Every other phase of the six phase input leads are measured [0.3], and this signal is converted into a relative position indication [0.2]. (1.0)

b. During a trip [0.5], because no input pulses are applied to the RPI motor while the API follows the rod as it goes in [0.5]. (1.0)

REFERENCE
TMI-1 OP Training Manual Vol V, Control Rod Drive sys, pg 27-29

ANSWER 3.03 (3.00)

a. Q = u a (Tsat- Tave). Q,u,Tstm,Th remain constant[0.5]. To control Tc, 'a' is varied by changing feedwater flow to the OTSG[0.5]. The reduced RCS flow is detected by a difference amp. in the dTc circuit[0.5]. By detecting a flow change the system can respond faster than waiting for a dTc error to develope. The flow error will increase feedwater to the 2 pump loop and decrease feedwater to the 1 pump loop. Total feedwater remains the same[0.5]. (2.0)

b. No [0.5]. During power reduction the OTSG in the 1 pump loop will hit low level limits before the other loop. Any futher power decrease will result in a dTc error [0.5]. (1.0)

REFERENCE
TMI-1 OP Training Manual Vol VI, ICS

ANSWER 3.04 (3.00)

a. The trace from A to B is a rod withdrawal increment and the subsequent subcritical multiplication to an equilibrium value. (1.5)

b. The trace from C to D is a rod withdrawal increment to 'critical conditions' i.e. slightly supercritical with a steady SUR. (1.5)

REFERENCE
TMI-1 OP Training Manual Vol. II, Reactor Theory, ch 3, pg 118,119

ANSWER 3.05 (3.00)

a. The thermal barrier acts as an insulator between the RCS and the CRD by restricting the circulation of hot (579 F) reactor coolant. Cooling is also provided by SERVICE STRUCTURE FANS and the 2 gpm/CRD cooling water flow. (1.0)

b. water (reactor coolant) (1.0)

c. The normal power supply is a DC 'hold bus'. It cannot move the safety group(s). The AUX power supply is used to move one safety group at a time. (1.0)

ANSWERS -- TMI-1 -84/11/13-KING, M.

REFERENCE
TMI-1 OP Training Manual Vol. V, Misc P .c., Control Rod Drive Sys.

ANSWER 3.06 (1.50)

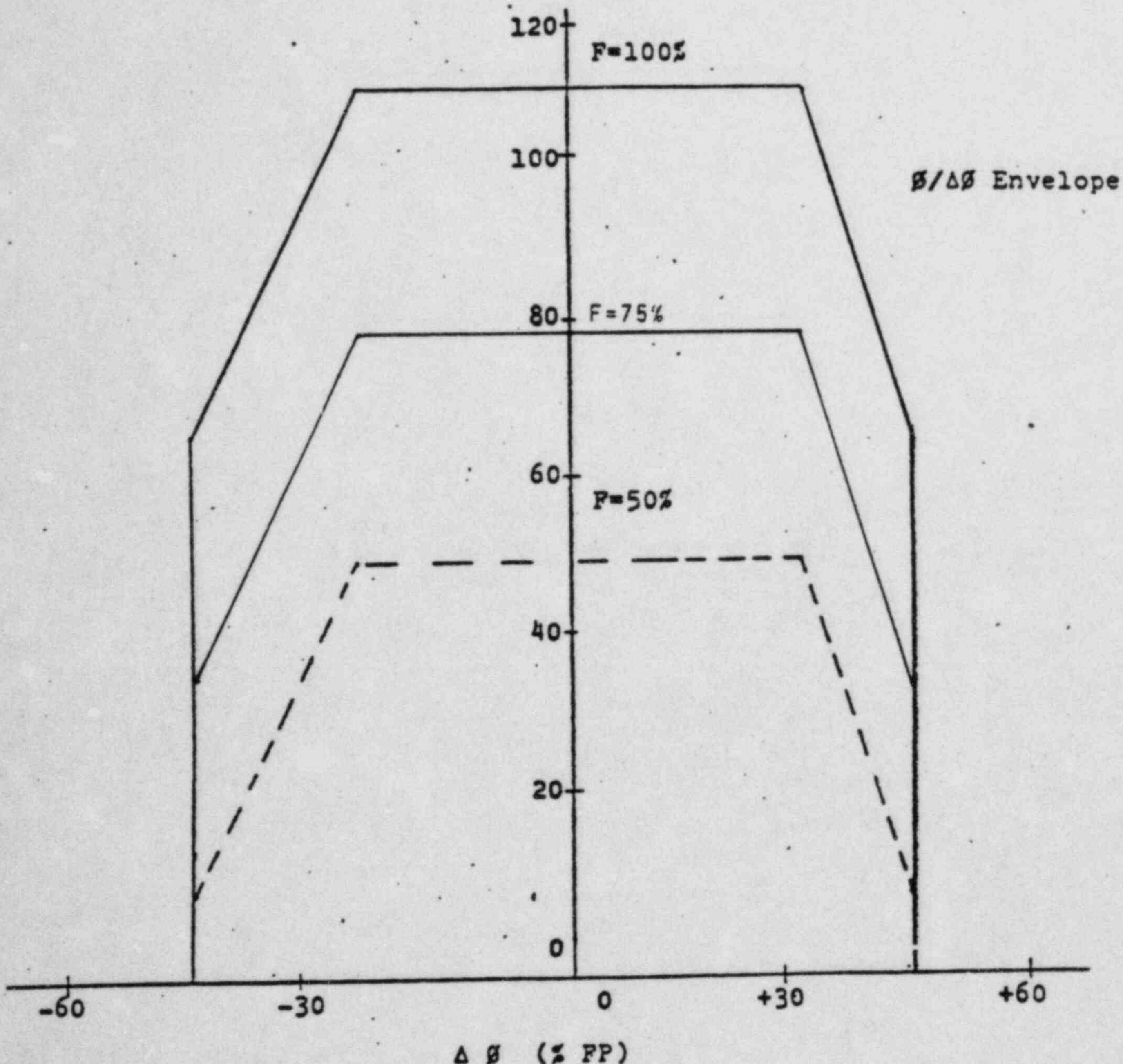
a,b,c, & e would trip reactor, d would not. (5 @ 0.3 ea.)

REFERENCE
TMI-1 OP Training Manual Vol. VI, Reactor Protection Sys.

ANSWER 3.07 (4.00)

a. The Function Generator has two inputs and one output[0.3]. One input is the output of the Difference Amplifier[0.3]. The second input is a signal from the flow channel[0.3]. The Function Generator produces an output voltage curve that represents a function of the power imbalance signal with vertical displacement controlled by the flow level[0.6]. The output signal is used as the setpoint signal by the power-imbalance-flow trip Bistable [0.5]. (2.0)
b. In Regions I and V, the *IMBALANCE SIGNAL* is outside of the allowable limits and the power-imbalance-flow bistable would go to its tripped state for any flow or power level. In the deadband region (Region III) the imbalance signal is within the design limits of the reactor. In the deadband region the power-imbalance-flow trip is essentially reduced to a *POWER-FLOW* trip. In Regions II and IV of the function curve, the output signal of the Function Generator is a function of the *IMBALANCE SIGNAL AND the FLOW SIGNAL*. The effect of the imbalance signal on the output signal in these regions is determined by the values of slopes M1 and M2 and the location of breakpoints B2 and B3. These are the slope regions of the Function Generator. In the slope regions, as the magnitude of the imbalance signal increases, the output signal decreases. (1.5)
c. See attached figure, next page. (0.50)

REFERENCE
TMI-1 OP Training Manual Vol VI, RPS



Ø /Δ Ø/F TRIP SETPOINT FUNCTION

Answer

ANSWERS -- TMI-1 -84/11/13-KING, M.

ANSWER 3.08 (1.00)

The seventh photo detector in the set energizes the 3-2 hold circuit. When the mechanisms stop with three phases energized, this cell is activated. A relay is energized which causes a jog in signal to be sent to the programmer. When it steps back/in (one step) to a two phase energized condition, the photo detector turns off, the relay de-energizes and rod motion stops. (1.0)

REFERENCE
TMI-1 OP Training Manual Vol V, Misc Procedures, Control Rod Drive Sys, sec 4, pg 15

ANSWER 3.09 (1.50)

At high power, no effect, because gamma flux from fission is proportional to power and the 'background gamma' flux is to small to be seen. (0.75)

At low power levels (below the power range) the gamma flux is no longer proportional to power because the 'background gamma' flux is now a significant portion of the total gamma flux. This will cause the IR NI's to read approx. 2 decades high (without comp. volt) (0.75)

REFERENCE
TMI-1 OP Training Manual Vol. V, Nuclear Inst. sys, pg 12,25

ANSWER 3.10 (2.00)

1. neutron power
2. RCS flow
3. temperature
4. pressure (4 @ 0.5 ea.)

REFERENCE
TMI-1 Tech. SPEC. Pg. 2-1

ANSWERS -- TMI-1 -84/11/13-KING, M.

ANSWER 4.01 (3.00)

a. Insert the CRA's to achieve a 1% dk/k shutdown and recalculate the ECP to determine the error. (1.5)

b. Return the CRA's to the 0.5%dk/k position below the ECP and recalculate the ECP to determine the error. (1.5)

REFERENCE
TMI-1 OP Proc 1103-8, pg 3&6

ANSWER 4.02 (2.40)

	AH-V-1A	AH-V-1B	AH-V-1C	AH-V-1D
a.	--	--	X	X
b.	X	X	X	X
c.	X	X	X	X
d.	X	X	X	X
e.	X	--	--	X
f.	X	--	--	X

(24 @ 0.1 ea.)

REFERENCE
TMI-1 OP Proc. 1102-14 rev.15, pg 9,10

ANSWER 4.03 (1.00)

The individual. (1.0)

REFERENCE
TMI-1 OP Training Manual Vol IV, sec XIII, pg 153

ANSWER 4.04 (1.00)

"a" does ~~not~~ require a RWP, b,c, & b require a RWP. (4 @ 0.25 ea.)

REFERENCE
TMI-1 OP Training Manual vol IV, Radiation Protection (CAF)

Proc 1613, [illegible]

ANSWER 4.05 (2.00)

SS/SF/CRO are responsible for identifying and logging instrument OOS, assuring that a work request for repair is submitted, place a yellow OOS tag or sticker on instrument. (When instrument is repaired, SS/SF/CRO is responsible for removing yellow tag and clearing OOS log.) (2.0)

REFERENCE
TMI-1 Proc. AP 1036

ANSWER 4.06 (2.50)

1 25°F subcooling in RCS and (0.90)
2 RCS pressure greater than NPSH for RCP (emerg. limit) (0.80)
3 --OR-- more than one hour has passed since the reactor trip. (0.80)

REFERENCE
TMI-1 OP Proc. 1210-2, Loss of Subcooled Margin an 1210-10

ANSWER 4.07 (2.30)

a. Hazard associated with introducing removable contamination into the body through smoking and eating (or drinking) (0.5)

b. Ingesting radioactive materials dangerous:
(1) Leads to concentrate in certain areas or organs. (0.6)
(2) No shielding to minimize ionization damage. (0.6)
(3) No way to put distance between you and material. (0.6)

---This answer is not all inclusive. Other verifiable answers will be accepted.--

REFERENCE
TMI-1 OP Training Manual Vol IV, Radiation Protection

ANSWER 4.08 (3.00)

a. PLCO hold point assures that acceptable peaking factors are maintained through Xenon transients. (1.0)

b. After load decrease, Xenon could be beyond its peak in the upper half of the core. Increasing power by withdrawing rods will increase power which will increase burnout of Xenon and could cause power peaking in the upper half. (2.0)

ANSWER 4.09 (3.00)

a. (Step 2.4)
   (1) Control room log
   (2) CRO turnover checklist
   (3) ES checklist (J 250°F)
   (Step 3.6.2)
   (1) TCN + SOP books
   (2) Operations memo book
   (3) Revision review book
   (Step 3.6.4)
   (1) Active tagging application book
   (2) Locked valve log
   (3) Outstanding surveillance schedule (6 @ 0.3 ea.)

b. After obtaining a properly qualified operator at the controls. (1.2)

REFERENCE
TMI-1 OP Proc. 1012, steps 2.4, 3.6.2 and OP Proc. 1028 pg3

ANSWER 4.10 (1.80)

a. To establish communications with the control room (0.6)

b. To verify proper operation of the EFW sys. (0

c. To enhance response time if manual (local) control is required. (0.6)

REFERENCE
TMI-1 OP Proc. 1106-6, pg 40

ANSWER 4.11 (3.00)

a. Verify one DG starts and loads [0.4]
Restore makeup [0.3] seal injection [0.3] and EFW [0.3]
Refer to EP 1202-2 [0.2] (1.5)

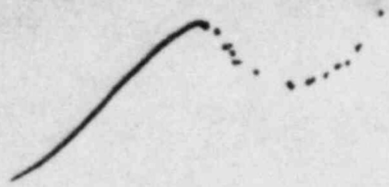
b. Nothing (assuming 2nd makeup pump has started) (0.5)

c. Manually trip GB1-12, CB1-2 [0.5] and field breaker [0.5] (1.0)

REFERENCE
OP 1210-1 p 1-2

Facility Comments

Exams



Category 1.

1.01 lent transfer rate as pressure decreases in DNB

Key doesn't adequately address question. OTM Vol III p.191 *

1.02 10³ CPS, AOV opens. - explain response at a. EOL vs b. BOL

Key a. effect also due to mod temp coeff. *

* OTM Vol II

1.03 Indications of Natural Circ (Oisaque/aque)

a. slow downward Tave trend

b. TH - TC of 65°C and increasing *

c. natur. circ flow rate can be increased by increasing in STM

1.04 Pump laws

1.05 0/A Xenon 100% vs 50%

Sm 100% vs 50% * Key contradicts itself

1.06 Condusate dijussion

a. plant efficiency effect

b NPSH

c. Cond Vac *

1.07 effect in rodworth (three things)

add position, time in life

RWP.

1.08 subcritical mult problem } need to look at OTM p. 129 Vol. II
b. doesn't clearly ask question *

1.09 flux tilts definitions
c. add voiding, *
d. incore TC for flux tilt ? *

1.10 a. SR CPS versus ECP
b. SR CPS versus power

1.11 steam tables.

Section

2.01 No Comment
2.02 No Comment
2.03 No Comment
2.04 No Comment
2.05 MU+P functions copy L.P. 11.2.01.069
2.06 part b should accept River as ultimate heat sink.
2.07 No Comment
2.08 No Comment
2.09 No Comment
2.10 No Comment

Section 3 1612

3.01 No Comment

3.02 RPI/ use stepping motor connected to ~~three~~ phases
Detail above not required. No Comment

3.03 No Comment

3.04 No Comment

3.05 Service Structor fans → 1104-14C Reactor Compartment fans AH-E-2A/B

3.06 No Comment

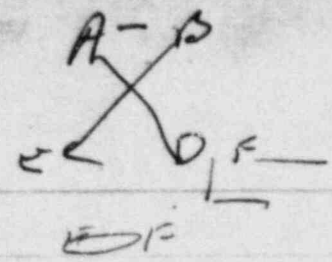
3.07 No Comment

3.08 No Comment

3.09 No Comment

3.10 No Comment

Sec # 4



ok. 4.1.

4.2 – need TO Review oK

4.3 — OK.

~~4.4. a~~

A 4.04. a – need revised procedure

4.06 ✓

2.

~~A. 2.06 → River — Possible → A~~