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

EXAMINATION REPORT NO. 50-289/84-09

FACILITY DOCKET NO. 50-289

FACILITY LICENSE NO. DPR-50

LICENSEE: GPU Nuclear Corporation
ATTN: Mr. H. D. Hukill
Vice President and Director of TMI-1
P. O. Box 480
Middletown, Pennsylvania 17057

FACILITY: TMI-1

DATES: March 6-8, 1984

CHIEF EXAMINER: N. Dudley (signed) — Date: 3-30-84

APPROVED BY: Chief, Project Section 1D (signed) — Date: 5/3/84

SUMMARY: Four SRO and three Instructor Certification exams were administered during the week of March 6, 1984. Three SRO candidates and one Instructor Certification candidate passed. One SRO candidate and two Instructor Certification candidates failed.

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	/	4 / 0	1 / 2	/
Oral Exam	/	4 / 0	2 / 1	/
Simulator Exam	/	3 / 1	/	/
Overall	/	3 / 1	1 / 2	/

1. CHIEF EXAMINER AT SITE: N. Dudley
2. OTHER EXAMINERS: B. Gore
   J. Huenefeld
3. PERSONS EXAMINED

SRO

McSorley, William P.
Maag, Ronald H.
Hass, David L.
Wynne, Michael E.

INSTRUCTOR CERTIFICATIONS

Frederick, Edward R.
Wilt, Daryl L.
Kacinko, Frank J.

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

   None

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

   Some instructor certification candidates were weak in the area of administrative procedures, conditions and limitations.

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

   SRO candidates were very familiar with reference material available in the main control room.

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

   None

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

   Plant operations staff ensured ready access to the facility and expedited issuing dosimetry.

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

   None

7. Personnel Present at Exit Meeting:

NRC Personnel

N. Dudley

NRC Contractor Personnel

J. Huenefeld

Facility Personnel

H. Hukill
M. Ross
B. Leonard

8. Summary of NRC Comments made at exit interview:

Six of the seven candidates were evaluated as definite passes on the oral examination. Two candidates performed extremely well on the oral examination.

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

The written examination was difficult.

10. CHANGES MADE TO WRITTEN EXAM

Question No.	Change	Reason
7.10b	Modify answer	Answer key should require the information contained in Step 12 of ATP 1210-5 rather than the recommendations for subsequent Emergency Director actions.
8.8	Modify reference	TS or 10 CFR 50.72 or 73 maybe used as basis for answering question.
8.12	Modify answer	Operations supervisor schedules staff activities upon notification from the GMS coordinator.

Attachment:

Written Examination(s) and Answer Key(s) (SRO/RO)

M J Ross 3/6/84 Bruce Lenard 3/6/84 Gore

DESIGNATED ORIGINAL

R L Boyer 3-6-84 Certified By RMcCaul

(Boyer)

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

Facility: TMI-I

Reactor Type: B&W

Date Administered: March 6, 1984

Examiner: Bryan Gore

Candidate: Key

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheet. Points for each question are indicated in parenthesis after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up six (6) hours after the examination starts.

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

Final Grade ______ %

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

Candidate's Signature

5.0 THEORY OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW (25 POINTS)

5.1 a. When constructing a 1/M plot during an approach to criticality, why must you wait after each rod withdrawal step before recording NI count rate? (1.0)

b. Suppose you record the count rate too soon, and use this count rate to add a point to the 1/M plot which you are constructing. If the plot is used to predict how much more rod withdrawal is required for criticality, will the predicted amount be larger or smaller than what you would have found if you had waited longer before recording NI count rate? Explain using a sketch. (1.5)

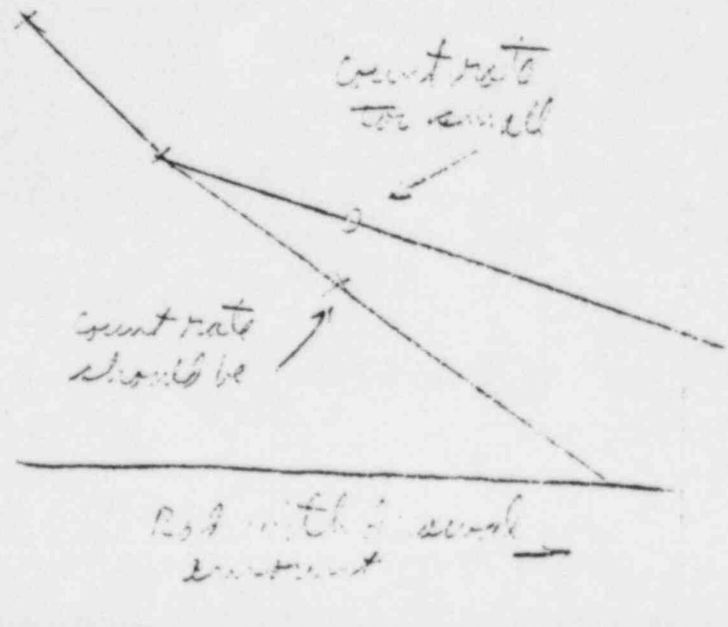
a) After rod withdrawal NI count rate increases, then eventually stabilizes at a new value where

$$\frac{CR_2}{CR_1} = \frac{1-K_1}{1-K_2}.$$

The 1/M plot uses this fact to predict when K will become 1.0. Unless enough neutron generations have passed for the count rate to stabilize, the relation is not satisfied and the prediction of the 1/M plot is in error.

b) Predicts more rod withdrawal needed than is actually required.

$$\frac{1}{M} = \frac{CR_0}{CR_i}$$



OTM
VOL II
pp 116-128

5.2 Primary flow rate is many times greater than secondary flow rate while secondary heat transfer rate is equal to the primary heat transfer rate. Explain the differences in flow rates. (1.0)

Δh for feed to steam is large due to a phase change. $C_p \Delta T$ for RCS is about 10 times smaller due to no phase change.

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5.3 Is the stress in the reactor vessel greater during heatup or cooldown? Explain your answer. (1.5)

e. On a cooldown, pressure induced stress is the same as a heatup since pressure inside is still higher than pressure outside. Temperature stress will be opposite, however, since the inner wall molecules are attempting to contract but are being restrained by the wall. This results in a tensile stress on the inner surface with compressive stress on the outer surface. Referring to (Figure 4-19c) it can be seen that resultant stress during a cooldown more closely approaches maximum allowable stress and therefore cooldown is much more restrictive than heatup. 0.5 0.5 0.5

OTM, Vol II p226

5.4 How do the magnitude of the moderator temperature coefficient and the doppler coefficient of reactivity change corresponding to increases in the following parameters. Assume reactor power is about 50%.

a. thermal power level (0.75)
b. moderator temperature (0.75)
c. fuel temperature (0.75)
d. boron concentration in the coolant (0.75)

	MTC	Doppler Coef.
a.	Constant above 15% power (moderator temp. program constant) [0.35]	Becomes less negative [0.4]
b.	Becomes more negative or less positive [0.4]	No significant change [0.35]
c.	No change [0.35]	Becomes less negative [0.4]
d.	Becomes less negative or more positive [0.4]	No change [0.35]

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-Category 5 Continued Next Page-

5.5 Why is there a pressure-temperature limit on the RCS when the control rods are withdrawn?

(1.0)

P-T combinations are limited in order to keep dissolved gasses in solution so they cannot collect in the CRDM's. 0.5
This ensures hydraulic buffer action. 0.5
(The TS limit curve will maintain up to 100 std cc/liter of gas in solution, which exceeds the total dissolved gas concentration expected in the RCS.)
Not Req'd

TS 3.1

-Category 5 Continued Next Page-

5.6 Your reactor is operating slightly below full power when an RC pump trips off.

a. Which RPS trip limit would normally be reached first? (1.0)

b. Explain why the RPS would or would not trip the plant. Include automatic ICS actions and inherent plant characteristics. (2.0)

a. Flux/Flow/Imbalance 1.0

b. ICS runs back demand at 50% per minute, as RC flow decreases due to pump loss. Rods are driven in at run speed. Reactor does not become subcritical immediately, however, due to positive reactivity from doppler deficit. Tave may increase, adding negative reactivity due to the MTC. Net result depends on core life, but yields roughly a 25% per minute neutron power reduction. Depending on initial flux/flow ratio, imbalance, and the rate of flow decrease the trip setpoint may or may not be exceeded.

0.5
0.5
0.4
0.6

OTM Vol VI Ch 9 - ICS

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-Category 5 Continued Next Page-

5.7 Saturated steam at a pressure 1400 psia leaks past a valve into a tank pressurized to 100 psia. What temperature is the steam which enters the tank? Use the Mollier chart of Figure 5.7 for this question. Explain how you used the chart to determine this value. (Hint: how much work does the steam do in these process?) (1.5)

$\Delta H = \Delta Q - W = 0$

No heat transfer, no work done 0.5

For this constant enthalpy process follow the h = 1172 BTU/lb line to the 0.5
100 psia line. Follow the 100 psia line to the saturation line & read 0.5
$T_{sat} = 330°F$

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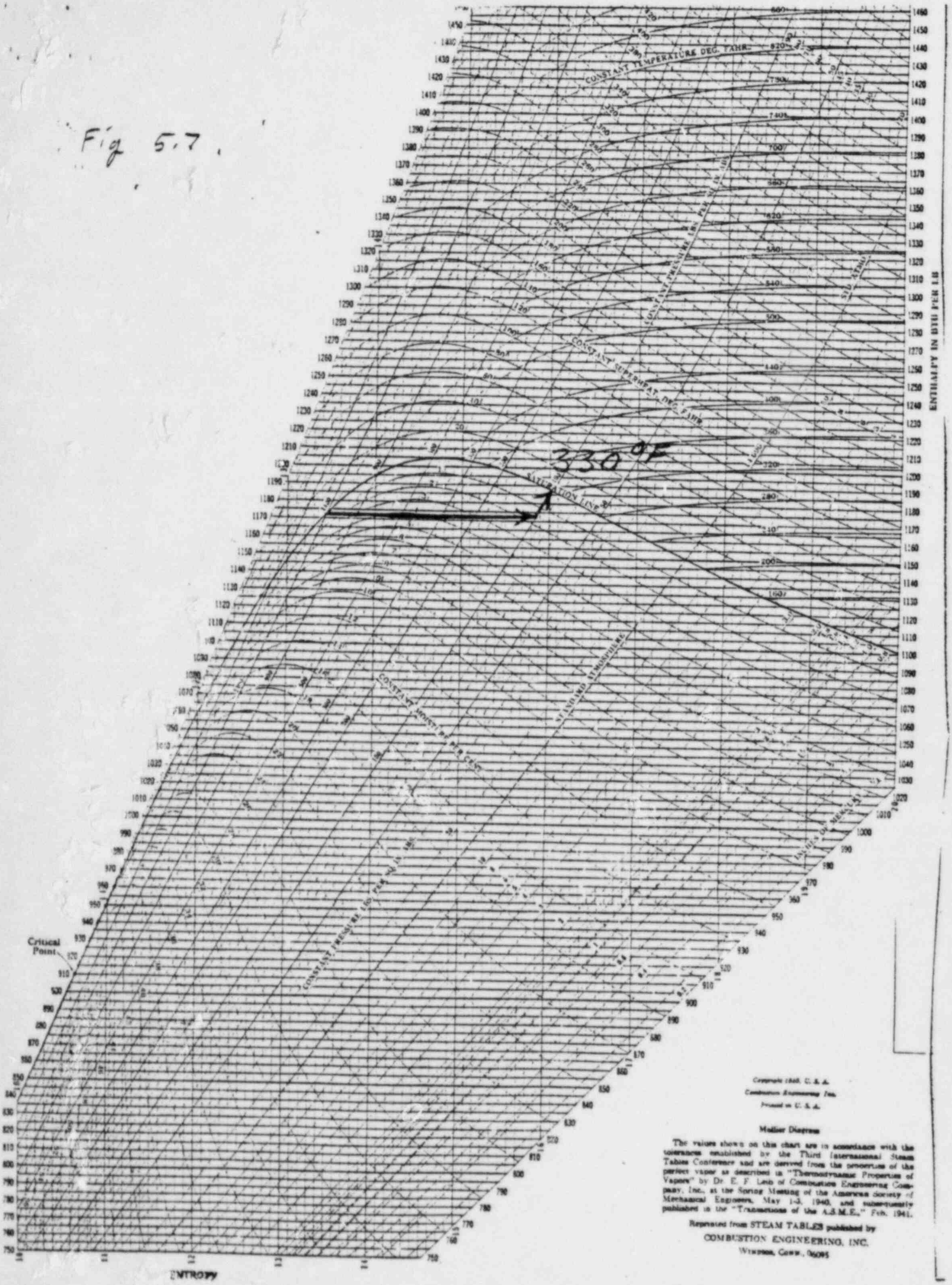
Fig 5.7.

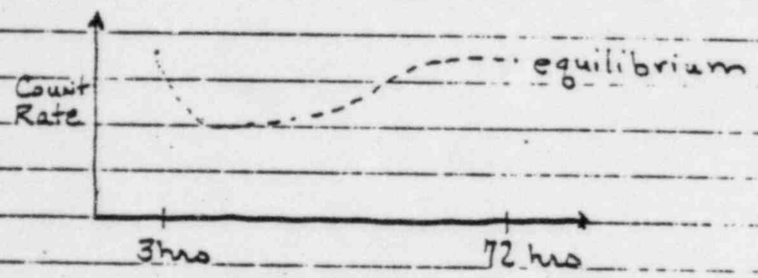


Mollier Diagram

The values shown on this chart are in accordance with the tolerances established by the Third International Steam Tables Conference and are derived from the properties of the perfect vapor as described in "Thermodynamic Properties of Vapors" by Dr. E. F. Lieb of Combustion Engineering Company, Inc., at the Spring Meeting of the American Society of Mechanical Engineers, May 1-3, 1940, and subsequently published in the "Transactions of the A.S.M.E.," Feb. 1941.

Reprinted from STEAM TABLES published by
COMBUSTION ENGINEERING, INC.
Windsor, Conn., 06095

5.8 A reactor trip occurs after 10 days at 100% power. Explain what will happen to subcritical neutron count rate from the time "TRIP + 3 hr" to "TRIP + 72 hr." (2.0)



Count level still slowly decreasing at TRIP + 3 hours. As xenon inserts more and more negative reactivity (to a maximum @ 10-13 hrs) count rate will continue to decrease, then slowly increase to an equilibrium value as xenon decays off.

OTM Vol II 8-165

5.9 The attached Figure 5.9 shows the response of RCS pressure and pressurizer level to a trip of one RCP at power. Which curve represents pressure and which represents level? Justify your selection. (2.0)

curve 1 pressure
curve 2 level 0.5

Tave increases initially, then drops as the ICS runback continues. Both pressure and level increase due to RCS swell, until the 0.5
PZR spray valve starts to open at 2205 psig. Then pressure 0.5
stabilizes while level follows Tave. When level stabilizes, spray continues to reduce pressure until the PZR spray valve 0.5
closes at 2155, so the pressure decrease leads the level decrease

B&W Operational Transient Lecture Notes - R. Winks 6/80

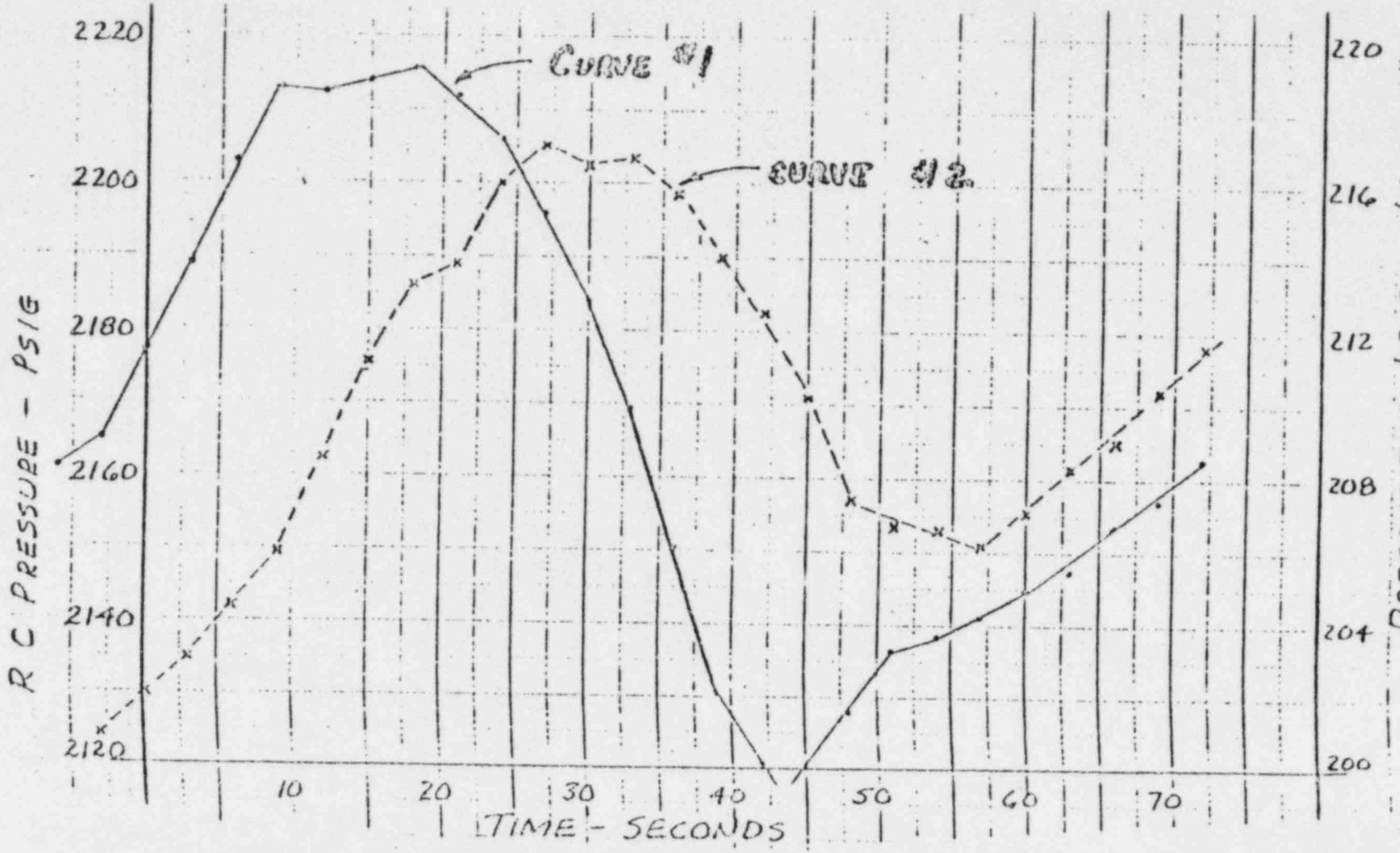
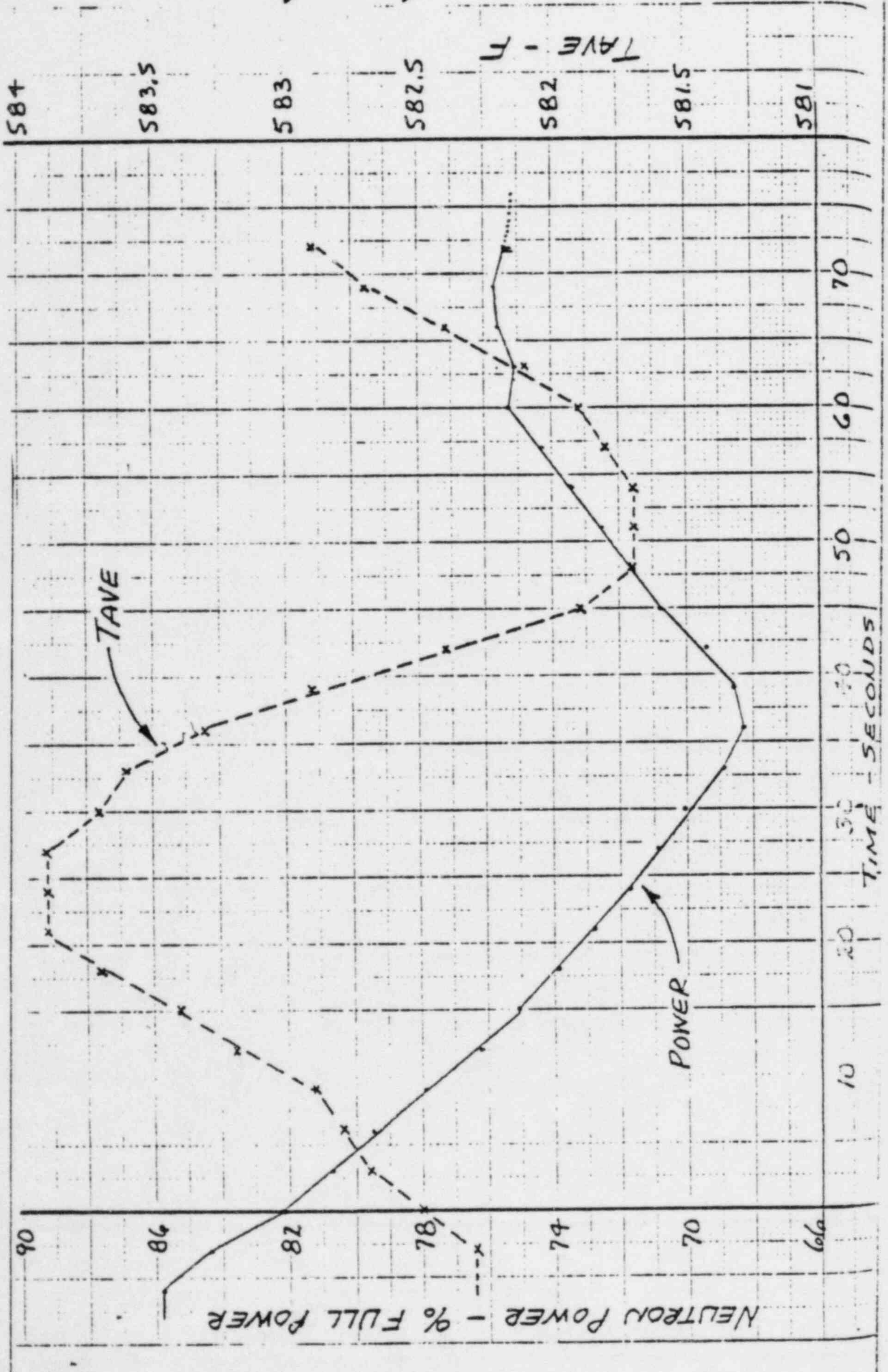

R C PRESSURE - PSIG
2220
2200
2180
2160
2140
2120
PRESSURIZER LEVEL - INCHES
220
216
212
208
204
200
CURVE #1
CURVE #2
10
20
30
40
50
60
70
TIME - SECONDS

FIGURE 5.9

Fig 5.9 (key)


TAVE - F
584
583.5
583
582.5
582
581.5
581
TAVE
POWER
TIME - SECONDS
10
20
30
40
50
60
70
NEUTRON POWER - % FULL POWER
90
86
82
78
74
70
66

5.10 The reactor is shutdown by 4% delta K/K with a count rate (CR) of 10 cps. How much negative reactivity would have to be inserted to reduce the count rate by 1/2? Show work. (Note: equation sheet attached). (1.5)

$$\frac{CR_2}{CR_1} = \frac{1-K_1}{1-K_2} = \frac{1}{2}$$

$$\frac{1}{2} - \frac{1}{2}K_2 = 1-K_1$$

$$K_2 = 2K_1 - 1$$

$K_1 = 1-.04 = .96$ (0.5)

$\left(K_1 = \frac{1}{1-\rho} = \frac{1}{1.04} = .962\right)$

$K_2 = 2*.96 - 1 = .92$ (0.5)

$(k_2 = .924)$

$\rho_2 = 8.34\%$

Negative Reactivity inserted = .96 - .92 = 4% $\Delta k/k$ (0.5)

$\left(8.34 - 4.0 = 4.3\% \frac{\Delta k}{k}\right)$

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5.11 For the attached Figure 5.11 <u>state</u> what portion (ex. 20 to 40% tube length) corresponds to:

a. Nucleate boiling (.65)
b. Film boiling (.65)
c. Superheat (.65)

a. Nucleate Boiling 0 - 58%

b. Film Boiling 58 - 72%

c. Superheat 72 - 100%

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-Category 5 Continued Next Page-

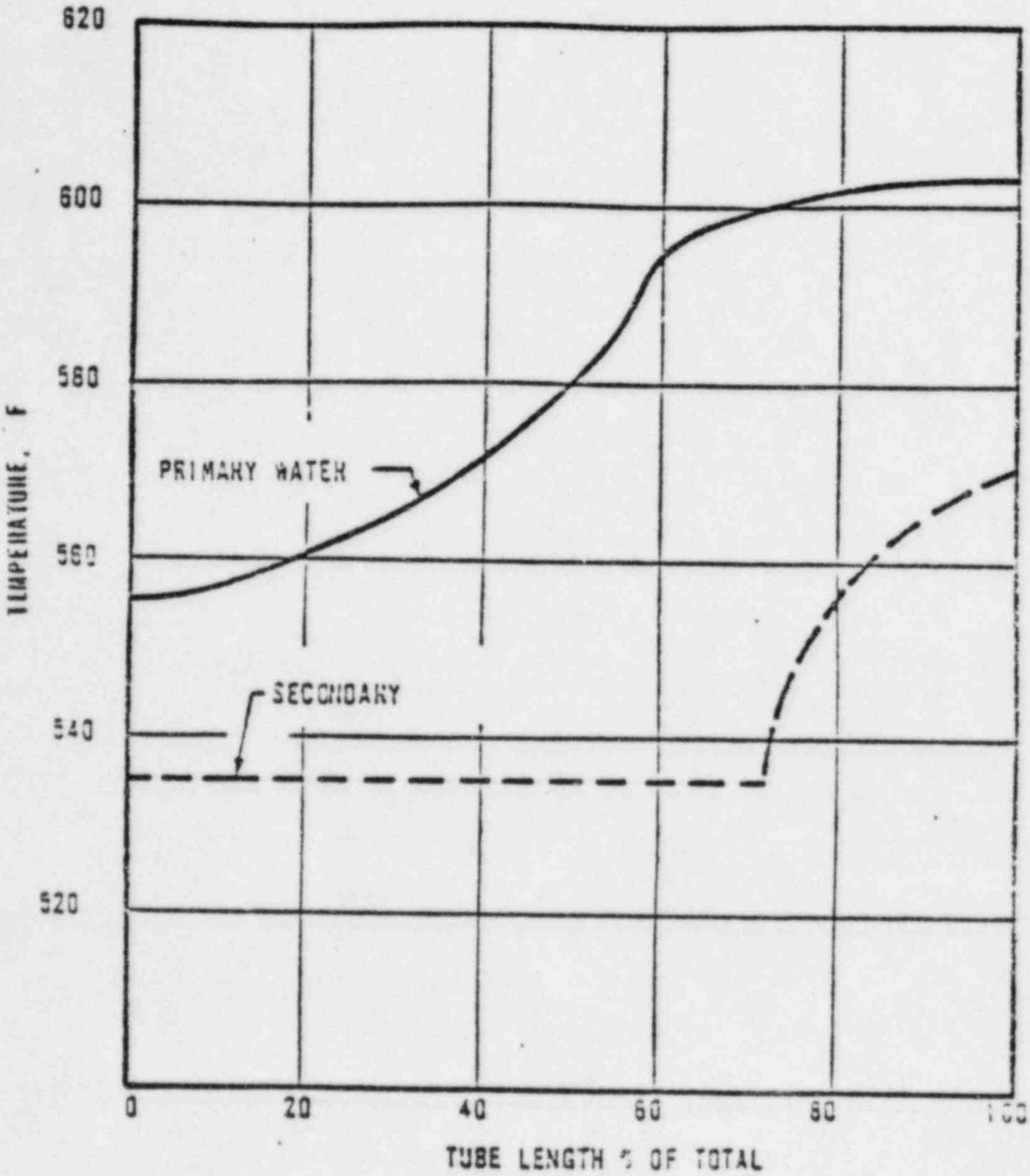


FIGURE 5.11

(Continued on Next Page)

5.12 a. State the formula defining quadrant power tilt. (0.5)

b. Why is quadrant power tilt limited by your technical specifications? (1.0)

c. Explain how a dropped rod affects quadrant power tilt? (1.0)

a. $100 \left(\frac{\text{Power in any core quadrant}}{\text{average power in all quadrants}} - 1 \right)$

b. A positive QPT is associated with linear heat rate peaking during normal power operation. Limiting QPT limits heat rate peaking.

c. A dropped rod depresses flux in its vicinity, reducing QPT in its quadrant. Peak flux is displaced away from the dropped rod, increasing QPT in other quadrants. 0.5 0.5

TS 1.6

OTM Vol II pp 136-140

5.13 Water having a specific heat of 1.0 Btu/lb °F cools a heat exchanger for oil having a specific heat of 0.5 Btu/lb °F. Mass flow rates for water and oil are the same. The oil is cooled from 140 to 100°F. If water enters at 70°F, what is its exit temperature? Show your work. (Note: Equation sheet attached.) (1.5)

$C_w \Delta T_w = C_{oil} \Delta T_{oil}$ 0.5

$\Delta T_w = 0.5 * 40 = T_{exit} - 70$ 0.5

$T_{exit} = 90°F$ 0.5

OTM Vol III p 142

6.1 With regard to ICS feedwater control:

a. What is "feedwater temperature error" and how does it affect feedwater demand. (1.0)

b. Explain why this is important. (1.0)

a. Feedwater temperature error is the difference between FW temperature expected for normal operation and actual. Feedwater demand for normal operation is altered according to the size and direction of the error so that 0.5 0.5

b. the total amount of BTU available from the primary circuit are matched to those required to produce proper SG outlet conditions from the feedwater flow. For colder feedwater, flow is reduced. 0.5 0.5

B&W ICS lesson p IV-2

6.2 Explain how a quick check for proper compensation of an intermediate range detector may be made after reactor shutdown. Explain the indications of both undercompensation and overcompensation. (1.5)

6.2

During a shutdown, the decay rate should reach the limiting -80 second period (-1/3 DPM) value if the response is reflecting the neutron behavior only. One quick check, after allowing time for the other delayed neutron groups to decay, is to measure the time required for the indicated level to decay by one decade. It turns out mathematically that a negative 80-second period corresponds to a decade fall-time of approximately 3 minutes. If insufficient compensation is applied and the detector current is being influenced by the more slow decay of gammas, the decade fall-time will be substantially longer than 3 minutes and the level signal will "round out" to a residual current level well above the true neutron level. 0.7 0.4

Conversely, when the detector is over-compensated, the current takes a rapid "nose-dive" and pegs at full down-scale. 0.4

OTM Vol II p269

6.3 a. Explain the principle of operation of a self-powered neutron detector. (0.7)

b. List two factors other than neutron flux level which affect SPND readings and must be compensated for. (0.8)

a) Rh + n yields β decay. e^- is ejected from Rh (→Pd) and collected on (grounded) outer case, leaving detector charged. Current flows through meter connecting detector & ground & is measured. 0.7

b. electrons are also ejected by gammas 0.4

Rh is depleted by neutron interactions 0.4

OTM Vol II p258

B&W Descriptions

6.4 State the function of "aspirating steam" (or "bleed steam") in an OTSG, and describe how this function is accomplished. (2.0)

Aspirating steam heats feedwater sprayed into the OTSG downcomer region to saturation temperature.	0.5
Steam rising along the OTSG tube region is drawn through apertures in the wall separating this region from the tube region. It is condensed by the cooler feedwater, heating it.	0.5
Condensation of this steam creates a lower pressure region in the downcomer,	0.5
drawing in (aspirating) more steam to continue the process.	0.5

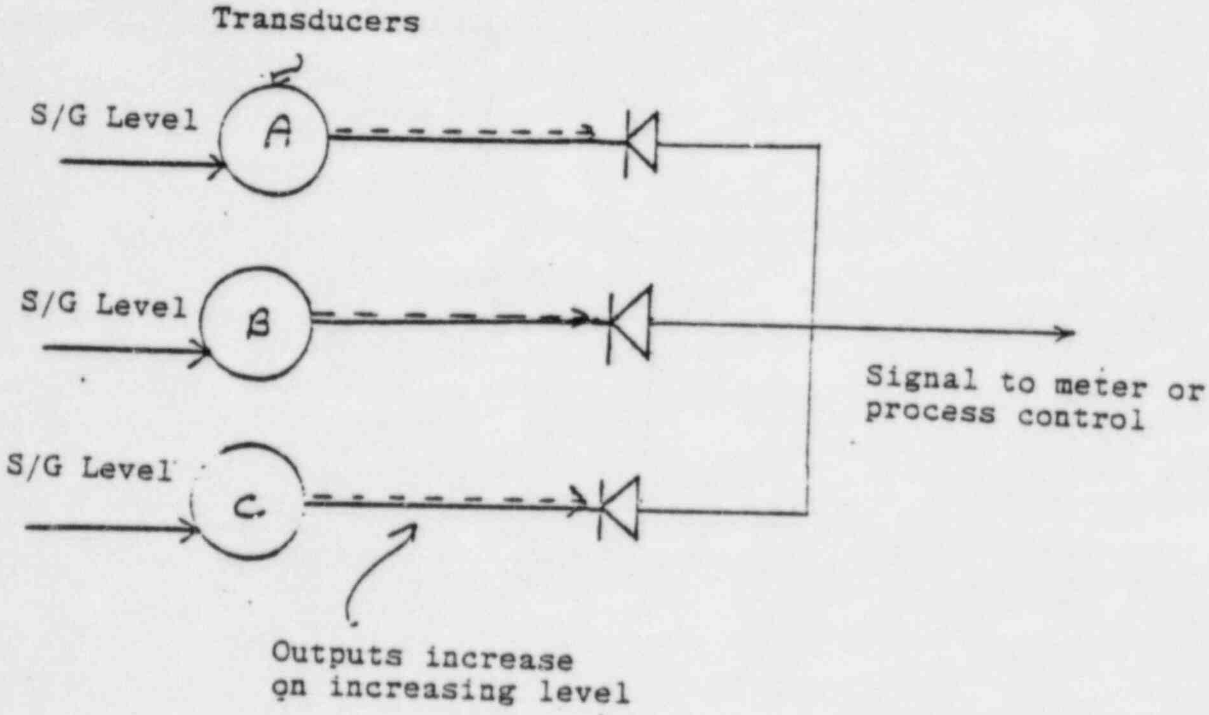
OTM Vol V RCS lesson p33

6.5 The attached Figure 6.5 copied from your training materials shows a S/G level auctioneering circuit. Explain how this circuit functions to pass only one of the transducer outputs and tell if it is the highest or lowest. (2.0)

Diodes are required to have a certain voltage differential in order to allow an electrical signal to pass, therefore, one diode passing the highest signal will effectively block the output from the other diodes and the process variable will be controlled by the diode which has the highest output. 1.0 1.0

OTM Vol I Instrumentation Appendix p25

Figure 6.5


Transducers
S/G Level
A
S/G Level
B
S/G Level
C
Signal to meter or
process control
Outputs increase
on increasing level

6.6 a. True or False: The control rod sequence monitor does not consider too little overlap between rod groups. (0.3)

b. What two rod position permits must be satisfied in order to satisfy the plant's feed and bleed permit requirements? (0.8)

c. Which of the following control rod drive breaker combinations, if tripped, will NOT cause a reactor trip?

a. A + B
b. A + C + E
c. A + D + F
d. B + C + E (0.4)

a. True 0.3

b. Group 1-4 out Limits 0.4

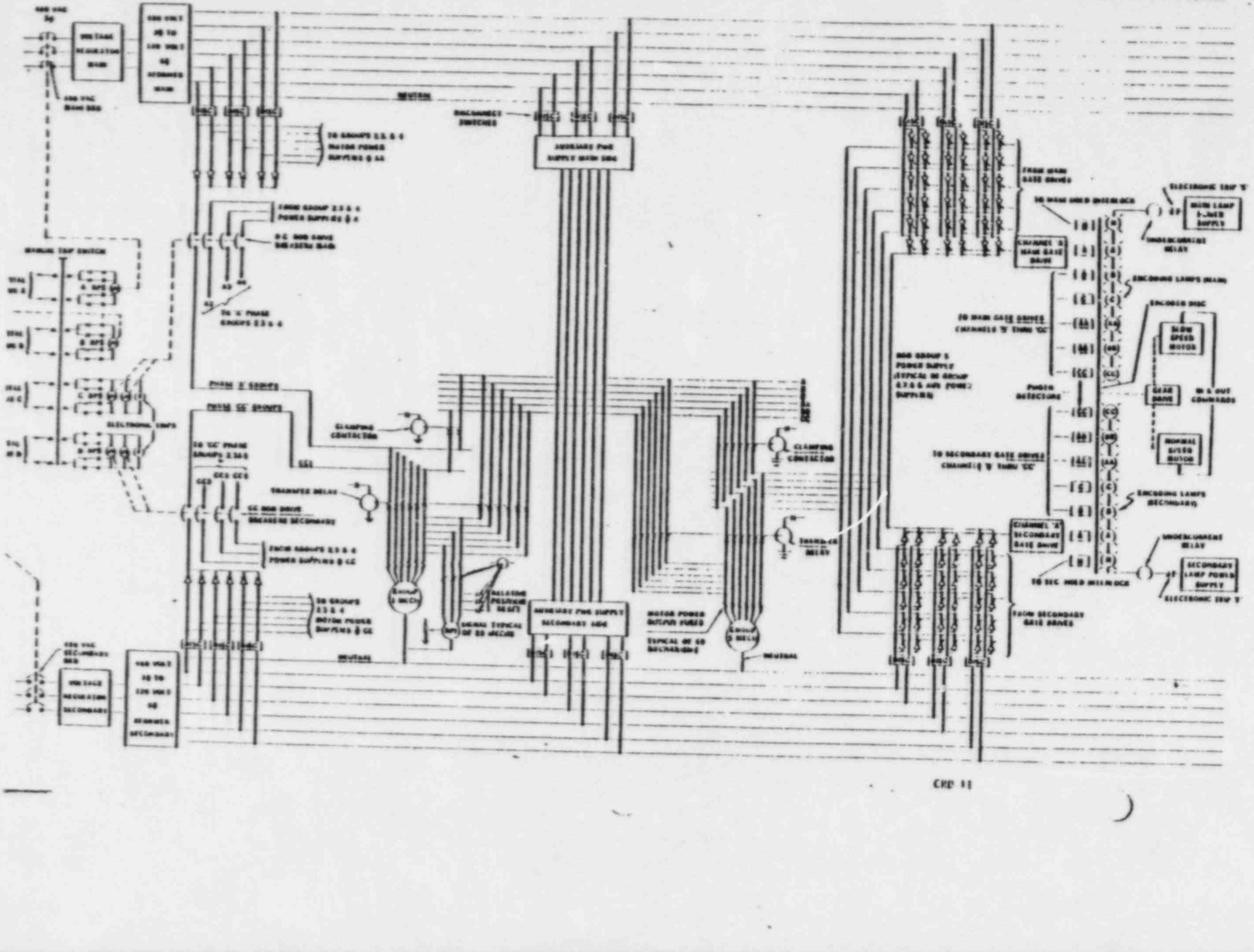
Regulating Group minimum withdrawal Limits 0.4

c. b 0.4

OARP CRD Lesson pp 11, 29, 30

-Category 6 Continued on Next Page-

Figure 2. Control Rod Drive System



CRP 11

6.7 During operation at power, will pressurizer level read higher or lower than actual (and explain why) if:

a. Temperature compensation is lost. (1.0)

b. dp cell connection to tank top ruptures. (1.0)

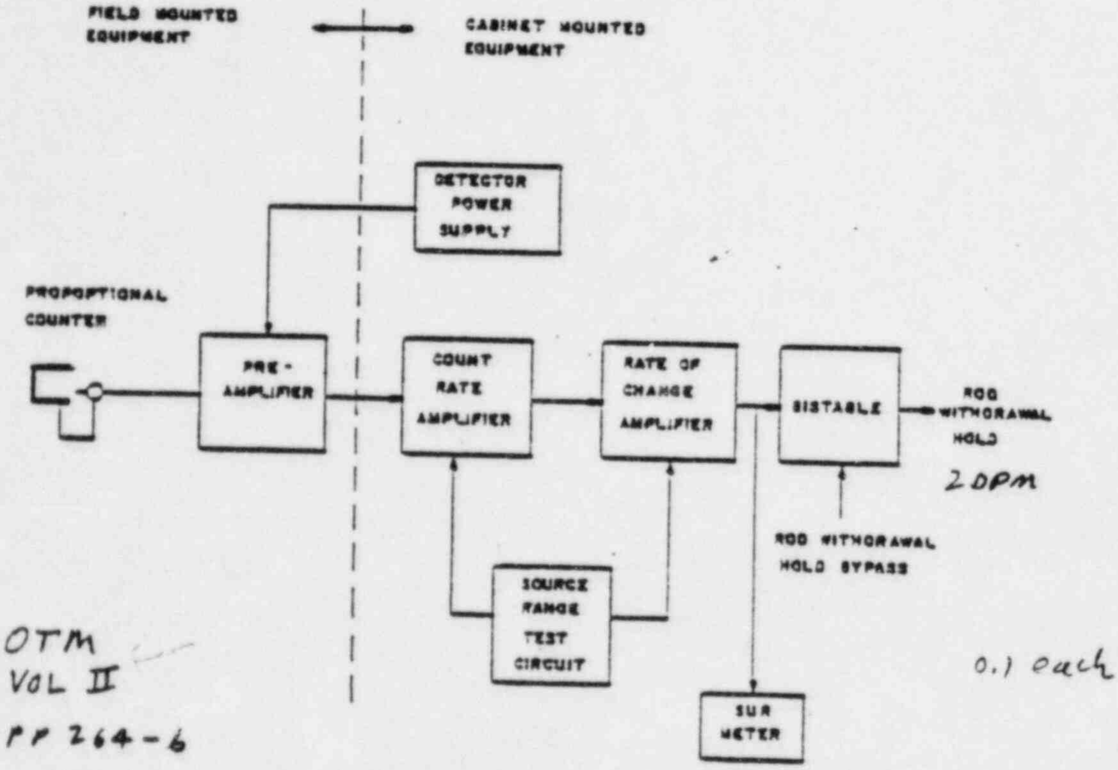
a) reads low (0.4) - water density is reduced so level is higher than at lower temp. 0.6

b) reads high (0.4) - less pressure from top indicates more water weight than actual 0.6

OTM Vol I appendix p14

6.8 a. Label the components indicated on the attached Source Range channel diagram, Figure 6.8, and indicate the control function performed by this circuit. (1.0)

b. Describe how the detector output is adjusted to indicate only neutron flux. (1.0)



b. Fortunately, because the specific ionization is lower, the amplitudes of the pulses from gamma radiation are lower than the amplitude of the pulses produced by the alpha particles. Thus, one may discriminate out these unwanted pulses. 0.5

$_5B^{10} + _0n^1 \rightarrow {}_2\alpha^4 + {}_3Li^7$

The current pulses of the various sizes arriving at the main amplifier are processed first by the discriminator. Again, the purpose of the discriminator is to separate the pulses due to the alpha particles (in the case of a BF_3 chamber) from pulses of other types of radiation and electrical noise. This goal is accomplished by discarding (or discriminating) all pulses having amplitudes below a preset level and allowing only those pulses which have amplitudes greater than the preset level to be passed on for further processing. 0.5

6.9 a. If a total loss of main and emergency feedwater occurs <u>and</u> only one HPI pump is available, <u>is</u> it possible for HPI cooling to match decay heat production? (0.75)

b. <u>Why</u> is it important to open MU-V-36 and MU-V-37 when HPI is manually throttled? (0.75)

a.

<u>NOTE</u>:	If only one HPI pump is available RCS temperatures will rise until HPI cooling capacity matches decay heat (approximately 70 minutes after trip).

b. to provide a recirculation path to the MUT to protect the HPI pumps

ATP 1210-9

-Category 6 Continued on Next Page-

6.10 Explain how the Integrated Master Subsystem of the ICS (in full auto) controls turbine valves in response to an increased load demand. (1.5)

b. How does the plant accommodate a rapid load increase? (1.0)

a. Turbine valves are controlled to maintain steam header pressure at a "modified setpoint" value. The demand error (difference between demand and MW generated) is used to modify the header pressure setpoint. Setpoint is biased low if generation is low. This opens turbine valves and increases steam production and generation. b. If the demand error results from a rapid demand increase, increased steam production results more rapidly than the Rx can respond to demand changes. Energy stored in the OTSG saturated water inventory is thus borrowed, to be redeposited when Rx heat production catches up with load demand.

0.5
0.5
0.5
0.5
0.5

OARP ICS Lesson

-Category 6 Continued on Next Page-

6.11 Upon loss of ICS/NNI power

a. What position will Hand/Auto station indicators assume? (0.5)

b. What position will the main feedwater [redacted] valves (FW-V17A/B) assume? (0.5)

c. How do the main feedwater pumps respond? (0.5)

d. Why is it important not to immediately attempt to restore ICS/NNI power? (1.0)

a. Midscale

b. ~~closed~~ Midstroke

c. Running at ~ 2800 RPM

d. CAUTION: Do not select alternate ICS/NNI Power or otherwise attempt to restore power at this point. Upon restoration of HAND power, main and startup feedwater valves will stroke fully open. 0.5 Upon restoration of AUX power, emergency feedwater valves will stroke fully open (unless selected to the backup manual loader). 0.5

EP 1202-40

6.12 a. When one channel of the Reactor Protection System is in channel bypass, what will happen if you attempt to bypass a second channel? Explain why. (2.0)

b. If one RPS channel is bypassed, and a second channel is switched to "test," how many of the remaining channels must receive a trip signal to trip the reactor? (1.0)

a. Interlocks - Only one channel can be bypassed at one time because of an electrical interlock. The power to keep the bypass relay energized must pass through the switch and contacts from all other switches to get ground. Once a channel bypass is energized, it opens contacts which precent any other bypass relay from being energized. 1.0 1.0

b. one 1.0

OARP RPS Lesson

6.13 What other two methods may be used to open the emergency feedwater valves EF-V-30A and B if they fail to open as needed to control SG level when the hand/auto station is in AUTO, and if they still remain closed when the station is switched to HAND? (1.0)

If the valves have not opened, switch to the back-up manual loader and attempt to open using the backup manual control station located in the Control Room. 0.5

If the valves are still not open, have the auxiliary operator establish communications with Control Room Operator and take local handwheel control of the valves and open them as directed by the Control Room Operator. 0.5

ATP 1210-10

-Category 6 Continued on Next Page-

7.1 Plant heatup is beginning, with pressurizer heaters maintaining RCS pressure appropriately. Describe how the RC pumps are to be operated prior to RCS venting. (1.5)

~~Start~~ and run each RCP, one at a time, 0.7
for at least 5 minutes (10 for first pump 0.3
started). Leave one RCP running. 0.5

not req'd BG

OP 1102-1

7.2 Under what condition may the fuel pin compression curve of OP 1102-11 be exceeded by procedure. (1.5)

only during tube rupture emergencies when ~~subcooling margins must be minimized above 25°F~~ Not Req'd - This is a "why" BG

1.5 ~~0.75~~ ~~0.75~~

ATP 1210-5

7.3 Following shutdown of the last RC pump during plant cooldown, RCS pressure is controlled using the anxiliary pressurizer, spray throttle valve. How and why is the auxiliary spray throttle valve adjusted for proper flow during cooldown? (2.5)

____36. Slowly open the auxiliary spray throttle valve DH-V-64 to the pressurizer until a temperature increase is detected in the pressurizer surge line. Adjust the auxiliary spray throttle valve (in the close direction) until the temperature returns to its previous value. 0.75 0.75

NOTE: This spray adjustment is to prevent pressurizer outsurge into the R.C. hot leg. The pressurizer surge temperature should be monitored closely throughout the continuation of cooldown. If the surge line temperature increases again, adjust the auxiliary spray throttle valve (in the close direction) until the temperature returns to its previous value. 0.5

NOTE: Hot pressurizer water out surge into the hot leg during depressurization could induce voids in the RCS that will be noticed by a sudden increase of the pressurizer level. 0.5

Also part credit for p-T considerations, degassification & Boron Concentration
OP 1102-11 BS

-Category 7 Continued on Next Page-

7.4 When feeding a dry steam generator:

a. What condition indicates that the SG is "dry?" 0.75

b. State the three limitations which must be observed. 2.25

a. < 18" SU range 0.75

b. 1. Use MFW if possible 0.75
2. feedrate ≤ 0.5×10^6 lbm/hr until level restored 0.75
3. tube to shell ΔT < 70°F 0.75

ATP 1210-10

7.5 Following a thermal power change exceeding 15 percent of rated thermal power during a 1-hour period, what two places must be sampled, how soon, and for what are the samples to be analyzed? (2.0)

80% credit BS

{RCS primary coolant; in (4) hrs; for I-131
Condenser vacuum pump discharge; in (4) hrs, for individual gamma emitters

[redacted]

OP 1102-4 p11

-Category 7 Continued on Next Page-

7.6 a. Following a reactor trip where all plant systems and indications respond as expected, what immediate manual actions must be taken? Do not include verification. (1.0)

b. What actions are required if OTSG level is at 50% on the operating range and increasing, with no indication of a tube leak? (1.0)

a. Manually Trip Rx
Manually Trip Turbine
S~~tart~~ a second MUP
Announce Rx trip (0.25 [redacted] each)

b. Take hand control of MFW regulating valve and run MFW flow back until a 0.7
level of 30" is established 0.3

ATP 1210-1

-Category 7 Continued on Next Page-

7.7 Briefly explain how a heat balance ~~calibration~~ calculation is performed. Include the two major values which are calculated and when each is most accurate. (2.0)

The heat balance calculation determines the reactor power from thermal power in either (both) the primary (more accurate at low power) or secondary (more accurate at high power). Between 15% and 100% FP a weighted average of primary & secondary results is used. Both calculate ~~0.25~~ 0.6 ~~0.25~~ 0.6 0.6

$$(\text{Mass flow})(\Delta H_{OTSG}) + (\dot{m}_{Letdown})(\Delta H_{Makeup-LD}) - (\text{Pump Energy})$$ ~~1.0~~ 0.2

Primary: $\dot{m}_{per\ loop}(H_h - H_c)$ for both loops ~~0.25~~

Secondary: $\dot{m}_{feed\ per\ OTSG}(H_s - H_F)$ for both loops ~~0.25~~

(Not theory section - Reduced weight for details [illegible])
(heat loss corrections, conversion factors not required)

OP 1103-16

-Category 7 Continued on Next Page-

7.8 How is uniform heating of the OTSG shell accomplished during plant heatup when RCS temperature is less than 220°F? (1.0)

Draw a vacuum on both OTSG's by cracking open the turbine bypass valves in manual. This causes steaming into the shell region above the water and heats the rest of the shell as the steam condenses on cooler metal. (0.5) (0.5)

OP 1102-1

-Category 7 Continued on Next Page-

7.9 a. What is the required subcooling margin (SCM)? (0.5)

b. What immediate actions are required if the required SCM is lost? (2.0)

a. SCM ≥ 25°F 0.5

b. 1.0 IMMEDIATE ACTIONS

1. Trip all RCPs.
2. Initiate HPI. (2 pumps full flow)
3. Verify EFW has auto started.
4. Raise OTSG level to 90%-95%.

0.5 each

ATP 1210-2

-Category 7 Continued on Next Page-

7.10 If the plant is operating at 100% FP and a 40 gpm tube leak is identified in the A OTSG:

a. What immediate actions should be taken? (1.0)

b. Under what conditions should consideration be given to isolating OTSG A? (2.0)

a. (Rx not tripped) Close MU-V-3 0.3
Shutdown at rate to minimize risk of MS safety valve lifting 0.4

If Rx trips complete Rx trip actions 0.3

b. ~~RCP's operating~~ NOT req'd per facility Review 0.5 each
~~condenser unavailable~~ BG
~~iodine dose rates are high~~
~~B OTSG not leaking or leak rate < 1/8 of OTSG A~~
~~ATP 1210-5~~

b. RCS Thot and Incore temps < 540° 0.5
BWST < 21' 0.5
offsite Dose Projections approaching
50 mr/hr or 0.5
250 mr/hr Thyroid 0.5

Step 12 of ATP 1210-5

-Category 7 Continued on Next Page-

7.11 If RC-V-3 must be closed to control pressurizer spray, how must it be operated subsequently? 1.0

Cycle it open (0.5) as necessary to keep PZR spray line temperature within 250°F of (0.5) PZR temperature - computer temp indication.
(point 520 not required)

AP 1202-29

7.12 Answer TRUE or FALSE:

a. When seal leakoff flow from a No. 1 RC pump seal is 7 gpm, and outlet temperature is higher than normal, the seal leakoff valve must be closed within 5 minutes. (1.0)

b. When high RC pump vibration is observed coincident with a high stand pipe level the pump must be secured within 20 minutes. (1.0)

c. If RC pump seal injection is lost the No. 1 seal bypass valve must not be opened. (1.0)

a. True

b. False (24 hrs)

c. True (protect Thermal barrier ht x capacity)

AP 1203-15 & 16

8.0 ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS (25 POINTS)

8.1 How is a component or system determined to be capable of performing its intended function within the required range, according to technical specifications. (1.0)

1.3 OPERABLE

A component or system is operable when it is capable of performing its intended function within the required range. The component or system shall be considered to have this capability when: (1) it satisfies the limiting conditions for operation defined in Specification 3, and (2) it has been tested periodically in accordance with Specification 4, and has met its performance requirements.

0.5
0.5

TS 1.3

-Category 8 Continued on Next Page-

8.2 Answer TRUE or FALSE

a. The Emergency Director may overrule the Emergency Support Director in the classification of an emergency. 0.5

b. The Emergency Director may direct an SRO to handle approvals of offsite agency official notifications. 0.5

c. The Emergency Director may authorize emergency workers to exceed 10 CFR 20 Radiation Exposure Limits. 0.5

d. The Emergency Support Director may overrule the Emergency Director in directing deviations from established emergency operating procedures. 0.5

a. False

b. False

c. True

d. False

EPIP 1004.3

8.2 NOTE: The Emergency Director is vested with certain authority and responsibility that may not be delegated to a subordinate. Included are:

a. Classification of an emergency event.
b. Approving and directing official notification to offsite agencies. b. False
c. Approving and directing information releases to the media.
d. Approving and, if possible, personally conveying appropriate Protective Action Recommendations to the Bureau of Radiation Protection.
e. Directing onsite evacuation at the Alert or lower level emergency classification based on potential hazard to non-essential personnel.
f. Authorizing emergency workers to exceed 10 CFR 20 Radiation Exposure Limits. C. True
g. Approving and directing deviation from established operating procedures, emergency operating procedures, normal equipment operating limits or technical specifications during attempts to control the emergency. (Note: It is imperative that the Emergency Director consult to the fullest extent practicable with the Parsippany Technical Functions Center in arriving at a decision to deviate from prescribed procedures.)

When the designated Emergency Support Director (ESD) arrives at the site and declares himself to be ready to assume that role, he will assume overall responsibility for management of the response to the accident and recovery operations. With activation of the ESD function, the ESD specifically will assume decision authority for Items C and D. However, decision authority for Items A, B, E, F, and G will be retained by the Emergency Director (ED). Decisions on all of the listed actions normally will result from close and continuous consultation between the ESD and the ED and it is the responsibility of the ED to ensure the ESD is provided with the necessary information to arrive at timely and appropriate decisions. In the special case of event classification, the ESD shall retain the prerogative to overrule the ED if, in the judgment of the ESD, uncertainty or other considerations exist to the extent warranting classification of a higher level of emergency than that classified by the ED.

d. False

a. False

8.3 The attached Figure 8.3 is a composite of two figures from your Technical Specifications. Identify (name) both the outer and inner curves and state when operation is allowed in Regions A, B and C. (2.5)

Outer Curve - RPS trip max. allowable setpoints

Inner curve - Limiting condition for operation

Region A - never operate

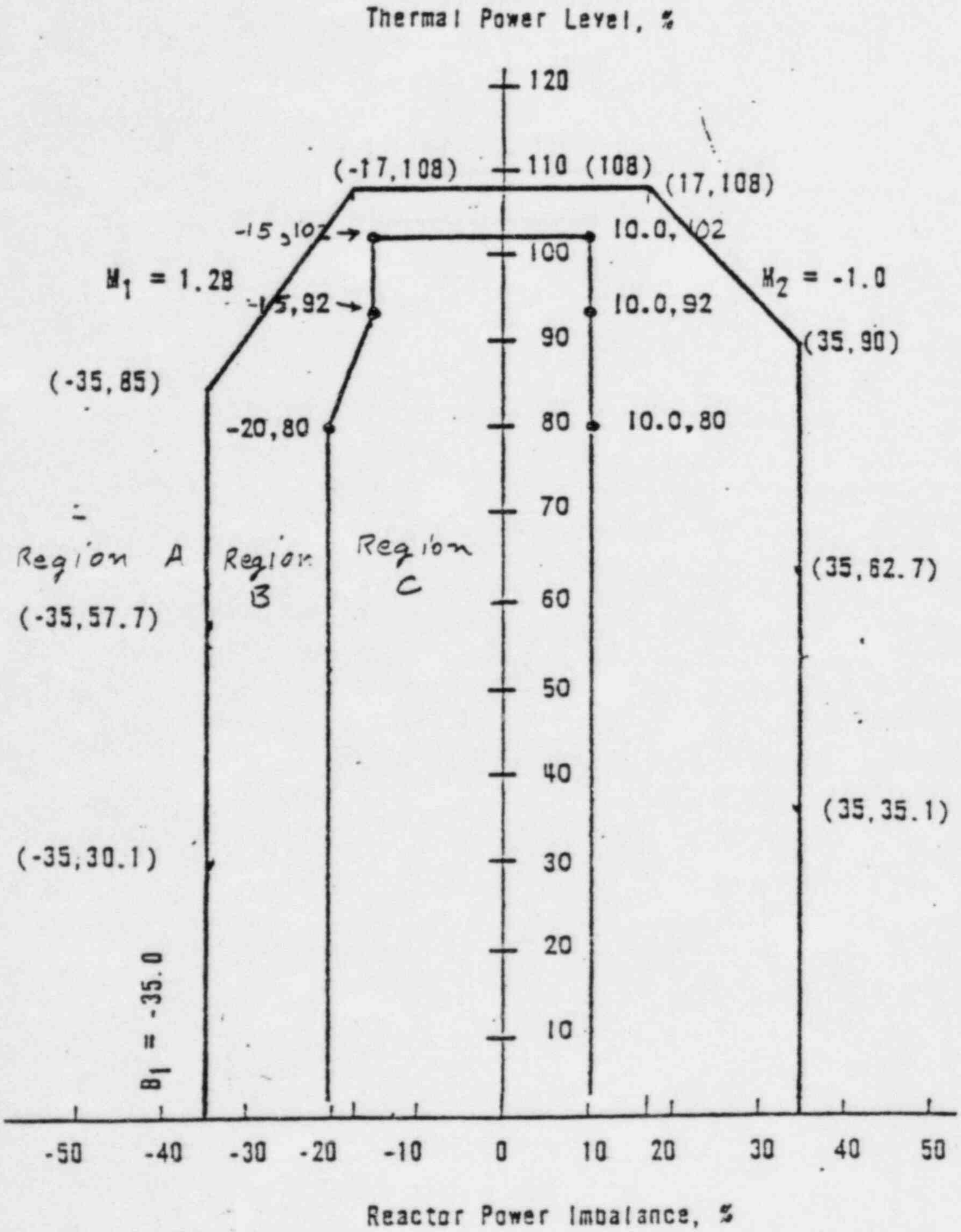
Region B - operation for 4 hours if immediate corrective action is taken

Region C - continuous operation

0.5 each

TS 2.3 and 3.5

Figure 8.3



Thermal Power Level, %
120
110
(108)
100
90
80
70
60
50
40
30
20
10
(-17,108)
(17,108)
-15,102
10.0,102
M1 = 1.28
M2 = -1.0
-15,92
10.0,92
(35,90)
(-35,85)
-20,80
10.0,80
Region A
Region B
Region C
(35,62.7)
(-35,57.7)
(35,35.1)
(-35,30.1)
B1 = -35.0
-50
-40
-30
-20
-10
0
10
20
30
40
50
Reactor Power Imbalance, %

8.4 If an error is discovered in a surveillance sheet during a review, what must be done? (1.5)

When errors are identified during reviews, audits, etc:

a. Place an asterisk by the incorrect entry that refers to correction discussed below. 0.3

b. Adjacent to the incorrect entry write:

   1. the correct entry or an explanation why a correct or appropriate log entry was not made 0.4

   2. legible signature of the individual that identifies the error and enters the explanation 0.4

   3. time and date the explanation is entered. 0.4

AP 1012

-Category 8 Continued on Next Page-

8.5 When the RCS temperature is less than 200°F, what are the minimum shift operations manning requirements, as required in OP 1102-11. (2.0)

When the RCS is less than 200°F the minimum shift operations manning requirements shall be:

a. 1 Shift Supervisor (SRO) 0.5

***1 Shift Foreman** 0.5

2 Control Room Operators (at least 1 RO) 0.5

4 Auxiliary Operators 0.5

***May be waived by the Manager, Plant Operations TMI-1**

b. A minimum of 1 SRO or 1 RO must be in the Control Room at all times when the RCS is less than 200°F. X

Not Req'd BG

OP 1102-11 p16

-Category 8 Continued on Next Page-

8.6 a. What does the signature of a maintenance supervisor on a tagging application indicate? (1.0)

b. Whose permission is required to energize Non-ES equipment bearing a Blue Tag? (1.0)

c. If the power supply to a component is Red Tagged for maintenance, when would the manual operator for the component not be tagged? (1.0)

a. He has made an independent check of tag coverage and usage to ensure it is correct and complete

b. any duty operations control room personnel

c. If manual operation of the component does not affect the electrical safety or maintenance associated with the power supply?

AP 1002

-Category 8 Continued on Next Page-

8.7 Explain why a shift supervisor should or should not approve each of the following maintenance requests. Assume that the plant is at steady state, 100% FP.

a. A request to tag out MUP-IC for 20 minutes for routine maintenance when MUP-IB is inoperable. (1.0)

b. A request to replace the gasket on the containment airlock inner door which has been identified as leaking excessively. Overall airlock leakage is within technical specification limits. (1.0)

a. Allowed by TS. Would not do if avoidable.
CAF – Any Admin prohibitions against entering NO
TS action statements for normal maintenance? NO

TS 3.3.1.1 b. Two makeup pumps are operable in the engineered safeguards mode powered from independent essential busses. Req'd for Criticality.

3.3.2 Maintenance shall be allowed during power operation on any component(s) in the makeup and purification, decay heat, RB emergency cooling water, RB spray, CFT pressure instrumentation, CFT level instrumentation, BWST level instrumentation, or cooling water systems which will not remove more than one train of each system from service. Components shall not be removed from service so that the affected system train is inoperable for more than 72 consecutive hours. If the system is not restored to meet the requirements of Specifications 3.3.1 within 72 hours, the reactor shall be placed in a cold shutdown condition within twelve hours.

3.3.4 Prior to initiating maintenance on any of the components, the duplicate (redundant) component shall be tested to assure operability.

b. Allowed by TS. Would wait for shutdown if possible, due to RB personnel hazards (Rad'n, H_2, closed atm, etc)

TS 1.7 f. One door of the personnel hatch or emergency hatch may be open for up to 24 hours for maintenance, repair or modification provided the other door of the hatch is maintained closed and has been leak tested and found to meet the local leak rate criteria for door seals within 24 hours prior to the maintenance, repair or modification.

-Category 8 Continued on Next Page-

8.8 State for each of the scenarios listed below whether the NRC Operations Center must be notified within 1 hour. Explain your answer with regard to your technical specification requirements.

a. RPS trip of reactor at 620°F. (.75)

b. Turbine trip due to windstorm damage to electrical transmission lines. (.75)

c. RPS trip setpoint discovered to be 2350 psig during surveillance. (.75)

d. Failure of the reactor to achieve criticality by 0.5% delta k/k beyond the ECP. (.75)

a. NOTIFY Failure of the reactor protection system or other systems subject to limiting safety system settings to initiate the required protective function by the time a monitored parameter reaches the setpoint specified as the limiting safety system setting in the Technical Specifications or failure to complete the required protective function.

b. NOTIFY Conditions arising from natural or man-made events that, as a direct result of the event required plant shutdown, operation of safety systems, or other protective measures required by Technical Specifications.

c. NOT Required Note: Instrument drift discovered as a result of testing need not be reported under this item but may be reportable under items 6.9.2.A.5, 6.9.2.A.6, or 6.9.2.B.1 below.

d. NOT Required Reactivity anomalies involving disagreement with the predicted value of reactivity balance under steady state conditions during power operation greater than or equal to 1% $\Delta k/k$; a calculated reactivity balance indicating a shutdown margin less conservative than specified in the Technical Specifications; short term reactivity increases that correspond to a reactor period of less than 5 seconds or, if sub-critical an unplanned reactivity insertion of more than 0.5% $\Delta k/k$; or occurrence of any unplanned criticality.

TS 6.9.2

-Category 8 Continued on Next Page-

8.9 What two conditions require reevaluation of a Standing RWP? 1.5

A standing RWP (SRWP) may be issued for routine operations; it will be reevaluated every six months; and/or when conditions change, as determined by radiation monitoring or surveys, such that the resulting exposures warrant of change of the permit.

0.75 each

OTM Vol IV p151

8.10 During functional testing of power-operated valves in the decay heat removal system, what indications are used for valve cycle timing? (1.5)

1104-4
Revision 40

NOTE:	During valve functional testing, it is necessary to record the time for power-operated valves to open or close. In order to assure the valve operating time measured is consistent for all tests, the time required for the tested valve to fully open (or close) shall be established as the time from pushing the local or remote open (or close) button until only the red open (green close) light is energized on the appropriate panel.

0.75 each

-Category 8 Continued on Next Page-

8.11 Answer TRUE or FALSE:

a. A CRO trainee shall use a procedure marked "Verified Copy" for system walk-down and familiarization. (0.5)

b. Controlled copies of procedures used in performance of official work activities may be thrown away at the completion of the activity. (0.5)

c. During emergencies, plant operations personnel may deviate from established procedures as necessary to minimize personnel injury. (0.5)

a. False - "Information only"

b. True (but not required)

c. True - also minimize plant damage, stabilize plant, protect public

AP 1001 G

-Category 8 Continued on Next Page-

8.12 a. Who performs scheduling of Technical Specification Surveillance (TSS) Testing activities? (Give title, not name.) (0.5)

b. When TSS testing is initiated prior to the scheduled performance date, under what two conditions may only part of the entire test be performed? (1.5)

Operations Supervisor, per his notification by:

a. GMS Coordinator (0.5)

b. The entire test need not be performed providing:

1. The equipment tested is left in the same or greater degree of operability as before the test; and
2. Sufficient precautionary measures (from Section 5.0 of the procedure) are taken to insure that the performance of the partial test has no greater impact on the plant than if the entire test were performed.

0.75 each

AP 1001 J

-Category 8 Continued on Next Page-

8.13 Describe the in-plant marking methods used to identify locked valves listed on the locked valve list. (1.5)

Unit 1 Only - All locked valves identified on the locked valve list are additionally marked as follows:

a. All locked valves have metal tags attached to their locks that identify the valve and also its desired position. 0.5

b. All normally locked closed valves have their locks painted green. 0.5

c. All normally locked open valves have their locks painted red. 0.5

AP 1011 P3

EQUATION SHEET

Where $\dot{m}_1 = \dot{m}_2$

$(density)_1(velocity)_1(area)_1 = (density)_2(velocity)_2(area)_2$

$KE = \frac{mv^2}{2}$ $PE = mgh$ $PE_1+KE_1+P_1V_1 = PE_2+KE_2+P_2V_2$ where V = specific volume
P = pressure

$Q = \dot{m}c_p(T_{out}-T_{in})$ $Q = UA(T_{ave}-T_{stm})$ $Q = \dot{m}(h_1-h_2)$

$P = P_o 10^{sur(t)}$ $P = P_o e^{t/T}$ $SUR = \frac{26.06}{T}$

T = (Beta - Rho)/Rho x Lambda

delta $K = (K_{eff}-1)/K_{eff}$ $CR_1(1-K_{eff1}) = CR_2(1-K_{eff2})$

$M = \frac{(1-K_{eff1})}{(1-K_{eff2})}$ $SDM = \frac{(1-K_{eff}) \times 100\%}{K_{eff}}$

decay constant $= \frac{\ln(2)}{t_{1/2}} = \frac{0.693}{t_{1/2}}$ $A = A_o e^{-(decay\ constant)x(t)}$

<u>Water Parameters</u>

1 gallon = 8.345 lbs
1 gallon = 3.78 liters

1 ft^3 = 7.48 gallons

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 psia = 29.9 in Hg

<u>Miscellaneous Conversions</u>

1 Curie = 3.7×10^{10} dps
1 kg = 2.21 lbs

1 hp = 2.54×10^3 Btu/hr

1 Mw = 3.41×10^6 Btu/hr

1 inch = 2.54 centimeters
Degrees F = (1.8) x (Degrees C) + 32
1 Btu = 778 ft-lbf
g = 32.174 ft-$lbm/lbf\text{-}sec^2$

R C Boyer 3-6-84 Bruce Leonard 3/6/84
[illegible] 3/6/84

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

Facility: TMI-I

Reactor Type: B&W

Date Administered: March 6, 1984

Examiner: Bryan Gore

Candidate: ______________________

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheet. Points for each question are indicated in parenthesis after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up six (6) hours after the examination starts.

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

Final Grade ______ %

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

____
Candidate's Signature

5.0 THEORY OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW (25 POINTS)

5.1 a. When constructing a 1/M plot during an approach to criticality, why must you wait after each rod withdrawal step before recording NI count rate? (1.0)

b. Suppose you record the count rate too soon, and use this count rate to add a point to the 1/M plot which you are constructing. If the plot is used to predict how much more rod withdrawal is required for criticality, will the predicted amount be larger or smaller than what you would have found if you had waited longer before recording NI count rate? Explain using a sketch. (1.5)

5.2 Primary flow rate is many times greater than secondary flow rate while secondary heat transfer rate is equal to the primary heat transfer rate. Explain the differences in flow rates. (1.0)

5.3 Is the stress in the reactor vessel greater during heatup or cooldown? Explain your answer. (1.5)

5.4 How do the magnitude of the moderator temperature coefficient and the doppler coefficient of reactivity change corresponding to increases in the following parameters. Assume reactor power is about 50%.

a. thermal power level (0.75)
b. moderator temperature (0.75)
c. fuel temperature (0.75)
d. boron concentration in the coolant (0.75)

5.5 Why is there a pressure-temperature limit on the RCS when the control rods are withdrawn? (1.0)

5.6 Your reactor is operating slightly below full power when an RC pump trips off.

a. Which RPS trip limit would normally be reached first? (1.0)

b. Explain why the RPS would or would not trip the plant. Include automatic ICS actions and inherent plant characteristics. (2.0)

-Category 5 Continued Next Page-

5.7 Saturated steam at a pressure of 1400 psia leaks past a valve into a tank pressurized to 100 psia. What temperature is the steam which enters the tank? Use the Mollier chart of Figure 5.7 for this question. Explain how you used the chart to determine this value. (Hint: how much work does the steam do in these process?) (1.5)

5.8 A reactor trip occurs after 10 days at 100% power. Explain what will happen to subcritical neutron count rate from the time "TRIP + 3 hr" to "TRIP + 72 hr." (2.0)

5.9 The attached Figure 5.9 shows the response of RCS pressure and pressurizer level to a trip of one RCP at power. Which curve represents pressure and which represents level? Justify your selection. (2.0)

5.10 The reactor is shutdown by 4% delta K/K with a count rate (CR) of 10 cps. How much negative reactivity would have to be inserted to reduce the count rate by 1/2? Show work. (Note: equation sheet attached). (1.5)

5.11 For the attached Figure 5.11 state what portion (ex. 20 to 40% tube length) corresponds to:

a. Nucleate boiling (0.65)
b. Film boiling (0.65)
c. Superheat (0.65)

5.12 a. State the formula defining quadrant power tilt. (0.5)

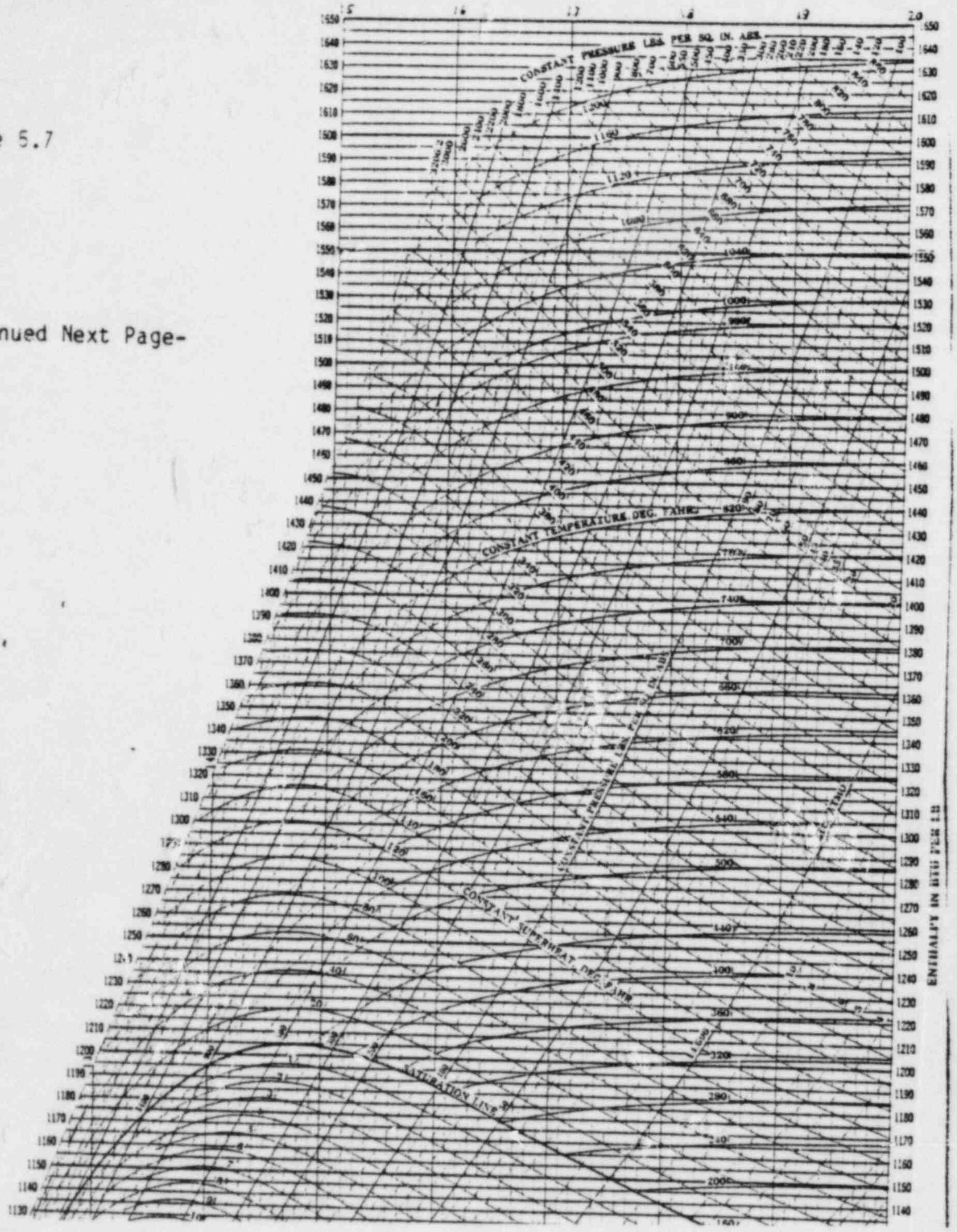
b. Why is quadrant power tilt limited by your technical specifications? (1.0)

c. Explain how a dropped rod affects quadrant power tilt? (1.0)

5.13 Water having a specific heat of 1.0 Btu/lb °F cools a heat exchanger for oil having a specific heat of 0.5 Btu/lb °F. Mass flow rates for water and oil are the same. The oil is cooled from 140 to 100°F. If water enters at 70°F, what is its exit temperature? Show your work. (Note: Equation sheet attached.) (1.5)

Figure 5.7

-Category 5 Continued Next Page-



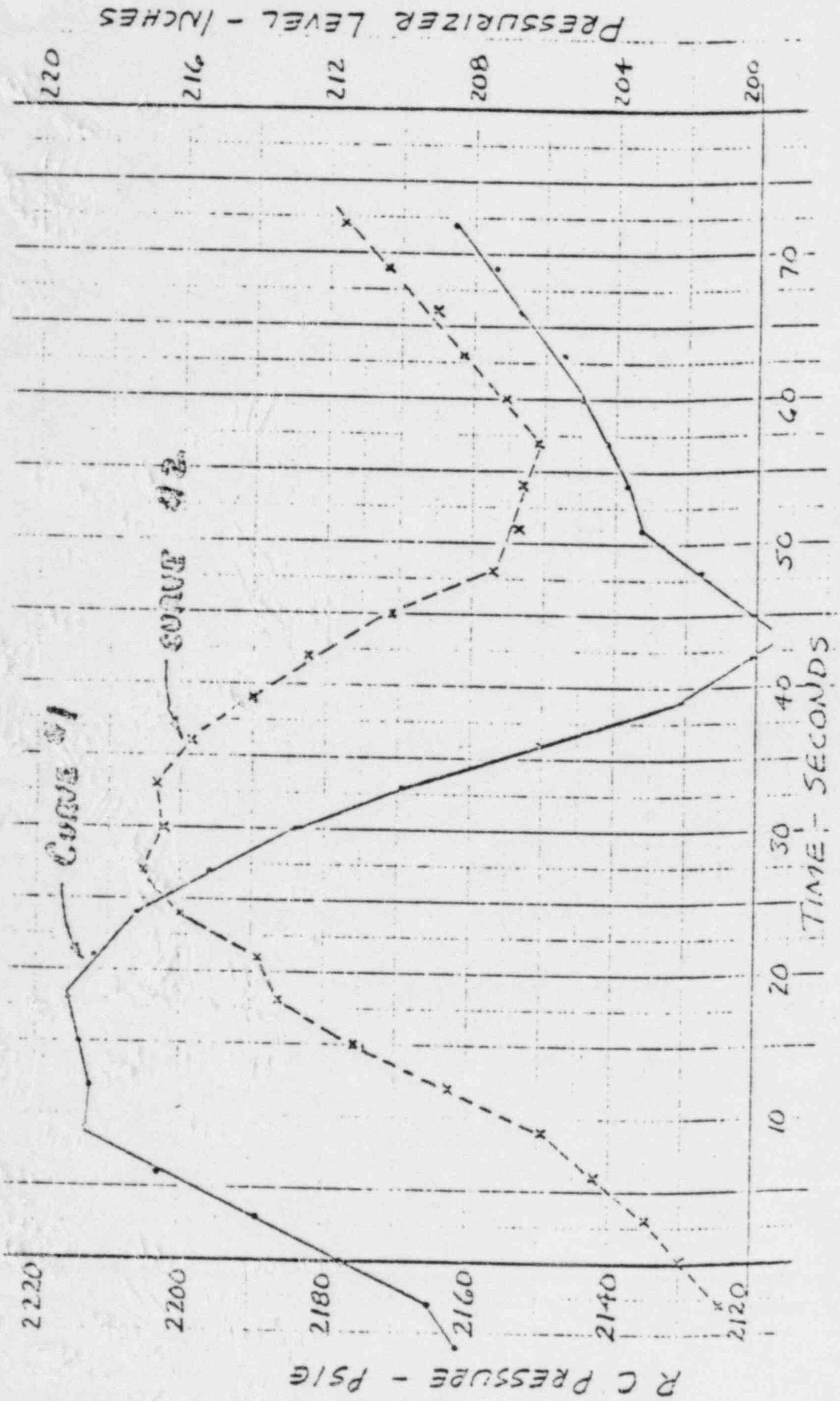
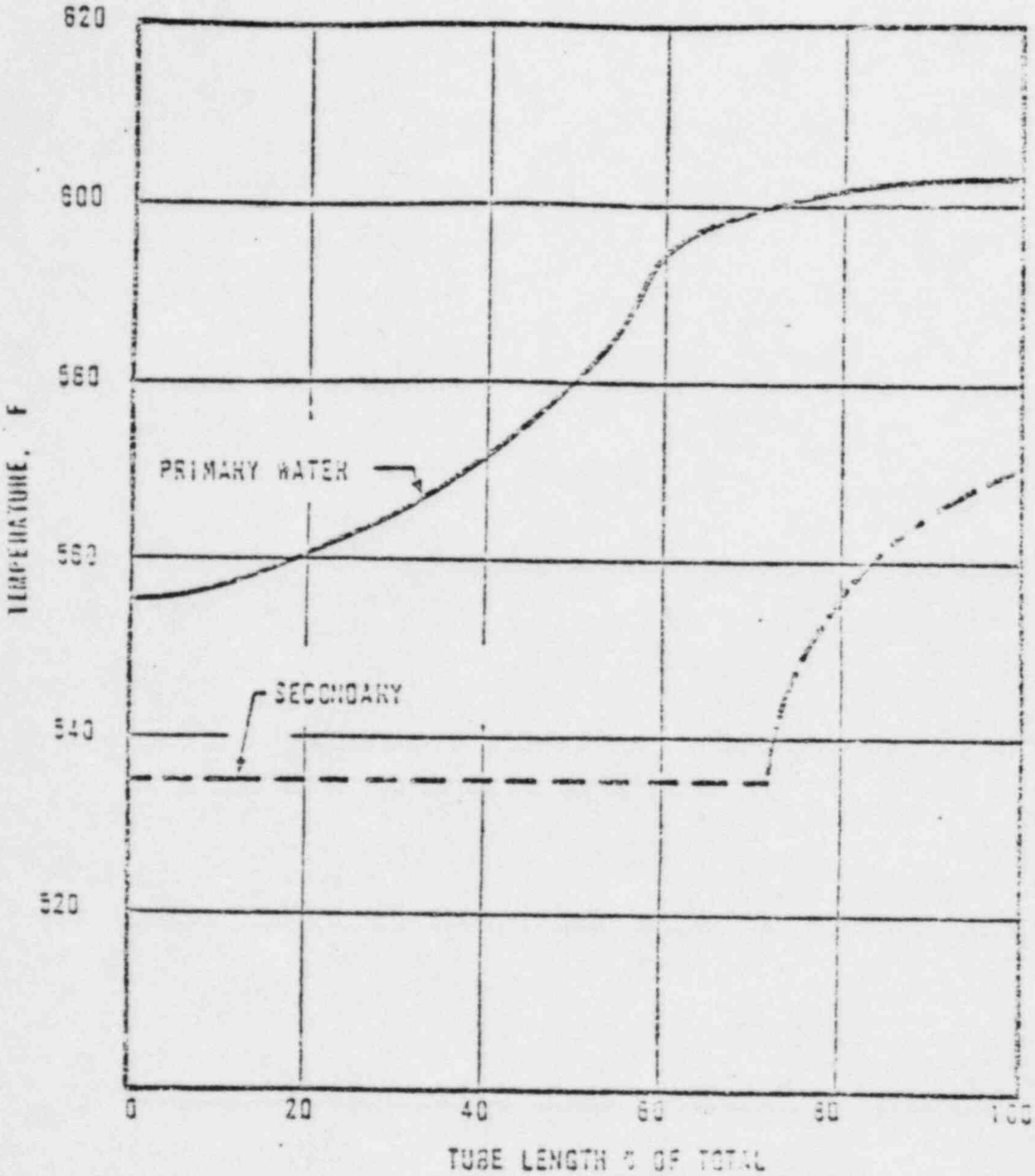


Figure 5.9

-Category 5 Continued Next Page-

Figure 5.11.



-End Section 5-

6.0 PLANT SYSTEM DESIGN, CONTROL, AND INSTRUMENTATION (25 POINTS)

6.1 With regard to ICS feedwater control:

a. What is "feedwater temperature error" and how does it affect feedwater demand. (1.0)

b. Explain why this is important. (1.0)

6.2 Explain how a quick check for proper compensation of an intermediate range detector may be made after reactor shutdown. Explain the indications of both undercompensation and overcompensation. (1.5)

6.3 a. Explain the principle of operation of a self-powered neutron detector. (0.7)

b. List two factors other than neutron flux level which affect SPND readings and must be compensated for. (0.8)

6.4 State the function of "aspirating steam" (or "bleed steam") in an OTSG, and describe how this function is accomplished. (2.0)

6.5 The attached Figure 6.5 copied from your training materials shows a S/G level auctioneering circuit. Explain how this circuit functions to pass only one of the transducer outputs and tell if it is the highest or lowest. (2.0)

6.6 a. True or False: The control rod sequence monitor does not consider too little overlap between rod groups. (0.3)

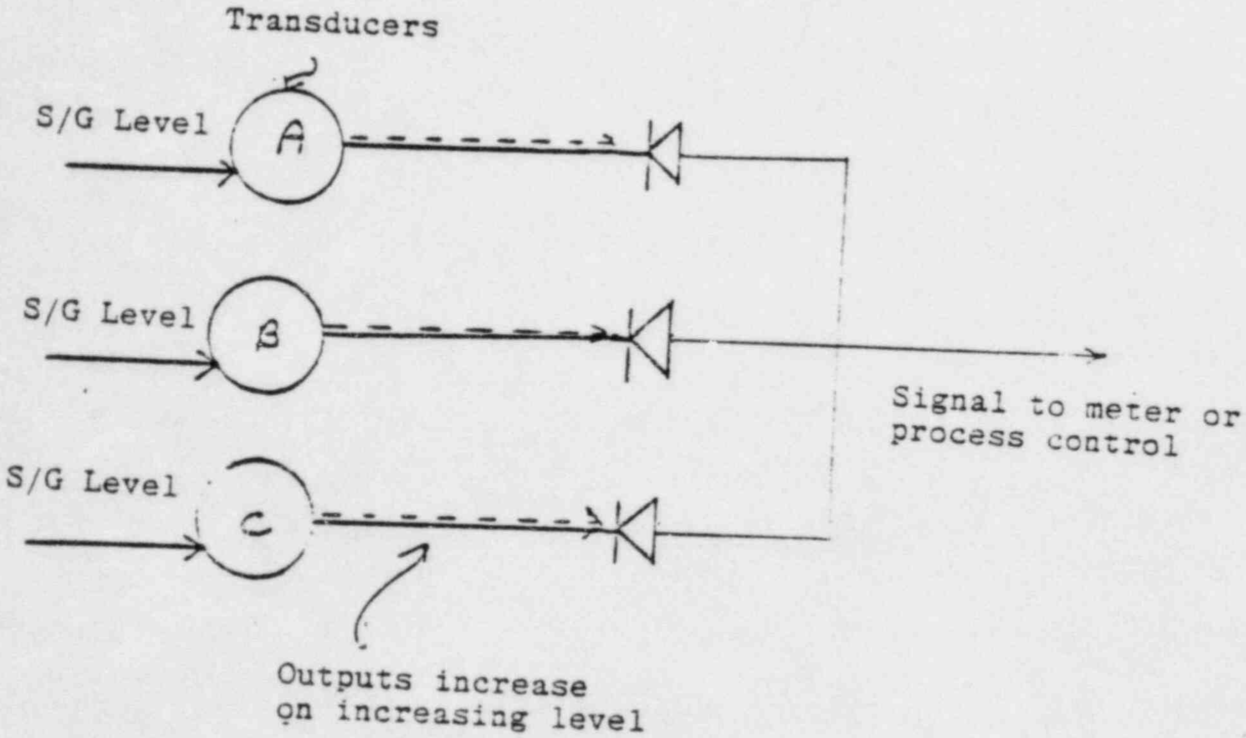
b. What two rod position permits must be satisfied in order to satisfy the plant's feed and bleed permit requirements? (0.8)

c. Which of the following control rod drive breaker combinations, if tripped, will NOT cause a reactor trip?

a. A + B
b. A + C + E
c. A + D + F
d. B + C + E (0.4)

-Category 6 Continued on Next Page-

Figure 6.5.



-Category 6 Continued on Next Page-

6.7 During operation at power, will pressurizer level read higher or lower than actual (and explain why) if:

a. Temperature compensation is lost. (1.0)

b. dp cell connection to tank top ruptures. (1.0)

6.8 a. Label the components indicated on the attached Source Range channel diagram, Figure 6.8, and indicate the control function performed by this circuit. (1.0)

b. Describe how the detector output is adjusted to indicate only neutron flux. (1.0)

6.9 a. If a total loss of main and emergency feedwater occurs and only one HPI pump is available, is it possible for HPI cooling to match decay heat production? (0.75)

b. Why is it important to open MU-V-36 and MU-V-37 when HPI is manually throttled? (0.75)

6.10 a. Explain how the Integrated Master Subsystem of the ICS (in full auto) controls turbine valves in response to an increased load demand. (1.5)

b. How does the plant accommodate a rapid load increase. (1.0)

6.11 Upon loss of ICS/NNI power:

a. What position will Hand/Auto station indicators assume? (0.5)

b. What position will the main feedwater [redacted] valves (FW-V17A/B) assume? (0.5)

c. How do the main feedwater pumps respond? (0.5)

d. Why is it important not to immediately attempt to restore ICS/NNI power? (1.0)

-Category 6 Continued on Next Page-

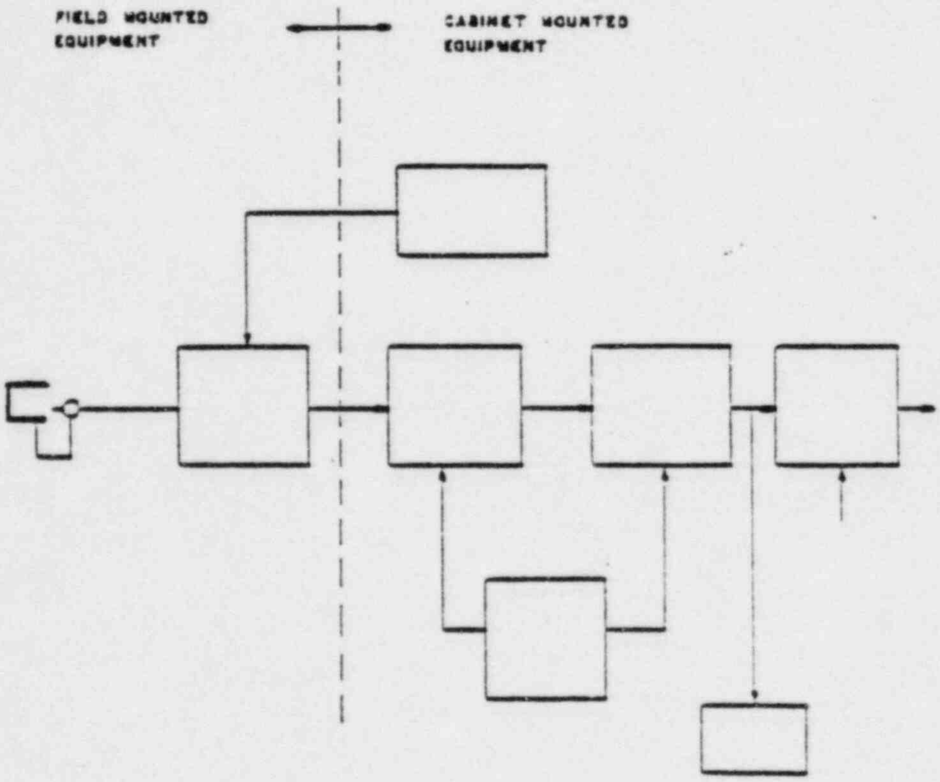
6.12 a. When one channel of the Reactor Protection System is in channel bypass, what will happen if you attempt to bypass a second channel? Explain why. (2.0)

b. If one RPS channel is bypassed, and a second channel is switched to "test," how many of the remaining channels must receive a trip signal to trip the reactor? (1.0)

6.13 What other two methods may be used to open the emergency feedwater valves EF-V-30A and B if they fail to open as needed to control SG level when the hand/auto station is in AUTO, and if they still remain closed when the station is switched to HAND? (1.0)

-Category 6 Continued on Next Page-

Figure 6.8



-End Section 6-

7.0 PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL (25 POINTS)

7.1 Plant heatup is beginning, with pressurizer heaters maintaining RCS pressure appropriately. Describe how the RC pumps are to be operated prior to RCS venting. (1.5)

7.2 Under what condition may the fuel pin compression curve of OP 1102-II be exceeded by procedure. (1.5)

7.3 Following shutdown of the last RC pump during plant cooldown, RCS pressure is controlled using the anxiliary pressurizer, spray throttle valve. How and why is the auxiliary spray throttle valve adjusted for proper flow during cooldown? (2.5)

7.4 When feeding a dry steam generator:

a. What condition indicates that the SG is "dry?" (0.75)
b. State the three limitations which must be observed. (2.25)

7.5 Following a thermal power change exceeding 15 percent of rated thermal power during a 1-hour period, what two places must be sampled, how soon, and for what are the samples to be analyzed? (2.0)

7.6 a. Following a reactor trip where all plant systems and indications respond as expected, what immediate manual actions must be taken? Do not include verification. (1.0)

b. What actions are required if OTSG level is at 50% on the operating range and increasing, with no indication of a tube leak? (1.0)

7.7 Briefly explain how a heat balance ~~calibration~~ calculation is performed. Include the two major values which are calculated and when each is most accurate. (2.0)

7.8 How is uniform heating of the OTSG shell accomplished during plant heatup when RCS temperature is less than 220°F. (1.0)

-Category 7 Continued on Next Page-

7.9 a. What is the required subcooling margin (SCM)? (0.5)

b. What immediate actions are required if the required SCM is lost? (2.0)

7.10 If the plant is operating at 100% FP and a 40 gpm tube leak is identified in the A OTSG:

a. What immediate actions should be taken? (1.0)

b. Under what conditions should consideration be given to isolating OTSG A? (2.0)

7.11 If RC-V-3 must be closed to control pressurizer spray, how must it be operated subsequently? (1.0)

7.12 Answer TRUE or FALSE:

a. When seal leakoff flow from a No. 1 RC pump seal is 7 gpm, and outlet temperature is higher than normal, the seal leakoff valve must be closed within 5 minutes. (1.0)

b. When high RC pump vibration is observed coincident with a high stand pipe level the pump must be secured within 20 minutes. (1.0)

c. If RC pump seal injection is lost the No. 1 seal bypass valve must not be opened. (1.0)

-End Section 7-

8.0 ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS (25 POINTS)

8.1 How is a component or system determined to be capable of performing its intended function within the required range, according to technical specifications. (1.0)

8.2 Answer TRUE or FALSE

a. The Emergency Director may overrule the Emergency Support Director in the classification of an emergency. (0.5)

b. The Emergency Director may direct an SRO to handle approvals of offsite agency official notifications. (0.5)

c. The Emergency Director may authorize emergency workers to exceed 10 CFR 20 Radiation Exposure Limits. (0.5)

d. The Emergency Support Director may overrule the Emergency Director in directing deviations from established emergency operating procedures. (0.5)

8.3 The attached Figure 8.3 is a composite of two figures from your Technical Specifications. Identify (name) both the outer and inner curves and state when operation is allowed in Regions A, B and C. (2.5)

8.4 If an error is discovered in a surveillance sheet during a review, what must be done? (1.5)

8.5 When the RCS temperature is less than 200°F, what are the minimum shift operations manning requirements, as required in OP 1102-11. (2.0)

8.6 a. What does the signature of a maintenance supervisor on a tagging application indicate? (1.0)

b. Whose permission is required to energize Non-ES equipment bearing a Blue Tag? (1.0)

c. If the power supply to a component is Red Tagged for maintenance, when would the manual operator for the component not be tagged? (1.0)

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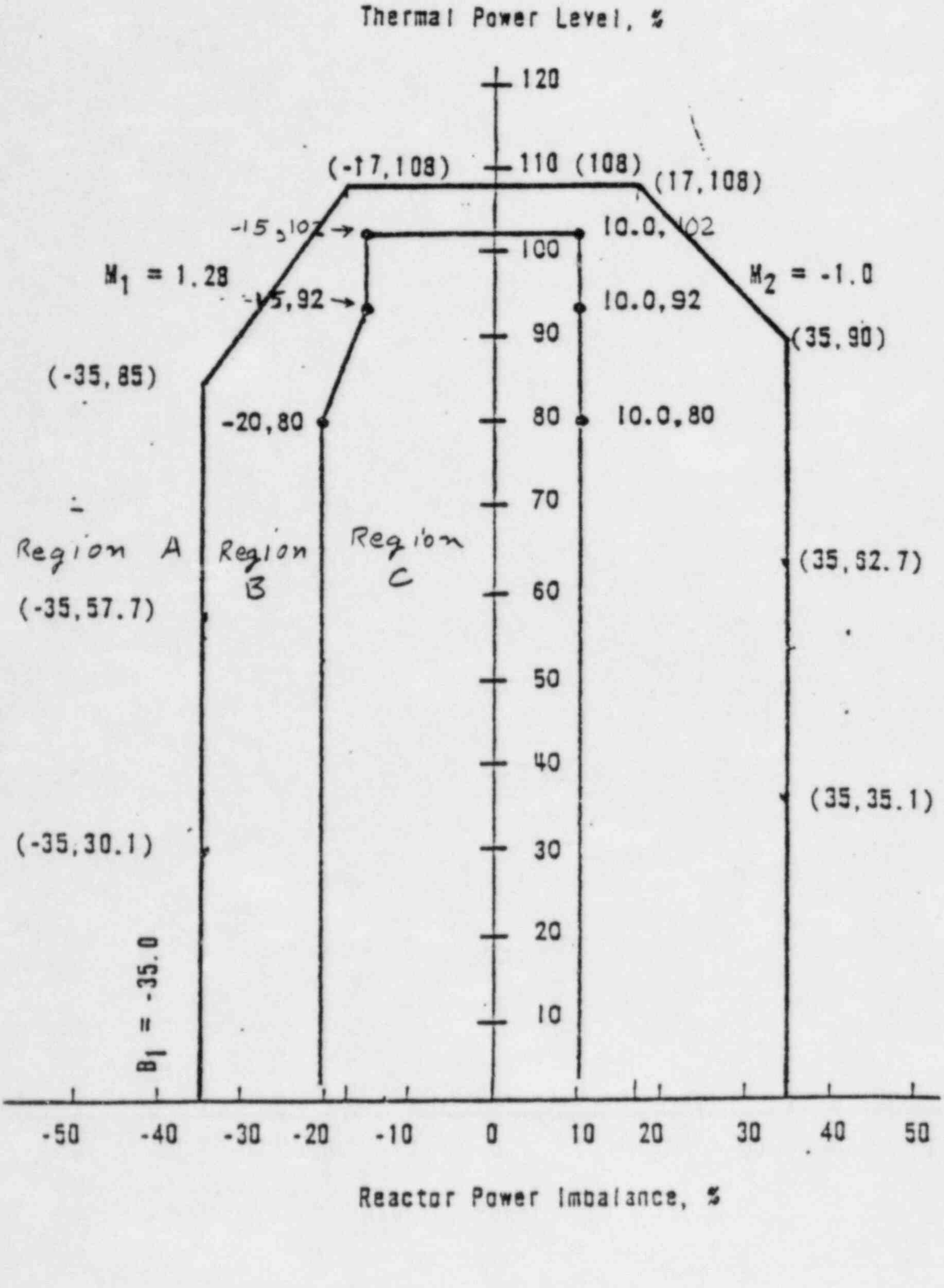
Figure 8.3.



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8.7 Explain why a shift supervisor should or should not approve each of the following maintenance requests. Assume that the plant is at steady state, 100% FP.

a. A request to tag out MU-P-1C for 20 minutes for routine maintenance when MU-P-1B is inoperable. (1.0)

b. A request to replace the gasket on the containment airlock inner door which has been identified as leaking excessively. Overall airlock leakage is within technical specification limits. (1.0)

8.8 State for each of the scenarios listed below whether the NRC Operations Center must be notified within 1 hour. Explain your answer with regard to your technical specification requirements.

a. RPS trip of reactor at 620°F. (.75)

b. Turbine trip due to windstorm damage to electrical transmission lines. (.75)

c. RPS trip setpoint discovered to be 2350 psig during surveillance. (.75)

d. Failure of the reactor to achieve criticality by 0.5% delta k/k beyond the ECP. (.75)

8.9 What two conditions require reevaluation of a Standing RWP? (1.5)

8.10 During functional testing of power-operated valves in the decay heat removal system, what indications are used for valve cycle timing? (1.5)

8.11 Answer TRUE or FALSE:

a. A CRO trainee shall use a procedure marked "Verified Copy" for system walk-down and familiarization. (0.5)

b. Controlled copies of procedures used in performance of official work activities may be thrown away at the completion of the activity. (0.5)

c. During emergencies, plant operations personnel may deviate from established procedures as necessary to minimize personnel injury. (0.5)

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8.12 a. Who performs scheduling of Technical Specification Surveillance (TSS) testing activities? (Give title, not name.) (0.5)

b. When TSS testing is initiated prior to the scheduled performance date, under what two conditions may only part of the entire test be performed? (1.5)

8.13 Describe the in-plant marking methods used to identify locked valves listed on the locked valve list. (1.5)

-End Section 8-

EQUATION SHEET

Where $\dot{m}_1 = \dot{m}_2$

$(\text{density})_1(\text{velocity})_1(\text{area})_1 = (\text{density})_2(\text{velocity})_2(\text{area})_2$

$KE = \frac{mv^2}{2}$ $PE = mgh$ $PE_1+KE_1+P_1V_1 = PE_2+KE_2+P_2V_2$ where V = specific volume
P = pressure

$Q = \dot{m}c_p(T_{out}-T_{in})$ $Q = UA(T_{ave}-T_{stm})$ $Q = \dot{m}(h_1-h_2)$

$P = P_o10^{sur(t)}$ $P = P_oe^{t/T}$ $SUR = \frac{26.06}{T}$

T = (Beta - Rho)/Rho x Lambda

$\text{delta } K = (K_{eff}-1)/K_{eff}$ $CR_1(1-K_{eff1}) = CR_2(1-K_{eff2})$

$M = \frac{(1-K_{eff1})}{(1-K_{eff2})}$ $SDM = \frac{(1-K_{eff}) \times 100\%}{K_{eff}}$

$\text{decay constant} = \frac{\ln(2)}{t_{1/2}} = \frac{0.693}{t_{1/2}}$ $A = A_oe^{-(\text{decay constant})x(t)}$

Water Parameters

1 gallon = 8.345 lbs
1 gallon = 3.78 liters

1 ft^3 = 7.48 gallons

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 psia = 29.9 in Hg

Miscellaneous Conversions

1 Curie = 3.7×10^{10} dps
1 kg = 2.21 lbs

1 hp = 2.54×10^3 Btu/hr

1 Mw = 3.41×10^6 Btu/hr

1 inch = 2.54 centimeters
Degrees F = (1.8) x (Degrees C) + 32
1 Btu = 778 ft-lbf
g = 32.174 $ft\text{-}lbm/lbf\text{-}sec^2$