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

EXAMINATION REPORT NO. 50-244/85-11 (OL)

FACILITY DOCKET NO. 50-244

LICENSEE: Rochester Gas and Electric Corporation
89 East Avenue
Rochester, New York 14649-0001

FACILITY: Ginna

EXAMINATION DATE: June 24, 1985

CHIEF EXAMINER: _____ 7/11/85
F. Johnson, Lead Reactor Engineer (Examiner) Date

REVIEWED BY: _____ 7/11/85
R. M. Keller, Chief, Project Section 1C Date

APPROVED BY: _____ 7/11/85
H. B. Kister, Chief, Project Branch No. 1 Date

SUMMARY: A written examination was administered to three candidates, two SRO and one Instructor Certification. All passed the examination. No significant generic deficiencies were noted from grading of the written exams.

REPORT DETAILS

TYPE OF EXAMS: Replacement

EXAM RESULTS:

	SRO Pass/Fail	Inst. Cert Pass/Fail
Written Exam	2/0	1/0
Overall	2/0	1/0

1. Examiners:

   D. F. Johnson, NRC
   B. S. Norris, NRC
   O. W. Burke, NRC

2. Examination Review:

   The examiners and licensee personnel met to review the exam and answer key to identify inappropriate answers relative to plant specific design, and to ensure that the questions reflect current plant conditions, and would elicit the answers in the key.

   Examiners

   D. F. Johnson, NRC
   B. S. Norris, NRC

   Licensee

   R. A. Carroll, Assistant Training Coordinator
   J. Garber, Westinghouse Representative

ATTACHMENT

Comments and Resolution

Question 5.03	Typographical error with respect to the given value of K_{eff} should have been 0.94.	Accepted calculations using either 0.94 or 0.0094.
Question 6.08	Reviewers supplied documentation supporting another secondary source of water for the standby auxiliary feedwater pumps; additionally, another interlock for starting of the pump was identified.	Question and answer corrected accordingly.

Several editorial clarifications were made to Section 8.0 as noted on the attachment.

Attachment

Written Examination and Answer Key

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

FACILITY: GINNA

REACTOR TYPE: PWR-WEC2

DATE ADMINISTERED: 85/06/24

EXAMINER: BURKE, O. W.

APPLICANT: _____

INSTRUCTIONS TO APPLICANT:

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

CATEGORY VALUE	% OF TOTAL	APPLICANT'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	25.00			5. THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
25.00	25.00			6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
25.00	25.00			7. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
25.00	25.00			8. ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
100.00	100.00			TOTALS

FINAL GRADE _____%

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

_____
APPLICANT'S SIGNATURE

5. THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS

QUESTION 5.01 (2.00)

Following a reactor trip from 100% power, how long would you expect it to take for the source range instrumentation to be energized? Show by calculation and also state any assumptions used.

QUESTION 5.02 (3.00)

a. What are the major constituents of the secondary neutron source? (1.0)

b. Describe the reactions by which this source emits neutrons. (2.0)

QUESTION 5.03 (2.00)

During a reactor startup, the operator stops rod pull #9 at 144 steps on Bank C. The Source Range Monitor (SRM) count rate levels off at 1800 cps. The initial SRM count rate was 400 cps at 0 steps withdrawn on control Bank A with Keff = 0.894. Should be 0.94

a. Calculate 1/M value for this control position. (1.0)

b. What is the new value of Keff at this condition? (1.0)

QUESTION 5.04 (3.00)

The reactor has just reached criticalty when a very rapid 15 ppm dilution of the RCS occurs. Answer the following showing all work and assumptions:

a. What is the resulting stable SUR from this dilution assuming that the core is at BOL? (2.25)

b. Assume that the same events occurred at EOL. Would the SUR at EOL be higher, lower, or the same? Explain why. (0.75)

(***** CATEGORY 05 CONTINUED ON NEXT PAGE *****)

QUESTION 5.05 (3.50)

Explain (in detail) what causes reactor power to follow a turbine load increase. In your discussion, include all of the various parameter changes, including reactivity changes, and the reasons for these changes.

QUESTION 5.06 (1.50)

List three objectives of the control rod insertion limits.

QUESTION 5.07 (3.00)

Refer to Figure 5-1 (attached):

What will be the total system flow rate (gpm) and the operating pressure with all three pumps operating? Give a brief explanation of the reasoning process used to arrive at your solution. You may mark on the figure in doing your solution if you desire.

QUESTION 5.08 (1.00)

Calculate the amount of primary subcooling that exists at a steady-state ten percent (10%) power. Include all assumptions and calculations.

QUESTION 5.09 (.50)

Figure 5-2 (attached) is a graph of heat flux vs. delta-T film (fuel rod surface temperature to fluid bulk temperature). Indicate (on the figure) the point at which DNBR = 10.0.

QUESTION 5.10 (2.00)

List four (4) system design considerations and/or system considerations that must exist to ensure natural circulation subsequent to a loss of all RCPs.

(***** CATEGORY 05 CONTINUED ON NEXT PAGE *****)

QUESTION 5.11 (2.00)

For the following questions, show all work and describe all sources of information.

a. Determine the quality of saturated steam at 1000 PSIA if the enthalpy is 1100 BTU/LBM. (1.0)

b. Find the enthalpy change in an isentropic expansion of steam through a turbine into a condenser. (NOTE: Pstm = 825 PSIA, saturated vapor, Pcond = 2 PSIA) (1.0)

QUESTION 5.12 (.50)

When a pressurizer PORV is used to depressurize the RCS, would you expect pressurizer level to increase, decrease, or remain the same?

QUESTION 5.13 (1.00)

A reactor has been operating at 40% power for 24 hours when the load is step increased to 50%. Describe the xenon transient that follows.

(***** END OF CATEGORY 05 *****)

QUESTION 6.01 (2.00)

What four (4) conditions must be met for the operator to be able to manually open the letdown isolation valve (AOV-427) from the main control board?

QUESTION 6.02 (1.00)

NOTE: Refer to Figure 6-1 (attached) when answering the question.

During makeup operations, with the makeup system mode selector switch in "auto", system control valves will be as follows (select one):

1.	110A-modulated	111-open	110B-open	110C-closed
2.	110A-modulated	111-modulated	110B-open	110C-open
3.	110A-modulated	111-modulated	110B-open	110C-closed
4.	110A-modulated	111-modulated	110B-closed	110C-open

QUESTION 6.03 (1.00)

NOTE: refer to Figure 6-1 (attached) when answering the question.

During makeup operations, with the makeup system mode selector switch in "dilute", the system control valves will be as follows (select one):

1.	110A-closed	111-open	110B-closed	110C-open
2.	110A-closed	111-modulated	110B-open	110C-closed
3.	110A-closed	111-open	110B-open	110C-open
4.	110A-closed	111-modulated	110B-closed	110C-open

QUESTION 6.04 (1.00)

NOTE: refer to Figure 6-1 (attached) when answering the question.

During makeup operations, with the makeup system mode selector switch in "alternate dilute", the system control valves will be positioned as follows (Select one answer):

1.	110A-closed	111-modulated	110B-open	110C-closed
2.	110A-closed	111-modulated	110B-closed	110C-open
3.	110A-closed	111-open	110B-open	110C-open
4.	110A-closed	111-modulated	110B-open	110C-open

(***** CATEGORY 06 CONTINUED ON NEXT PAGE *****)

QUESTION 6.05 (1.00)

What automatic actions would occur (if any) and what immediate manual operator actions would be required in response to a valid 'Low Feed Pump Suction Pressure' alarm?

QUESTION 6.06 (3.50)

What are five (5) of the interlocks that must be satisfied before a main feedwater pump will start?

QUESTION 6.07 (1.00)

Explain the effect of a loss of instrument air on the operation of the atmospheric steam dump valves.

QUESTION 6.08 (2.00)

Answer the following questions about the Standby Auxiliary Feedwater System

a. What are the primary and secondary sources of water available to the pumps? (1.0)

b. What are two (2) of the interlocks that will prevent starting the pump? (1.0)

QUESTION 6.09 (.50)

What protective turbine trip is blocked by use of the 'Turbine Latch' pushbutton during plant startup?

(***** CATEGORY 06 CONTINUED ON NEXT PAGE *****)

QUESTION 6.10 (2.25)

Following a reactor trip, the trace of one of the intermediate range detectors levels out at 10^{-9} amps:

a. Is the detector over compensated or undercompensated? (0.5)

b. What is the compensating voltage used for? (0.75)

c. Expalin why a compensating voltage is not necessary for the power range detectors. (1.0)

QUESTION 6.11 (2.00)

a. What is the primary protection afforded by the OT/delta-T reactor trip? (0.5)

b. What are the system inputs to the OT/delta-T setpoint calculation? (1.5)

QUESTION 6.12 (2.00)

What are the input signals used to generate the control rod drive controller demand signal?

QUESTION 6.13 (4.50)

Relay 20 can be called the steam dump arming relay. Two permissives and an arming signal are required to energize Relay 20:

a. List the two (2) permissives (include setpoints and coincidences where applicable). (1.6)

b. List the three (3) arming signals, any of which will, in conjunction with the two above permissives, energize Relay 20. Include setpoints and coincidences where applicable. (2.4)

c. What operator action should be taken after the steam dump valves close following an automatic dumping action? (Relay 20 has been energized) ? (0.5)

(***** CATEGORY 06 CONTINUED ON NEXT PAGE *****)

QUESTION 6.14 (1.25)

List the automatic start signals for:

a. The turbine driven auxiliary feed pump (0.5)

b. The motor driven auxiliary feed pump (0.75)

(***** END OF CATEGORY 06 *****)

7. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL

QUESTION 7.01 (1.50)

Fill in the blanks in the following statement from Admin. Procedure A-1.1:

All areas in which the radiation intensity is such that a major portion of the body could receive in any one hour a dose in excess of 1000 Mrem shall be (1)_____, (2)_____, and (3)_____.

QUESTION 7.02 (2.00)

Plant Heatup from Cold Shutdown states that "...as the bubble forms, RCS pressure increases and a subsequent increase in letdown flow will be noted."

List all ways in which can the operator avoid exceeding the maximum letdown flow rate under these conditions?

QUESTION 7.03 (1.50)

What are the purposes for Shift Relief Turnover in the Control Room?

QUESTION 7.04 (5.00)

With reference to immediate operator actions, section 2.0 of procedure E-1.1 [Immediate Action and Diagnostics for Spurious Actuation of SI, LOCA, Loss of Secondary Coolant, and Steam Generator Tube Rupture] answer the following questions:

a. Article 2.2 under immediate operator actions for the above procedure states, "Verify the following actions and system status. If any of the following automatic actions have not occurred and are required, they should be manually initiated."

   Give the ten (10) automatic action verifications. (4.0)

b. Article 2.3.3 under immediate operator actions for the above procedure states, "Verify that heat is being removed from the reactor plant via the steam generators by noting the following:"

   Give the two verifications. (1.0)

(***** CATEGORY 07 CONTINUED ON NEXT PAGE *****)

QUESTION 7.05 (2.50)

In procedure E-1.5, Void Formation in the RCS, the statement is made 'The following indicate a potential approach to inadequate core cooling:'

Give five (5) possible symptoms of void formation in the RCS.

QUESTION 7.06 (4.50)

Listed below are six (6) of the immediate actions for a Station Blackout (procedure E-4). Explain the basis for each:

a. Verify that at least one service water pump is in operation.

b. Start one containment fan cooler.

c. Clear all loads off non-safeguards 480v buses 13 & 15 and energize by closing bus ties 13-to-14 and 15-to-16.

d. Start two instrument air compressors.

e. Restore instrument bus 1D by energizing motor control center 1B and reset alarms.

f. Restore emergency feed to instrument buses by energizing MCC-1A.

QUESTION 7.07 (3.00)

In accordance with procedure E-5, Control Room Inaccessibility, what are the emergency stations and primary responsibilities of the:

a. Shift Supervisor

b. Head Control Operator

c. Control Operator

d. Primary Side Auxiliary Operator

(***** CATEGORY 07 CONTINUED ON NEXT PAGE *****)

QUESTION 7.08 (1.00)

What is the primary source of radiation in the containment under the following conditions:

a. Entry into the containment while at power (0.5)

b. Entry into the containment 24 hours after shutdown (0.5)

QUESTION 7.09 (1.00)

What would be your response to finding an employee working in violation of a radiation work procedure or special work permit?

QUESTION 7.10 (3.00)

What four (4) things should be done following the discovery of a potentially contaminated spill?

(***** END OF CATEGORY 07 *****)

QUESTION 8.01 (2.00)

What conditions must exist for containment integrity to exist in accordance with the Technical Specification definition?

QUESTION 8.02 (2.00)

List the two (2) criteria required to make a change in the sequence of steps in procedures.

QUESTION 8.03 (1.00)

What are the limiting conditions for operation applicable to the reactor coolant loops when the reactor power is above 130 MWT?

QUESTION 8.04 (2.50)

In accordance with the Technical Specification LCOs, what CVCS conditions must be met for the reactor to be made critical?

QUESTION 8.05 (1.25)

There is an LCO that applies to the availability of electrical power for the operation of plant auxiliaries. It says that 'The reactor shall not be maintained critical without:'

Supply the five (5) electrical power source requirements.

QUESTION 8.06 (1.50)

a. What criteria determines whether or not a system, subsystem, train, component or device is operable? (0.5)

b. What operator actions are required when a limiting condition for operation is not met, except as provided in the associated ACTION requirements? (1.0)

(***** CATEGORY 08 CONTINUED ON NEXT PAGE *****)

QUESTION 8.07 (2.00)

What is the Technical Specification limit pertaining to steam generator tube leakage?

QUESTION 8.08 (2.50)

What conditions pertaining to the safety injection and heat removal systems must be met before going critical (except for low temperature physics testing)? Give five (5) conditions exclusive of those pertaining to various valve positions.

QUESTION 8.09 (1.00)

What reporting action should be taken in response to the following situation:

During shift turnover, you notice that the time limit for the repair of #1A charging pump has passed without the pump being returned to service; #1B charging pump is tagged out for surveillance testing.

QUESTION 8.10 (2.00)

a. Who may initiate a Ginna Station Event Report? (1.0)

b. Who must perform the initial assessment of the reported event? (1.0)

QUESTION 8.11 (1.00)

During a reactor post-trip review, the shift supervisor assigns the 'Condition Three' classification to the event. What would this indicate about the trip?

QUESTION 8.12 (2.25)

Discuss the relationship among Limiting Conditions for Operation, Limiting Safety System Settings and Safety Limits with regard to preverting release of radioactivity to the environment.

(***** CATEGORY 08 CONTINUED ON NEXT PAGE *****)

QUESTION 8.13 (2.00)

Answer the following concerning Reactor Coolant System (RCS) limits:

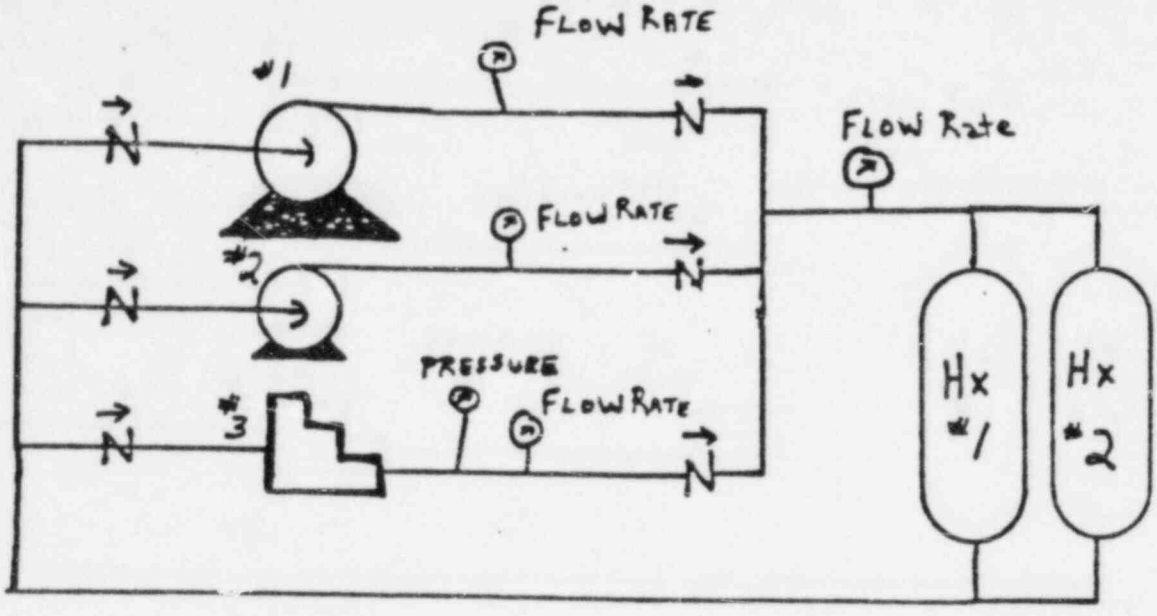
a. Technical Specifications provide steady state and transient RCS chemistry limits. What is the period of time you are allowed to operate if the actual chemisty concentrations are between these two limits? [1.0]

b. RCS specific activity limits refer to the term Dose Equivalent I-131. What is Dose Equivalent I-131? [1.0]

QUESTION 8.14 (2.00)

The monthly surveillance tests for the containment spray pump were performed on September 4th, October 6th, November 9th, and December 15th. The Operations Supervisor states that it was still within the extension time allowed by the ~~Technical Specifications~~ Administrative Procedures Is he correct? Explain your answer.

(***** END OF CATEGORY 08 *****)
(********** END OF EXAMINATION **********)


FLOW RATE
#1
N
FLOW Rate
FLOW RATE
#2
PRESSURE
FLOW RATE
#3
Hx #1
Hx #2

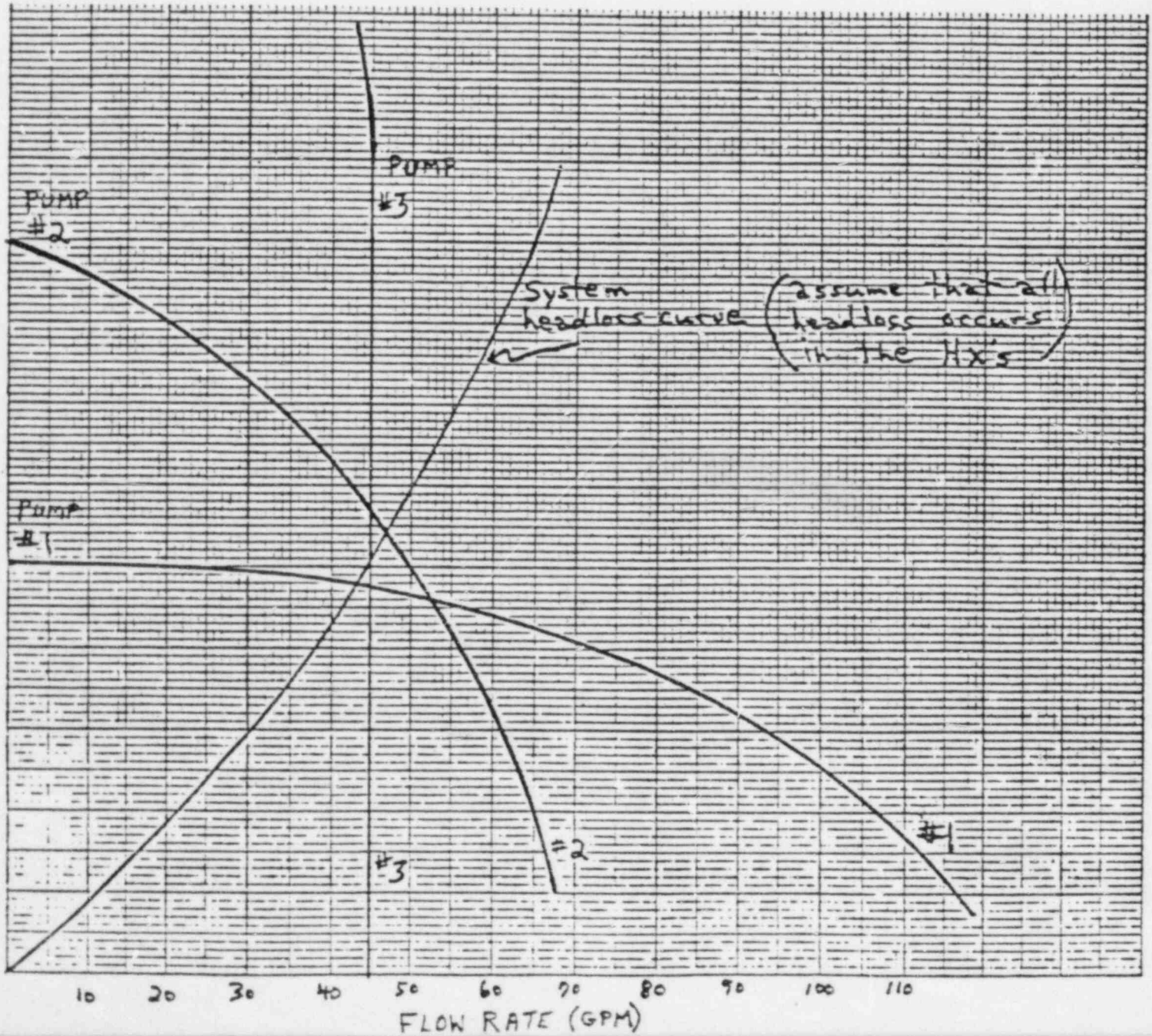
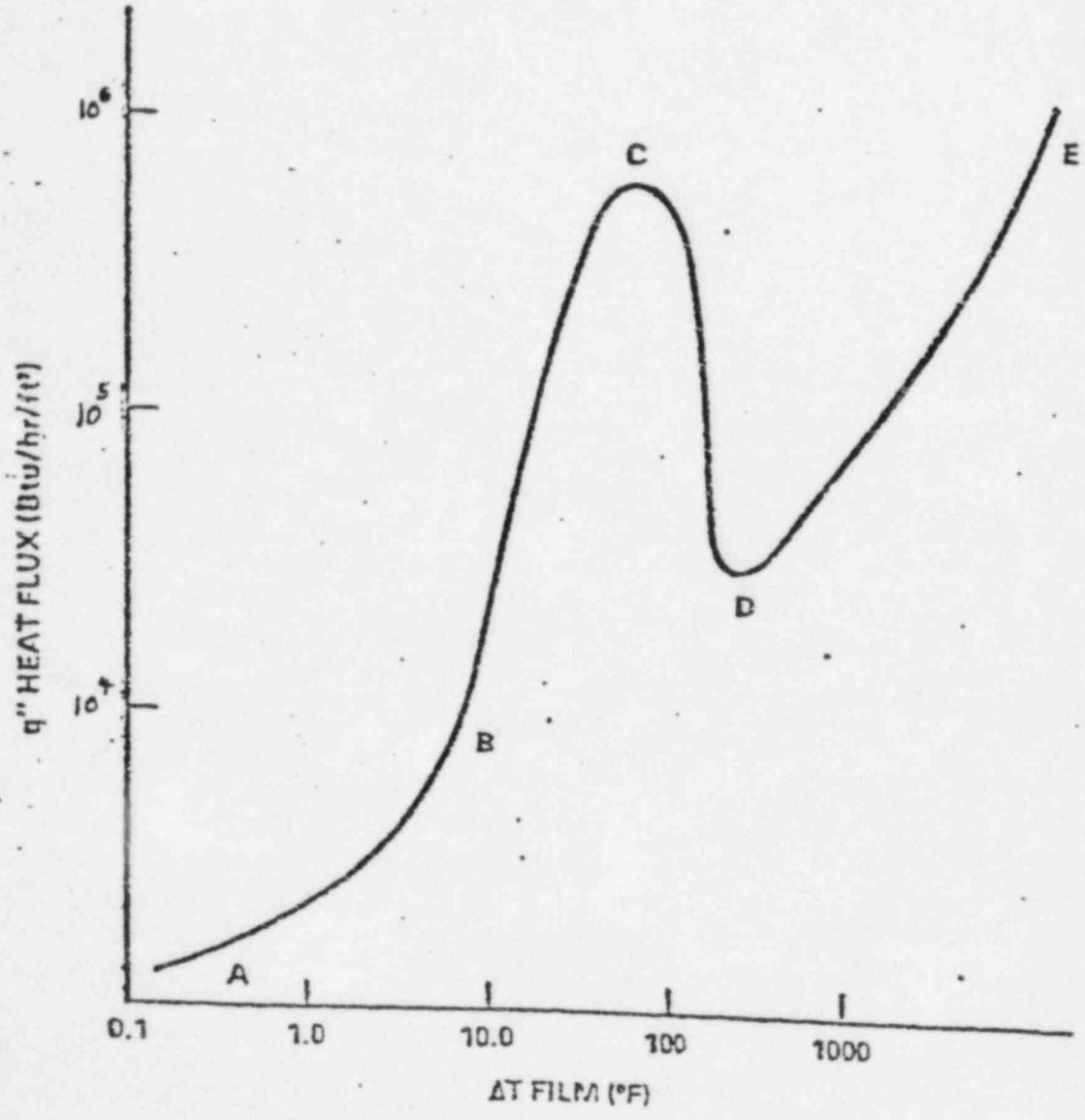

PUMP #3
PUMP #2
System headloss curve (assume that all headloss occurs in the Hx's
Pump #1
90
80
70
60
50
40
30
20
10
#1
#2
#3
10
20
30
40
50
60
70
80
90
100
110
FLOW RATE (GPM)

Figure 5-2

U.S. NUCLEAR REGULATORY COMMISSION

VARIATION OF HEAT FLUX WITH FILM TEMPERATURE DIFFERENCE



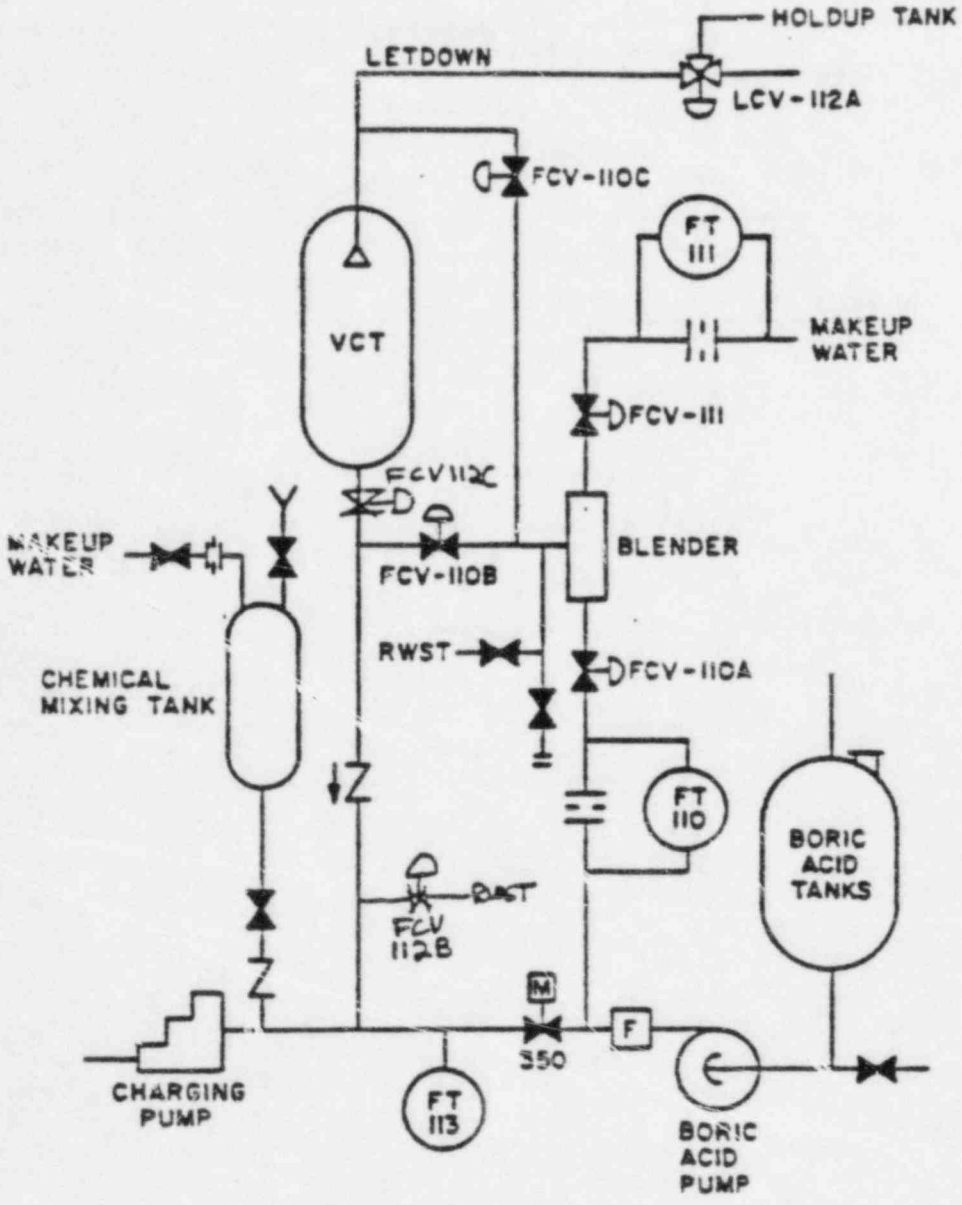

HOLDUP TANK
LETDOWN
LCV-112A
FCV-110C
FT 111
VCT
MAKEUP WATER
FCV-111
FCV112C
MAKEUP WATER
FCV-110B
BLENDER
RWST
FCV-110A
CHEMICAL MIXING TANK
FT 110
BORIC ACID TANKS
BAST
FCV 112B
M
F
350
CHARGING PUMP
FT 113
BORIC ACID PUMP

FIGURE 6.1

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ANSWERS -- GINNA -85/06/24-BURKE, D. W.

ANSWER 5.01 (2.00)

$P(d) = Po(e^{-t/T})$, where T =56 sec/.693 ==> T = approximately 80 sec

Assume that after prompt drop, Po = 10^{-6} amps

and that P-6 is energized at 10^{-10} amps. (1.0)

$10^{-10} = 10^{-6}(e^{-t/T})$ ==> $t = -80\ln[10^{-10}/10^{-6}]$

t = 737 sec = 12.3 min (1.0)

REFERENCE
Energy Training Corp. Manual for Reactor Theory
Chapter 4, page 28

ANSWER 5.02 (3.00)

a. Antimony (Sb) and Beryllium (Be) (1.0)

b. $^{123}_{51}Sb + n \rightarrow {}^{124*}_{51}Sb \xrightarrow{\text{gamma}} {}^{124}_{51}Sb$ + Gamma(low energy) (0.5)

${}^{124}_{51}Sb \xrightarrow{\text{beta}} {}^{124*}_{52}Te$ + Beta + Gamma(low energy) (0.5)

${}^{124*}_{52}Te \xrightarrow{\text{gamma}} {}^{124}_{52}Te$ + Gamma(high energy) (0.5)

${}^{9}_{4}Be$ + Gamma --> ${}^{8}_{4}Be + {}^{1}_{0}n$ (0.5)

α 2 He^4 + n'

REFERENCE
Energy Training Corp. Manual for Reactor Theory
Chapter 4, page 51

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

ANSWER 5.03 (2.00)

a. 1/M = CR1/CR2
= 400/1800
= 0.222 (1.0)

b. 1/M = (1-Keff2)/(1-Keff1)
0.222 = (1-Keff9)/(1 - 0.94)
Keff9 = 1 - 0.0132
= 0.9868 (1.0)

Typo on exam, 0.094 vice 0.94; corrected, but some candidates had already answered the question. Will grade accordingly:

$0.222 = (1 - K_{eff9})/(1 - 0.094)$

$K_{eff9} = 1 - (0.222)(0.906)$

$= 1 - 0.2013 = 0.7987$

REFERENCE
Energy Training Corp. Manual for Reactor Theory
Chapter 4, page 61

ANSWER 5.04 (3.00)

Assumptions: Boron worth (BOL) = -9.5 pcm/ppm (1600 ppm Boron) (0.25)
Lambda (λ) = 0.1 (0.25)
β_{eff} (BOL) = 0.006 (0.25)

a. (-9.5 pcm/ppm)(-15 ppm) = 142.5 pcm = 0.001425 (0.5)

$T = (\beta - \rho)/\rho\lambda$ (0.5)

$= (0.006 - 0.001425)/(0.1)(0.001425)$

$= 32.1$

SUR = 26.06/T = 0.8117 DPM (0.5)

b. The SUR will be greater at EOL (0.25) due to a decrease in β_{eff} (0.5)

~~and an increase in boron worth (0.25).~~

REFERENCE
Energy Training Corp. Manual for Reactor Theory
Chapter 4, pages 25 & 31
Chapter 7, page 41

ANSWERS -- GINNA -85/06/29-BURKE, D. W.

ANSWER 5.05 (3.50)

The following equations may be used in lieu of discussion:

$\dot{Q}_{RX} = \dot{M}_{pri}(C_p)(\Delta T) = \dot{Q}_{S/G} = UA(T_{avg} - T_{stm}) = \dot{M}_{sec}(\Delta H)$

(0.5 each part)

1. Turbine control valves open wider thus decreasing the resistance to steam flow which causes the mass flow rate of the secondary to increase and steam pressure to decrease.
2. Since the S/G is at saturated conditions, a decrease in pressure will cause a decrease in temperature (Tstm).
3. Lowering Tstm increases the delta-T across the S/G u-tubes, thereby transferring more energy from the primary coolant.
4. As more energy is removed from the primary, Tc decreases.
5. As Tc and thus Tave decrease, positive reactivity is added to the core by MTC.
6. As positive reactivity is added, reactor power increases.
7. The system will inherently reach a new steady state through the actions of the MTC and the fuel reactivity coefficient of reactivity.

REFERENCE

Energy Training Corp. Manual for Reactor Theory
Chapter 5, pages 11,19 & 38

Energy Training Corp. Manual for Thermodynamics & Fluid Flow
Chapter 8, pages 17 & 28
Chapter 9, pages 6 & 22

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

ANSWER 5.06 (1.50)

1. Maintain acceptable power distribution during normal operation. (0.5)
2. Make the consequences of a postulated rod ejection accident acceptable. (0.5)
3. Insure a minimum shutdown margin (of 1.80% negative reactivity to prevent return to criticality during the credible steam line break accident) (0.5)

REFERENCE
Westinghouse document "The Nuclear Design and Core Management of the R.E. Ginna Nuclear Reactor Cycle 14" page 4-4

T.S. - 3.10

ANSWER 5.07 (3.00)

On Figure 1, sketch in the flow vs. pressure curve for all three pumps operating at the same time. We note that Pump No. 3 will continuously discharge 45 gpm and that Pump No. 1 will have zero flow since it is operating at a pressure greater than its shutoff head. The combined flow vs. pressure curve can be generated by adding 45 gpm to the flow rate of Pump No. 2 at the various pressures. The intersection of this curve with the system head loss curve determines the operating point. (1.0)
The approximate values are:
Flow rate = 62 gpm (1.0)
Operating pressure = 82 psig (1.0)

REFERENCE
Energy Training Corp. Manual for Thermodynamics & Fluid Flow
Chapter 6, pages 18, 21 & 35
Chapter 7, page 5

ANSWER 5.08 (1.00)

(602 - 547)(.10) + 547 = 552.5

652.0 F Sat. temp. for 2250 psia from the steam tables
-552.5 F Operating Th at 10% power

99.5 F Subcooled at 10% power (1.0)

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

REFERENCE
Ginna drawing RGE-RC-4 (from System Description #30) & steam tables

ANSWER 5.09 (.50)

See Figure 2

REFERENCE
Energy Training Corp. Manual for Thermodynamics & Fluid Flow
Chapter 9, page 37

ANSWER 5.10 (2.00)

1. The heat source must be physically located below the heat sink.
2. Primary system subcooling must be maintained.
3. The steam generator tubes must be covered by secondary water.
4. Steam flow from the steam generator must be maintained (heat sink).

(0.5 each, all 4 required)

REFERENCE
Energy Training Corp. Manual for Thermodynamics & Fluid Flow
Chapter 9, pages 43 & 45

Procedure 0-8

ANSWERS -- GINNA -85/06/24-BURKE, O. W.

ANSWER 5.11 (2.00)

a. From the steam tables, @ 1000 psia: hf = 542.6 BTU/lbm
hfg = 650.4 BTU/lbm
hg = 1192.9 BTU/lbm

x = (h - hf)(100)/hfg = (1100 - 542.6)(100)/650.4 = 85.7% (1.0)

b. Using Mollier diagram, read 1198 BTU/lbm enthalpy for saturated vapor at 825 psia. Trace constant entropy line to its intersection with the 2 psia line. Read h = 820 BTU/lbm.

Delta-h = 1198 - 820 = 378 BTU/lbm (1.0)

ALTERNATE SOLUTION using steam tables:
For saturated vapor @ 825 psia, h = 1198.7 BTU/lbm
S = 1.4129 BTU/lbm

Find steam quality at 2 psia and S = 1.4129

x = (1.4129 - .1750)(100)/1.7450 = 70.94%

h2psia = (1022.1)(.7094) + 94.02 = 819 BTU/lbm

1198.7 - 819 = 379.7 BTU/lbm

REFERENCE
Steam tables or Mollier diagram
Energy Training Corp. Manual of Thermodynamics & Fluid Flow
Chapter 9, pages 31 & 39

ANSWER 5.12 (.50)

Increase

REFERENCE
E-1.4:6

ANSWER 5.13 (1.00)

The xenon concentration decreases following the power increase (due to an increase in the burnout) [0.5] and then it later increases to the higher equilibrium value for 50% power [0.5].

REFERENCE
Energy Training Corp. Manual on Reactor Theory
Section 6, page 12

ANSWERS -- DIMNA -85/06/24-BURKE, D. W.

ANSWER 6.01 (2.00)

(0.5 each, all required

1. All letdown orifice isolation valves (ADV-100A, B, and 202) must be closed.
2. Pressurizer level must be greater than 10.6 percent.
3. Proper control voltage (and/or air) must be available to the valve.
4. No containment isolation signal present.

REFERENCE
RGE-16, page 5

ANSWER 6.02 (1.00)

#3

REFERENCE
RGE-18, pages 3, 6, 7, & 10; and drawing RGE-VC-4 & 6

ANSWER 6.03 (1.00)

#4

REFERENCE
RGE-18, pages 3, 6, 7, & 10; and drawing RGE-VC-4 & 6

ANSWER 6.04 (1.00)

#4

REFERENCE
RGE-18, pages 3, 6, 7, & 10, and drawing RGE-VC-4 & 6

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

ANSWER 6.05 (1.00)

If the condensate bypass valve is in 'automatic', the valve will open. If in 'manual', the operator must open the bypass valve from the main control board.

or "closed"

REFERENCE
RGE-43, page 11

ANSWER 6.06 (3.50)

(5 required, 0.7 each)

a. Suction valve open

b. Suction pressure greater than 185 psig

c. Discharge valve closed (Administrative only)

d. Recirculation valve open

e. Lubrication system operating with oil pressure above preset value.

f. Seal water booster pumps operating with seal water pressure 15 psig greater than feedpump suction pressure.

g. Blowdown selector switch in normal

REFERENCE
REG-43, pages 12 & 13

ANSWER 6.07 (1.00)

No effect, instrument air is automatically backed up by pressurized nitrogen with no operator action.

REFERENCE
RGE-40, page 6

ANSWERS -- GINNA -85/06/24-BU'.E, O. W.

ANSWER 6.08 (2.00)

a. Primary - service water (0.5)

Secondary - auxiliary ' ndensate storage tank or Fire Hose Connection (0.5)

b. Normal auxiliary eedwater pump breaker closed (0.5)

Associated ' ndby pump suction valve closed (0.5)

2 required

Associated AFWP Isv. or racked fully out

REFERENCE

RGE-42, pages 7 & 8

Procedure SM-3021.3 / Design Criteria EWR-3021, Pg 1

ANSWER 6.09 (.50) — Procedure T-41D, Pg 2

Low vacuum trip

REFERENCE

RGE-49, pages 10 & 20

Logic Diagram Sheet #3

ANSWER 6.10 (2.25)

a. Undercompensated (0.5)

b. Counteracts the signal produced by the gamma radiation so that only the neutron level is indicated. (0.75)

c. In the power range, the signal due to gamma is much smaller than the signal from the neutrons (0.5) and is also essentially proportional to the power level (0.5). (1.0)

REFERENCE

RGE-33, pages 16 & 17

ANSWERS -- GINNA -85/06/24-BURKE, O. W.

ANSWER 6.11 (2.00)

a. Protection from DNB (0.5)

b. (1) Tavg (0.5)
(2) Pressurizer pressure (0.5)
(3) Axial flux difference (0.5)

REFERENCE
RGE-20, page 7
RGE-35, page 17

ANSWER 6.12 (2.00)

(4 required, 0.5 each)

a. Average Tavg
b. Tref
c. Turbine first stage pressure
d. Nuclear power level

REFERENCE Average
RGE-20, page 5
RGE-30, page 13

ANSWERS -- CINNA -85/06/24-BURKE, D. W.

ANSWER 6.13 (4.50)

a.(1) Condenser vacuum must be at least 20 inches vacuum as sensed by 2/2 pressure switches in the condensers 'Condenser Available.' (0.8)

(2) At least one (1) circulating water pump must be running 'Circulating Water Running' sensed by pump breaker contacts. (0.8)

b.(1) The steam dump mode selector switch is in MANUAL. (0.8)

(2) The steam dump mode selector switch is in AUTO, and 'Turbine Trip' exists [as sensed by 2/3 'Auto Stop Oil pressure switches <40 psig or 2/2 turbine main stop valves shut and as indicated by alarms D-24 (Turbine Auto Stop) or D-32 (Turbine Valves)]. (0.8)

(3) The steam dump mode selector switch is in AUTO, and P-4 is energized (partial loss of turbine load >10% step decrease or >10% decrease in 120 seconds). (0.8)

c. Reset or deenergize Relay 20 using the steam dump 'Reset-Auto-Manual' switch on the MCB. (0.25)

REFERENCE
RGE-45, pages 4 & 5

ANSWER 6.14 (1.25)

a. (2/3) low-low level in both S/G's (<17%) (0.25)
Loss of voltage on both 4160 volt buses (11A&B) (0.25)

b. (2/3) low-low level in either S/G (<17%) (0.25)
Open on both MFP circuit breakers (0.25)
Safety injection signal (SIS) (0.25)

REFERENCE
BOP system descriptions, Auxiliary Feed Section, page 4

ANSWERS -- GINNA -85/06/24-BURKE, O. W.

ANSWER 7.01 (1.50)

(0.5 each)

(1) barricaded

(2) posted (with a high radiation sign)

(3) locked

REFERENCE
Procedure A-1.1

ANSWER 7.02 (2.00)

1. Reduce the charging pump speed. & throttle PCV-135 (0.4)
2. Place excess letdown system in service. (0.4)
3. Place Letdown Temperature Divert Valve (TCV-145) in divert (0.4)
4. Shut off the pressurizer heaters for a short time. (0.4)
5. Close the orifice (0.4)

REFERENCE
Procedure O-1.1, article 5.36.1, pages 16 & 20

ANSWER 7.03 (1.50)

1. To provide an aid to awareness of plant conditions at the time of shift change. (0.5)
2. To formalize review of control board general status to assure proper configuration of controls and systems. (0.5)
3. To provide for identification of vital safety parameters and equipment deserving particular attention during shift turnover. (0.5)

REFERENCE
Procedure O-9

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

ANSWER 7.04 (5.00)

a. (all 10 required, 0.4 each)

(1) Reactor trip (all rods on bottom) and turbine stop valves closed.

(2) Busses 14, 16, 17, & 18 are energized and at approximately 480 volts.

(3) Main feedwater isolation has occurred.

(4) Containment isolation has occurred (Alarm A26), and all X & Y relay green lights are off on Containment Isolation panel.

(5) Auxiliary feedwater pumps have started and the auxiliary feedwater system valves are in their proper emergency alignment; that is, the discharge MOVs are fully open and after pump start, throttle back to deliver approximately 230 gpm.

(6) SI & RHR pumps have started and the monitor lights indicate that the safety injection system valves are in the proper safeguards position.

(7) Service water pumps have started and indicate sufficient service water pressure.

(8) Containment ventilation isolation has occurred (Alarm A25).

(9) Containment recirc. fans running and charcoal filters in service.

(10) SI pump suction swap-over if <10% BAST level, 825 A and/or B open.

b. (both required, 0.5 each)

(1) Automatic steam dump to the condenser is occurring.

(2) Reactor coolant average temperature is decreasing toward programmed no-load temperature.

REFERENCE
Procedure E-1.1

ANSWERS -- GINNA -85/06/24-BURKE, O. W.

ANSWER 7.05 (2.50)

(any 5 ~~required~~ 0.5 each)

1. Core thermocouple temperature reach or exceed saturation for existing RCS pressure (approximately 700 F).
2. Possible low running current on running RCPs.
3. Loss of, low, or erratic RCS flow with RCP running.
4. Possible over temperature delta-T set point decrease.
5. Erratic or high pressurizer level following either a loss of coolant, a loss of coolant flow, a loss of heat sink, or rapid depressurization.
6. Alarm AA-8 Subcooling Margin

REFERENCE
Procedure E-1.5

ANSWER 7.06 (4.50)

a. Supply service water to the emergency diesel generator (0.75)
b. Maintain containment temperature below design limits (0.75)
c. Reduce load on emergency bus prior to starting [backup the sequencer] (or to energize instrument air compressors). (0.75)
d. Ensure valve operability to ensure capability to isolate and provide system safety operations (0.75)
e. To provide minimum vital instrumentation (0.75)
f. To restore normal vital instrumentation (0.75)

REFERENCE
~~CHECK AT FACILITY~~
Supplied by facility representatives during exam review

ANSWERS -- GINNA -85/06/24-BURKE, O. W.

ANSWER 7.07 (3.00)

a. The SHIFT SUPERVISOR will supervise the immediate and subsequent actions of those individuals below him and provide other guidance or assistance as necessary. (0.75)

b. The HEAD CONTROL OPERATOR will report to the control station near the auxiliary feedwater pumps and commence directing the manual operations required for the hot shutdown xenon free condition. (0.75)

c. The CONTROL OPEATOR will report to the charging pump room, being knowledgeable of the fact that he is in a high radiation area. (0.75)

d. The PRIMARY SIDE AUXILIARY OPERATOR will report to the boric acid storage tank area for boric acid injection operations required for the xenon free hot shutdown condition.

REFERENCE
Procedure E-5

ANSWER 7.08 (1.00)

a. N-16 gammas (& neutrons when away from the shield). (0.5)

b. Gammas from corrosion products & activation products (0.5)

REFERENCE
~~CHECK AT FACILITY~~ Supplied by facility representatives during exam review

ANSWER 7.09 (1.00)

Inform the individual
Report the incident to the Health Physicist.

REFERENCE
Procedure A-1:22

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

ANSWER 7.10 (3.00)

1. Notify all personnel in the area of the spill and advise them to leave the area if a possible radiation hazard exists. (0.75)
2. If possible, stop the source of the spill and confine its spread. (0.75)
3. Notify the control room and radiation protection section. (0.75)
4. All persons involved should be monitored and decontaminated as necessary. (0.75)

REFERENCE
Procedure A-1:35

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

ANSWER 8.01 (2.00)

(all 5 required, 0.4 each)

1. All non-automatic containment isolation valves that are not required to be open during accidnet conditions are closed and blind flanges are installed where required.
2. The equipment door is properly closed and sealed.
3. At least one (1) door in each personnel air lock is properly closed and sealed.
4. All automatic containment isolation valves are operable, or are secured in the closed position or isolated by closing manual vlaves or flange as permitted by limiting conditions for operation.
5. Containment leakage satisfies T.S.-4.4 requirements.

REFERENCE
RGE-21, page 11

ANSWER 8.02 (2.00)

1. The procedure consists of valve line-ups or an inactivated system whereby the sequence of steps will not affect safe plant operation. (1.0)
2. The procedure is written in definitive sections whereby the change of sequence will not affect safe operation of the plant. (1.0)

REFERENCE
Procedure A-503.

ANSWER 8.03 (1.00)

Both reactor coolant loops and their associated steam generators and reactor coolant pumps shall be in operation.

REFERENCE
Technical Specification LCO, page 3.1-1

ANSWERS -- DINNA -85/06/24-BURKE, D. W.

ANSWER 8.04 (2.50)

(all 5 required, 0.5 each)

1. At least two (2) charging pumps shall be operable.
2. Both boric acid transfer pumps shall be operable.
3. The boric acid tanks (together shall contain a minimum of 2000 gallons of a 12% to 13% by weight boric acid solution at a temperature of at least 145 F) are available
4. System piping and valves shall be operable to the extent of establishing two flow paths from the boric acid tanks to the reactor coolant system and a flow path from the refueling water storage tank to the reactor coolant system.
5. Both channels of heat tracing shall be operable for the above flow paths.

REFERENCE
Technical Specification LCOs for the CVCS, Spec. 3.2.2, page 3.2-1

ANSWER 8.05 (1.25)

(all 5 required, 0.25 each)

1. 34.5 KV-4160 volt station service transformer in service
2. 480 volt buses 14, 16, 17, & 18 energized
3. 4160 volt buses 12A and 12B energized
4. Two diesel generators operable with onsite supply of 10,000 gallons of fuel available.
5. Both batteries and both DC systems operable, and at least one 150 amp battery charger or two 75 amp battery chargers in service for each battery.

REFERENCE
Technical Specifications for LCO 3.7.1, page 3.7-1

ANSWERS -- GINNA -85/06/24-BURKE, O. W.

ANSWER 8.06 (1.50)

a. It is capable of performing its specified function(s). (0.5)

b. Within one hour action shall be initiated to place the reactor in a MODE in which the specification does not apply by placing it in the appropriate shutdown condition. (1.0)

REFERENCE
Procedure A-52.4

ANSWER 8.07 (2.00)

Steam generator tube leakage shall not exceed 0.1 gpm when averaged over 24 hours.

REFERENCE
Leakage specification 3.1.5.2, page 3.1-25.

ANSWER 8.08 (2.50)

(all 5 required, 0.5 each)

1. The refueling water tank contains not less than 230,000 gallons of water, with a boron concentration of at least 2000 ppm.
2. Each accumulator is pressurized to at least 700 psig, with an indicated level of at least 50% and a maximum of 82% with a boron concentration of at least 1800 ppm. Neither accumulator may be isolated.
3. Three safety injection pumps are operable.
4. Two residual heat removal pumps are operable.
5. Two residual heat exchangers are operable.

REFERENCE
Tech.spec LCO 3.3.1.1, page 3.3-1

ANSWER 8.09 (1.00)

Report the condition and the circumstances to the NRC within 24 hours.

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

REFERENCE
Technical Specification 6.9, page 6.9-4

ANSWER 8.10 (2.00)

a. Any person who thinks one is required (1.0)

b. Shift Supervisor (1.0)

REFERENCE
Procedure A-25.1, pages 1 & 2

ANSWER 8.11 (1.00)

The cause of the trip is not known.

REFERENCE
Procedure A-25.4, page 2

ANSWER 8.12 (2.25)

LCOs indicate the lowest functional capability or performance level of equipment required for safe operation of the facility. [0.75] As long as automatic protection occurs prior to exceeding a LSSS, then the abnormal condition will be corrected prior to exceeding a Safety Limit. [0.75] The integrity of the physical barriers which guard against the uncontrolled release of radioactivity is protected as long as a Safety Limit is not violated. [0.75].

REFERENCE
10CFR50.36
~~SHEET AT PAGE 37A~~

ANSWER 8.13 (2.00)

a. 48 hours [1.0]

b. Dose Equivalent I-131 is that concentration of I-131 which alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134 and I-135 actually present. [1.0]

ANSWERS -- GINNA -85/06/24-BURKE, D. W.

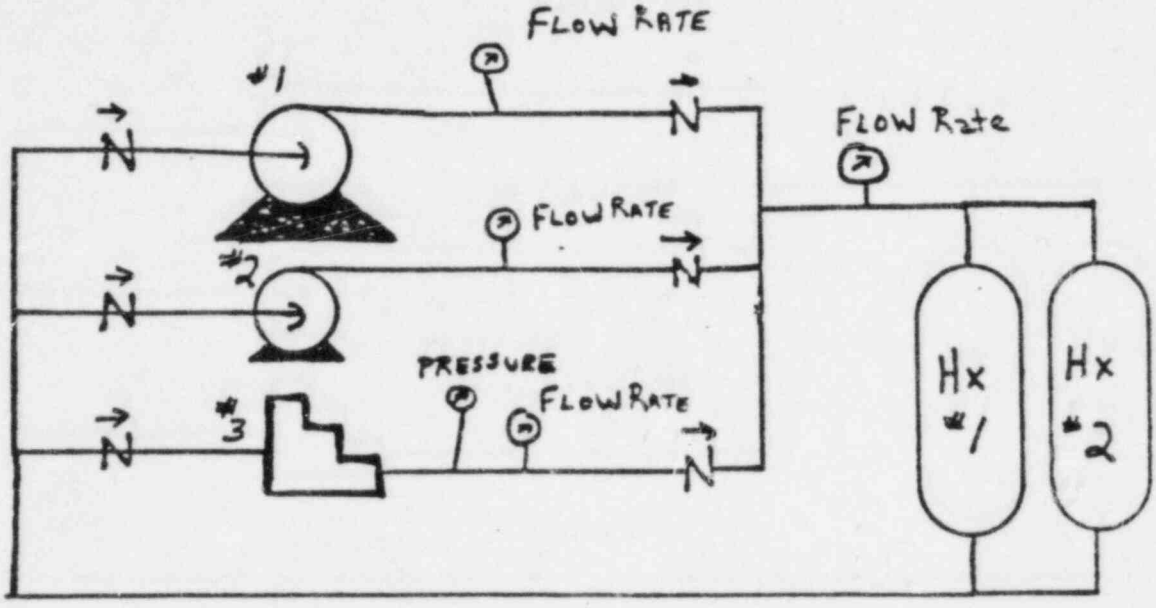
REFERENCE
a. TS 1.18-1.7
b. TS 3.1-32

ANSWER 8.14 (2.00)

No. (1.0)

The 3.25 rule has been exceeded. (1.0)

REFERENCE
~~SHIFT AT FACILITY~~
Procedure A-1101:3


FLOW RATE
#1
FLOW Rate
FLOW RATE
#2
PRESSURE
FLOW RATE
#3
Hx #1
Hx #2

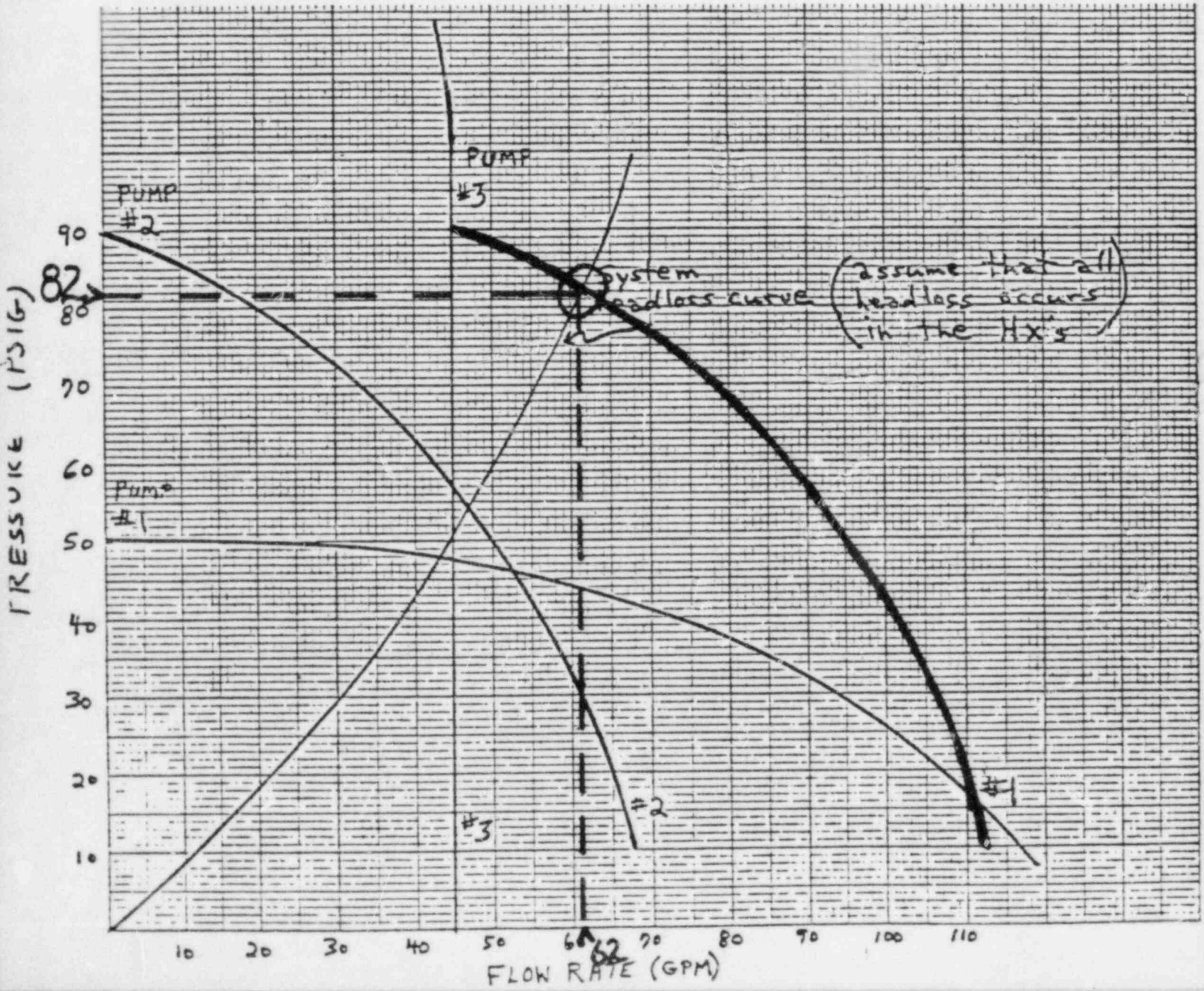
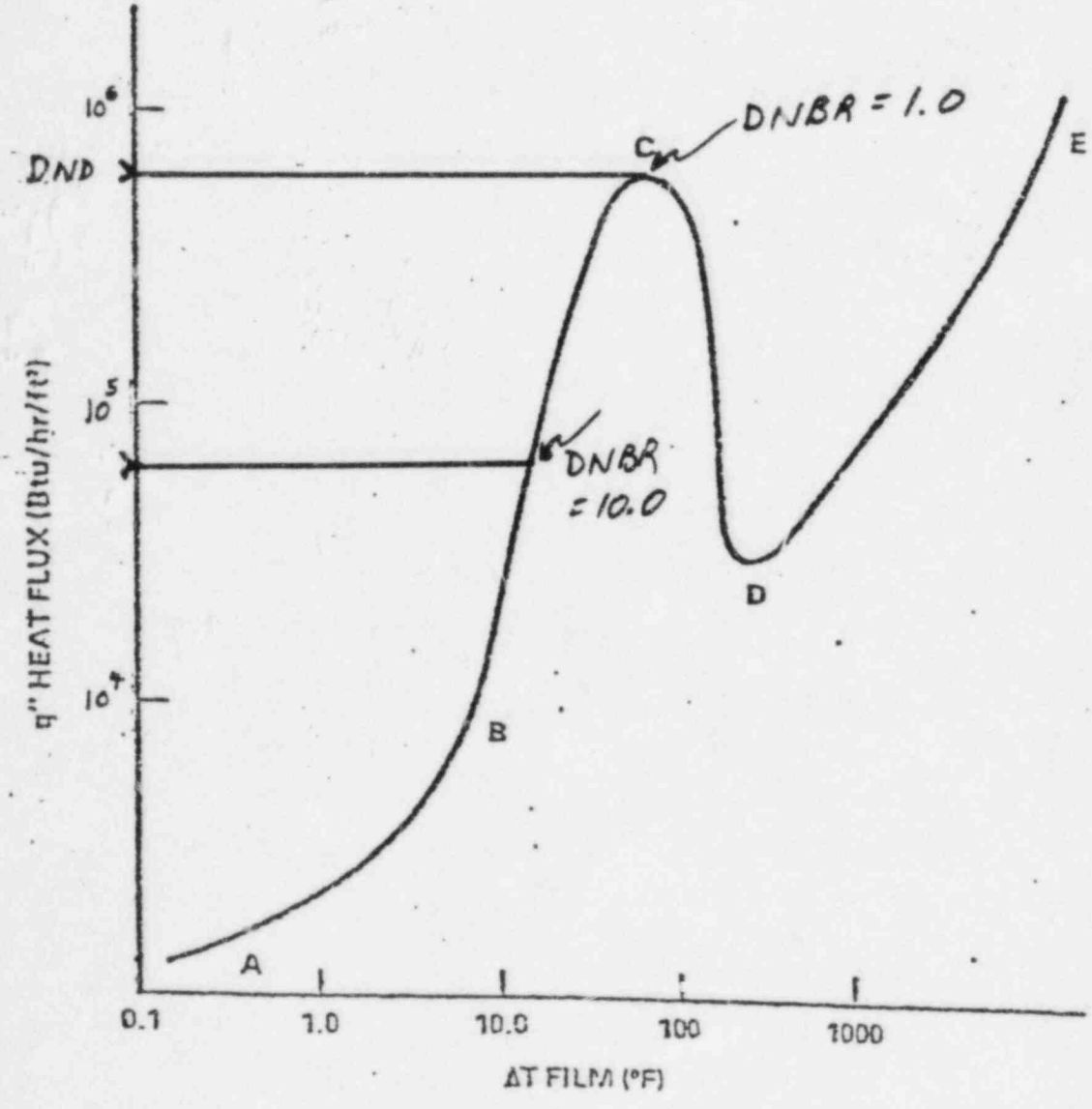

PUMP #3
PUMP #2
82
System headloss curve
(assume that all headloss occurs in the Hx's
Pump #1
#1
#2
#3
PRESSURE (PSIG)
90
80
70
60
50
40
30
20
10
10
20
30
40
50
60
62
70
80
90
100
110
FLOW RATE (GPM)

Figure 5-2

U.S. NUCLEAR REGULATORY COMMISSION

VARIATION OF HEAT FLUX WITH FILM TEMPERATURE DIFFERENCE



EQUATION SHEET

$f = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgh$

$V_f = V_o + at$

$W = v\ \Delta P$

$\Delta E = 931\ \Delta m$

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

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

$Pwr = W_f \Delta h$

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

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

$\pm = \sigma N$

$v = s/t$

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

$a = (V_f - V_o)/t$

$w = \theta/t$

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

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

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

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

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

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

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

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$

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

$M = (1 - K_{eff_o})/(1 - K_{eff_1})$

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

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

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

$I_1 d_1 = I_2 d_2$

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

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

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

Water Parameters

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

Miscellaneous Conversions

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