ENCLOSURE 1

EXAMINATION REPORT - 50-261/OL-86-02

Facility Licensee: Carolina Power and Light Company
P. O. Box 1551
Raleigh, NC 27602

Facility Name: H. B. Robinson

Facility Docket No.: 50-261

Written and oral examinations were administered at H. B. Robinson near Hartsville, South Carolina.

Chief Examiner: Charles A Casto 12-1-86
C. A. Casto Date Signed

Approved by: for John F. Munro, Section Chief 12-29-86
Date Signed

Summary:

Examinations on H. B. Robinson

Oral examinations were administered to eight candidates; eight of whom passed.

Written examinations were administered to seven candidates; five of whom passed. Based on the results described above, three of four RO's passed and three of four SRO's passed.

REPORT DETAILS

1. Facility Employees Contacted:

*C. Bethea, Director-Training
*S. Allen, Project Specialist-License Training
*D. Neal, Specialist, License Training

*Attended Exit Meeting

2. Examiners:

*C. Casto
P. Isaksen
F. Victor
K. Parkinson
H. Krug (SRI)

*Chief Examiner

3. Examination Review Meeting

At the conclusion of the written examinations, the examiners provided Steve Allen with a copy of the written examination and answer key for review. The comments made by the facility reviewers are included as Enclosure 3 to this report and the NRC Resolutions to these comments are listed below.

a. SRO Exam

Section 5

(1) Question 5.06

NRC Resolution Comment:

Concur. Answer key revised accordingly.

(2) Question 5.09, Part a.1

NRC Resolution:

Do not concur. SD-0001, page 29 states that delta T is used to calculate RIL. The question asked for the parameter that necessitates changing RIL, not what parameter is used to compute RIL. Power Defect is the parameter that necessitates changing RIL. Answer key not revised.

(3) Question 5.10

NRC Resolution:

Do not concur to delete the question. Sufficient information was given within the question for the candidates to ascertain a correct response. No reference material was provided for this comment.

Section 6

(4) Question 6.01, Part b

NRC Resolution:

Concur. Answer key revised accordingly.

(5) Question 6.02, Part b

NRC Resolution:

Concur. Answer Key revised accordingly.

(6) Question 6.03, Part a

Concur. Answer Key revised accordingly.

(7) Question 6.03, Part b

Concur. Answer key revised to correspond to updated reference material.

(8) Question 6.06

NRC Resolution:

Concur. Answer key revised accordingly.

(9) Question 6.08

NRC Resolution:

Concur. Answer key revised accordingly.

(10) Question 6.09, Part a

NRC Resolution:

Concur. Answer key revised to accept other reasonable sources.

(11) Question 6.12

NRC Resolution:

Concur. Answer key revised accordingly.

(12) Question 6.13, Part b

Concur. Answer key revised accordingly.

Section 7

(13) Question 7.02, Part a

NRC Resolution:

Do not concur. The reference provided with the facility comment states that each operator should be generally familiar with each EOP. Knowledge of the EOP entry conditions demonstrates familiarity with the EOP. The operator(s) must be cognizant of entry conditions at all times throughout EOP usage.

(14) Question 7.02, Part c

NRC Resolution:

Do not concur. The reference provided with the facility comment states that each operator should be generally familiar with each EOP. Knowledge of the criteria used to verify adequate core cooling demonstrates familiarity with the EOP.

(15) Question 7.05

NRC Resolution:

Do not concur. The reference provided with the facility comment states that each operator should be generally familiar with each EOP. Knowledge of components to check if the RCS is isolated demonstrates familiarity with the EOP. In addition, vendor background documentation indicates a need for operator memorization of these steps. These steps are not contained on flow chart procedures.

(16) Question 7.14

NRC Resolution:

Concur. Answer key revised accordingly.

Section 8

(17) Question 8.05, Part f

Do not concur. The reference provided with the facility comments specifies the workers immediate supervisor. Answer key was not revised.

(18) Question 8.08, Parts a and b

NRC Resolution:

Do not concur. The time requirements specified in technical specifications are an integral part of the specified action.

(19) Question 8.12, Parts a and b

NRC Resolution:

Concur. Answer key was revised to require an answer of 1 and 3 for part a and an answer of 1 and 2 for part b.

b. RO Exam

Section 1

(1) Question 1.01, Part a

NRC Resolution:

Concur. Answer key changed accordingly.

(2) Question 1.04, Part a

NRC Resolution:

Concur. Answer key changed accordingly.

(3) Question 1.07, Parts and b

NRC Resolution:

Concur. Answer key changed accordingly.

(4) Question 1.13

NRC Resolution:

Concur. Answer key changed accordingly.

(5) Question 1.15

NRC Resolution:

Concur. Answer key changed accordingly.

Section 2

(6) Question 2.08

NRC Resolution:

Concur. Answer key changed accordingly.

(7) Question 2.09, Part a

NRC Resolution:

Concur. Answer key changed accordingly.

(8) Question 2.13

NRC Resolution:

Concur. Answer key changed to accept any two of three answers (Temperature, Boron Concentration, Pressure).

(9) Question 2.14, Parts a and b

NRC Resolution:

Concur. Answer key changed accordingly.

(10) Question 2.15

NRC Resolution:

Concur. Parenthesis placed around "transformed to 118V A.C." to indicate not required as part of the answer.

(11) Question 2.16, Part b

NRC Resolution:

Concur that failed valve position should be deleted. The second part asked for the flow path on loss of power. The facility's response provided flow path on loss of instrument air. The portion of the question dealing with the failed valve position was deleted and the point value for the question was reduced by a corresponding 0.5 points.

Section 3

(12) Question 3.03

NRC Resolution:

Concur. Answer key changed accordingly.

(13) Question 3.04

NRC Resolution:

Concur. Points were not taken off for P10 additional information.

(14) Question 3.05

NRC Resolution:

Answers were evaluated based on the candidates assumptions and using the guidance provided by the facility. It should be noted that neither reference OST-005 nor the material originally provided support changing the answer. Rod Control Handout 1, page 11 cited by the facility supports changing the answer; however this material was <u>not</u> provided in the facility's original reference material.

(15) Question 3.07

NRC Resolution:

Concur. Answer key changed accordingly.

(16) Question 3.08

NRC Resolution:

Based on the facility's comments, the answer key was modified to give credit for "pressure less than 465 psig" and deleted that part of answer dealing with the RWST flow path to the RHR Pumps.

(17) Question 3.09

NRC Resolution:

Concur. Answer key changed accordingly.

(18) Question 3.10

NRC Resolution:

Concur. Answer key changed accordingly.

(19) Question 3.11

NRC Resolution:

Concur. Answer key changed accordingly.

(20) Question 3.13, Part b

NRC Resolution:

Lube Oil holds the valve closed against spring pressure, whether the turbine is tripped or not tripped the system design is unchanged. Answer stands as originally stated.

(21) Question 3.15, Part b

NRC Resolution:

Concur. Answer key changed accordingly.

Section 4

(22) Question 4.01 Part b

NRC Resolution:

Concur. Answer key changed accordingly.

(23) Question 4.05

NRC Resolution:

Concur. Answer key changed accordingly.

(24) Question 4.11

NRC Resolution:

Concur. Answer key changed accordingly.

(25) Question 4.12, Part a

NRC Resolution:

Concur. Answer key changed accordingly.

(26) Question 4.12, Part b

NRC Resolution:

Answer changed to be consistent with Technical Specifications since the question specifically addressed Technical Specification.

(27) Question 4.13

NRC Resolution:

Concur. Answer key changed accordingly.

4. Exit Meeting

At the conclusion of the site visit the examiners met with representatives of the plant staff to discuss the results of the examination.

There were no generic weaknesses noted during the oral examination.

The cooperation given to the examiners and the effort to ensure an atmosphere in the control room conductive to oral examinations was also noted and appreciated.

The licensee did not identify as proprietary any of the material provided to or reviewed by the examiners.

MASTER COPY

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: ROBINSON

REACTOR TYPE: PWR-WEC3

DATE ADMINISTERED: 86/09/30

EXAMINER: VICTOR,F.

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

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	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	25.06			1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
24.50	24.56			2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
~~25.25~~ 25.5	25.31			3. INSTRUMENTS AND CONTROLS
~~25.00~~ 24.5	25.06			4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
99.75		Final Grade		Totals

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

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

3. Use black ink or dark pencil only to facilitate legible reproductions.

4. Print your name in the blank provided on the cover sheet of the examination.

5. Fill in the date on the cover sheet of the examination (if necessary).

6. Use only the paper provided for answers.

7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.

8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write only on one side of the paper, and write "Last Page" on the last answer sheet.

9. Number each answer as to category and number, for example, 1.4, 6.3.

10. Skip at least three lines between each answer.

11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.

12. Use abbreviations only if they are commonly used in facility literature.

13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.

14. Show all calculations, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.

15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

16. If parts of the examination are not clear as to intent, ask questions of the examiner only.

17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

(2) Exam aids - figures, tables, etc.

(3) Answer pages including figures which are part of the answer.

b. Turn in your copy of the examination and all pages used to answer the examination questions.

c. Turn in all scrap paper and the balance of the paper that you did not use for answering the questions.

d. Leave the examination area, as defined by the examiner. If after leaving, you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION 1.01 (2.50)

a. Define DNBR. (0.5)

b. What is the DNBR limit for your plant? (0.5)

c. Since the DNBR is not a directly observable parameter, name SIX parameters the operator monitors and/or controls to ensure the DNBR limit is not violated. (1.5)

QUESTION 1.02 (1.00)

The reactor is operating at 100% power at BOL when a steam dump valve OPENS. State what happens to the following parameters. (Increases, Decreases or Remains The Same) (Assume all Control Systems in MANUAL)

1. Tavg
2. Reactor Power
3. Steam Generator Pressure
4. Core DELTA-T

QUESTION 1.03 (2.00)

Compared to other control rods,would the center control rod worth be a smaller or larger value under the follow conditions? Why?

a. The rod is partially ejected during a reactor startup. (1.0)
b. The rod drops while the plant is operating at full power. (1.0)

QUESTION 1.04 (1.00)

a. The latent heat of vaporization for water at 2235 psig is _____ (include units). (0.5)

b. If pressure is reduced from 2235 psig to 100 psig, will latent heat of vaporization INCREASE, DECREASE, or REMAIN THE SAME (0.5)

(***** CATEGORY 01 CONTINUED ON NEXT PAGE *****)

QUESTION 1.05 (1.50)

Does critial heat flux INCREASE, DECREASE, or REMAIN THE SAME for the following conditions: (consider each separately)

a. Reactor coolant flow rate increases.
b. Reactor coolant average temperature increases.
c. Reactor coolant pressure increases.

QUESTION 1.06 (1.00)

During a Xenon-free reactor startup, critical data was inadvertently taken two decades below the required Intermediate Range (IR) level (1xE-10 amps). The critical data was taken again at the proper IR level (1xE-8 amps). Assuming RCS temperatures and boron concentrations were the same for each set of data, how will the control rod position data compare?

QUESTION 1.07 (1.00)

a. If the reactor is operating in the power range, how long will it take to raise power from 20% to 40% with a +0.5 DPM Start-up rate? (0.5)

b. How long will it take to raise power from 40% to 60% with the same +0.5 DPM Startup rate? (0.5)

QUESTION 1.08 (1.50)

TRUE or FALSE?

a. Volumetric flow rate for a positive displacement pump increases in the same proportion as the speed increases. (0.5)

b. As VCT temperature decreases, net positive suction head of the Charging Pump decreases. (0.5)

c. Pump runout is the term used to describe the condition of a centrifugal pump were maximum flow is recirculating to the pump suction. (0.5)

(***** CATEGORY 01 CONTINUED ON NEXT PAGE *****)

QUESTION 1.09 (1.50)

a. Steam exit§ing the HP turbine is at 785 psig, 90% quality. Steam entering the LP turbine is superheated by 100 F. What is the enthalpy change of the steam? (1.0)

b. During the process in part "a", how much is steam enthalpy changed by mechanical moisture separation in the MSR assuming that the steam quality after separation is 100%. (0.5)

QUESTION 1.10 (1.50)

An ECC has been calculated for a startup following a reactor trip from 100% power with equilibrium xenon(BOL). Indicate if the actual critical rod position will be HIGHER, LOWER or the SAME from the calculated position for each of the following situations. Use attached curves as appropriate and treat each case individually.

a. Xenon reactivity curve for trip from 60% is used to calculate conditions to startup 20 hours after the trip. (0.5)

b. The Samarium reactivity curve is used instead of the xenon reactivity curve for startup 60 hours after trip. (0.5)

c. The power defect curve for 750 ppm is used instead of the 1100 ppm curve. (0.5)

QUESTION 1.11 (2.00)

a. Define shutdown margin. (1.0)

b. List FOUR of the reactivity effects which must be considered when calculating shutdown margin. (1.0)

(***** CATEGORY 01 CONTINUED ON NEXT PAGE *****)

QUESTION 1.12 (1.50)

Match the heat transfer process in Column A to the equation or equations that applies to that process in Column B.

COLUMN A	COLUMN B
a. Across the core	1. $Q = m\ Cp\ \Delta T$
	2. $\dot{Q} = \dot{m}\Delta T$
b. Across S/G tubes (primary to secondary)	3. $\dot{Q} = U\ A\Delta T$
c. Across S/G (feedwater to steam)	4. $\dot{Q} = \dot{m}\ Cp\Delta h$
	5. $\dot{Q} = \dot{m}\Delta h$

QUESTION 1.13 (1.00)

Using the attached steam tables, what is the amount of primary subcooling at the core exit if the pressurizer is at 2235 psig and Tavg is 575 degrees? (assume normal operating conditions)

QUESTION 1.14 (1.00)

Equilibrium samarium conditions are reached when production rate of Sm-149 equals the removal rate of Sm-149. For the MOST part, production rate is achieved by the _____(0.5) process, while removal rate depends on the _____(0.5) process.

QUESTION 1.15 (1.00)

Explain how a venturi can be used to measure flow.

QUESTION 1.16 (2.00)

If the Source Range (SR) instruments indicate 50 cps with Keff equal to 0.9, what would the SR instrument indicate if rods were withdrawn to bring Keff equal to 0.95? How much reactivity was added? (Show all work)

(***** CATEGORY 01 CONTINUED ON NEXT PAGE *****)

QUESTION 1.17 (2.00)

Give two characteristics of doppler coefficient that make it a prime elements in reactor safety.

(***** END OF CATEGORY 01 *****)

QUESTION 2.01 (1.00)

What is the basis for the Condensate Storage Tank minimum level requirement listed in Technical Specifications.

QUESTION 2.02 (1.00)

Name FOUR locations where water collected in the Blowdown Flash Tank may be sent.

QUESTION 2.03 (2.00)

Monitors R-11 and R-12 (C.V.& PLANT VENT) and R-20 and R-21 (Fuel Handling Building) are similar but Monitor R-11 has an additional alarm light. What is being detected by each monitor and why does Monitor R-11 have an additional alarm?

QUESTION 2.04 (2.00)

a. If a main steam line should rupture just prior to exiting the Containment Vessel, what TWO main steam line design related features would mitigate the consequences of this accident? (1.0)
b. Describe the events which occur to shut an MSIV when the control switch is placed in the CLOSE position. (1.0)

QUESTION 2.05 (1.00)

State the system and what parameters are measured to detect leakage through the reactor closure head "O" RING SEALS.

(***** CATEGORY 02 CONTINUED ON NEXT PAGE *****)

QUESTION 2.06 (1.50)

Indicate which of the Excore Nuclear Instrumentation Ranges (SOURCE, INTERMEDIATE, POWER or NONE), apply to each of the following statements.

a. Uses an opposing current technique to compensate for gamma radiation.

b. Operates in the Proportional region of the Gas-filled Detector curve.

c. Covers eight (8) decades of neutron flux.

d. Provides input to P-10.

e. Detector location is lowest outside the core.

QUESTION 2.07 (1.00)

Explain why an operator would select the ALTERNATE DILUTE mode instead of the DILUTE mode.

QUESTION 2.08 (1.50)

At what pressure are the following components designed to begin providing water to the RCS during a SAFETY INJECTION.

a. Safety Injection Pumps
b. Safety Injection Accumulators
c. Residual Heat Removal Pumps

QUESTION 2.09 (3.00)

a. List FOUR conditions which will automatically trip the Diesel Engine.
b. Indicate whether the following statements about the Diesel Generator are TRUE or FALSE.
   1. The synchronizer control is not used if the Diesel Generator is the sole emergency bus power supply.
   2. If a Diesel Generator shutdown sequence has been initiated in local control and a start signal is received, the Diesel Generator will return to a ready for service condition.
   3. When the diesel is started and stopped the diesel's ventilation system is automatically started and stopped.
   4. Prelube pump is not run for automatic diesel start; only for manual starts.

(***** CATEGORY 02 CONTINUED ON NEXT PAGE *****)

QUESTION 2.10 (3.00)

a. Describe the normal electrical flow path to the 480V busses E-1 and E-2 starting from the appropriate 4160V bus. (2.0)
b. Explain what conditions cause the DEGRADED GRID VOLTAGE sensors to actuate to protect safeguards systems from the detrimental effects of reduced voltage. What actions occur when the sensors actuate? (1.0)

QUESTION 2.11 (1.50)

List the THREE pressurization system(s) that supply the Containment Penetration System and indicate for each if it is the normal or backup supply.

QUESTION 2.12 (1.00)

(TRUE or FALSE)
a. Placing the circuit breakers for the circulating water pump motor in the OPEN position prevents the pump discharge valve from opening when the valve control switch is placed in the OPEN position.
b. Auxiliary feedwater backup supply comes from the SERVICE WATER system and connects to the pumps suction through two solenoid valves with a tell-tale drain in between.

QUESTION 2.13 (1.00)

Prior to placing the RHR system into operation for plant cooldown, the _____(0.5) and the _____(0.5) differences between the RCS and RHR systems must be minimized.

QUESTION 2.14 (2.00)

a. Describe the runback process that occurs with the Main Turbine when the OT Delta-T setpoint is exceeded? (1.0)

b. If the Power Range "ROD DROP AUTO TURBINE RUNBACK" is bypassed, what other conditions and what other system could initiate a turbine runback? (1.0)

(***** CATEGORY 02 CONTINUED ON NEXT PAGE *****)

QUESTION 2.15 (1.00)

What is the NORMAL power supply for Instrument Bus No.1.

QUESTION 2.16 (1.00)

a. Which of the following is NOT a function of the Volume Control Tank:
   1. Provide NPSH to charging pumps
   2. Add hydrazine for oxygen scavenging
   3. Strip fission gases
   4. Used for dilution and boration of RCS (0.50)

b. On loss of power to LCV-115A (VCT/HOLDUP TANK DIVERSION) flow is directed to _____. (0.50)

(***** END OF CATEGORY 02 *****)

QUESTION 3.01 (2.50)

When a Reactor Trip signal is initiated, explain how the control circuits function to open TRAIN A Reactor Trip Breakers and their associated Reactor Trip Bypass Breakers. Include the power sources for the control circuits.

QUESTION 3.02 (1.00)

What level will the Steam Generator Water Level Control System maintain as power changes from 0% to 100%?

QUESTION 3.03 (2.00)

List the automatic signals that will cause Main Steam Line Isolation. Setpoints are not required.

QUESTION 3.04 (1.00)

After a Reactor trip what conditions must be met for the Source Range Detectors High Voltage to automatically reenergized.

QUESTION 3.05 (3.00)

The plant is operating at 100% power with all control systems in automatic. Given the following conditions, how will rod height be affected (INCREASE, DECREASE, NO CHANGE)? Assume no operator action and consider each case separately. Assume the Reactor does NOT trip. Briefly explain your answer.

a. A safety valve on B steam generator fails open. (0.75)
b. One power range detector fails high. (0.75)
c. C loop narrow-range Tcold instrument fails low. (0.75)
d. Turbine load is ramped to 80% power. (0.75)

QUESTION 3.06 (1.50)

List ALL the sensors that provide an input to the CORE SUBCOOLING MONITOR.

(***** CATEGORY 03 CONTINUED ON NEXT PAGE *****)

QUESTION 3.07 (2.00)

What FOUR conditions will ONLY block MANUAL ROD WITHDRAWAL. Include setpoints and required coincidence for each.

QUESTION 3.08 (1.75)

Explain how the valve interlocks in the RHR system function to prevent the system from being overpressurized.

QUESTION 3.09 (1.50)

With the plant at NORMAL operating conditions list the events that would occur if Pressurizer Level Channel 459 FAILED HIGH. Cover the period from initiation of the casualty until the plant is stable or the Reactor Trips.

QUESTION 3.10 (1.00)

In which position(s) of the Service Water Strainers Switch (CONTINUOUS, OFF, or INTERMITTENT) will an alarm be received at the RTGB when a HIGH DIFFERENTIAL PRESSURE exists across the strainer?

QUESTION 3.11 (1.00)

Explain the function of the LOAD BISTABLE and the TEMPERATURE BISTABLE used in the Steam Dump Control System.(Setpoints not required)

QUESTION 3.12 (1.00)

List the TWO conditions which must be satisfied before the Dedicated Shutdown Diesel air start solenoid valve will open.

(***** CATEGORY 03 CONTINUED ON NEXT PAGE *****)

QUESTION 3.13 (1.50)

Indicate whether the following statements concerning the Main Turbine and Turbine Control System are TRUE or FALSE.

a. The reheat stop valve and interceptor valve will close if the governing and intercept valve close on loss of load.
b. Lube oil supplied to the interface trip valve will hold the valve closed.
c. When the discharge pressure for the D.C. motor driven oil pump is above 25 psig the pump will stop if the switch is in the AUTO position.

QUESTION 3.14 (1.00)

What TWO type of instrumentation are used to provide leak indication for the Pressurizer Safety Valves?

QUESTION 3.15 (2.00)

a. List FOUR Signals that cause automatic closure of the Steam Generator blowdown isolation valves. (1.0)
b. What are FOUR Conditions which cause automatic closure of the CVCS orifice isolation valves? (1.0)

QUESTION 3.16 (1.50)

List SIX Reactor trips which are blocked by the Reactor Protection system interlock P-7.

(***** END OF CATEGORY 03 *****)

QUESTION 4.01 (1.00)

a. In EPP-1, Loss Of All AC Power, it states that the SI SIGNAL should be reset. Why is this action important? (0.5)
b. Another requirement in EPP-1 is to VERIFY Phase A Isolation. How is this step accomplished? (0.5)

QUESTION 4.02 (2.50)

a. In automatic rod control, one reason for a Continuous Withdrawal of a Control Bank is a malfunction or problem with the Rod Control System. What is another problem or malfunction that could also cause CONTINUOUS WITHDRAWAL of a Control Bank and name TWO systems that could cause this problem. (1.0)
b. If a CONTINUOUS WITHDRAWAL of a Control Bank causalty had been initiated list FIVE Automatic actions that could prevent a Reactor Trip. (1.5)

QUESTION 4.03 (1.50)

In accordance with AOP-18 what FOUR parameters are required to be monitored if Coolant Pump is to continue operating without Seal Water Injection?

QUESTION 4.04 (1.00)

If DEPRESSURIZATION of the RCS is required, list the THREE methods to be used in their preferred order.

QUESTION 4.05 (1.00)

With the plant above 400 degrees F, ONE Safety Injection Pump becomes inoperable. In accordance with Technical Specifications, what action is required prior to initiating repairs to the pump?

(***** CATEGORY 04 CONTINUED ON NEXT PAGE *****)

QUESTION 4.06 (3.00)

a. List FIVE TREND VALUES used to verify that Natural Circulation has been established. (2.5)
b. What action is required if Natural Circulation is NOT verified? (0.5)

QUESTION 4.07 (1.50)

a. Explain the process for implementation and approval of a TEMPORARY CHANGE which does NOT violate the intended function of the original procedure. (1.0)
b. What is the MAXIMUM time period until a Temporary Change must be cancelled? (0.5)

QUESTION 4.08 (2.00)

List THREE reasons why the Control Banks are maintained above their respective insertion limits while the Reactor is critical.

QUESTION 4.09 (2.00)

a. Prior to transferring from MANUAL to AUTOMATIC Rod Control what are the limitations on temperature? Why? (1.5)
b. Inaccordance with GP-006 during a Reactor Shutdown, when should the operator shift to MANUAL Rod Control? Why? (0.5)

QUESTION 4.10 (1.00)

With the Low Temperature Overpressure Protection System in operation and BOTH PORVs become inoperable, what action should be initiated?

QUESTION 4.11 (1.50)

In accordance with AOP-012 what THREE Immediate Operator Action are required if a Partial Loss Of Condenser Vacuum occurs?

(***** CATEGORY 04 CONTINUED ON NEXT PAGE *****)

QUESTION 4.12 (2.00)

a. List the location of the following Facilities:
Operations Support Center (OSC)
Techinical Support Center (TSC) (0.5)
Emergency Operations Facility (EOF)

b. With the plant at normal temperature, by Technical Specifications what personnel comprise the minimum on shift organization? (1.5)

QUESTION 4.13 (1.50)

Under what conditions would it be necessary to use DSP-001 (Hot Shutdown Procedure Using The Dedicated/Alternate Shutdown System)?

QUESTION 4.14 (1.00)

Explain the process for the removal of a Jumper or Wire Removal Tag from a Safety Related System and the return of the system to service.

QUESTION 4.15 (1.50)

List the SIX Critial Safety Functions in order of importance.

QUESTION 4.16 (1.00)

When changing plant conditions from Cold Solid to Hot Subcritical at No-load T-avg, it may be necessary to start and stop the Reactor Coolant Pumps at frequent intervals. If THREE starts and stops or attempted starts have been made within a two-hour period (pumps are not running), what action is required by OP-101 if it is necessary to start a RCP again?

(***** END OF CATEGORY 04 *****)
(********** END OF EXAMINATION **********)

EQUATION SHEET

$f = ma$

$w = mg$

$E = mC^2$

$KE = \frac{1}{2}mv^2$

$PE = mgh$

$W = v\Delta P$

$\Delta E = 931\Delta m$

$v = s/t$

$s = v_o t + \frac{1}{2}at^2$

$a = (v_f - v_o)/t$

$v_f = v_o + at$

$\omega = \theta/t$

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

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

$Pwr = W_f \dot{m}$

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

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

$SUR = 26.06/T$

$T = 1.44\ DT$

$SUR = 26\left(\frac{\lambda_{eff}\rho}{\bar{\beta} - \rho}\right)$

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

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

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

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

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

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

$\Sigma = N\sigma$

Cycle efficiency = $\frac{\text{Net Work (out)}}{\text{Energy (in)}}$

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

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

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

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

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

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

$TVL = 1.3/\mu$

$HVL = 0.693/\mu$

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

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

$CR_1(1 - K_{eff})_1 = CR_2(1 - K_{eff})_2$

$M = 1/(1 - K_{eff}) = CR_1/CR_0$

$M = (1 - K_{eff})_0/(1 - K_{eff})_1$

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

$\ell^* = 1 \times 10^{-5}$ seconds

$\lambda_{eff} = 0.1\ \text{seconds}^{-1}$

$I_1 d_1 = I_2 d_2$

$I_1 d_1^2 = I_2 d_2^2$

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

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 Btu = 778 ft-lbf

1 inch = 2.54 cm

$^oF = 9/5\,^oC + 32$

$^oC = 5/9\ (^oF - 32)$

Temp F	Press. psia	Volume, ft³/lb			Enthalpy, Btu/lb			Entropy, Btu/lb x F			Temp F
		Water	Evap	Steam	Water	Evap	Steam	Water	Evap	Steam	
		v_f	v_{fg}	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g	
32	0.08859	0.01602	3305	3305	-0.02	1075.5	1075.5	0.0000	2.1873	2.1873	32
35	0.09991	0.01602	2948	2948	3.00	1073.8	1076.8	0.0061	2.1706	2.1767	35
40	0.12163	0.01602	2446	2446	8.03	1071.0	1079.0	0.0162	2.1432	2.1594	40
45	0.14744	0.01602	2037.7	2037.8	13.04	1068.1	1081.2	0.0262	2.1164	2.1426	45
50	0.17795	0.01602	1704.8	1704.8	18.05	1065.3	1083.4	0.0361	2.0901	2.1262	50
60	0.2561	0.01603	1207.6	1207.6	28.06	1059.7	1087.7	0.0555	2.0391	2.0946	60
70	0.3629	0.01605	868.3	868.4	38.05	1054.0	1092.1	0.0745	1.9900	2.0645	70
80	0.5068	0.01607	633.3	633.3	48.04	1048.4	1096.4	0.0932	1.9426	2.0359	80
90	0.6981	0.01610	468.1	468.1	58.02	1042.7	1100.8	0.1115	1.8970	2.0086	90
100	0.9492	0.01613	350.4	350.4	68.00	1037.1	1105.1	0.1295	1.8530	1.9825	100
110	1.2750	0.01617	265.4	265.4	77.98	1031.4	1109.3	0.1472	1.8105	1.9577	110
120	1.6927	0.01620	203.25	203.26	87.97	1025.6	1113.6	0.1646	1.7693	1.9339	120
130	2.2230	0.01625	157.32	157.33	97.96	1019.8	1117.8	0.1817	1.7295	1.9112	130
140	2.8892	0.01629	122.98	123.00	107.95	1014.0	1122.0	0.1985	1.6910	1.8895	140
150	3.718	0.01634	97.05	97.07	117.95	1008.2	1126.1	0.2150	1.6536	1.8686	150
160	4.741	0.01640	77.27	77.29	127.96	1002.2	1130.2	0.2313	1.6174	1.8487	160
170	5.993	0.01645	62.04	62.06	137.97	996.2	1134.2	0.2473	1.5822	1.8295	170
180	7.511	0.01651	50.21	50.22	148.00	990.2	1138.2	0.2631	1.5480	1.8111	180
190	9.340	0.01657	40.94	40.96	158.04	984.1	1142.1	0.2787	1.5148	1.7934	190
200	11.526	0.01664	33.62	33.64	168.09	977.9	1146.0	0.2940	1.4824	1.7764	200
210	14.123	0.01671	27.80	27.82	178.15	971.6	1149.7	0.3091	1.4509	1.7600	210
212	14.696	0.01672	26.78	26.80	180.17	970.3	1150.5	0.3121	1.4447	1.7568	212
220	17.186	0.01678	23.13	23.15	188.23	965.2	1153.4	0.3241	1.4201	1.7442	220
230	20.779	0.01685	19.364	19.381	198.33	958.7	1157.1	0.3388	1.3902	1.7290	230
240	24.968	0.01693	16.304	16.321	208.45	952.1	1160.6	0.3533	1.3609	1.7142	240
250	29.825	0.01701	13.802	13.819	218.59	945.4	1164.0	0.3677	1.3323	1.7000	250
260	35.427	0.01709	11.745	11.762	228.76	938.6	1167.4	0.3819	1.3043	1.6862	260
270	41.856	0.01718	10.042	10.060	238.95	931.7	1170.6	0.3960	1.2769	1.6729	270
280	49.200	0.01726	8.627	8.644	249.17	924.6	1173.8	0.4098	1.2501	1.6599	280
290	57.550	0.01736	7.443	7.460	259.4	917.4	1176.8	0.4236	1.2238	1.6473	290
300	67.005	0.01745	6.448	6.466	269.7	910.0	1179.7	0.4372	1.1979	1.6351	300
310	77.67	0.01755	5.609	5.626	280.0	902.5	1182.5	0.4506	1.1726	1.6232	310
320	89.64	0.01766	4.896	4.914	290.4	894.8	1185.2	0.4640	1.1477	1.6116	320
340	117.99	0.01787	3.770	3.788	311.3	878.8	1190.1	0.4902	1.0990	1.5892	340
360	153.01	0.01811	2.939	2.957	332.3	862.1	1194.4	0.5161	1.0517	1.5678	360
380	195.73	0.01836	2.317	2.335	353.6	844.5	1198.0	0.5416	1.0057	1.5473	380
400	247.26	0.01864	1.8444	1.8630	375.1	825.9	1201.0	0.5667	0.9607	1.5274	400
420	308.78	0.01894	1.4808	1.4997	396.9	806.2	1203.1	0.5915	0.9165	1.5080	420
440	381.54	0.01926	1.1976	1.2169	419.0	785.4	1204.4	0.6161	0.8729	1.4890	440
460	466.9	0.0196	0.9746	0.9942	441.5	763.2	1204.8	0.6405	0.8299	1.4704	460
480	566.2	0.0200	0.7972	0.8172	464.5	739.6	1204.1	0.6648	0.7871	1.4518	480
500	680.9	0.0204	0.6545	0.6749	487.9	714.3	1202.2	0.6890	0.7443	1.4333	500
520	812.5	0.0209	0.5386	0.5596	512.0	687.0	1199.0	0.7133	0.7013	1.4146	520
540	962.8	0.0215	0.4437	0.4651	536.8	657.5	1194.3	0.7378	0.6577	1.3954	540
560	1133.4	0.0221	0.3651	0.3871	562.4	625.3	1187.7	0.7625	0.6132	1.3757	560
580	1326.2	0.0228	0.2994	0.3222	589.1	589.9	1179.0	0.7876	0.5673	1.3550	580
600	1543.2	0.0236	0.2438	0.2675	617.1	550.6	1167.7	0.8134	0.5196	1.3330	600
620	1786.9	0.0247	0.1962	0.2208	646.9	506.3	1153.2	0.8403	0.4689	1.3092	620
640	2059.9	0.0260	0.1543	0.1802	679.1	454.6	1133.7	0.8686	0.4134	1.2821	640
660	2365.7	0.0277	0.1166	0.1443	714.9	392.1	1107.0	0.8995	0.3502	1.2498	660
680	2708.6	0.0304	0.0808	0.1112	758.5	310.1	1068.5	0.9365	0.2720	1.2086	680
700	3094.3	0.0366	0.0386	0.0752	822.4	172.7	995.2	0.9901	0.1490	1.1390	700
705.5	3208.2	0.0508	0	0.0508	906.0	0	906.0	1.0612	0	1.0612	705.5

TABLE A.2 PROPERTIES OF SATURATED STEAM AND SATURATED WATER (TEMPERATURE)

Press. psia	Temp F	Volume, ft³/lb			Enthalpy, Btu/lb			Entropy, Btu/lb x F			Energy, Btu/lb		Press. psia
		Water	Evap	Steam	Water	Evap	Steam	Water	Evap	Steam	Water	Steam	
		v_f	v_{fg}	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g	u_f	u_g	
0.0886	32.018	0.01602	3302.4	3302.4	0.00	1075.5	1075.5	0	2.1872	2.1872	0	1021.3	0.0886
0.10	35.023	0.01602	2945.5	2945.5	3.03	1073.8	1076.8	0.0061	2.1705	2.1766	3.03	1022.3	0.10
0.15	45.453	0.01602	2004.7	2004.7	13.50	1067.9	1081.4	0.0271	2.1140	2.1411	13.50	1025.7	0.15
0.20	53.160	0.01603	1526.3	1526.3	21.22	1063.5	1084.7	0.0422	2.0738	2.1160	21.22	1028.3	0.20
0.30	64.484	0.01604	1039.7	1039.7	32.54	1057.1	1089.7	0.0641	2.0158	2.0809	32.54	1032.0	0.30
0.40	72.869	0.01606	792.0	792.1	40.92	1052.4	1093.3	0.0799	1.9762	2.0562	40.92	1034.7	0.40
0.5	79.586	0.01607	641.5	641.5	47.62	1048.6	1096.3	0.0925	1.9446	2.0370	47.62	1036.9	0.5
0.6	85.218	0.01609	540.0	540.1	53.25	1045.5	1098.7	0.1028	1.9186	2.0215	53.24	1038.7	0.6
0.7	90.09	0.01610	466.93	466.94	58.10	1042.7	1100.8	0.3	1.8966	2.0083	58.10	1040.3	0.7
0.8	94.38	0.01611	411.67	411.69	62.39	1040.3	1102.6	0.1117	1.8775	1.9970	62.39	1041.7	0.8
0.9	98.24	0.01612	368.41	368.43	66.24	1038.1	1104.3	0.1264	1.8606	1.9870	66.24	1042.9	0.9
1.0	101.74	0.01614	333.59	333.60	69.73	1036.1	1105.8	0.1326	1.8455	1.9781	69.73	1044.1	1.0
2.0	126.07	0.01623	173.74	173.76	94.03	1022.1	1116.2	0.1750	1.7450	1.9200	94.03	1051.8	2.0
3.0	141.47	0.01630	118.71	118.73	109.42	1013.2	1122.6	0.2009	1.6854	1.8864	109.41	1056.7	3.0
4.0	152.96	0.01636	90.63	90.64	120.92	1006.4	1127.3	0.2199	1.6428	1.8626	120.90	1060.2	4.0
5.0	162.24	0.01641	73.515	73.53	130.20	1000.9	1131.1	0.2349	1.6094	1.8443	130.18	1063.1	5.0
6.0	170.05	0.01645	61.967	61.98	138.03	996.2	1134.2	0.2474	1.5820	1.8294	138.01	1065.4	6.0
7.0	176.84	0.01649	53.634	53.65	144.83	992.1	1136.9	0.2581	1.5587	1.8168	144.81	1067.4	7.0
8.0	182.86	0.01653	47.328	47.35	150.87	988.5	1139.3	0.2676	1.5384	1.8060	150.84	1069.2	8.0
9.0	188.27	0.01656	42.385	42.40	156.30	985.1	1141.4	0.2760	1.5204	1.7964	156.28	1070.8	9.0
10	193.21	0.01659	38.404	38.42	161.26	982.1	1143.3	0.2836	1.5043	1.7879	161.23	1072.3	10
14.696	212.00	0.01672	26.782	26.80	180.17	970.3	1150.5	0.3121	1.4447	1.7568	180.12	1077.6	14.696
15	213.03	0.01673	26.274	26.29	181.21	969.7	1150.9	0.3137	1.4415	1.7552	181.16	1077.9	15
20	227.96	0.01683	20.070	20.087	196.27	960.1	1156.3	0.3358	1.3962	1.7320	196.21	1082.0	20
30	250.34	0.01701	13.7266	13.744	218.9	945.2	1164.1	0.3682	1.3313	1.6995	218.8	1087.9	30
40	267.25	0.01715	10.4794	10.497	236.1	933.6	1169.8	0.3921	1.2844	1.6765	236.0	1092.1	40
50	281.02	0.01727	8.4967	8.514	250.2	923.9	1174.1	0.4112	1.2474	1.6586	250.1	1095.3	50
60	292.71	0.01738	7.1562	7.174	262.2	915.4	1177.6	0.4273	1.2167	1.6440	262.0	1098.0	60
70	302.93	0.01748	6.1875	6.205	272.7	907.8	1180.6	0.4411	1.1905	1.6316	272.5	1100.2	70
80	312.04	0.01757	5.4536	5.471	232.1	900.9	1183.1	0.4534	1.1675	1.6208	281.9	1102.1	80
90	320.28	0.01766	4.8777	4.895	290.7	894.6	1185.3	0.4643	1.1470	1.6113	290.4	1103.7	90
100	327.82	0.01774	4.4133	4.431	298.5	888.6	1187.2	0.4743	1.1284	1.6027	298.2	1105.2	100
120	341.27	0.01789	3.7097	3.728	312.6	877.8	1190.4	0.4919	1.0960	1.5879	312.2	1107.6	120
140	353.04	0.01803	3.2010	3.219	325.0	868.0	1193.0	0.5071	1.0681	1.5752	324.5	1109.6	140
160	363.55	0.01815	2.8155	2.834	336.1	859.0	1195.1	0.5206	1.0435	1.5641	335.5	1111.2	160
180	373.08	0.01827	2.5129	2.531	346.2	850.7	1196.9	0.5328	1.0215	1.5543	345.6	1112.5	180
200	381.80	0.01839	2.2689	2.287	355.5	842.8	1198.3	0.5438	1.0016	1.5454	354.8	1113.7	200
250	400.97	0.01865	1.8245	1.8432	376.1	825.0	1201.1	0.5679	0.9585	1.5264	375.3	1115.8	250
300	417.35	0.01889	1.5238	1.5427	394.0	808.9	1202.9	0.5882	0.9223	1.5105	392.9	1117.2	300
350	431.73	0.01913	1.3064	1.3255	409.8	794.2	1204.0	0.6055	0.8909	1.4968	408.6	1118.1	350
400	444.60	0.0193	1.14162	1.1610	424.2	780.4	1204.6	0.6217	0.8630	1.4847	422.7	1118.7	400
450	456.28	0.0195	1.01224	1.0318	437.3	767.5	1204.8	0.6360	0.8378	1.4738	435.7	1118.9	450
500	467.01	0.0198	0.90787	0.9276	449.5	755.1	1204.7	0.6490	0.8148	1.4639	447.7	1118.8	500
550	476.94	0.0199	0.82183	0.8418	460.9	743.3	1204.3	0.6611	0.7936	1.4547	458.9	1118.6	550
600	486.20	0.0201	0.74962	0.7698	471.7	732.0	1203.7	0.6723	0.7738	1.4461	469.5	1118.2	600
700	503.08	0.0205	0.63505	0.6556	491.6	710.2	1201.8	0.6928	0.7377	1.4304	488.9	1116.9	700
800	518.21	0.0209	0.54809	0.5690	509.8	689.6	1199.4	0.7111	0.7051	1.4163	506.7	1115.2	800
900	531.85	0.0212	0.47968	0.5009	526.7	669.7	1196.4	0.7279	0.6753	1.4032	523.2	1113.0	900
1000	544.38	0.0216	0.42435	0.4460	542.6	650.4	1192.9	0.7434	0.6476	1.3910	538.6	1110.4	1000
1100	556.22	0.0220	0.37863	0.4006	557.5	631.5	1189.1	0.7579	0.6216	1.3794	553.1	1107.5	1100
1200	567.19	0.0223	0.34013	0.3625	571.9	613.0	1184.8	0.7714	0.5969	1.3683	566.9	1104.3	1200
1300	577.42	0.0227	0.30722	0.3299	585.6	594.6	1180.2	0.7843	0.5733	1.3577	580.1	1100.9	1300
1400	587.07	0.0231	0.27871	0.3018	598.8	576.5	1175.3	0.7966	0.5507	1.3474	592.9	1097.1	1400
1500	596.20	0.0235	0.25372	0.2772	611.7	558.4	1170.1	0.8085	0.5288	1.3373	605.2	1093.1	1500
2000	635.80	0.0257	0.16256	0.1883	672.1	466.2	1138.3	0.8628	0.4256	1.2881	662.6	1068.6	2000
2500	668.11	0.0286	0.10209	0.1307	731.7	361.6	1093.3	0.9139	0.3206	1.2345	718.5	1032.9	2500
3000	695.33	0.0343	0.05073	0.0850	801.8	218.4	1020.3	0.9728	0.1891	1.1619	782.8	973.1	3000
3208.2	703.47	0.0508	0	0.0508	906.0	0	906.0	1.0612	0	1.0612	875.9	875.9	3208.2

TABLE A.3 PROPERTIES OF SATURATED STEAM AND SATURATED WATER (PRESSURE)

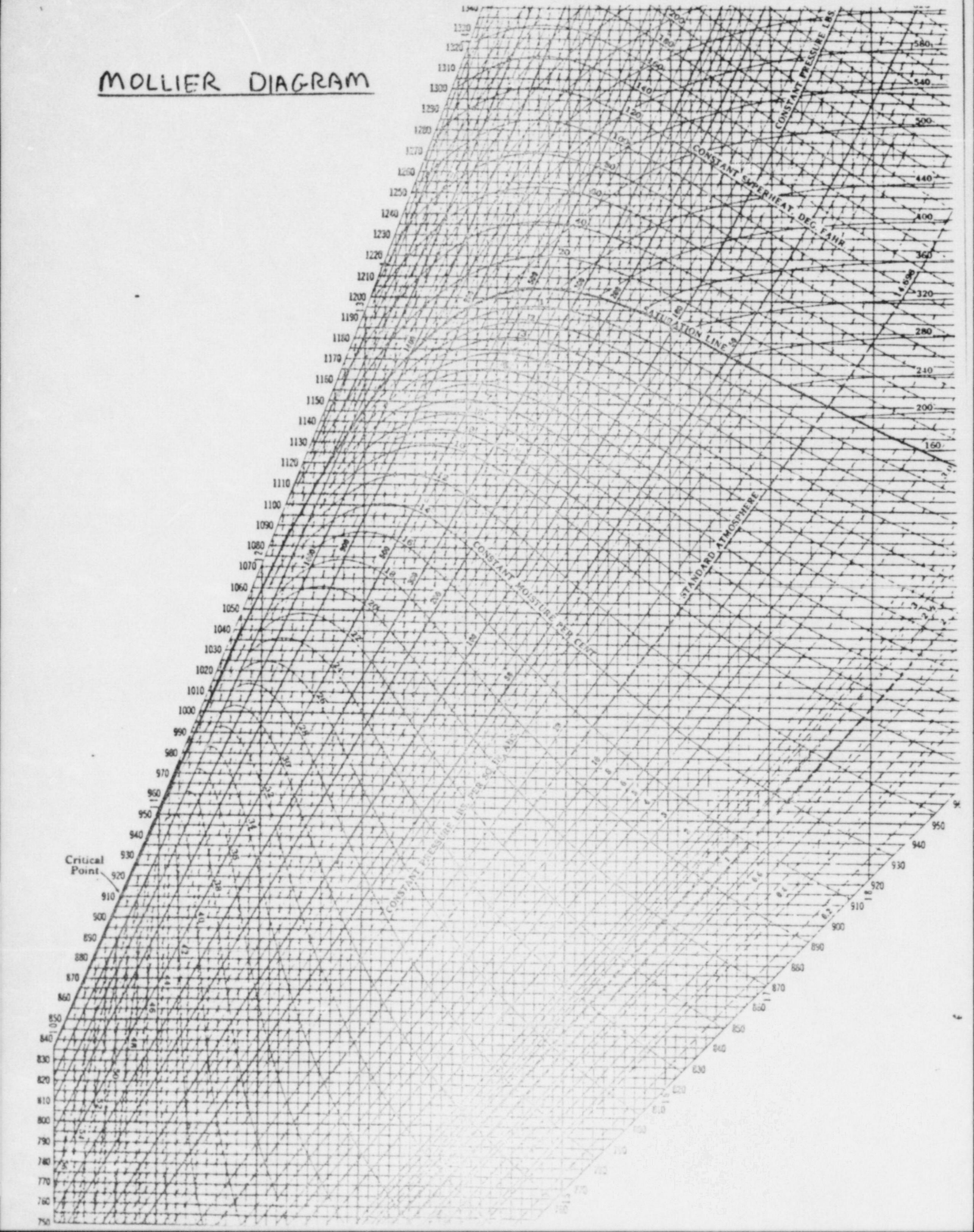
Abs press. lb/sq in. (sat. temp)		Temperature, F													
		100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
1 (101.74)	v	0.0161	392.5	452.3	511.9	571.5	631.1	690.7								
	h	68.00	1150.2	1195.7	1241.8	1288.6	1336.1	1384.5								
	s	0.1295	2.0509	2.1152	2.1722	.2237	2.2708	2.3144								
5 (162.24)	v	0.0161	78.14	90.24	102.24	114.21	126.15	138.08	150.01	161.94	173.86	185.78	197.70	209.62	221.53	233.45
	h	68.01	1148.6	1194.8	1241.3	1288.2	1335.9	1384.3	1433.6	1483.7	1534.7	1586.7	1639.6	1693.3	1748.0	1803.5
	s	0.1295	1.8716	1.9369	1.9943	2.0460	2.0932	2.1369	2.1776	2.2159	2.2521	2.2866	2.3194	2.3509	2.3811	2.4101
10 (193.21)	v	0.0161	38.84	44.93	51.03	57.04	63.03	69.00	74.98	80.94	86.91	92.87	98.84	104.80	110.76	116.72
	h	68.02	1146.6	1193.7	1240.6	1287.8	1335.5	1384.0	1433.4	1483.5	1534.6	1586.6	1639.5	1693.3	1747.9	1803.4
	s	0.1295	1.7928	1.8593	1.9173	1.9692	2.0166	2.0603	2.1011	2.1394	2.1757	2.2101	2.2430	2.2744	2.3046	2.3337
15 (213.03)	v	0.0161	0.0166	29.899	33.963	37.985	41.986	45.978	49.964	53.946	57.926	61.905	65.882	69.858	73.833	77.807
	h	68.04	168.09	1192.5	1239.9	1287.3	1335.2	1383.8	1433.2	1483.4	1534.5	1586.5	1639.4	1693.2	1747.8	1803.4
	s	0.1295	0.2940	1.8134	1.8720	1.9242	1.9717	2.0155	2.0563	2.0946	2.1309	2.1653	2.1982	2.2297	2.2599	2.2890
20 (227.96)	v	0.0161	0.0166	22.356	25.428	28.457	31.466	34.465	37.458	40.447	43.435	46.420	49.405	52.388	55.370	58.352
	h	68.05	168.11	1191.4	1239.2	1286.9	1334.9	1383.5	1432.9	1483.2	1534.3	1586.3	1639.3	1693.1	1747.8	1803.3
	s	0.1295	0.2940	1.7805	1.8397	1.8921	1.9397	1.9836	2.0244	2.0628	2.0991	2.1336	2.1665	2.1979	2.2282	2.2572
40 (267.25)	v	0.0161	0.0166	11.035	12.624	14.165	15.685	17.195	18.699	20.199	21.697	23.194	24.689	26.183	27.676	29.168
	h	68.10	168.15	1186.6	1236.4	1285.0	1333.6	1382.5	1432.1	1482.5	1533.7	1585.8	1638.8	1992.7	1747.5	1803.0
	s	0.1295	0.2940	1.6992	1.7608	1.8143	1.8624	1.9065	1.9476	1.9860	2.0224	2.0569	2.0899	2.1224	2.1516	2.1807
60 (292.71)	v	0.0161	0.0156	7.257	8.354	9.400	10.425	11.438	12.446	13.450	14.452	15.452	16.450	17.448	18.445	19.441
	h	68.15	168.20	1181.6	1233.5	1283.2	1332.3	1381.5	1431.3	1481.8	1533.2	1585.3	1638.4	1692.4	1747.1	1802.8
	s	0.1295	0.2939	1.6492	1.7134	1.7681	1.8168	1.8612	1.9024	1.9410	1.9774	2.0120	2.0450	2.0765	2.1068	2.1359
80 (312.04)	v	0.0161	0.0166	0.0175	6.218	7.018	7.794	8.560	9.319	10.075	10.829	11.581	12.331	13.081	13.829	14.577
	h	68.21	168.24	269.74	1230.5	1281.3	1330.9	1380.5	1430.5	1481.1	1532.6	1584.9	1638.0	1692.0	1746.8	1802.5
	s	0.1295	0.2939	0.4371	1.6790	1.7349	1.7842	1.8289	1.8702	1.9089	1.9454	1.9800	2.0131	2.0446	2.0750	2.1041
100 (327.82)	v	0.0161	0.0166	0.0175	4.935	5.588	6.216	6.833	7.443	8.050	8.655	9.258	9.860	10.460	11.060	11.659
	h	68.26	168.29	269.77	1227.4	1279.3	1329.6	1379.5	1429.7	1480.4	1532.0	1584.4	1637.6	1691.8	1746.5	1802.2
	s	0.1295	0.2939	0.4371	1.6516	1.7088	1.7586	1.8036	1.8451	1.8839	1.9205	1.9552	1.9883	2.0199	2.0502	2.0794
120 (341.27)	v	0.0161	0.0166	0.0175	4.0786	4.6341	5.1637	5.6831	6.1929	6.7006	7.2060	7.7096	8.2119	8.7130	9.2134	9.7130
	h	68.31	168.33	269.81	1224.1	1277.4	1328.1	1378.4	1428.8	1479.8	1531.4	1583.9	1637.1	1691.3	1746.2	1802.0
	s	0.1295	0.2939	0.4371	1.6286	1.6872	1.7376	1.7829	1.8246	1.8635	1.9001	1.9349	1.9680	1.9996	2.0300	2.0592
140 (353.04)	v	0.0161	0.0166	0.0175	3.4661	3.9526	4.4119	4.8585	5.2995	5.7364	6.1709	6.6036	7.0349	7.4652	7.8946	8.3233
	h	68.37	168.38	269.85	1220.8	1275.3	1326.8	1377.4	1428.0	1479.1	1530.8	1583.4	1636.7	1690.9	1745.9	1801.7
	s	0.1295	0.2939	0.4370	1.6085	1.6686	1.7196	1.7652	1.8071	1.8461	1.8828	1.9176	1.9508	1.9825	2.0129	2.0421
160 (363.55)	v	0.0161	0.0166	0.0175	3.0060	3.4413	3.8480	4.2420	4.6295	5.0132	5.3945	5.7741	6.1522	6.5293	6.9055	7.2811
	h	68.42	168.42	269.89	1217.4	1273.3	1325.4	1376.4	1427.2	1478.4	1530.3	1582.9	1636.3	1690.5	1745.6	1801.4
	s	0.1294	0.2938	0.4370	1.5906	1.6522	1.7039	1.7499	1.7919	1.8310	1.8678	1.9027	1.9359	1.9676	1.9980	2.0273
180 (373.08)	v	0.0161	0.0166	0.0174	2.6474	3.0433	3.4093	3.7621	4.1084	4.4505	4.7907	5.1289	5.4657	5.8014	6.1363	6.4704
	h	68.47	168.47	269.92	1213.8	1271.2	1324.0	1375.3	1426.3	1477.7	1529.7	1582.4	1635.9	1690.2	1745.3	1801.2
	s	0.1294	0.2938	0.4370	1.5743	1.6376	1.6900	1.7362	1.7784	1.8176	1.8545	1.8894	1.9227	1.9545	1.9849	2.0142
200 (381.80)	v	0.0161	0.0166	0.0174	2.3598	2.7247	3.0583	3.3783	3.6915	4.0008	4.3077	4.6128	4.9165	5.2191	5.5209	5.8219
	h	68.52	168.51	269.96	1210.1	1269.0	1322.6	1374.3	1425.5	1477.0	1529.1	1581.9	1635.4	1689.8	1745.0	1800.9
	s	0.1294	0.2938	0.4369	1.5593	1.6242	1.6770	1.7239	1.7663	1.8057	1.8426	1.8776	1.9109	1.9427	1.9732	2.0025
250 (400.97)	v	0.0161	0.0166	0.0174	0.0186	2.1504	2.4662	2.6872	2.9410	3.1909	3.4382	3.6837	3.9278	4.1709	4.4131	4.6546
	h	68.66	168.63	270.05	375.10	1263.5	1319.0	1371.6	1423.4	1475.3	1527.6	1580.6	1634.4	1688.9	1744.2	1800.2
	s	0.1294	0.2937	0.4368	0.5567	1.5951	1.6502	1.6976	1.7405	1.7801	1.8173	1.8524	1.8858	1.9177	1.9482	1.9776
300 (417.35)	v	0.0161	0.0165	0.0174	0.0186	1.7665	2.0044	2.2263	2.4407	2.6509	2.8585	3.0643	3.2688	3.4721	3.6746	3.8764
	h	68.79	168.74	270.14	375.15	1257.7	1315.2	1368.9	1421.3	1473.6	1526.2	1579.4	1633.3	1688.0	1743.4	1799.6
	s	0.1294	0.2937	0.4367	0.5565	1.5703	1.6274	1.6758	1.7192	1.7591	1.7964	1.8317	1.8652	1.8972	1.9278	1.9572
350 (431.73)	v	0.0161	0.0166	0.0174	0.0186	1.4913	1.7028	1.8970	2.0332	2.2652	2.4445	2.6219	2.7980	2.9730	3.1471	3.3205
	h	68.93	168.85	270.24	375.21	1251.5	1311.4	1366.2	1419.2	1471.8	1524.7	1578.2	1632.3	1687.1	1742.6	1798.9
	s	0.1293	0.2936	0.4367	0.5564	1.5483	1.6077	1.6571	1.7009	1.7411	1.7787	1.8141	1.8477	1.8798	1.9105	1.9400
400 (444.60)	v	0.0161	0.0166	0.0174	0.0162	1.2841	1.4763	1.6499	1.8151	1.9759	2.1339	2.2901	2.4450	2.5987	2.7515	2.9037
	h	69.05	168.97	270.33	375.27	1245.1	1307.4	1363.4	1417.0	1470.1	1523.3	1576.9	1631.2	1686.2	1741.9	1798.2
	s	0.1293	0.2935	0.4366	0.5563	1.5282	1.5901	1.6406	1.6850	1.7255	1.7632	1.7988	1.8325	1.8647	1.8955	1.9250
500 (467.01)	v	0.0161	0.0166	0.0174	0.0186	0.9919	1.1584	1.3037	1.4397	1.5708	1.6992	1.8256	1.9507	2.0746	2.1977	2.3200
	h	69.32	169.19	270.51	375.38	1231.2	1299.1	1357.7	1412.7	1466.6	1520.3	1574.4	1629.1	1684.4	1740.3	1796.9
	s	0.1292	0.2934	0.4364	0.5560	1.4921	1.5595	1.6123	1.6578	1.6990	1.7371	1.7730	1.8069	1.8393	1.8702	1.8998

TABLE A.4 PROPERTIES OF SUPERHEATED STEAM AND COMPRESSED WATER (TEMPERATURE AND PRESSURE)

Abs press. lb/sq in. (sat. temp)		Temperature, F														
		100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
600 (486.20)	v	0.0161	0.0166	0.0174	0.0186	0.7944	0.9456	1.0726	1.1892	1.3008	1.4093	1.5160	1.6211	1.7252	1.8284	1.9309
	h	69.58	169.42	270.70	375.49	1215.9	1290.3	1351.8	1408.3	1463.0	1517.4	1571.9	1627.0	1682.6	1738.8	1795.6
	s	0.1292	0.2933	0.4362	0.5657	1.4590	1.5329	1.5844	1.6351	1.6769	1.7155	1.7517	1.7859	1.8184	1.8494	1.8792
700 (503.08)	v	0.0161	0.0166	0.0174	0.0186	0.0204	0.7928	0.9072	1.0102	1.1078	1.2023	1.2948	1.3858	1.4757	1.5647	1.6530
	h	69.04	169.65	270.89	375.61	487.93	1281.0	1345.6	1403.7	1459.4	1514.4	1569.4	1624.8	1680.7	1737.2	1794.3
	s	0.1291	0.2932	0.4360	0.5655	0.6889	1.5090	1.5673	1.6154	1.6580	1.6970	1.7335	1.7679	1.8005	1.8318	1.8617
800 (518.2.)	v	0.0161	0.0166	0.0174	0.0186	0.0204	0.6774	0.7829	0.8759	0.9631	1.0470	1.1289	1.2093	1.2885	1.3669	1.4446
	h	70.11	169.88	271.07	375.73	487.88	1271.1	1339.2	1399.1	1455.8	1511.4	1566.9	1622.7	1678.9	1735.0	1792.9
	s	0.1290	0.2930	0.4358	0.5652	0.6885	1.4869	1.5484	1.5980	1.6413	1.6807	1.7175	1.7522	1.7851	1.8164	1.8464
900 (531.95)	v	0.0161	0.0166	0.0174	0.0186	0.0204	0.5869	0.6858	0.7713	0.8504	0.9262	0.9998	1.0720	1.1430	1.2131	1.2825
	h	70.37	170.10	271.26	375.84	487.83	1260.6	1332.7	1394.4	1452.2	1508.5	1564.4	1620.6	1677.1	1734.1	1791.6
	s	0.1290	0.2929	0.4357	0.5649	0.6881	1.4659	1.5311	1.5822	1.6263	1.6662	1.7033	1.7382	1.7713	1.8028	1.8329
1000 (544.58)	v	0.0161	0.0166	0.0174	0.0186	0.0204	0.5137	0.6080	0.6875	0.7603	0.8295	0.8966	0.9622	1.0266	1.0901	1.1529
	h	70.63	170.33	271.44	375.96	487.79	1249.3	1325.9	1389.6	1448.5	1504.4	1561.9	1618.4	1675.3	1732.5	1790.3
	s	0.1289	0.2928	0.4355	0.5647	0.6876	1.4457	1.5149	1.5677	1.6126	1.6530	1.6905	1.7256	1.7589	1.7905	1.8207
1100 (556.28)	v	0.0161	0.0166	0.0174	0.0185	0.0203	0.4531	0.5440	0.6188	0.6865	0.7505	0.8121	0.8723	0.9313	0.9894	1.0468
	h	70.90	170.56	271.63	376.08	487.75	1237.3	1318.8	1384.7	1444.7	1502.4	1559.4	1616.3	1673.5	1731.0	1789.0
	s	0.1289	0.2927	0.4353	0.5644	0.6872	1.4259	1.4996	1.5542	1.6000	1.6410	1.6787	1.7141	1.7475	1.7793	1.8097
1200 (567.19)	v	0.0161	0.0166	0.0174	0.0185	0.0203	0.4016	0.4805	0.5615	0.6250	0.6845	0.7418	0.7974	0.8519	0.9055	0.9584
	h	71.16	170.78	271.82	376.20	487.72	1224.2	1311.5	1379.7	1440.9	1449.4	1556.9	1614.2	1671.6	1729.4	1787.6
	s	0.1288	0.2926	0.4351	0.5642	0.6868	1.4061	1.4851	1.5415	1.5883	1.6298	1.6679	1.7035	1.7371	1.7691	1.7996
1400 (587.07)	v	0.0161	0.0166	0.0174	0.0185	0.0203	0.3176	0.4059	0.4712	0.5282	0.5809	0.6311	0.6798	0.7272	0.7737	0.8195
	h	71.68	171.24	272.19	376.44	487.65	1194.1	1296.1	1269.3	1433.2	1493.2	1551.8	1609.9	1668.0	1726.3	1785.0
	s	0.1287	0.2923	0.4348	0.5636	0.6859	1.3652	1.4575	1.5182	1.5670	1.6096	1.6484	1.6845	1.7185	1.7508	1.7815
1600 (604.87)	v	0.0161	0.0166	0.0173	0.0185	0.0202	0.0236	0.3415	0.4032	0.4555	0.5031	0.5482	0.5915	0.6336	0.6748	0.7153
	h	72.21	171.69	272.57	376.69	487.60	616.77	1279.4	1358.5	1425.2	1486.9	1546.6	1605.6	1664.3	1723.2	1782.3
	s	0.1286	0.2921	0.4344	0.5631	0.6851	0.8129	1.4312	1.4963	1.5478	1.5916	1.6312	1.6678	1.7022	1.7344	1.7657
1800 (621.92)	v	0.0160	0.0165	0.0173	0.0185	0.0202	0.0235	0.2909	0.3500	0.3988	0.4426	0.4836	0.5229	0.5609	0.5980	0.6343
	h	72.73	172.15	272.95	376.93	487.56	615.58	1261.1	1347.2	1417.1	1480.6	1541.1	1601.2	1660.7	1720.1	1779.7
	s	0.1284	0.2918	0.4341	0.5626	0.6843	0.8109	1.4054	1.4768	1.5302	1.5753	1.6156	1.6528	1.6876	1.7204	1.7516
2000 (635.80)	v	0.0160	0.0165	0.0173	0.0184	0.0201	0.0233	0.2488	0.3072	0.3534	0.3942	0.4320	0.4680	0.5027	0.5365	0.5695
	h	73.26	172.60	273.32	377.19	487.53	614.48	1240.9	1353.4	1408.7	1447.1	1536.2	1596.9	1657.0	1717.0	1777.1
	s	0.1283	0.2916	0.4337	0.5621	0.6834	0.8091	1.3794	1.4578	1.5138	1.5603	1.6014	1.6391	1.6743	1.7075	1.7389
2500 (668.11)	v	0.0160	0.0165	0.0173	0.0184	0.0200	0.0230	0.1681	0.2293	0.2712	0.3068	0.3390	0.3692	0.3980	0.4259	0.4529
	h	74.57	173.74	274.27	377.82	487.50	612.08	1176.7	1303.4	1386.7	1457.9	1522.9	1585.9	1647.8	1709.2	1770.4
	s	0.1280	0.2910	0.4329	0.5609	0.6815	0.8048	1.3076	1.4129	1.4766	1.5269	1.5703	1.6094	1.6456	1.6796	1.7116
3000 (695.33)	v	0.0160	0.0165	0.0172	0.0183	0.0200	0.0228	0.0982	0.1759	0.2161	0.2484	0.2770	0.3033	0.3282	0.3522	0.3753
	h	75.83	174.88	275.22	378.47	487.52	610.03	1060.5	1267.0	1363.2	1440.2	1509.4	1574.8	1635.5	1701.4	1761.8
	s	0.1277	0.2904	0.4320	0.5597	0.6796	0.8009	1.1966	1.3692	1.4429	1.4975	1.5434	1.5841	1.6214	1.6561	1.6888
3200 (705.08)	v	0.0160	0.0165	0.0172	0.0183	0.0199	0.0227	0.0335	0.1588	0.1987	0.2301	0.2576	0.2827	0.3065	0.3291	0.3510
	h	76.4	175.3	275.6	378.7	487.5	609.4	800.8	1250.9	1353.4	1433.1	1503.8	1570.3	1634.8	1698.3	1761.2
	s	0.1276	0.2902	0.4317	0.5592	0.6788	0.7984	0.9708	1.3515	1.4300	1.4866	1.5335	1.5749	1.6126	1.6477	1.6806
3500	v	0.0160	0.0164	0.0172	0.0183	0.0199	0.0225	0.0307	0.1364	0.1764	0.2066	0.2326	0.2563	0.2784	0.2995	0.3198
	h	77.2	176.0	276.2	379.1	487.6	608.4	779.4	1224.6	1338.2	1422.2	1495.5	1563.3	1629.2	1693.6	1757.2
	s	0.1274	0.2899	0.4312	0.5585	0.6777	0.7973	0.9508	1.3242	1.4112	1.4709	1.5194	1.5618	1.6002	1.6358	1.6691
4000	v	0.0159	0.0164	0.0172	0.0182	0.0198	0.0223	0.0287	0.1052	0.1463	0.1752	0.1984	0.2210	0.2411	0.2601	0.2783
	h	78.5	177.2	277.1	379.8	487.7	606.5	762.0	1174.3	1311.6	1403.0	1481.3	1552.2	1619.8	1685.7	1750.6
	s	0.1271	0.2893	0.4304	0.5573	0.6760	0.7940	0.9343	1.2764	1.3807	1.4461	1.4976	1.5417	1.5812	1.6177	1.6516
5000	v	0.0159	0.0164	0.0171	0.0181	0.0196	0.0219	0.0268	0.0591	0.1038	0.1312	0.1529	0.1718	0.1890	0.2050	0.2203
	h	81.1	179.5	279.1	381.2	488.1	604.6	746.0	1042.9	1252.9	1364.6	1452.1	1529.1	1600.9	1670.0	1737.4
	s	0.1265	0.2881	0.4287	0.5550	0.6726	0.7880	0.9163	1.1593	1.3207	1.4001	1.4582	1.5061	1.5481	1.5863	1.6216
6000	v	0.0159	0.0163	0.0170	0.0180	0.0195	0.0216	0.0256	0.0397	0.0757	0.1020	0.1221	0.1391	0.1544	0.1684	0.1817
	h	83.7	181.7	281.0	382.7	488.6	602.9	736.1	945.1	1188.8	1323.6	1422.3	1505.9	1582.0	1654.2	1724.2
	s	0.1258	0.2870	0.4271	0.5528	0.6693	0.7826	0.9026	1.0176	1.2615	1.3574	1.4229	1.4749	1.5194	1.5593	1.5962
7000	v	0.0158	0.0163	0.0170	0.0180	0.0193	0.0213	0.0248	0.0334	0.0573	0.0816	0.1004	0.1160	0.1298	0.1424	0.1542
	h	86.2	184.4	283.0	384.2	489.3	601.7	729.3	901.3	1124.9	1281.7	1392.2	1482.6	1563.1	1639.6	1711.1
	s	0.1252	0.2859	0.4256	0.5507	0.6663	0.7777	0.8926	1.0050	1.2055	1.3171	1.3904	1.4486	1.4983	1.5345	1.5735

TABLE A.4 PROPERTIES OF SUPERHEATED STEAM AND COMPRESSED WATER (TEMPERATURE AND PRESSURE) (CONTINUED)

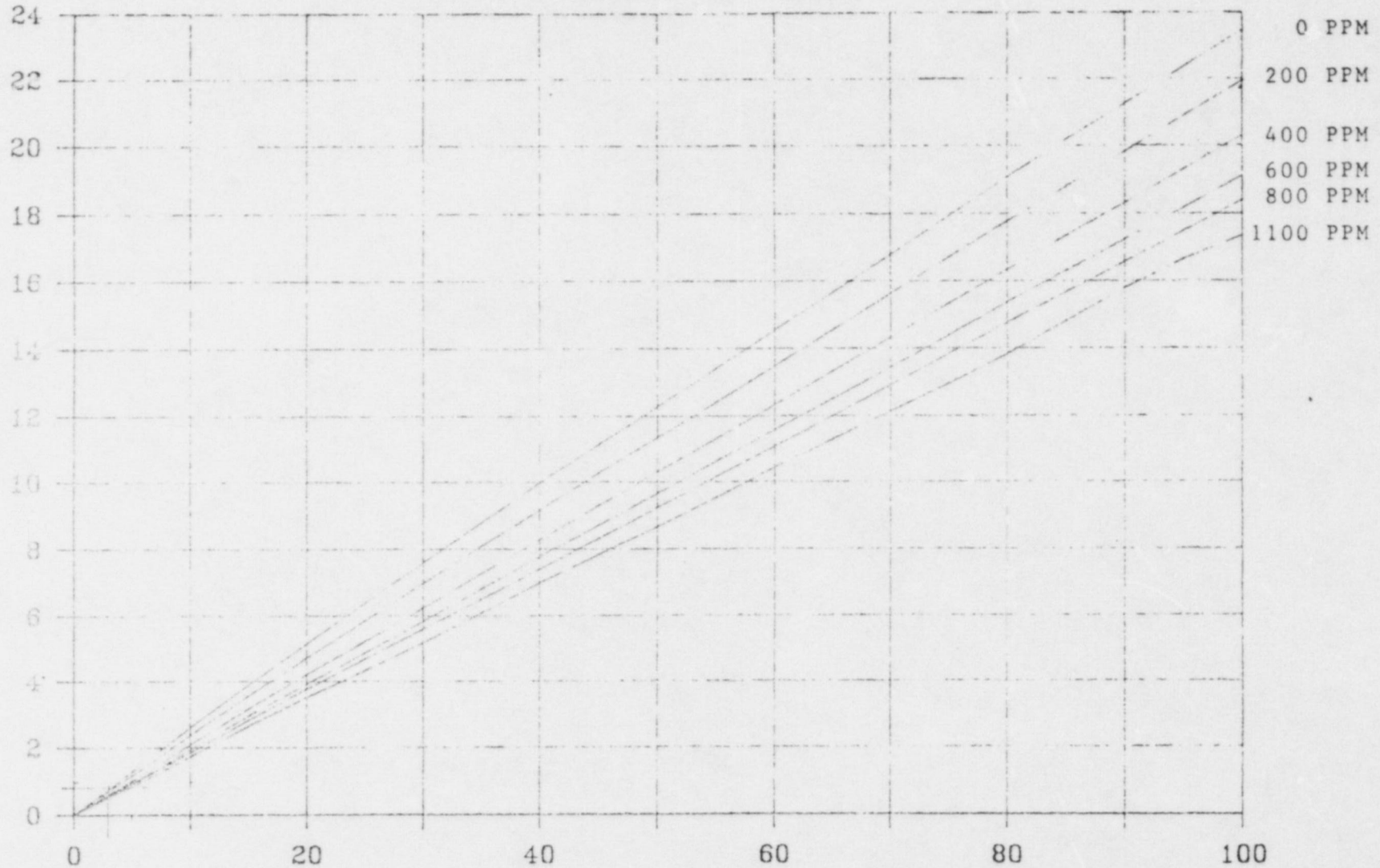
MOLLIER DIAGRAM



Curve 1.3

CYCLE 11

POWER DEFECT VS. POWER



Curve 1.3

Drawn By/Date: Timothy P Hart 12 MAR 86

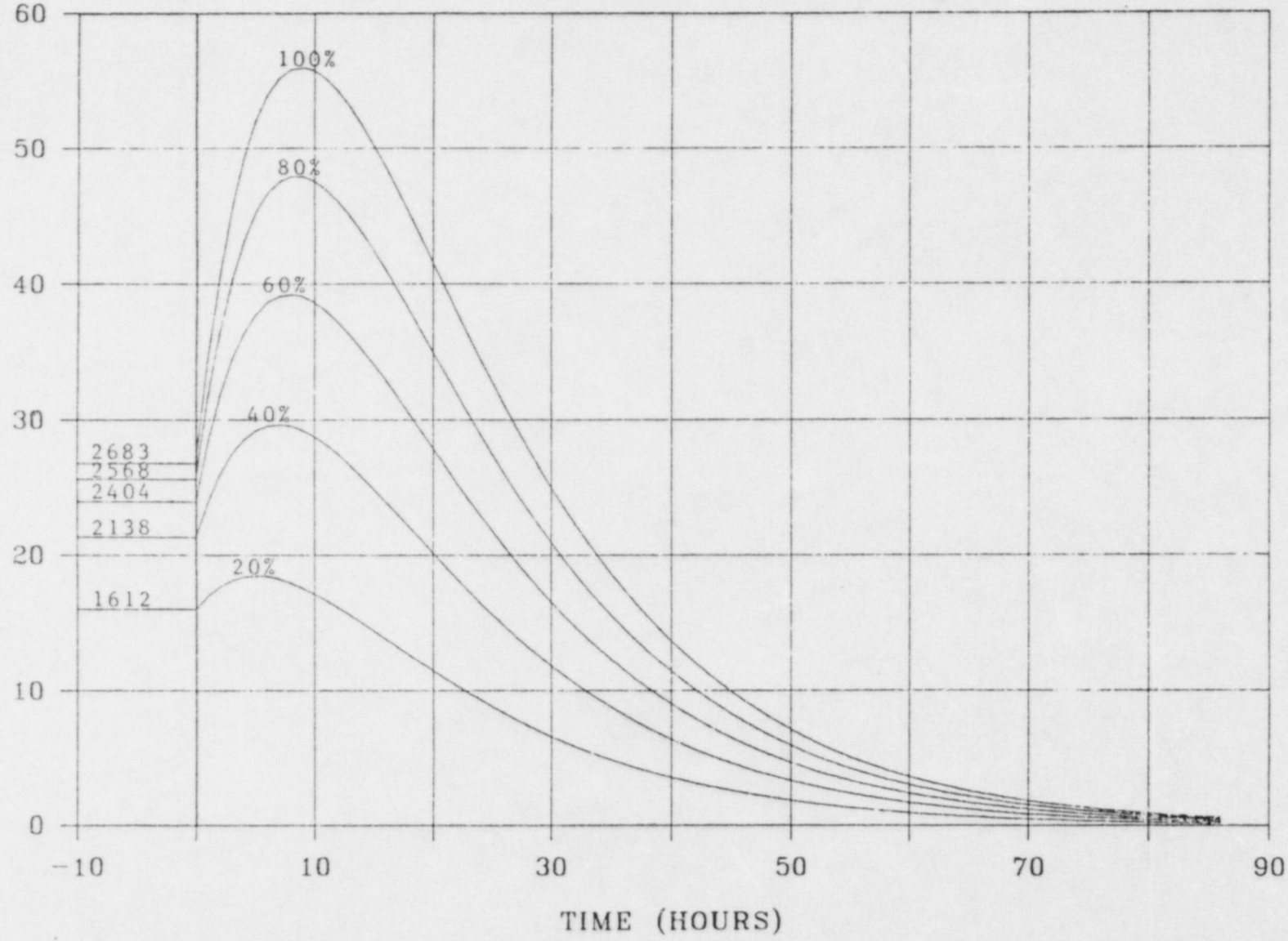
Checked By/Date: Ray H. Chambers 3/12/86

ted copies enhanced with color.

Re.. .2

CYCLE 11

BOC XE WORTH AFTER TRIP FROM EQUIL.



Drawn By/Date: [illegible] 14MAR86

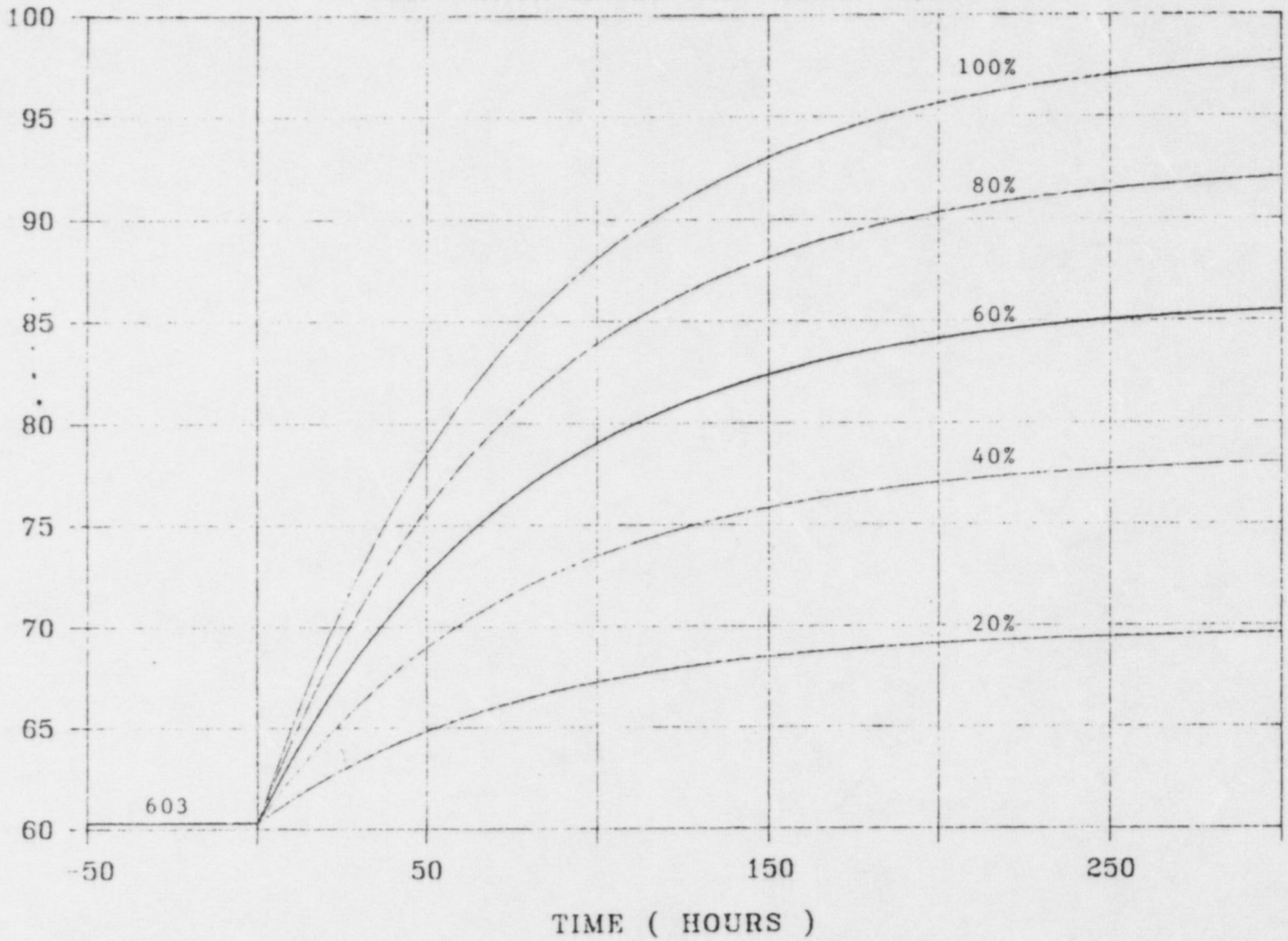
Checked By/Date: RA Linsley 3/14/86

Colored copies enhanced with color.

Curve 2.3A

CYCLE 11

SM WORTH AFTER TRIP FROM EQUIL.



Drawn By/Date: [illegible] 14MAR86

Checked By/Date: HHC [illegible] 3/15/86

Curve 2.4

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 1.01 (2.50)

a. DNBR = Heat flux (power) to cause DNB / actual heat flux (power) (0.5)
or CHF/actual heat flux
b. Greater than or equal (0.2 pts) to 1.17 (0.3 pts) (0.5)
c. 1. RCS pressure 2. RCS temperature
3. RCS flow 4. Rx power
5. AFD 6. QPTP
7. Rod sequencing 8. Rod overlap
9. Rod position (any 6 at 0.25 pts each) (1.5)
CONSIDER OTHERS ON CASE-BY-CASE BASIS

REFERENCE
HBR TS SEC 2.1; SEC 3.10.8.3 pp3.10-13,3.10-14.

ANSWER 1.02 (1.00)

1. Decreases 2. Increases 3. Decreases 4. Increases (0.25 each)

REFERENCE
HBR RXTH Session 48

ANSWER 1.03 (2.00)

a. Larger value since fully withdrawing rod substantially increases the flux in the area of the rod. (1.0)
b. Value decreases since flux in the area of the rod decreases. (1.0)

REFERENCE
HBR RXTH Session 35 pp3 &4.

ANSWER 1.04 (1.00)

a. At 2235 psig h-stm = 1118, h-w = 701, h-stm minus h-w = 417 (+/- 4) BTU/lbm (0.5)
b. Increases (0.5)

REFERENCE
HBR HTT & FF pp 44.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 1.05 (1.50)

a.Increases b.Decreases a.Increases (0.5)each

REFERENCE
HBR HTT & FF pp226

ANSWER 1.06 (1.00)

The critical rod position taken at the proper IR level is THE SAME AS the critical rod position taken two decades below the proper IR level.

REFERENCE
HBR, Reactor Theory, Sessions 20.

ANSWER 1.07 (1.00)

a. 36SECONDS (+/- 1sec)
b. 21SECONDS (+/- 1sec) (0.5)each

REFERENCE
HBR RXTH Session 43, pp3.

ANSWER 1.08 (1.50)

a. True

b. False

c. False (0.5 each)

REFERENCE
HBR HTT & FF Part B,Sect 1.

ANSWER 1.09 (1.50)

a. 155 (Plus or Minus 4) BTU/lbm (1.0)
b. 71 (Plus or Minus 4)BTU/lbm (0.5)

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

REFERENCE
HBR HTT & FF Part A, chapter 2 pp85-96.

ANSWER 1.10 (1.50)

a. Higher
b. Lower
c. Higher (0.5 ea)

REFERENCE
HBR FMP 0125,HBR TOC (Curve Book).

ANSWER 1.11 (2.00)

a Shutdown margin is the % reactivity by which the reactor is maintained or could be made instantaneously subcritical assuming the most reactive rod is fully withdrawn. (1.0)

b. Control Rods, Xenon, Samarium,Power Defect, Boron.(any 4 at 0.25 each)

REFERENCE
HBR FMP-012; HBR RXTH Session 50 TS 3.10.8 p.3.10-11a

ANSWER 1.12 (1.50)

a. 1, 5 (0.50)
b. 3 (0.50)
c. 5 (0.50)

REFERENCE
HBR HTT & FF, pp 101-105.

ANSWER 1.13 (1.00)

for 2250 psia, sat temp = 652 (+/- 2 degrees) (0.25)
with Tavg = 575, Th = (Delta T=57/2) + 575=603.5 (+/- 2 degrees) (+.5)

Answer 652-603.5=48.5 (+/- 4 degrees) (0.25)

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

REFERENCE
Steam Tables, HBR SD-001.

ANSWER 1.14 (1.00)

Decay (0.5)
Burnout or Neutron Absorbtion (0.5)

REFERENCE
HBR RXTH Session 37.

ANSWER 1.15 (1.00)

Flow through a venturi causes a pressure decrease in the throat area. The high pressure side of a D/P cell is connected upstream of the throat and the low pressure side is connected at the throat. The difference in pressure is proportional to the flow. (Reasonably worded answers accepted)
[flow $\propto \sqrt{\Delta P}$ (.2)] cc 11/2/86

REFERENCE
HBR HTT & FF pp313,314.

ANSWER 1.16 (2.00)

CR1(1-Keff1)=Cr2(1-Keff2); 50(1-0.9)=CR2(1-0.95) Ans.100cps

Rho1=(Keff1-1)/Keff1 Rho2=(Keff2-1)/Keff2 Rho added=Rho2-Rho1
Rho1=-.1111 Rho2=-.0526 Rho added=-.0526(-)-.1111
Ans. .0585 Delta-K per K

(Partial credit for wo) (1.0 each)

REFERENCE
HBR RXTH Session 42 pp3-4.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 1.17 (2.00)

It is always negative and therefore will reduce fission rate as fuel temperature increases. (1.0)

It acts immediately to inhibit power increases. (1.0)

REFERENCE
HBR RXTH Sesion 29

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 2.01 (1.00)

The amount of water needed for at least 2 hours operation at hot standby.

REFERENCE
HBR TS p.3.4-3

ANSWER 2.02 (1.00)

Condenser Hotwell
Circulation Water System
Waste Disposal System
Condensate Storage Tank (0.25 each)

REFERENCE
HBR SD-020 p.22.

ANSWER 2.03 (2.00)

Monitors R-20 and R-21 are radioactive gas monitors.(0.5) Monitor R-11 collects particulate matter (0.5) and then passes the sample on to the R-12 gas monitor.(0.5) Filter paper is not used for gas monitoring.(0.5)

REFERENCE
HBR SD-019 p. 14,20.

ANSWER 2.04 (2.00)

a. Steam flow limiting devices in the S/G outlet nozzle chokes steam flow should a steam line break.(0.5) Each steam line contains a venturi for flow instrumentation which will provide a resistance to steam flow should a rupture occur downstream.(0.5) (1.0)

b. Placing the control switch in the CLOSE position causes the closing solenoid valve to energize and admit air pressure to the upper volume of a double acting air cylinder, open air is vented from the lower volume and the valve closes with a spring assist. (1.0)

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

REFERENCE
HBR SD-025 p.1,2a.,9.

ANSWER 2.05 (1.00)

A leak is detected by noting an increasing temperature on the TEMPERATURE MONITORING SYSTEM for the flange leakoff connection.
REFERENCE
HBR SD-001, p.6.

ANSWER 2.06 (1.50)

a. Intermediate
b. Source
c. Intermediate
d. Power
e. Source (0.3 each letter)

REFERENCE
HBR SD-010, p.6-8,13,19,22,41,42.

ANSWER 2.07 (1.00)

The delay time for injecting a portion of primary unborated water is reduced.

REFERENCE
HBR SD-021 p.25

ANSWER 2.08 (1.50)

a. 1500 (+/-25) psig b. 600 to 700 psig c.130 (+/-25) psig (0.5 each)

REFERENCE
HBR SD-002 p.29,30.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 2.09 (3.00)

a. Trips are: High Crankcase Pressure,Engine Overspeed,LO Lube Oil Pressure,LO Jacket Water Pressure(coolant),HI Jacket Water Temperature(coolant), Overcrank(Start Failure). (any 4 at 0.25 each)
b. 1. FALSE; 2. FALSE; 3. FALSE; 4. TRUE (0.5 each)

REFERENCE
HBR SD-005 p.2,3,8.

ANSWER 2.10 (3.00)

a. Normal supply for E-1 is 4160V Bus No.2 via Station Service Transformer 2F.(1.0) Normal supply for E-2 is 4160V Bus No.3 via Station Service Transformer 2G.(1.0)
b. If bus voltage decreases (below 412V) (0.25) for longer then 10 seconds (0.25) the bus supply breaker trips.(0.25) Emergency Diesel Generators will auto start and pick up E-1 and E-2 loads.(.25)

REFERENCE
HBR SD-016 p.27,46.

ANSWER 2.11 (1.50)

Instrument Air System, normal; Station Service Air, backup; Nitrogen, backup. (0.5each)

REFERENCE
HBR SD-037 p.4,5.

ANSWER 2.12 (1.00)

a. FALSE b. FALSE (0.5)each

REFERENCE
HBR SD-004 p.22. SD-027 p.6.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 2.13 (1.00)

Temperature, Boron Concentration, Pressure. (any two at 0.5 each).

REFERENCE
HBR SD-003 p.11.

ANSWER 2.14 (2.00)

a. Tubine is runback at 200%/min for 1.5 seconds, stops for 30 seconds (+.5) then repeats cycle if condition still exists (+.5) or 5% runback at 30 second intervals until condition clears.
b. The rod position indicating system initiates the runback (+.5) as long as a dropped rod is sensed.(+.5), or OP/OT DELTA T runback.

REFERENCE
HBR SD-011 p.27,28; Dwg No.5379-2760.

ANSWER 2.15 (1.00)

From MCC-5 (480V AC) (transformed to 118 V a.c.)

REFERENCE
HBR/SD-016, p.15, 29.

ANSWER 2.16 (1.00)

a. 2 (0.5)
b. the holdup tank. (0.5)

REFERENCE
HBR SD-021 p.12,16; DWG No. 5379-685 sheet 2.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 3.01 (2.50)

The undervoltage coil and trip coil for Trip Breaker A and Trip Bypass Breaker B are powered from the "A" 125 VDC Distribution Panel.(0.5) Manual and automatic trip signals deenergize the under voltage coils(0.5)which mechanically trip the A Trip Breaker(0.5) and B Bypass Breaker.(0.5) The automatic Shunt Trip Relay is deenergized at the same time which energizes the trip coil for Trip Breaker A.(0.5)

REFERENCE
HBR SD-011 p.12 & 35.

ANSWER 3.02 (1.00)

From 0% to 20% Power the S/G Level is 39% to 52%. (0.5)
From 20% to 100% Power the S/G Level is 52%. (0.5)

REFERENCE
HBR SD-027 p.19

ANSWER 3.03 (2.00)

1. Spray Actuation, or P-Signal (0.5)
2. Hi Steam Flow coincident (0.5) with Low S/G pressure (0.5) or Low Tavg (0.5) (1.5)

REFERENCE
HBR SD-006 p.16.

ANSWER 3.04 (1.00)

When both Intermediate Range detectors indicate below P-6.

REFERENCE
HBR SD-010 p.9.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 3.05 (3.00)

a. INCREASE because Tavg decreases creating a Tavg-Tref mismatch.
b. DECREASE since NI increase creats a rate mismatch with P-NI & P-ref, if N-44 fails. If assumption is that another detector fails NO Change.
c. NO CHANGE since low Tc would not affect auctioneered high Tavg which is the input to Rod Control.
d. DECREASE since a power mismatch exists between turbine power (Pref) and Reactor power. (0.75 each)

REFERENCE
HBR SD-007 p.20,21,Attachment 2.

ANSWER 3.06 (1.50)

Input comes from the core outlet thermocouples,(0.3) from each RCS hot (0.3) and cold(0.3) leg wide range(0.3) RTDs and system pressure.(0.3)

REFERENCE
HBR SD-001 p.28

ANSWER 3.07 (2.00)

Power Range NI 1/4(0.25) above 103% power.(0.25)
Intermediate Range NI 1/2(0.25) above 20% power.(0.25)
Overtemperature DELTA-T 2/3(0.25) above calculated setpoint.(0.25)
Overpower DELTA-T 2/3(0.25) above calculated setpoint.(0.25)
ti

REFERENCE
HBR SD-011 p.26.

ANSWER 3.08 (1.75)

Loop 2 Hot Leg isolation valves (.25) cannot be opened (.25) unless RCS pressure is less than 465 psig (.25) and RHR Recirc to RWST (.25) is closed (.25) and RHR Pump Suction valves (.25) are closed.(.25)

REFERENCE
HBR SD-002 p.13, HBR DWG 5379-1082 sheet 1 and 1484.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 3.09 (~~1.50~~ 1.75)

Charging pumps would slowdown,(.25) Pressurizer level would decrease,(.25) Letdown would isolate,(.25) Heaters would deenergize,(.25) Level would oscillate around the setpoint (.25) until Reactor trips on low RCS pressure. (.25) backup heaters on cc 11/2/88 .25

REFERENCE
HBR SD-001 p.34; SD-021 p.27,28

ANSWER 3.10 (1.00)

All positions.

REFERENCE
HBR SD-004 p.8,9.

ANSWER 3.11 (1.00)

The Load Bistable provides the arming signal for the Steam Dump valves(0.5) The Temperature Bistable will trip open the steam dump valves after they are armed.(0.5)

REFERENCE
HBR SD-025 p.15.

ANSWER 3.12 (1.00)

a. Turbocharger lube oil pump running with output pressure (above 10 psig).(0.5)
b. Engine Speed Control set to idle.(0.5)

REFERENCE
HBR SD-056 p.12.

ANSWER 3.13 (1.50)

a. False b. True c. False (0.5 each)

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

REFERENCE
HBR SD-033 p.15.

ANSWER 3.1~~1~~ 4 ~~1 FAIL~~ (1.00)

Acoustic accelerometers (0.5)
Temperature detectors (0.5)

REFERENCE
HBR SD-001 p.35.

ANSWER 3.15 (2.00)

a. Loss of power supply
AFW Pump auto start
Containment Phase A Isolation signal
Loss of both Main Feedwater Pumps
High radiation signal (any 4 at 0.25 each)

b. Manual safety injection
High containment pressure
High DELTA pressure between any steam generator and the steam line header
Pressurizer low pressure
High steam flow in 2/3 steam lines coincident with low Tavg or low steam pressure
Phase A containment isolation signal
Loss of air
Loss of electrical power
Manual (any 4 at (0.25 each)

REFERENCE
HBR SD-020 Section 5.0 and 5.1; SD-021 p.18: TS Tables 3.5-3 &4

ANSWER 3.16 (1.50)

-PZR high water level
-PZR lo pressure
-Lo primary coolant flow
-RCP breakers open
-Under voltage
-Under frequency
-Turbine trip (Any 6 of 7 at 0.25 each)

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

REFERENCE
HBR SD-011 p.24.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 4.01 (1.00)

a. Resetting the SI Signal permits manual loading of equipment on E-1 and E-2. (0.5)
b. The Operator should refer to EPP Supplement A for a listing of those valves that should have closed and compare them to actual valve position or by checking safeguards status panel lights. (0.5)

REFERENCE
HBR EPP-1 pp17, SD-006 pp11.

ANSWER 4.02 (2.50)

a. Continuous addition of Boric Acid Solution (0.5) from CVCS,(0.25) or Safety Injection System.(0.25)
b. Actuation of PRZ Spray,(0.3) or PORV,(0.3) Over Temperature(0.3) or Over Power(0.3) Rod Withdrawl Stop with Turbine Runback,(0.3) NI Rod Withdrawl Stop.(0.3) (any five)

REFERENCE
HBR AOP-001 pp12,14.

ANSWER 4.03 (1.50)

Must monitor Component Cooling Water flow and temperature for the RCP Thermal Barrier.(0.5) Must monitor Pump Bearing temperature.(0.5) Must monitor No.1 Seal leakoff temperature.(0.5)

REFERENCE
HBR AOP-18 p.14,16.

ANSWER 4.04 (1.00)

First--Normal Spray;(0.25) Second--Aux Spray with Letdown;(0.25) Third--PZR PORVs.(0.25) (0.25 for correct order)

REFERENCE
HBR Table 1 for Path 1.

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 4.05 (1.00)

The remaining SI Pumps must be tested to ensure that they are operable.

REFERENCE
HBR TS p.3.3-10

ANSWER 4.06 (3.00)

a. RCS Subcooling greater than 25 degrees F.(0.5) Steam Pressure stable or Decreasing.(0.5) RCS hot leg temperature stable or decreasing.(0.5) Subcooling Monitor T/C stable or decreasing.(0.5) RCS cold leg temperature trending to or at saturation temperature for steam pressure.(0.5)
b. Increase dumping steam.(0.5)

REFERENCE
HBR EPP-4 p.12

ANSWER 4.07 (1.50)

a. Implemented on a temporary basis following approval by two members(0.25) of the Plant(0.25) (or C&A Management) Staff,at least one must hold a SRO license.(0.5)
b. Not to exceed 21 days.(0.5)

REFERENCE
HBR AP-004 p.28,29

ANSWER 4.08 (2.00)

Ensure adequate shutdown margin in the event of a Reactor trip.(1.0) Ensure that the maximum possible ejected rod reactivity limits are maintained.(0.5) Ensure acceptable core power distrubition.(0.5)

REFERENCE
HBR GP-003 p.11

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

ANSWER 4.09 (2.00)

a. Should adjust T-AVG to within plus .5 degrees F (0.25) and minus 2.5 degrees F (0.25) of T-REF (0.25) to avoid a transient after transfer.(0.25)
b. Shift to Manual as Turbine load decreases below P-2 setpoint(0.5) (15% Turbine Load) since Automatic Control Rod Withdrawal is now blocked.(0.5)

REFERENCE
HBR GP-005 p.6,8 GP-006 p6

ANSWER 4.10 (1.00)

Cooldown and depressurize the RCS or heatup the RCS above 350 degrees F.
~~(1.0 for either)~~ is each CC 11/10/86

REFERENCE
HBR OP-006 P.5 TS p.3.1-4

ANSWER 4.11 (1.50)

Start the Standby Circulating Pump;(0.5) Verify that the Standby Vacuum Pump is running;(0.5) Verify that the Conderser Vacuum Breaker Valves are closed.(0.5) Reduce turbine load if vacuum is approaching low vacuum trip.(0.5) (any three answers)

REFERENCE
HBR AOP-012 p.4 SD-026 p.19

ANSWER 4.12 (2.00)

a. OSC is located in the Plant Maintenance Shop.
TSC is located in the Training,EOF/TSC Building.
EOF is located in the Training,EOF/TSC Building. (need all three 0.75)
b. One Shift Foreman~~(SRO)~~;(.25) Two Control Room Operators~~(RO licensed)~~ (.25) Two additional Shift Personnel;(.25) One Senior Control Operator ~~(SRO licensed)~~(.25); One Shift Technical Advisor.(.25)

License is required.
CC 11/7/86

ANSWERS -- ROBINSON -86/09/30-VICTOR,F.

REFERENCE
HBR TS p.6.2-1

ANSWER 4.13 (1.50)

To safely bring the Reactor Plant to a hot shutdown condition after a severe fire(0.75) when the use of EOPs is precluded.(0.75)

REFERENCE
HBR DSP-001 P.29

ANSWER 4.14 (1.00)

The Operating Supervisor authorizes removal of the tag.(0.25) The Shift Foreman approves the removal.(0.25) A functional test is performed(0.25) or the SCO,CO,or AO verifies that the tag has been removed.(0.25)

REFERENCE
HBR OMM-012 p9

ANSWER 4.15 (1.50)

1. Subcriticality, 2. Core Cooling, 3. Heat Sink, 4. RCS Integrity 5. Containment Integrity, 6. RCS Inventory. (.20 each CFS, .30 for proper order)

REFERENCE
HBR CSFST

ANSWER 4.16 ~~(1.00)~~ .5

A fourth start can not be attempted until the motor has cooled by standing idle for at least one hour.

REFERENCE
HBR OP-101 p.11

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

FACILITY: ROBINSON

REACTOR TYPE: PWR-WEC3

DATE ADMINISTERED: 86/09/30

EXAMINER: KEITH PARKINSON

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

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	CANDIDATE'S SCORE	% OF CATEGORY VALUE		CATEGORY
25.00	25.51	_____	_____	5.	THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
25.00	25.51	_____	_____	6.	PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
23.00	23.47	_____	_____	7.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
25.00	25.51	_____	_____	8.	ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
98.00		_____ Final Grade			Totals

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

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

3. Use black ink or dark pencil only to facilitate legible reproductions.

4. Print your name in the blank provided on the cover sheet of the examination.

5. Fill in the date on the cover sheet of the examination (if necessary).

6. Use only the paper provided for answers.

7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.

8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write only on one side of the paper, and write "Last Page" on the last answer sheet.

9. Number each answer as to category and number, for example, 1.4, 6.3.

10. Skip at least three lines between each answer.

11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.

12. Use abbreviations only if they are commonly used in facility literature.

13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.

14. Show all calculations, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.

15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

16. If parts of the examination are not clear as to intent, ask questions of the examiner only.

17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

(2) Exam aids - figures, tables, etc.

(3) Answer pages including figures which are part of the answer.

b. Turn in your copy of the examination and all pages used to answer the examination questions.

c. Turn in all scrap paper and the balance of the paper that you did not use for answering the questions.

d. Leave the examination area, as defined by the examiner. If after leaving, you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION 5.01 (1.50)

A motor driven centrifugal pump is operating at a low flow condition. You then start opening the upstream throttle valve on the discharge side. How will each of the following be affected? [INCREASE, DECREASE,OR NO CHANGE]

a. Pump Discharge Pressure [0.5]

b. Available NPSH [0.5]

c. Motor Amps [0.5]

QUESTION 5.02 (2.50)

a. How does DNBR change [INCREASE, DECREASE, NO CHANGE] as the following are increased? [Consider each separately].

1. Tavg [0.5]
2. RCS pressure [0.5]
3. RCS flow [0.5]
4. Reactor power [Constant Tavg] [0.5]

b. What adverse fuel assembly condition could result if actual heat flux exceeds the critical heat flux in a PWR core? EXPLAIN. [0.5]

QUESTION 5.03 (2.00)

a. The plant has been operating at 100% reactor power power for several weeks. Power is reduced to 75% using rods only. What ROD MOTION would be required to maintain the plant at 75% power over the next 40 hours assuming no change in boron concentration? Include applicable TIME FRAMES. [1.5]

b. The equilibrium [at power] value of samarium reactivity is _____ [DEPENDENT ON or INDEPENDENT OF] power level. [0.5]

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

QUESTION 5.04 (2.00)

a. Does Beta bar effective INCREASE, DECREASE, OR REMAIN THE SAME from BOL to EOL? EXPLAIN your answer. [1.5]

b. For two equivalent positive reactivity additions to a critical reactor, will the SUR be the SAME, LARGER, OR SMALLER at EOL as compared to BOL? [No explanation is necessary] [0.5]

QUESTION 5.05 (2.00)

a. Primary system flow rate is many times greater than secondary system flow rate while the heat transferred by the two systems is essentially the same. EXPLAIN how this is possible. [1.5]

b. Which of the following describes the changes to the steam that occur between the inlet and outlet of a real [not ideal] turbine? [0.5]

1. Enthalpy decreases, entropy decreases, quality decreases.

2. Enthalpy increases, entropy increases, quality increases.

3. Enthalpy constant, entropy decreases, quality decreases.

4. Enthalpy decreases, entropy increases, quality decreases.

QUESTION 5.06 (2.00)

Given the following, CALCULATE the required boron change to increase reactor power from 75% to 100% while maintaining constant rod position. [SHOW WORK] [2.0]

Moderator Temperature Coefficient	-15 pcm/degree
Doppler-only Power Coefficient	-12 pcm/%power
Void Reactivity change	-25 pcm
Xenon change	-50 pcm
Boron Coefficient	-10 pcm/ppm

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

QUESTION 5.07 (1.00)

The reactor is operating at 85% power at BOL when a steam dump valve OPENS. State what happens to the following paramters. [INCREASES, DECREASES or REMAINS THE SAME] [assume all control systems in MANUAL]

a. Tave [0.25]

b. Reactor Power [0.25]

c. Steam Generator Pressure [0.25]

d. Core DELTA-T [0.25]

QUESTION 5.08 (2.00)

With all systems in manual and no operator action, what effect [INCREASE, DECREASE, NO CHANGE] will decreasing the circulating water temperature have on the following?

a. Condenser vacuum [0.5]

b. Condensate temperature [0.5]

c. Steam generator pressure [0.5]

d. Reactor power [0.5]

QUESTION 5.09 (3.00)

a. 1. State the core PARAMETER that necessitates changing rod insertion limits [RIL] as reactor power increases. [0.5]

2. EXPLAIN why the RIL is changed as reactor power increases [1.5]

b. A control rod, located near the center of the core, is withdrawn and inserted under the following conditions:

Condition 1. All rods are in and the rod is fully withdrawn.

Condition 2. All rods are out and the rod is fully inserted.

Under which condition [1. or 2.] will the rod have the LARGER ROD WORTH? [1.0]

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

QUESTION 5.10 (3.00)

a. How does the initial source range level [cps] affect critical rod position? EXPLAIN. [1.0]

b. How does the positive reactivity insertion rate affect the source range count level at which criticality is achieved? EXPLAIN. [1.0]

c. During a reactor startup, count rate is 250 CPS with a corresponding K-eff of 0.95. The count rate increases to 500 CPS. WHAT IS THE RESULTANT K-eff? [SHOW WORK] [1.0]

QUESTION 5.11 (2.00)

The reactor is operating at 30% power when one RCP trips. Assuming no reactor trip or turbine load change occur, indicate whether the following parameters will INCREASE, DECREASE, or REMAIN THE SAME.

a. Flow in operating reactor coolant loops [0.5]

b. Core delta T [0.5]

c. Reactor vessel delta P [0.5]

d. Operating loop steam generator pressure [0.5]

QUESTION 5.12 (2.00)

For each change in the parameter listed in column A, select the correct change in Moderator Temperature Coefficient [MTC] from column B. [Consider each parameter change separately]

COLUMN A [parameter change]	COLUMN B [MTC change]	
a. Moderator temperature increases	1. More Negative	[0.5]
b. Boron concentration increases	2. Less Negative	[0.5]
c. All rods in vs. all rods out [temperature and boron remain the same]	3. No Effect	[0.5]
d. Flux shape shifting towards edge of core		[0.5]

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

QUESTION 6.01 (2.50)

The following concern the DIESEL GENERATORS:

a. List two Diesel Engine COMPONENTS supplied [cooled] by the Service Water System. [0.5]

b. LIST five ENGINE trips. [1.25]

c. List three GENERATOR trips. [0.75]

QUESTION 6.02 (2.00)

a. LIST four [4] SIGNALS that cause automatic closure of the Steam Generator blowdown isolation valves. [1.0]

b. WHAT are four CONDITIONS which cause automatic closure of the CVCS orifice isolation valves ? [1.0]

QUESTION 6.03 (1.75)

a. WHAT are the TWO INPUTS to the Reactor Control System variable gain circuitry? [1.0]

b. STATE the ROD SPEEDS for the following temperature deviations:

1.Tave 4.0 F above Tref [0.25]

2.Tave 6.0 F above Tref [0.25]

3.Tave 1.5 F below Tref [with Tave increasing] [0.25]

QUESTION 6.04 (1.00)

a. HOW is complete DRAINING of the spent fuel pit via the spent fuel cooling loop lower suction line PREVENTED? [0.5]

b. How is SIPHONING of the spent fuel pit via the spent fuel cooling discharge line PREVENTED? [0.5]

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

QUESTION 6.05 (1.50)

The plant is operating at 45% power with all systems in automatic control. For each condition listed below, STATE the INITIAL DIRECTION of rod motion, and STATE the REASON for this initial rod motion.

1. Loop 3 Tc fails high. [0.5]

2. A main steam power operated relief valve fails open. [0.5]

3. The turbine is ramped to 100% power at 5% per minute. [0.5]

QUESTION 6.06 (1.00)

What TWO SIGNALS can cause turbine runbacks? [1.0]

QUESTION 6.07 (1.00)

Which of the following statements is CORRECT with respect to a Load Limit Reduction? [1.0]

a. The Load Limit Reduction is a cyclic load reduction at the 200%/min rate for 5 seconds and a 30 second wait.

b. The Load Limit Reduction is a cyclic load reduction at the 70%/min rate for 5 seconds and a 30 second wait.

c. The Load Limit Reduction is a continuous load reduction at the 200%/min rate.

d. The Load Limit Reduction is a continuous load reduction at the 70%/min rate.

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

QUESTION 6.08 (2.50)

For the following RPS trips, LIST the SETPOINT [where applicable], required COINCIDENCE, and the BASIS for each trip.

a. Power range high flux trip - Low setpoint [0.5]

b. Overtemperature delta T trip [0.5]

c. Overpower delta T trip [0.5]

d. Steam generator Low-Low water level trip [0.5]

e. High pressurizer water level trip [0.5]

QUESTION 6.09 (2.50)

a. List THREE SOURCES of water that may be injected into the reactor to provide core cooling. [1.5]

b. Give TWO REASONS for mixing the spray additive tank chemical with safety injection water. [1.0]

QUESTION 6.10 (1.00)

What is the BASIS for the Condensate Storage Tank minimum level requirement listed in Technical Specifications? [1.0]

QUESTION 6.11 (2.00)

a. If a main steam line should rupture just prior to exiting the Containment Vessel, what TWO main steam line DESIGN FEATURES would mitigate the consequences of this accident? [1.0]

b. DESCRIBE the EVENTS which occur to shut an MSIV when the control switch is placed in the CLOSE position. [1.0]

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

QUESTION 6.12 (1.50)

With the plant at NORMAL operating conditions LIST the EVENTS that would occur if Pressurizer Level Channel 459 FAILED HIGH. Cover the period from initiation of the casualty until the plant is stable or the Reactor Trips [1.5]

QUESTION 6.13 (2.50)

a. Relief valves are installed in the CCW System to provide over pressure protection for the CCW System.

   1. What is the CCW surge tank relief valve designed [sized] for? [0.5]

   2. What is the excess letdown heat exchanger CCW down stream relief valve designed [sized] for? [0.5]

b. STATE two different INDICATIONS of Reactor Coolant leakage into the CCW System [1.5]

QUESTION 6.14 (2.25)

a. WHY is the operability of the steam generator code safety valves important during power operation? [0.5]

b. What is the BASIS for the requirement for the MSIVs to close during a steam line rupture? [0.5]

c. List 4 SIGNALS that will close the MSIVs. [setpoints are not required] [1.25]

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

QUESTION 7.01 (1.00)

The shift foreman is responsible for classifying events in accordance with the Emergency Action Levels [EALs]. LIST the four EALs IN ORDER of severity [with 1 being least severe and 4 being most severe] [1.0]

QUESTION 7.02 (3.00)

a. What are the TWO ENTRY CONDITIONS to FRP-H.1, "Response to Loss of Secondary heat Sink"? [1.0]

b. What TWO CONDITIONS [include applicable criteria], caused by a loss of secondary heat sink, call for tripping the RCPs and initiating feed and bleed? [1.0]

c. In FRP-C.1," Response To Inadequate Core Cooling", what TWO system PARAMETERS [include applicable CRITERIA] are checked to verify adequate core cooling? [1.0]

QUESTION 7.03 (1.00)

The plant is in the Cold Shutdown Condition conducting Refueling Operations. What are the operator IMMEDIATE ACTIONS if the R-2 containment monitor alarms? [1.0]

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

QUESTION 7.04 (1.00)

During an accident recovery procedure, the operator who has been monitoring the Critical Safety Functions reports the following information.

a. Subcriticality - green

b. Core cooling - orange

c. Integrity - orange

d. Heat sink - red

e. Containment - yellow

Rank the CSFs according to their importance in numerical order from 1 to five. [1.0]

QUESTION 7.05 (.00)

EPP-1, LOSS OF ALL AC POWER, operator action instructions include the statement " check if RCS is isolated". What FOUR things does the operator check to satisfy this step? [question deleted - see exam report]

QUESTION 7.06 (2.00)

List FOUR possible CAUSES [excluding channel failure] for receiving a PZR PROTECTION HI LEVEL ALARM? [2.0]

QUESTION 7.07 (1.00)

Answer TRUE or FALSE for the following statements concerning the Low Temperature Overpressure Protection System: [1.0]

a. The Low Temperature Overpressure Protection System shall be operable whenever the RCS temperature is below 350 F and not vented to containment. [0.5]

b. Operation of the Low Temperature Overpressure System to relieve a pressure transient must be reported to the NRC. [0.5]

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

QUESTION 7.08 (2.00)

A startup is in progress with reactor power at approximately 8-10%. What are the operator IMMEDIATE ACTIONS if the turbine trips? [2.0]

QUESTION 7.09 (2.50)

Match the following column A limits with the appropriate temperature in column B. The temperature selections may be used more than once.

Column A [LIMITS]	Column B [TEMPERATURES]	
1. Maximum allowable reactor coolant system heatup rate limit per hour	a. 25 degrees F	[0.5]
2. Maximum allowable pressurizer heatup rate limit per hour	b. 60 degrees F	[0.5]
3. The maximum allowable reactor coolant system cooldown rate limit per hour	c. 100 degrees F	[0.5]
4. The maximum allowable temperature differential between the pressurizer and the pressurizer spray water	d. 120 degrees F	[0.5]
5. The maximum SG pressure is limited to 200 psig when the RCS temperature is below this limit	e. 200 degrees F	[0.5]
	f. 320 degrees F	

QUESTION 7.10 (2.00)

What is the procedure for BORATION during normal operations.[ASSUME that the total volume of boric acid required has been determined and DESCRIBE HOW you will inject the volume of boric acid into the RCS] [2.0]

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

QUESTION 7.11 (1.00)

A normal plant startup from hot shutdown to critical is being conducted in accordance with GP-003.

a. what is the MAXIMUM allowed Startup Rate? [0.5]

b. What is the MAXIMUM allowable difference between the estimated critical rod position and the actual critical rod position? [0.5]

QUESTION 7.12 (2.00)

During power operation in accordance with GP-005, Power Operation, the turbine is manually tripped for the Turbine Valve Test. What VALVES close when the turbine is tripped for the Turbine Valve Test? [2.0]

QUESTION 7.13 (1.00)

With the Low Temperature Overpressure Protection System in operation and BOTH PORVs become inoperable, what ACTION should be initiated? [1.0]

QUESTION 7.14 (1.50)

Under what conditions would it be necessary to use DSP-001 "Hot Shutdown Procedure Using The Dedicated/Alternate Shutdown System"? [1.5]

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

QUESTION 7.15 (2.00)

When changing plant conditions from Cold Solid to Hot Subcritical at No-load Tave, it may be necessary to start and stop the Reactor Coolant Pumps at frequent intervals.

a. If THREE starts and stops or attempted starts have been made within a two-hour period [pumps are not running], what ACTION is required by OP-101 if it is necessary to start an RCP again? [0.5]

b. What is the TIME LIMIT for RCP motor operation without component cooling water flow to the motor oil coolers? [0.5]

c. HOW LONG is the Oil Lift Pump required to be running after an RCP is started? [0.5]

d. Prior to starting an RCP, WHAT OPERATION is performed on Emergency Buses E-1 and E-2? [0.5]

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

QUESTION 8.01 (2.00)

The plant is in the Cold Shutdown Condition conducting Refueling Operations.

a. What are COLD SHUTDOWN CONDITIONS as defined in the TECHNICAL SPECIFICATIONS? [1.0]

B. What are REFUELING OPERATIONS as defined in the TECHNICAL SPECIFICATIONS? [1.0]

QUESTION 8.02 (1.50)

List the three conditions stated in the Technical Specifications which make a control rod INOPERABLE. [1.5]

QUESTION 8.03 (1.00)

What is the Technical Specification BASIS for the following refueling operation condition?

" Movement of fuel within the core shall not be initiated prior to 100 hours after shutdown." [1.0]

QUESTION 8.04 (2.00)

The concentration of the boric acid solution in the Refueling Water Storage Tank must be verified once a week in accordance with Technical Specification Table 4.1.2. The chemist sampled the boron concentration on the following schedule. [All samples taken at 1200 hours].

AUG 31 --- SEP 7 --- SEP 15 --- SEP 23 --- SEP 30

a. Explain why surveillance time interval requirements WERE or WERE NOT exceeded on SEP 15. [1.0]

b. Explain why surveillance time interval requirements WERE or WERE NOT exceeded on SEP 23. [1.0]

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

QUESTION 8.05 (3.00)

The following questions pertain to Operations Management Procedure,OMM-005, Clearance and Test Request:

a. WHAT does clearance mean? [0.5]

b. WHAT is a test request? [0.5]

C. WHO issues station clearances? [0.5]

d. WHO can issue a Local Clearance? [0.5]

e. MAY equipment be operated when it is under a clearance? [0.5]

f. WHO may cancel a clearance if a worker to whom the clearance was issued to is not available to cancel a clearance? [0.5]

QUESTION 8.06 (1.50)

a. What is the MINIMUM TECHNICAL SPECIFICATION SHIFT COMPLEMENT during cold operations? [0.9]

b. What is the MAXIMUM NUMBER of conscutive days an individual may work without having two consecutive days off? [0.3]

c. WHO may authorize deviations from the overtime policy stated in the Technical Specifications? [0.3]

QUESTION 8.07 (2.50)

a. When is a component OPERABLE? [1.0]

b. The plant is operating at 50% reactor power. All electric buses are being supplied from their normal supplies. Diesel Generator "A" is removed from service for surveillance testing. What is the OPERABILITY STATUS of Safety Injection Pump "A"? EXPLAIN. [1.5]

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

QUESTION 8.08 (2.00)

For the following situations, WHAT ACTIONS ARE REQUIRED? [consider each situation independently]

a. A diesel generator is loaded and can not be shutdown. The CO2 fire protection system for the diesel generator is determined to be inoperable. [1.0]

b. The north cable vault CO2 fire protection system is determined to be inoperable. [1.0]

QUESTION 8.09 (2.50)

To maintain critical operations, what electrical power is required [without entering a Technical Specification action statement] to be operable? [2.5]

QUESTION 8.10 (1.50)

Administrative Procedure, AP-006, Procedure Adherence, provides for deviation from a procedure under emergency conditions. What APPROVALS and NOTIFICATIONS are required to deviate from a procedure? [your answer should include who grants the approval, time, consultations, who is notified, method of notification, and criteria for notification] [1.5]

QUESTION 8.11 (1.50)

STATE two reasons for locking a valve in position. [1.5]

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

QUESTION 8.12 (1.50)

As Shift foreman, during an outage requiring extensive maintenance on highly radioactive components, you determine that the situations listed in column 2 have occurred. Consider each situation separately and SELECT the appropriate required action from column 1. [1.5]

Column 1 [ACTIONS]	Column 2 [SITUATIONS]
1. advise RC Foreman or higher line management as soon as possible	a. worker received 400 rems to the extremeties [0.5]
2. notify the NRC within 24 hours	b. worker received 40 rems to the skin [0.5]
3. immediately notify the NRC	c. worker may have exceeded more than 5 rem in a calendar year [0.5]

QUESTION 8.13 (2.50)

Special Hazards areas are Locked High Radiation Areas in which there exists or potentially exists whole body exposure rates in excess of 120R/hr. LIST three Special Hazards areas in the plant. [include any qualifying conditions] [2.5]

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

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 5.01 (1.50)

a. Decrease [0.5]

b. Decrease [0.5]

c. Increase [0.5]

REFERENCE
HBR[GPC] HEAT TRANSFER THERMODYNAMICS AND FLUID FLOW FUNDAMENTALS
SECTION III PART B CHAPTER 1
COMPONENT: PUMPS-CENTRIFUGAL[2.6/2.6]

ANSWER 5.02 (2.50)

a. 1. Decrease [0.5]

2. Increase [0.5]

3. Increase [0.5]

4. Decrease [0.5]

b. Clad failure [melting, burnout] probability is greatly increased [0.25]

because film boiling will reduce the heat being transferred from the fuel [0.25]

[reasonably worded answers accepted]

REFERENCE
HBR[GPC] HEAT TRANSFER THERMODYNAMICS AND FLUID FLOW FUNDAMENTALS
SECTION II PART B CHAPTER 4 AND PART C
003/000-K5.01[3.3/3.9]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 5.03 (2.00)

a. Withdraw rods [0.375]

for about 5 [4-6] hours [0.375]

Insert rods [0.375]

for the next 35 [34-36] hours [0.375]

b. INDEPENDENT OF [0.5]

REFERENCE
HBR RXTH-HO-1 SESSION 39
001/000-K5.13[3.7/4.0]
-K5.35[2.1/2.3]

ANSWER 5.04 (2.00)

a. Over core life Pu-239 concentration increases [0.5]

As the Pu-239 concentration increases Pu-239 fission rate increases [0.5]

Pu-239 beta is less than U-235 beta; consequently beta-bar-effective DECREASES with increased Pu-239 fission rate [0.5]

b. LARGER [0.5]

[reasonable wording accepted]

REFERENCE
HBR RXTH-HO-1 SESSION 44, 47
001/000-K5.47[2.9/3.4]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 5.05 (2.00)

a. In the secondary system there is a phase change. [0.5]

A phase change requires a large delta h. [0.5]

With the larger delta h of the secondary, the same heat can be transferred with a lower flow rate. [0.5]

b. 4. [0.5]

[reasonable wording accepted]

REFERENCE
HBR[GPC] HEAT TRANSFER THERMODYNAMICS AND FLUID FLOW FUNDAMENTALS SECTION II PART B CHAPTER 1&2
002/000-K5.01[3.1/3.4]

ANSWER 5.06 (2.00)

Tave :	28.5 X 0.25 X -15 =	-107 pcm	[0.4]
Power:	25 X -12 =	-300 pcm	[0.4]
Void :		- 25 pcm	
Xenon:		- 50 pcm	
Total:		-482 pcm	[0.4]
Boron:	-482 / -10 =	48.2 ppm [46-51]	[0.4]
		Dilution	[0.4]

REFERENCE
HBR RXTH-HO-1 SESSION 51
001/000-K5.28[3.5/3.8]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 5.07 (1.00)

a. DECREASES [0.25]

b. INCREASES [0.25]

c. DECREASES [0.25]

d. INCREASES [0.25]

REFERENCE
HBR RXTH-HO-1 Session 48
[041/020]-A2.01[3.6/3.9]

ANSWER 5.08 (2.00)

a. Increase [0.5]

b. Decrease [0.5]

c. Decrease [0.5]

d. Increase [0.5]

REFERENCE
HBR[GPC] HEAT TRANSFER THERMODYNAMICS AND FLUID FLOW FUNDAMENTALS
SECTION II PART B CHAPTERS 1&2
039/000-A1.05[3.2/3.3]
002/000-K5.11[4.0/4.2]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 5.09 (3.00)

a. 1. POWER DEFECT [0.5]

2. As reactor power increases, power defect inserts negative reactivity. [0.5]

On a reactor trip this negative reactivity is removed [0.5]

thus more negative reactivity must be available from control rods to ensure adequate shutdown margin. [0.5]

b. Condition 1. [1.0]

[reasonable wording accepted]

REFERENCE
HBR RXTH-H0-1 SESSION 35, 50
001/000-K5.02[2.9/3.4]
001/000-K5.04[4.3/4.7]

ANSWER 5.10 (3.00)

a. It doesn't.[0.5] The critical rod position reflects the positive reactivity necessary to bring the reactor critical and is independent of source magnitude.[0.5] Also accept higher initial count rate would have lower ECP [0.5] because subcritical multiplication reflects the condition of being closer to critical [0.5].

b. The faster the rate, the lower the source range counts at criticality [0.5]

due to the reduced time for subcritical multiplication. [0.5]

c. CR2/CR1 = [1-Keff1]/[1-Keff2]
500/250 = 1-.95/[1-Keff2]
Keff2 = 0.975 [1.0]

[reasonable wording accepted]

REFERENCE
HBR RXTH-HO-1 SESSION 41, 42, 51, 52
001/000-K5.18[4.2/4.3]
004/000-K5.08[2.6/3.2]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 5.11 (2.00)

a. INCREASE [0.5]

b. INCREASE [0.5]

c. DECREASE [0.5]

d. DECREASE [0.5]

REFERENCE
HBR[GPC]HEAT TRANSFER THERMODYNAMICS AND FLUID FLOW FUNDAMENTALS
002/000-K5.01[3.1/3.4]

ANSWER 5.12 (2.00)

a. 1. $\tilde{r}$ CN [0.5]

b. 2. [0.5]

c. 1. [0.5]

d. 1. [0.5]

REFERENCE
HBR[GPC]RXTH-HO-1 SESSION 26
001/000-K5.15[3.4/3.7]
-K5.26[3.3/3.6]
-K5.49[3.4/3.7]
001/010-K5.29[2.9/3.4]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 6.01 (2.50)

a. 1. Air Cooler

2. Lube Oil Cooler

3. Water Jacket Heat Exchanger [any 2, 0.25 each]

b. 1. Manual

2. Overcrank [Start Failure]

3. Overspeed

4. High Crankcase Pressure

5. Low Lube Oil Pressure

6. Low Jacket Water Pressure

7. High Jacket Water Temperature [any 5, 0.25 each]

c. 1. Reverse Power [0.25]

2. Over Current [0.25]

3. Over Voltage [0.25]

REFERENCE
HBR SD-005 DIESEL GENERATORS para. 2
HBR SD-004 CIRCULATING WATER, SERVICE WATER & HYPOCHLORITE SYSTEMS para. 1
064/000-K4.01[3.9/4.1]
-K4.02[3.9/4.2]

ANSWER 6.02 (2.00)

a. 1. Loss of power supply

2. AFW Pump auto start

3. Containment Phase A Isolation signal

4. Loss of both Main Feedwater Pumps

5. High radiation signal [any 4, 0.25 each]

b. 1. Manual safety injection

2. High containment pressure

3. High differential pressure between any steam generator and the steam line header

4. Pressurizer low pressure

5. High steam flow in 2/3 steam lines coincident with low Tave or low steam pressure

6. Manual
7. Loss of air
8. Loss of electrical power [any 4, 0.25 each]

OR

1. Phase A isolation signal
2. Loss of electrical power
3. Loss of air
4. Manual [all 4, 0.25 each]

REFERENCE
HBR SD-020 STEAM GENERATOR BLOWDOWN/WET LAYUP SYSTEM para 2.
HBR SD-021 CHEMICAL AND VOLUME CONTROL SYSTEM para 3.
HBR TECHNICAL SPECIFICATIONS Tables 3.5-3 & 4
035/010-K4.03[2.6/2.8]
004/000-A3.2[3.6/3.6]

ANSWER 6.03 (1.75)

a. Output of the nonlinear gain unit [0.5]

turbine first stage impulse pressure [0.5]

b.1. 40 spm [0.25]

2. 72 spm cr 11/10/88 [0.25]

3. 0 ~~or 8 SPM [either answer accepted]~~ [0.25]

REFERENCE
HBR SD-007 ROD CONTROL SYSTEM Figure 4 & para 4
001/000-K6.02[2.8/3.3]
-K4.08[3.2/3.4]

ANSWER 6.04 (1.00)

a. A valve inside the spent fuel pit is closed and locked. [0.5]

b. A vacuum breaker is installed in the discharge line. [0.5]

REFERENCE
HBR SD-014 SPENT FUEL PIT SYSTEM para 1.
033/000-K4.01[2.9/3.2]
-K4.03[2.6/2.9]

ANSWER 6.05 (1.50)

1. Rods move IN, because Tavg is higher than Tref. [0.5]

2. rods move OUT, because Tavg becomes less than Tref. [0.5]

3. Rods move OUT, because the power mismatch circuit sees turbine power [as sensed by Pimp] increasing above Rx power. [0.5]

REFERENCE
HBR SD-007 ROD CONTROL SYSTEM para 2. & 4.
016/000-A2.01[3.0/3.1]
039/000-K1.02[3.3/3.3]
045/010-K4.21[3.1/3.2]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

001/000-K4.03[3.5/3.8]

ANSWER 6.06 (1.00)

1. Rod drop NIS
2. Rod drop/bottom from RPI
   [reasonable wording accepted]
3. OT delta T
4. OP delta T

[any 2, 0.5 each]

REFERENCE
HBR SD-011 REACTOR PROTECTION SYSTEM para 3.
045/000-4.12[3.3/3.6]

ANSWER 6.07 (1.00)

C. [1.0]

REFERENCE
HBR SD-011 REACTOR PROTECTION SYSTEM para 3.
045/000-4.12[3.3/3.6]

ANSWER 6.08 (2.50)

	Setpoint	Coincidence	Basis
a.	<25%[24%]	2/4	protection for power excursions beginning from low power during a start up
b.	variable	2/3	protection against DNB
c.	variable	2/3	protection against exceeding Linear Power Rating [KW/ft]
d.	>16%	2/3	Protects against loss of feedwater flow accident [or loss of heat sink]
e.	<92%[91%]	2/3	Protects pressurizer safety valves against water relief

1/3 5/6 [-.03] cc 11/10/86

[0.1 for setpoint, 0.1 for coincidence, 0.3 for basis]

REFERENCE
HBR TECHNICAL SPECIFICATIONS 2.3
HBR SD-011 REACTOR PROTECTION SYSTEM para 3.
012/000-K4.02[3.9/4.3]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 6.09 (2.50)

a. 1. Refueling water storage tank [0.5]

2. Accumulators [0.5]

3. Containment vessel sump [0.5]
[or other reasonable sources]

b. 1. Remove free iodine from the containment vessel atmosphere [0.5]

2. Prevent chloride stress corrosion of stainless steel piping and components in the containment vessel following SI initiation [0.5]

[partial credit will be given for other appropriately phrased answers such as control ph in containment]

REFERENCE
HBR SD-002 SAFETY INJECTION para 1. & 2.
006/030-K4.02[3.4/3.8]
026/020-K4.01[2.8/3.2]

ANSWER 6.10 (1.00)

The amount of water needed for at least 2 hours operation at hot standby [1.0]

REFERENCE
HBR TECHNICAL SPECIFICATIONS page 3.4-3
061/000-K4.01[3.9/4.2]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 6.11 (2.00)

a. 1. steam flow limiting devices in the S/G outlet nozzle chokes steam flow should a steam line break [0.5]

2. each steam line contains a venturi for flow instrumentation which will provide a resistance to steam flow should a rupture occur downstream [0.5]

b. closing solenoid valve energizes [0.25]

air pressure admitted to the upper volume of the double acting air cylinder [0.25]

open air is vented from the lower volume [0.25]

valve closes with a spring assist [0.25]

REFERENCE
HBR SD-025 pages 1, 2a, 9
039/000-K1.01[3.1/3.2]

ANSWER 6.12 (1.50)

charging pumps slowdown [0.25]
pressurizer level decreases .15 [0.25]
letdown isolates .15 Back up heaters on .2 [0.25]
pressurizer heaters deenergize cc 11/10/86 [0.25]

level would oscillate [increase and decrease] around the setpoint [0.25]

reactor trips on low RCS pressure [or over temperature delta T] [0.25]

REFERENCE
HBR SD-001 page 34
HBR SD-021 pages 27 & 28
000/028-EA2.02[3.4/3.8]
016/000-K1.02[3.4/3.3]
-K4.03[2.8/2.9]
-A2.01[3.0/3.1]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 6.13 (2.50)

a. 1. The surge tank relief is sized to relieve maximum flow from a ruptured RCP Thermal BARRIER Cooling Coil. [0.5]

2. The relief valve downstream from the excess letdown heat exchanger is sized to relieve the volumetric expansion occurring if the heat exchanger shell side is isolated when cool and high temperature coolant flows through the tube side [0.5]

b. 1. CCW Surge Tank High Level Alarm [CCW surge tank level increase]
2. CCW pump suction header radiation monitor annunciator
3. CCW valve 626 [CCW return] goes shut [any 2, 0.75 each]

REFERENCE
HBR SD-013 COMPONENT COOLING para 1.
000/026-EA2.01[2.9/3.5]

ANSWER 6.14 (2.25)

a. Ensures that secondary system pressure will be limited to within its design pressure during the most severe transient [loss of load] [0.5]

[If give answer of "maintain Tave in proper limits" then give partial credit of 0.25]

b. Minimize positive reactivity effects of RCS cooldown associated with the rupture [0.5]

[If give answer of "prevent more than 1 steam generator blowing down" then give partial credit of 0.25]

c. 1. High steam flow coincident with low steam line pressure [0.375]

2. High steam flow coincident with low Tave [0.375]

3. High-High containment pressure [0.25]

4. Manual actuation [0.25]

REFERENCE
HBR TECHNICAL SPECIFICATIONS 3.4 & 4.7
039/000-K6.01[2.1/2.4]
-K4.05[3.7/3.7]
000/040-SG5[3.2/4.1]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 7.01 (1.00)

1. unusual event [0.25]

2. alert [0.25]

3. site emergency [0.25]

4. general emergency [0.25]

REFERENCE
HBR PEP-101 para 2.1.1
PWG-36[2.9/4.7]

ANSWER 7.02 (3.00)

a. 1. PATH-1 [0.5]

2. Critical Safety Function Status Tree [0.5]

b. 1. If RCS pressure and RCS hot leg temperatures start to increase [0.5]

2. Pressurizer pressure [0.25]

greater than 2335 psig [0.25]

c. 1. Subcooling Monitor T/Cs [0.5]

2. At least two RCS hot leg temperatures < 350F [0.5]

[< 350F not required for full credit]

REFERENCE
HBR FRP-H.1 page 3
HBR FRP-C.1 page 9
000/038-EA2.07[4.4/4.8]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 7.03 (1.00)

Source CHECK the alarming monitor [0.5]

AND VERIFY alarm is valid [0.5]

REFERENCE
HBR TECHNICAL SPECIFICATIONS para 1.2.2 and 1.2.6
HBR AOP-005 para 1.3.1.1
SWG-5[2.9/3.9]

ANSWER 7.04 (1.00)

1. d [0.2]

2. b [0.2]

3. c [0.2]

4. e [0.2]

5. a [0.2]

REFERENCE
HBR OMM-022 page 12
SWG-10[4.1/4.5]

ANSWER 7.05 (.00)

1. PZR PORVs - closed

2. Letdown isolation valves - closed [LCV-460A/460B]

3. Excess letdown isolation valve - closed [CVC-387]

4. Reactor vessel head vent valves - closed
[question deleted - see examination report]

REFERENCE
HBR EPP-1 page 4
SG-10[4.3/4.5]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 7.06 (2.00)

1. Insufficient letdown [0.5]

2. Letdown - charging mismatch [0.5]

3. Load rejection [0.5]

4. Increasing Tave [0.5]

[OTHER REASONABLE ANSWERS WILL BE ACCEPTED]

REFERENCE
HBR APP-003 page 29
000/028-EA2.01[3.4/3.6]
-EA2.02[3.4/3.8]

ANSWER 7.07 (1.00)

a. TRUE [0.5]

b. TRUE [0.5]

REFERENCE
HBR OP-006 page 5
SWG-3[2.8/3.8]
010/000-K4.03[3.8/4.1]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 7.08 (2.00)

1. Manually insert control rods [0.25]
2. Verify all turbine valves have closed [0.25]

   and that turbine speed is decreasing [0.25]
3. Verify turbine casing drain valves DV-1 through DV-7 are open [0.25]
4. Verify turbine AC lube oil pump [0.25]

   and bearing lift pump are running [0.25]
5. Verify plant auxiliaries shift to start-up transformer [0.25]

   and generator lockout occurs approximately 1 minute after generator trip [0.25]

RFFERENCE
HBR AOP-007 page 4
045/050-A1.01[3.8/4.1]
-A1.02[3.3/3.7]
-SG12[2.4/2.4]

ANSWER 7.09 (2.50)

1 - b. [0.5]

2.- c. [0.5]

3.- c. [0.5]

4. f. [0.5]

5.- d. [0.5]

REFERENCE
HBR PLS-2 pages 1&2
SWG-7[3.5/4.0]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 7.10 (2.00)

1. Place the RCS Makeup Mode Selector Switch in the BORATE postion [0.5]

2. Set the Boric Acid Flow Controller, FCV-113A, dial setpoint to the desired quantity of boric acid [0.5]

3. Set the Boric Acid Totalizer, YIC-113, to the desired quantity of boric acid [0.5]

4. Place the RCS Makeup System Start/Stop switch in the START position [0.5]

[paraphrased steps will be accepted]

REFERENCE
HBR OP-301 Para 6.0
004/010-A4.03[3.9/3.7]

ANSWER 7.11 (1.00)

a. 1 DPM [0.5]

b. 500 pcm [0.5]

REFERENCE
HBR GP-003 para 5.0
001/050-SG12[3.7/3.7]

ANSWER 7.12 (2.00)

1. Turbine Stop Valves [0.5]

2. Govenor Valves [0.5]

3. Reheat Stop Valves [0.5]

4. Reheat Intercept Valves [0.5]

REFERENCE
HBR GP-005 para 5.0
045/050-SG12[2.4/2.5]

ANSWERS -- ROBINSON -86/09/00-KEITH PARKINSON

ANSWER 7.13 (1.00)

Cooldown and depressurize the RCS [0.5]

or heatup the RCS above 350 F [0.5]

REFERENCE
HBR OP-006 page 5
HBR TECHNICAL SPECIFICATIONS page 3.1-4
010/000-SG8[3.6/4.3]

ANSWER 7.14 (1.50)

to safely bring the Reactor Plant to a hot shutdown condition after a severe fire [0.75]

when the use of EOPs is precluded [0.75]

REFERENCE
HBR OMM-012 page 12
000/068-EK3.18[4.2/4.5]

ANSWER 7.15 (2.00)

a. a fourth start can not be attempted until the motor has cooled by standing idle for at least one hour. [0.5]

b. 2 minutes [0.5]

c. 50 SECONDS [0.5]

d. Defeat the degraded grid voltage protection [0.5]

REFERENCE
HBR OP-101 pages 9-11
003/000-A4.06[2.9/2.9]
-K6.14[2.6/2.9]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 8.01 (2.00)

a. When the reactor is subcritical [0.5]

and Tave is equal to or < 200 F [0.5]

b. Any operation involving movement of core components when there is fuel in the containment vessel [0.5]

and the pressure vessel head is unbolted or removed [0.5]

REFERENCE
HBR TECHNICAL SPECIFICATIONS para 1.2.2 and 1.2.6
HBR AOP-005 para 1.3.1.1
SWG-5[2.9/3.9]

ANSWER 8.02 (1.50)

1. Rod can't be moved by its drive mechanism [0.5]

2. Rod misaligned by > 15 inches with its bank [0.5]

3. Rod drop time not met [0.5]

REFERENCE
HBR TECHNICAL SPECIFICATION 3.10.6.1
000/001-EK3.02[3.2/4.3

ANSWER 8.03 (1.00)

Reduce the consequences of a fuel handling accident [0.5]

by providing for the decay of short-lived fission products [0.25]

and the reduction of fission gas inventory in any potentially failed fuel. [0.25]

REFERENCE
HBR TECHNICAL SPECIFICATIONS page 3.8-5
SG-8[2.9/4.0]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 8.08 (2.00)

a. post a continuous fire watch until the CO2 system is restored to operable condition [reasonable wording accepted]. immediately ~~[1.0]~~

cc 11/10/86

b. post a continuous fire watch with backup fire suppression capability [reasonable wording accepted] within one hour ~~[1.0]~~

REFERENCE
HBR TECHNICAL SPECIFICATIONS para 3.14.5
000/067-EA2.15[2.9/3.9
SWG-8[3.5/4.5]
PWG-19[3.4/4.2]

ANSWER 8.09 (2.50)

1. 110KV-4160V startup transformer is in service [0.5]
2. 480V buses E1 & E2 energized [0.5]
3. 4160V buses 2 & 3 energized [0.5]
4. 2 diesel generators operable [0.5]
5. both batteries & the DC distribution system operable [0.5]

REFERENCE
HBR TECHNICAL SPECIFICATIONS para 3.7.1
062/000-SG8[3.4/4.3]
063/000-SG8[3.2/4.1]
064/050-SG8[3.4/4.4]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 8.04 (2.00)

a. Interval requirement not exceeded [0.5]

Eight days does not exceed 1.25 times the specified interval [0.5]

b. Interval requirement exceeded [0.5]

The last 3 consecutive intervals exceed 3.25 times the specified interval [0.5]

REFERENCE
HBR TECHNICAL SPECIFICATION 4.0.1
SWG-1[3.5/3.9]
-8[3.5/4.5]

ANSWER 8.05 (3.00)

a. de-energizing, isolating and clearing a piece of equipment [0.5]
[appropriate answers will be accepted]

b. used to request post maintenance testing for purpose of documenting equipment operability [0.5]

c. Bulk Load Dispatcher [0.5]

d. Shift Foreman or designated alternate [0.5]

e. no [0.5]

f. the worker's supervisor [0.5]

REFERENCE
HBR OMM-005 para 4.1 & 5.1
PWG-14[3.6/4.0]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 8.06 (1.50)

a. one shift foreman holding a SRO license [0.3]

one control operator holding a RO license [0.3]

one additional shift member [0.3]

b. 14 [0.3]

c. Plant General Manager [0.3]

REFERENCE
HBR TECHNICAL SPECIFICATIONS para 6.2.3
PWG-23[2.8/3.5]

ANSWER 8.07 (2.50)

a. When it is capable of performing its function. [1.0]

b. OPERABLE because [0.5]

1. the normal source is operable and [0.5]

2. all it's redundant systems, subsystems, trains, components and devices are operable [0.5]

[reasonably worded answers accepted]

REFERENCE
HBR TECHNICAL SPECIFICATIONS para 1.3
SWG-5[2.9/3.9]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 8.10 (1.50)

1. If time exists the shift foreman shall consult with another member of plant management prior to approval [0.5]

2. If time does not exist to consult management, the shift foreman approves the deviation prior to performing the protective action. [0.5]

3. the NRC must be notified, via the red phone, if protection action would violate TECHNICAL SPECIFICATIONS. [0.5]

[reasonably worded answers accepted]

REFERENCE
HBR AP-006 para 5.2
PWG-21[3.8/4.1]

ANSWER 8.11 (1.50)

1. The valve is part of a safety-related system [0.75]

2. The valve serves an important function in maintaining plant/system reliability [0.75]

REFERENCE
HBR OMM-001 para 5.19.3
PWG-13[3.7/4.0]

ANSWER 8.12 (1.50)

a. 1&3 [both required, 0.25 each]

b 1&2 [both required, 0.25 each]

c. 1. [0.5]

REFERENCE
HBR DP-004 para 10.5
PWG-15[3.4/3.9]

ANSWERS -- ROBINSON -86/09/30-KEITH PARKINSON

ANSWER 8.13 (2.50)

1. spent resin storage tank [0.5]

2. containment sump [0.5]

   when thimbles are withdrawn [0.5]

3. the areas below the transfer canal [0.5]

   during fuel movement [0.5]

REFERENCE
HBR HPP-001 para 4.1.15
PWG-16[3.4/3.7]
-17[2.9/3.5]