UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA ST., N.W.
ATLANTA, GEORGIA 30323

ENCLOSURE 1

EXAMINATION REPORT - 50-259/OL-88-02

Facility Licensee: Tennessee Valley Authority
6N 38N Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Facility Name: Browns Ferry Nuclear Plant

Facility Docket Nos.: 50-259, 50-260, and 50-296

Facility License Nos.: DPR-33, DPR-52, and DPR-68

Examinations were administered at Browns Ferry Nuclear Plant near Decatur, Alabama.

Chief Examiner: _____ 4/4/89
D. Charles Payne — Date Signed

Approved by: _____ 4/6/89
Kenneth E. Brockman, Chief — Date Signed
Operator Licensing Section 2

SUMMARY

Examinations were administered on December 12-15, 1988.

Written examinations and operating tests were administered to four SRO and ten RO applicants. Three SROs and nine ROs passed these examinations. All others failed.

REPORT DETAILS

1. Facility Employees Contacted:

* J. Hutton, Operations Superintendent
* T. Dexter, Browns Ferry Training
* J. Johnson, Nuclear Training
* A. R. Champion, Operations Training
* E. S. Howard, Operations Training
* T. E. Mayfield, Operations Training

*Attended Exit Meeting

2. Examiners:

* D. C. Payne, RII
C. W. Rapp, RII
M. Daniels, Sonalysts
R. Miller, Sonalysts

* Chief Examiner

3. Pre-Examination Review

During the week of November 28, 1988, members of the examination team and the facility Training and Operations staff reviewed the written examination and simulator scenarios. This review is part of an NRC initiative to improve examination quality and ensure all test items were accurate and concise before examination administration. It should be noted that three post-examination review comments requested additional answer responses be accepted that were originally in the answer key but deleted at the request of the facility pre-reviewers.

4. Exit Meeting:

At the conclusion of the site visit, the Chief Examiner met with representatives of the plant staff to discuss the results of the examinations. There were no generic weaknesses noted during the operating tests.

The examiners made the following observations concerning your training program:

a. Question 4.02 concerning pressure control unit failure in the EHC system, raised confusion in both the candidates and the instructors. The direction in which the procedure states that the pressure control unit fails is exactly opposite of that for which the pressure transmitter fails in order to cause the plant response stated in the

procedure. Apparently Training/Operations may have requested this be changed in the procedure, but it had not been accomplished at the time of the exit. In the procedure (AOI-47-2), it is very confusing/ unclear as to what the "pressure control unit" is.

b. It was noted that some candidates avoided the use of Annunciator Response Procedures. As a result, some diagnostic assistance and follow-up actions were missed which degraded from the candidates' performance. This area should be reviewed for additional emphasis during simulator training.

c. It was noted that communications among the candidates during the simulator tests, with the exception of one team, has shown a marked improvement. This one team's primary difficulty was speaking too softly and not sharing all known information among the rest of the team. The facility is encouraged to continue its efforts in crew communications.

There were procedural items of concern identified during the examination:

1. A note in AOI-85-6, Control Rod Drift Out, allows the operator to bypass step 4.1.2.3 (valve out the HCU) if the control rod does not latch at position 00. However, if the HCU is not valved out, the rod will drift out of the core again.

2. Many procedural changes are being made in the plant in preparation for Unit 2 startup. The candidates had significant difficulty in locating selected administrative procedures due to them being renumbered following revision. Additionally, the revision occasionally moved the procedure to a different procedure group (e.g., from BFSP to SDSP). This difficulty was further complicated by the cross reference index being out of date. The NRC is concerned with the volume of procedural changes, with the training of the operators in these many changes, and with their orderly update in the control areas.

It was noted during the exit meeting that all candidates had participated in the Commission's pilot BWR Generic Fundamentals Examination. However, two candidates elected to retake Section 1/5, as was their option. As a result, point totals for these two candidates will differ from those of their fellow candidates.

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

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

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: BROWNS FERRY

REACTOR TYPE: BWR-GE4

DATE ADMINISTERED: 88/12/12

EXAMINER: NRC REGION II

CANDIDATE: MASTER COPY

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
28.50	26.21	_____	_____	1.	PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
26.50	24.37	_____	_____	2.	PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
27.25	25.06	_____	_____	3.	INSTRUMENTS AND CONTROLS
26.50	24.37	_____	_____	4.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
108.75		_____ Final Grade	_____ %		Totals

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

_____
Candidate's Signature

MASTER COPY

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 (1.00)

MULTIPLE CHOICE

With the reactor critical at 75 on IRM range 4, rod withdrawal is used to increase and stabilize power at 75 on IRM range 6. Reactor recirculation coolant temperature is constant at 190 deg F.

Select the ONE statement that correctly describes the position of the rods and the reason for the rod position, after the power is stabilized on IRM range 6.

a. The rods will be further withdrawn on range 6 than on range 4 because more fuel must be exposed to the available neutrons to maintain the higher power level.

b. The rods will be further withdrawn on range 6 to overcome the power defect.

c. The rod position will be the same since the outward rod motion needed to achieve a given period equals the inward motion needed to return the period to infinity.

d. The rods will be less withdrawn on range 6 due to the increased delayed neutron population associated with the higher power level.

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

QUESTION 1.02 (1.50)

A Refueling Outage has just been completed on Unit 2 and the core has been COMPLETELY loaded with new fuel.

HOW will the Shutdown Margin (Reactivity Margin) at the beginning of the operating cycle (just following the refueling) compare with the Shutdown Margin at the end of the operating cycle?
(LARGER, SMALLER, or the SAME (0.50))
EXPLAIN YOUR CHOICE. (TWO (2) REASONS REQUIRED at 0.50 ea.)

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

QUESTION 1.03 (1.00)

Complete the following statements comparing the start of a centrifugal pump with its discharge valve closed to a start with the discharge valve open. (Assume no recirculation/minimum flow.)

a) The pump motor STARTING current with its discharge valve CLOSED will be (LARGER THAN, SMALLER THAN, OR THE SAME AS) the starting current for a pump start with its discharge valve open.

b) The pump motor RUNNING current with its discharge valve CLOSED will be (LARGER THAN, SMALLER THAN, OR THE SAME AS) the running current for a pump running with its discharge valve open.

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

QUESTION 1.04 (1.00)

EOI-1 Contingency 5, Level/Power Control, requires a reduction in RPV water level in order to reduce reactor power during an ATWS.

How will lowering reactor water level help reduce reactor power?

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

QUESTION 1.05 (1.50)

The reactor is brought critical at 40 on IRM range 2 with the shortest permissible stable positive period allowed by GOI 100-1A, Unit Startup From Cold Shutdown to Power Operations. Heating power is determined to be 40 on range 8 of the IRMs.

****SHOW ALL WORK****

a) CALCULATE the doubling time if the period remains constant? (0.50)

b) CALCULATE how long will it take for power to reach the point of adding heat if the period remains constant? (1.00)

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

QUESTION 1.06 (1.50)

Following an auto initiation of RCIC at a reactor pressure of 800 psig, reactor pressure decreases to 400 psig. The RCIC System is operating as designed and was in the normal standby lineup prior to initiation.

Indicate how EACH of the following parameters will respond (INCREASES, DECREASES, or REMAINS THE SAME) due to the decrease in reactor pressure.

a) RCIC Flow to the Reactor

b) RCIC Pump Discharge Head

c) RCIC Turbine RPM

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

QUESTION 1.07 (1.00)

MULTIPLE CHOICE

Which ONE of the following CORRECTLY describes the behavior of equilibrium Xenon CONCENTRATION over core life? (ASSUME REACTOR POWER CONSTANT AT 100%)

a. Xenon concentration increases because of the increased fuel burnup.

b. Xenon concentration decreases because of the decrease in the fission yield of Xenon.

c. Xenon concentration increases because of the decrease in the delayed neutron fraction.

d. Xenon concentration decreases because of the decrease in thermal flux.

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

QUESTION 1.08 (1.50)

State which coefficient of reactivity would act first to change core reactivity for each of the following events:

a) Loss of extraction steam to feedwater heaters

b) Main turbine trips from 28% reactor power and one BPV fails to open.

c) The operator withdraws a central control rod from 08 to 10 at 50% reactor power.

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

QUESTION 1.09 (2.00)

Unit 2 is operating at 50% rated power when the Main Turbine Generator trips on an electrical fault.

How does EACH of the following parameters initially respond after the Turbine Generator trip? (INCREASES, DECREASES, OR REMAINS THE SAME). EXPLAIN WHY EACH PARAMETER RESPONDS AS IT DOES.

a) Injection temperature of feedwater to the reactor vessel

b) Reactor Water Level

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

QUESTION 1.10 (1.50)

SELECT the appropriate response for each of the following statements concerning Control Rod Worth:

a) Control Rod Worth will (INCREASE/DECREASE) with an INCREASE in the Void Fraction surrounding the rod.

b) Control Rod Worth will (INCREASE/DECREASE) with an INCREASE in moderator temperature.

c) Control Rod Worth will (INCREASE/DECREASE) as the adjacent control rods are withdrawn.

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

QUESTION 1.11 (2.50)

ANSWER the following questions concerning "CRITICAL POWER." (ASSUME the reactor is operating at 100% rated power.)

a) How will EACH of the following conditions affect the Critical Power of a fuel pin? (INCREASES, DECREASES, or REMAINS THE SAME) (ASSUME ALL OTHER VARIABLES REMAIN CONSTANT.) (2.00)

(1) Reactor pressure is INCREASED

(2) The axial power peak is RAISED (i.e., power profile peaks higher in the core)

(3) Coolant flow rate is INCREASED

(4) Feedwater injection temperature to the reactor vessel is INCREASED

b) WHAT is the CAUSE of fuel failure when the "Critical Power" of a fuel pin is exceeded? (0.50)

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

QUESTION 1.12 (2.50)

Following a reactor scram from power, several control rods fail to insert to the full-in position. Within one hour, the Reactor Engineer determines the reactor is shutdown by 0.22% delta K/K.

a. If reactor coolant temperature and control rod positions remain constant during the next hour, will the reactivity by which the reactor is shutdown (INCREASE, DECREASE, or REMAIN THE SAME)? EXPLAIN YOUR CHOICE. (1.00)

b. Fifteen (15) hours after the scram, reactor pressure is decreasing at a rate of 15 psig/hour. EXPLAIN how the reactivity by which the reactor is shutdown changes? (TWO (2) REASONS REQUIRED.) (1.50)

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

QUESTION 1.13 (2.50)

A normal reactor startup is in progress on Unit 1.

a) As K-eff of the reactor increases, DESCRIBE the effect on each of the following parameters for equal reactivity additions. (1.50)

(1) The magnitude of the change in count rate

(2) The initial rate of rise in the count rate

(3) The time it takes to reach a new equilibrium count rate

b) Does the magnitude of the initial source neutron level affect the critical rod position? (YES or NO) EXPLAIN YOUR CHOICE. (1.00)

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

QUESTION 1.14 (3.00)

During operation at 80% power a feedwater train automatically isolates due to high water level in a heater.

State whether EACH of following coefficients of reactivity will add POSITIVE or NEGATIVE reactivity. EXPLAIN YOUR ANSWER.

a) Doppler Coefficient

b) Moderator Temperature Coefficient

c) Void Coefficient

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

QUESTION 1.15 (1.50)

A startup is in progress per GOI-100-1A, Unit Startup From Cold Shutdown to Power Operation. The reactor is operating at 60% power. The operator has just completed starting the third Condensate and Condensate Booster pumps and Reactor Feed pumps A and C are running when Condensate pump C trips due to a motor fault.

STATE whether EACH of the following parameters INCREASES, DECREASES, or REMAINS THE SAME.

a) Condensate pump B flowrate

b) The discharge pressure of the condensate booster pumps

c) Feedwater pump A speed

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

QUESTION 1.16 (3.00)

Complete the following table by indicating HOW EACH of the following conditions will affect AVAILABLE and REQUIRED Net Positive Suction Head for the reactor recirculation pumps. (INCREASES, DECREASES, or REMAINS THE SAME)

CONDITION	AVAILABLE NPSH	REQUIRED NPSH
a) Feedwater injection temperature increases		
b) Reactor pressure increases by 10 psig (Assume reactor power 60% and recirc pump suction temperature constant)		
c) Recirculation pump speed is slowly increased by 10%		

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

QUESTION 2.01 (2.50)

The HPCI (High Pressure Coolant Injection) System has automatically initiated and is taking a suction on the suppression pool.

a) State the FINAL position for EACH of the following HPCI system valves following an automatic ISOLATION signal. (OPEN or CLOSED) (1.00)

   1. Suppression pool suction valve (73-26)

   2. Minimum flow bypass valve to the torus (73-30)

b) What are THREE (3) of the four conditions which could cause a HPCI system ISOLATION? (INCLUDE SETPOINTS) (1.50)

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

QUESTION 2.02 (1.75)

Unit 2 is operating at 100% rated power when a small LOCA occurs. The ADS initiation logic is satisfied and the 120 second timer has initiated.

a) MULTIPLE CHOICE

Which one of the following failures would prevent the automatic initiation of ADS? (1.00)

1. Loss of 250 VDC
2. Core Spray pumps A and B fail to start
3. Loss of drywell control air
4. RHR pumps B and D fail to start

b) What is the BASIS for setting the timer in the ADS initiation logic at 120 seconds. (0.75)

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

QUESTION 2.03 (2.00)

a) What determines the LENGTH of the TIME DELAY in the automatic start circuit of the EECW (Emergency Equipment Cooling Water) pumps? (INCLUDE TIMES)

b) What are FOUR (4) conditions which will AUTOMATICALLY START the RHRSW (Residual Heat Removal Service Water) pumps associated with the EECW system.

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

QUESTION 2.04 (1.50)

Following a reactor transient causing a reactor scram the operator places the mode switch to SHUTDOWN per AOI 100-1, Reactor Scram.

a) Why is the SCRAM SIGNAL generated by placing the mode switch in the SHUTDOWN position automatically BYPASSED after 2 seconds?

b) Why is the operator prevented from resetting the reactor scram signal for 10 seconds after the mode switch is placed into SHUTDOWN?

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

QUESTION 2.05 (2.50)

The operator is conducting a normal reactor startup, when a control rod blade drops out of the core.

a) In order to create a DESIGN BASIS rod drop accident, what are THREE (3) of the five events that would have to occur, aside from the control rod falling out of the core? (1.50)

b) What are the TWO (2) Engineering Safeguard Features (equipment or components) designed to prevent a control rod DROP from inserting an excessive amount of reactivity? (1.00)

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

QUESTION 2.06 (1.50)

What are THREE (3) OPERATIONAL PROBLEMS (OR control rod drive responses) resulting from air in the CRD pressure underpiston OR overpiston lines?

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

QUESTION 2.07 (1.25)

Unit 1 was operating at 100% power when a rupture in the recirculation piping caused reactor water level to decrease rapidly to -114.5 inches on the Emergency Systems Range level indicator on panel 9-5.

What are FIVE (5) of the ~~six~~ Rm system functions which AUTOMATICALLY occur at or before -114.5 inches?

Clarification (during exam): 6 is not applicable. What are 5 ...

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

QUESTION 2.08 (1.75)

While performing the monthly exercise surveillance of the drywell-suppression chamber vacuum breakers on Unit 2, ONE of the vacuum breakers fails to close and is determined to be nearly full open. (The reactor is operating at 85% power.)

a) LIST THREE (3) Control Room INDICATIONS that will aid the operator in determining that this vacuum breaker is STUCK greater than 80% open. (0.75)

b) What ADVERSE EFFECT will this vacuum breaker failure have if a Design Basis LOCA occurs? EXPLAIN WHY. (1.00)

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

QUESTION 2.09 (2.25)

The SGTS (Standby Gas Treatment System) has automatically initiated on a high drywell pressure of 2.45 psig.

a) What are THREE (3) AUTOMATIC ACTIONS which the operator should observe from the Control Room as an indication of proper SGTS operation. (0.75)

b) What are the THREE (3) additional automatic INITIATION SIGNALS for the SGTS? (SETPOINTS NOT REQUIRED.) (1.50)

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

QUESTION 2.10 (1.75)

Diesel Generators A - D have automatically started due to an accident signal on Unit 2.

a) State THREE (3) of the four conditions which must be met for the Diesel Generator OUTPUT breaker to AUTOMATICALLY CLOSE. (0.75)

b) MULTIPLE CHOICE
Which ONE of the following conditions will result in a trip of the Diesel Generator following this automatic startup. (1.00)

1. A low oil pressure of 20 psig
2. Reverse power
3. High differential current
4. A low cooling water pressure of 20 psig

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

QUESTION 2.11 (3.00)

Diesel Generator B is being run for its monthly surveillance and is tied to Shutdown Board B. RHR pump 2B is running to supply Torus cooling. A Loss of Offsite Power (LOP) simultaneously occurs with a LOCA on Unit 2. (ASSUME NO OPERATOR ACTION IS TAKEN.)

a) What is the INITIAL AND FINAL response for each of the following components immediately following the LOCA/LOP? (1.50)

1. Diesel Generator B

2. Diesel Generator B output breaker

3. RHR pump 2B

b) What is the INITIAL AND FINAL response of the following 480 VAC loads immediately following the LOCA/LOP?
(INCLUDE APPLICABLE TIMES) (1.50)

1. RBCCW pump 2A

2. Drywell Blower A4 on Unit 2

3. Control air compressor B

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

QUESTION 2.12 (1.75)

Each of the Main Steam Lines contains a large venturi located between the reactor pressure vessel and the inboard MSIVs.

a) What are THREE (3) of the four SIGNAL INPUTS derived from this venturi? (0.75)

b) What are TWO (2) of the three DESIGN FUNCTIONS (in addition to the signal inputs of part a above) provided by this venturi during a Main Steam Line Rupture OUTSIDE the drywell? (1.00)

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

QUESTION 2.13 (3.00)

Units 1 and 2 are operating at 100% rated power and Unit 3 is in Cold Shutdown when Unit 1 receives a Reactor Zone Ventilation Exhaust Radiation High alarm.

a) What are SIX (6) AUTOMATIC SYSTEM ACTUATIONS that should occur on Unit 1?

b) State the THREE (3) CONDITIONS which will satisfy the TRIP LOGIC of the Reactor Zone Ventilation Exhaust Radiation System.

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

QUESTION 3.01 (2.00)

The operator is withdrawing control rods for a normal reactor startup. The SRM detectors are fully inserted into the core. The operator begins to withdraw the SRM detectors and a Rod Withdrawal Block alarm annunciates.

a) What are the TWO (2) CONDITIONS which must exist to initiate the control rod withdrawal block, due to withdrawal of the SRM detectors?

b) What are the TWO (2) CONDITIONS which will bypass ALL of the control rod withdrawal BLOCKS initiated by the SRMs?

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

QUESTION 3.02 (2.00)

A reactor shutdown is in progress and the operator is inserting control rods. IRM B is reading 11 on range 7.

a) State the response of the plant, when the operator places the IRM B range switch to range 6. (rod block, half scram, full scram, or no action.)
EXPLAIN THE PLANT'S RESPONSE.

b) As reactor power is reduced, IRM E indication decreases to a reading of 3 on range 1. What is the response of the plant? (rod block, half scram, full scram, or no action.)
EXPLAIN THE PLANT'S RESPONSE.

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

QUESTION 3.03 (3.00)

Unit 1 is operating at 40% of rated power and the operator is increasing reactor power by withdrawing control rods.

a) How is the 9-5 panel INDICATION for the following affected when the operator selects an edge rod for withdrawal? (1.50)

1. RBM recorders

2. Meters in the four rod display

3. Detector bypass lights for meters in the four rod display

b) The RBM system is designed with a gain change circuit which can increase the LPRM averaging circuit output such that the RBM sees a HIGHER local power around the selected control rod.

1. How does the RBM gain change circuit determine how much to increase the averaging circuit output? (1.00)

2. State ONE (1) of the two reasons for increasing the gain of the RBM channel. (0.50)

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

QUESTION 3.04 (2.75)

Answer the following questions concerning the RMCS (Reactor Manual Control System).

a) How does control rod insertion using the Emergency In control switch differ from that of the normal rod movement switch? (0.50)

b) State the TWO (2) control rod blocks which will prevent the insertion of rods using the "Emergency In" control switch. (1.00)

c) FOUR indicating lights are located above the CRD control switch.

1. The WHITE light "ON" usually indicates that no rod blocks are present to prevent the movement of a control rod. What is the one (1) rod block which will not be indicated by this light? (0.50)

2. What is indicated when each of the following lights is "ON" (0.75)

(a) Red light

(b) Green light

(c) Amber light

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

QUESTION 3.05 (1.25)

MATCHING

Select the correct purpose from Column 2 for each of the reactor scrams listed in Column 1.

(Each scram in Column 1 has only ONE answer; however, Column 2 choices may be used MORE than once or NOT AT ALL.)

COLUMN 1		COLUMN 2	
a)	APRM High Flux Scram	(1)	Scrams the reactor when the core is in danger of inadequate cooling.
b)	Main Steam Isolation Valves Not Full Open Scram	(2)	Scrams the reactor to limit the fission products released from the fuel.
c)	Reactor Low Water Level Scram	(3)	Scrams the reactor due to the anticipation of the rapid pressure and neutron flux increase
d)	Low Air Header Pressure Scram	(4)	Scrams the reactor to protect the fuel cladding against high heat generation rates.
e)	Generator-Load Reject Scram	(5)	Scrams the reactor before rods begin drifting into the core and before the scram discharge volume is filled.

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

QUESTION 3.06 (2.00)

Complete the following table by providing the requested information concerning the RPV water level instrumentation.

INSTRUMENT	REFERENCED ZERO	METHOD OF TEMPERATURE COMPENSATION	CALIBRATION CONDITIONS
Normal Control Range		(a)	(b)
Emergency System Range	(c)	(d)	
Shutdown Vessel Flooding Range	(e)		(f)
Post Accident Flooding Range	(g)	(h)	

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

QUESTION 3.07 (1.00)

A Reactor Shutdown is in progress. The reactor is at 40% power and the operator is inserting control rods to reduce power. Answer the following questions concerning the RWM (Rod Worth Minimizer).

a) State the RESPONSE of the RWM SYSTEM (including indications) when the Low Power Alarm is received.

b) State the power level at which the red "Auto Light" on the RWM Operator Display Panel will extinguish.

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

QUESTION 3.08 (2.00)

a) How do the Backup Scram Valves respond to a trip on RPS Channel A? (Both valves open, Backup scram valve A opens, Backup scram valve B opens, Neither Backup Scram valve opens.) (0.50)

b) What is the INITIAL response of the following valves if Backup Scram Valve B is inadvertently opened during testing? (OPEN, CLOSE, REMAIN THE SAME) (1.50)

1. Scram pilot solenoid valves

2. Inboard Scram Discharge Volume drain valves

3. Scram inlet valves

General clarification (during exam):
Part b) is seperate from part a).

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

QUESTION 3.09 (2.00)

A reactor scram has just occurred.

a) If the operator selects a rod, using the rod select pushbutton on panel 9-5, WHY will the Four Rod Group display not indicate any rod positions? (0.50)

b) If the reactor scram cannot be reset, WHEN will the Four Rod Group Display begin indicating rod positions? (0.50)

c) What are TWO (2) METHODS that the operator can use to determine that ALL control rods are fully inserted into the core? (1.00)

(No Four Rod Display Information)

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

QUESTION 3.10 (1.00)

Unit 3 is operating at 100% rated power and recirculation flow when seal number 2 FAILS on reactor recirculation pump B.
FIGURE 3 IS ATTACHED FOR REFERENCE.

a) What are the TWO (2) recirculation system INDICATION(S)/ALARM(S) which the operator would use in the control room to determine that seal number 2 has failed?

b) What are TWO (2) recirculation system INDICATION(S)/ALARM(S) which the operator would use in the control room to verify that seal number 1 is fully functional?

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

QUESTION 3.11 (1.75)

A reactor scram has been initiated but control rods have failed to insert fully into the core. The Control Room Supervisor has directed the initiation of SLC (Standby Liquid Control). When the operator takes the SLC handswitch to the "Start Pump A" position, the squib valves fail to open. (ASSUME all other SLC components operate properly.)

a) What are FIVE (5) Control Room INDICATIONS (ALARMS) available to the operator for determining that the squib valves have failed to open? (1.25)

b) What are TWO (2) Control Room INDICATIONS available to the operator to verify that SLC pump A has started and is running? (0.50)

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

QUESTION 3.12 (1.00)

MULTIPLE CHOICE

Answer the following question concerning the operation of the Diesel Generator controls.

a) State the Diesel Generator operating condition which requires the the "Operational Mode Switch" to be placed to the UNITS IN PARALLEL position.

b) Two (2) CONDITIONS will automatically place the Diesel Generator into the "Single Unit Mode" of operation without lighting the indicator above the Single Unit position of the "Operational Mode Switch". What are these TWO (2) CONDITIONS.

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

QUESTION 3.13 (1.50)

A Unit 2 startup is in progress. The reactor is operating at 15% power when a Main Steam Line High Radiation condition causes the Unit 2 MSIVs to automatically close.

a) What are FOUR (4) of the five additional AUTOMATIC ACTIONS initiated by the Main Steam Line High Radiation condition? (1.00)

b) Why is the minimum closing time for the MSIVs limited to 3 seconds? (0.50)

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

QUESTION 3.14 (1.00)

MULTIPLE CHOICE

Which ONE of the following signals from the Post-Treatment Radiation Monitoring System will initiate an AUTOMATIC ISOLATION of the Off-Gas Discharge to the main stack (FCV-66-28)?

a. High trip in channel B

b. High-High-High trip in Channel A

c. High trip in Channel A and Downscale trip in Channel B

d. Downscale trip in Channel A and High-High-High trip in Channel B

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

QUESTION 3.15 (3.00)

The Unit 1 operator is running RCIC (Reactor Core Isolation Cooling) in the test mode (CST to CST) for surveillance testing.

a) What is the RCIC system RESPONSE to an automatic initiation signal. (TWO (2) actions required.)

b) 1. State the RESPONSE of the RCIC system, if the RCIC turbine trips on electrical (110%) overspeed TWO (2) minutes after the automatic initiation signal. (TWO (2) actions required.)

2. Will the RCIC turbine automatically restart when the electrical overspeed condition has cleared? (YES or NO)
EXPLAIN why RCIC WILL or WILL NOT restart when the electrical overspeed condition has cleared.

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

QUESTION 4.01 (1.50)

A reactor plant startup is in progress on Unit 2 per GOI-100-1A, Unit Startup from Cold Shutdown to Power Operation. Reactor power is on IRM range 8, increasing, and reactor pressure is 500 psig, increasing. Both Reactor Feed Pump Turbines (RFPTs) are on the turning gear per OI-3, Reactor Feedwater System.

a) Per OI-3 and GOI-100-1A, WHY is it preferable to wait until reactor pressure is greater than or equal to 750 psig before placing a RFPT into service?

b) Which system(s) is(are) used to maintain reactor water level until 750 psig is reached? (INCLUDE INJECTION AND REJECTION PATH.)

c) After ONE RFPT is placed into service, WHY should the operator stabilize the reactor feedwater flow rate to the reactor vessel during low power operations, per GOI-100-1A?

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

QUESTION 4.02 (1.50)

The Unit 2 plant is operating at 8% rated power with the Reactor Mode Switch in STARTUP when a failure of the controlling reactor pressure control unit occurs.
Answer the following questions in accordance with AOI-47-2, Reactor Pressure Control Unit Failure.

a) State the AUTOMATIC ACTION which will occur if the reactor pressure control unit fails UPSCALE. (0.50)

b) State TWO (2) IMMEDIATE operator actions, aside from verification of the automatic actions, which the operator must perform if the reactor pressure control unit fails DOWNSCALE. (1.00)

General Clarification (during exam):
a) pressure control unit sends a signal to CVs calling for a higher reactor pressure. (Signal to CVs is demanding higher Rx pressure.)

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

QUESTION 4.03 (1.50)

Unit 2 is operating at 25% rated power when a turbine trip occurs. The operator is directed to immediately verify the automatic actions listed in AOI-47-1, Unplanned Turbine Trip.

State SIX (6) of the ten AUTOMATIC ACTIONS that must be verified.

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

QUESTION 4.04 (1.50)

OI-65, Standby Gas Treatment System, requires Unit 2 and 3 stack dilution fans to be in operation if the Unit 1, 2, or 3 reactor plants are in operation.

a) Why does OI-65 require the dilution fans to be in operation? (0.50)

b) List FOUR (4) SYSTEMS/COMPONENTS in operation which would require the Unit 2 and 3 dilution fans to be in operation. (1.00)

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

QUESTION 4.05 (3.00)

Unit 2 is operating at 80% rated power when reactor recirculation pump B trips. AOI-68-1, Recirculation Pump Trip, directs the operator to close the tripped recirculation pump discharge valve and then reopen it after 5 minutes.
After 4 hours of one pump operation, the operator is ready to restart recirculation pump B per OI-68, Recirculation System.

a) Why is the operator directed to close recirculation pump B discharge valve for 5 minutes?

b) Why is the operator directed to open recirculation pump B discharge valve after 5 minutes?

c) What is the basis for the requirement that recirculation loop B discharge temperature be within 50deg F of the ~~saturated temperature of the reactor vessel water before restarting Recirculation Pump B?~~ operating recirculation loop?

Kept in

d) What is the basis for the requirement that the speed of recirculation pump A be less than 50% before restarting recirculation pump B?

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

QUESTION 4.06 (1.25)

Unit 2 is operating at 35% rated power with reactor water level control selected to LEVEL B when a Loss of Instrument and Controls Bus A occurs.

a) In accordance with 2-AOI-57-5A, Loss of I&C Bus A, the operator should immediately verify that all automatic actions have occurred, and he should ensure that the Reactor Water Level Selector Switch is in Level A.
How will the plant respond if the operator fails to place the Reactor Water Level Selector Switch in Level A? (0.75)

b) Why does 2-AOI-57-5A caution the operator NOT to manually transfer I&C Bus A to its alternate power supply? BE SPECIFIC. (0.50)

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

QUESTION 4.07 (2.00)

Unit 2 is operating at 75% rated power when a COMPLETE LOSS OF RBCCW (Reactor Building Closed Cooling Water) occurs. 2-AOI-70-1, Loss of RBCCW, requires the operator to verify all automatic actions have occurred.

a) What are TWO (2) of the three AUTOMATIC ACTIONS that the operator should verify per 2-AOI-70-1?

b) What are the TWO (2) IMMEDIATE ACTIONS required by 2-AOI-70-1 if RBCCW flow cannot be restored within 2 minutes?

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

QUESTION 4.08 (1.00)

A reactor startup is in progress on Unit 2. The reactor is adding heat and reactor pressure is 520 psig when the operating CRD pump trips. In accordance with 2-AOI-85-3, CRD System Failure:

What are TWO (2) CONDITIONS which require the operator to initiate a manual scram?

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

QUESTION 4.09 (1.75)

EOI-1, Pressure Control (RC/P), cautions the operator that if a high drywell pressure ECCS initiation signal exists, THEN prevent injection from those Core Spray and LPCI pumps not required to assure adequate core cooling prior to depressurizing below 340 psig.

a) What is the definition of the term "adequate core cooling"? (1.00)

b) List the THREE (3) MECHANISMS (METHODS) of ensuring that "adequate core cooling" exists. (0.75)

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

QUESTION 4.10 (1.00)

SDSP 3.15, Independent Verification, states that there is only one exception to the requirement for independent verification during normal plant operations.

In accordance with SDSP 3.15:

a) State the ONE (1) CONDITION for which the requirement for independent verification may be waived.

b) Who (by title) has the authority to waive the independent verification requirement?

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

QUESTION 4.11 (1.00)

EOI-01 RC/P states that SRVs should be opened in a predetermined sequence.

a) State the purpose for using this sequence.

b) State the possible adverse consequence if SRVs are opened when suppression pool water level is below 5.5 feet.

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

QUESTION 4.12 (1.00)

EXPLAIN the OPERATOR VERIFICATION that is required PRIOR to resetting a Primary CONTAINMENT ISOLATION, per SDSP 12.17, Administrative Controls for Plant Operation?

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

QUESTION 4.13 (1.50)

An operator returns from two days off (Thursday and Friday) and works the following shift hours as a control room operator during a Unit 1 outage:

Saturday - 6 am to 2 pm
Sunday - 6 am to 2 pm
Monday - 6 am to 6 pm
Tuesday - 6 am to 6 pm

** EXCERPTS FROM PROCEDURES SDSP 19.3, STAFFING HOURS, AND **
** PMI 12.12, CONDUCT OF OPERATION, ARE ATTACHED FOR REFERENCE **

a) What is the earliest hour at which the operator can return and reassume the shift on Wednesday as a unit operator?

b) What is the maximum number of hours that this operator can work before 6 pm on Wednesday?

c) The operator works the following hours on Wednesday and Thursday:

Wednesday - 6 am to 2 pm
Thursday - 12 pm to 6 pm

What is the maximum number of hours that the operator can work on Friday? (Between 12:00 am and 11:59 pm.)

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

QUESTION 4.14 (1.50)

Administrative Procedure PMI-12.12, Conduct of Operations, states that an operator may take an action which departs from any Technical Specification during an emergency situation.

a) What are the TWO (2) CONDITIONS, that must be met to depart from Technical Specifications? (1.00)

b) Who (by title) as a MINIMUM must authorize the unit operator to make this departure from Technical Specifications? (0.50)

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

QUESTION 4.15 (2.00)

Answer the following questions concerning the Browns Ferry Guidelines for Valve Operation in accordance with PMI-12.12, Conduct of Operations and OSIL (Operations Section Instructions Letter) Number 47.

a) How is the operator directed to CLOSE a MOTOR OPERATED GATE valve using the MANUAL handwheel? BE SPECIFIC. (1.00)

b) State the only time that the backseat of a MANUAL-OPERATED valve should be used. (Do not include use of the backseat for stem sealing.) (0.50)

c) Why should operation of the Main Steam Isolation Valves be limited to times when there is steam flowing through the line? (0.50)

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

QUESTION 4.16 (1.50)

The Unit 2 reactor is operating at 100% rated power when a failure of the EHC System causes the turbine control valves to fully open. The plant status is as follows:

- The mode switch is in RUN
- Reactor pressure is 775 psig decreasing
- All MSIVs are open
- Reactor Feed pumps (RFPs) have tripped
- Reactor level is 0 inches decreasing
- Reactor power is 50% by APRMs

State the THREE (3) REQUIREMENTS which have been met for entry into EOI-1, Reactor Control.

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

QUESTION 4.17 (1.00)

Answer the following question in accordance with the most limiting dose allowed by Federal or Browns Ferry Administrative Radiation Exposure Limits?

STATE the operator's most restrictive exposure limit and CALCULATE the length of time that an operator can work in an area with a dose rate of 40 mrem/hr. (The Health Physics Supervisor has approved a whole body dose of greater than 250 mrem for this entry if necessary to complete the work.)

The operator's radiation history is as follows:

Quarterly dose	1000 mrem
Annual dose	3.6 Rem
Lifetime dose	60 Rem
Quarterly extremities dose	1100 mrem
Quarterly skin dose	1100 mrem
Radiation History (NRC Form 4)	On File
Age	40 years

** SHOW ALL WORK AND ASSUMPTIONS **

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

QUESTION 4.18 (1.00)

MULTIPLE CHOICE

Which one of the following is correct concerning the Minimum Alternate Flooding Pressure used in EOI-01 C5, Level/Power Control?

a. Once RPV pressure decreases below the Minimum Alternate Flooding Pressure, adequate core cooling is assured.

b. Once RPV pressure decreases below the Minimum Alternate Flooding Pressure, steam flow through the core does not provide adequate core cooling.

c. If there are no SRVs open and pressure remains above the Minimum Alternate Flooding Pressure, sufficient natural circulation flow through the core exists to provide adequate core cooling.

d. If at least 2 SRVs are open and pressure remains above the Minimum Alternate Flooding Pressure, insufficient natural circulation to provide adequate core cooling exists and injection must be reestablished to increase RPV water level.

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

MASTER COPY

ANSWER KEY

BROWNS FERRY

RO EXAM

NRC REGION II

88/12/12

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 1.01 (1.00)

c.

REFERENCE
GE Reactor Theory, pg 7-9,10.
292008K108 (4.1)...K/A VALUE
292008K108 ...(KA'S)

ANSWER 1.02 (1.50)

SDM at the end of the operating cycle will be larger (0.50) due to fission product poisoning (Samarium) (0.50) and fuel depletion (0.50).

REFERENCE
GE Reactor Theory, pg 1-33 and 38.
292002K114(2.6)
292002K114 ...(KA'S)

ANSWER 1.03 (1.00)

a) Smaller than (0.50)

b) Smaller than (0.50)

REFERENCE
GE Heat Transfer and Fluid Flow, pg 6-108.
291004K107(2.8)
291004K107 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 1.04 (1.00)

Decreases the driving head for natural circulation thereby reducing core flow (causing increased voiding/lowering the void boundary lower into the core (1.00)

REFERENCE
EOP Training Supplement
295037EA202(4.1)...K/A VALUE
295037A202 ...(KA'S)

ANSWER 1.05 (1.50)

a) From GOI 100-1, shortest permissible stable period equals 60 sec. (0.25).

Thus Doubling time = T/1.44 (0.15)
= 60/1.44
= 41.7 seconds (0.10)

b) 40 range 2 is equal to 0.04 on range 8
P(0) = 0.04 P(f) = 40 Period = 60 seconds
P(f) = P(0) e ^(t/period) (0.25)
40 = 0.04 e ^(t/60 sec) (0.25)
60 [ln(40/0.04)] = t (0.25)
Time = 414 seconds (+/- 20 sec) (0.25)
(NOTE: Grade method if error in period is carried forward)

REFERENCE
GE Reactor Theory, Chapter 3
292003K108(2.7) 292008K104(3.3)...K/A VALUE
292003K108 292008K104 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 1.06 (1.50)

a) Remains the Same
b) Decreases
c) Decreases

(3 required, 0.50 ea.)

REFERENCE
RCIC Lesson Plan pg 21 and 22.
GE Heat Transfer and Fluid Flow pg 6-96.
217000K502(3.1) 217000K506(2.7)...K/A VALUE
217000K506 217000K505 217000K502 ...(KA'S)

ANSWER 1.07 (1.00)

b.

REFERENCE
GE Reactor Theory Chapter 6.
292006K114(3.1)
292006K114 ...(KA'S)

ANSWER 1.08 (1.50)

a) Moderator coefficient
b) Void coefficient
c) Doppler coefficient

(3 required, 0.50 ea.)

REFERENCE
GE Reactor Theory, Chapter 4
201003K507(3.3) 292003K119(3.1) 292008K121(2.9)
201003K507 292003K119 292008K121 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 1.09 (2.00)

a) Feedwater inlet temperature decreased (0.50), due to the loss of feedwater heating (isolation of extraction steam) (0.50)

b) Reactor water level will decrease (0.50) as steam flow is abruptly interrupted (or due to the shrink caused by the collapse of core voids upon the reactor scram) (0.50).

REFERENCE
Lesson Plan on Transient Analysis Index HO-8.
Objective A.
241000K102(3.9) 241000K103(3.6) 241000K104(3.7) 245000A205(3.6)
245000A206(2.9)
241000K102 241000K103 241000K104 245000A205 245000A206
...(KA'S)

ANSWER 1.10 (1.50)

a) decrease
b) increase
c) increase

(3 required, 0.50 ea.)

REFERENCE
GE Reactor Theory pg 5-9 to 5-16.
292005K109(2.5) 201003K506(2.7)
292005K109 201003K506 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 1.11 (2.50)

a) (1) Decreases
(2) Decreases
(3) Increases
(4) Decreases

(4 required, 0.50 ea.)

b) The loss of nucleate boiling around the fuel cladding (a lack of cooling due to the onset of transition boiling). (0.50)

REFERENCE
GE Heat Transfer and Fluid Flow pg 9-15, 9-26 to 9-30.
293009K120(3.1) 293009K122(2.9) 293009K123(2.8) 293009K124(2.7)
293009K126(2.6) ...K/A VALUE
293009K120 293009K122 293009K123 293009K124 293009K126
...(KA'S)

ANSWER 1.12 (2.50)

a. Increase (0.50) due to Xe build in (0.50)

b. 1. Decrease (0.25) due to the positive reactivity added by the moderator coefficient (Pressure decrease in the saturated system implies that the reactor coolant temperature decreases) (0.50)
2. Decrease (0.25) due to the decay of xenon. (0.50)

REFERENCE
GE Reactor Theory pg 1-33 to 1-40.
292002K110(3.2) 292002K114(2.6) 292004K101(3.2) ...K/A VALUE
292002K110 292002K114 292004K101 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 1.13 (2.50)

a) (1) The magnitude of the change in the count rate becomes larger as Keff increases.

(2) The rate at which the count rate increases becomes larger.

(3) The time it takes to reach a new equilibrium count rate will become longer.

(3 required, 0.50 ea.)

b) No (0.50). The critical control rod position is a function of Keff or reactivity of the reactor and is not a function of the source count rate (0.50).

REFERENCE
GE Reactor Theory pg 3-5 to 3-13.
292003K101(2.9)...K/A VALUE
292003K101 ...(KA'S)

ANSWER 1.14 (3.00)

a) Doppler will mitigate the transient (0.50) because the increase in fuel temperature causes doppler to add negative reactivity. (0.50)

b) Moderator Temperature Coefficient will increase the severity, (0.50) due to increase in core inlet subcooling (decrease in moderator temperature) the moderator will add positive reactivity. (0.50)

c) Void coefficient will increase the severity of the transient (0.50) because of the increase in core inlet subcooling (decrease in moderator temperature) will result in the collapse of voids adding positive reactivity. (0.50)

REFERENCE
GE Reactor Theory Chapter 4.
295014K203(3.3) 295014K204(3.2) 295014K206(3.4)...K/A VALUE
295014K203 295014K204 295014K206 ...(KA'S)

ANSWER 1.15 (1.50)

a) increases (0.50)
b) decreases (0.50)
c) increases (0.50)

REFERENCE
GE Heat Transfer and Fluid Flow Chapter 6.
256000A101(2.9) 256000A201(3.3) 259001A101(3.3) 259001A203(3.6)
...K/A VALUE
256000A101 256000A201 259001A101 259001A203 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 1.16 (3.00)

	CONDITION	AVAILABLE NPSH	REQUIRED NPSH
a)	Feedwater injection temperature increases	Decreases (0.50)	Remains the Same (0.50)
b)	Reactor pressure increases	Increases (0.50)	Remains the Same (0.50)
c)	Recirculation pump speed is slowly increased by 10%	Decreases (0.50)	Increases (0.50)

REFERENCE
GE Heat Transfer and Fluid Flow Chapter 6.
202001K607(3.3) 202001K609(3.4) 293006K110(2.8)...K/A VALUE
202001K607 202001K609 293006K110 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.01 (2.50)

a) 1. Closed
2. Closed

(2 required, 0.50 ea.)

b) 1. Low reactor pressure, 100 PSIG (+/- 10 psig)
2. High HPCI area temperature, 200 deg F (+ 0/- 25 deg F)
3. High HPCI steam line flow, 150% (+/- 15%) (or 90 psid, + 0/- 10 psid)
4. Turbine exhaust inboard disc rupture, 10 psig (+/- 1 psig)

(3 sets required, 0.25 per trip, 0.25 per setpoint)

REFERENCE
LESSON PLAN ON HPCI PG 23 AND 29.
OBJECTIVE B AND E.
206000A210(4.0) 206000K402(3.9)...K/A VALUE
206000A210 206000K402 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.02 (1.75)

a) 1 (1.00)

b) (The 120 second time delay is long enough) so that HPCI has time to start (0.25) and yet not so long that Core Spray and LPCI are unable to adequately cool the fuel (0.25) if HPCI should fail to start. (0.25)

REFERENCE
LESSON PLAN ON ADS PG 5, 6, AND 8.
OBJECTIVE B, D.2, AND F.
218000K403(3.8) 218000K501(3.3) 218000K601(3.9) 218000K604(3.6)
218000K606(3.4) ...K/A VALUE
218000K403 218000K501 218000K601 218000K604 218000K606
...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.03 (2.00)

a) 1. With normal voltage available, 28 second time delay (+/- 3 sec)
2. With diesel generator supplying shutdown board, 14 second delay (+/- 2 sec)

(2 required, 0.25 per condition, 0.25 per time delay)

b) 1. Low RCW header pressure to the control air compressors (30 psig)
2. Low RCW header pressure to the RBCCW heat exchangers (15 psig)
3. Any diesel generator start
4. Any Core Spray pump start
5. Low reactor water level -114.5 inches
6. High drywell pressure 2.45 psig and reactor pressure < 450 psig

NOTE: Also accept Accident Signal as alternate to answers 5 and 6, but dual credit will not be awarded.
(4 required, 0.25 ea.)

REFERENCE
LESSON PLAN ON EECW PG 12 AND 13.
OBJECTIVE D AND E.
295018A101(3.3) 295018K101(3.5) 295018K202(3.4)...K/A VALUE
295018A101 295018K101 295018K202 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.04 (1.50)

a) The mode switch in shutdown scram is bypassed after 2 seconds so that the operator can reset the scram with the mode switch in the shutdown position. (0.75)

b) The operator is prevented from resetting the scram for 10 seconds in order to ensure that all control rods have completed their scram stroke into the reactor before the scram is reset. (0.75)

REFERENCE
LESSON PLAN ON RPS PG 3 AND 15.
OBJECTIVE A AND I.
212000G004(4.2) 212000K408(4.2) 212000K412(3.9)...K/A VALUE
212000G004 212000K408 212000K412 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.05 (2.50)

a) 1. Inadvertent selection of the highest worth out of sequence control rod by the operator.
2. Failure of the rod-to-drive coupling.
3. Sticking of the control rod blade in the reactor core in the fully inserted position.
4. Withdrawal of the control rod drive with failure of the operator to note a lack of neutron monitoring system response.
5. Withdrawal of the control rod drive with failure of the operator to perform the coupling integrity check.

(3 required, 0.50 ea.)

b) 1. RWM
2. RSCS
3. Control Rod Velocity Limiter
(2 required, 0.50 ea.)

REFERENCE
LESSON PLAN ON RSCS PG 3 AND 4.
OBJECTIVE A AND B.
201004K501(3.6) 201004G004(3.7) 201006K105(3.5) 201003K401(2.9)
...K/A VALUE
201004K501 201004G004 201006K105 201003K401 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.06 (1.50)

1. The CRD will fail to notch out (because of a loss of unlatching dp).
2. The CRD will fail to notch in (because sufficient pressure will not be produced to move the rod to the next latched position).
3. The rod will have a long settling time as it settles back to its original position following an insertion signal.
4. The rod may not settle fully.
5. Erratic rod motion/response to control drive signals occurs.

(3 required, 0.50 ea.)

(also accept answers indicating increased CRDM maintenance as ONE answer)

REFERENCE
LESSON PLAN ON CRD HYDRAULICS PG 39.
OBJECTIVE Z.
201001K303(3.1) 201003K101(3.2)...K/A VALUE
201001K303 201003K101 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.07 (1.25)

1. Core Spray initiation
2. PCIS Group I (Main Steam) isolation
3. RHR initiation
4. ADS permissive
5. Emergency Diesel Generators start
6. EECW pumps start

(5 required, 0.25 ea.)

7. HPCI initiation
8. RCIC initiation
9. Recirc pump trip
10. Reactor Scram
11. SGT initiates
12. PCIS Group 2, 3, 6, 8
13. Emerg Pressurization Unit Starts

(Additional Appropriate Answers)

REFERENCE
LESSON PLAN ON PCIS PG 9.
OBJECTIVE E.
LESSON PLAN ON RPV INSTRUMENTATION PG 12 AND 13.
OBJECTIVE F AND J.
LESSON PLAN ON MAIN STEAM.
OBJECTIVE G.
216000K405(3.8) 216000K406(3.8) 223002A102(3.7) 223002K101(3.8)

...K/A VALUE

216000K405 216000K406 223002A102 223002K101 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.08 (1.75)

a) 1. The ~~red~~ green check light will be OFF
2. The red light (>3 deg open) (next to the vacuum breaker hand switch) will be ON and
3. The green light (>80 deg open) (next to the vacuum breaker hand switch) will be OFF
4. D/W to suppression chamber dp low
(3 required, 0.25 ea.)

b) Drywell pressure will increase more and will probably exceed design pressure (the drywell and the torus pressures will equalize, so that each may exceed its design pressure) (0.50) because the steam will flow directly from the drywell to the torus air space, short cycling/defeating the pressure suppression function of the water volume in the torus. (0.50)

REFERENCE
LESSON PLAN ON PRIMARY AND SECONDARY CONTAINMENT SYSTEMS PG 21 AND 22.
OBJECTIVE E AND F.
TECH SPECS BASES ON VACUUM RELIEF PG 4.7-44.
223001A209(3.4) 223001A302(3.4) 223001A303(3.4) 223001K303(3.4)
223001K609(3.4)...K/A VALUE
223001A209 223001A302 223001A303 223001K303 223001K609
...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.09 (2.25)

a) 1. SGTS blowers start
2. SGTS inlet dampers open
3. SGTS filter bank control heaters energize

(3 required, 0.25 ea.)

b) 1. High radiation in the reactor zone exhaust ~~duct~~ (72 mr/hr or <100 mr/hr)
2. High radiation in the refueling zone exhaust ~~duct~~ (67 mr/hr or <100 mr/hr)
3. Low reactor vessel water level (+11 inches/+538 inches above vessel zero)

(3 required, 0.50 ea.)

REFERENCE
LESSON PLAN ON SGT PG 10.
OBJECTIVE D AND G.
0-OI-65 ON SGTS PG 9.
261000A302(3.2) 261000A303(3.0) 261000K401(3.7)...K/A VALUE
261000A302 261000A303 261000K401 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.10 (1.75)

a) 1. Diesel is at rated speed (> 870 rpm)
2. All other supply breakers to the 4160V Shutdown Board are open
3. No supply breaker overcurrent lockout exists
4. An undervoltage condition exists on the 4160V Shutdown Board

(3 required, 0.25 ea.)

b) 3 (1.00)

REFERENCE
LESSON PLAN ON EDGS PG 10 AND 11.
OBJECTIVE E AND F.
264000A206(3.4) 264000K402(4.0) 264000K408(3.8)...K/A VALUE
264000A206 264000K402 264000K408 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.11 (3.00)

a) 1. Diesel Generator B shifts to single unit (0.50) (OR D/G running ready to accept load.)

2. Diesel Generator B breaker trips open (0.25), and then recloses (0.25)

3. RHR pump 2B breaker trips open (load sheds after 5 sec time delay) (0.25), then recloses when the Diesel Generator Breaker closes (or when Shutdown Board is reenergized) (0.25)

b) 1. RBCCW pump 2A trips (0.25) and then receives a start signal (0.125) at 40 sec after the load shed (0.125)

2. Drywell Blower A4 is tripped (and is locked out) (0.50)

3. Control Air compressor B is tripped (on undervoltage) (0.50)

REFERENCE
LESSON PLAN ON EDGS PG 18, 19, AND 20.
OBJECTIVE I.
LESSON PLAN ON RBCCW PG 14.
OBJECTIVE B5 AND B6.
LESSON PLAN ON CONTROL AIR PG 6.
OBJECTIVE A AND B.
262001A203(3.9) 262001A303(3.4) 264000A207(3.5) 264000A209(3.7)
264000A210(3.9) 264000A305(3.4) 264000K405(3.2)...K/A VALUE
262001A203 262001A303 264000A207 264000A209 264000A210
264000A305 264000K405 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.12 (1.75)

a) 1. Steam flow indication
2. Steam flow input to reactor level control system
3. Steam flow into containment isolation system (Group I)
4. RWM

(3 required, 0.25 ea.)

b) 1. Limit flow rate (to 200% of rated)
2. Limit the dp across the core internals
3. Limit the loss of coolant from the reactor vessel

(2 required, 0.50 ea.)

REFERENCE
LESSON PLAN ON MAIN STEAM PG 10 AND 11.
OBJECTIVE C.
239001G007(3.7) 239001K404(3.5) 239001K405(3.1)...K/A VALUE
239001G007 239001K404 239001K405 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 2.13 (3.00)

a) 1. Isolates Reactor Building Ventilation system
2. Starts SGTS
3. Isolates Refueling Zone Ventilation system
4. Starts CREV (Control Room Emergency Ventilation)
5. Isolates drywell air compressor suction valves
6. PCIS Group 6 isolation
7. Isolated drywell vent and purge valves
8. Isolates drywell dp system
9. Isolates Control Room Ventilation
(6 required, 0.25 ea.)

b) 1. ONE channel High level trip OR
2. TWO Downscale trips
3. Any (radiation monitor) mode switch out of operate

(3 required, 0.50 ea.)

REFERENCE
LESSON PLAN ON SGT.
LESSON PLAN ON PROCESS RAD MONITORING SYSTEM PG 16.
OBJECTIVE E.
290001A203(3.4) 290001A204(3.4) 290001A301(3.9) 290001G007(3.8)
290001K104(3.7)...K/A VALUE
290001A203 290001A204 290001A301 290001G007 290001K104
...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.01 (2.00)

a) 1. SRM count rate < 100 cps (0.50)
2. One (or more) IRM range switch(es) below range 3 (0.50)
3. SRM withdrawn
b) 1. All IRM range switches on range 8 or above (0.50)
2. Mode switch in RUN (0.50)

REFERENCE
LESSON PLAN ON SRM SYSTEM PG 18 AND 19.
OBJECTIVE E AND H.
215004A304(3.6) 215004K401(3.7) 215004K406(3.2)...K/A VALUE
215004A304 215004K401 215004K406 ...(KA'S)

ANSWER 3.02 (2.00)

a) Rod block (0.50) IRM B will indicate 110 on range 6, rod block setpoint is 108. (0.50)

b) No action (0.50)
The downscale rod block is bypassed when the IRM range switch is on range 1. (0.50)

REFERENCE
LESSON PLAN ON IRM SYSTEM PG 14, 16, AND FIG. 8.
OBJECTIVE B.4 AND B.5.
215003A304(3.5) 215003A401(3.3) 215003A403(3.6) 215003K401(3.7)
...K/A VALUE
215003A304 215003A401 215003A403 215003K401 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.03 (3.00)

a) 1. recorders drive downscale
2. meters indicate actual LPRM output from LPRMs surrounding that rod
3. all of the detector bypass lights are illuminated

(0.50 ea., 3 required)

b) 1. The RBM system compares the LPRM averaging circuit output (0.25) to the APRM reference power level (0.25) and increases the gain if the averaging circuit output is less than the APRM reference power level (0.25) until the averaging circuit 's output is equal to or greater than the reference APRM signal. (0.25) (OR Gain change circuit increases LPRM average ckt output until it is ≥ the APRM reference power signal)

2. (1) Local power may be significantly lower than core average power, making the rod being withdrawn one of abnormally high worth.

(2) Several of the highest reading LPRMs that normally input to a RBM channel might be bypassed.

(1 required, 0.50 ea.)

REFERENCE
LESSON PLAN ON RBM PG 8 AND 9.
OBJECTIVE C AND D.
215002A301(3.1) 215002A302(3.1) 215002G007(3.8) 215002K105(3.0)
215002K106(3.0)

...K/A VALUE

215002A301 215002A302 215002G007 215002K105 215002K106
...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.04 (2.75)

a) Insertion using the emergency in switch bypasses the rod motion timer and results in a loss of the settle function. (0.50)

b) 1. RWM insert block
2. Any select block

(2 required, 0.50 ea.)

c) 1. RSCS (rod withdraw block) (0.50)

2. (a) Withdraw signal sent to rod movement control valves
(b) Insert signal sent to rod movement control valves
(c) Rod is in settle cycle

(3 required, 0.25 ea.)

REFERENCE
LESSON PLAN ON RMCS PG 12, 13, AND 23.
OBJECTIVE B.1, E, AND J.
201002A302(2.8) 201002A204(3.2) 201002A402(3.5) 201002K406(3.5)
...K/A VALUE
201002A302 201002A204 201002A402 201002K406 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.05 (1.25)

a) (4)
b) (3)
c) (1)
d) (5)
e) (3)

(5 required, 0.25 ea.)

REFERENCE
LESSON PLAN ON RPS PG 6 - 13.
OBJECTIVE E.
212000G007(4.0) 212000K101(3.7) 212000K112(3.4) 212000K114(3.6)
212000K115(3.8) ...K/A VALUE
212000G007 212000K101 212000K112 212000K114 212000K115
...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.06 (2.00)

a) Temperature compensated by a pressure signal
b) Calibrated at normal operating pressure and temperature (Hot)
c) Referenced to instrument zero (528 inches above vessel zero)
d) Temperature compensated via heat clamps between the reference and variable leg
e) Referenced to instrument zero (528 inches above vessel zero)
f) Calibrated for cold plant conditions (<212 deg F, 0 psig)
g) Referenced to Top of Active Fuel (+360 inches above vessel zero)
h) No temperature compensation

(a - h required, 0.25 ea.)

REFERENCE
LESSON PLAN ON RPV PROCESS INSTRUMENTATION PG 5-8.
OBJECTIVE A AND E.
216000K414(3.3) 216000K122(3.6) 216000G007(3.6)...K/A VALUE
216000K414 216000K122 216000G007 ...(KA'S)

ANSWER 3.07 (1.00)

a) The RWM display function will begin operating (or the RWM will begin providing rod sequence information and alarms but will not provide any blocks) (0.50)

b) 35% power (or the LPAP) (0.50)

REFERENCE
LESSON PLAN ON RWM PG 10.
OBJECTIVE E.2 AND E.3.
201006A303(3.1) 201006K407(3.1) 201006K104(3.1) ...K/A VALUE
201006A303 201006K407 201006K104 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.08 (2.00)

a) Neither Backup Scram Valve opens (0.50)

b) 1. Remain the same
2. Close
3. Open

(3 required, 0.50 ea.)

REFERENCE
LESSON PLAN ON CRD HYDRAULICS PG 34 AND 35.
OBJECTIVE F, R, AND W.
201001G007(3.6) 201001K203(3.5) 201001K404(3.6) 201001K406(3.8)
...K/A VALUE
201001G007 201001K203 201001K404 201001K406 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.09 (2.00)

a) The rods will be in the overtravel "IN" position (0.50)

b) When the SDV has filled. (The dp across the CRD piston (Reactor pressure to SDV pressure) no longer exists.) (0.50)

c) 1. The green full in lights on the full core display of panel 9-5 will be illuminated.
2. Mode switch in refuel will illuminate the white light over the rod select power switch.
3. OD-7 computer printout of rod positions would display a rod at any notch position other than overtravel "IN".

(2 required, 0.50 ea.)

REFERENCE
LESSON PLAN ON RMCS OBJECTIVE E.
LESSON PLAN ON CRD HYDRAULICS PG 40.
OBJECTIVE S.
214000A201(3.6) 214000A203(3.6) 214000A301(3.4) 214000A402(3.8)
214000K103(3.3)...K/A VALUE
214000A201 214000A203 214000A301 214000A402 214000K103
...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.10 (1.00)

a) 1. Seal number 2 pressure will decrease
2. RECIRC LOOP B SEAL LEAKAGE FLOW DETECT HI will alarm (0.1 gpm flow switch will alarm high)

(2 required, 0.25 ea.)

b) 1. DWEDS CONTROLLED LEAKAGE not in the alarmed condition (leakage through restricting orifice 2 less than the high alarm setpoint)
2. Seal number 1 pressure constant at reactor pressure

(2 required, 0.25 ea.)

REFERENCE
LESSON PLAN ON RECIRC SYSTEM FIG 3.
OBJECTIVE G.
202001A202(3.7) 202001A210(3.5) 202001K404(3.0)...K/A VALUE
202001A202 202001A210 202001K404 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.11 (1.75)

a) 1. Squib valve amber hold lights remain energized
2. The SLC Loss of Continuity alarm does NOT annunciate
3. Reactor power is NOT decreasing (on APRMs)
4. SLC tank level is NOT decreasing
5. The white (Flow) light above the SLC handswitch DOES NOT illuminate
6. The SLC Injection Flow alarm DOES NOT annunciate
7. SLC pump discharge pressure at relief valve setpoint (1425 psig)
8. SLC continuity meter indicates trickle current flow.
(5 required, 0.25 ea.)

b) 1. The pump A red running light illuminates
2. Pressure is indicated on the SLC pump discharge pressure gage

(2 required, 0.25 ea.)

REFERENCE
2-OI-63 ON SLC PG 7 AND 8.
OBJECTIVE NONE
211000A202(3.6) 211000A301(3.5) 211000A302(3.9) 211000A303(3.8)
211000A304(4.3) 211000A305(4.1) 211000A307(3.7) 211000A308(4.2)

...K/A VALUE

211000A202	211000A301	211000A302	211000A303	211000A304
211000A305	211000A307	211000A308	...(KA'S)	

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.12 (1.00)

a) When two Diesel Generators are to be tied together. (0.50)

b) 1. Diesel Generator fast start (Accept Manual fast start, Accident Signal fast start, or Undervoltage fast start as alternate condition)
2. Loss of Diesel Generator DC control power
(Accept 3 fast starts as independent answers.)
(2 required, 0.25 ea.)

REFERENCE
LESSON PLAN ON EDGS PG 14 AND 14A.
OBJECTIVE G AND H.
264000A403(3.2) 264000A205(3.6) 264000K407(3.3) 264000K408(3.8)

...K/A VALUE

264000A403 264000A205 264000K407 264000K408 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.13 (1.50)

a) 1. Reactor scram
2. Group I isolation of Main Steam Line drain valves
3. Mechanical vacuum pump trip
4. Mechanical vacuum pump suction valve closure
5. Offgas sample vial box suction valves close
6. Reactor sample valves
(4 required, 0.25 ea.)

b) The MSIV closure must be slow enough to minimize the severity of the pressure transient on the RPV. (0.50)

REFERENCE
LESSON PLAN ON MAIN STEAM PG 13 AND 21.
OBJECTIVE D AND F.
LESSON PLAN ON PROCESS RAD MONITORING PG 6 AND 7.
OBJECTIVE A.
239001A205(3.9) 239001G007(3.7)...K/A VALUE
239001A205 239001G007 ...(KA'S)

ANSWER 3.14 (1.00)

d.

REFERENCE
LESSON PLAN ON PROCESS RAD MONITORING SYSTEM PG 9.
OBJECTIVE C.
272000G007(3.5) 272000K403(3.6)...K/A VALUE
272000G007 272000K403 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 3.15 (3.00)

a) 1. Injection valve opens (FCV-71-37)
2. Test return to CST (FCV-71-39) closes

(2 required, 0.50 ea.)

b) ~~1.~~ Trip and throttle valve closes (71-9)
~~2.~~ The minimum flow valve closes (71-34)

(2 required, 0.50 ea.)

~~No~~ 2. No (0.50) because the turbine trip and throttle valve must be run closed and then opened using the control room handswitch (0.50).

REFERENCE
LESSON PLAN ON RCIC PG 17, 18, AND 20.
OBJECTIVE 5C AND 5F.
217000A201(3.8) 217000A202(3.8) 217000A203(3.4) 217000A402(3.9)
217000K404(3.0)...K/A VALUE
217000A201 217000A202 217000A203 217000A402 217000K404
...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 4.01 (1.50)

a) Improved RFPT governor control functions are obtainable (0.50)

b) CRD for injection (0.25) and RWCU for rejection (0.25)

c) The feedwater flow rate should be stabilized to minimize the thermal duty on the feedwater nozzles. (0.50)

REFERENCE
OI-3 PG 2A AND 3.
OBJECTIVE C AND G.
GOI-100-1A PG 8 AND 48.
259001G010(3.2)...K/A VALUE
259001G010 ...(KA'S)

ANSWER 4.02 (1.50)

a) The backup reactor pressure control unit takes control (controlling reactor pressure approximately 10 psig higher than before). (0.50)

b) 1. Decrease the maximum combined flow limit potentiometer setting (0.25) until reactor pressure stabilizes. (0.25)
2. (If unable to stabilize reactor pressure), manually scram the reactor and
3. (If unable to stabilize reactor pressure) close the MSIVs

(2 required, 0.50 ea., partial credit as indicated)

REFERENCE
AOI-47-2 PG 2 AND 3.
245000A207(3.8) 245000G014(3.5)...K/A VALUE
245000A207 245000G014 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 4.03 (1.50)

1. Turbine stop valves close
2. Turbine control valves close
3. Turbine combined intermediate valves close } OR ALL VALVES CLOSED
4. Extraction non-return valves close
5. Turbine bypass valves open to maintain reactor pressure
6. Generator air circuit breaker opens
7. Exciter field breaker opens
8. Generator load set runs back to minimum
9. Generator voltage regulator transfers to manual
10. Recorder for control valve position transfers to turbine speed (2-XR-47-16)

(6 required, 0.25 ea.)

REFERENCE
AOI-47-1 PG 1 AND 2.
245000A201(3.7) 245000G014(3.5)...K/A VALUE
245000A201 245000G014 ...(KA'S)

ANSWER 4.04 (1.50)

a) (Operation of the Unit 2 and 3 stack dilution fans) prevents any backflow of radioactive materials into the discharge duct of an idle SGT train. (0.50)

b) 1. Any train of SGT in operation
2. Mechanical vacuum pump in operation
3. Steam packing exhauster in service
4. Offgas system in operation
5. Steam Jet Air Ejectors

6. HPCI in operation
7. D/W purge in progress

NOTE: Appropriate additional answers will be accepted.
(4 required, 0.25 ea.)

REFERENCE
OI-55 PG 4.
OBJECTIVE A.
261000GD10(3.1) 261000K107(3.1)...K/A VALUE
261000G010 261000K107 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 4.05 (3.00)

a) The discharge valve is closed to prevent the reverse rotation of the tripped recirculation pump. (0.75)

b) The discharge valve is opened after 5 minutes to maintain the idle loop temperature (prevent idle loop cooldown). (0.75)

c) The 150deg F dT ~~reduces the positive reactivity added by the idle loop startup (to an acceptably low value).~~ assures that the changes in the coolant temperature at the reactor vessel nozzles and bottom head region are acceptable. (0.75)

d) Less than 50% speed in the operating loop prevents excessive vibration of the jet pump risers (when going from one-pump to two-pump operation) (0.75)

REFERENCE
AOI-68-1 PG 2 AND 4.
OI-68 PG 5.
OBJECTIVE F.
TECH SPECS BASIS ~~3.6.F/4.6.F PG 32~~. 3.6.A/4.6.A
202001G006(3.0) 202001G010(3.5)...K/A VALUE
202001G006 202001G010 ...(KA'S)

ANSWER 4.06 (1.25)

a) Reactor feed pumps will increase feed flow (0.25) until a turbine (RFPTs and main turbine) trip occurs (0.25) causing a reactor scram (power > 30%). (0.25)

b) I&C Bus A should not be manually transferred to its alternate power supply to prevent overloading Unit 3 I&C Transformer. (0.50)

REFERENCE
2-AOI-57-5A PG 1 - 4.
295003A103(4.4) 295003A202(4.2) 295003A204(3.5) 295003K301(3.3)

			...K/A VALUE	
295003A103	295003A202	295003A204	295003K301	...(KA'S)

ANSWER 4.07 (2.00)

a) 1. RBCCW sectionalizing valve (FCV-70-48) closes
2. RWCU pumps trip
3. RWCU system isolates

(2 required, 0.50 ea.)

b) 1. Trip both reactor recirc pumps
2. Scram the reactor

(2 required, 0.50 ea.)

REFERENCE
2-AOI-70-1 PG 2.
2-AOI-64-6 PG 2.
295012G010(3.8) 295012G011(4.1) 295018G007(3.2) 295018G010(3.4)
295018G011(3.8) 295018K101(3.5) 295018K303(3.1) 295028G010(3.9)
295028G011(4.2)

			...K/A VALUE	
295012G010	295012G011	295018G007	295018G010	295018G011
295018K101	295018K303	295028G010	295028G011	...(KA'S)

ANSWER 4.08 (1.00)

1. The backup CRD pump cannot be started
2. The charging water pressure cannot be maintained above 1410 psig.
3. Two control rod accumulator lights (on the Full Core Display are illuminated due to low pressure).

(2 required, 0.50 ea.)

REFERENCE
2-AOI-85-3 PG 2.
295022G007(3.1) 295022G010(3.7)...K/A VALUE
295022G007 295022G010 ...(KA'S)

ANSWER 4.09 (1.75)

a) Adequate Core Cooling: heat removal from the reactor is sufficient to restore and maintain peak fuel cladding temperature at or below 2200 deg F. (1.00)

b) 1. Maintain level above TAF (Core Submergence)
2. Core Cooling without level restoration (Spray Cooling or Contingency 7)
3. Steam Cooling (Contingency 3)

(3 required, 0.25 ea.)

REFERENCE
LESSON PLAN ON EOIS PG 7.
OBJECTIVE 4 AND 5.
EOI-1 RC/P PG 1.
295031K101(4.6) 295031K302(4.4) 295031K304(4.0)...K/A VALUE
295031K101 295031K302 295031K304 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 4.10 (1.00)

a) Excessive (or significant) exposure (> 50 mrem) to radiation (0.50)

b) Shift Operating Supervisor (or Assistant SOS) (0.50)

REFERENCE
OBJECTIVE A OF BF 3.15.
BF 3.15 PG 5.
294001K102(3.9)...K/A VALUE
294001K102 ...(KA'S)

ANSWER 4.11 (1.00)

a) To distribute heat evenly in the suppression pool. (0.50)

b) (Steam would not be condensed) and rapidly pressurize the containment. (0.50)

REFERENCE
BSEP: EOP-01-UG
14C, LO# 8.
BFNP: OPL155.001
239002A108(3.8) 239002G009(3.9) 239002G010(3.4) 239002K107(3.6)
239002K404(3.4) ...K/A (K/A VALUE)
239002A108 239002G009 239002G010 239002K107 239002K404
...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 4.12 (1.00)

(Prior to resetting a primary containment isolation,) the operator must assure that an evaluation ~~(0.50)~~ has been made to ensure that inadvertent transfer of significant amounts of containment fluids will not occur. ~~(0.50)~~ (1.00)
(Also Accept: leak isolated ~~(0.34)~~ with the cause known and corrected ~~(0.33)~~ and permission obtained from the SOS ~~(0.33)~~.)

REFERENCE
OBJECTIVE A OF BF 12.17.
BF 12.17 PG 2.
223002G001(3.9)...K/A VALUE
223002G001 ...(KA'S)

ANSWER 4.13 (1.50)

a) ~~2~~ 6 am (0.50) (requirement for an 8 hour break between shifts)

b) 12 hr (0.50) (requirement limiting the maximum number of hours worked to 24 in a 48 hour period)

c) 16 hr (0.50) (requirement limiting the maximum number of hours worked to 16 in a 24 hour period)

REFERENCE
SDSP 19.23 PG 2.
PMI 12.12 PG 7.
294001A109(3.3)...K/A VALUE
294001A109 ...(KA'S)

ANSWER 4.14 (1.50)

a) 1. Action is immediately needed ~~(0.25)~~ to protect the public health (and safety) ~~(0.25)~~ and (0.50)
2. No action consistent with Technical Specifications (License Conditions) that can provide adequate (or equivalent) protection ~~(0.25)~~ is immediately apparent. ~~(0.25)~~ (0.50)

b) ASOS/SOS (0.50)

REFERENCE
PMI-12.12 PG 34.
295038G001(3.4) 295038G010(3.8)...K/A VALUE
295038G001 295038G010 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 4.15 (2.00)

a) Turn the handwheel until the disc comes into contact with the seat (0.50) and then do not exceed a maximum of 1/4 turn of the handwheel in the closed direction. (0.50)

b) When checking the valve full open (0.50)

c) (MSIV operation should be limited to times when steam is flowing through the line) to prevent closing the valves on corrosion products (or to prevent damage to valve seats due to closure onto corrosion products in the lowest portion of the valve). (0.50)

REFERENCE
OSIL # 47 PG 2 AND 3.
PMI-12.12 PG 45-47.
294001K101(3.7)...K/A VALUE
294001K101 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 4.16 (1.50)

1. < 775 psig in RUN mode (Condition requiring a MSIV isolation)
2. Reactor level 0 inches (< +11 inches)
3. Reactor level at 0 inches and power at 50% (condition requiring a reactor scram and power > 3%)

(3 required, 0.50 ea.)

REFERENCE
LESSON PLAN ON EOIS.
OBJECTIVE B.2.
EOI-1.
295031G011(4.2) 295037G011(4.4)...K/A VALUE
295031G011 295037G011 ...(KA'S)

ANSWERS -- BROWNS FERRY -88/12/12-NRC REGION II

ANSWER 4.17 (1.00)

Annual Administrative limit of 4 Rem/yr is most limiting dose. (0.50)
Max dose allowed = 4000 mrem - 3600 mrem = 400 mrem (0.25)
t = 400 / 40 = 10 hr (+/- 0.1 hr) (0.25)

REFERENCE
RCI-1 PG 9.
294001K103(3.3)...K/A VALUE
294001K103 ...(KA'S)

ANSWER 4.18 (1.00)

b.

REFERENCE
BSEP: EOP-1-LPC LO# 27, 28.
BFNP: EOI-01 C5-2.1
295037K209(4.0) 295037K210(3.8) 295037K303(4.1) 295037G007(3.7)
...K/A (K/A VALUE)
295037G007 295037K204 295037K209 295037K302 295037K303
...(KA'S)

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ATTACHMENTS

BROWNS FERRY

RO EXAM

NRC REGION II

88/12/12

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4.1 Station Operating Complement (Continued)

4.1.9 The Shift Operations Supervisor shall determine the alertness and attentiveness of all operators assigned to safety-related duties. If, in the opinion of the Shift Operations Supervisor, an operator does not possess the capabilities, he shall be relieved or reassigned to non-safety related functions. In order to reduce the potential for operator error due to fatigue, it is the plant's policy not to assign operators to shift duties while in a fatigued condition that could significantly reduce their mental alertness or affect their decision-making capabilities. [NRC/C] Every effort shall be employed to ensure that a sufficient number of operating personnel remain available to maintain adequate shift coverage without routine reliance on excessive overtime. The objective, therefore, is to have personnel work an eight-hour day, forty-hour week under routine operating conditions. However, in the event that overtime becomes necessary, the following guidelines will be followed:

4.1.9.1 An individual should not be permitted to work more than 16 hours straight (excluding shift turnover time).

4.1.9.2 An individual should not be permitted to work more than 16 hours in any 24-hour period, nor more than 24 hours in any 48-hour period, nor more than 72 hours in any seven-day period (all excluding shift turnover time).

4.1.9.3 A break of at least (8) hours should be allowed between work periods (including shift turnover time).

4.1.9.4 Except during extended shutdown periods, the use of overtime should be considered on an individual basis, and not for the entire staff on shift.

4.1.9.5 A Unit Operator required to work more than eight hours continuous at the controls, as his primary job, shall have a 30 minute break every four hours.

4.1.9.6 When operating personnel are required to work in excess of 12 continuous hours, every reasonable effort will be made to assign them to tasks that do not affect core reactivity on operating units.

4.1.9.7 If unusual circumstances arise that require deviation from the above guidelines, such changes shall be authorized by the Plant Manager or Unit Superintendent or higher levels of management. The SOS shall indicate in his log when any Operations shift personnel exceed the above guidelines and the circumstances that prevailed. [NRC GL No. 82-12]

NUCLEAR STAFF WORK HOURS FOR PERSONNEL
PERFORMING SAFETY-RELATED FUNCTIONS (Continued)

5.0 Instruction

5.1 Personnel involved with operation, maintenance or testing of controls, equipment, etc., that could affect the reactivity or core cooling systems of the power plant are subject to the following restrictions on overtime:

- Work not more than 16 hours straight (not including shift turnover time).
- Have a break of 8 hours or more (including shift turnover time) between all scheduled non-consecutive 8 hour work periods.
- Work no more than 16 hours in any 24 hour period, nor more than 24 hours in any 48 hour period, nor more than 72 hours in any 7-day period (all excluding shift turnover).

5.2 Personnel engaged in core alterations are governed by the provisions of Reference 3.3 regarding working hours.

5.3 Exceptions may be authorized by the plant manager or plant superintendent. It shall be documented in an appropriate log as to:

- Who is involved
- Who authorizes the waiver
- The unusual circumstances requiring the waiver.

5.4 A reactor operator required to work more than eight hours continuous at the control board, as the person's primary job, shall have a break each four hours.

5.5 When operating personnel are required and authorized to work in excess of 12 continuous hours, every reasonable effort will be made to assign them to tasks that do not affect core reactivity on operating units.

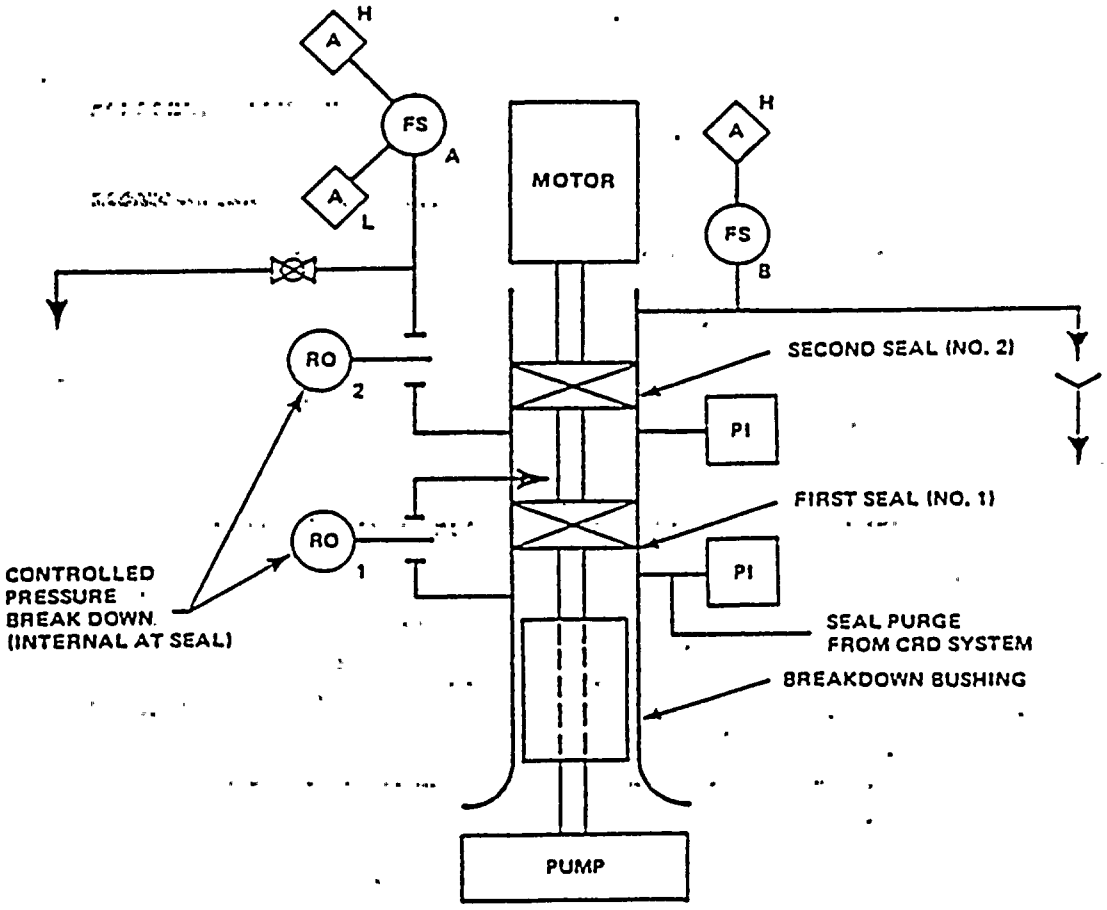

FIGURE 3 RECIRCULATION PUMP SEAL ASSEMBLEY

EQUATION SHEET

$f = ma$

$w = mg$

$E = mC^2$

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

$PE = mgh$

$W = v\Delta P$

$\Delta E = 931\Delta m$

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

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

$Pwr = W_f \dot{m}$

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

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

$SUR = 26.06/T$

$T = 1.44\ DT$

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

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

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

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

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

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

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

$\Sigma = N\sigma$

$v = s/t$

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

$a = (v_f - v_o)/t$

$v_f = v_o + at$

$\omega = \theta/t$

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

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

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

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

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

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

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

$TVL = 1.3/\mu$

$HVL = 0.693/\mu$

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

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

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

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

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

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

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

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

$I_1 d_1 = I_2 d_2$

$I_1 d_1^2 = I_2 d_2^2$

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

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

WATER PARAMETERS

1 gal. = 8.345 lbm

1 gal. = 3.78 liters

1 ft^3 = 7.48 gal.

Density = 62.4 lbm/ft^3

Density = 1 gm/cm^3

Heat of vaporization = 970 Btu/lbm

Heat of fusion = 144 Btu/lbm

1 Atm = 14.7 psi = 29.9 in. Hg.

1 ft. H_2O = 0.4335 lbf/in^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

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

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

Nuclear Regulatory Commission

Operator Licensing

Examination

This document is removed from
Official Use Only category on
date of examination.

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

FACILITY: Browns Ferry

REACTOR TYPE: BWR-GE4

DATE ADMINISTERED: 88/12/12

EXAMINER: REGION II

CANDIDATE: MASTER

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
28.50	25.00			5.	THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
28.25	24.78			6.	PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
28.50	25.00			7.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
28.75	25.22			8.	ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
114.00			%		Totals
		Final Grade			

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 time you START and STOP on the cover sheet of the examination.
6. Use only the paper provided for answers.
7. Print your name in the upper right-hand corner of each page of the exam.
8. The exam has one question per page. Write the answer beneath the question. Write only on one side of the exam and any extra answer sheets.
9. Number each answer continued on additional paper as to category and number, for example, 1.4, 6.3.
10. Attach continued answers to back of question to which it applies.
11. 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 with answers on top.

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

        (3) Scratch paper used during the examination.

    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 (1.00)

Which one of the following statements correctly explains why the coolant flow through a high power bundle will be LESS than the flow through a low power bundle if core orificing was NOT present.

a. The channel quality increases.

b. The two phase flow friction multiplier decreases.

c. The fuel rods expand due to thermal effects.

d. The bypass flow increases.

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

QUESTION 5.02 (1.50)

Regarding thermal limits:

a) State three (3) parameters that affect the MCPR calculation. (0.75)

b) State the mathematical relationship between MAPRAT and MAPLHGR. (0.25)

c) State the protection provided by the MAPRAT limit. (0.50)

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

QUESTION 5.03 (1.50)

An SRV opens while operating at 100% power and 1000 psia. Using a Mollier Diagram or Steam Tables, answer each of the following.

a) State the tailpipe temperature assuming atmospheric pressure in the Suppression Pool and NO reactor depressurization.

b) If reactor pressure starts to decrease when the SRV opens, state whether the tailpipe temperature will initially INCREASE, DECREASE, or REMAIN THE SAME verses if reactor pressure had not decreased.

c) State the reactor pressure at which the tailpipe temperature would be at its MAXIMUM value during the depressurization.

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

QUESTION 5.04 (1.00)

Which one of the following is NOT a factor in decay heat generation rate?

a. Time at power

b. Power level

c. Time since shutdown

d. Xenon inventory

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

QUESTION 5.05 (1.00)

Which one of the following is NOT a characteristic of subcritical multiplication?

a. The subcritical neutron level is directly proportional to the neutron source strength.

b. Doubling the indicated count rate by reactivity addition will reduce the margin of shutdown by approximately one-half.

c. For equal reactivity additions, it takes longer for the new equilibrium count rate to be reached as Keff approaches one.

d. A single notch of rod withdrawal will produce an equivalent equilibrium count rate increase independent of the value of Keff.

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

QUESTION 5.06 (1.00)

Assuming 100% RTP conditions, which one of the following, acting INDEPENDENTLY, would cause critical power to DECREASE?

a. Inlet subcooling is INCREASED

b. Reactor pressure is INCREASED

c. Peak axial power is DECREASED

d. Core flow rate is INCREASED

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

QUESTION 5.07 (1.00)

The reactor is operating at 95% power when the operator rapidly reduces power to 60% by reducing recirculation flow. Approximately twenty five minutes later, the operator notices that power has been slowly increasing.

Which one of the following best explains the cause of the power INCREASE?

a. fuel temperature decrease

b. core void fraction decrease

c. feedwater temperature decrease

d. Xenon inventory decrease

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

QUESTION 5.08 (1.50)

State whether each of the following statements, concerning a reactor heat balance, is TRUE or FALSE.

a) If the feedwater temperature used in the heat balance calculation was HIGHER than the actual feedwater temperature then actual reactor power is HIGHER than calculated reactor power.

b) If the steam enthalpy value used in the heat balance calculation was LOWER than the actual steam ~~flow~~ then actual reactor power is LOWER than calculated reactor power.
enthalphy value

c) If the RWCU return temperature used in the heat balance calculation was HIGHER than the actual RWCU return temperature then actual reactor power is LOWER than calculated reactor power.

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

QUESTION 5.09 (1.00)

Which one of the following does an operator INCREASE to increase VARs.

a. Generator speed

b. Capacity factor

c. Generator voltage

d. Generator stator cooling

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

QUESTION 5.10 (1.00)

Which one of the following is EQUAL to the total amount of reactivity that must be added to cause criticality?

a. Excess Reactivity

b. Reactivity Defect

c. Margin of Shutdown

d. Subcritical Factor

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

QUESTION 5.11 (1.00)

Which one of the following operating conditions would cause a centrifugal pump to draw the LEAST current?

a. "runout"

b. "cavitation"

c. "shutoff head"

d. "operating point"

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

QUESTION 5.12 (1.00)

Which one of the following is dependent on radiation field intensity for the amount of hydrogen released?

a. $Zr + H_2O \rightarrow ZrO + H_2$

b. $2H_2O \rightarrow 2H_2 + O_2$

c. $2Al + 3H_2O \rightarrow Al_2O_3 + 3H_2$

d. $Fe + H_2O \rightarrow FeO + H_2$

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

QUESTION 5.13 (1.00)

State whether each of the following is TRUE or FALSE:

a) As condenser vacuum is INCREASED, more energy can be extracted from the steam.

b) Air ejectors would not be needed if the main condenser was absolutely airtight.

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

QUESTION 5.14 (1.00)

Explain why reactor period stabilizes at -80 sec. following a reactor scram.

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

QUESTION 5.15 (1.00)

Which one of the following correct describes the effect on indicated flow if a leak develops in the low pressure side of a flow transmitter?

a. The indicated dP would DECREASE causing the indicated flow to DECREASE.

b. The indicated dP would DECREASE causing the indicated flow to INCREASE.

c. The indicated dP would INCREASE causing the indicated flow to DECREASE.

d. The indicated dP would INCREASE causing the indicated flow to INCREASE.

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

QUESTION 5.16 (1.00)

With the reactor critical at 75 on IRM range 4, rod withdrawal is used to increase and stabilize power at 75 on IRM range 6. Reactor recirculation coolant temperature is constant at 190 F.

Which one of the following correctly describes the position of the rods, and the reason for the rod position, after the power is stabilized on IRM range 6?

a. The rods will be further withdrawn because more fuel must be exposed to the available neutrons to maintain the higher power level.

b. The rods will be further withdrawn to overcome the power defect.

c. The rod position will be the same since the outward rod motion needed to achieve a given period equals the inward motion needed to return the period to infinity.

d. The rods will be less withdrawn due to the increased delayed neutron population associated with the higher power level.

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

QUESTION 5.17 (1.00)

Unit 2 has been COMPLETELY reloaded with new fuel. State two (2) reasons why the Shutdown Margin (Reactivity Margin) at the beginning of an operating cycle will be LESS THAN the Shutdown Margin at the end of the operating cycle.

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

QUESTION 5.18 (1.00)

EOI-1 C5, Level/Power Control, requires a reduction in RPV water level in order to reduce reactor power during an ATWS.

Explain how lowering reactor water level will reduce reactor power.

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

QUESTION 5.19 (1.50)

State the coefficient of reactivity which would act first to change core reactivity for each of the following events:

a) Loss of extraction steam to feedwater heaters

b) Main turbine trips from 28% reactor power and one BPV fails to open.

c) The operator withdraws a central control rod from 08 to 10 at 50% reactor power.

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

QUESTION 5.20 (1.50)

State whether control rod worth will INCREASE, DECREASE, or REMAIN THE SAME for each of the following statements.

a) An INCREASE in the Void Fraction surrounding the rod.

b) An INCREASE in moderator temperature.

c) An adjacent control rod is WITHDRAWN.

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

QUESTION 5.21 (2.50)

A normal reactor startup is in progress.

a) As Keff of the reactor increases, describe the effect on each of the following parameters for equal reactivity additions. (1.50)

(1) The magnitude of the change in count rate

(2) The initial rate of rise in count rate

(3) The time it takes to reach a new equilibrium count rate

b) Explain why the magnitude of the source neutron level does NOT affect critical rod position. (1.00)

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

QUESTION 5.22 (1.50)

A startup is in progress per GOI-100-1A, Unit Startup From Cold Shutdown to Power Operation. The reactor is operating at 60% power. The operator has just completed starting the third Condensate and Condensate Booster pumps. Reactor Feed pumps A and C are running when Condensate pump C trips.

State whether each of the following parameters INCREASES, DECREASES, or REMAINS THE SAME.

a) Condensate pump B flowrate

b) The discharge pressure of the condensate booster pumps

c) Feedwater pump A speed

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

QUESTION 5.23 (1.00)

Explain why it is necessary to simulate the fuel time constant as an input to the APRM flow-biased scram to achieve a thermal power trip.

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

QUESTION 5.24 (1.00)

Referring to Figure 5-1:

a) Explain why the detector being too close to the source would produce this curve.

b) Explain why this curve would lead to a NON-CONSERVATIVE estimate of the number of fuel bundles required for criticality.

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

QUESTION 6.01 (1.00)

The operator is withdrawing control rods for a normal reactor startup. The operator begins to withdraw the SRM detectors and a "Rod Withdrawal Block" alarm annunciates.

a) State the two (2) conditions which could have initiated the control rod withdrawal block due to SRM withdrawal.

b) State the two (2) conditions which will bypass ALL of the control rod withdrawal BLOCKS initiated by the SRMs?

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

QUESTION 6.02 (1.50)

The RBM system is designed with a gain change circuit which can increase the LPRM averaging circuit output such that the RBM sees a HIGHER local power around the selected control rod.

a) Explain how the RBM gain change circuit determines the amount of increase to the averaging circuit output. (1.00)

b) State the two (2) reasons for increasing the gain of the RBM channel. (0.50)

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

QUESTION 6.03 (1.50)

Answer the following questions concerning the RMCS (Reactor Manual Control System).

a) Explain how control rod insertion using 'Emergency In' differs from that of normal control rod insertion

b) State the two (2) control rod blocks which will prevent the insertion of rods using the "Emergency In" control switch.

c) The "white" indicating light, located above the CRD control switch, indicates that no rod blocks are present to prevent movement of a control rod when lit. State the one (1) rod block which will NOT be indicated by this light.

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

QUESTION 6.04 (1.25)

For each of the reactor scrams listed in Column 1, select the correct purpose from Column 2.

(Each scram in Column 1 has only ONE answer; however, Column 2 choices may be used MORE than once or NOT AT ALL.)

COLUMN 1	COLUMN 2
a) APRM High Flux Scram	(1) Scrams the reactor when the core is in danger of inadequate cooling.
b) Main Steam Isolation Valves Not Full Open Scram	(2) Scrams the reactor to limit the fission products released from the fuel.
c) Reactor Low Water Level Scram	(3) Scrams the reactor due to the anticipation of the rapid pressure and neutron flux increase
d) Low Air Header Pressure Scram	(4) Scrams the reactor to protect the fuel cladding against high heat generation rates.
e) Generator-Load Reject Scram	(5) Scrams the reactor before rods begin drifting into the core and before the scram discharge volume is filled.

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

QUESTION 6.05 (1.50)

A reactor scram has ~~just~~ occurred, and NOT been reset.

a) Explain why the Four Rod Group display will not indicate any rod positions when a rod is selected. (0.25)

b) If the reactor scram cannot be reset, state when the Four Rod Group Display will begin indicating rod positions. (0.50)

c) State three (3) methods the operator can use to determine that ALL control rods are fully inserted into the core before the FOUR ROD GROUP DISPLAY will begin indicating rod position. (0.75)

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

QUESTION 6.06 (1.75)

A reactor scram has been initiated but control rods have failed to insert fully into the core. The ASOS has directed the initiation of SLC. When the operator takes the SLC handswitch to the "Start Pump A" position, the squib valves fail to open.

a) State five (5) Control Room indications/alarms available for determining that the squib valves have failed to open. (1.25)

b) State two (2) Control Room indications available to verify that SLC pump A has started and is running. (0.50)

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

QUESTION 6.07 (1.00)

Which one of the following signals from the Post-Treatment Radiation Monitoring System will initiate an AUTOMATIC isolation of the Off-Gas Discharge to the main stack (FCV-66-28)?

a. High trip in channel B

b. High-High-High trip in Channel A

c. High trip in Channel A and Downscale trip in Channel B

d. Downscale trip in Channel A and High-High-High trip in Channel B

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

QUESTION 6.08 (1.75)

Unit 2 is operating at 100% rated power when a small LOCA occurs. The ADS initiation logic is satisfied and the 120 second timer has started.

a) Which one of the following failures would prevent the automatic initiation of ADS? (1.00)

1. Loss of 250 VDC
2. Core Spray pumps A and B fail to start
3. Loss of drywell control air
4. RHR pumps B and D fail to start

b) Explain why the ADS timer is set at 120 seconds. (0.75)

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

QUESTION 6.09 (1.00)

Following a reactor scram the operator places the mode switch to SHUTDOWN per AOI 100-1, Reactor Scram.

a) Explain why the scram signal generated by placing the mode switch in the SHUTDOWN position is automatically BYPASSED after 2 seconds.

b) Explain why the operator is prevented from resetting the reactor scram for 10 seconds after the mode switch is placed into SHUTDOWN.

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

QUESTION 6.10 (1.00)

State four (4) operational problems or control rod drive responses resulting from air in the CRD underpiston or overpiston lines.

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

QUESTION 6.11 (1.75)

Unit 2 is operating at 80% RTP while performing a surveillance of the drywell-suppression chamber vacuum breakers. One (1) of the vacuum breakers failed to close.

a) List three (3) Control Room indications that will aid in determining the vacuum breaker is open. (0.75)

b) Explain the adverse effect the vacuum breaker failure will have if a Design Basis LOCA occurs. (1.00)

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

QUESTION 6.12 (1.00)

Diesel Generators A - D have automatically started due to an accident signal on Unit 2.

Which one of the following conditions will result in a trip of the Diesel Generator following an automatic start?

a. Low oil pressure of 20 psig

b. Reverse power

c. High differential current

d. Low cooling water pressure of 20 psig

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

QUESTION 6.13 (1.00)

The turbine control valve (73-19) for the HPCI turbine is CLOSED in standby while the governor valve (71-10) for the RCIC turbine is OPEN in standby. Explain the design features that allow for this difference in standby alignment.

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

QUESTION 6.14 (1.00)

State the reason for the scram outlet valve opening BEFORE the scram inlet valve.

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

QUESTION 6.15 (1.00)

Which one of the following would result from failure of a Reactor Recirculation pump # 1 seal assembly at rated conditions?

a. A decrease in # 1 seal cavity pressure from approximately 1000 psig to about 500 psig.

b. An increase in # 1 seal cavity pressure from approximately 500 psig to approximately 1000 psig.

c. An increase in # 2 seal cavity pressure from approximately 500 psig to approximately 1000 psig.

d. A decrease in # 2 seal cavity pressure from approximately 500 psig to approximately 0 psig.

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

QUESTION 6.16 (1.00)

When transferring from the RPS MG set to the RPS alternate power source in accordance with OI-99, Reactor Protection System Operating Instructions, the operator is required to reset the half-scram signal after transferring power to the ALTERNATE source.

a) Explain why a half-scram occurs.

b) Explain the resultant impact on plant operation if the transfer is performed with a half-scram signal present on the unaffected bus.

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

QUESTION 6.17 (1.00)

Answer each of the following concerning the Transversing Incore Probe System:

a) Explain why primary containment isolation would not be complete if a TIP is stuck OUTSIDE the shield.

b) State the ALTERNATE method of achieving primary containment isolation.

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

QUESTION 6.18 (1.00)

Which one of the following is the purpose of the recirculation pump 75% limiter?

a. Prevent cavitation of the recirculation pumps

b. Prevent runout of the remaining feedpump

c. Prevent a low reactor water level scram

d. Prevent jet pump vibration

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

QUESTION 6.19 (1.00)

Describe the two (2) methods by which RSCS determines control rod position; including any applicable plant conditions.

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

QUESTION 6.20 (1.00)

The main turbine is at 1800 rpm with the generator output breakers SHUT.

Which one of the following will occur if the "all valves closed" pushbutton is depressed?

a. All the control valves (TCVs and ICVs) and main stop valves (MSVs) will remain OPEN.

b. The turbine control valves (TCVs) and main stop valves (MSVs) will CLOSE, but the intercept valves (ICVs) will remain OPEN.

c. All of the control valves (TCVs and ICVs) and main stop valves (MSVs) will CLOSE.

d. The control valves (TCVs and CIVs) will CLOSE, but the main stop valves (MSVs) will remain OPEN.

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

QUESTION 6.21 (1.00)

A reactor startup is in progress with the following plant conditions:

- Reactor Power is below the RSCS LPSP
- Rod Withdrawal Sequence B is in effect
- No RWM errors or blocks exist
- The RWM was placed in BYPASS following withdrawal of all RSCS Group 6 rods to the withdraw limit at position 36.

The operator attempts to continue withdrawing Group 6 rods to position 48.

Which one of the following describes plant response to this operator action?

a. Rod withdrawal will occur with NO rod position restrictions.

b. Rod withdrawal will occur, provided all Group 6 rods are maintained within 1 notch of each other.

c. Rod withdrawal will NOT occur beyond the RWM withdrawal limit for Group 6.

d. Rod withdrawal will NOT occur beyond position 36, due to RSCS immediately imposing a rod block.

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

QUESTION 6.22 (1.25)

Concerning the Reactor Manual Control System:

a) Describe the operation of the AUXILIARY TIMER, including any applicable setpoints and protective functions. (0.75)

b) State the basis of the AUXILIARY TIMER. (0.25)

c) State how the AUXILIARY TIMER can be defeated. (0.25)

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

QUESTION 6.23 (1.00)

Which one of the following would DEFEAT manual opening of the RHR Test Return Line valves 74-57 and 74-59?

a. Reactor water level at 27"

b. LPCI initiation

c. Minimum flow valves not fully shut

d. Containment Spray initiation

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

QUESTION 6.24 (1.00)

Which one of the following will NOT generate a "RPS ATU Trouble" alarm?

a. Master Trip Unit calibration in progress

b. Slave Trip Unit trip

c. RPS bus power lost

d. Slave Trip Unit card removed

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

QUESTION 7.01 (1.00)

Fuel is being moved in Quadrant A of the reactor. Which one of the following SRM combinations is required to be operable?

a. A and C

b. C and D

c. B and D

d. B and C

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

QUESTION 7.02 (1.00)

Unit 2 is operating at 90% power when an Off-Gas Hydrogen High alarm is received. Both Hydrogen analyzers indicate a Hydrogen level of ~ 5.3%.

Which one of the following describes the action that should be taken?

a. Switch to the alternate recombiner

b. Switch to the alternate Off-Gas train

c. Start an additional SJAE

d. Manually scram the reactor.

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

QUESTION 7.03 (1.00)

The following parameter changes or alarms are observed:

- RBCCW temperature LOWER than normal
- RBCCW Surge Tank HI Level alarm

Which one of the following would explain the cause of these indications?

a. Raw Cooling Water leak in the RBCCW heat exchangers

b. Reactor Coolant leak into RBCCW through the NRHX

c. RBCCW Makeup valve leak

d. DWEDS heat exchanger leak into RBCCW

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

QUESTION 7.04 (1.00)

In accordance with OI-47, a reactor Scram would occur if turbine 1st stage pressure became > 142 psig during Shell Warming. Explain why these conditions would result in a reactor Scram.

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

QUESTION 7.05 (1.00)

In accordance with OI-82, Standby Diesel Generator System Operating Instruction, Diesel Generator Fast Starts should be avoided during the time period of 15 minutes to 3 hours after Diesel shutdown.

a) Explain the bases for this precaution.

b) State the method by which a Diesel Generator should be started during this time interval and from where it would be started.

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

QUESTION 7.06 (1.00)

EOI-01 RC/P states that SRVs should be opened in a predetermined sequence.

a) State the purpose for using this sequence.

b) State the possible adverse consequence if SRVs are opened when suppression pool water level is below 5.5 feet.

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

QUESTION 7.07 (1.25)

In accordance with AOI-85-2, Uncoupled Control Rod:

a) Except for no change in the nuclear instrumentation, state three (3) additional symptoms which indicate a control rod is UNCOUPLED. (0.75)

b) State the restriction that may be placed on control rod withdrawal for a control rod which has been recoupled and coupling integrity verified. (0.50)

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

QUESTION 7.08 (1.50)

State the basis for requiring a minimum of three (3) SRVs to be open during emergency depressurization in accordance with EOI-1 C2, Emergency Reactor Depressurization.

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

QUESTION 7.09 (1.00)

Which one of the following is correct concerning the Minimum Alternate Flooding Pressure used in EOI-01 C5, Level/Power Control?

a. Once RPV pressure decreases below the Minimum Alternate Flooding Pressure, adequate core cooling is assured.

b. Once RPV pressure decreases below the Minimum Alternate Flooding Pressure, steam flow through the core does not provide adequate core cooling.

c. If there are no SRVs open and pressure remains above the Minimum Alternate Flooding Pressure, sufficient natural circulation flow through the core exists to provide adequate core cooling.

d. If at least 2 SRVs are open and pressure remains above the Minimum Alternate Flooding Pressure, insufficient natural circulation to provide adequate core cooling exists and injection must be reestablished to increase RPV water level.

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

QUESTION 7.10 (1.00)

In accordance with EOI-01 RC/Q, Power Control, state the basis for requiring SLC be initiated before suppression pool temperature reaches 110 F.

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

QUESTION 7.11 (1.50)

Step C5-2.1 of EOI-01 C5, Level/Power Control, requires terminating and preventing all injection into the reactor except from SLC and CRD until reactor pressure is below the Minimum Alternate Flooding Pressure before Emergency Reactor Depressurization is initiated.

State the bases for terminating and preventing injection into the reactor before initiating Emergency Reactor Depressurization.

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

QUESTION 7.12 (1.50)

Concerning EOI-1 C4, Reactor Flooding:

a) State the bases for the Minimum Alternate Flooding Interval. (0.50)

b) State the bases for reinitiating injection if reactor water level indication is not restored within the Maximum Core Uncovery Time Limit. (1.00)

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

QUESTION 7.13 (1.00)

Which one of the following is correct if ALL rod position indication is lost in accordance with AOI-85-4, Loss of RPIS?

a. Immediately move the control rods to position with an operable position indication.

b. Obtain an OD-7 printout before and after moving any control rod.

c. Withdrawal of control rods is allowed using only single notch movement.

d. Control rod movement is allowed only by scram.

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

QUESTION 7.14 (1.00)

OI-74, Residual Heat Removal Operating Instruction, states the RHR system OUTBD injection valve should be immediately throttled after starting the RHR pump for Shutdown Cooling.

a) State the reason for placing the RHR minimum flow valve low flow bypass switch to 'BYPASS'.

b) State the adverse consequences if the minimum flow valve was NOT bypassed.

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

QUESTION 7.15 (1.00)

Step C5-1 of EOI-01 C5, Level/Power Control, requires lowering of reactor level to reduce reactor power by terminating and preventing injection into the reactor except for SLC and CRD.

a) State the basis for reducing reactor power.

b) State the reasons for allowing SLC and CRD to continue injection.

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

QUESTION 7.16 (2.00)

Unit 2 is operating at 80% rated power when reactor recirculation pump B trips. AOI-68-1, Recirculation Pump Trip, directs the operator to close the tripped recirculation pump discharge valve and then reopen it after 5 minutes. After 4 hours of one pump operation, the operator is ready to restart recirculation pump B per OI-68, Recirculation System.

a) State the reason recirculation pump B discharge valve is required to be closed for 5 minutes.

b) State the reason recirculation pump B discharge valve is required to be opened after 5 minutes.

c) State the basis for requiring recirculation loop B discharge temperature be within ~~75 F of the saturated temperature~~ 50°F of the ~~reactor vessel water~~ operating recirculation loop before restarting recirculation pump B.

d) State the basis for requiring the speed of recirculation pump A be less than 50% before restarting recirculation pump B.

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

QUESTION 7.17 (1.25)

Unit 2 is operating at 35% rated power with reactor water level control selected to LEVEL B when a Loss of Instrument and Controls Bus A occurs.

a) In accordance with 2-AOI-57-5A, Loss of I&C Bus A, the operator should immediately verify that all automatic actions have occurred, and he should ensure that the Reactor Water Level Selector Switch is in Level A. Explain how the plant will respond if the operator FAILS to place the Reactor Water Level Selector Switch in Level A? (0.75)

b) Explain why 2-AOI-57-5A caution the operator NOT to manually transfer I&C Bus A to its alternate power supply. (0.50)

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

QUESTION 7.18 (2.00)

Unit 2 is operating at 75% rated power when a COMPLETE LOSS OF RBCCW occurs. AOI-70-1, Loss of RBCCW, requires the operator to verify all automatic actions have occurred.

a) State two (2) automatic actions that are to be verified in accordance with AOI-70-1.

b) State the two (2) immediate actions required by AOI-70-1 if RBCCW flow cannot be restored within 2 minutes.

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

QUESTION 7.19 (1.00)

Browns Ferry Standard Practice 12.8, Unit Trip and Reactor Transient Analysis, defines the reactor TRANSIENT EVENT.

Which one of the following conditions would be classified as a reactor transient event?

a. A 10% power decrease as indicated by APRMs due to a recirculation flow controller failure and subsequent scoop tube lock.

b. An unplanned reactor water level oscillation of 3 inches before the operator can respond to a startup level controller failure.

c. The Off-Gas pretreatment radiation monitor increases by 5% over one 8 hour shift during steady state 100% power operation.

d. Generator megawatts (MWe) decreases by 17 MWe during scheduled turbine valve testing.

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

QUESTION 7.20 (2.00)

Answer the following questions concerning the Browns Ferry Guidelines for Valve Operation in accordance with PMI-12.12, Conduct of Operations and OSIL #47.

a) Explain how the operator is to close a motor operated gate valve using the MANUAL handwheel. (1.00)

b) Excluding stem sealing, state the only time that the backseat of a MANUAL-OPERATED valve should be used. (0.50)

c) State why operation of the Main Steam Isolation Valves should be limited to times when there is steam flowing through the line? (0.50)

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

QUESTION 7.21 (1.00)

Step PC/P-1 of EOI-2, Containment Control, allows the primary containment to be vented only if the temperature is LESS THAN 210 F. State the bases for this procedural restriction.

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

QUESTION 7.22 (0.50)

Step SP/L-3.2 of EOI-2, Containment Control, requires drywell sprays be terminated before drywell pressure drops below 2.4 psig. State the bases for this procedural requirement.

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

QUESTION 7.23 (1.00)

Step SP/L-2.2 of EOI-2, Containment Control, requires HPCI be secured if suppression pool level CANNOT be maintained above 12.75 feet. State the bases for this procedural requirement.

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

QUESTION 7.24 (1.00)

State the bases for initiating Drywell Spray only when in the SAFE region of the Drywell Spray Initiation Pressure Limit curve.

QUESTION 8.01 (1.00)

Special concern is required when returning MANUALLY closed MOVs to service.

a) Describe how to verify the operability of an MOV in a safety system that has been manually closed.

b) Describe the malfunction that this operability check is intended to identify.

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

QUESTION 8.02 (1.25)

In accordance with Browns Ferry Standard Practice 12.8, following a reactor scram and post trip review:

a) State the two (2) criteria that must be met before the Shift Engineer can recommend a unit restart. (0.50)

b) State whom, by title, is responsible for authorizing a unit restart (criticality). (0.25)

c) List all additional actions, if any, which would be required prior to restart if the SOS and the STA DISAGREED on the restart recommendation. (0.50)

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

QUESTION 8.03 (1.00)

Units 1 and 3 are in Cold Shutdown; Unit 2 is in Startup, but SUBCRITICAL. The ASOS requests the SOS's assistance in the reactor building to help resolve a significant problem with a CRD pump.

If the SOS is the ONLY SRO in the Unit 1/Unit 2 Control Room, which one of the following correctly describes your allowable response?

a. The SOS may leave provided there are two (2) licensed ROs in the control room and the STA replaces the SOS.

b. The SOS may leave provided there are two (2) licensed ROs in the control room and no additional control rods are withdrawn.

c. The SOS may leave provided there are two (2) licensed ROs and a STA in the control room and the SOS remains in constant contact with, and is within ten (10) minutes of, the control room.

d. The SOS may not leave the control room unless relieved by another SRO.

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

QUESTION 8.04 (2.00)

Units 1 and 2 are in refueling outages and Unit 3 is in an extended maintenance outage. While operating the Unit 1 and 2 standby diesel generator 'D', a mechanical overspeed trip occurs. Diesel generator 'A' is out of service for extended maintenance.

Referring to Technical Specifications, specify any LCOs which are not met and why.

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

QUESTION 8.05 (1.50)

Unit 2 has just completed a refueling outage. RHR pump 2D is running for the purpose of maintaining reactor coolant temperature above 100F. The following equipment status is reported:

RHR Pump '2B' - OOS for maintenance
RHRSW Pump 'D1' - OOS for maintenance
Diesel Generator 'D' - OOS for scheduled preventive maintenance

RHR Loop I S/D Cooling and LPCI modes are now declared INOPERABLE. Referring to Technical Specifications, specify any LCOs which are not met.

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

QUESTION 8.06 (1.00)

Which one of the following correctly describes the Technical Specification definition of an "Instrument Functional Test"?

a. The adjustment of an instrument signal output so that it corresponds, within acceptable range and accuracy, to a known value of the parameter which the instrument monitors.

b. The injection of a simulated signal into the instruments' primary sensor to verify the proper instrument channel response, alarm, and/or initiating action.

c. The qualitative determination of acceptable operability by observation of instrument behavior during operation, including where possible, comparison of the instrument with other independent instruments measuring the same variable.

d. A test of all relays and contacts of a logic circuit to insures all components and instruments are operable per the design intent.

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

QUESTION 8.07 (1.00)

Unit 1 is in Hot Shutdown following a reactor trip. The SOS receives a request to move some equipment through the Unit 1 565' elevation access hatch (air lock).

Which one of the following statements most accurately describes the allowances/limitations provided by Technical Specifications and OSIL #35, Secondary Containment Control?

a. Secondary Containment integrity is NOT required for the existing condition so BOTH the inner and outer doors can be opened.

b. Although Secondary Containment integrity is NOT required for the existing condition, OSIL #35 requires the outer doors to be closed on a Hold Order while the inner doors are open.

c. Although Secondary Containment integrity is required, stationing a public safety officer allows BOTH the inner and outer doors to be opened for up to one (1) hour.

d. Secondary Containment integrity is required and the outer doors shall not be opened unless the inner doors are closed, the outer door Hold Order is cleared, and a public safety officer is stationed at the outer doors whenever they are open.

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

QUESTION 8.08 (1.00)

While operating at 100% RTP, the RWCU return isolation valve (FCV 69-12) failed in the OPEN position. Which one of the following describes the allowances/limitations imposed by Technical Specifications for this condition.

a. An orderly shutdown shall be initiated and the reactor shall be in COLD SHUTDOWN within 24 hours.

b. Reactor power operation may continue provided that one of the RWCU supply isolation valves is shut and its' position recorded daily.

c. Reactor power operation may continue with no additional requirements.

d. The Unit shall be placed in at least HOT STANDBY within 6 hours and in COLD SHUTDOWN within the following 30 hours.

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

QUESTION 8.09 (2.00)

If an Immediate Temporary Change (ITC) to the surveillance and testing requirements of a procedure which does not change the intent of the approved procedure is to be made, state who is required to make the change, who reviews the change, and all personnel that approve the change.

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

QUESTION 8.10 (1.00)

Which one of the following would result in the assumption that the Unit 1 Technical Specification Fuel Cladding Integrity Safety Limit had been exceeded?

a. Reactor power is at 42% RTP; the main turbine trips due to an EHC malfunction; the reactor scrams on HIGH PRESSURE; the BPVs control pressure.

b. Reactor power is at 70% RTP; a steam leak to the Drywell occurs and Drywell pressure increases; the reactor scrams on HIGH DRYWELL PRESSURE; HPCI fails to auto actuate but is manually started; the reactor is placed in COLD SHUTDOWN.

c. Reactor is in Start-up at 12% RTP; power is increased by control rod withdrawal; the reactor scrams at 12.5% power; level and pressure are maintained by normal plant systems.

d. Reactor power is 18% RTP; 1-1/2 BPVs are open in preparation for turbine warmup; a controller failure reduces pressure to 875 psig; MSIVs close and the reactor scrams; level and pressure are maintained by normal plant systems.

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

QUESTION 8.11 (1.00)

The SOS encounters circumstances that are NOT specifically addressed in Technical Specifications which result in the inability to satisfy a LCO.

Which one of the following statements describes the action the SOS should take?

a. An orderly shutdown shall be initiated and the reactor placed in COLD SHUTDOWN within 24 hours.

b. Notify the Unit Superintendent and request a Technical Specification interpretation.

c. The reactor may remain in operation for a period not to exceed 7 days, after which time the unit must be placed in HOT STANDBY.

d. Be in at least HOT STANDBY within 6 hours and be in COLD SHUTDOWN within 30 hours.

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

QUESTION 8.12 (0.75)

An OPERABILITY TEST is conducted on a safety-related system following the installation of an approved modification. State three (3) unique criteria which would procedurally require that a TEST DEFICIENCY be initiated (documented).

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

QUESTION 8.13 (2.00)

Standard Practice 12.17, Administrative Control for Plant Operation, establishes plant policy for the control of containment isolation and safety systems during an emergency.

a) State the evaluation which must be made prior to resetting a Primary Containment Isolation.

b) State two (2) conditions which allow operators to OVERRIDE continued operation of ESF equipment following automatic initiation.

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

QUESTION 8.14 (1.25)

Unit 2 Technical Specifications requires a sufficient number of control rods shall be operable so that the core could be made subcritical assuming five (5) conditions. State the five (5) conditions that are assumed.

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

QUESTION 8.15 (1.00)

During a Unit 1 reactor startup following refueling the Rod Worth Minimizer (RWM) fails and is declared inoperable. The RWM was bypassed and second party verification used to continue the startup. Reactor power is currently 15% RTP and control rod scram timing is to be performed.

Referring to the attached Technical Specifications, state any LCO restrictions on performing control rod scram timing.

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

QUESTION 8.16 (1.00)

During a Site Area Emergency, the SOS, acting as the Site Emergency Director (SED), directs certain actions. The NRC Resident Inspector does NOT agree with the actions and requests different actions be directed.

In accordance with EPIP-6, Activation and Operation of the Technical Support Center, which one of the following is correct?

a. Take action as requested by the NRC Resident Inspector.

b. Continue with actions the SOS determines appropriate

c. Require the NRC Resident Inspector assume SED responsibility.

d. Require the NRC Resident Inspector to sign a written order

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

QUESTION 8.17 (1.50)

a) In accordance with RCI-1, Radiological Control Program, state the conditions when an individual will NOT be considered to be performing work in the Radiologically Controlled Area (RCA). (0.50)

b) State four (4) conditions when an RWP is required prior to the initiation of work in accordance with RCI-9, Radiation Work Permits. (1.00)

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

QUESTION 8.18 (1.00)

Unit 1 is operating at 100% RTP when the automatic swapover of the HPCI suction on low CST level is determined to be INOPERABLE. It is estimated that four (4) days will be required to return the automatic swapover to OPERABLE.

Which one of the following actions describes the Technical Specification limitations on plant operations?

a. An orderly shutdown shall be initiated and the reactor vessel pressure shall be reduced to 122 psig or less within 24 hours.

b. The reactor may remain in operation for a period not to exceed 7 days provided ADS, CSS, RHRS (LPCI), and RCICS are operable.

c. The reactor may remain in operation provided the suction valve to the suppression pool is opened and de-energized and the suction to the CST is shut and de-energized.

d. The reactor shall be in at least HOT STANDBY in 6 hours and in COLD SHUTDOWN within the following 30 hours.

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

QUESTION 8.19 (1.00)

Unit 1 is operating at 75% RTP when the SOS is informed that two (2) SRVs may not operate in the Relief, Safety, or ADS modes and declares these SRVs INOPERABLE.

Referring to Technical Specifications, which one of the following describes the action required for the above situation.

a. The reactor may remain in operation for a period not to exceed 7 days provided the HPCI system is OPERABLE.

b. Immediately initiate an orderly shutdown with the reactor in HOT SHUTDOWN in 6 hours and in COLD SHUTDOWN in the following 18 hours.

c. An orderly shutdown shall be initiated and the reactor depressurized to less than 105 psig within 24 hours.

d. Be in at least STARTUP within next 6 hours and in at least HOT SHUTDOWN within the following 6 hours and in COLD SHUTDOWN within the next 24 hours.

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

QUESTION 8.20 (1.00)

Unit 3 is operating at 100% RTP. Unit 2 is operating at 60% RTP with CS pump 'A' inoperative for the past 24 hours and no estimated repair time. DG 3C has failed to start twice during performance of scheduled surveillance and has been declared inoperable.

Referring to Unit 2 Technical Specifications, which one of the following describes the allowances/limitations for the above situation.

a. Operation may continue for 7 days provided the other CSS loop and the RHR system (LPCI mode) and the diesel generators are OPERABLE.

b. The reactor shall be shutdown in the Cold Condition within 24 hours.

c. The unit shall be placed in at least HOT STANDBY within 6 hours and in COLD SHUTDOWN within the following 30 hours.

d. Operation may continue without restriction provided the RHR system (LPCI mode) cross-connects are in the open position.

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

QUESTION 8.21 (1.00)

Regarding Unit 3 Technical Specification 3.6.B, Chemistry Limits:

a) State the basis for the more restrictive chloride limit when in STARTUP and at steaming rates less than 100,000 lbs/hr.

b) Explain how the surveillance requirement for conductivity monitoring to ensures chemistry limits are acceptable.

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

QUESTION 8.22 (0.50)

In accordance with EPIP-1, state the two (2) actions the SOS cannot delegate when acting as the SED.

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

QUESTION 8.23 (1.00)

Unit 2 is defueled with one (1) control rod fully withdrawn and one (1) control rod removed from the core. Fuel loading is scheduled to begin.

Referring to the attached Technical Specifications, which one of the following describes the Technical Specification allowances/limitations for the above condition.

a. Fuel loading may NOT begin until all control rods are inserted.

b. Fuel loading may begin and continue as long as Shutdown Margin requirements are met.

c. Fuel loading may begin; however, the fuel assemblies surrounding the removed control rods may not be loaded.

d. Fuel loading may begin AFTER one of the control rods is inserted and the fuel assemblies surrounding the remaining removed control rod may not be loaded.

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

QUESTION 8.24 (1.50)

Unit 3 is in STARTUP with reactor pressure at 110 psig. Units 1 and 2 are at 100% power. RHR pump 2C has been declared inoperable due to a failed surveillance and investigation has begun. Unit 3 RCIC steam supply has been manually isolated to allow for maintenance on the RCIC turbine. Division 1 of Unit 3 ADS initiation logic has been bypassed for ten (10) hours for troubleshooting activities. Unit 3 suppression pool water level has been determined to be -7.5". Diesel Generator '3B' has been slow started from the Local Control Cabinet for testing.

Referring to the attached Technical Specifications, state all LCOs applicable to Unit 3 for the above situation.

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

QUESTION 8.25 (0.50)

Browns Ferry Standard Practice 3.15, Independent Verification, states that there is only one exception to the requirement for independent verification during normal plant operations.

In accordance with BF 3.15:

a) State the one (1) condition when the requirement for independent verification may be waived.

b) State whom, by title, has the authority to waive the independent verification requirement.

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

ATTACHMENTS

Browns Ferry

SRO EXAM

REGION II

88/12/12

FORMULA SHEET
AND
STEAM TABLES

$f = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgh$

$V_f = V_o + at$

$W = v\ \Delta P$

$\Delta E = 931\ \Delta m$

$\dot{Q} = \dot{m}\Delta h$

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

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

$\dot{W}r = W_f\Delta h$

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

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

$\Sigma = \sigma N$

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

$v = s/t$

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

$a = (V_f - V_o)/t$

$w = o/t$

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

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

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

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

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

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

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

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

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

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

$SDM = 1 - K_{eff\ SRO}$

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

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

$I_1 d_1 = I_2 d_2$

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

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

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

Water Parameters

1 gal. = 8.345 lbm.

1 gal. = 3.78 liters

1 ft^3 = 7.48 gal.

Density = 62.4 lbm/ft^3

Density = 1 gm/cm^3

Heat of vaporization = 970 Btu/lbm

Heat of fusion = 144 Btu/lbm

1 Atm = 14.7 psi = 29.9 in. Hg.

1 ft. H_2O = 0.4335 lbf/in.

Miscellaneous conversions

1 curie = 3.7×10^{10} dps

1 kg = 2.21 lbm

1 hp = 2.54×10^3 Btu/hr

1 mw = 3.41×10^6 Btu/hr

1in = 2.54 cm

°F = 9/5°C + 32

°C = 5/9 (°F-32)

1 BTU = 778 ft-lbf

e = 2.718

Temp F	Press. psia	Volume, ft³/lb			Enthalpy, Btu/lb			Entropy, Btu/lb x F			Temp F
		Water v_f	Evap v_{fg}	Steam v_g	Water h_f	Evap h_{fg}	Steam h_g	Water s_f	Evap s_{fg}	Steam 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	1067.7	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	1.4516	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	2.0168	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	1.6585	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	282.1	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	0.0181S	2.8155	2 834	336.1	859.0	1195.1	0.5205	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	1115.6	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 95	0 0212	0.47965	0 5009	526 7	669 7	1196 4	0 7279	0 6753	1.4032	523 2	1113 0	900
1000	544 58	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 26	0.0220	0.37863	0 4006	557.5	631 5	1189 1	0 7578	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 16260	0 1883	672 1	465 2	1138 3	0 8605	0 4256	1.2881	662 6	1038 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	0 050/3	0 0850	801 8	218 4	1070 3	0 9723	0 1891	1.1619	782 8	973 1	3000
3208 2	705 47	0 0408	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	2.2237	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	1146.6	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	1691.6	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	6.1925	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	3.4651	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	1.6776	1.7239	1.7663	1.8057	1.8426	1.8776	1.9109	1.9427	1.9732	2.0025
250 (400.97)	v	0.0161	0.0165	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	68.56	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	1.9573
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	3.320
	h	68.92	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
	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	1.8795	1.9105	1.940
400 (444.60)	v	0.0161	0.0166	0.0174	0.0186	1.2841	1.4763	1.6490	1.8151	1.9759	2.1339	2.2901	2.4450	2.5987	2.7515	2.903
	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
	s	0.1293	0.2935	0.4365	0.5563	1.5282	1.5901	1.6406	1.6850	1.7255	1.7632	1.7988	1.8325	1.8647	1.8955	1.925
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	2.320
	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
	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	1.899

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
	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
600	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
(486.20)	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
	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
700	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
(503.08)	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
	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
800	h	70.11	169.88	271.07	375.73	487.88	1271.1	1339.2	1399.1	1455.8	1511.8	1566.9	1622.7	1678.9	1735.0	1792.9
(518.2.)	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
	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
900	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
(531.95)	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
	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
1000	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
(544.58)	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
	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
1100	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
(556.28)	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
	v	0.0161	0.0166	0.0174	0.0185	0.0203	0.4016	0.4905	0.5615	0.6250	0.6845	0.7418	0.7974	0.8519	0.9055	0.9584
1200	h	71.16	170.78	271.82	376.20	487.72	1224.2	1311.5	1379.7	1440.9	1499.4	1556.9	1614.2	1671.6	1729.4	1787.6
(567.19)	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
	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
1400	h	71.68	171.24	272.19	376.44	487.65	1194.1	1296.1	1369.3	1433.2	1493.2	1551.8	1609.9	1668.0	1726.3	1785.0
(587.07)	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
	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
1600	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
(604.87)	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
	v	0.0160	0.0165	0.0173	0.0185	0.0202	0.0235	0.2906	0.3500	0.3988	0.4426	0.4836	0.5229	0.5609	0.5980	0.6343
1800	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
(621.02)	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
	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
2000	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
(635.80)	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
	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
2500	h	74.57	173.74	274.27	377.82	487.50	612.08	1176.7	1303.4	1386.7	1457.5	1522.9	1585.9	1647.8	1709.2	1770.4
(668.11)	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
	v	0.0160	0.0165	0.0172	0.0183	0.0200	0.0228	0.0982	0.1755	0.2161	0.2484	0.2770	0.3033	0.3282	0.3522	0.3753
3000	h	75.83	174.88	275.22	378.47	487.52	610.08	1050.5	1267.0	1363.2	1440.2	1503.4	1574.8	1635.5	1701.4	1761.8
(695.33)	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	1.6218	1.6561	1.6888
	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
3200	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	1761.1
(705.08)	s	0.1276	0.2902	0.4317	0.5592	0.6788	0.7994	0.9708	1.3515	1.4300	1.4866	1.5335	1.5749	1.6126	1.6477	1.6806
	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
3500	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
	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	1.669
	v	0.0159	0.0164	0.0172	0.0182	0.0198	0.0223	0.0287	0.1052	0.1463	0.1752	0.1994	0.2210	0.2411	0.2601	0.2781
4000	h	78.5	177.2	277.1	379.8	487.7	606.5	763.0	1174.3	1311.6	1403.6	1481.3	1552.2	1619.8	1685.7	1750
	s	0.1271	0.2893	0.4304	0.5573	0.6760	0.7940	0.9343	1.2754	1.3807	1.4461	1.4976	1.5417	1.5812	1.6177	1.651
	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
5000	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
	s	0.1265	0.2881	0.4287	0.5550	0.6726	0.7880	0.9153	1.1593	1.3207	1.4001	1.4582	1.5061	1.5481	1.5863	1.621
	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	0.1818
6000	h	83.7	181.7	281.0	382.7	488.6	602.9	736.1	945.1	1168.8	1323.6	1422.3	1505.9	1582.0	1654.2	1724
	s	0.1258	0.2870	0.4271	0.5528	0.6693	0.7826	0.9026	1.0176	1.2615	1.3574	1.4229	1.4748	1.5194	1.5593	1.596
	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	0.1543
7000	h	86.2	184.4	283.0	384.2	489.3	601.7	729.3	901.8	1124.9	1281.7	1392.2	1482.6	1563.1	1639.6	1711
	s	0.1252	0.2859	0.4256	0.5507	0.6663	0.7777	0.8926	1.0350	1.2055	1.3171	1.3904	1.4486	1.4938	1.5345	1.573

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

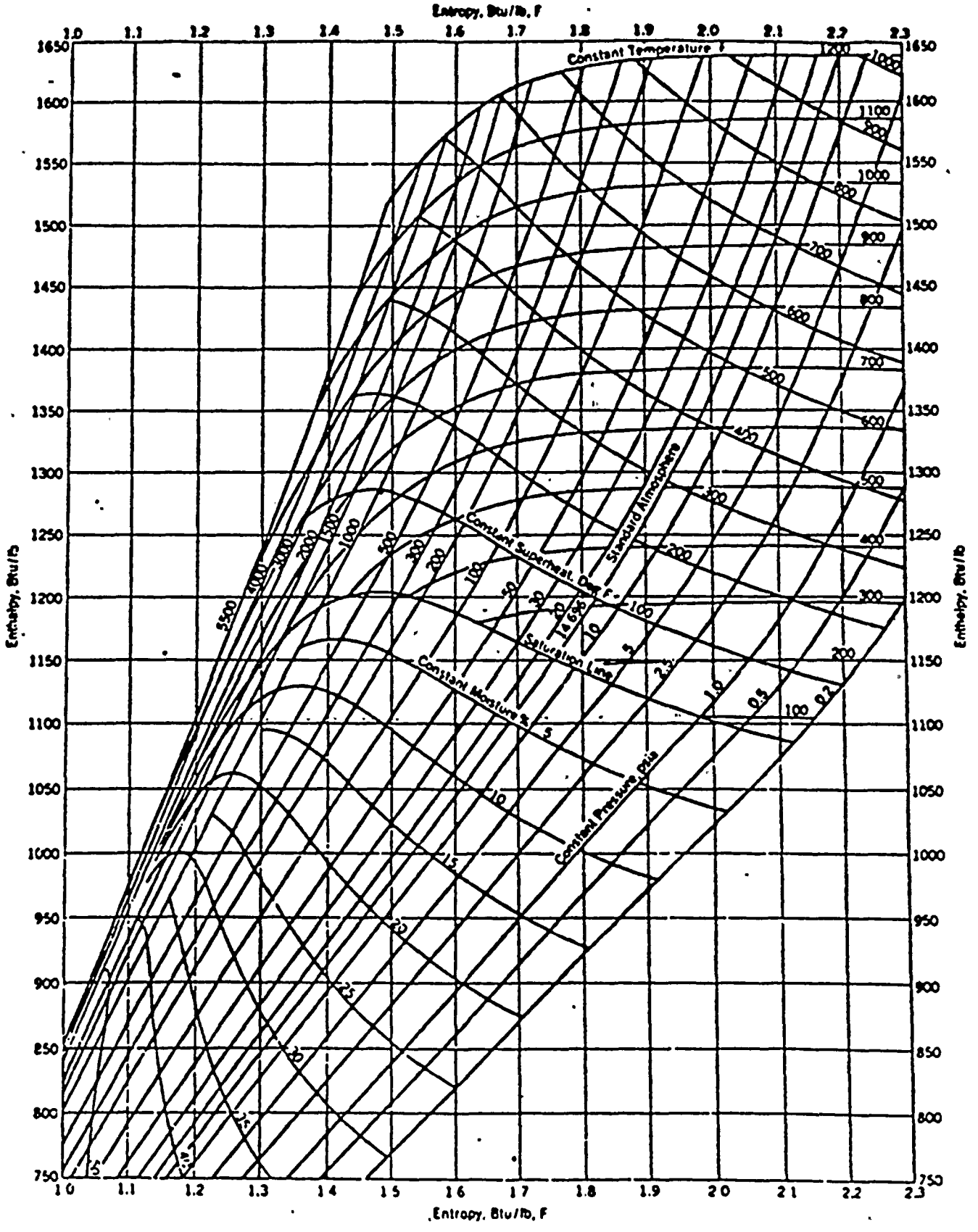

FIGURE A.5 MOLLIER ENTHALPY-ENTROPY DIAGRAM

PROPERTIES OF WATER

Density ρ
(lbs/ft³)

Temp (°F)	Saturated Liquid	PSIA							
		1000	2000	2100	2200	2300	2400	2500	3000
32	62.414	62.637	62.846	62.867	62.888	62.909	62.93	62.951	63.056
50	62.38	62.55	62.75	62.774	62.798	62.822	62.846	62.87	62.99
100	61.989	62.185	62.371	62.390	62.409	62.427	62.446	62.465	62.559
200	60.118	60.314	60.511	60.53	60.549	60.568	60.587	60.606	60.702
300	57.310	57.537	57.767	57.79	57.813	57.836	57.859	57.882	57.998
400	53.651	53.903	54.218	54.249	54.28	54.311	54.342	54.373	54.529
410	53.248	53.475	53.79	53.825	53.86	53.89	53.925	53.95	54.11
420	52.798	53.025	53.36	53.40	53.425	53.46	53.50	53.53	53.69
430	52.356	52.575	52.925	52.95	52.99	53.02	53.065	53.09	53.265
440	51.921	52.125	52.42	52.45	52.475	52.51	52.54	52.56	52.275
450	51.546	51.66	52.025	52.065	52.10	52.14	52.175	52.21	52.41
460	51.020	51.175	51.56	51.61	51.64	51.68	51.725	51.76	51.96
470	50.505	50.70	51.1	51.14	51.175	51.22	51.25	51.30	51.50
480	50.00	50.20	50.62	50.66	50.7	50.74	50.78	50.825	51.035
490	49.505	49.685	50.13	50.175	50.22	50.265	50.31	50.35	50.575
500	48.943	49.097	49.618	49.666	49.714	49.762	49.81	49.858	50.098
510	48.31	48.51	49.05	49.101	49.152	49.203	49.254	49.305	49.56
520	47.85	47.91	48.46	48.515	48.57	48.625	48.68	48.735	49.01
530	47.17	47.29	47.86	47.919	47.978	48.037	48.096	48.155	48.45
540	46.51		47.23	47.296	47.362	47.428	47.494	47.56	47.89
550	45.87		46.59	46.658	46.726	46.794	46.862	46.93	47.27
560	45.25		45.92	45.994	46.068	46.142	46.216	46.29	46.66
570	44.64		45.22	45.30	45.38	45.46	45.54	45.62	46.02
580	43.86		44.50	44.586	44.672	44.758	44.844	44.93	45.36
590	43.10		43.73	43.825	43.92	44.015	44.11	44.205	44.68
600	42.321		42.913	43.017	43.122	43.226	43.33	43.434	43.956
610	41.49		41.96	42.08	42.196	42.314	42.432	42.55	43.14
620	40.552		40.950	41.083	41.217	41.35	41.483	41.616	42.283
630	39.53								41.44
640	38.491								40.388
650	37.31								39.26
660	36.01								38.008
670	34.48								36.52
680	32.744								34.638
690	30.516								32.144

TABLE A.6 PROPERTIES OF WATER, DENSITY

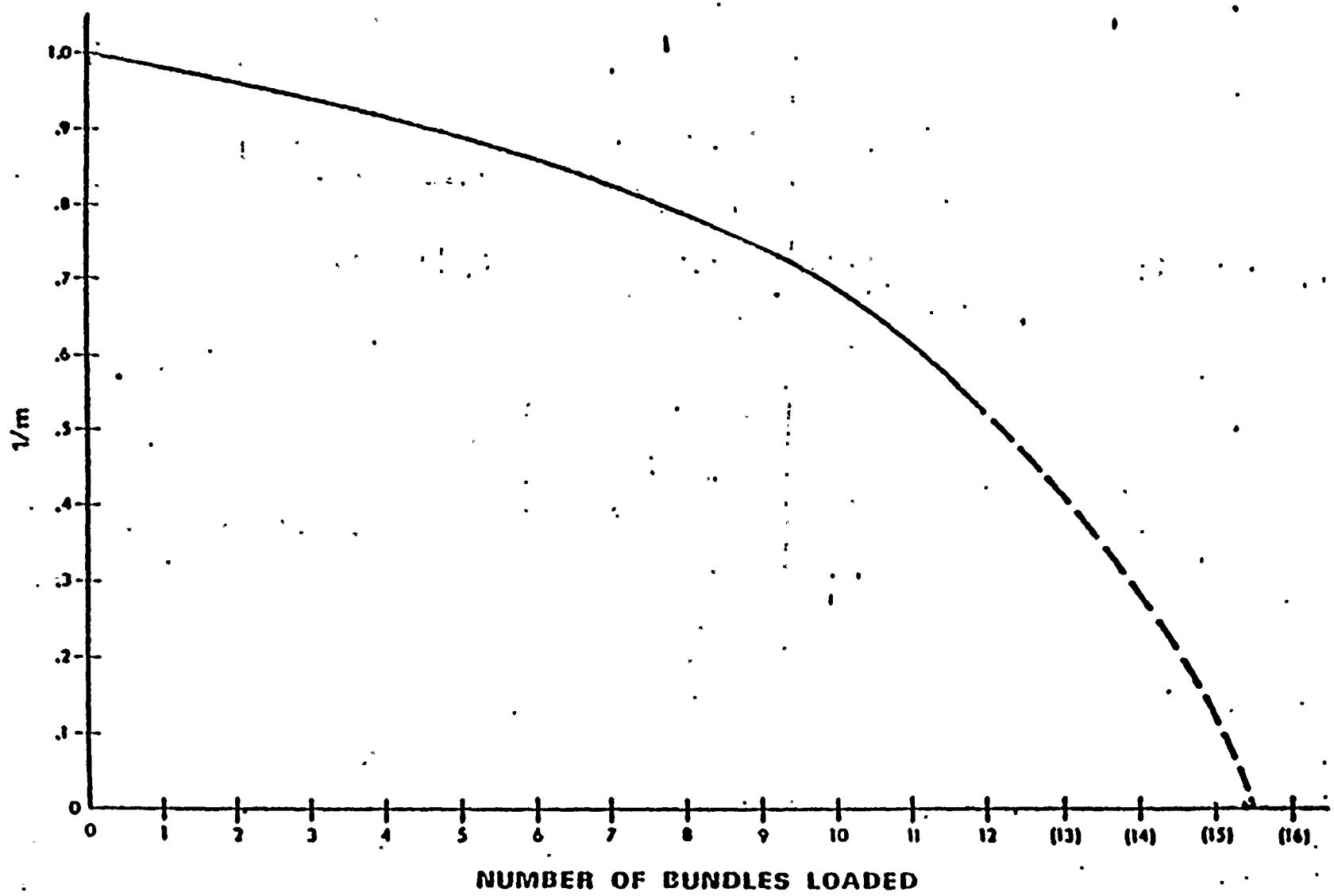
1/m
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
0
1
2
3
4
5
6
7
8
9
10
11
12
(13)
(14)
(15)
(16)
NUMBER OF BUNDLES LOADED

Figure 5 - 7

ANSWER KEY

Browns Ferry

SRO EXAM

REGION II

88/12/12

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.01 (1.00)

a.

REFERENCE
BSEP: SSM Thermalhydraulics and Thermal Limits LO# page 9-1A
BFNP: HTFF Chap 8 LO# 9.2
2.8/3.0 2.7/2.7 2.9/3.0
293008K129 293008K130 293008K131 ...(KA'S)

ANSWER 5.02 (1.50)

a) Any 3 of the following at (0.25) each:
Power
Core Flow
Pressure
Inlet temperature (inlet subcooling)

b) MAPRAT = APLHGR(act)/MAPLHGR(LCO) -(or MAPLHGR/LIMLHGR) (0.25)

c) The clad temperature will not exceed 2200 F during a DBA (LOCA). (0.50)

REFERENCE
BSEP: SSM Thermalhydraulics and Thermal Limits LO# page 9-1A
BFNP: HTFF Chap 9 LO# 3.3,4.6
3.3/3.7 3.1/3.6 3.1/3.6
293009K110 293009K113 293009K121 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.03 (1.50)

(0.50) each:
a) 295 F (+/- 15 F)
b) Increase
c) 450 psia (+/- 50 psia)

REFERENCE
BSEP: SSM Steam LO# page 4-1
BFNP: HTFF Chap 3 LO# 1.1,1.3,1.4
3.4/3.6 2.8/3.2 3.3/3.5 3.3/3.4
218000A101 293003K123 293002K504 293002A101 ...(KA'S)

ANSWER 5.04 (1.00)

d.

REFERENCE
BSEP: SSM 2A Chapter 15 LO# 63
BFNP: Reactor Theory Chap LO#
3.2/3.5
292008K130 ...(KA'S)

ANSWER 5.05 (1.00)

d.

REFERENCE
BSEP: SSM 2A Chapter 13 LO# 48,49
BFNP: Reactor Theory Chap 3 LO# 1.1,1.2,1.3
2.9/3.0
292003K101 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.06 (1.00)

b.

REFERENCE
BSEP: SSM Thermalhydraulics and Thermal Limits LO# 3.
BFNP: HTFF Chap 9 LO# 4.6
3.3/3.7 2.9/3.3 2.8/3.2 2.7/3.2 2.6/3.1
293009K118 293009K122 293009K123 293009K124 293009K126
...(KA'S)

ANSWER 5.07 (1.00)

c.

REFERENCE
BSEP: SSM 2A LO# 46,47,59
BFNP: Reactor Theory LO# 2.3
2.8/3.0
293008K129 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.08 (1.50)

(0.50) each:
a) TRUE
b) FALSE
c) FALSE

REFERENCE
BSEP: L/P 04-2/3-E p 66
BFNP: HTFF Chap 7 LO# 5.1.
2.6/3.1 2.3/2.9
293007K111 293007K113 ...(KA'S)

ANSWER 5.09 (1.00)

c.

REFERENCE
BSEP: SSM 20-2-A LO# j
BFNP:
2.6/2.9 3.5/3.4
245000K507 245000G009 ...(KA'S)

ANSWER 5.10 (1.00)

c.

REFERENCE
BSEP: SSM 2A LO# 65
BFNP: Reactor Theory Chap 3 LO# 1.5
3.5/3.5 3.2/3.5 3.2/3.3
292002K107 292002K110 292002K111 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.11 (1.00)

c.

REFERENCE
GGNS: HTFF pg. 6-95,96 LO# 10.12,.10.14
BFNP: HTFF Chap 6 LO# 4.1
2.5/2.6 2.4/2.5 2.6/2.7
293006K108 293006K111 293006K117 ...(KA'S)

ANSWER 5.12 (1.00)

b.

REFERENCE
GGNS: OP-PC-505 Pg 6-10
BFNP: Degraded Core (NEDE-30050A)
2.6/2.9
223002K509 ...(KA'S)

ANSWER 5.13 (1.00)

(0.50) each:
a) TRUE
b) FALSE

REFERENCE
GGNS: HTFF Chap. 4 LO# 10.4,10.6
BFNP: HTFF Chap 4 LO# 9.4
2.5/2.6 2.6/2.7
293004K113 293004K114 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.14 (1.00)

Long-lived delayed neutron precursors continue to supply neutrons after the scram. This (-80 sec) period corresponds to the half-life of the longest lived delayed neutron precursor.

REFERENCE
BFNP: Reactor Theory Chap 3. LO# 5.5
3.7/3.7
292003K107 ...(KA'S)

ANSWER 5.15 (1.00)

d.

REFERENCE
BFNP: HTFF Chap 6. LO# 6.1
2.9/3.1 3.1/3.1
291002K104 291002K105 ...(KA'S)

ANSWER 5.16 (1.00)

c.

REFERENCE
GE Reactor Theory, pg 7-9,10.
292008K108 (4.1)...K/A VALUE
292008K108 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.17 (1.00)

fission product poisoning (Samarium) (0.50) and fuel depletion (0.50).

REFERENCE
GE Reactor Theory, pg 1-33 and 38.
292002K114(2.6)

292002K114 ...(KA'S)

ANSWER 5.18 (1.00)

Causes decrease in natural circulation (core flow) which Increases voiding (1.00)

REFERENCE
EOP Training Supplement pg 149.

295037EA202(4.1)...K/A VALUE
295037A202 ...(KA'S)

ANSWER 5.19 (1.50)

(0.50) each:
a) Moderator coefficient
b) Void coefficient
c) Doppler coefficient

REFERENCE
GE Reactor Theory, Chapter 4
201003K507(3.3) 292003K119(3.1) 292008K121(2.9)
201003K507 292003K119 292008K121 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.20 (1.50)

(0.50) each:
a) decrease
b) increase
c) increase

REFERENCE
GE Reactor Theory pg 5-9 to 5-16.
292005K109(2.5) 201003K506(2.7)
292005K109 201003K506 ...(KA'S)

ANSWER .5.21 (2.50)

a) (0.50) each:
(1) (The magnitude of the change in the count rate) becomes larger as Keff increases.

(2) (The rate at which the count rate increases) becomes larger.

(3) (The time it takes to reach a new equilibrium count rate) will become longer.

b) The critical control rod position is a function of Keff or reactivity of the reactor and is not a function of the source count rate (1.00).

REFERENCE
GE Reactor Theory pg 3-5 to 3-13.
292003K101(2.9)...K/A VALUE
292003K101 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.22 (1.50)

(0.50) each:
a) increases
b) decreases
c) increases

REFERENCE
GE Heat Transfer and Fluid Flow pg 6-73 to 6-110.
256000A101(2.9) 256000A201(3.3) 259001A101(3.3) 259001A203(3.6)
...K/A VALUE
256000A101 256000A201 259001A101 259001A203 ...(KA'S)

ANSWER 5.23 (1.00)

(Thermal power increase is developed after the initial neutron flux increase due to the fuel time constant). Since APRM's sense flux, not thermal power (0.50), the simulated fuel time constant provides a trip signal that is analogous to thermal power. (0.50).

REFERENCE
GGNS: OP-LP-SYS-LP-C51-4-02 pg. 9 of 28 LO #3a.,9b.,9c.
BFNP: OPL171.022 LO# K
4.0/4.0 4.1/4.2 3.7/3.7 4.1/4.1 3.8/3.9 3.5/3.6
215000K101 215000K402 215000K407 215000A104 215000A204
215000G007 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 5.24 (1.00)

(0.50) each:

a) Most neutrons at the detector are from the source. The effect of neutrons from fuel are seen later.

b) (Since curve does not turn until very close to critical), a linear fit would predict criticality with a greater number of fuel bundles than actually required.

REFERENCE
BFNP: OPL171.053 LO# 5.
...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.01 (1.00)

(0.25) each:
a) 1. SRM count rate < 100 cps and IRM's < Range 3 (Wrong Position)
2. One (or more) IRM range switch(es) below range 3 and < 3 cps (DNSCL)

b) 1. All IRM range switches on range 8 or above
2. Mode switch in RUN

REFERENCE
LESSON PLAN ON SRM SYSTEM PG 18 AND 19.
.OBJECTIVE E AND H.
215004A304(3.6) 215004K401(3.7) 215004K406(3.2)...K/A VALUE
...K/A VALUE
215004A304 215004K401 215004K406 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.02 (1.50)

a) (The RBM system compares the LPRM averaging circuit output) (~~0.25~~) to the APRM reference power level (0.25) and increases the gain if the averaging circuit output is less than the APRM reference power level (0.25) (until the averaging circuit 's output is equal to or greater than the reference APRM signal. (~~0.25~~))

b) (0.25) each:
(1) Local power may be significantly lower than core average power, making the rod being withdrawn one of abnormally high worth.

(2) Several of the highest reading LPRMs that normally input to a RBM channel might be bypassed.

REFERENCE
LESSON PLAN ON RBM PG 8 AND 9.
OBJECTIVE C AND D.
215002A301(3.1) 215002A302(3.1) 215002G007(3.8) 215002K105(3.0)
215002K106(3.0) ...K/A VALUE
215002A301 215002A302 215002G007 215002K105 215002K106
...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.03 (1.50)

a) Insertion using the emergency in switch bypasses the rod motion timer and results in a loss of the settle function. (0.50)
(Operates on insert bus solenoids directly)

b) 1. RWM insert block
2. Any select block

(2 required, 0.25 ea.)

c) RSCS (rod withdraw block) (0.50)

REFERENCE
LESSON PLAN ON RMCS PG 12, 13, AND 23.
OBJECTIVE B.1, E, AND J.
201002A302(2.8) 201002A204(3.2) 201002A402(3.5) 201002K406(3.5)
...K/A VALUE
201002A302 201002A204 201002A402 201002K406 ...(KA'S)

ANSWER 6.04 (1.25)

(0.25) each:
a) (4)
b) (3)
c) (1)
d) (5)
e) (3)

REFERENCE
LESSON PLAN ON RPS PG 6 - 13.
OBJECTIVE E.
212000G007(4.0) 212000K101(3.7) 212000K112(3.4) 212000K114(3.6)
212000K115(3.8)
...K/A VALUE
212000G007 212000K101 212000K112 212000K114 212000K115
...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.05 (1.50)

a) The rods will be in the overtravel "IN" position (0.25)

b) When the SDV has filled. (The dp across the CRD piston (Reactor pressure to SDV pressure) no longer exists.) (0.50)

c) (0.25) each:

1. The green full in lights on the full core display of panel 9-5 will be illuminated.

2. Mode switch in refuel and rod select power off will illuminate the white light over the rod select power switch.

3. OD-7 computer printout of rod positions would display a rod at any notch position other than overtravel "IN".

REFERENCE
LESSON PLAN ON RMCS OBJECTIVE E.
LESSON PLAN ON CRD HYDRAULICS PG 40.
OBJECTIVE S.
214000A201(3.6) 214000A203(3.6) 214000A301(3.4) 214000A402(3.8)
214000K103(3.3)...K/A VALUE
214000A201 214000A203 214000A301 214000A402 214000K103
...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.06 (1.75)

a) 1. Squib valve amber hold lights remain energized
2. The SLC Loss of Continuity alarm does NOT annunciate
3. Reactor power is NOT decreasing (on APRMs)
4. SLC tank level is NOT decreasing
5. The white (Flow) light above the SLC handswitch DOES NOT illuminate
6. The SLC Injection Flow alarm DOES NOT annunciate
7. SLC pump discharge pressure at relief setpoint (1425 psig)

(5 required, 0.25 ea.)

b) 1. The pump A red running light illuminates
2. Pressure is indicated on the SLC pump discharge pressure gage

(2 required, 0.25 ea.)

REFERENCE
2-OI-63 ON SLC PG 7 AND 8.
OBJECTIVE NONE
211000A202(3.6) 211000A301(3.5) 211000A302(3.9) 211000A303(3.8)
211000A304(4.3) 211000A305(4.1) 211000A307(3.7) 211000A308(4.2)
...K/A VALUE
211000A202 211000A301 211000A302 211000A303 211000A304
211000A305 211000A307 211000A308 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.07 (1.00)

d.

REFERENCE
LESSON PLAN ON PROCESS RAD MONITORING SYSTEM PG 9.
OBJECTIVE C.
272000G007(3.5) 272000K403(3.6)...K/A VALUE
272000G007 272000K403 ...(KA'S)

ANSWER 6.08 (1.75)

a) 1 (1.00)

b) (The 120 second time delay is long enough) so that HPCI has time to start (0.25) and yet not so long that Core Spray and LPCI are unable to adequately cool the fuel (0.25) if HPCI should fail to start. (0.25)

REFERENCE
LESSON PLAN ON ADS PG 5, 6, AND 8.
OBJECTIVE B, D.2, AND F.
218000K403(3.8) 218000K501(3.3) 218000K601(3.9) 218000K604(3.6)
218000K606(3.4) ...K/A VALUE
218000K403 218000K501 218000K601 218000K604 218000K606
...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.09 (1.00)

a) (The mode switch in shutdown scram is bypassed after 2 seconds) so that the operator can reset the scram with the mode switch in the shutdown position. (0.50)

b) (The operator is prevented from resetting the scram for 10 seconds in order to) ensure that all control rods have completed their scram stroke into the reactor before the scram is reset. (0.50)

REFERENCE
LESSON PLAN ON RPS PG 3 AND 15.
OBJECTIVE A AND I.
212000G004(4.2) 212000K408(4.2) 212000K412(3.9)...K/A VALUE
212000G004 212000K408 212000K412 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.10 (1.00)

Any four (4) at (0.25) each:

1. The CRD will fail to notch out (because of a loss of unlatching dp).
2. The CRD will fail to notch in (because sufficient pressure will not be produced to move the rod to the next latched position).
3. The rod will have a long settling time (as it settles back to its original position following an insertion signal).
4. The rod may not settle fully.
5. Erratic rod motion/response to control drive signals occurs.
6. Increased drive maintenance (seal damage, slow scram time, slow insert/withdraw time)

REFERENCE
LESSON PLAN ON CRD HYDRAULICS PG 39.
OBJECTIVE Z.
201001K303(3.1) 201003K101(3.2)...K/A VALUE
201001K303 201003K101 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.11 (1.75)

a) 1. The ~~red~~ green check light will be OFF
2. The red light (>3% open) (next to the vacuum breaker hand switch) will be ~~OFF~~ ON and
3. The green light (>80% open) (next to the vacuum breaker hand switch) will be OFF
4. D/W to Suppression Chamber Δp low (3 required, 0.25 ea.)

b) Drywell pressure will increase more and will probably exceed design pressure (the drywell and the torus pressures will equalize, so that each may exceed its design pressure) (0.50) because the steam will flow directly from the drywell to the torus air space, short cycling/defeating the pressure suppression function of the water volume in the torus. (0.50)

REFERENCE
LESSON PLAN ON PRIMARY AND SECONDARY CONTAINMENT SYSTEMS PG 21 AND 22.
OBJECTIVE E AND F.
TECH SPECS BASES ON VACUUM RELIEF PG 4.7-44.
223001A209(3.4) 223001A302(3.4) 223001A303(3.4) 223001K303(3.4) 223001K609(3.4)...K/A VALUE
223001A209 223001A302 223001A303 223001K303 223001K609 ...(KA'S)

ANSWER 6.12 (1.00)

c.

REFERENCE
LESSON PLAN ON EDGS PG 10 AND 11.
OBJECTIVE E AND F.
264000A206(3.4) 264000K402(4.0) 264000K408(3.8)...K/A VALUE
264000A206 264000K402 264000K408 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.13 (1.00)

The HPCI system employs a DC powered oil pump to open the control valve upon initiation (0.50).

The RCIC system employs a shaft driven oil pump to operate the governor (therefore, the governor valve must be open initially). (0.50)

REFERENCE
BSEP: 14-B, LO# 4.,10.
14-C, LO# 4.,8.
BFNP: OPL171.040
OPL171.042
4.3/4.3 3.5/3.5 3.4/3.5 3.7/3.7 4.1/4.2 2.8/2.8 3.3/3.3 3.5/3.5
3.8/3.7
206000K407 206000A203 206000A215 206000A404 206000G007
217000K201 217000A205 217000A301 217000G007 ...(KA'S)

ANSWER 6.14 (1.00)

Ensures there will be no rod binding or excessive hydraulic forces (high dP) on the control rod (during insertion (scram)) (1.00).

REFERENCE
BSEP: HO-28-2/3-A
BFNP: OPL171.005 LO# G
3.4/3.4 3.8/3.8 3.6/3.7 3.8/3.9 2.6/2.7 3.0/3.0
201001K107 201001K405 201001K604 201001A204 201001A211
201001A301 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.15 (1.00)

c.

REFERENCE
BSEP: HO-10-2/3-A Figure 5, p.79
BFNP: OPL171.007 LO# D
3.6/3.6 3.0/3.1 3.3/3.3 2.8/2.8 3.2/3.3 3.8/3.8
202001K105 202001K404 202001A109 202001A410 202001A411
202001G007 ...(KA'S)

ANSWER 6.16 (1.00)

a) The bus being transferred will momentarily be de-energized (0.50) (causing a Scram signal from that RPS bus).

b) (With a Scram signal present on the unaffected bus), this would result in a full scram. (0.50).

REFERENCE
BSEP: OP-03
HO-28-3-A, LO# i.
BFNP: OPL171.028 LO# C
OI-99 step 8.1.12
3.4/3.6 3.2/3.3 3.0/3.1 3.1/3.1 3.6/3.8 3.7/3.9
212000K104 212000K201 212000K403 212000K404 212000K601
212000A202 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.17 (1.00)

a) The ball valve is prevented from closing. (0.50)

b) Firing the Shear Valve (for the affected probe). (0.50)

REFERENCE
BSEP: OP-9.1
HO 25-F LO# 3.,4.,5.
BFNP: OPL171.023 LO# B
OPL171.017 LO# E
3.3/3.4 2.6/2.7 3.4/3.5 3.1/3.4 3.4/3.7 2.8/3.0
215001K105 215001K109 215001K401 215001K604 215001A207
215001G007 ...(KA'S)

ANSWER 6.18 (1.00)

c.

REFERENCE
BSEP: HO 10A, LO# 3.,4.,11.
BFNP: OPL171.008 LO# A
3.1/3.1 3.8/3.9 3.5/3.5 3.1/3.2 3.3/3.4 3.1/3.1 3.3/3.3 3.6/3.6
3.4/3.5
259001K116 259001K312 259001K411 202002K109 202002K409
202002K605 202002A206 202002G007 259002K116 ...(KA'S)

ANSWERS --- Browns Ferry -88/12/12-REGION II

ANSWER 6.19 (1.00)

When rod density >50% (0.25) the RSCS uses the "full in" or "full out" reedswitch (0.25). When in notch control (<50% rod density to 32% 30% power) (0.25) the position indication is assumed by a circuit counting pulses (settle) generated by the rod movement control switch (0.25).

REFERENCE
BSEP: H027-3-C LO# c.,e.
BFNP: OPL171.025 LO# C.,F.
3.2/3.3 3.1/3.1 3.2/3.2 3.3/3.3 3.3/3.6 3.7/3.7
201004K101 201004K103 201004K405 201004K601 201004A201
201004G004 ...(KA'S)

ANSWER 6.20 (1.00)

a.

REFERENCE
BSEP: GP-03
H0-19-2/3-B, LO# 9.
BFNP: OPL171.
3.2/3.3 3.0/3.2
245000K101 262001K105 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.21 (1.00)

b.

REFERENCE
BSEP: HO-27-2C LO# d.,e.
HO-27-2B LO# 4.,5.,7.
BFNP: OPL171.025 LO# H
3.4/3.6 3.4/3.5 3.2/3.3 3.5/3.5 3.2/3.1 3.6/3.6 3.6/3.7 2.8/3.0
3.3/3.4 3.3/3.4 3.1/3.3 3.3/3.5 3.3/3.3 3.7/3.7 3.9/3.9 3.4/3.4
3.2/3.3 3.2/3.5 3.5/3.5 3.4/3.5 2.9/3.0 3.2/3.3 3.4/3.5 3.1/3.5
3.5/3.4 3.2/3.4 3.3/3.2 3.4/3.4 3.4/3.5 3.3/3.2 3.7/3.5
201002K103 201002K105 201002K106 201002K402 201002A204
201002G004 201002G007 201004K104 201004K403 201004K406 20100
4K502 201004K503 201004A101 201004G004 201004G007 201006K101
201006K108 201006K301 201006K402 201006K404 201006K502
201006K510 201006A102 201006A205 201006A304 201006A401 20100
6A404 201006G004 201006G007 201006G008 201006G009 ...(KA'S)

ANSWER 6.22 (1.25)

a) If a withdraw signal is sent to the directional control valves (0.25) for more than 2 seconds (0.25) the auxiliary timer will time out. (When the auxiliary timer times out,) it will generate a select block (which will deselect the rod). (0.25)

b) This prevents a faulty master timer from causing an uncontrolled withdrawal signal. (0.25)

c) Using CRD notch override switch (0.25)

REFERENCE
BSEP: SSM, RMCS, LO# d.
BFNP: OPL171.029 LO# D
3.2/3.2 3.4/3.6 3.4/3.4 2.7/2.7 3.5/3.5 2.5/2.5 2.7/2.8 2.9/2.8
3.6/3.6 3.6/3.7
201002K101 201002K103 201002K301 201002K401 201002K402
201002K407 201002A201 201002A203 201002A303 201002G004 20100
2G007 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 6.23 (1.00)

b.

REFERENCE
BSEP: SSM 14D LO# 2.,10.
BFNP: OPL171.044 LO# E.8
3.4/3.6 3.5/3.7 3.2/3.4 3.2/3.2 3./3.4 3.0/3.0 2.8/2.9.3.5/3.5
226001K101 226001K102 226001K409 226001K613 226001A105
226001A204 226001A213 226001A407 ...(KA'S)

ANSWER 6.24 (1.00)

b.

REFERENCE.
BFNP: OPL171.077 LO# 5
...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.01 (1.00)

c.

REFERENCE
BFNP: GOI-100-3 LO# C
OPL171.053 LO# 6.
3.3/3.4 2.9/3.6
295023A106 295023G007 ...(KA'S)

ANSWER 7.02 (1.00)

d.

REFERENCE
BFNP: OI-66 LO# I
3.3/3.6 3.8/4.1
271000G015 271000K404 ...(KA'S)

ANSWER 7.03 (1.00)

a.

REFERENCE
BFNP: OI-70 LO# A
AOI-70
LP-171.047
3.8/4.1 3.3/3.4 2.9/3.2
295018K302 295018A103 295018G011 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.04 (1.00)

The Turbine Stop Valve position scram is armed when power is above 30% (142 psig) as sensed by 1st stage pressure (0.50). In Shell Warming, the stop valves are closed (0.50).

REFERENCE
BFNP: OPL 171.010 LO# D
OI-47
3.6./3.7 3.3/3.5 3.2/3.4 4.0/4.1
212000A212 212000K110 245000G001 245000K104 ...(KA'S)

ANSWER 7.05 (1.00)

a) Minimizes the possibility of damage to the turbocharger thrust bearing. (0.50)

b) Manual Slow starts (0.25) from the Engine (local) control cabinet (panel). (0.25)

REFERENCE
BFNP: OI-82 LO# A
3.7/3.7 3.7/4.2
264000A404 264000G001 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.06 (1.00)

a) To distribute heat evenly in the suppression pool. (0.50)

b) (Steam would not be condensed) and rapidly pressurize the containment. (0.50)

REFERENCE
BSEP: EOP-01-UG
14C, LO# 8.
BFNP: OPL155.001
3.6/3.8 3.4/3.6 3.8/4.1 3.9/3.8 3.4/3.4 3.7/3.7 3.8/3.9 4.0/4.0
3.8/3.9 3.6/3.6 3.8/3.7 3.4/3.5
239002K107 239002K404 239002A108 239002G009 239002G010
206000K106 206000K401 206000A201 206000G010 217000K103 21700
0A202 217000G010 ...(KA'S)

ANSWER 7.07 (1.25)

(0.25) each:
a) 1. The Full Core Display will have no digital display
2. "rod overtravel" alarm
3. "Rod drift" alarm
4. Rod drift light 5. No backlight
b) NOTCH withdrawal (0.50)

REFERENCE
BSEP: GP-02
OP-07
BFNP: AOI-85-2
3.2/3.3 3.2/3.4 3.8/3.9 3.2/3.3 3.3/3.4 3.7/3.8 3.7/3.6 3.6/3.7
3.5/3.6 3.6/3.4 3.2/3.2 3.4/3.3
201003K101 201003K301 201003K402 201003K405 201003K503
201003A202 201003A301 201003G001 201003G004 201003G008 20100
3G010 201003G013 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.08 (1.50)

Assures a sufficiently rapid depressurization rate (0.50) to limit peak clad temperature to below 2200 F (0.50) with one or more low pressure ECCS systems to recover the core (0.50).

REFERENCE
BSEP: GE ERG Background Document
BFNP: OPL155.001
3.8/3.9 4.3/4.4 4.4/4.4 4.3/4.3 3.8/4.0 3.4/3.4 3.9/3.8
239002K101 239002K303 239002A401 239002A405 239002G001
239002G010 239000G013 ...(KA'S)

ANSWER 7.09 (1.00)

b.

REFERENCE
BSEP: EOP-1-LPC LO# 27,28
BFNP: EOI-01 C5-2.1
4.4/4.5 4.0/4.2 4.3/4.5 4.1/4.5
295037K204 295037K209 295037K302 295037K303 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.10 (1.00)

Shutdown the reactor (0.50) before the Heat Capacity Temperature Limit is exceeded (0.50) (and Emergency RPV Depressurization is required).

REFERENCE
BSEP: EOP-01-UG
BFNP: EOI-01 RC/Q-4
3.8/3.8 3.9/4.1 4.0/3.9 4.1/4.3 4.2/4.4 4.0/4.2 4.3/4.5 3.8/4.1
295015K104 295015K102 295015G010 295037K101 295037K103
295037K106 295037K302 295037K306 ...(KA'S)

ANSWER 7.11 (1.50)

Injection of large volumes of cold, unborated water (0.50) could add sufficient net positive reactivity (0.50) to induce reactor power excursion which could damage the core (0.50).

REFERENCE
BSEP: EOP-01-LPC
EOP-01-EDP
BFNP: OPL155.001
3.2/4.3 3.8/4.5
2950266003 2950266012 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.12 (1.50)

a) (MAFI is) the time it would take to go from an empty vessel to level above TAF. (0.50)

b) This is maximum time period which the core may remain completely uncovered (0.50) with no heat transfer to water or steam without exceeding 1500 F (at any point) (0.50).

REFERENCE
GGNS: OP-LP-EP/SPDS-LP-013
BFNP: OPL155.001
4.4/4.4 3.9/4.5
295031K201 295031G012 ...(KA'S)

ANSWER 7.13 (1.00)

d.

REFERENCE
GGNS: ONEP 05-1-02-IV-6 Rev 12 pg 1
BFNP: AOI-85-4
3.4/3.4 3.3/3.3 3.5/3.7 3.8/3.8 2.9/3.8 3.1/3.2 3.7/4.0
214000K106 214000K304 214000A303 214000A402 214000G005
214000G010 214000G015 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.14 (1.00)

(0.50) each:
a) ~~Results in~~ Prevents RHR minimum flow valve from opening
b) Draining of the RPV to the suppression pool (resulting in isolation of shutdown cooling on RPV low level)

REFERENCE
GGNS: IOI-3 Rev 29 pg 17
BFNP: OI-74
3.6/3.6 3.2/3.3 2.7/2.8 2.8/2.9 3.6/3.6 3.3/3.2 3.4/3.4 2.9/2.9
3.2/3.1 3.2/3.2 3.1/3.9
205000K102 205000K302 205000K407 205000K502 205000K604
205000A102 205000A105 205000A210 205000A301 205000A405 20500
0G005 ...(KA'S)

ANSWER 7.15 (1.00)

a) Reduce suppression pool heatup rate (minimize energy added to containment) (0.50)

b) (0.25) each:
SLC - adds negative reactivity
CRD - required to manually insert control rods.

REFERENCE
BFNP: OPL1S5.001
4.1/4.3 4.2/4.4 3.4/3.8 4.4/4.5 4.0/4.1 4.0/4.2 4.3/4.5 4.1/4.5
4.1/4.2 4.3/4.4 4.2/4.3
295037K102 295037K103 295037K107 295037K204 295037K205
295037K209 295037K302 295037K303 295037A202 295037A203 29503
7A205 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.16 (2.00)

a) The discharge valve is closed to prevent the reverse rotation of the tripped recirculation pump. (0.50)

b) The discharge valve is opened after 5 minutes to maintain the idle loop temperature (prevent idle loop cooldown). (0.50)

c) Assures that the changes Changes in coolant temperature at the reactor vessel nozzles and ~~The 75 F dT reduces the positive reactivity added by the idle loop startup (to an acceptably low value).~~ bottom head are acceptable. (0.50)

d) Less than 50% speed in the operating loop prevents excessive vibration of the jet pump risers (when going from one-pump to two-pump operation) (0.50)

REFERENCE
AOI-68-1 PG 2 AND 4.
OI-68 PG 5.
OBJECTIVE F. 3.6.A
TECH SPECS BASIS 3.6.F/4.6.F PG 32.
202001G006(3.0) 202001G010(3.5)...K/A VALUE
202001G006 202001G010 ...(KA'S)--

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.17 (1.25)

a) Reactor feed pumps will increase feed flow (0.25) until a turbine (RFPTs and main turbine) trip occurs (0.25) causing a reactor scram (power > 30%). (0.25)

b) (I&C Bus A should not be manually transferred to its alternate power supply to) prevent overloading Unit 3 I&C Transformer. (0.50)

alternate power supply

REFERENCE
2-AOI-57-5A PG 1 - 4.
295003A103(4.4) 295003A202(4.2) 295003A204(3.5) 295003K301(3.3)

...K/A VALUE

295003A103 295003A202 295003A204 295003K301 ...(KA'S)

ANSWER 7.18 (2.00)

a) 1. RBCCW sectionalizing valve (FCV-70-48) closes
2. RWCU pumps trip
3. RWCU system isolates

(2 required, 0.50 ea.)

b) 1. Trip both reactor recirc pumps
2. Scram the reactor

(2 required, 0.50 ea.)

REFERENCE
2-AOI-70-1 PG 2.
2-AOI-64-6 PG 2.
295012G010(3.8) 295012G011(4.1) 295018G007(3.2) 295018G010(3.4)
295018G011(3.8) 295018K101(3.5) 295018K303(3.1) 295028G010(3.9)
295028G011(4.2) ...K/A VALUE

295012G010	295012G011	295018G007	295018G010	295018G011
295018K101	295018K303	295028G010	295028G011	...(KA'S)

ANSWER 7.19 (1.00)

a.

REFERENCE
OBJECTIVE A OF BF 12.8.
BF 12.8 PG 2.
215005G002(3.1)...K/A VALUE
215005G002 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.20 (2.00)

a) Turn the handwheel until the disc comes into contact with the seat (0.50) and then do not exceed a maximum of 1/4 turn of the handwheel in the closed direction. (0.50)

b) When checking the valve full open (0.50)

c) (MSIV operation should be limited to times when steam is flowing through the line) to prevent closing the valves on corrosion products (or to prevent damage to valve seats due to closure onto corrosion products in the lowest portion of the valve). (0.50)

REFERENCE
OSIL # 47 PG 2 AND 3.
PMI-12.12 PG 45-47.
294001K101(3.7)...K/A VALUE
294001K101 ...(KA'S)

ANSWER 7.21 (1.00)

(At higher temperatures, venting could lead to removal of all noncondensibles and result in a saturated steam environment.) Subsequent condensing of the steam may reduce pressure to less than the design negative pressure (2 psig) ~~(0.50)~~ leading to potential collapse of the containment ~~(0.50)~~. 1.00

REFERENCE
BFNP: EOI-2
OPL 171.057 LO# 10.
3.8/4.0 3.6/3.8
295010K301 295010G007 ...(KA'S)

ANSWER 7.22 (0.50)

~~The (suppression chamber-to-drywell) vacuum breakers will open allowing noncondensibles to return to the drywell. (0.50)~~

Prevent* Prevent D/W pressure from becoming negative

REFERENCE
BFNP: OPL155.001
3.3/3.5
295010G007 ...(KA'S)

ANSWER 7.23 (1.00)

Operating HPCI with suppression pool level below this point would dump exhaust steam into the suppression pool airspace which could result in a loss of primary integrity. (1.00)

REFERENCE
BFNP: OPL155.001
3.7/3.7 3.5/3.7 3.7/3.8 3.4/3.6 3.6/3.6 3.5/3.5 3.3/3.5 3.1/3.2
3.4/3.5

206000K106	206000K605	206000A104	206000A207	217000K103
217000K603	217000A107	217000A218	217000G010	...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 7.24 (1.00)

(Initiation above this limit may, through the effects of convective cooling (steam condensation)), result in exceeding the negative pressure design limit of the primary containment (2 psig) ~~(0.50)~~ 1.00 leading to primary containment failure ~~(0.50)~~ 1.00.

REFERENCE
BFNP: OPL155.001
3.3/3.5
295010G007 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.01 (1.00)

a) It shall be cycled by the motor operator (0.50) (prior to being declared operational).

b) Torque switch could become activated before the valve is off its seat (improper operation of the opening circuitry). (0.50)

REFERENCE
BFNP:OSIL #47 LO# T
3.4/3.4
291001K107 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.02 (1.25)

a) Any two (2) of the following at (0.25) each:

(1) The cause of the reactor scram has been identified and is understood.

(2) There should be reasonable assurance that the unit will not scram again due to the same causes.

(3) The responses of safety related equipment are understood and acceptable for safe operation.

b) Plant manager (0.25)

c) (0.25) each:
(1) Scram Committee will investigate the scram.

(2) PORC will make the recommendation on unit restart to the Plant Manager.

REFERENCE
BFNP: SP 12.8 LO# C,D,E
x.x/3.8 x.x/4.1
296006A206 ...(KA'S)

ANSWER 8.03 (1.00)

d.

REFERENCE
BFNP: SP 12.24 LO# B,C
10CFR50.54
3.3/3.8 3.3/4.3
294001K103 294001A111 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.04 (2.00)

TS 3.7.b.1 (two (2) SBGT trains to be operable at all times when secondary containment integrity is required) (0.50). (The TS definition of OPERABLE requires both normal and emergency power sources available.) Since both A and D diesel generators are not operable, emergency power to A and B SBGT fans is not available. (0.50)

TS 3.7.c.1 (0.50) Since both trains of SBGT are inoperable, secondary containment integrity cannot be met. (0.50)

REFERENCE
BFNP: TS 3.7.b.1,3.7.c.1
3.0/4.1
261000G005 ...(KA'S)

ANSWER 8.05 (1.00 ~~1.50~~)

TS 3.5.b.9 (0.50)
TS 3.5.c.7 (0.50)
~~TS 3.7.A.1.a (0.50)~~

REFERENCE
BFNP: TS 3.5.b.9 and 3.5.c.7 LO# 2,23,25
LER 50-296-85007
LER 50-296-85017
LER 50-259-86009
3.5/4.4 3.1/3.9
203000G005 205000G005 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.06 (1.00)

b.

REFERENCE
BFNP: Unit 1 TS 1.0.V.3

...(KA'S)

ANSWER 8.07 (1.00)

d.

REFERENCE
BFNP: OSIL #35 LO# K
TS 3.7.c LO# 76
3.3/3.4 3.3/4.2 4.2/4.2
290001G010 290001G011 294001A102 ...(KA'S)

ANSWER 8.08 (1.00)

c.

REFERENCE
BFNP: TS 3.7 LO# 2,76
2.9/3.8
204000G005 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.09 (2.00)

(0.50) each:

Change made by member of plant staff knowledgeable in the area affected by the procedure.

Change approved by Section Supervisor responsible for the procedure and a member of the plant staff who holds a SRO license.

Change reviewed by PORC

Change approved by Plant Manager

REFERENCE
BFNP: TS 6.0.B
PMI-8.1 LO# G,H
2.9/3.4
294001A101 ...(KA'S)

ANSWER 8.10 (1.00)

a.

REFERENCE
BFNP: Unit 1 TS 1.1.C
OPL174.728 LO#3
3.2/3.7
293009K118 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.11 (1.00)

d.

REFERENCE
BFNP: OPL174.728 LO#2
TS
2.7/3.5
2950186004 ...(KA'S)

ANSWER 8.12 (0.75)

(0.25) each:
1) System fails to operate
2) System operates in a suspected adverse manner
3) System operates outside of the limits of the acceptance criteria

REFERENCE
BFNP: SP 10.9 LO# B
PMI-17.1
3.9/4.5
294001K102 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.13 (2.00)

a) Ensure inadvertent transfer of significant amount of containment fluids will not occur. (1.00)

b) (0.50) each:
1) Continued operation of the engineered safety features will result in an unsafe plant condition (with regard to either personnel or operability of safety features).

2) The plant is in a stable condition (in which technical specifications clearly indicate that) operability of the engineered safety feature is no longer required.

3) When directed by the EOIs.

REFERENCE
BFNP: SP 12.17 LO# A,B
3.4/3.5 3.6/3.5
223002K406 223002A403 ...(KA'S)

ANSWER 8.14 (1.25)

(0.25) each:
1) Most reactive condition during the operating cycle
2) Strongest control rod fully withdrawn
3) All other OPERABLE control rods fully inserted
4) Cold conditions
5) Xe free

REFERENCE
BFNP: U2 TS 3.3,Bases
OPL171.058 LO# 9
3.3/3.9 2.8/3.7
201003G005 201003G006 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.15 (1.00)

Control rod scram timing cannot be performed (because the RWM is inoperable and second party verification cannot be used). (1.00)

REFERENCE
BFNP: Unit 1 TS 3.3.B.3.a, 3.3.B.3.b, 4.3.C.1
3.2/4.0
2010066005 ...(KA'S)

ANSWER 8.16 (1.00)

d.

REFERENCE
BFNP: BFN-EPIP-6
OPL171.075
2.9/4.7
294001A116 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.17 (1.50)

a) Entry for tour, data taking, or observation provided they are knowledgeable of the radiological conditions in the area. (0.50)

b) Any four (4) at (0.25) each:
1) Employee may receive whole body dose greater than 50 mR in any regular work day.
2) Whole body dose rates greater than 100 mR/hr (high radiation area)
3) Airborne radioactivity greater than 25% MPC
4) Work in contaminated areas
5) When radiation or contamination hazards for a particular job are unknown or for other reasons which the RADCON Shift Supervisor (or representative) deem appropriate
6) Radiographic operations conducted on the Browns Ferry site.

REFERENCE
BFNP: RCI-1
RCI-9
3.3/3.8 3.3/3.6
294001K103 294001K104 ...(KA'S)

ANSWER 8.18 (1.00)

b.

REFERENCE
BFNP: Unit 1 Technical Specification 3.5.E.2
3.6/4.3
206000G005 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.19 (1.00)

c.

REFERENCE
GGNS TS 3.5.1
OP-PB-601 Rev 1 LO# 4
BFNP: Unit 1 TS 3.6.D.1,3.5.G.2
3.5/4.4 3.6/4.3
203000G005 218000G005 ...(KA'S)

ANSWER 8.20 (1.00)

~~b.~~ a.

REFERENCE
GGNS: OP-PB-601 LO#4
TS 3.8.1.1
BFNP: Unit TS 3.5.A.3
2.9/3.9 3.4/4.1
262001G005 264000G005 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.21 (1.00)

a) The oxygen concentration and temperature (in Mode 2) promote chloride stress corrosion (so chloride must be limited to a smaller amount). (0.50)

b) When the conductivity is within limits, the ph, chlorides, (and other impurities affecting conductivity) must also be within their acceptable limits. (0.50)

REFERENCE
GGNS TS Bases 3.4.4 pg B3/4 4-3
OP-PB-601 Rev 1 LO# 4
BFNP: U3 TS Bases 3.6.B/4.6.B
OPL171.058 LO# 42
2.9/3.6 2.7/2.9
256000G005 256000A108 ...(KA'S)

ANSWER 8.22 (0.50)

(0.25) each:
1) Classify the event (in accordance with EPIP-1)
2) ~~Downgrade (de-escalate) to a lower classification~~
Protective action recommendations

REFERENCE
GGNS 01-S-06-2 Rev 20 pg 21 6.3.2
OP-LO-AD-LP-001-02 LO# 2,4
BFNP: OPL171.075 LO# 5
2.9/4.7
294001A116 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.23 (1.00)

a.

REFERENCE
GGNS: TS 3.9.10.2
OP-PB-601 Rev 1 LO# 4
BFNP: U2 TS 3.3.B.1,3.3.A.1,3.3.10.A.2

3.0/4.1
234000G005 ...(KA'S)

ANSWER 8.24 (1.50)

(0.50) each:
RHR - TS ~~1.C.1~~ 1.C.2
ADS - TS 3.2.B action A
Suppression Pool - 3.7.A.1.a

REFERENCE
GGNS: TS 3.7.3,3.5.1,3.5.3
OP-PB-601 Rev 1 LO# 4
TS 3.5.1,3.5.3,3.6.3.1,3.0.3,3.7.3,3.3.1
BFNP: U3 Technical Specifications
3.3/4.3 3.5/4.4 3.6/4.3
217000G005 203000G005 218000G005 ...(KA'S)

ANSWERS -- Browns Ferry -88/12/12-REGION II

ANSWER 8.25 (0.50)

a) Excessive (or significant) exposure (> 50 mrem) to radiation (0.25)

b) SOS (or ASOS) (0.25)

REFERENCE
OBJECTIVE A OF BF 3.15.
BF 3.15 PG 5.
294001K102(3.9)...K/A VALUE
294001K102 ...(KA'S)