EXAMINATION REPORT 50-453/OL-85-01

Facility Licensee: Gulf States Utilities
P. O. Box 2951
Beaumont, Texas 77704

Facility Docket No: 50-458

Facility License No:

Examination Conducted: River Bend Station (RBS)

Chief Examiner: David N. Graves
David N. Graves, Operator Licensing Section — Date 3/15/85

Approved: R. A. Cooley
R. A. Cooley, Section Chief, OLS — Date 3/15/85

Summary

Examinations were administered to eight reactor operator candidates and twenty-two senior reactor operator candidates. Eight senior reactor operator candidates failed. No reactor operator candidates failed.

DETAILS

1. Persons Examined

Written and oral/simulator operating examinations were administered to eight reactor operator candidates. All candidates passed all portions of these examinations.

Written and oral/simulator operating examinations were administered to twenty-two senior reactor operator candidates. Four candidates failed the written examination. Four candidates failed the oral portion of the operating examination. Four candidates failed the simulator portion of the operating examination. This resulted in a total of eight different candidates failing at least one portion of the examination.

2. Examiners

D. N. Graves (Chief Examiner), NRC
J. L. Pellet, NRC
J. C. Kvamme, EG&G Idaho
D. E. Hill, EG&G Idaho

3. Examination Report

This report is composed of the following sections:

a. Examination Review and Comment Resolution

b. Exit Meeting

c. Master copies of the Reactor Operator and Senior Reactor Operator written examinations and answer keys.

a. Examination Review and Comment Resolution

This section reflects the comments made by the facility during the examination review meeting held after completion of the written examinations. The comments accepted by the NRC reviewers are incorporated into the master copies of the examinations. The following personnel participated in the review:

NRC	Utility	
D. N. Graves	B. Price	B. Byrd
J. L. Pellet	J. Peters	B. Hobbs
	L. Miller	S. Blake
	L. Baker	R. Persons

Comments and resolutions are listed by section question number.

Comments

1.01	Equally correct but more detailed responses for "Temperature Effects," are "Doppler or Fuel Temperature Effects" and "Moderator Temperature Effects."
Resolution:	Agree. Key modified to accept as separate answers.
1.02a.	Another reason that should be included as possible responses on the answer key should be, "to provide a signal to noise ratio of at least 3:1," per the Simulator Text, page 16-8. Also applies to question 5.01a.
Resolution:	Accepted signal to noise ratio and to provide background level of indication as acceptable.
1.02b.	Questions asks for primary intrinsic source at BOL and EOL. Answer key addressed spontaneous fission at BOL and photo-neutron at EOL. Candidate could interpret question as primary isotope at BOL. Full credit should also be given for: Curium is the primary contributor to intrinsic source neutron population. Also applies to question 5.02b.
Resolutions:	Not accepted. Question asks for methods of production.
1.12b.	Question wording was difficult to understand. This should be taken into account in credit assignment. It did not include the important assumption provided in GOP-0002, page 8. If candidate did not make this assumption, an increase in KW output would be correct, due to reactor power increase from colder feedwater.
Resolution:	Agree. Key modified.
2.03	Answer key states "500 psig" is the pressure permissive allowing manual operation of the LPCI injection valve. Due to a recent change, the permissive is now 50 psig. Candidates may respond with either answer and should be allowed full credit.
Resolution:	Agree. Key modified.
2.05b	"Water leg fill pumps" should be an acceptable full credit answer.
Resolution:	Agree.

2.06a RHR steam condensing mode is also a potential source of heat input to the suppression pool via the following two flow paths detailed in the steam condensing mode startup section of the RHR SOP-0031:

1. A continuous vent path for non-condensables from the RHR heat exchanger to the suppression pool established in step 4.4.4, page 12.

2. The initial effluent flow path for the reactor water (being condensed in the RHR HX) to the suppression pool, step 4.4.5, page 12.

Resolution: Agree. Key modified.

2.07 Regarding the motive forces for opening an SRV, in addition to the Penetration Valve Leakage Control Air System provided in the key, two other equally valid answers could be provided:

1. Reactor pressure (for the safety mode of SRV operation), or

2. The main steam safety and relief valve air supply.

This comment also applies to the answer key for question 6.05a.2 on the SRO exam.

Resolution: Agree. Key modified.

3.07a. Answer should be "4" instead of "d".
b. "Cross-around" or "cross-over" pressure should be equally acceptable for "HP turbine exhaust" pressure in answer key.

Comments also apply for question 6.06a and b.

Resolution: Agree. Key modified for part a.

4.03b. Candidates could interpret the question to mean that condenser vacuum was broken at the time of reactor shutdown. In this case, a response to the effect that, "the steam packing exhauster is not required to be operating because condenser vacuum has been broken for >4 hours," should be acceptable. This response provides a reason based on knowledge of the precaution, thus demonstrating familiarity with the procedure and its precautions. This comment also applies to question 7.02b. on the SRO exam.

Resolution: Agree.

4.10 Although the referenced AOP does not include acoustic monitor indication as a means of determining if an SRV is open, they are part of the plant design (FSK-32-8A and 8B). It seems appropriate to give credit to candidate responding with acoustic monitor as they will have this indication available in the control room and are aware of its upcoming installation.

Resolution: Agree. Key modified.

5.04b. Credit should be given for a "yes" answer based on detectors seeing delayed neutrons from fission fragment daughters formed after beta decay, per the Reactor Theory Student Handout, Figure 10.3.

Resolution: Disagree. The delayed neutron production is not the major source of decay heat.

5.11 Oxidation of the cladding should be acceptable for "embrittlement." Per page 50 of Heat Transfer and Thermal Limits Text.

Resolution: Agree. Key modified.

6.02 Two references indicate different types of detectors are used in the Off-Gas post treatment radiation monitors. Either GM or scintillation should be given full credit.

Resolution: Disagree. Further discussion with utility resulted in answer key remaining as is.

6.04a. Answer key item 4 reasoning for the auto transfer includes a reference to "End of Cycle" which may not be included in the candidates answer since the feature will be operable throughout cycle life. The reference only states that the need is greatest near end of core cycle. Also, consideration should be given to accepting "to prevent thermal limits from being exceeded" or "to ensure adequate MCPR is mentioned."

Resolution: Agree with end of cycle comment. Would not have accepted the last two answers for full credit without further explanation on candidates part.

7.07b. To answer the question, the candidate must have a knowledge of the basis for step 11 of FHP-0001 which states "RPV steam separator being lifted as reactor cavity level is increased per SOP-0091 to keep separator under water during lift." The basis cannot be located in any plant reference material.

Resolution: Question and answer stand as written. Reviewer acknowledged that the indicated reason for the floodup was correct, but couldn't find it in plant material.

8.05 Since the exam question does not specify the response must be from the Technical Specifications, the applicable guidance on temporary changes in ADM-0003, Development, Control, and Use of Procedures, should also be acceptable for full credit.

a. Items 6.6.7 and 6.6.8 (page 18 and 19) of ADM-0007 address the Technical Specification review requirement (6.8.3.b) by specifying, "the section supervisor, discipline supervisor, or foreman," and "the COF or SS."

b. Item 6.6.1 on page 17 of ADM-0003 provides an additional condition to be met for use of a temporary change, that being, "to continue work in progress."

Resolution: a. Agree. Key modified.
b. Agree. Key modified.

8.06 Since the question doesn't request different types of reference material, System Operating Procedures, Abnormal Operating Procedures, Emergency Operating Procedures, and Administrative Procedures should be considered for credit as individual reference items referred to in ADM-0022 as Plant Operating Procedures. It also seems appropriate that Emergency Implementing Procedures should be considered an equally correct alternate for Emergency Plan.

Resolution: Agree. Key modified.

8.09 The Shift Supervisor position of "advisor to the COF" is further detailed in OSP-0009, page 18 and 19, Item. 8.1.1 and 8.1.3, which should also be given full credit as being positions he will assume during use of EOP's.

Resolution: Disagree. Item 8.1.1. describes how the SS should perform as COF advisor. Item 8.1.3 only applies if the Emergency Implementing Procedures are utilized or required, not in all cases.

8.09b. Other equally important "ingredient," of successful EOP usage were emphasized during EOP training and should be given full credit. Candidates were trained to:

1. Have a thorough understanding of the entry conditions to know when they must use the EOP's, OSP-0009, page 19, step 8.2.1.

2. Have a thorough understanding of the intent of the EOP's, i.e., "treat the symptons."

3. As directed in Sections 8.1 and 8.2 of OSP-0009, the SS and COF are to maintain overall picture (big picture) point of view.

4. Comply verbatim with procedures as discussed in item 8.2.2, page 19 of OSP-0009.

It should also be acceptable for full credit to use the term "communication(s)" as a substitute for "dialog between COF and NCO."

Resolution: Items 1 and 2 above were added to the key. "Communications" is an acceptable substitute for "dialog."

b. Exit Meeting Summary

At the conclusion of the site visit, the examiners met with utility representatives to discuss results of the examinations. The following personnel were present for the exit meeting:

NRC	Utility
D. Graves	P. Freehill
J. Pellet	D. Ashley
D. Chamberlain	W. Odell
J. Jaudon	T. Plunkett
	J. Deddens
	W. Cahill
	B. Price (GPC)

Mr. Graves started the meeting by detailing preliminary results of the oral/simulator operating examinations with 13 of the 30 candidates being "not clear passes" as of that time. It was explained to those present that these results were extremely preliminary and subject to change during further reviews and evaluations.

General candidate weaknesses were identified to the facility. It was explained that a general weakness was a weakness displayed in more than one candidate. The identified weaknesses were as follows:

1. Radiation Work Permits

2. Radioactive Releases and/or Discharge Permits

3. Plant Fire Protection: Types of systems and detection devices in specific areas.

4. Instrument Power Supplies (not the power system, but power supplies to specific instruments).

5. Communications between operators during the simulator examination.

6. Control Board Awareness (specifically the silencing and resetting of annunciators prior to identifying them).

7. Ability of SRO's to direct and/or control plant operations.

Conditions of concern to the examiners were identified to the facility.

1. The number of people and noise level in the control room made examining more difficult. Several candidates were obviously distracted by the high level of activity in the control room.

2. The general state of plant references (operating procedures, technical specifications, administrative procedures, etc.) hindered candidates performance. Several candidates had difficulty following procedures due to the wording.

Also noted were areas where candidate performance was thought to be above average.

1. Radiation Protection: Theory, understanding, limits, etc.

2. Systems Knowledge

3. Technical Specification: Knowledge and use.

The utility was informed that the examiner would try to have results in 30 days but could not guarantee such due to the number of candidates.

Mr. Jaudon reminded the facility that the operator requalification program must be in place and begin functioning upon issuance of the operators' licenses.

The meeting concluded with the examiners thanking the staff for their efforts and cooperation during the examination.

c. Examinations

Master copies of the Reactor Operator and Senior Reactor Operator examinations are attached.

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: RIVER BEND 1

REACTOR TYPE: BWR-GE6

DATE ADMINISTERED: 85/01/22

EXAMINER: GRAVES, D.

APPLICANT: _____

INSTRUCTIONS TO APPLICANT:

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

CATEGORY VALUE	% OF TOTAL	APPLICANT'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	25.00	_____	_____	1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	25.00	_____	_____	2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
25.00	25.00	_____	_____	3. INSTRUMENTS AND CONTROLS
25.00	25.00	_____	_____	4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
100.00	100.00	_____	_____	TOTALS

FINAL GRADE _____%

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

_____
APPLICANT'S SIGNATURE

QUESTION 1.01 (2.00)

What are four (4) mechanisms that may cause the reactivity of the core to decrease during reactor operation? Specific elements or isotopes are NOT required. (2.0)

QUESTION 1.02 (2.50)

a. Give one (1) reason for maintaining a visible neutron level at all times in the reactor? (0.5)

b. What are three (3) methods of producing intrinsic source neutrons? Include which is the major contributor at BOL and EOL. Reaction equations are NOT required. (2.0)

QUESTION 1.03 (2.50)

a. As Keff approaches one, a (LARGER/SMALLER) change in neutron level occurs for a given change in Keff. (0.5)
b. As Keff approaches one, a (LONGER/SHORTER) period of time is required to reach a new equilibrium level for a given change in Keff. (0.5)
c. As Keff approaches one, the "count rate doubling" technique becomes (MORE/LESS) accurate for predicting criticality. (0.5)
d. When a count rate "doubling" has occurred, what relationship exists between the previous reactivity addition and the amount of reactivity remaining to reach criticality? (1.0)

QUESTION 1.04 (2.50)

Indicate whether each of the following is TRUE or FALSE. If FALSE, explain WHY it is FALSE. (2.5)

a. Xenon and Samarium concentrations increase following a scram from high power operation (within the first five hours).
b. Samarium is not as significant an operating concern as Xenon, even though Samarium has a higher microscopic absorption cross section than Xenon.
c. A reactor startup several days after a scram from extended high power operation is considered to be Xenon and Samarium free.
d. The equilibrium concentration of Samarium at 50% power is approximately the same as at 100% power.
e. The equilibrium concentration of Xenon at 50% power is approximately one-half the equilibrium concentration at 100% power.

QUESTION 1.05 (2.50)

For each of the following events, STATE WHICH coefficient of reactivity would act FIRST to change reactivity.

a. Control rod drop at power (0.5)
b. SRV opening at power (0.5)
c. Loss of shutdown cooling when shutdown (0.5)
d. Main turbine trips while at 30% power (0.5)
e. Loss of one feedwater heater (extraction steam isolated) (0.5)

QUESTION 1.06 (3.00)

Assume the reactor is operating at 100% power and one recirculation pump trips. Indicate how each listed indicated parameter would first change (Increase or Decrease) and briefly explain why the change occurs.

a. reactor power (one reason) (1.0)

b. reactor water level (two reasons) (1.0)

c. feedwater flow (two reasons) (1.0)

QUESTION 1.07 (2.00)

State the mode(s) of heat transfer for the following situations:

a. Center of fuel pellet out to the pellet edge (0.5)
b. Across the Helium gap in the fuel rod (0.5)
c. Clad surface to the center of the coolant channel (0.5)
d. Clad surface to coolant under film boiling conditions (0.5)

QUESTION 1.08 (1.00)

Which of the following statements BEST describes what happens to a fluid as it passes through a venturi? (1.0)

a. Pressure remains constant, but the velocity increases as the diameter of the venturi decreases.

b. Pressure increases and velocity decreases as the diameter of the venturi decreases.

c. Pressure increases and velocity remains constant as the diameter of the venturi increases.

d. Pressure increases, but the velocity decreases as the diameter of the venturi increases.

QUESTION 1.09 (1.00)

A temperature instrument with an out of date calibration sticker on it is reading 400 degrees F. A recently calibrated pressure gage sensing in the same area indicates 350 psig. Is the temperature instrument reading accurately (within + or - 2 degrees F)? If not, how close is it reading to the actual temperature? Assume the system is under saturated conditions. SHOW ALL WORK. (1.0)

QUESTION 1.10 (2.00)

Give ONE undesirable result for each of the following (Be more specific than "pump failure"):

a. Operating a centrifugal pump for extended periods of time with the discharge valve shut. (1.0)

b. Starting a motor driven centrifugal pump with the discharge valve open. (1.0)

QUESTION 1.11 (2.00)

Match one of the following numbered items with each of the four lettered statements. A letter-number sequence is sufficient. (2.0)

1.	MAPRAT	5.	PCIOMR
2.	APLHGR	6.	GEXL
3.	CPR	7.	TOTAL PF
4.	FLPD	8.	LHGR

a. Parameter by which plastic strain and deformation are limited to less than 1%.
b. Ratio of bundle power required to produce onset of transition boiling somewhere in the bundle to actual bundle power.
c. Parameter by which peak clad temperature is maintained less than 2200 degrees F during postulated design basis accident.
d. Contains guidelines restricting power ramp rates above the threshold power.

QUESTION 1.12 (2.00)

a. Isolation of extraction steam to the highest pressure feedwater heater results in a(n) (INCREASE/DECREASE) in MWe output. JUSTIFY your choice. (1.0)
b. Isolation of extraction steam to a feedwater heater other than the highest pressure heater results in a(n) (INCREASE/DECREASE) in MWe output. JUSTIFY your choice. (1.0)

QUESTION 2.01 (3.50)

a. What are the normal values for CRD HYDRAULIC SYSTEM FLOW and DRIVE WATER DIFF. PRESS. as indicated in the Main Control Room? (1.0)

b. Approximately what percentage of the flow in "a" above is supplied to the cooling water header? (0.5)

c. Explain HOW/WHY requesting single rod insertion causes cooling header flow to vary (include by how much the flow varies). (1.0)

d. The system flow in "a" above is less than the normal flow output of one pump. List three (3) taps off the CRDH system upstream of the flow sensing element. (1.0)

QUESTION 2.02 (3.00)

a. The majority of Reactor Water Cleanup pump suction flow is from _____, with a smaller portion from _____. (1.0)

b. What three (3) RWCU flow signals feed into the Leak Detection System, and HOW are they processed to indicate a leak? (2.0)

QUESTION 2.03 (3.00)

Answer the following with regard to the RHR system and its various modes of operation:

a. Match the following actions, events, or interlocks in Column A with the item in Column B that initiates that item. (1.5)

Column A	Column B
1. Shutdown cooling isolates	125 psig
2. Allows manual operation of the LPCI injection valve	135 psig
3. Input to ADS	350 psig
	400 psig
	500 psig

b. WHICH loop of RHR is the preferred loop for Shutdown Cooling operation (1.0)

c. From where does the Shutdown Cooling Mode of RHR takes its suction? Assume normal operation. (0.5)

QUESTION 2.04 (3.00)

a. How is radioactive steam prevented from leaking past the RCIC turbine gland seals into the atmosphere? (1.0)

b. List four (4) conditions that will trip the RCIC turbine. Setpoints are not required. INCLUDE all trips that must be reset locally. (2.0)

QUESTION 2.05 (1.50)

a. List two (2) reasons for maintaining the discharge piping of the ECC Systems full at all times. (1.0)
b. How is the above objective accomplished? (0.5)

QUESTION 2.06 (2.00)

a. What are two (2) heat loads that may discharge to the suppression pool (do not include LOCA)? (1.0)
b. Describe the flow path through the containment that will provide a continuous supply of water for the ECC Systems following a LOCA. (1.0)

QUESTION 2.07 (3.00)

a. What provides the motive force(s) for opening and closing the following valves (include system name if applicable): (1.5)

1. Main Steam Isolation Valve

2. Safety Relief Valve

3. Main Steam Shutoff Valve

b. Briefly describe how the Main Steam Isolation Valve Positive Leakage Control System establishes a leakage control barrier. (1.5)

QUESTION 2.08 (2.00)

a. What systems provide the normal and alternate heat sinks for the RPCCW System? (0.5)

b. Indicate what actions occur in the RPCCW System at each of the following pressures. Include pumps starting and/or stopping and valve realignments. Valve numbers not required. (1.5)

1. 100 psig

2. 56 psig

QUESTION 2.09 (2.50)

a. What are three (3) signals that will cause a diesel generator to automatically Emergency Start (exclude manual, setpoints not required)? (1.5)

b. Following an Emergency Start, what are the two (2) automatic protective trips still in effect (exclude manual, setpoints not required) for the diesel generators? (1.0)

QUESTION 2.10 (1.50)

For each of the following HPCS initial conditions, indicate the final position of the valves following an automatic HPCS initiation:

a. CST suction valve open, Suppression Pool suction valve shut (0.5)

b. CST suction valve shut, Suppression Pool suction valve shut (0.5)

c. CST suction valve shut, Suppression Pool suction valve open (0.5)

QUESTION 3.01 (3.00)

How is the integrity of the ECC piping inside the reactor vessel verified during normal operation (include sensing points, specific portion of piping verified, why it needs to be verified, and response of the instrumentation to a loss of integrity in your answer)? (3.0)

QUESTION 3.02 (3.50)

a. What are the three (3) thermal shock or differential temperature interlocks that must be satisfied in the recirculation pump starting sequences prior to starting a recirculation pump (INCLUDE SETPOINTS)? (1.5)

b. List the two (2) inputs into the ATWS recirculation pump trip circuit (include setpoints). (1.0)

c. How is an ATWS trip different from a Recirculation Pump Trip (RPT)? Answer in terms of pump power supplies only. Assume high power operation when the events occur. (1.0)

QUESTION 3.03 (3.00)

Indicate at what reactor water level each of the following actions is directly initiated. If more than one level applies, indicate all of the applicable levels. (3.0)

a. Direct reactor scram

b. Standby Gas Treatment System starts

c. RCIC starts

d. HPCS injection valve closes

e. Recirculation pumps transfer to the LFMG

f. Recirculation flow control valves run back (RFP is tripped)

QUESTION 3.04 (2.50)

a. If reactor water level decreases below _____ with the Feedwater Control System in automatic, a (HIGHER/LOWER) than normal preprogrammed setpoint is inserted for _____(time), at which time a (HIGHER/LOWER) than normal setpoint is called for. (1.0)

b. What activates the "Reactor Water Level Signal Failure" alarm? (0.5)

c. How are the steam flow and feed flow signals for the Feedwater Control System 3-element control generated (include where the signal is sensed and number of detectors required)? (1.0)

QUESTION 3.05 (4.00)

a. A reactor plant startup is in progress. For each of the following conditions, state whether or not the RCIS will allow the attempted control rod movement. (3.0)

1. The first control rod withdrawal attempt is a control rod in Group 2 ("A" sequence selected, 100% rod density).

2. Group 1 is fully withdrawn. Group 2 is still fully inserted. A withdrawal attempt is made on a control rod in Group 3.

3. Groups 1 and 2 are fully withdrawn, and a control rod in Group 3 is selected. An attempt is made to fully withdraw the rod.

4. Groups 1-4 are fully withdrawn. The next control rod selected is in Group 7 and a one-notch withdrawal is attempted.

5. Reactor power is 40% and an attempt is made to withdraw the selected control rod three (3) notches.

6. Reactor power is 75% and an attempt is made to withdraw the selected control rod three (3) notches.

b. Explain why use of the Timer Skip pushbutton to effect continuous control rod motion should be minimized. (1.0)

QUESTION 3.06 (2.50)

For EACH of the following conditions, state whether a scram, half-scram, rod block, or no action is directly generated. For conditions that produce more than one action, state the more severe action (i.e. half-scram is more severe than a rod block). (2.5)

a. Loss of one RPS MG set
b. Turbine trip at 30% power
c. Two main steam lines isolated, Mode switch in RUN
d. APRM B downscale, Mode switch in RUN
e. Scram discharge volume level is at 40 gallons, Mode switch in STARTUP

QUESTION 3.07 (3.50)

a. Which of the following provides the signal for a Turbine Control Valve (TCV) Fast Closure scram? (0.5)

   1. TCV position limit switches

   2. Rate of TCV position change

   3. Power to the TCV fast acting solenoids

   4. ETS oil pressure at the TCV

b. When is a TCV Fast Closure (NOT the scram) initiated (include setpoints, bypasses, parameters sensed, and where sensed)? (2.0)

c. How will the TCV fail (OPEN, SHUT, or AS IS) on: (1.0)

   1. Loss of electrical signal to the servo valve coils

   2. Loss of hydraulic fluid (FJS) to the control jet pipe

QUESTION 3.08 (1.00)

List four (4) systems that have components that can be operated or controlled from the Remote Shutdown System control panels. (1.0)

QUESTION 3.09 (2.00)

For each of the IRM (Intermediate Range Monitoring) range changes listed below provide the following:

- The indicated level on the NEW RANGE,
- Any automatic actions initiated as a result of the indicated level on the new range.

a. Switching from range setting 5, reading 25, up to range setting 7. (1.0)

b. Switching from range setting 6, reading 39, down to range setting 5. (1.0)

QUESTION 4.01 (1.50)

Answer the following with regard to GOP-0001, Plant Startup to Low Power Alarm Point:

a. When is the reactor determined to be critical? (1.0)

b. Control rods are withdrawn until the reactor is critical and a steady, reasonable period is achieved. Per the referenced procedure, what is a steady, reasonable period? (0.5)

QUESTION 4.02 (3.00)

Match the following events (a-f) with the approximate pressure at which they should be performed per GOP-0001, Plant Startup to Low Power Alarm Point. The pressures may be used more than once or not at all. (3.0)

a. Place steam seals in service	1. 20 psig
b. Startup the Offgas System	2. 100 psig
c. Warm up the RCIC piping	3. 150 psig
d. Startup the first reactor feed pump	4. 250 psig
e. Start turbine shell warming	5. 400 psig
f. Startup the SJAE	6. 450 psig
	7. 600 psig
	8. 850 psig

QUESTION 4.03 (2.00)

a. It is prudent NOT to operate with the auxiliary boiler supplying steam seals any longer than is absolutely necessary (per GOP-0003). Why should use of the auxiliary boiler for steam seals be minimized? (1.0)

b. The reactor has been shutdown five (5) hours. Main condenser vacuum is broken. Why is it necessary to maintain the steam packing exhauster and air removal pump(s) in operation? (1.0)

QUESTION 4.04 (2.50)

Instrument Air header pressure is decreasing. All systems are responding properly to the decreasing air pressure. Besides keeping the Shift Supervisor informed of plant conditions, what actions should be taken by the control room operator(s) and at what point (if applicable) per AOP - 0008, Loss of Instrument Air? (2.5)

QUESTION 4.05 (3.00)

a. What are two (2) primary concerns regarding an inadvertent initiation of an ECCS? (1.0)

b. Under what conditions can the ECCS be shutdown or placed in manual? (1.0)

c. HPCS inadvertently initiates while at power. As the injection valve is stroking open, the operator takes the control switch to CLOSE. Is this proper procedure? If not, WHY not? (1.0)

QUESTION 4.06 (3.00)

List the six (6) conditions that require implementing EOP - 0001, RPV CONTROL. (3.0)

QUESTION 4.07 (3.00)

Complete the following sentences with regard to Immediate Operator Actions for AOP - 0021, Anticipated Transient Without Scram. Answers may require more than one word.

a. This procedure is used whenever a reactor scram is required and control rods are not inserted past _____. (0.5)

b. If the main turbine is on the line, rapidly reduce reactor recirculation flow by _____. (0.5)

c. If all control rods cannot be inserted beyond "part a above" before suppression pool temperature reaches _____, then _____. (1.0)

d. If reactor power is above _____, then _____. (1.0)

QUESTION 4.08 (1.50)

The operator at the controls needs to be relieved for a short interval with the reactor at power. List three (3) requirements/items that must be satisfied/completed for the relief to occur in accordance with OSP - 0002, Shift Relief and Turnover. (1.5)

QUESTION 4.09 (2.00)

What are the GSU/River Bend Administrative Radiation Limits for whole body penetrating radiation (include prenatal)? (2.0)

QUESTION 4.10 (3.50)

a. Excluding annunciators, list five (5) indications in the control room that are available to verify a stuck open relief valve (SORV) with the reactor at power per AOP - 0035, Safety Relief Valve Stuck Open. (1.5)

b. What attempts are made to close a SORV per AOP - 0035 (2 methods required for full credit)? (1.0)

c. The reactor must be scrammed if one of two conditions exist with regard to a SORV. What are these two (2) conditions? (1.0)

Table 2
Properties of saturated steam and saturated water (pressure)

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	1.6586	250.1	1095.3	50
60	292.71	0.01738	7.1562	7.174	262.2	915.4	1177.6	0.4273	1.2167	1.6440	262.0	1098.0	60
70	302.93	0.01748	6.1875	6.205	272.7	907.8	1180.6	0.4411	1.1905	1.6316	272.5	1100.2	70
80	312.04	0.01757	5.4536	5.471	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	0.01815	2.8155	2.834	336.1	859.0	1195.1	0.5206	1.0435	1.5641	335.5	1111.2	160
180	373.08	0.01827	2.5129	2.531	346.2	850.7	1196.9	0.5328	1.0215	1.5543	345.6	1112.5	180
200	381.80	0.01839	2.2689	2.287	355.5	842.8	1198.3	0.5438	1.0016	1.5454	354.8	1113.7	200
250	400.97	0.01865	1.8245	1.8432	376.1	825.0	1201.1	0.5679	0.9585	1.5264	375.3	1115.8	250
300	417.35	0.01889	1.5238	1.5427	394.0	808.9	1202.9	0.5882	0.9223	1.5105	392.9	1117.2	300
350	431.73	0.01913	1.3064	1.3255	409.8	794.2	1204.0	0.6059	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	0.47968	0.5009	526.7	669.7	1196.4	0.7279	0.6753	1.4032	523.2	1113.0	900
1000	544.58	0.0216	0.42436	0.4460	542.6	650.4	1192.9	0.7434	0.6476	1.3910	538.6	1110.4	1000
1100	556.28	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	0.16266	0.1883	672.1	466.2	1138.3	0.8625	0.4256	1.2881	662.6	1068.6	2000
2500	668.11	0.0286	0.10209	0.1307	731.7	361.6	1093.3	0.9139	0.3206	1.2345	718.5	1032.9	2500
3000	695.33	0.0343	0.05073	0.0850	801.8	218.4	1020.3	0.9728	0.1891	1.1619	782.8	973.1	3000
3208.2	705.47	0.0508	0	0.0508	906.0	0	906.0	1.0612	0	1.0612	875.9	875.9	3208.2

EQUATION SHEET

$f = ma$

$v = s/t$

Cycle efficiency = (Network out)/(Energy in)

$w = mg$

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

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

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

$PE = mgh$

$V_f = V_o + at$

$w = \theta/t$

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

$W = V \Delta P$

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

$\Delta E = 931\ \Delta m$

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

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

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

$Pwr = W_f \Delta h$

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

$SUR = 26.06/T$

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

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

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

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

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

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

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

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

$M = (1 - K_{effo})/(1 - K_{eff1})$

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

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

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

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

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

$I_1 d_1 = I_2 d_2$

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

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

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

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

$\Sigma = \sigma N$

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 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 1.01 (2.00)

1. Fuel burnup
2. Fission product poison buildup
3. Resonant absorber buildup
4. Moderator temperature increase
5. Fuel temperature increase
6. Void formation

(4 of 6 required @ 0.5 each)

REFERENCE
G. P. BWR Reactor Theory, pg 11

ANSWER 1.02 (2.50)

a. 1. Verify SRM operability
   2. Accurately predict approach to criticality
   3. Provide sufficient neutrons for a safe reactor startup
   4. Provide background level of indication
   5. Provide a signal to noise ratio of at least 3:1

   (1 of 5 required at 0.5)

b. 1. Spontaneous fission (0.5)
   2. Gamma-Deuterium or Photo-Neutron (0.5)
   3. Alpha-Oxygen (0.5)

   BOL - Spontaneous fission (0.25)
   EOL - Photo-Neutron (0.25)

REFERENCE
G. P. BWR Reactor Theory, pg 34-37
River Bend Simulator Text, Chapter 16, SRM, pg 16-8

ANSWER 1.03 (2.50)

a. larger (0.5)
b. longer (0.5)
c. more (0.5)
d. The amount of reactivity required to produce the doubling of the count rate is approximately the amount of reactivity which must be added to achieve criticality (1.0).

REFERENCE
G. P. BWR Reactor Theory, pg 42-44

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 1.04 (2.50)

a. True (0.5)
b. False (0.25). Xenon has a higher microscopic absorption cross section (0.25).
c. False (0.25). It may be Xenon free, but Samarium will increase following the scram (0.25).
d. True (0.5).
e. False (0.25). 50% equilibrium Xenon is > one-half the 100% equilibrium value (0.25).

REFERENCE
G. P. BWR Reactor Theory, pg 79-85

ANSWER 1.05 (2.50)

a. Doppler or fuel temperature
b. Void
c. Moderator temperature or Fuel temperature
d. Void
e. Moderator temperature
(0.5 each)

REFERENCE
G. P. BWR Reactor Theory Section F. Reactivity Coefficients and Defects

ANSWER 1.06 (3.00)

a. Decrease (0.5) due to increased void content in the core as flow decreases (0.5).

b. Increase (0.34) due to increased voiding in the core (0.33) and recirc pump no longer taking a suction on the annulus (0.33).

c. Decrease (0.34) due to steam flow decrease (0.33) and level increase (0.33).

REFERENCE
Annotated River Bend BWR-6 Transients

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 1.07 (2.00)

a. Conduction
b. Conduction
c. Conduction and convection
d. Radiation
(4 @ 0.5 each) (2.0)

REFERENCE
G. P. Heat Transfer Fundamentals Section A. Heat Transfer Mechanisms, pg 3-6

ANSWER 1.08 (1.00)

d (1.0)

REFERENCE
G. P. Thermodynamics, pg 70-71

ANSWER 1.09 (1.00)

350 psig + 14.7 psia = 364.7 psia (0.25)

Saturation temperature for 364.7 psia:

(444.6 deg F - 431.73 deg F)(14.7/50) + 431.73 deg F = 435.5 deg F (0.5)

The temperature instrument is reading approximately 35.5 degrees low (0.25)

REFERENCE
Steam Tables

ANSWER 1.10 (2.00)

a. The pump will eventually add a sufficient amount of heat to the fluid to cause cavitation. Also will accept overheating of the pump. (1.0)

b. Could cause excessively long starting currents or water hammer if the downstream piping was not filled. (1.0)

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

REFERENCE
GE THERMO HT & FF pg 7-123, 124

ANSWER 1.11 (2.00)

a. 8
b. 3
c. 2
d. 5
(0.5 each)

REFERENCE
G. P. Heat Transfer and Thermal Limits, pg 47,53,58-59,65

ANSWER 1.12 (2.00)

a. Increase (0.5). Steam that had been extracted to the feed heater is now passing through the turbine producing more MWe OR the increased subcooling causes reactor power to increase, causing reactor pressure to increase, and the EHC system responds accordingly to pass more steam through the turbine (either answer acceptable 0.5).
b. Decrease (0.5). Extraction steam to the next downstream (higher pressure heater) will increase (0.5) due to the increased feedwater differential temperature across the next heater. This assumes CV position is constant. Also accept power increase due to increased subcooling and EHC response as above.

REFERENCE
BWR Plant Response to Operational Transients pg 37
River Bend BWR-6 Transient Trace No. 10
GOP-0002, Power Operations, Rev 0, pg 8

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 2.01 (3.50)

a. 45 gpm, accept 40 - 50 gpm (0.5)
   260 psid, accept 250 - 270 psid (0.5)
b. 100% (0.5)
c. When a rod is inserted, one set of stabilizing valves, 2 valves, close (0.5) to direct 4 gpm (0.5) to the CRD and away from the cooling water header.
d.- minimum flow line
  - recirculation pump seal purge
  - sample probe
  (0.33 each)

REFERENCE
SOP 0002, Control Rod Drive Hydraulics, Rev Draft, pg 5
River Bend Simulator Text, Chapter 6, Control Rod Drive Hydraulics, pg 6-7, 6-10

ANSWER 2.02 (3.00)

a. recirculation loops (0.5)
   reactor vessel bottom head drain (0.5)
b. - Flow into the RWCU system
   - Return flow into the reactor
   - Blowdown flow, flow to radwaste or the main condenser
   (0.33 each)
   The two outlet flows, reactor return and blowdown, are summed (0.5) and compared to the RWCU inlet flow(0.5).

REFERENCE
River Bend BWR Simulator Text, Chapter 9, RWCU, pg 9-9, 9-10

ANSWER 2.03 (3.00)

a. 1. 135 psig
   2. 500 psig (or 50 psig if written in)
   3. 125 psig
   (0.5 each)
b. RHR loop A is preferred (0.5) because of its connection to the RCIC head spray line (0.5).
c. Recirculation loop B (0.5)

REFERENCE
River Bend Simulator Text, Chapter 10 - RHR System, pg 10-11,20 pg 10-30, insert #9

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 2.04 (3.00)

a. The RCIC gland seal system provides air to the turbine seals (1.0) at slightly higher than turbine exhaust pressure.
b. - manual
- high turbine exhaust backpressure
- low pump suction pressure
- high reactor water level
- system isolation
- overspeed
(4 at 0.5 each, overspeed must be one of the four)

REFERENCE
River Bend Simulator Text, Chapter 11, RCIC, pg 11-11,12

ANSWER 2.05 (1.50)

a. - minimizes water hammer (0.5)
- minimizes any delay injecting into the reactor vessel (0.5)
b. The ECC systems have water leg fill pumps to maintain the associated piping full (0.5).

REFERENCE
River Bend Simulator Text, Chapter 12, HPCS, pg 12-3,4

ANSWER 2.06 (2.00)

a. - RCIC turbine
- SRV's
- RHR HX vent (non-condensables) during steam condensing mode
- Initial effluent flow path for rx water condensed in the HX
(2 required at 0.5 each)
b. Water spilling from the break fills the drywell to the top of the weir wall (0.25), where it spills over into the weir wall-suppression pool annulus (0.25), through the pressure relief vents (0.25), back into the suppression pool where it will be pumped back into the reactor (0.25).

REFERENCE
River Bend Simulator Text, Chapter 23, Primary Containment, pg 23-19
SOP-0031, RHR, Steps 4.4.4 and 4.4.5, pg 12,13

ANSWER 2.07 (3.00)

a. 1. MSIV opening: Instrument air (0.25)
MSIV closing: Instrument air (0.25) and spring pressure (0.25)
2. SRV opening: Penetration Valve Leakage Control Air System
OR Main Steam Safety and Relief Valves Air Supply
OR Reactor pressure in the safety mode (0.25)
SRV closing: Spring pressure (0.25)
3. MSSV opening and closing: Motor (0.25)

b. The leakage control barrier is established by pressurizing the volume between the inboard MSIV and the outboard MSIV (0.5) and the volume between the outboard MSIV and the MSSV (0.5) to greater than containment pressure (0.5) such that any leakage through the MSIV's is into the containment.

REFERENCE
River Bend Simulator Text, Chapter 34, Main Steam, pg 34-3,9,10,11
J. O. No. 12210, LSK 32-8, page 2

ANSWER 2.08 (2.00)

a. Normal Service Water is the normal heat sink (0.25). Standby Service Water is the alternate heat sink (0.25).
b. 1. At 100 psig, the standby RPCCW pump(s) start (0.5)
2. At 56 psig, the RPCCW Division I and II normal supply and return valves shut (0.5), and the Standby Service Water supply and return valves open (0.5) to supply Standby Service Water directly into the RPCCW system.

REFERENCE
River Bend Simulator Text, Chapter 48, RPCCW, pg 48-4,5

ANSWER 2.09 (2.50)

a. - high drywell pressure
- low reactor water level
- sustained bus undervoltage
(0.5 each)
b. - overspeed
- generator differential
(0.5 each)

REFERENCE
River Bend Simulator Text, Chapter 45, Diesel Generators, pg 45-12

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 2.10 (1.50)

a. Positions remain the same, CST open, Suppression pool shut (0.5)
b. CST open, Suppression pool shut (0.5)
c. Positions remain the same, CST shut, Suppression pool open (0.5)

REFERENCE
River Bend Simulator Text, Chapter 12, HPCS, pg 12-11

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 3.01 (3.00)

LPCI injection line A and LPCS feed one dp transmitter (0.5), LPCI injection lines B and C feed one dp transmitter (0.5), and HPCS and above-core plate pressure feed one dp transmitter (0.5). If a break occurs between the reactor vessel wall and the shroud (0.25), the effectiveness of that ECC system may be lost (0.25). Under normal conditions, little or no dp should exist across the dp transmitters. When a break occurs in the area of concern, the dp transmitter will then sense the pressure drop across the shroud and annunciate an alarm (1.0).

REFERENCE
River Bend Simulator Text, Chapter 10, RHR, pg 10-23, Chapter 12, HPCS, pg 12-9

ANSWER 3.02 (3.50)

a. - vessel bottom head drain and steam dome temperature differential (0.3) less than 100 deg F (0.2)
   - recirculation loop and steam dome temperature differential (0.3) less than 50 deg F (0.2)
   - less than 50 deg F temperature differential (0.2) between the two recirculation loop suction lines (0.3)

b. - reactor vessel level (0.25) < level 2 or -30" (0.25)
   - reactor pressure (0.25) > 1130 psig (0.25)

c. - The ATWS trips both the high and low speed power supplies to the recirculation pumps (0.5).
   - The RPT trips only the high speed power supply and causes a high to low speed transfer to occur (0.5).

REFERENCE
River Bend Simulator Text, Chapter 8, Recirculation Flow Control, pg 8-8,9,12,14

ANSWER 3.03 (3.00)

a. level 8 or +55", level 3 or +10"
b. level 2 or -30"
c. level 2 or -30"
d. level 8 or +55"
e. level 3 or +10"
f. level 4 or +33"
(a. 0.25 each, b.- f. 0.5 each)

REFERENCE
River Bend Simulator Text, Chapter 3, Nuclear Boiler Process Instrumentation, pg 3-19 through 23.

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 3.04 (2.50)

a. - level 3 or +10"
   - higher
   - 10 seconds
   - lower
   (0.25 each)

b. Any of the three narrow range instruments (A, B, or C) differing by more than 2" from either of the other 2 channels (0.5)

c. Steam flow: Sensed as a differential pressure drop across the elbow tap in each of the 4 main steam lines (0.25) and then summed to provide a total steam flow signal (0.25).
   Feed flow: Sensed as a differential pressure across flow elements in each of the two main feed lines (0.25) and summed to provide a total feed flow (0.25).

REFERENCE
River Bend Simulator Text, Chapter 33, Feedwater Control, pg 33-2,8,23

ANSWER 3.05 (4.00)

a. 1. yes
   2. no
   3. no
   4. yes
   5. yes
   6. no
   (0.5 each)

b. Use of the Timer Skip pushbutton bypasses the settle function. With no settle function, the differential pressure across the CRD piston has no way of equalizing except by way of the graphitar seals. This will cause additional wear and reduce the expected life of the seals. (0.5 for reduced life or additional wear of seals, 0.5 for explanation)

REFERENCE
River Bend Simulator Text, Chapter 21, Rod Control and Information System, pg 21-7,9 through 11

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 3.06 (2.50)

a. half-scram
b. no action
c. half scram
d. rod block
e. scram
(0.5 each)

REFERENCE
River Bend Simulator Text, Chapter 22, RPS, pg 22-18
River Bend Simulator Text, Chapter 19, APRM, pg 19-5

ANSWER 3.07 (3.50)

a. 4 or ETS oil pressure at the TCV (0.5)
b. The TCV Fast Closure is initiated by actuation of the Power/Load Unbalance Circuit, which compares turbine power (0.4) as sensed at the HP turbine exhaust (0.2) to generator load (0.4). If the difference exceeds 40% of rated (0.4), the Unbalance circuit is actuated to initiate a fast closure. The fast closure is bypassed if reactor power is <40% (0.4) as sensed by first stage turbine pressure (0.2).
If turbine trips only are listed, allow 1.5 pts for the trips. (trips are in Simulator Text, Chapter 35, Table 1, pg 35-17,18)
c. 1. shut (0.5)
2. shut (0.5)

REFERENCE
River Bend Simulator Text, Chapter 36, EHC/Steam Bypass and Pressure Regulating Systems, pg 36-29,31,82
River Bend Simulator Text, Chapter 35, Main Turbine, Table 1, pg 35-17,18

ANSWER 3.08 (1.00)

- SRV or Nuclear Boiler or Pressure Relief
- RCIC
- RHR
- SSW
(0.25 each)

REFERENCE
River Bend System Description for Remote Shutdown System, 1-SD-200, REV 0, pg 4 of 37

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 3.09 (2.00)

a. 2.5 on range 7 (0.5). No automatic action (0.5)
b. 39 on range 5 (0.5). IRM high rod block (0.25) and IRM high high half-scram (0.25).

REFERENCE
River Bend Simulator Text, Chapter 17, IRM, pg 17-7,14,15

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 4.01 (1.50)

a. The reactor is critical when the neutron count rate increases (0.5) at an exponential rate without further control rod motion (0.5).
b. Accept 50 - 150 seconds (0.5)

REFERENCE
GOP-0001, Plant Startup to Low Power Alarm Point, Rev 0, pg 18

ANSWER 4.02 (3.00)

a. 3 or 150 psig
b. 4 or 250 psig
c. 2 or 100 psig
d. 5 or 400 psig
e. 6 or 450 psig or 2 or 100 psig
f. 4 or 250 psig

REFERENCE
GOP-0001, Plant Startup to Low Power Alarm Point, Rev 0, pg 18-20
SOP-0080, Main Turbine and EHC Control System, Rev Draft, pg 5

ANSWER 4.03 (2.00)

a. With the auxiliary boiler operating, there is a constant input of non-radioactive water into the condensate system. This water will increase the liquid radwaste inventory and will have to eventually be discharged (1.0).
b. Without the steam packing exhauster and air removal pump(s) in operation, a high airborne activity condition could exist in the Turbine Building (1.0).

REFERENCE
GOP-0003, Shutdown from LPAP to Hot Standby or Hot Shutdown, Rev Draft, pg 5

ANSWER 4.04 (2.50)

When the second individual control rod has scrammed (0.5) or it becomes apparent that instrument air will not be restored (0.5), scram the reactor (0.5) and trip the main turbine (0.5). Start RCIC (0.5).

REFERENCE
River Bend AOP - 0008, Loss of Instrument Air, Rev 0, pg 3

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 4.05 (3.00)

a. - Introducing large quantities of relatively cool water to the RPV which could cause a reactivity transient
   - Flooding the RPV to the steam lines which could introduce water into steam driven equipment and/or the SRV's, damaging the affected equipment
   - Suppression pool water is not normally reactor grade and the introduction of large quantities of this water to the RPV could result in a lengthy cleanup
   (2 at 0.5 each)

b. Do not secure or place an ECCS in manual mode unless:
   1. Misoperation in automatic mode is confirmed (0.33) or
   2. Adequate core cooling is assured (0.33)
   by at least two independent indications (0.33).

c. No (0.25). Selecting CLOSE on a MOV that is stroking in the open direction could trip the MOV supply breaker (0.75) making remote operation impossible. (0.25 for remote operation impossible with no mention of breaker tripping)

REFERENCE
River Bend AOP - 0034, Inadvertent Initiation of an ECCS, Rev 0, pg 2,3

ANSWER 4.06 (3.00)

- RPV water level below +10 inches
- RPV pressure above 1065 psig
- Drywell pressure above +2 psig
- A condition which requires RPV isolation
- A condition requiring a reactor scram and reactor power is > 5 %
- A condition requiring a reactor scram and reactor power cannot be determined

(6 at 0.5 each)

REFERENCE
River Bend EOP - 0001, RPV Control, Rev 1, pg 3,4

ANSWER 4.07 (3.00)

a. 06 (0.5)
b. transferring the recirculation pumps to slow speed/LFMG (0.5)
c. 110 deg F (0.5), inject boron with SLC/initiate SLC (0.5)
d. 5% (0.5), trip the recirculation pumps (0.5)

REFERENCE
River Bend AOP - 0021, Anticipated Transient Without Scram, Section 4, Immediate Operator Actions

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 4.08 (1.50)

- Relief must be licensed
- Relief msut be assigned to the on-duty shift
- Verbal exchange of current plant status
- Entry in control room operator's log noting relief
- Control Operations Foreman's concurrence

(3 required at 0.5 each)

REFERENCE
River Bend OSP - 0002, Shift Relief and Turnover, Rev 0, pg 3

ANSWER 4.09 (2.00)

- 100 mREM/wk
- 1000 mREM/qtr
- 4000 mREM/yr
- 500 mREM/gestation

(4 at 0.5 each)

REFERENCE
Health Physics and Practical Applications, pg 39-40

ANSWER 4.10 (3.50)

a. - SRV open indication/red light on
   - Unexplained decrease in TCV position
   - Unexplained decrease in Mwe load
   - Unexplained increase in main steam line flow
   - Increase in steam flow/feed flow mismatch
   - Increase in SRV tailpipe temperature
   - Suppression pool water level increase
   - Suppression pool water temperature increase
   - Acoustic monitor alarm or indication

   (5 required at 0.3 each)

b. Place SRV control switch to OPEN and then to OFF 3 times (0.5). Deenergize DC power to the affected valve's solenoids (0.5).

c. If the SORV cannot be closed within two minutes from the first attempt to reclose (0.5), or if the suppression pool temperature reaches 100 deg F (0.5).

REFERENCE
River Bend AOP - 0035, Safety Relief Valve Stuck Open, Rev 0, pg 2,3
FSK-32-8A,8B

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

FACILITY: RIVER BEND 1

REACTOR TYPE: BWR-GE6

DATE ADMINISTERED: 85/01/22

EXAMINER: GRAVES, D.

APPLICANT: _____

INSTRUCTIONS TO APPLICANT:

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

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

FINAL GRADE _____%

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

_____
APPLICANT'S SIGNATURE

QUESTION 5.01 (3.00)

a. What are two (2) reasons for maintaining a visible neutron level at all times in the reactor? (1.0)

b. What are three (3) methods of producing intrinsic source neutrons? Include which is the major contributor at BOL and EOL. Reaction equations are NOT required. (2.0)

QUESTION 5.02 (3.00)

Assume the reactor is operating at 100% power and one recirculation pump trips. Indicate how each listed indicated parameter would first change (Increase or Decrease) and briefly explain why the change occurs.

a. reactor power (one reason) (1.0)

b. reactor water level (two reasons) (1.0)

c. feedwater flow (two reasons) (1.0)

QUESTION 5.03 (3.00)

For each of the events listed below, state WHICH reactivity coefficient will respond first, WHY it responds first, and WHETHER it adds positive or negative reactivity.

a. SRV opening at 100% power (1.0)

b. Rod drop from 100% power (1.0)

c. Isolation of a feedwater heater string's extraction steam at 100% power (1.0)

QUESTION 5.04 (2.50)

a. Define decay heat. (1.0)

b. In general, does this thermal power, decay heat, indicate on the nuclear instrumentation? WHY or WHY NOT? (1.0)

c. How much decay heat is present in the core immediately following a scram from high power operation (answer in percent of rated power)? (0.5)

QUESTION 5.05 (1.50)

State whether control rod worth INCREASES, DECREASES, or is UNAFFECTED as plant conditions change from cold to hot at 1% power. JUSTIFY your answer. (1.5)

QUESTION 5.06 (2.00)

State the mode(s) of heat transfer for the following situations:

a. Center of fuel pellet out to the pellet edge (0.5)
b. Across the Helium gap in the fuel rod (0.5)
c. Clad surface to the center of the coolant channel (0.5)
d. Clad surface to coolant under film boiling conditions (0.5)

QUESTION 5.07 (2.00)

Match one of the following numbered items with each of the four lettered statements. A letter-number sequence is sufficient. (2.0)

1. MAPRAT
2. APLHGR
3. CPR
4. FLPD
5. PCIOMR
6. GEXL
7. TOTAL PF
8. LHGR

a. Parameter for which plastic strain and deformation are limited to less than 1%.
b. Contains guidelines restricting power ramp rates above the threshold power.
c. APLHGR over MAPLHGR
d. LHGR over LHGR limit

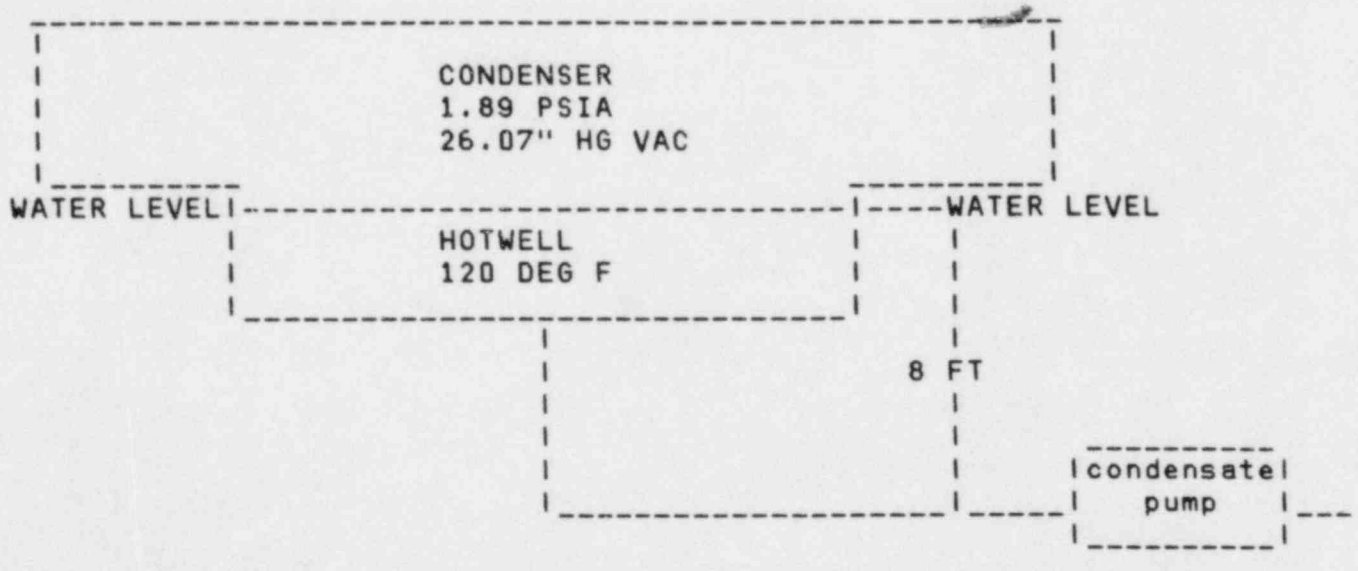
QUESTION 5.08 (2.00)

Explain WHY core orificing is necessary and HOW orificing accomplishes this purpose. (2.0)

QUESTION 5.09 (1.50)

Since MCPR is not a directly measurable parameter, what are three (3) directly measurable parameters needed by the process computer to calculate MCPR? (1.5)

QUESTION 5.10 (2.00)



Using the above figure, calculate:

a. Pressure at the condensate pump inlet (1.0)

b. Degrees F subcooling of the condensate in the hotwell (1.0)

SHOW ALL ASSUMPTIONS AND WORK

QUESTION 5.11 (1.50)

List three (3) important effects that may occur directly as a result of the Zirconium-Water reaction during a BWR LOCA. (1.5)

QUESTION 5.12 (1.00)

Indicate whether each of the following is TRUE or FALSE. If FALSE, explain WHY it is FALSE. (1.0)

a. A reactor startup several days following a scram from extended high power operation is considered Xenon and Samarium free.
b. Samarium is not as significant an operating concern as Xenon, even though Samarium has a higher microscopic absorption cross section.

QUESTION 6.01 (2.00)

The plant is operating at 100% power. APRM channels A and C have failed high. Instrument technicians are investigating while you research Technical Specifications. A plant auxiliary operator wants to shift RPS B power supply to its alternate power supply for training. Should you let him? Explain why or why not. Direct your answer toward system response instead of administrative requirements. (2.0)

QUESTION 6.02 (3.00)

Match the radiation detectors in COLUMN A with the appropriate application(s) and characteristic(s) from COLUMN B. All items in COLUMN B apply. (3.0)

COLUMN A	COLUMN B
a. Ion chamber	1. Used primarily as a device for precise measurements or where high sensitivity is required.
b. Scintillation	2. The size of the electron avalanche is proportional to the original incoming radiation energy.
c. Geiger-Mueller	3. Uses a photocathode to convert light into free electrons.
	4. Normally used to set dose rates.
	5. The same size pulse is generated regardless of the type and specific ionization characteristics of the radiation.
	6. Normally reads out in counts per minute.
	7. Main Steam Line Radiation Monitors
	8. Off-Gas Pretreatment Radiation Monitors
	9. Off-Gas Post Treatment Radiation Monitors

QUESTION 6.03 (2.00)

a. Describe a typical 120 VAC Uninterruptible Power Supply. Include power sources (i.e. 120 VAC, not switchgear or MCC number), how they are arranged to ensure power is continuously supplied to its connected loads, and any automatic transfers.

b. What provides the NORMAL power supply to the EHC System (except for the EHC pumps)? (0.5)

QUESTION 6.04 (3.50)

a. List three (3) of the four (4) conditions that will cause an automatic high to low speed transfer of the recirculation pumps. Include SETPOINTS and the REASON(s) for the transfer (i.e. what does the transfer protect against or prevent). (3.0)

b. Why are the recirculation pumps always started in fast speed? (0.5)

QUESTION 6.05 (3.00)

a. What provides the motive force(s) for opening and closing the following valves (include system name if applicable): (1.5)

1. Main Steam Isolation Valve

2. Safety Relief Valve

3. Main Steam Shutoff Valve

b. Briefly describe how the Main Steam Isolation Valve Positive Leakage Control System establishes a leakage control barrier. (1.5)

QUESTION 6.06 (3.50)

a. Which of the following provides the signal for a Turbine Control Valve (TCV) Fast Closure scram? (0.5)

1. TCV position limit switches

2. Rate of TCV position change

3. Power to the TCV fast acting solenoids

4. ETS oil pressure at the TCV

b. When is a TCV Fast Closure (NOT the scram) initiated (include setpoints, bypasses, parameters sensed, and where sensed)? (2.0)

c. How will the TCV fail (OPEN, SHUT, or AS IS) on: (1.0)

1. Loss of electrical signal to the servo valve coils

2. Loss of hydraulic fluid (FJS) to the control jet pipe

QUESTION 6.07 (1.50)

For each of the following initial conditions, indicate the final position of the valves following an automatic HPCS initiation:

a. CST suction valve open, Suppression Pool suction valve shut (0.5)

b. CST suction valve shut, Suppression Pool suction valve shut (0.5)

c. CST suction valve shut, Suppression Pool suction valve open (0.5)

QUESTION 6.08 (2.50)

For EACH of the following conditions, state whether a scram, half-scram, rod block, or no action is generated. For conditions that produce more than one action, state the more severe action (i.e. half-scram is more severe than a rod block). (2.5)

a. Loss of one RPS MG set
b. Turbine trip at 30% power
c. Two main steam lines isolated, Mode switch in RUN
d. APRM B downscale, Mode switch in RUN
e. Scram discharge volume level is at 40 gallons, Mode switch in STARTUP

QUESTION 6.09 (1.50)

a. If reactor water level decreases below _____ with the Feedwater Control System in automatic, a (HIGHER/LOWER) than normal preprogrammed setpoint is inserted for _____(time), at which time a (HIGHER/LOWER) than normal setpoint is called for. (1.0)

b. What activates the "Reactor Water Level Signal Failure" alarm? (0.5)

QUESTION 6.10 (2.50)

a. What are three (3) signals that will cause a diesel generator to automatically Emergency Start (exclude manual, setpoints not required)? (1.5)

b. Following an Emergency Start, what are the two (2) automatic protective trips still in effect (exclude manual, setpoints not required) for the diesel generators? (1.0)

QUESTION 7.01 (3.00)

Match the following events (a-f) with the approximate pressure at which they should be performed per GOP-0001, Plant Startup to Low Power Alarm Point. The pressures may be used more than once or not at all. (3.0)

a. Place steam seals in service
b. Startup the Offgas System
c. Warm up the RCIC piping
d. Startup the first reactor feed pump
e. Start turbine shell warming
f. Startup the SJAE

1. 20 psig
2. 100 psig
3. 150 psig
4. 250 psig
5. 400 psig
6. 450 psig
7. 600 psig
8. 850 psig

QUESTION 7.02 (2.00)

a. It is prudent NOT to operate with the auxiliary boiler supplying steam seals any longer than is absolutely necessary (per GOP-0003). Why should use of the auxiliary boiler for steam seals be minimized? (1.0)
b. The reactor has been shutdown five (5) hours. Main condenser vacuum is broken. Why is it necessary to maintain the steam packing exhauster and air removal pump(s) in operation? (1.0)

QUESTION 7.03 (3.50)

a. What are three (3) primary concerns regarding an inadvertent initiation of an ECCS? (1.5)
b. Under what conditions can the ECCS be shutdown or placed in manual? (1.0)
c. HPCS inadvertently initiates while at power. As the injection valve is stroking open, the operator takes the control switch to CLOSE. Is this proper procedure? If not, WHY not? (1.0)

QUESTION 7.04 (2.50)

Instrument Air header pressure is decreasing. All systems are responding properly to the decreasing air pressure. Besides keeping the Shift Supervisor informed of plant conditions, what actions should be taken by the control room operator(s) and at what point (if applicable) per AOP - 0008, Loss of Instrument Air? (2.5)

QUESTION 7.05 (3.00)

List the six (6) conditions that require implementing EOP - 0001, RPV CONTROL. (3.0)

QUESTION 7.06 (3.00)

a. List three (3) conditions that require the use of a Radiation Work Permit. (1.0)
b. What are the two (2) types of Radiation Work Permits? Include what general types of tasks are covered by each and for how long each is valid. (2.0)

QUESTION 7.07 (1.50)

a. During refueling, what action should be taken by personnel on the refueling floor prior to withdrawing a control rod from a control cell which contains fuel? (0.5)
b. During refueling, as the RPV steam separators are removed, what is done simultaneously to minimize airborne contamination? (0.5)
c. How is a leaking or defective fuel bundle isolated from the surrounding water and equipment (to minimize the spread of contamination)? (0.5)

QUESTION 7.08 (3.00)

a. What are the GSU/River Bend Administrative Radiation Limits for whole-body penetrating radiation (include prenatal)? (2.0)
b. What are the whole-body dose equivalent Emergency Exposure Limits or guidelines for life-saving activities and to prevent major releases of radioactivity to the environment if no preplanning is possible? (1.0)

QUESTION 7.09 (2.50)

a. With the plant operating at 100% power, what action(s) are required for a complete loss of RPCCW? (2.0)
b. When should a partial loss of RPCCW be treated as a complete loss of RPCCW? (0.5)

QUESTION 7.10 (1.00)

For each of the following initial conditions (a and b), indicate all of the numbered items that apply if a Turbine Bypass Valve fails open in that condition. (1.0)

a. Reactor power 17%, Mode Switch in RUN

b. Reactor power 3%, Mode Switch in STARTUP/HOT STANDBY

1. RPV pressure decreases
2. MSIV's automatically close
3. TCV's position decrease
4. Reactor scram
5. MWe decrease
6. May require closing of the MSIV's by the operator to prevent excessive RPV cool-down

QUESTION 8.01 (3.00)

Fill in the blanks regarding the River Bend Safety Limits: (3.0)

THERMAL POWER shall not exceed ___(a)___ of RATED THERMAL POWER with the reactor vessel steam dome pressure less than ___(b)___ or core flow less than ___(c)___ of rated flow.

The Minimum Critical Power Ratio (MCPR) shall not be less than ___(d)___ with the reactor vessel steam dome pressure greater than or equal to ___(b)___ and core flow greater than or equal to ___(c)___ of rated flow.

The reactor coolant system pressure, as measured in the reactor vessel steam dome, shall not exceed ___(e)___.

The reactor vessel water level shall be above ___(f)___.

QUESTION 8.02 (2.50)

Indicate whether each of the following is considered a "core alteration" per the River Bend Technical Specifications: (2.5)

a. Withdrawal and insertion of an SRM detector to check the drive motor

b. Removal of an LPRM string for replacement

c. Removal of an uncoupled control rod for replacement

d. Removal of a control rod's position indicator probe for repair

e. Control rod withdrawal and insertion to test the position indicator probe

QUESTION 8.03 (1.50)

a. How many licensed Operator(s) and/or Senior Operator(s) must be IN THE CONTROL ROOM during Operational Condition 1 per the Technical Specifications? (1.0)

b. When is a Radiation Protection Technician required to be on site per the Technical Specifications? (0.5)

QUESTION 8.04 (3.00)

Indicate whether the following statements are TRUE or FALSE. (3.0)

a. STA's are required to be licensed Senior Operators.

b. A Shift Supervisor may concurrently fill the position of the STA while on shift.

c. The Fire Brigade must include at least one of the following: SS, STA or COF.

d. All core alterations must be directly supervised by a licensed Senior Operator (or Senior Operator limited to fuel handling).

e. An Operator license is required for an operator to perform a core alteration.

f. During Operational Condition 4 or 5, an individual with a valid Operator license may be designated to assume the control room command function during an absence of the Shift Supervisor from the control room.

QUESTION 8.05 (1.50)

a. A temporary change to a procedure must be reviewed by whom (include any qualifications required of the individual[s])? (1.0)

b. With the exception of the above review, what other condition must the temporary change meet? (0.5)

QUESTION 8.06 (3.00)

List six (6) controlled reference items required to be in the control room area per ADM - 0022, Conduct of Operations. (3.0)

QUESTION 8.07 (1.00)

When is a Supplemental Clearance used? (1.0)

QUESTION 8.08 (1.50)

a. When does removal of a temporary alteration require double verification ? (0.5)
b. Under what condition(s) may a required double verification be waived? (0.5)
c. What is the maximum time a temporary alteration is allowed to remain in effect? (0.5)

QUESTION 8.09 (1.50)

a. When an emergency condition requires implementation and use of the Emergency Operating Procedures, what positions/roles are assumed by the Control Operating Foreman and the Shift Supervisor? (1.0)
b. What is the most important "ingredient" in successful use of the Emergency Operating Procedures? (0.5)

QUESTION 8.10 (1.00)

What personnel are allowed to manipulate the controls that directly affect reactivity or power level of the reactor per ADM - 0022, Conduct of Operations? (1.0)

QUESTION 8.11 (2.00)

List eight (8) situations, events, or conditions that require verbal notification of the Operations Supervisor. (2.0)

QUESTION 8.12 (1.00)

a. Fill in the blank. In accordance with 10 CFR 55, "if a licensee has not been actively performing the functions of an operator or senior operator for a period of _____ months or longer, he shall, prior to resuming activities licensed pursuant to this part, demonstrate to the Commission that his knowledge and understanding of facility operation and administration are satisfactory." (0.5)
b. Actions may be taken that depart from a license condition or technical specification under what conditions (if any)? (0.5)

QUESTION 8.13 (1.00)

List five (5) agencies that must be notified within 15 minutes after a General Emergency is declared at River Bend. (1.0)

QUESTION 8.14 (1.50)

During emergencies, it may be necessary to utilize equipment beyond its design limit.

a. Where are the Guidelines on Equipment Use During Emergencies? (0.5)

b. What are two (2) items of information that should be recorded if any equipment is operated beyond its design specification? (1.0)

Table 2
Properties of saturated steam and saturated water (pressure)

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	1.6586	250.1	1095.3	50
60	292.71	0.01738	7.1562	7.174	262.2	915.4	1177.6	0.4273	1.2167	1.6440	262.0	1098.0	60
70	302.93	0.01748	6.1875	6.205	272.7	907.8	1180.6	0.4411	1.1905	1.6316	272.5	1100.2	70
80	312.04	0.01757	5.4536	5.471	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	0.01815	2.8155	2.834	336.1	859.0	1195.1	0.5206	1.0435	1.5641	335.5	1111.2	160
180	373.08	0.01827	2.5129	2.531	346.2	850.7	1196.9	0.5328	1.0215	1.5543	345.6	1112.5	180
200	381.80	0.01839	2.2689	2.287	355.5	842.8	1198.3	0.5438	1.0016	1.5454	354.8	1113.7	200
250	400.97	0.01865	1.8245	1.8432	376.1	825.0	1201.1	0.5679	0.9585	1.5264	375.3	1115.8	250
300	417.35	0.01889	1.5238	1.5427	394.0	808.9	1202.9	0.5882	0.9223	1.5105	392.9	1117.2	300
350	431.73	0.01913	1.3064	1.3255	409.8	794.2	1204.0	0.6059	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	0.9278	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	0.47968	0.5009	526.7	669.7	1196.4	0.7279	0.6753	1.4032	523.2	1113.0	900
1000	544.58	0.0216	0.42436	0.4460	542.6	650.4	1192.9	0.7434	0.6476	1.3910	538.6	1110.4	1000
1100	556.28	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	0.16266	0.1883	672.1	466.2	1138.3	0.8625	0.4256	1.2881	662.6	1068.6	2000
2500	668.11	0.0286	0.10209	0.1307	731.7	361.6	1093.3	0.9139	0.3206	1.2345	718.5	1032.9	2500
3000	695.33	0.0343	0.05073	0.0850	801.8	218.4	1020.3	0.9728	0.1891	1.1619	782.8	973.1	3000
3208.2	705.47	0.0508	0	0.0508	906.0	0	906.0	1.0612	0	1.0612	875.9	875.9	3208.2

EQUATION SHEET

$f = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgn$

$V_f = V_o + at$

$W = \nu\ \Delta P$

$\Delta E = 931\ \Delta m$

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

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

$Pwr = W_f \Delta h$

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

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

$\Sigma = \sigma N$

$v = s/t$

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

$a = (V_f - V_o)/t$

$w = \theta/t$

Cycle efficiency = (Network out)/(Energy in)

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

$\lambda = \ell n 2/t_{1/2} = 0.693/t_{1/2}$

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

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

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

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

$M = (1 - K_{effo})/(1 - K_{eff1})$

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

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

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

$I_1 d_1 = I_2 d_2$

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

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

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

Water Parameters

1 gal. = 8.345 lbm.
1 gal. = 3.78 liters
1 ft^3 = 7.48 gal.
Density = 62.4 lbm/ft^3
Density = 1 gm/cm^3
Heat of vaporization = 970 Btu/lbm
Heat of fusion = 144 Btu/lbm
1 Atm = 14.7 psi = 29.9 in. Hg.
1 ft. H_2O = 0.4335 $lbf/in.^2$

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 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 5.01 (3.00)

a. 1. Verify SRM operability
2. Accurately predict approach to criticality
3. Provide sufficient neutrons for a safe reactor startup
4. Provide a background level of indication
5. Provide a signal to noise ratio of at least 3:1
(2 of 5 at 0.5 each)

b. 1. Spontaneous fission (0.5)
2. Gamma-Deuterium or Photo-Neutron (0.5)
3. Alpha-Oxygen (0.5)
BOL - Spontaneous fission (0.25)
EOL - Photo-Neutron (0.25)

REFERENCE
G. P. BWR Reactor Theory, pg 34-37
River Bend Simulator Text, Chapter 16, SRM, pg 16-8

ANSWER 5.02 (3.00)

a. Decrease (0.5) due to increased void content in the core as flow decreases (0.5).

b. Increase (0.34) due to increased voiding in the core (0.33) and recirc pump no longer taking a suction on the annulus (0.33).

c. Decrease (0.34) due to steam flow decrease (0.33) and level increase (0.33).

REFERENCE
Annotated River Bend BWR-6 Transients

ANSWER 5.03 (3.00)

a. Void coefficient would add negative reactivity first. The decrease in pressure caused by the SRV opening would cause void production to increase.
b. Fuel temperature coefficient would add negative reactivity first. The rapid addition of positive reactivity due to rod removal causes a rapid increase in power and fuel temperature.
c. Moderator temperature coefficient will add positive reactivity first. The loss of feed heating will increase inlet subcooling.
(0.25 for each coefficient, 0.25 for + or - reactivity, and 0.5 for each reason)

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

REFERENCE
G. P. BWR Reactor Theory, pg 33

ANSWER 5.04 (2.50)

a. Decay heat is that heat which is given off, after the reactor is shutdown, due to the decay of fission products (1.0)
b. No (0.25), because fission products normally decay by beta emission which would not be detected by the nuclear instrumentation (0.75).
c. Approximately 6%. Accept 5-7% (0.5).

REFERENCE
G. P. BWR Reactor Theory, pg 58, 93

ANSWER 5.05 (1.50)

Rod worth increases (0.5). Increasing coolant temperature decreases the moderator density allowing the neutrons to travel further before being absorbed. This increases the probability of the neutrons interacting with a control rod (1.0).

REFERENCE
G. P. BWR Reactor Theory, pg 72

ANSWER 5.06 (2.00)

a. Conduction
b. Conduction
c. Conduction and convection
d. Radiation
(4 @ 0.5 each) (2.0)

REFERENCE
G. P. Heat Transfer Fundamentals Section A. Heat Transfer Mechanisms, pg 3-6

ANSWER 5.07 (2.00)

a. 8
b. 5
c. 1
d. 4
(0.5 each)

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

REFERENCE
G. P. Heat Transfer and Thermal Limits, pg 47,53,58-59,65,73

ANSWER 5.08 (2.00)

As the boiling rate increases, two-phase flow resistance increases. This would tend to divert coolant flow from the higher powered center fuel bundles where it is needed the most (concept 1.0). Orificing has the effect of providing a large resistance to flow so that any additional resistance caused by two-phase flow is acceptably small (concept 1.0).

REFERENCE
G. P. Heat Transfer and Thermal Limits, pg 28

ANSWER 5.09 (1.50)

- power, local power, flux, local flux
- core flow
- vessel pressure
- feedwater temperature
- feedwater flow
(3 required at 0.5 each)

REFERENCE
G. P. Heat Transfer and Thermal Limits, pg 68

ANSWER 5.10 (2.00)

a. P = Patm + Pwater column (0.5)
= 1.89 psia + 8 ft / 2.3 ft / psia (0.4)
= 5.4 psia (0.1)
b. Interpolating from steam tables 1.0 - 2.0 psia (0.9) yields 3.4 degrees subcooling (0.1).

REFERENCE
GE Thermodynamics, Heat Transfer, and Fluid Flow, pg 7-94
Steam Tables

ANSWER 5.11 (1.50)

- cladding embrittlement or oxidation
- heat generated by the reaction
- Hydrogen production
(0.5 each)

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

REFERENCE
G. P. Heat Transfer and Thermal Limits, pg 50

ANSWER 5.12 (1.00)

a. False (0.25). It may be Xenon free, but Samarium will increase following the scram (0.25).
b. False (0.25). Xenon has a higher microscopic absorption cross section (0.25).

REFERENCE
G. P. BWR Reactor Theory, pg 79-85

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 6.01 (2.00)

No (0.5). When transferring RPS power supplies, the RPS is momentarily deenergized because the transfer is break before make. This could result in a scram due to the 1/2 scram already present (1.5). (2.0)

REFERENCE
River Bend Simulator Text, Chapter 22, RPS, pg 22-5

ANSWER 6.02 (3.00)

a. 2, 4, 7
b. 1, 3, 9
c. 5, 6, 8
(0.33 each)

REFERENCE
River Bend Simulator Text, Chapter 53, Radiation Monitoring Data Sheet, Chapter 53a, Process Radiation Monitoring, pg 3-6

ANSWER 6.03 (2.00)

a. An uninterruptible power supply inverter (0.25) receives power from rectified 480 VAC (0.25), which is the normal source. A second source of power to the inverter is 125 VDC (0.25) from the station battery. This supply will feed the inverter without interruption should the normal supply fail (0.25). Malfunction of both DC sources or the inverter will cause a static switch (0.25) to automatically transfer the power source to a 120 VAC regulating transformer (0.25).
b. Permanent magnet generator (0.5) on the turbine front standard.

REFERENCE
River Bend Simulator Text, Chapter 36, EHC, pg 36-52
River Bend Simulator Text, Chapter 44, AC Electrical Distribution, pg 44-10

ANSWER 6.04 (3.50)

a. 1. Main steam dome / recirculation loop suction line temperature differential (0.25) less than 8 deg F (0.25) for 15 seconds (0.25). This ensures NPSH for the recirculation pumps and jet pumps (0.25).
2. Total feedwater flow (0.25) less than 30% (0.25) for 15 seconds (0.25).
This protects the FCV from cavitation (0.25) that could occur with the pump running in fast speed.
3. Low reactor vessel level (0.33) at level 3 or +10" (0.33). This protects the recirculation pumps against loss of NPSH due to loss of level in the vessel (0.33).
4. Recirculation Pump Trip or RPT (0.5) transfer aids in the addition of negative reactivity on a turbine trip or load reject (0.5). Late in cycle life, the control rods add insufficient negative reactivity the first few feet of travel, and the above transfer is necessary to ensure that adequate MCPR is maintained.
(3 of 4 required)

b. The LFMG cannot provide the required breakaway torque to start the pump and motor from fully stopped condition (0.5).

REFERENCE
River Bend Simulator Text, Chapter 8, Recirculation Flow Control, pg 8-2,12,13

ANSWER 6.05 (3.00)

a. 1. MSIV opening: Instrument air (0.25)
MSIV closing: Instrument air (0.25) and spring pressure (0.25)
2. SRV opening: Penetration Valve Leakage Control Air System
OR Main Steam Safety and Relief Valves Air Supply
OR Reactor pressure in the safety mode (0.25)
SRV closing: Spring pressure (0.25)
3. MSSV opening and closing: Motor (0.25)

b. The leaknge control barrier is established by pressurizing the volume between the inboard MSIV and the outboard MSIV (0.5) and the volume between the outboard MSIV and the MSSV (0.5) to greater than containment pressure (0.5) such that any leakage through the MSIV's is into the containment.

REFERENCE
River Bend Simulator Text, Chapter 34, Main Steam, pg 34-3,9,10,11
J. O. No. 12210, LSK 32-8, page 2

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 6.06 (3.50)

a. 4 or ETS oil pressure at the TCV (0.5)
b. The TCV Fast Closure is initiated by actuation of the Power/Load Unbalance Circuit, which compares turbine power (0.4) as sensed at the HP turbine exhaust (0.2) to generator load (0.4). If the difference exceeds 40% of rated (0.4), the Unbalance circuit is actuated to initiate a fast closure. The fast closure is bypassed if reactor power is <40% (0.4) as sensed by first stage turbine pressure (0.2).
If turbine trips only are listed, allow 1.5 pts for the trips. (trips are in Simulator Text, Chapter 35, Table 1, pg 35-17,18)
c. 1. shut (0.5)
2. shut (0.5)

REFERENCE
River Bend Simulator Text, Chapter 36, EHC/Steam Bypass and Pressure Regulating Systems, pg 36-29,31,82
River Bend Simulator Text, Chapter 35, Main Turbine, Table 1, pg 35-17,18

ANSWER 6.07 (1.50)

a. Positions remain the same, CST open, Suppression pool shut (0.5)
b. CST open, Suppression pool shut (0.5)
c. Positions remain the same, CST shut, Suppression pool open (0.5)

REFERENCE
River Bend Simulator Text, Chapter 12, HPCS, pg 12-11

ANSWER 6.08 (2.50)

a. half-scram
b. no action
c. half scram
d. rod block
e. scram
(0.5 each)

REFERENCE
River Bend Simulator Text, Chapter 22, RPS, pg 22-18
River Bend Simulator Text, Chapter 19, APRM, pg 19-5

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 6.09 (1.50)

a. - level 3 or +10"
   - higher
   - 10 seconds
   - lower
   (0.25 each)
b. Any of the three narrow range instruments (A, B, or C) differing by more than 2" from either of the other 2 channels (0.5)

REFERENCE
River Bend Simulator Text, Chapter 33, Feedwater Control, pg 33-4,8

ANSWER 6.10 (2.50)

a. - high drywell pressure
   - low reactor water level
   - sustained bus undervoltage
   (0.5 each)
b. - overspeed
   - generator differential
   (0.5 each)

REFERENCE
River Bend Simulator Text, Chapter 45, Diesel Generators, pg 45-12

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 7.01 (3.00)

a. 3 or 150 psig
b. 4 or 250 psig
c. 2 or 100 psig
d. 5 or 400 psig
e. 6 or 450 psig or 2 or 100 psig
f. 4 or 250 psig

REFERENCE
GOP-0001, Plant Startup to Low Power Alarm Point, Rev 0, pg 18-20
SOP-0080, Main Turbine and EHC Control System, Rev Draft, pg 5

ANSWER 7.02 (2.00)

a. With the auxiliary boiler operating, there is a constant input of non-radioactive water into the condensate system. This water will increase the liquid radwaste inventory and will have to eventually be discharged (1.0).
b. Without the steam packing exhauster and air removal pump(s) in operation, a high airborne activity condition could exist in the Turbine Building (1.0).

REFERENCE
GOP-0003, Shutdown from LPAP to Hot Standby or Hot Shutdown, Rev Draft, pg 5

ANSWER 7.03 (3.50)

a. - Introducing large quantities of relatively cool water to the RPV which could cause a reactivity transient
   - Flooding the RPV to the steam lines which could introduce water into steam driven equipment and/or the SRV's, damaging the affected equipment
   - Suppression pool water is not normally reactor grade and the introduction of large quantities of this water to the RPV could result in a lengthy cleanup
   (3 at 0.5 each)
b. Do not secure or place an ECCS in manual mode unless:
   1. Misoperation in automatic mode is confirmed (0.33) or
   2. Adequate core cooling is assured (0.33)
   by at least two independent indications (0.33).
c. No (0.25). Selecting CLOSE on a MOV that is stroking in the open direction could trip the MOV supply breaker (0.75) making remote operation impossible. (0.25 for remote operation impossible with no mention of breaker tripping)

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

REFERENCE
River Bend AOP - 0034, Inadvertent Initiation of an ECCS, Rev 0, pg 2,3

ANSWER 7.04 (2.50)

When the second individual control rod has scrammed (0.5) or it becomes apparent that instrument air will not be restored (0.5), scram the reactor (0.5) and trip the main turbine (0.5). Start RCIC (0.5).

REFERENCE
River Bend AOP - 0008, Loss of Instrument Air, Rev 0, pg 3

ANSWER 7.05 (3.00)

- RPV water level below +10 inches
- RPV pressure above 1065 psig
- Drywell pressure above +2 psig
- A condition which requires RPV isolation
- A condition requiring a reactor scram and reactor power is > 5 %
- A condition requiring a reactor scram and reactor power cannot be determined

(6 at 0.5 each)

REFERENCE
River Bend EOP - 0001, RPV Control, Rev 1, pg 3,4

ANSWER 7.06 (3.00)

a. - Entry into a Radiation Area
   - Entry into a Contamination Area
   - Entry into an Airborne Activity Area
   - Opening a system, component, or container which contains or potentially contains radioactive fluids
   - At the discretion of the Radiation Protection Foreman/Supervisor

   (3 at 0.33 each)

b. 1. Special RWP (0.5): Issued for non-repetitive tasks (0.25). Valid for the duration of the task (0.25).
   2. Routine RWP (0.5): Issued for repetitive tasks (0.25) such as instrument calibration or chemistry lab work. Valid until the end of the quarter in which it was written (0.25). The Radiation Protection Foreman, or his designee, may terminate an RWP at his/her discretion.

REFERENCE
River Bend T. P. 84 - 03, Radiation Work Permits, Rev 0, pg 2-3

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 7.07 (1.50)

a. All personnel will evacuate the reactor line-of-sight (0.5).
b. Reactor cavity water level is increased to keep the separators under water during the lift (0.5).
c. The defective fuel is stored in the sealed Defective Fuel Storage Container(0.5).

REFERENCE
River Bend Fuel Handling Procedure 0001, Control of Refueling Operations, Rev Draft, pg 11
NRC I & E BWR-6 Design, pg 12.3-11

ANSWER 7.08 (3.00)

a. - 100 mREM/wk
- 1000 mREM/qtr
- 4000 mREM/yr
- 500 mREM/gestation
(4 at 0.5 each)
b. release prevention - 25 REM (0.5)
life-saving activities - 75 REM (0.5)

REFERENCE
Health Physics and Practical Applications, pg 39-40
River Bend GET - 020, Administrative Radiation Control Requirements (Site Specific), Rev 0, pg 4
River Bend EIP - 2 - 012, Radiation Exposure Controls, Rev 0, pg 2,3

ANSWER 7.09 (2.50)

a. - Scram the reactor (0.5)
- Trip the recirculation pumps (0.25) within one minute (0.125) or upon any significant temperature increase in the pump or motor windings (0.125)
- Verify SSW auto starts (0.5)
- If surge tank level is low and cannot be restored (0.25), trip any running RPCCW pumps (0.25)
b. Recirculation pump temperatures cannot be maintained below the alarm setpoint (0.5)

REFERENCE
River Bend AOP - 0011, Loss of Reactor Plant Component Cooling Water, Rev 0, pg 4

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 7.10 (1.00)

a. 3, 5
b. 1, 6
(4 at 0.25 each)

REFERENCE
River Bend AOP - 0041, Main Turbine Bypass Valve Stuck Open, Rev 0, pg 2

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 8.01 (3.00)

a. 25%
b. 785 psig
c. 10%
d. 1.06
e. 1325 psig
f. the top of the active irradiated fuel
(6 at 0.5 each)

REFERENCE
River Bend Technical Specifications, Safety Limits

ANSWER 8.02 (2.50)

a. no
b. yes
c. yes
d. no
e. yes
(5 at 0.5 each)

REFERENCE
River Bend Technical Specifications, Definition Section

ANSWER 8.03 (1.50)

a. 1 Operator (0.5), 1 Senior Operator (0.5)
b. A Radiation Protection Technician is required to be on site when fuel is in the reactor (0.5).

REFERENCE
River Bend Technical Specifications, Section 6.2.2

ANSWER 8.04 (3.00)

a. False
b. True
c. False
d. True
e. False
f. True
(6 at 0.5 each)

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

REFERENCE
River Bend Technical Specifications, Section 6.2.2

ANSWER 8.05 (1.50)

a. Two members of plant management staff (0.5), one of which holds a Senior Operator license (0.5). Also accept section supervisor, discipline supervisor or foreman AND COF or SS as the two members of plant management staff, if candidates' answers are that specific.
b. The intent of the procedure is not changed OR to continue work already in progress (either one at 0.5).

REFERENCE
River Bend Technical Specifications, Section 6.8.3
River Bend Administrative Procedure ADM-0003, Development, Control, and Use of Procedures, Rev 2, pg 17-19, items 6.6.1, 6.6.7, and 6.6.8

ANSWER 8.06 (3.00)

- Plant Operating Procedures
- Final Safety Analysis Report
- Technical Specifications
- Selected Technical Manuals
- Selected Prints
- Emergency Plan or EIP's
- Setpoints Document
- Selected Tables and Curves
- Radiation Protection Plan

Also accepted System Operating Procedures, Abnormal Operating Procedures, Emergency Operating Procedures, and Administrative Procedures as separate answers in lieu of Plant Operating Procedures.

REFERENCE
ADM - 0022, Conduct of Operations, Rev 0, pg 19

ANSWER 8.07 (1.00)

When additional work is to be performed on a system already under a clearance, and the clearance is satisfactory for the additional work (1.0).

REFERENCE
ADM - 0027, Protective Tagging, Rev 1, Section 6.2, pg 6

ANSWER 8.08 (1.50)

a. Double verification is required if the temporary alteration is on a safety related component or system (0.5).
b. A double verification may be waived only tc prevent significant radiation exposure (0.5).
c. 90 days (0.5)

REFERENCE
ADM - 0031, Temporary Alterations, Rev 0, pg 3,4,6

ANSWER 8.09 (1.50)

a. The Control Operating Foreman will assume the position of EOP Director/Coordinator (0.5) and the Shift Supervisor will assume the role of advisor to the COF (0.5).
b. The most important "ingredient" is the dialogue (communications) between the Nuclear Control Operator(s) and the Control Operating Foreman (0.5). Also accepted 1) Having a thorough understanding of the entry conditions and 2) Having a thorough understanding of the intent of the EOP, i.e., "treat the symptoms".

REFERENCE
OSP - 0009, Author's Guide / Control and Use of the Emergency Operating Procedures, Rev 0, pg 18-20

ANSWER 8.10 (1.00)

Only licensed operators (0.5) or trainees (0.25) under the direct supervision of a licensed operator (0.25) are permitted to manipulate the controls.

REFERENCE
ADM - 0022, Conduct of Operations, Rev 0, pg 12

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

ANSWER 8.11 (2.00)

- Reactor scram
- Major equipment failure or malfunction
- Unexplained reactivity changes
- Loss of offsite power
- Any circumstance requiring unit outage
- Any circumstance affecting ability to meet unit operation schedule
- Accidents occurring on plant property
- Inadvertant liquid or gaseous radiation release
- Major personnel injury
- Personnel radiation overexposure
- All reportable events
- Events requiring immediate NRC notification
- Violation of local, state, or federal pollution (NPDES) regulations
- Turbine trip
- Load restrictions
- Inability to meet load dispatcher requests

(8 required at 0.25 each)

REFERENCE
ADM - 0022, Conduct of Operations, Rev 0, pg 14,15

ANSWER 8.12 (1.00)

a. Four (0.5)
b. When the action is immediately needed to protect the public health and safety (0.5), and no action consistent with license conditions and technical specifications that can provide adequate or equivalent protection is immediately apparent.

REFERENCE
10 CFR 55.31
10 CFR 50.54(x)

ANSWER 8.13 (1.00)

- Louisiana Nuclear Energy Division
- Louisiana Office of Emergency Preparedness
- East Feliciana Parish
- West Feliciana Parish
- Pointe Coupee Parish
- East Baton Rouge Parish
- West Baton Rouge Parish
- Mississippi Highway Safety Patrol

(5 required at 0.2 each)

ANSWERS -- RIVER BEND 1 -85/01/22-GRAVES, D.

REFERENCE
EIP - 2 - 005, General Emergency, Rev 0, pg 5

ANSWER 8.14 (1.50)

a. OSP - 0009 or Procedure for Use of the EOP's (exact title of procedure not required) (0.5)
b. - component affected
- parameter exceeded
- value operated at
- length of time operated above design limit
(2 required at 0.5 each)

REFERENCE
OSP - 0009, Author's Guide/Control and Use of Emergency Procedures, Rev 0, pg 22