EXAMINATION REPORT 50-298/OL-86-02

Facility Licensee: Nebraska Public Power District
P. O. Box 499
Columbus, Nebraska 68601

Facility Docket No.: 50-298

Facility License No.: DPR-46

Operator License examinations administered at Cooper Nuclear Station (CNS)

Chief Examiner: David N. Graves 9/9/86
D. N. Graves Date

Approved By: R. A. Cooley 9/10/86
R. A. Cooley, Chief, Operator Licensing Section Date

Summary

Two Reactor Operator candidates, were administered retake operating examinations. One Reactor Operator candidate was administered a retake written examination. All three candidates passed.

1. Persons Examined

	Pass	Fail	Total
RO Candidates	3	0	3

2. Examiners

D. N. Graves, (Chief Examiner), NRC
R. A. Cooley, NRC
E. A. Plattner (Proctor), NRC CNS Resident Inspector

3. Examination Report

Performance results for individual candidates are not included in this report.

a. Examination Review Comments and Resolution

This section reflects the comments made by the facility during the examination review conducted following the written examination. The comments accepted by the NRC reviewer have been incorporated into the master copies of the examination included in this report. Comments and resolutions are listed by section and question number.

1.02

Part C.

Answer: This answer allows two possible approaches. The second option (GV's already at limit) would not be a normal condition at Cooper and, therefore, the assumption should be stated. (Answer Key reflects this.) However, the first option (Load reference above 100% load) is a normal situation. Procedure 2.2.14 (Turbine operating procedure) instructs the operator to enter a DEMAND of 800 MWE. The DEH student handout (p 27) states that a large bias signal is then applied so that the PRESSURE Control signal has priority. (The pressure control signal is compared to the load demand plus bias signal in a Low Valve Gate.) The student may not state the assumption since this is the normal mode of operation. Therefore, we feel the student should not lose points (required by answer key) for not stating " . . . if load demand is set greater than 100% load."

Resolution: Agree. Answer key modified.

1.04

Answer: The answer key uses a reactor pressure of 1060 psig for 100% reactor power. The Main Steam system student handout (P 15) states that reactor pressure will be about 1015 psig at 100% reactor power. Here at Cooper, we generally simplify this to "approximately 1000 psig." We feel that any reasonable pressure near 1000 psig should be accepted as correct and the student's calculations based on the assumed reactor pressure.

Resolution: Agree. Answer key modified to accept + or - 20 psi for 1% values and + or - 50 psi for 100% values.

1.05

Part A

Answer: Operating Procedure 2.1.1 (Cold Startup) also discusses avoiding fast period scrams. It instructs the operator to adhere to the "Banked Position Withdrawal Method:" for the third and fourth RSCS groups withdrawn. The student should receive credit (0.5 pts) for the "Banked Position Withdrawal Method:" as the second portion of the answer.

Resolution: Agree. "Banked Position Withdrawal Method" added as alternate wording for second portion of answer.

1.12

Answer: One of the things stressed during EOP training is adequate core cooling. The term "steam cooling" is used in discussing heat removal. The student could use the term "steam cooling" to answer this question. This should be considered an acceptable answer. NEDC-30873 (EOP Training Material) defines steam cooling.

Resolution: Agree. Steam cooling accepted. Answer key modified.

2.02

Answer: B. Question states list features, answer key requires a description of each feature. Should not require a description for full credit.

Resolution: Agree. Answer key modified to exclude description in grading.

2.04

Answer: A. Bearing spray is considered one area because when the spray is initiated, it sprays all three bearings. Therefore, "bearing area" should be considered three correct answers.

Reference: Fire Protection Lesson Plan, Pages 4 and 14.

Resolution: Disagree. Bearing area counted as three only if the three bearings specified; otherwise counted as one area. Five other areas still available to complete the six areas required.

2.04

Answer: B. There are (2) local pushbuttons for local actuation. The student may list each pushbutton as a method since they are approximately 30 feet apart. Each pushbutton should be considered separately.

Reference: Fire Protection Lesson Plan, Page 14.

Resolution: Agree. Answer key modified.

2.07

Answer: A. SBGT lines up to take a suction on Primary Containment also. ADR-1A closers, ADR-1B opens.

Reference: SBGT Lesson Plan, Pages 5 and 7 (Attachment Figure 2)

Resolution: Agree. Answer key modified.

3.02

Answer: C. Number 2 speed limiter is also called single limiter and should be accepted for full credit.

Reference: Figure 14, Recirc Lesson Plan

Resolution: Agree. Added as alternate acceptable wording.

3.03

Answer: B. Level Signal is also sealed in. Should require both for full credit.

Reference: Nuclear Pressure Relief Lesson Plan, Page 9

Resolution: Agree. Answer key modified.

4.11

Answer: B. Recirc discharge valve has been improved to prevent hydraulically locking valve and causing it to stick in seat. A hole has been drilled in reactor side disc to allow pressure between discs to be relieved. Should accept cold water injection for full credit as per G.O.P. 2.1.15, Rev. 17, Page 1.

Reference: Recirc Lesson Plan, Page 11
G.O.P. 2.1.15, Rev. 17, Page 1

Resolution: Agree. Hydraulic lock answer replaced with cold water injection.

b. Examination Master Copies

Enclosed are final copies of the examination and answer key.

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: COOPER

REACTOR TYPE: BWR-GE4

DATE ADMINISTERED: 86/08/07

EXAMINER: GRAVES, D.

CANDIDATE: ______________________

INSTRUCTIONS TO CANDIDATE:

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

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	25.00	________	________	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		________ Final Grade		Totals

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

____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

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

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

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

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

6. Use only the paper provided for answers.

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

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

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

10. Skip at least three lines between each answer.

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

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

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

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

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

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

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

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

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

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

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

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

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

QUESTION 1.01 (2.00)

The reactor is operating at 80% power. Recirculation flow is increased to raise power. Describe how the various reactivity coefficients function to cause and terminate the power increase. Include in your answer each effect that causes a reactivity change, and why that effect causes its associated reactivity change. (2.0)

QUESTION 1.02 (3.00)

Reactor power has been at 50% for the past three days. Power is now raised to 100%. Four hours later, how will each of the following compare with their initial values (at 100%), assuming no operator action? EXPLAIN why in each case. Values are not required. (3.0)

a. core flow

b. reactor power

c. megawatt output (electrical)

QUESTION 1.03 (2.00)

During refueling, the reactor is subcritical with a stable countrate of 200 cps. Keff = 0.99. A new fuel bundle is added to the core and the countrate stabilizes at 400 cps.

a. What is the new Keff? SHOW ALL WORK. (1.0)

b. What effect does adding the same amount of reactivity again have on the condition of the reactor? JUSTIFY YOUR ANSWER. (1.0)

QUESTION 1.04 (2.00)

The reactor is critical at ~ 1% power. RPV pressure is 920 psig. How much reactivity will be added due to the moderator temperature coefficient as reactor power is increased to 100%. JUSTIFY your answer and SHOW ALL WORK. (2.0)

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

QUESTION 1.05 (2.00)

a. Describe the control rod withdrawal method used that is meant to help eliminate fast period scrams caused by high notch worths. (1.5)

b. What scram is designed to shut the reactor down in a short period situation during a reactor startup? (0.5)

QUESTION 1.06 (2.50)

The reactor is operating at 100% when one Safety/Relief Valve opens and stays open. Indicate how each of the following parameters will change, steady state to steady state, and briefly explain why each responds that way. Assume no operator action. (2.5)

a. Turbine steam flow

b. Reactor vessel level

c. Reactor pressure

QUESTION 1.07 (1.50)

A motor operated centrifugal pump is operating with a discharge pressure of 50 psig, flow of 150 gpm, and power consumption of 2 kw. If the speed of the pump is increased to raise the flow to 400 gpm, what is the new: (1.5)

a. discharge pressure?

b. power consumption?

QUESTION 1.08 (.50)

Why does decay heat NOT indicate on the nuclear instrumentation? (0.5)

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

QUESTION 1.09 (1.50)

List six (6) energy factors used in the calculation of a reactor heat balance and indicate whether each is a positive or negative energy input to the calculation. (1.5)

QUESTION 1.10 (2.00)

a. State the mode of heat transfer for each of the following items (assume BOL): (1.0)

1. fuel pellet to the clad

2. through the cladding

3. cladding to the coolant channel

b. Is the fuel centerline temperature higher at the beginning of a fuel cycle or at the end of a fuel cycle? JUSTIFY your answer. (1.0)

QUESTION 1.11 (1.00)

HOW and WHY would removal of 100% of the inert and noncondensible gases from the reactor coolant affect heat transfer in the reactor? (1.0)

QUESTION 1.12 (1.00)

What is the mechanism or process by which a fuel rod is cooled following the occurrence of transition boiling (NOT one of the three basic heat transfer modes)? (1.0)

QUESTION 1.13 (2.50)

Which BWR thermal limit(s) must be maintained within design values to ensure adequate thermal margin during: (2.5)

a. normal steady state operations

b. transient conditions

c. accident conditions

QUESTION 1.14 (1.50)

Concerning control rod worths during a reactor startup from 100% PEAK XENON versus a startup under XENON-FREE conditions, which statement is correct? JUSTIFY YOUR CHOICE. (1.5)

a. PERIPHERAL control rod worth will be LOWER during the PEAK XENON startup than during the XENON-FREE startup.

b. CENTRAL control rod worth will be HIGHER during the PEAK XENON startup than during the XENON-FREE startup.

c. BOTH control rod worths will be the SAME regardless of core Xenon conditions.

d. PERIPHERAL control rod worth will be HIGHER during the PEAK XENON startup than during the XENON-FREE startup.

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

QUESTION 2.01 (3.50)

a. From where does the RHR Service Water Booster system take its suction and to where does it discharge? (0.5)

b. HOW is an inadvertent admission of RHR Service Water into the RHR system prevented (physically, not administratively)? (0.5)

c. WHAT is the relationship between RHR Service Water system pressure and RHR system pressure and WHY? (1.0)

d. HOW is the relationship in "c" above controlled or varied? (0.5)

e. A RHR Service Water Booster Pump control switch is positioned to START and the switch stays in this position. Is this desirable? EXPLAIN. (1.0)

QUESTION 2.02 (3.00)

a. Describe the arrangement of components that ensures no portion of the primary containment exceeds the maximum design EXTERNAL pressure? Include the maximum design EXTERNAL pressure. (1.5)

b. The secondary containment system utilizes four different features to mitigate the consequences of a postulated loss of coolant accident or refueling accident. LIST three (3) of these features. (1.5)

QUESTION 2.03 (3.50)

a. The reactor is at 400 psig. Describe how the Core Spray injection valves (MO-11 and MO-12) must be operated to have them both open at the same time. (0.5)

b. The reactor is at 500 psig. Can the Core spray injection valves (MO-11 and MO-12) both be opened at the same time? If so, describe how they must be opened. If not, can EITHER of the two valves be opened with no injection signal present? EXPLAIN. (1.0)

c. What is the meaning of the white light above the MO-11 and MO-12 control switches? Once illuminated, what THREE (3) conditions will cause the condition to clear? (2.0)

QUESTION 2.04 (2.00)

a. What are six (6) areas served by the Low Pressure CO2 System? Indicate whether the area is covered AUTOMATICALLY or requires MANUAL actions. (1.5)

b. After the initial 50 second discharge of CO2, how are subsequent discharges initiated (2 methods or locations required)? (0.5)

QUESTION 2.05 (2.00)

For each of the following items (a - d), indicate whether it describes proper system response or not. If it does not, describe how the discussed event should occur.

a. With the RCIC system operating, a low level occurs in an ECST. The pump suction from the ECST (RCIC-MO-18) closes and the pump suction from the suppression chamber (RCIC-MO-41) then opens. (0.5)

b. The RCIC system is operating with reactor level increasing. When the high level setpoint is reached, the steam supply inboard and outboard isolation valves (RCIC-MO-15 and 16) close. (0.5)

c. The RCIC system is operating in the TEST mode, discharging to the ECST. A valid low reactor level initiation signal is received. The test circuitry is automatically bypassed, the test bypass to ECST closes, and the flow controller controls RCIC flow automatically. (0.5)

d. With the RCIC system operating, a high steam line space temperature isolation signal is generated. The following valves close as a result of the isolation: Steam supply inboard and outboard isolation valves (RCIC-MO-15 and 16), the minimum flow valve (RCIC-MO-27), the RCIC pump discharge valve (RCIC-MO-20), and the injection valve (RCIC-MO-21). NOTE: The above listed valves are not the only valves that are affected by the isolation. EVALUATE ONLY THE VALVES LISTED. DO NOT ATTEMPT TO COMPLETE THE LIST. (0.5)

QUESTION 2.06 (1.50)

a. What two (2) mechanisms or methods are used in the Offgas System to maintain or reduce hydrogen concentration of the offgas? (1.0)

b. Why is there a maximum power limit imposed on the use of the mechanical vacuum pumps? (0.5)

QUESTION 2.07 (1.50)

a. Where does the Standby Gas Treatment System line up to take a suction on an automatic initiation due to a refueling accident? (0.5)

b. Other than the normal automatic initiation supply and dilution air, what are two (2) additional areas or components that can provide a supply to the Standby Gas Treatment System? (1.0)

QUESTION 2.08 (3.00)

Explain for each system given below, the relationship or interface with the Control Rod Drive Hydraulic system (CRDH). Be specific about CRDH components which interface with each.

a. Demineralized Water System. (0.75)

b. Reactor Equipment Cooling System. (0.75)

c. Reactor Building Equipment Drain System. (0.75)

d. 125 V DC. (0.75)

QUESTION 2.09 (3.00)

Explain how AND why a complete loss of the plant air system, while operating at full power, with no operator action, would affect the following plant parameters or components.

a. Main condenser vacuum. (0.75)

b. RWCU operation. (0.75)

c. Main Steam Isolation Valves. (0.75)

d. Control Rod position. (0.75)

QUESTION 2.10 (2.00)

The blowdown flow control valve (FCV-55) in the Reactor Water Cleanup system is tripped closed when either of two abnormal conditions exist. What are these two conditions and what do they prevent? (2.0)

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

QUESTION 3.01 (2.00)

The reactor is operating at 100% under steady state conditions. An instrument technician mistakenly isolates and equalizes the pressure across one of the MAIN STEAM line flow transmitters. DESCRIBE the response of the Feedwater Control System until steady state conditions are again established. ASSUME 3-ELEMENT CONTROL. (2.0)

QUESTION 3.02 (3.00)

For each of the situations listed below, describe how the recirculation and flow control systems will respond and why. Include which component is controlling speed and whether both or only one pump is affected.

a. 28% power, recirculation pumps at minimum speed with both M/A transfer stations in manual. Recirculation pump "A" M/A transfer station is switched to AUTO. (1.0)

b. 75% power, recirculation flow control is in master manual when the MG set "A" tachometer output fails to a zero output. (1.0)

c. 75% power, recirculation flow control is in master manual when one reactor feed pump trips. (1.0)

QUESTION 3.03 (3.50)

a. All parameter inputs to the ADS are present for initiation and the timer is counting down. What are two (2) ways the operator can prevent the ADS valves from actuating? (1.0)

b. Which of the four initiation logic signals is(are) sealed in? (0.5)

c. With NO ADS initiation signals present, what is the status of the red and blue lights on the 9-3 panel associated with the ADS valves? (0.5)

d. What do the red and blue lights on the 9-3 panel indicate about the state or status of the ADS valves? (1.0)

e. Experience has shown that the SRV's can inadvertently open if what condition occurs? Assume the logic is functioning properly and there are no breaks in the system. (0.5)

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

QUESTION 3.04 (2.00)

Describe the response of the Main Turbine Control System (DEH) to each of the events described below. Assume all control systems function normally and NO RPS TRIP is generated.

a. One steam bypass valve partially opens while at 70% power (DEH in Mode 4) (1.0)

b. Reactor power is manually increased above the load reference setpoint (DEH in Mode 4) (1.0)

QUESTION 3.05 (3.50)

a. What provisions are made in the Offgas System to DETECT an explosion or burn-back? (1.0)

b. If an explosion or burn-back is detected, what automatic action takes place in the Offgas System? (0.5)

c. What are three ways that an Offgas System isolation can be accomplished (with the exception of individually closing each isolation valve)? Include any time delays that occur as appropriate. (2.0)

QUESTION 3.06 (1.50)

Following a reactor scram, the four rod display position goes blank, but the green full-in light on the full core display for that control rod is lighted. Is this normal? If so, explain why it occurs. If not, describe the probable cause. (1.5)

QUESTION 3.07 (.50)

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. Turbine control fluid pressure

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

QUESTION 3.08 (2.00)

A LOCA has occurred and HPCI initiated, operated, and tripped on high level. Level is now 37 inches and decreasing. How can the system be restarted? TWO METHODS REQUIRED. (2.0)

QUESTION 3.09 (3.00)

a. Other than alarm lights, what are three (3) instruments that utilize the recirculation flow converter output as an input? An instrument that has more than one channel counts as one instrument. (1.5)

b. What are three (3) indications that the operator will have on the control room front panels that the A flow converter unit output is 15% higher than the B flow converter unit output? (1.5)

QUESTION 3.10 (.50)

True or False. Flow-biased scrams and rod blocks are not required, by design, to prevent exceeding the fuel thermal limits. (0.5)

QUESTION 3.11 (2.50)

a. What action must be taken to make the NMS RPS logic "noncoincident" (Any single NMS channel will cause a full RPS trip)? (1.0)

b. What IRM/APRM conditions are necessary to generate a companion IRM/APRM scram? (1.0)

c. The companion IRM/APRM scram is automatically bypassed when the reactor mode switch is placed in any position other than ________. (0.5)

QUESTION 3.12 (1.00)

Describe how an equalizing valve leak on a reactor level transmitter affects the indicated level from that transmitter. (1.0)

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

QUESTION 4.01 (2.50)

a. Annunciator windows on panel 9-5 having a RED background are associated with WHAT CONDITION? (0.5)

b. Indicate the color of the annunciator windows that denotes each of the following conditions:

   1. Priority I - A critical condition that requires immediate operator action (0.5)

   2. Priority II - An off-normal condition which could rapidly develop into a critical condition (0.5)

   3. Priority III - An off-normal condition which requires operator followup (0.5)

c. WHO must give his/her approval before any annunciator card may be removed (identify by minimum requirements, NOT name)? (0.5)

QUESTION 4.02 (2.00)

What are two (2) undesirable consequences of a loss of both Control Rod Drive Hydraulic pumps? Include WHY the consequences are undesirable. (2.0)

QUESTION 4.03 (2.50)

a. What are three (3) areas or locations that will be manned by operations personnel following an evacuation of the control room? (1.5)

b. If the reactor was not scrammed prior to leaving the control room, what are two (2) alternate methods of scramming the reactor, per EOP 5.2.1, Shutdown from Outside the Control Room? (1.0)

QUESTION 4.04 (2.00)

A loss of the Service Water System has occurred and it is not expected that the system will be restored within a short period of time. What are four (4) actions that must be performed? (2.0)

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

QUESTION 4.05 (1.00)

Boron injection into the reactor is required per EOP1, RPV Control, and the Standby Liquid Control System is incapable of injecting into the RPV. Describe basically how boron injection to the RPV is accomplished under the above circumstances. Specific procedural steps ARE NOT required. (1.0)

QUESTION 4.06 (2.00)

Answer the following questions concerning GOP 2.1.5, Emergency Shutdown from Power:

a. After the manual scram buttons are depressed, what two (2) checks should the operator make to verify all control rods inserted? (1.0)

b. If it becomes necessary to shut the MSIV's after the scram, what are the two (2) methods stated in the procedure for accomplishing this? (1.0)

QUESTION 4.07 (2.00)

a. How long can an operator stay in a 25 mREM/hr radiation field without exceeding a CNS administrative radiation exposure limit? (1.0)

b. What action(s) should be taken by an individual who finds his/her pocket chamber dosimeter is reading greater than full scale? (1.0)

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

QUESTION 4.08 (2.50)

A loss of all site AC power has occurred. Answer the following questions concerning EOP 5.2.5.1, Loss of All AC Power Station Blackout.

a. What reactor water level indication(s) are available in the control room following this event? (1.0)

b. What reactor water level indication(s) are available outside the control room following this event? (0.5)

c. Why should reactor pressure NOT be reduced below the saturation pressure corresponding to the maximum drywell temperature? (1.0)

QUESTION 4.09 (2.00)

MATCH each of the events (a - d) with the pressure at which the event may be performed during a cold plant startup per GOP 2.1.1, "Cold Startup Procedure". Items may be used more than once or not at all as appropriate. (2.0)

_____a.	Begin placing RFP pump in service	1. 25 psig
_____b.	Open HPCI steam isolation valves	2. 50 psig
_____c.	Steam seals placed in service	3. 100 psig
_____d.	Reset and unisolate RCIC	4. 150 psig
		5. 350 psig

QUESTION 4.10 (3.00)

a. What provision is made for contacting personnel in the diesel generator room from the control room during diesel generator operations. (1.0)

b. Describe how the diesel generator would be paralleled to an energized bus. Assume the diesel generator is running, the synchroscope is on, and the voltage regulator is in automatic. Your answer should include indications and controls used and adjustments made during the performance of the evolution. (2.0)

QUESTION 4.11 (2.50)

State the undesirable consequence associated with each of the following operating conditions or precautions regarding the recirculation system:

a. A recirculation pump is shutdown and isolated, but the seal purge is not isolated. (1.0)

b. The recirculation pump is left isolated (suction and discharge valve shut) with the reactor at rated temperature and pressure. (0.5)

c. The reactor is operating at power with severely unbalanced jet pump flows. (1.0)

QUESTION 4.12 (1.00)

Indicate which of the following methods of operating the recirculation pumps is more desirable during extended outages (a or b) AND state why the other method is undesirable. (1.0)

a. Run the recirculation pumps continuously at low pressure.

b. Shutdown the recirculation pumps and restart them when desired.

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

NRC LICENSE EXAMINATION HANDOUT

EQUATIONS, CONSTANTS, AND CONVERSIONS

$\dot{Q} = \dot{m} * C_p * \text{deltaT}$ $\dot{Q} = U*A*\text{deltaT}$

$P = P_o * 10^{sur*(t)}$ $P = P_o * e^{t/T}$ $SUR = 26/T$

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

$\rho = (K_{eff} - 1)/K_{eff} = \text{delta}K_{eff}/K_{eff}$ $\rho = l^*/TK_{eff} + \bar{\beta}_{eff}/(1 + \bar{\lambda}T)$

$\lambda = \ln 2/t_{1/2} = 0.693/t_{1/2}$ $\bar{\lambda} = 0.1 \text{ seconds}^{-1}$

$I = I_o * e^{-ux}$

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

$R/hr = 6*CE/d^2$ feet

Water Parameters

1 gallon = 8.345 lb_m = 3.87 liters
1 ft^3 = 7.48 gallons
Density @ STP = 62.4 lb_m/ft^3 = 1 gm/cm^3
Heat of vaporization = 970 Btu/lb_m
Heat of fusion = 144 Btu/lb_m
1 atmosphere = 14.7 psia = 29.9 inches Hg.

Miscellaneous Conversions

1 curie = 3.7×10^{10} disintegrations per second
1 kilogram = 2.21 lb_m
1 horsepower = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 inch = 2.54 centimeters
degrees F = 9/5 degrees C + 32
degrees C = 5/9 (degrees F - 32)
1 Btu = 778 $ft\text{-}lb_f$

ANSWER 1.01 (2.00)

As flow increases, the void content in the core decreases (0.25), causing a positive reactivity addition due to the void coefficient (0.25). As power starts to increase, the fuel temperature begins to rise (0.25). As the fuel temperature increases, the fuel temperature coefficient adds negative reactivity (0.25) to slow the power rise. As the higher fuel temperature is transferred to the coolant (0.25), void generation increases (0.25), which also adds negative reactivity. The power increase is terminated by the combined negative effects of the void and doppler coefficients (0.5).

REFERENCE
Reactor Physics Review, pg 52

ANSWER 1.02 (3.00)

a. Core flow would be lower (0.5). As power increases, 2 phase flow resistance increases (0.5), which would cause a decrease in core flow.

b. Reactor power would increase (0.5). Xenon would be burning out (0.5), which adds positive reactivity.

c. Megawatt output would increase (0.5) if the load reference is set at greater than 100% rated load (0.5) OR due to pressure increaseing as a result of power increasing (0.5).

REFERENCE
SOP 2.2.7, Turbine Generator, Rev 26, pg 24
GE Thermodynamics, Heat Transfer, and Fluid Flow, Chapter 9, pgs 45-48
Reactor Physics Review, pg 45

ANSWER 1.03 (2.00)

a. CR2/CR1 = (1 - Keff1)/(1 - Keff2) (0.5 points for correct method)

400/200 = (1 - 0.99)/(1 - Keff2)

Keff2 = 0.995 (0.5 points)

b. The reactor would be slightly supercritical (will accept critical). (0.25 points)

reactivity = p

p1 = (Keff1 - 1)/Keff1 = (0.99 - 1.0)/0.99 = -.0101 (0.25 points)

p2 = (0.995 - 1.0)/0.995 = -.00503 (0.25 points)

p2 - p1 = .00507 (added by the fuel bundle) (0.25 points)

if .00507 was added again, the reactor would be slightly super-critical (.00507 > .00503).

REFERENCE
Reactor Physics Review, pg 14, 18

ANSWER 1.04 (2.00)

MTC = -1 X 10E-4/deg F (accept -.7 to -1.8 X 10E-4/deg F) (0.25 point)

920 psig @ 1% = 934.7 psia = 536.4 deg F (0.5)

1000 psig @ 100% (0.25) = 1014.7 psia = 546.3 deg F (0.5)

546.3 - 536.4 = 9.9 deg F change from 1% to 100% power

9.9 deg F X MTC = -9.9 X 10E-4 (0.5)
Accept + or - 20 psi for 1% pressure and + or - 50 psi for 100% pressure

REFERENCE
Reactor Physics Review, pg 26
Steam Tables

ANSWER 1.05 (2.00)

a. The first two groups are withdrawn completely (0.5). The next two groups are withdrawn in a banked configuration to the full out position (Banked Position Withdrawal Method) (0.5). Beyond the 50% rod density pattern, the RSCS group notch control enforces the desired pattern or withdrawal sequence (0.5).

b. IRM high flux (0.5)

REFERENCE
CNS Procedure 10.13, Control Rod Sequence and Movement Control, Attachment A, Rev 13, pg 2 of 6
Reactor Physics Review, pg 50

ANSWER 1.06 (2.50)

a. Decrease (0.33). The SRV opening causes a decrease in pressure at the turbine inlet which causes DEH to close down on the turbine governor valves (0.5).

b. Decrease (0.33). RPV level stays low due to the steam flow/feed flow mismatch (0.5).

c. Decrease (0.33). With the DEH controlling throttle pressure, the SRV open keeps reactor pressure less than normal 100% pressure (0.5).

REFERENCE
GE BWR Simulator Reactor Physics Lesson Plan
BWR-4 Transients

ANSWER 1.07 (1.50)

a. N is proportional to flow (0.25)

400 gpm/150 gpm = 2.7 (0.25)

dp is proportional to N squared (0.25)

dp = (2.7)(2.7)(50 psig) = 364.5 psig (0.25)

b. pwr is proportional to N cubed (0.25)

pwr = (2.7)(2.7)(2.7)(2 kw) = 39.4 kw (0.25)

REFERENCE
GE Thermodynamics, Heat Transfer, and Fluid Flow, pg 7-111

ANSWER 1.08 (.50)

Decay heat is the result of the decay of fission fragments, which are not neutron reactions, and thus are not detected (0.5).

REFERENCE
Basic Reactor Theory

ANSWER 1.09 (1.50)

Core thermal power = RWCU water out + reactor steam out + radiative losses out - RWCU water in - CRD water in - pump heat - feedwater in (6 required at .125 for each parameter and .125 for each + or -)

REFERENCE
CNS Procedure 10.3, Core Thermal Evaluation, Rev 6, pg 1

ANSWER 1.10 (2.00)

a. 1. convection (0.5)
   2. conduction (0.5)
   3. convection (0.5)

b. New fuel (0.5). The heat transfer is more efficient later in life due to the lack of fuel to clad gap (0.5).

REFERENCE
GE Thermodynamics, Heat Transfer, and Fluid Flow, Problem 8-1

ANSWER 1.11 (1.00)

The removal of the gases would suppress nucleate boiling (0.5), thus reducing the rate of heat transfer from the fuel to the coolant (0.5). Also accept increasing heat transfer (0.5) due to decreasing the corrosion rate (0.5).

REFERENCE
GE Thermodynamics, Heat Transfer, and Fluid Flow, pg 9-4

ANSWER 1.12 (1.00)

Impingement of tiny moisture droplets travelling at high velocity OR steam cooling (1.0).

REFERENCE
GE Thermodynamics, Heat Transfer, and Fluid Flow, pg 9-19

ANSWER 1.13 (2.50)

a. MCPR, LHGR

b. MCPR, LHGR

c. MAPLHGR
   (0.5 each)

REFERENCE
GE Thermodynamics, Heat Transfer, and Fluid Flow, Chapter 9, pgs 100-101

ANSWER 1.14 (1.50)

"d" is the correct answer (0.5). The highest xenon concentration will be in the center of the core (0.5), the high flux region from the previous operating period. This will increase the flux in the area of the peripheral rods (0.5) thus increasing their worth.

REFERENCE
GE Reactor Physics Review, pg 36-37

ANSWER 2.01 (3.50)

a. suction - Station Service Water headers (0.25)
discharge - Circulating Water discharge canal (0.25)

b. Two manual, locked-closed valves are in the line (0.5).
Number not required.

c. RHRSW pressure is maintained greater than RHR system pressure (0.5) to prevent any radioactive leakage from the RHR system into the Service Water system (0.5).

d. The pressure relationship is maintained by varying the position of the RHR HX Service water outlet valve (0.5).

e. No (0.25). The RHR HX Service Water outlet valve will continue to open and RHRSW pump runout could occur (0.75).

REFERENCE
CNS Service Water System Description, pg SVW-5, 15, 16, 28

ANSWER 2.02 (3.00)

a. Suppression pool to drywell vacuum breakers (0.6) and reactor building to suppression pool vacuum breakers (0.6) prevent exceeding the maximum design external pressure limit of 2 psi (0.3).

b. - negative pressure barrier (which minimizes the ground level release by exfiltration)
- low leakage containment volume (which provides a holdup time for fission product decay prior to release)
- (removal of particulates and iodines by) filtration (prior to release)
- (exhausting of the secondary containment atmosphere through) an elevated release point
(3 required at 0.5 each, parts in parentheses not required for full credit)

REFERENCE
CNS Containment System Description, pg CON-7, 10-11, 19-20

ANSWER 2.03 (3.50)

a. MO-11 must be opened first (0.5)

b. No (0.25), Yes (0.25), either of the two valves can be opened, but both cannot be open at the same time (0.5).

c. The white light means that only manual operation of the valve is allowed (0.5). Also accept that the valve is shut and an initiation signal is present.

The condition can be cleared by :
- termination of the auto initiation signal (0.5)
- reactor pressure increases to > 450 psig (0.5)
- loss of power to the pump motor bus (0.5)

REFERENCE
CNS Core Spray System Description, CS-5, 6,
CNS Procedure 2.2.9, Core Spray System, Rev 26, pg 2

ANSWER 2.04 (2.00)

a. Reactor building MG set room - Manual
Control building cable spreading room - manual
Control room entrance - manual
Turbine building switchgear room - manual
Main generator - manual
Turbine bearing #1 area - automatic
Turbine bearing #2 area - automatic
Turbine bearing #3 area - automatic
(6 areas at 0.15 each, 6 initiations at 0.1 each)

b. - Reset button on the sprinkler control and fire alarm panel in the Control Room
- Manual pushbutton in the NW corner of the turbine generator operating floor
- Manual pushbutton on the North wall of the turbine generator operating floor shield wall
(2 required at 0.25 each)

REFERENCE
OP 2.2.2, Carbon Dioxide System, Rev 14, pg 2,5

ANSWER 2.05 (2.00)

a. No, the torus suction valve opens first, then the ECST suction valve shuts (0.5).

b. No, the steam supply block valve (RCIC-MO-131) shuts (0.5).

c. Yes (0.5)

d. No, the discharge and injection valves (RCIC-MO-20 and 21) do not close on an isolation (0.5).

REFERENCE
SOP 2.2.67, RCIC, Rev 25, pg 2-4
RCIC System Description, pg 9, 10, 13, 14, 15, 30, 31

ANSWER 2.06 (1.50)

a. - dilution (0.5)
 - recombination (0.5)

b. Due to the possibility of combustion within the vacuum pump (0.5)

REFERENCE
Offgas and Augmented Offgas System Description, pg AOG-5, 8

ANSWER 2.07 (1.50)

a. Reactor building exhaust plenum (0.5)
 Primary containment exhaust ventilation line (0.5)

b. HPCI gland steam condenser exhauster (0.5)

REFERENCE
SBGTS System Description, pg 3, 4

ANSWER 2.08 (3.00)

a. Backup water source for CRDH pump suction (0.75).

b. Cooling for CRDH pump oil cooler and pump thrust bearing (0.75).

c. Collects water drainage from the SDV & leakage from the HCU valves. Collects discharge from the HCU accumulator when recharging (0.75).

d. Power to valves 140A & 140B (backup scram valves) (0.75).

REFERENCE
Control Rod Drive Hydraulic System Lesson Plan, p. CRDH-30, 31

ANSWER 2.09 (3.00)

a. Decrease (0.25) due to loss of steam supply to SJAE (0.5).

b. RWCU pumps trip (0.25) due to low flow as F/D FCV fails closed (0.5).

c. Outboard MSIV's drift closed (0.25) as accumulators discharge (0.5).

d. Rods indiscriminately scram (0.25) as scram valves open under spring pressure (0.5).

REFERENCE
Plant Air System Lesson Plan, p. PA-16

ANSWER 2.10 (2.00)

The flow control valve is tripped closed when pressure upstream of the valve is low (0.5) (less than 5 psig) to prevent drawing a vacuum on the RWCU system (0.5). When pressure between the flow control valve and the drain valves to the main condenser and radwaste system is high (0.5) (greater than 140 psig), the valve trips to prevent overpressurizing the piping downstream of the FCV (0.5).

REFERENCE
Reactor Water Cleanup Lesson Plan, Rev 0, pg RWCU-9

ANSWER 3.01 (2.00)

Total steam flow would indicate 75% instead of the actual 100% (0.5). The FWLCS would assume steam flow has decreased and reduce feed flow accordingly (0.5). Level will begin to decrease. As level continues to decrease, a level error signal is generated which will increase feed flow back to the 100% value (0.5). A new steady state level will be established lower than the original level (0.5).
Will accept any similar explanation.

REFERENCE
CNS Feedwater Control System Description, pg FCS-16, 17

ANSWER 3.02 (3.00)

a. "A" pump speeds up to 45% (0.5), the low setting on the dual speed control limiter (0.25). "B" pump speed is unaffected (0.25).

b. "A" MG will trip on field undervoltage (0.5). The tachometer output is the reference signal to the voltage regulator (0.25). "B" pump speed is unaffected (0.25).

c. No change until reactor vessel level reaches 27.5" (0.25), then both pumps (0.25) runback to 45% speed (0.25) due to the #2 speed limiter or single limiter (0.25).

REFERENCE
CNS Recirculation System Description, pg Recirc-14, 15, 18, 19, Fig 10

ANSWER 3.03 (3.50)

a. Depress both logic RESET pushbuttons
Turn off all running CS and RHR pumps
Inhibit switches to INHIBIT
(2 at 0.5 each)

b. 120 second timer (0.25) and low level (0.25)

c. With no initiation signal present, the red light should be off (0.25), and the blue light should be on (0.25)

d. The red light indicates on when the solenoid is energized for valve opening (0.5). The blue light indicates on when a a high pressure in the tail pipe does not exist (0.5).

e. Excessive air supply pressure (0.5) can cause inadvertent opening.

REFERENCE
CNS Nuclear Pressure Relief System, pg NPR 6, 7-10, Fig 3

ANSWER 3.04 (2.00)

a. Increased steam flow causes steam header pressure to decrease. DEH closes down on the governor valves to maintain the steam pressure setpoint (1.0) or similar explanation.

b. Increased reactor power causes steam header pressure to increase. DEH opens the governor valves until the load reference limit is reached. At this point the increase in steam header pressure would overcome the bypass valves close bias and DEH would start to open the bypass valves (1.0) or similar explanation.

REFERENCE
CNS DEH System Description, pg 29, 30

ANSWER 3.05 (3.50)

a. Pressure (0.33) and temperature (0.33) sensors in the SJAE discharge piping (0.33).

b. The SJAE inlet isolation valves shut (0.5).

c. Offgas rad monitors (0.5) with a 15 minute time delay (0.25)
Dilution fan low flow (0.5) with a 5 minute time delay (0.25)
Offgas timer switch to CLOSE (0.5) with no time delay.

REFERENCE
CNS Offgas and Augmented Offgas Systems Description, pg 31-32

ANSWER 3.06 (1.50)

Yes, it is normal (0.5). The drive piston moves the RPIS magnet past the "00" reed switch and actuates only the green full-in "overtravel" reed switch (1.0).

REFERENCE
CRD System Description,
RMC System Text

ANSWER 3.07 (.50)

4 or turbine control fluid pressure (0.5)

REFERENCE
RPS System Description, pg 12

ANSWER 3.08 (2.00)

- The system will automatically restart when level decreases to the initiation setpoint (1.0).
- The high level trip signal may be reset and the system will restart (1.0).

REFERENCE
HPCI Lesson Plan, Rev 0, pg HPCI-8, 32

ANSWER 3.09 (3.00)

a. APRM channels (0.5)
RBM channels (0.5)
Recirc loop flow recorder (0.5)

b. - recirc loop flow recorder
- rod block
- "Flow Ref. Off Normal" annunciator
- "Compar" indicating light
(3 required at 0.5 each)

REFERENCE
APRM System Description, pg APRM-8

ANSWER 3.10 (.50)

True (0.5).

REFERENCE
APRM System Description, pg APRM-9

ANSWER 3.11 (2.50)

a. The NMS shorting links must be physically removed (1.0)

b. If the IRM indicates a Hi-Hi (0.25) or INOP (0.25) condition with its companion APRM indicating a downscale condition (0.5).

c. RUN (0.5)

REFERENCE
RPS System Description, pg 18-19

ANSWER 3.12 (1.00)

An equalizing valve leak allows the pressure in the reference and variable legs to equalize. This causes a zero differential pressure between the two legs. This causes the level to indicate high.
(0.5 for high, 0.5 for zero dp explanation)

ANSWERS -- COOPER -86/08/07-GRAVES, D.

REFERENCE
Nuclear Boiler Instrumentation System Description, pg 22

ANSWERS -- COOPER -86/08/07-GRAVES, D.

ANSWER 4.01 (2.50)

a. Scram or half-scram (0.5)

b. 1. red
   2. green
   3. white
   (0.5 each)

c. An SRO licensed individual (0.5)

REFERENCE
CNS Alarm Procedure 2.3.1, General Alarm Procedure, Rev 9, pg 4,7

ANSWER 4.02 (2.00)

- Failure of the CRD pumps stops cooling water to the drives (0.5), shortening seal life (0.5).
- Failure of the CRD pumps also allows the CRD accumulators to slowly depressurize (0.5). At low reactor pressures, the accumulators are required to ensure that the control rods are fully scrammed within the required time (0.5).

REFERENCE
CNS AP 2.4.1.1.4, Loss of CRD Pump, Rev 6, pg 2

ANSWER 4.03 (2.50)

a. - Reactor Building RCIC Pump Area
   - Control Building Cable Spreading Area
   - Turbine Building 4160V Switchgear Room
   - Turbine Building Control Corridor, 882'
   - Telephone Switchboard in the Administration Office
   - Reactor Building 931'6" instrument racks
   (3 required at 0.5 each)

b. - Deenergize the APRMs at the RPS Power Panels (0.5)
   - Trip the Scram Discharge Volume High-High level switches (0.5)

REFERENCE
CNS EOP 5.2.1, Shutdown From Outside the Control Room, Rev 13, pg 1,2

ANSWER 4.04 (2.00)

- Scram the reactor
- Trip the turbine
- Isolate the RWCU system
- Shut down both recirculation pumps and associated oil pumps when the MG sets have stopped
  (4 at 0.5 each)

REFERENCE
CNS EOP 5.2.3, Loss of All Service Water, Rev 8, pg 1

ANSWER 4.05 (1.00)

Filling the RWCU demineralizers with borated water and injecting this via the RWCU system (1.0).

REFERENCE
Emergency Procedure 5.2.14, Alternate Means to Inject Boron to RPV, Rev 0

ANSWER 4.06 (2.00)

a. Place the mode switch in REFUEL (0.25) and check the Refuel Permissive Light (0.25) illuminated.
   Observe all green full-in lights on Panel 9-5 illuminated (0.5).

b. Shut with individual control switches (0.5).
   Place the mode switch to RUN (0.25) when reactor pressure is less than 825 psig (0.25).

REFERENCE
GOP 2.1.5, Emergency Shutdown from Power, Rev 7, pg 2

ANSWER 4.07 (2.00)

a. 150 mREM/25 mREM per hour = 6 hours
(0.5 for the 150 mREM limit, 0.5 for the stay time)

b. Remove self from the radiation field (0.5).
Report the incident (0.25) to individual's immediate supervisor (0.125) and to Health Physics (0.125).

REFERENCE
HPP 9.1.1.3, Personnel Dosimeter Program, Rev 20, pg 4
HPP 9.1.2.1, Radiation, Contamination, and Airborne Radioactivity Limits, Rev 15, pg 5

ANSWER 4.08 (2.50)

a. The 3 GEMAC's and associated recorder on panel 9-5 (1.0).

b. The Yarways may be monitored locally in the Reactor Building (0.5).

c. The reactor vessel level reference legs will begin to flash when the RPV pressure approaches saturation pressure for the drywell temperature, causing erroneous high reactor level indication (1.0).

REFERENCE
CNS EOP 5.2.5.1, Loss of All Site AC Power Station Blackout, Rev 3, pg 3

ANSWER 4.09 (2.00)

a. 5
b. 3
c. 1
d. 2
(0.5 each)

REFERENCE
CNS GOP 2.1.1, Cold Startup Procedure, Rev 43, pg 8,9

ANSWER 4.10 (3.00)

a. A pushbutton on the control panel (Bd-C) turns on a blue flashing light in each Diesel room, alerting the operator to contact the control room (1.0).

b. Adjust diesel engine speed (0.2) using the governor control switch (0.2) until the synchroscope is rotating slowly in the clockwise direction (0.4). Adjust generator voltage (0.2) using the auto voltage adjust (0.2) until it is slightly higher than bus voltage (0.4). Close the output breaker at the "5 until 12:00" position (0.4).

REFERENCE
CNS Procedure 2.2.20, Diesel Generator, Rev 20, pg 3, 4, 14

ANSWER 4.11 (2.50)

a. This can overpressurize the pump casing (1.0).

b. This can cause a cold water injection to the RPV (0.5).

c. This may cause excessive jet pump vibration (1.0) and damage.

REFERENCE
CNS Procedure 2.2.68, Reactor Recirculation System, Rev 25, pg 13, 15
CNS Procedure 2.1.15, Reactor Recirculation Pump Startup and Shutdown, Rev 17, pg 1

ANSWER 4.12 (1.00)

b is the desired method of operation (0.5). Operation continuously at low pressure shortens the seal life (0.5).

REFERENCE
CNS Procedure 2.2.68, Recirculation System, Rev 25, pg 15