APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Operator Licensing Exam Report: 50-298/OL-88-01 Operating License: DPR-46

Docket No. 50-298

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

Facility Name: Cooper Nuclear Station (CNS)

Examination at: Cooper Nuclear Station

Chief Examiner: _____ 3/28/88
D. N. Graves, Examiner, Date
Operator Licensing Section,
Division of Reactor Safety

Approved by: _____ 3/29/88
J. L. Pellet, Chief, Date
Operator Licensing Section,
Division of Reactor Safety

Summary

NRC Administered Examinations Conducted During the Week of February 15, 1988 (Report 50-298/OL-88-01)

Results: NRC administered examinations to 13 candidates. Eleven (11) candidates passed all portions of the examination and will be issued the appropriate license.

DETAILS

1. Persons Examined

		SRO	RO	Total
License Examinations:	Pass -	6	5	11
	Fail -	1	1	2

2. Examiners

D. Graves, Chief Examiner
M. Spencer
M. Bishop

3. Examination Report

Performance results for individual examinees are not included in this report as it will be placed in the NRC Public Document Room and these results are not subject to public disclosure.

a. Examination Review Comment/Resolution

In general, editorial comments or changes made during the examination, or subsequent grading reviews are not addressed by this resolution section. This section reflects resolution of substantive comments made by CNS. The only comments addressed in this section are those which were not accepted for incorporation into the examination and/or answer key. Those comments accepted are incorporated into the master examination key which is included in this report. Comments may be paraphrased for brevity. The full text of the comments is attached.

(2.01b) "Airborne problem" should be considered an acceptable answer. The purpose of the condenser is not to prevent high temperatures in the area.

Response: Reject. High airborne activity does not affect the operation of the RCIC system.

(2.02) Also accept "perform the appropriate surveillance" since the required answer would be in the surveillance.

Response: Reject. The candidate must demonstrate sufficient knowledge such that the examiner is convinced the candidate knows flow path and system operation.

(5.06b) Also accept Position 10 as acceptable if accompanied with explanation regarding rod shadowing reducing rod worth at Position 40.

Response Reject. Sufficient information was given in the question for the candidate to determine the core was bottom-peaked and Position 40 was in a region of higher flux than Position 10.

b. Site Visit Summary

(1) At the end of the written examination administration, the facility licensee was provided a copy of the examination and answer key for the purpose of commenting on the examination content validity. It was explained to the facility licensee that regional policy was to have examination results finalized within 30 days. Thus, a timely response was desired to attain this goal.

(2) At the conclusion of the site visit, the Chief Examiner met with facility representatives to discuss the visit. The following personnel were present:

NRC	Facility
D. Graves	R. Brungardt
R. Bennett	J. Dutton
	D. Kuser
	M. Parrish
	G. Reece
	J. Surette

Mr. Graves opened the meeting by thanking those present for the cooperation received during the site visit and informing those present that current guidelines do not allow the disclosure of preliminary operating examination results. Other items discussed were as follows:

1. There is no administrative mechanism available to inform the supervisors on shift to know what restrictions apply to the licenses on his shift. For example, an operator may have a "No Solo" restriction on his license. The supervisor may not be aware of this and allow the operator to be alone in the control room under certain plant conditions.

2. While in the Radwaste Control Room, the examiner observed a rigid cardboard tube placed between a valve switch and a pump switch to hold the pump switch in the START position.

When the operator was asked about this, he stated that the pump trips off if the switch is not held in the START position.

c. Generic Comments

No areas of knowledge were identified as being generically weak.

d. Master Examination and Answer Key

Master copies of the CNS license examinations and answer keys are attached. The facility licensee comments which have been accepted are incorporated into the answer key.

e. Facility Examination Review Comments

The facility licensee comments regarding the written examination are attached. Those comments which were not acceptable for incorporation into the examination answer key have been addressed in the resolution section of this report.

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: COOPER

REACTOR TYPE: BWR-GE4

DATE ADMINISTERED: 88/02/16

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

QUESTION 1.01 (1.00)

Select the correct word in parenthesis for each of the following statements concerning subcritical multiplication. (1.0)

a. The closer the reactor gets to critical, the (SHORTER/LONGER) the wait must be to allow the subcritical neutron density to reach equilibrium given equal positive reactivity insertions.

b. Subcritical count rate is (PROPORTIONAL, INVERSELY PROPORTIONAL) to k-effective.

ANSWER 1.01 (1.00)

a. Longer (0.5)
b. Proportional (0.5)

REFERENCE
CNS Reactor Theory Chapter 3
292008K103 4.1/4.0
292008K103 ...(KA'S)

QUESTION 1.02 (1.00)

Which of the following best describes the behavior of equilibrium Xenon CONCENTRATION over core life? (1.0)

a. It decreases because of the increased fuel burn-up

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

c. It increases because of the decrease in the delayed neutron fraction

d. It increases because of the increase in thermal flux

ANSWER 1.02 (1.00)

b (1.0)

REFERENCE
CNS Reactor Theory, pg 6-13
292006K114 3.1/3.2
292006K114 ...(KA'S)

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

QUESTION 1.03 (1.00)

With the reactor critical at 75 on IRM range 4, rod withdrawal is used to increase and stabilize power at 75 on IRM range 6. RCS temperature is 190 deg F. Select the statement that correctly describes the position of rods, and reason, after the power is stabilized on range 6. (1.0)

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

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

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

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

ANSWER 1.03 (1.00)

c (1.0)

REFERENCE
CNS Reactor Theory, pg 4-36
292008K108 4.1/4.1
292008K108 ...(KA'S)

QUESTION 1.04 (1.50)

HOW will the Shutdown Margin (Reactivity Margin) just prior to a refueling outage compare with the Shutdown Margin following the refueling? WHY? Two (2) reasons required. (1.5)

ANSWER 1.04 (1.50)

SDM prior to the outage will be larger (0.5) due to fission product poisoning (0.5) and fuel depletion (0.5).

REFERENCE
LOTM-TH-4.11-0, Shutdown Margin, pg 5
CNS Reactor Theory, pg 1-35 and 36
K/A 292002 K1.14 2.6/2.9
292002K114 ...(KA'S)

QUESTION 1.05 (2.00)

Why does core thermal power decrease at a much slower rate than indicated neutron power (2 reasons required) following a scram from high power operation? (2.0)

ANSWER 1.05 (2.00)

Thermal power drops at a slower rate due to decay heat (1.0) and the time delay in getting the previously generated heat out of the fuel pellet into the coolant (1.0). Also accept residual or sensible heat of the core components as one answer.

REFERENCE
CNS Reactor Theory, pg 7-22
292008K125 2.8/2.8
292008K130 3.2/3.5
292008K125 292008K130 ...(KA'S)

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

QUESTION 1.06 (3.00)

a. Does the magnitude of the initial level of source range counts affect the critical rod position? WHY? (1.0)

b. The reactor is brought critical at 40 on IRM range 2 with the shortest permissible stable positive period allowed by GOP 2.1.1, "Cold Startup." Heating power is determined to be 40 on range 8 of IRM's.

****SHOW ALL WORK****

1. What is the doubling time if the period remains constant? (1.0)

2. How long will it take for power to reach the point of adding heat if the period remains constant? (1.0)

ANSWER 1.06 (3.00)

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

b. 1. From GOP 2.1.1, shortest permissible stable period equals 50 sec.(0.5).
Thus Doubling time equals 50/1.44 = 34.7 seconds. (0.5)

2. 40 range 2 is equal to 0.04 on range 8
P(0) = 0.04 P(t) = 40 Period = 50 seconds
P(t) = P(0) e ^(t/period)
40 = 0.04 e ^(t/50 sec)
Time = 345.4 seconds or 5 min. 45 sec (1.0)
(NOTE: Grade method if period is different)

REFERENCE
LOTM-TH-4.15-1
CNS Reactor Theory, Chapter 3
292003K108 2.7/2.8
292008K104 3.3/3.4
292003K108 292008K104 ...(KA'S)

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

QUESTION 1.07 (2.00)

The reactor is operating at 60% power when recirculation flow is increased to increase power. State the effect (INCREASE, DECREASE, REMAIN THE SAME) the power increase has on each of the following (steady state to steady state conditions): (2.0)

a. Void fraction

b. Doppler reactivity coefficient

c. Total Doppler reactivity

d. Feedwater enthalpy

ANSWER 1.07 (2.00)

a. decrease
b. decrease (less negative)
c. increase (more negative)
d. increase
(0.5 each)

REFERENCE
CNS Reactor Theory Chapter 4
CNS Heat Transfer and Fluid Flow 5-47 through 5-58
292008K120 3.3/3.4
292004K108 2.2*/2.4*
292008K120 292004K108 ...(KA'S)

QUESTION 1.08 (1.50)

For each of the following events, state which coefficient of reactivity would act first to change core reactivity: (1.5)

a. Loss of extraction steam to feedwater heaters

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

c. Inadvertent HPCI start (100% power)

ANSWER 1.08 (1.50)

a. Moderator
b. Void
c. Void
(0.5 each)

REFERENCE
CNS Reactor Theory, Chapter 4
292008K121 2.9/3.0
292008K121 ...(KA'S)

QUESTION 1.09 (1.00)

Which one of the below sets of parameters indicates a water system that is subcooled by greater than 30 F?

	TEMP. (F)	PRESS. (psia)
a.	540	1000
b.	560	1500
c.	665	2000
d.	640	2400

ANSWER 1.09 (1.00)

b (1.0)

REFERENCE
Steam Tables
293003K123 2.8*/3.1*
293003K123 ...(KA'S)

QUESTION 1.10 (1.00)

EXPLAIN how steam at 900 psig can be used as the motive force for RCIC injection into the reactor vessel at 1000 psig. (i.e., How can 900 psig steam raise water pressure to 1000 psig?) (1.0)

ANSWER 1.10 (1.00)

(As the steam expands through the turbine), the enthalpy given up in condensation/expansion is more than is required to be added to the water (to raise pressure from 15 psia to 1000 psig.) (i.e., steam delta h = 1197 - 910 = 287 Btu/lbm > water delta h = 98 - 68 = 30 Btu/lbm) [1.0]

REFERENCE
LOTM-TH-2.5-0
LOTM-TH-2.10-0
293002K104 2.1/2.4
293003K123 2.8/3.1
293003K123 293002K104 ...(KA'S)

QUESTION 1.11 (1.00)

Which one of the following BEST describes what occurs if a centrifugal pump is STARTED AND OPERATED with its discharge valve shut as compared to with its discharge valve open. (Assume no recirculation flow.) (1.0)

a. Higher/longer starting current and lower running current

b. Lower/shorter starting current and lower running current

c. Higher/longer starting current and higher running current

d. Lower/shorter starting current and higher running current

ANSWER 1.11 (1.00)

b (1.0)

REFERENCE
LOTM-TH-1.4-0
CNS Heat Transfer and Fluid Flow, pg 6-109
291004K107 2.8/2.8
291004K107 ...(KA'S)

QUESTION 1.12 (2.00)

CNS procedure EOP-1, "RPV Control", requires a reduction in RPV water level in order to reduce reactor power during an ATWS. What are two (2) reasons why lowering reactor water level will help reduce reactor power? (2.0)

ANSWER 1.12 (2.00)

Increased voiding (1.0)
Concentrating the boron during SLC injection (1.0)

REFERENCE
CNS EOP-1
GE EOP Fundamentals
295037 EA2.02 4.1*/4.2*
295037A202 ...(KA'S)

QUESTION 1.13 (1.00)

What effect would isolation of extraction steam to a HP heater have on Recirc Pump NPSH at 85% power? Explain your answer. (1.0)

ANSWER 1.13 (1.00)

NPSH would increase (0.5). Because the feedwater temperature would decrease, decreasing the annulus temperature and the temperature at the suction of the pump (0.5).

REFERENCE
LOTM-TH-1.4-0
CNS Heat Transfer and Fluid Flow, pgs 6-73 through 6-77
293006K110 2.7/2.8
293006K110 ...(KA'S)

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

QUESTION 1.14 (2.50)

Match each of the following statements with the appropriate numbered item:

a. The limiting parameter that assures PCT will not exceed 2200 degrees F during a design basis LOCA.

b. Total power passing through a unit length of fuel rod.

c. APLHGR divided by MAPLHGR limit. (2.5)

d. LHGR (max)/LHGR (LCO)

e. Power required to produce CTB/Actual bundle power

1.	MAPRAT	5.	LHGR
2.	FLCPR	6.	MFLPD
3.	APLHGR	7.	CPR
4.	MCPR	8.	GEXL

ANSWER 1.14 (2.50)

a. 3
b. 5
c. 1
d. 6
e. 7
(0.5 pts each)

REFERENCE
LOTM-TH-3.8-0 through 3.10-1
CNS Heat Transfer and Fluid Flow, Chapter 9
293009K105 3.3/3.5
293009K106 3.4/3.8
293009K111 2.8/3.6
293009K118 3.2/3.7
293009K105 293009K106 293009K118 293009K111 ...(KA'S)

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

QUESTION 1.15 (1.50)

Following an auto initiation of RCIC at a reactor pressure of 800 psig, reactor pressure decreases to 400 psig. Indicate how the following parameters would change (INCREASE, DECREASE, NO CHANGE) due to the decrease in reactor pressure. Assume the RCIC System is operating as designed. (1.5)

a. RCIC Flow to the Reactor

b. RCIC Pump Discharge Head

c. RCIC Turbine RPM

ANSWER 1.15 (1.50)

a. No Change
b. Decrease
c. Decrease
(0.5 each)

REFERENCE
LOTM-21-1, pg 7
CNS RCIC Lesson Plan
217000K502 3.1/3.1
217000K505 2.4*/2.4*
217000K506 2.7*/2.7
217000K506 217000K505 217000K502 ...(KA'S)

QUESTION 1.16 (2.00)

What are four parameters (factors) that affect the point at which boiling transition occurs in a fuel bundle? (2.0)

ANSWER 1.16 (2.00)

- inlet subcooling
- pressure
- inlet flow
- axial power shape
- local peaking
- bundle power

(4 required at 0.5 each)

REFERENCE
CNS Heat Transfer and Fluid Flow, pg 9-66
293009K122 - 293009K126
293009K125 293009K124 293009K123 293009K122 293009K126
...(KA'S)

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

QUESTION 2.01 (3.00)

In the Reactor Core Isolation Cooling (RCIC) system:

a. What function does the RCIC lube oil cooler water perform after leaving the cooler? (1.0)

b. How would failure of the barometric condenser affect operation of the RCIC system? (one effect required) (1.0)

c. How is the turbine exhaust line protected from overpressure during system operation? TWO required. (1.0)

ANSWER 2.01 (3.00)

a. It is used as the condensing medium for the barometric condenser (1.0)

b. System isolation (1.0) due to high area temperature

c. Rupture diaphragms (0.5)
Turbine trip on high exhaust pressure (0.5)

REFERENCE
RCIC pg 6, 7, 21
217000K404 3.0/3.1
217000K405 3.2/3.5
217000K405 217000K404 ...(KA'S)

QUESTION 2.02 (1.00)

How is SLC system flow capability verified without opening an injection path to the reactor vessel? (1.0)

ANSWER 2.02 (1.00)

Starting the pumps locally does not fire the squib valves (0.5) and the flow is to the test tank (0.5).

REFERENCE
SLC-14
211000K408 4.2*/4.2*
211000K408 ...(KA'S)

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

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 pressure in Column B that initiates or allows that item. (2.0)

Column A	Column B
1. Shutdown cooling isolates	50 psig
2. Allows manual operation of the LPCI injection valve	75 psig
3. Automatically opens the LPCI injection valve	100 psig
4. Input to ADS	135 psig
	277 psig
	400 psig
	432 psig
	450 psig

b. What is the most limiting failure of a single component in the RHR system with regard to core protection? (1.0)

ANSWER 2.03 (3.00)

a. 1. 75 psig
2. 450 psig
3. 450 psig
4. 100 psig or 135 psig (accept either)
(0.5 each)

b. LPCI injection valve failed shut (1.0)

REFERENCE
RHR-24, 37
205000K402 3.7/3.8
203000K106 3.9/3.9
203000K402 3.3/3.3
203000A211 3.4/3.6
205000K402 203000K402 203000K106 203000A211 ...(KA'S)

QUESTION 2.04 (1.00)

During startup under Cold Conditions the operator adjusts the Control Rod Drive Pressure Control Valve to maintain a +260 psid between CRD and reactor pressure. Explain how this pressure differential is maintained as reactor pressure increases during the ensuing startup.

ANSWER 2.04 (1.00)

The FCV opens up as reactor pressure increases maintaining a constant flow, therefore, a constant pressure differential across the PCV (1.0).

REFERENCE
CRDH-10
201001 K4.08 3.1/3.0
A1.01 3.1/2.9
201001K408 201001A101 ...(KA'S)

QUESTION 2.05 (2.00)

State whether the following conditions or signals WILL or WILL NOT cause initiation of the SBGT system: (2.0)

NOTE: Do not consider setpoints. If the indicated parameters will initiate the system, assume the setpoint has been reached.

a. High radiation (ARM) on the Refuel Floor

b. High radiation in the reactor building ventilation exhaust

c. High particulate activity in the drywell

d. Low flow in the offgas system

e. High drywell pressure coincident with high radiation in the drywell

f. Low RPV pressure coincident with high drywell temperature

g. High reactor pressure coincident with a low reactor level

h. Main Steam Line high radiation coincident with low reactor pressure

ANSWER 2.05 (2.00)

will: b, e, g

will not: a, c, d, f, h

(0.25 each)

REFERENCE
SGT-17, 18
261000K401 3.7/3.8

261000K401 ...(KA'S)

QUESTION 2.06 (2.00)

Answer TRUE or FALSE for the following:

a. The CRD pump will trip on low suction pressure. (0.5)

b. The standby CRD pump auto starts when the running pump trips. (0.5)

c. CRDM Accumulators are charged with air from the instrument air system. (0.5)

d. Speed Control of the CRDM is accomplished by the timing of the directional control solenoid valves. (0.5)

ANSWER 2.06 (2.00)

a. TRUE (0.5)
b. FALSE (0.5)
c. FALSE (0.5)
d. FALSE (0.5)

REFERENCE
CRDH-8, 15, 16
201001K412 2.9/2.9
201001K501 2.4/2.4
201001K501 201001K412 ...(KA'S)

QUESTION 2.07 (2.50)

List the RHR throttle valves that receive a sealed-in OPEN signal on an auto initiation. Include HOW LONG the signal is sealed in and WHY these valves receive a sealed in signal. (2.5)

ANSWER 2.07 (2.50)

RHR HX bypass (0.5), MO-66, sealed open for 2 minutes (0.5)
RHR injection (0.5), MO-27, sealed open for 5 minutes (0.5)
Signal is sealed in to ensure maximum flow to the vessel is provided following initiation (0.5).

REFERENCE
RHR-9, 11
203000K4.10 3.9/4.1
203000K410 ...(KA'S)

QUESTION 2.08 (2.00)

Indicate whether each of the following are TRUE or FALSE: (2.0)

a. The pneumatic supply for the inboard MSIVs is instrument air with a N2 backup source.

b. The MSIVs pneumatic cylinders are capable of closing the MSIV without assistance from the closing springs.

c. Only one of the two control solenoids must de-energize to cause the MSIVs to close.

d. The MSIVs closing springs are capable of closing the MSIV without assistance from the pneumatic cylinder.

ANSWER 2.08 (2.00)

a. false
b. true
c. false
d true

REFERENCE
MS-7, 8, 3
239001K601 3.1/3.3
239001K602 3.2/3.2
239001K602 ...(KA'S)

QUESTION 2.09 (4.00)

a. List ten (10) of the valve operations that automatically occur on a turbine trip signal. Assume the plant is operating at power when the turbine trip occurs. (2.0)

b. What are four (4) of the five (5) protective devices that operate independently on the main turbine to prevent damage to the unit if the turbine was not taken out of service immediately? (2.0)

ANSWER 2.09 (4.00)

a. 1. turbine main stop valves close
2. control valves close
3. reheat stop valves close
4. intercept valves close
5. bypass valves open
6. feed system startup flow control isolation valves open
7. feed pump discharge valves close
8. extraction steam non-return valves trip
9. extraction steam dump valves open
10. feed pump low pressure steam supply valves close
11. main turbine governor valve drain valves open
12. MSL drain valves shift from A5/B5 heaters to the main condenser
(10 required at 0.2 each)

b. 1. overspeed trip mechanism
2. low vacuum trip
3. low bearing pressure trip
4. thrust bearing trip
5. solenoid trip
(0.5 each)

REFERENCE
MN TURB-16, 17
245000A201 3.7/3.9
245000G007 3.5/3.6
245000G007 245000A201 ...(KA'S)

QUESTION 2.10 (2.50)

What are five (5) sources or flowpaths that may be used to restore fuel pool water level, if necessary. (2.5)

ANSWER 2.10 (2.50)

1. Skimmer surge tank condensate makeup (normal method)
2. Connecting hoses to the service box condensate and demin water connections
3. Fire hoses
4. Crosstie the RHR system with the fuel pool cooling system to take a suction on the CST.
5. Crosstie service water to the RHR system which is then crosstied to the fuel pool cooling system.

(5 at 0.5 each)

REFERENCE
FPC-18
233000K406 2.9/3.2
233000K406 ...(KA'S)

QUESTION 2.11 (2.00)

Match the following plant areas (a - g) with the type(s) of fire protection system (1 - 4) that is(are) available in that area: (2.0)

NOTE: MORE THAN ONE TYPE OF SYSTEM MAY APPLY TO EACH AREA

a. Reactor feed pump room
b. Service water pump room
c. Diesel generator day tank rooms
d. Fire pump house - diesel fire pump room
e. Control building, cable spreading room (918')
f. Turbine generator bearings 1, 2, 3
g. Main control room

1. Fire Water System
2. Carbon Dioxide System
3. Halon 1301 System
4. No Automatic System Available

ANSWER 2.11 (2.00)

a. 1
b. 3
c. 2
d. 1
e. 1, 2
f. 2
g. 4
(a - g at 0.25 each)

REFERENCE
FP system description
2860000004 3.8/3.9
2860000004 ...(KA'S)

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

QUESTION 3.01 (3.00)

a. STATE whether the solenoids associated with the following valves are NORMALLY Energized or Deenergized. NO SCRAM SIGNAL EXISTS. (1.0)

1. Back-up Scram Valves
2. Scram Discharge Volume Vent and Drain Valves

b. Repositioning the Mode Switch from STARTUP/HOT STANDBY to RUN causes certain reactor scram functions to be bypassed and others to be effective. LIST the three (3) scram functions (or setpoints) which are bypassed AND the three (3) scram functions (or setpoints) which become effective when the Mode Switch is taken to RUN. (2.0)

ANSWER 3.01 (3.00)

a. 1. Deenergized (0.5)
2. Energized (0.5)

b. Activated in RUN:
- MSIV Closure (0.33)
- Companion IRM/APRM (0.33)
- APRM flow biased scram (0.33)

Bypassed in RUN:
- IRM Inop (0.33)
- IRM Upscale (0.33)
- APRM 15% HIGH Flux (0.33)

REFERENCE
CRDH-17, 18
RPS-14, 16-18
212000K108 3.0/3.1
212000K412 3.9/4.1
212000A216 4.0/4.1
212000K412 212000K108 212000A216 ...(KA'S)

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

QUESTION 3.02 (1.50)

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. (1.5)

a. Direct reactor scram

b. Standby Gas Treatment System starts

c. RCIC starts

d. HPCI isolation

e. Recirculation pumps trip

f. Main Steam Line isolation (MSIVs)

ANSWER 3.02 (1.50)

a. +12.5"
b. +12.5"
c. -37"
d. +56.5"
e. -37"
f. -145.5"
(a - f 0.25 each)

REFERENCE
SGT-4, NBI Table 1
216000K101 3.9/4.1
216000K102 3.8/4.0
216000K103 3.4/3.6
216000K114 3.8/4.1*
216000K123 3.3/3.4
216000K103 216000K102 216000K101 216000K123 216000K114
...(KA'S)

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

QUESTION 3.03 (1.50)

Your shift is performing a reactor startup. Criticality is achieved with a 120 second period at a moderator temperature of 180 degrees F. Due to a personnel error during maintenance on the LPCS initiation circuitry, the LPCS system starts and injects to the vessel.

Assume NO OPERATOR ACTION.

a. If a reactor scram were received during this event, what reactor protection system function would initiate it? Assume the scram signal was not directly caused by the personnel error and all instrumentation is functioning properly. (1.0)

b. How would the system respond if the operator had just closed the suppression pool suction valve prior to the initiation signal and the CST suction valve was already shut? Address suction path only. (0.5)

ANSWER 3.03 (1.50)

a. IRM Flux Hi-Hi (1.0)

b. no suction path would be open (0.5). CST suction is manual valve and the suppression pool suction valve does not automatically open.

REFERENCE
CS-4
209001K406 2.6/2.9
209001G015 3.8/4.2*
209001G015 209001K406 ...(KA'S)

QUESTION 3.04 (1.50)

A reactor startup is in progress. The "A" SRM is bypassed so the Instrument Technicians can troubleshoot the power supply. The tech mistakenly takes the "B" SRM OPERATE switch to STANDBY and starts troubleshooting its power supply.

a. WHAT specific plant/system TRIP did this cause? (0.5)

b. HOW did this trip specifically affect the plant startup? (0.5)

c. On WHAT IRM range would the above trip have been automatically bypassed? (0.5)

ANSWER 3.04 (1.50)

a. SRM Inop. Trip.(also accept rod block) (0.5)
b. Inop trip on SRM's causes a Rod Block (0.5)
c. Range 8 or above (> Range 7 acceptable) (0.5)
(If rod block is given in a., accept discussion of S/U delay until rod block cleared in b.)

REFERENCE
SRM-21, 26
215004K103 3.0/3.0
215000K401 3.7/3.7
215000K406 3.2/3.2
215000K406 215004K103 215000K401 ...(KA'S)

QUESTION 3.05 (2.50)

LIST five (5) automatic reactor scram functions that are NEVER bypassed. (NOT individual channels) (2.5)

ANSWER 3.05 (2.50)

1. high drywell pressure
2. high reactor vessel pressure
3. low reactor water level
4. high main steam line radiation
5. APRM Inop. Accept neutron monitoring system (individual inputs may be bypassed, but there is always some type of NMS scram)
(0.5) each

REFERENCE
RPS-14, 15, 16, 17
212000K412 3.9/4.1
212000K412 ...(KA'S)

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

QUESTION 3.06 (2.00)

Given the following data for APRM channel C:

LPRM level:	A	B	C	D
LPRMs assigned:	5	4	4	4
LPRMs bypassed:	1	3	1	0

a. If APRM Channel Selector Switch on the local instrument is placed to the COUNT position, what would be the expected meter reading? Describe HOW you arrived at your answer. (1.0)

b. Based on the above information, is APRM C operable? Answer YES or NO and EXPLAIN WHY. (1.0)

ANSWER 3.06 (2.00)

a. (12 operable channels)(5% per operable channel) = 60%

OR

(60/125)(10v) = 4.8V
Either percentage or voltage is acceptable (1.0)

b. Inoperable (0.5) due to < 2 LPRMs per level (0.5)

REFERENCE
Technical Specifications, pg 31
APRM-17, Figure 3
215005K104 3.6/3.6
215005A208 3.2/3.4
2150056011 3.4/4.1
215005K104 2150056011 215005A208 ...(KA'S)

QUESTION 3.07 (1.00)

How far above the top of the active fuel (TAF) is RPV level INSTRUMENT ZERO (with the exception of the wide range yarways)? (1.0)

ANSWER 3.07 (1.00)

164 inches (accept 152 to 176 inches) (1.0)

REFERENCE
NBI Figure 10
216000K122 3.6/3.8
216000K122 ...(KA'S)

QUESTION 3.08 (1.50)

Assume both recirculation pumps are running at 80% speed. State how the recirculation pumps' speed is affected by each of the conditions below. Consider each case separately. (1.5)

a. The operator closes the B recirculation pump discharge valve to the mid position.

b. Two reactor feed pumps are operating and a feedwater problem causes RPV level to temporarily decrease to 20".

c. One of the two operating reactor feed pumps trips and the reactor scrams on low level.

ANSWER 3.08 (1.50)

a. (The B MG set trips and) the B recirc pump coasts to a stop (0.5)

b. No effect (0.5).

c. Both pumps runback to 45% speed (0.5).

REFERENCE
Recirculation System, Figure 14
202001A211 3.7/3.9
202001A212 3.6/3.8
202001A223 3.2/3.2
202001A211 202001A223 202001A212 ...(KA'S)

QUESTION 3.09 (2.00)

List the FOUR MSIV isolation signals that are never bypassed during normal plant operation. Setpoints NOT required. (2.0)

ANSWER 3.09 (2.00)

- low reactor level
- high steam line space temperature
- high MSL radiation
- high MSL flow
(0.5 each)

REFERENCE
MS-9
223002K404 3.2/3.6
223002K404 ...(KA'S)

QUESTION 3.10 (3.00)

For each of the conditions listed below, indicate in which direction the GOVERNOR VALVES and BYPASS VALVES will respond (answer with OPEN, CLOSE, NO CHANGE, or words to that effect). Assume the reactor is operating at power and the DEHC is in MODE 4. (3.0)

a. Raising the pressure control signal above the load reference.

b. Reducing the valve position limiter setting to below the pressure control signal.

c. A loss of the speed loop (speed signals) occurs.

ANSWER 3.10 (3.00)

	GOVERNOR VALVES	BYPASS VALVES
a.	No Change	Open More
b.	Close More	Open
c.	No Change	No Change

(6 at 0.5 each)

REFERENCE
DEH-6, 10, 11, 12
241000K106 3.8/3.9
241000K108 3.6/3.7
241000K615 2.3/2.4
241000K106 241000K615 241000K108 ...(KA'S)

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

QUESTION 3.11 (2.00)

a. The NORMAL/ISOLATE switches for a emergency diesel generator are in the ISOLATE position. How does this affect diesel generator operation locally and from the control room? (1.0)

b. With the diesel generator running, state what effect taking the diesel generator GOVERNOR CONTROL switch to RAISE has on the machine:

1. BEFORE the output breaker is closed. (0.5)

2. After the output breaker is closed (EDG paralleled with normal bus supply.) (0.5)

ANSWER 3.11 (2.00)

a. The EDG will respond to local manual signals only (1.0).

b. 1. increase generator frequency (or diesel speed) (0.5)
2. increases generator load (0.5)

REFERENCE
DG-24, 32
264000K401 3.5/3.7
264000K402 4.0/4.2
264000K406 2.6/2.7
264000K402 264000K401 ...(KA'S)

QUESTION 3.12 (2.00)

a. The plant is being started up with reactor level being controlled by one RFP with manual control on its M/A station and its startup flow valve in automatic on its Master Controller. The feed flow detector for the operating feed pump fails downscale. Explain how this failure affects reactor level control? (1.0)

b. What two (2) conditions will cause a Reactor Feed Pump lockup? (1.0)

ANSWER 3.12 (2.00)

a. The startup flow control valve uses only single element control (vessel level only) thus the loss of the feed flow signal will have no effect (1.0).

b. - low current control signal to the RFP speed control unit (0.5) of < 6 ma.

- loss of the selected level input to the level control system (0.5).

REFERENCE
FCS-9, 10
259002K406 3.1/3.2
259002K604 3.1/3.1
259002K409 3.1/3.1
259002K604 259002K409 259002K406 ...(KA'S)

QUESTION 3.13 (1.50)

What parameters/signals does the RSCS use to determine the position of a control rod when: (1.5)

a. Greater than 50% rod density?

b. Less than 50% rod density up to the auto bypass?

ANSWER 3.13 (1.50)

a. RSCS uses the full-in, full-out signals from the RPIS probes for each individual rod (0.5).

b. The RSCS uses the rod selected (0.33), the direction of movement requested (0.33), and the settle function of the RMCS timer (0.33).

REFERENCE
RSCS-6, 12
201004K405 3.2/3.2
201004K405 ...(KA'S)

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

QUESTION 4.01 (1.50)

a. When operating limitorque motor operated valves, how long should one wait (minimum) after releasing the switch before operating the valve in the opposite direction? (0.5)

b. A limitorque motor operated valve is operated using the manually engaged lever and handwheel. What should be done to the valve prior to returning the system to service? (1.0)

ANSWER 4.01 (1.50)

a. 3 seconds (0.5)

b. Stroke the valve electrically (1.0) to verify proper operation.

REFERENCE
SOP 2.2.9, Rev 28, pg 6
291001K108 3.4/3.5
291001K109 2.7/2.7
291001K109 291001K108 ...(KA'S)

QUESTION 4.02 (2.00)

Following a trip of the main turbine, WHY must the valve positioner of one feed pump turbine be run to the upper limit? Your answer should include what this step accomplishes and why it is necessary to be performed. (2.0)

ANSWER 4.02 (2.00)

Low pressure steam to the RFP turbines will be lost due to the turbine trip (1.0), and running the valve positioner to the upper limit allows the use of high pressure steam to the RFP turbine (1.0), ensuring feed flow.

REFERENCE
SOP 2.2.28, Rev 43, pg 7
259001K120 3.1/3.2
259001A209 2.6/2.7
259001K120 259001A209 ...(KA'S)

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

QUESTION 4.03 (1.50)

HOW and WHY does increased air inleakage into the Offgas System affect the indicated Offgas radiation level? (1.5)

ANSWER 4.03 (1.50)

Indicated radiation level increases (0.5) due to the higher offgas flow reducing the holdup time for activated product decay (1.0).

REFERENCE
AP 2.4.7.1, Rev 12, pg 4
271000A215 2.7/2.9
271000A215 ...(KA'S)

QUESTION 4.04 (3.50)

a. The control room is filling with a noxious vapor from an undetermined source. The Shift Supervisor decides to implement the "Toxic Gas in Control Room" procedure. What 3 IMMEDIATE ACTIONS are required of operating personnel by this procedure? (1.5)

b. The above actions are determined inadequate and the control room is to be evacuated. What actions or verifications should be performed, if possible, prior to leaving the control room by the Control Room Operators? (2.0)

ANSWER 4.04 (3.50)

a. - Start the Control Room Ventilation Booster Fan (0.5) BF-C-1A.
- Stop the Control Room Ventilation Supply Fans (0.5) SF-C-1A & 1B.
- Essential control room personnel obtain self contained breathing apparatus and use as necessary (0.5).

b. - Scram the reactor
- Leave Mode Switch in RUN
- Verify all control rods inserted

After rods verified in, TRIP:
- Main turbine
- ONE feed pump
- TWO condensate booster pumps
- TWO condensate pumps

- Ensure that both RFP turbine turning gear control switches are in AUTO

(each item marked with a "-" is 0.25)

REFERENCE
AP 2.4.8.5, Rev 5, pg 1
EP 5.2.1, Rev 16, pg 1
295016G010 3.8*/3.6*
295016G010 ...(KA'S)

QUESTION 4.05 (1.50)

Who may perform the independent verification of control rod movements performed with the Reactor Mode Switch in STARTUP or RUN? THREE (3) required for full credit. (1.5)

ANSWER 4.05 (1.50)

- licensed operator
- Reactor Engineering representative
- qualified STA
(0.5 each)

REFERENCE
GOP 2.1.10, Rev 15, pg 2
2010016001 3.7/3.7
2010016001 ...(KA'S)

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

QUESTION 4.06 (2.00)

What THREE (3) Group Isolations are expected to occur anytime an automatic or manual scram occurs from a normal operating water level, and WHAT causes them to occur? Assume power operation prior to the scram. (2.0)

ANSWER 4.06 (2.00)

Groups 2, 3, 6 (0.5 each) due to level shrink/void collapse as a result of the scram (0.5).

REFERENCE
GOP 2.1.4, Rev 27, pg 6
295006K301 3.8/3.9
223002G015 4.1/4.3*
295006K301 223002G015 ...(KA'S)

QUESTION 4.07 (3.00)

a. To avoid operation in the instability region of the power/flow curve, reactor power should not exceed the ___(1)___ rod line when total core flow is ___(2)___. (1.0)

b. What panel indication will alert the operator that flow instabilities are occurring? (0.5)

c. If instabilities occur, what two methods are available to suppress the instabilities (excluding scram) and which is preferred? (1.5)

ANSWER 4.07 (3.00)

a. 1. 80% (0.5)
2. < 45% or < 33 Mlbm/hr (either at 0.5)

b. Accept LPRM or APRM oscillations or increased noise band on APRM recorder (0.5).

c. - inserting control rods (0.5)
- increasing core flow (0.5)
- preferred method is to reverse the actions that caused the flux oscillations (0.5).

REFERENCE
GOP 2.1.10, Rev 15, pg 4, 10
202001G010 3.5/3.7
295001G011 3.9/4.2
295001G011 202001G010 ...(KA'S)

QUESTION 4.08 (3.00)

For each of the following conditions (a - d), state which EOP(s), if any, should be entered. (3.0)

a. Reactor water level 11"
Drywell pressure 1.87 psig
Drywell temperature 138 deg F

b. Suppression pool temperature 97 deg F
Reactor Building Sump A (NW Quad) indicates 40" (HI-HI at 34")
Turbines (main, RFP, HPCI, RCIC) tripped/ceased injecting on high reactor level

c. Reactor pressure 400 psig
Reactor water level -45"
Suppression pool level -1.0"
Suppression pool temperature 92 deg F
RCIC isolated due to high temperature in steam pipe area

d. Reactor water level 15"
Reactor pressure 1000 psig
Drywell pressure 1.9 psig

ANSWER 4.08 (3.00)

a. EOP-1 RPV Control

b. EOP-2 Primary Containment Control
EOP-3 Secondary Containment Control

c. EOP-1 RPV Control
EOP-3 Secondary Containment Control

d. none
(6 at 0.5 each)

REFERENCE
CNS EOPs
2950260011 4.4*/4.6*
2950310011 4.2/4.6*
2950320011 4.1/4.2*
2950360011 3.8*/4.1*
2950360011 2950320011 2950310011 2950260011 ...(KA'S)

QUESTION 4.09 (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. What are TWO (2) negative consequences or concerns regarding excessive drywell temperatures during this event? (1.0)

ANSWER 4.09 (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. - erroneous reactor water level indications
- failure of electrical components, i. e. wiring, solenoids, etc.
- unequal expansion of refueling bellows flange
(2 required at 0.5 each)

REFERENCE
CNS EOP 5.2.5.1, Loss of All Site AC Power Station Blackout, Rev 4, pg 3
CNS AP 2.4.8.4.2, Rev 11, pg 2
295003A202 4.2*/4.3*
295028K102 2.9/3.1
295028K102 295003A202 ...(KA'S)

QUESTION 4.10 (2.00)

Indicate whether each of the following statements is TRUE or FALSE: (2.0)

a. A reactor startup is NOT permissible under natural circulation flow conditions.

b. A reactor startup is NOT permissible with only one recirculation pump in operation.

c. If the reactor is operating at power (both recirculation pumps in operation) and one recirculation pump trips, reactor operation may continue for no more than 24 hours.

d. A reactor recirculation pump may not be started if the reactor is in natural circulation flow and reactor power is greater than 1%.

ANSWER 4.10 (2.00)

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

REFERENCE
SOP 2.2.62, Rev 27, pg 13, 14
CNS Technical Specifications 3.3.F.
2020010005 3.4/4.2*
2020010011 3.4/4.2*
2020010011 2020010005 ...(KA'S)

QUESTION 4.11 (2.50)

A condition arises which requires entry into a high radiation area. The operator entering the area will receive a whole body dose of 40 mrem. The following personnel, with their related personal information, are available to do the work: (2.5)

NOTE: Each exposure below (qtr, yr, life) includes the exposure above it.

Candidate	1	2	3	4
Sex	male	male	female	male
Age	27	38	24	20
Today's exposure	50 mrem	10 mrem	10 mrem	20 mrem
Wkly/exposure	260 mrem	150 mrem	150 mrem	250 mrem
Qtr/exposure	870 mrem	600 mrem	485 mrem	920 mrem
Yr/exposure	2200 mrem	2905 mrem	500 mrem	2810 mrem
Life exposure	-	54730 mrem	5200 mrem	9770 mrem
Remarks	history unavailable	-	4 months pregnant	-

Each candidate is technically competent and physically capable of performing the task. Emergency limits do not apply and time constraints do not permit obtaining authorization for an exposure limit increase. Which candidates have acceptable exposure margins to perform the task? Indicate the reason(s) for rejecting a candidate for the job, if applicable.

ANSWER 4.11 (2.50)

Candidate #1: Acceptable (0.5)

Candidate #2: Rejected (0.25) since he will exceed the yearly limit of 3000 MREM (0.5).

Candidate #3: Rejected (0.25) since she will exceed 500 MREM/GESTATION PERIOD (0.5).

Candidate #4: Acceptable (0.5)

REFERENCE
CNS HPP 9.1.1.3, Rev 23, pg 13, 14
CNS HPP 9.1.2.1, Rev 18, pg 5, 6
294001K103 3.3/3.8
294001K103 ...(KA'S)

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

FACILITY: COOPER

REACTOR TYPE: BWR-GE4

DATE ADMINISTERED: 88/02/16

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	_____	_____	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		_____ Final Grade	_____%		Totals

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

_____
Candidate's Signature

QUESTION 5.01 (1.00)

With the reactor critical at 75 on IRM range 4, rod withdrawal is used to increase and stabilize power at 75 on IRM range 6. RCS temperature is 190 deg F. Select the statement that correctly describes the position of rods, and reason after the power is stabilized on range 6. (1.0)

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

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

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

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

ANSWER 5.01 (1.00)

c (1.0)

REFERENCE
CNS Reactor Theory, pg 4-36
292008K108 4.1/4.1
292008K108 ...(KA'S)

QUESTION 5.02 (2.50)

a. HOW will the Shutdown Margin (Reactivity Margin) just prior to a refueling outage compare with the Shutdown Margin following the refueling? WHY? Two (2) reasons required. (1.5)

b. At what point in cycle life is compliance with the Shutdown Margin Technical Specification verified? (0.5)

c. What reactor conditions must be present for the verification to be reasonably accurate? (0.5)

ANSWER 5.02 (2.50)

a. SDM prior to the outage will be larger (0.5) due to fission product poisoning (0.5) and fuel depletion (0.5).

b. initial fuel loading or refueling (0.5)

c. cold, xenon free (0.5)

REFERENCE
LOTM-TH-4.11-0, Shutdown Margin, pg 5
CNS Reactor Theory, pg 1-35 and 36
CNS Tech Spec 3.3.A Bases
K/A 292002 K1.14 2.6/2.9
292002K114 ...(KA'S)

QUESTION 5.03 (3.00)

a. Does the magnitude of the initial level of source range counts affect the critical rod position? WHY? (1.0)

b. The reactor is brought critical at 40 on IRM range 2 with the shortest permissible stable positive period allowed by GOP 2.1.1, "Cold Startup." Heating power is determined to be 40 on range 8 of IRM's.

****SHOW ALL WORK****

1. What is the doubling time if the period remains constant? (1.0)

2. How long will it take for power to reach the point of adding heat if the period remains constant? (1.0)

ANSWER 5.03 (3.00)

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

b. 1. From GOP 2.1.1, shortest permissible stable period equals 50 sec.(0.5).
Thus Doubling time equals 50/1.44 = 34.7 seconds. (0.5)

2. 40 range 2 is equal to 0.04 on range 8
P(0) = 0.04 P(t) = 40 Period = 50 seconds
P(t) = P(0) e ^(t/period)
40 = 0.04 e ^(t/50 sec)
Time = 345.4 seconds or 5 min. 45 sec (1.0)
(NOTE: Grade method if period is different)

REFERENCE
LOTM-TH-4.15-1
CNS Reactor Theory, Chapter 3
292003K108 2.7/2.8
292008K104 3.3/3.4
292008K104 292003K108 ...(KA'S)

QUESTION 5.04 (2.00)

The reactor is operating at 60% power when recirculation flow is increased to increase power. State the effect (INCREASE, DECREASE, REMAIN THE SAME) the power increase has on each of the following (steady state to steady state conditions): (2.0)

a. Void fraction

b. Doppler reactivity coefficient

c. Total Doppler reactivity

d. Feedwater enthalpy

ANSWER 5.04 (2.00)

a. decrease
b. decrease (less negative)
c. increase (more negative)
d. increase
(0.5 each)

REFERENCE
CNS Reactor Theory Chapter 4
CNS Heat Transfer and Fluid Flow 5-47 through 5-58
292008K120 3.3/3.4
292004K108 2.2*/2.4*
292008K120 292004K108 ...(KA'S)

QUESTION 5.05 (1.00)

The HALING DISTRIBUTION is the ideal axial flux distribution for fuel utilization. EXPLAIN why the axial flux distribution is programmed to be BOTTOM PEAKED at BOC, instead of trying to exactly emulate the Haling Distribution. (1.0)

ANSWER 5.05 (1.00)

The axial flux peak is low in the core at BOC so that adequate fuel burnout will decrease power peaking problems at EOC (allowing the distribution to "move" into the Haling pattern at EOC) (1.0).

REFERENCE
CNS Reactor Theory, pgs 5-27, 28
292005K110 2.8/3.3
292005K110 ...(KA'S)

QUESTION 5.06 (2.00)

For each of the pairs of conditions listed below, state WHICH condition would have the GREATER differential rod worth and briefly, EXPLAIN WHY.

a. Reactor moderator temperature of 150 F or 500 F. (1.0)

b. For a rod at position 10 or position 40 of a core operating at 100% power (assume BOL). (1.0)

ANSWER 5.06 (2.00)

a. At 500 F (0.5) As moderator temperature increases, neutron leakage out of the fuel bundles is increased, thus the control rod is exposed to higher neutron flux and rod worth increases. (0.5)

b. At 40 (0.5) the core will be bottom peaked and the rod will be traveling through an area of high flux (0.5).

REFERENCE
CNS Reactor Theory, pgs 5-9, 5-23
292005K109 2.5/2.6
292005K112 2.6/2.9
292005K112 292005K109 ...(KA'S)

QUESTION 5.07 (2.00)

Answer EACH of the following TRUE or FALSE: (2.0)

a. Xenon and Samarium concentrations increase following a scram from high power operation (within the first five hours).

b. A reactor start-up several days after a scram from extended high power operation is considered to be Xenon and Samarium free.

c. The equilibrium concentration of Xenon at 50% power is approximately one-half the equilibrium concentration at 100% power.

d. The equilibrium concentration of Samarium at 50% power is approximately the same as at 100% power.

ANSWER 5.07 (2.00)

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

REFERENCE
CNS Reactor Theory, Chapter 6
292006K110 2.9/2.9
292006K114 3.1/3.2
292006K115 2.1*/2.1*
292006K110 292006K114 292006K115 ...(KA'S)

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

QUESTION 5.08 (1.00)

EXPLAIN how steam at 900 psig can be used as the motive force for RCIC injection into the reactor vessel at 1000 psig. (i.e., How can 900 psig steam raise water pressure to 1000 psig?) (1.0)

ANSWER 5.08 (1.00)

(As the steam expands through the turbine), the enthalpy given up in condensation/expansion is more than is required to be added to the water (to raise pressure from 15 psia to 1000 psig.) (i.e., steam delta h = 1197 - 910 = 287 Btu/lbm > water delta h = 98 - 68 = 30 Btu/lbm) [1.0]

REFERENCE
LOTM-TH-2.5-0
LOTM-TH-2.10-0
293002K104 2.1/2.4
293003K123 2.8/3.1
293002K104 293003K123 ...(KA'S)

QUESTION 5.09 (2.00)

CNS procedure EOP-1, "RPV Control", requires a reduction in RPV water level in order to reduce reactor power during an ATWS. What are two (2) reasons why lowering reactor water level will help reduce reactor power? (2.0)

ANSWER 5.09 (2.00)

Increased voiding (1.0)
Concentrating the boron during SLC injection (1.0)

REFERENCE
CNS EOP-1
GE EOP Fundamentals
295037 EA2.02 4.1*/4.2*
295037A202 ...(KA'S)

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

QUESTION 5.10 (3.00)

a. Define the term Critical Power (CP). (1.0)

b. State how Critical Power would change for each of the following events (i.e., INCREASE, DECREASE, or NO CHANGE). Assume that the reactor is at full power. Consider each event separately. (2.0)

1. Loss of a feedwater heater string (steam side)

2. Main Turbine Trip (Consider for the time immediately prior to the reactor scram.)

3. Recirc Flow Control system fails to maximum demand

4. Feedwater Control system fails to maximum demand

ANSWER 5.10 (3.00)

a. Critical Power is the bundle power needed to produce the critical quality or the bundle power needed to cause OTB to occur in the bundle (1.0).

b. 1. (inlet subcooling ^) CP increases (0.5)
2. (pressure ^) CP decreases (0.5)
3. (core flow ^) CP increases (0.5)
4. (inlet subcooling ^) CP increases (0.5)

REFERENCE
LOTM-TH-3.7-0
CNS Heat Transfer and Fluid Flow, Chapter 9
293009K117 3.3/3.7
293009K122 2.9/3.3
293009K123 2.8/3.2
293009K124 2.7/3.2
293009K117 293009K124 293009K123 293009K122 ...(KA'S)

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

QUESTION 5.11 (2.00)

Your reactor operator informs you MAPRAT is 1.02.

a. Is the MAPRAT, as stated, conservative? Explain your answer. (1.0)

b. TRUE or FALSE:

1. MAPRAT maintained within limits ensures transition boiling will not occur in 99 percent of the fuel bundles. (0.5)

2. Maintaining MAPRAT limits ensures the APLHGR limits are met.(0.5)

ANSWER 5.11 (2.00)

a. The MAPRAT of 1.02 is not conservative [0.5]. With a MAPRAT greater than one it means that the MAPLHGR has been exceeded because:
MAPRAT = or MAPLHGR (actual)/MAPLHGR (LCO)
(Actual formula is not required but the relationship's concept must be described)[0.5]

b. 1. False (0.5)
2. True (0.5)

REFERENCE
CNS Heat Transfer and Fluid Flow, Chapter 9
293009K110 3.3/3.7
293009K113 3.1/3.6
293009K110 293009K113 ...(KA'S)

QUESTION 5.12 (2.50)

While CNS is operating at 90% power, extraction steam to the highest pressure feedwater heater is removed. An engineer observed that the turbine load increased by 20 MW electric and concluded that this action has improved (increased) the plant's thermodynamic efficiency (not heat rate). Is this conclusion correct? Explain your answer. (Include what caused electrical output to increase.) (2.5)

ANSWER 5.12 (2.00)

No [0.5]. (Thermo efficiency is a comparison of Energy In to Energy Out.) The increase in output results from no steam being diverted to the high pressure feedwater heater [0.5] and increased Rx. power due to colder feedwater temperature [0.5]. Because the feedwater is now cooler, more energy from the reactor is required to bring the water up to saturation temperature [1.0] thus thermo efficiency is down.

REFERENCE
CNS Heat Transfer and Fluid Flow, Chapter 5
293005K105 2.7/2.8
293005K105 ...(KA'S)

QUESTION 5.13 (1.00)

A reactor heat balance was performed (by hand) during the midnight shift due to the Process Computer being OOC. The GAF's were computed, but the APRM GAIN ADJUSTMENTS HAVE NOT BEEN MADE. Which of the following statements is TRUE concerning reactor power? (1.0)

SELECT ONLY ONE ANSWER (Only one is true!)

a. If the feedwater temperature used in the heat balance calculation was LOWER than the actual feedwater temperature, then the actual power is HIGHER than the currently calculated power.

b. If the reactor recirculation pump heat input used in the heat balance calculation was OMITTED, then the actual power is LOWER than the currently calculated power.

c. If the steam flow used in the heat balance calculation was LOWER than the actual steam flow, then the actual power is LOWER than the currently calculated power.

d. If the RWCU return temperature used in the heat balance calculation was HIGHER than the actual RWCU return temperature, then the actual power is LOWER than the currently calculated power.

ANSWER 5.13 (1.00)

b (1.0)

REFERENCE
LOTM-TH-2.5-0, 1st Law of Thermodynamics
LOTM-TH-2.13-0, Reactor Heat Balance
CNS Heat Transfer and Fluid Flow, pg 7-45 through 7-48
293007K111 2.6/3.1
293007K113 2.3*/2.9*
293007k113 293007K111 ...(KA'S)

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

QUESTION 6.01 (1.00)

During startup under Cold Conditions the operator adjusts the Control Rod Drive Pressure Control Valve to maintain a +260 psid between CRD and reactor pressure. Explain how this pressure differential is maintained as reactor pressure increases during the ensuing startup.

ANSWER 6.01 (1.00)

The FCV opens up as reactor pressure increases maintaining a constant flow, therefore, a constant pressure differential across the FCV (1.0).

REFERENCE
CRDH-10
201001 K4.08 3.1/3.0
A1.01 3.1/2.9
201001A101 201001K408 ...(KA'S)

QUESTION 6.02 (3.00)

a. STATE whether the solenoids associated with the following valves are NORMALLY Energized or Deenergized. NO SCRAM SIGNAL EXISTS. (1.0)

1. Back-up Scram Valves
2. Scram Discharge Volume Vent and Drain Valves

b. Repositioning the Mode Switch from STARTUP/HOT STANDBY to RUN causes certain reactor scram functions to be bypassed and others to be effective. LIST the three (3) scram functions (or setpoints) which are bypassed AND the three (3) scram functions (or setpoints) which become effective when the Mode Switch is taken to RUN. (2.0)

ANSWER 6.02 (3.00)

a. 1. Deenergized (0.5)
2. Energized (0.5)

b. Activated in RUN:
- MSIV Closure (0.33)
- Companion IRM/APRM (0.33)
- APRM flow biased scram (0.33)

Bypassed in RUN:
- IRM Inop (0.33)
- IRM Upscale (0.33)
- APRM 15% HIGH Flux (0.33)

REFERENCE
CRDH-17, 19
RPS-14, 16-18
212000K108 3.0/3.1
212000K412 3.9/4.1
212000A216 4.0/4.1
212000A216 212000K108 212000K412 ...(KA'S)

QUESTION 6.03 (1.50)

Your shift is performing a reactor startup. Criticality is achieved with a 120 second period at a moderator temperature of 180 degrees F. Due to a personnel error during maintenance on the LPCS initiation circuitry, the LPCS system starts and injects to the vessel.

Assume NO OPERATOR ACTION.

a. If a reactor scram were received during this event, what reactor protection system function would initiate it? Assume the scram signal was not directly caused by the personnel error and all instrumentation is functioning properly. (1.0)

b. How would the system respond if the operator had just closed the suppression pool suction valve prior to the initiation signal and the CST suction valve was already shut? Address suction path only. (0.5)

ANSWER 6.03 (1.50)

a. IRM Flux Hi-Hi (1.0)

b. no suction path would be open (0.5). CST suction is manual valve and the suppression pool suction valve does not automatically open.

REFERENCE
CS-4
209001K406 2.6/2.9
2090016015 3.8/4.2*
209001K406 2090016015 ...(KA'S)

QUESTION 6.04 (2.00)

State whether the following conditions or signals will or will not cause initiation of the SBGT system: (2.0)

NOTE: Do not consider setpoints. If the indicated parameters will initiate the system, assume the setpoint has been reached.

a. High radiation (ARM) on the Refuel Floor

b. High radiation in the reactor building ventilation exhaust

c. High particulate activity in the drywell

d. Low flow in the offgas system

e. High drywell pressure coincident with high radiation in the drywell

f. Low RPV pressure coincident with high drywell temperature

g. High reactor pressure coincident with a low reactor level

h. Main Steam Line high radiation coincident with low reactor pressure

ANSWER 6.04 (2.00)

will: b, e, g

will not: a, c, d, f, h

(0.25 each)

REFERENCE
SGT-17, 18
261000K401 3.7/3.8
261000K401 ...(KA'S)

QUESTION 6.05 (1.50)

A reactor startup is in progress. The "A" SRM is bypassed so the Instrument Technicians can troubleshoot the power supply. The tech mistakenly takes the "B" SRM OPERATE switch to STANDBY and starts troubleshooting its power supply.

a. WHAT specific plant/system TRIP did this cause? (0.5)

b. HOW did this trip specifically affect the plant startup? (0.5)

c. On WHAT IRM range would the above trip have been automatically bypassed? (0.5)

ANSWER 6.05 (1.50)

a. SRM Inop. Trip.(also accept rod block) (0.5)
b. Inop trip on SRM's causes a Rod Block (0.5)
c. Range 8 or above (> Range 7 acceptable) (0.5)
(If rod block is given in a., accept discussion of S/U delay until rod block cleared in b.)

REFERENCE
SRM-21, 26
215004K103 3.0/3.0
215000K401 3.7/3.7
215000K406 3.2/3.2
215004K103 215000K401 215000K406 ...(KA'S)

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

QUESTION 6.06 (2.50)

LIST five (5) automatic reactor scram functions that are NEVER bypassed. (NOT individual channels) (2.5)

ANSWER 6.06 (2.50)

1. high drywell pressure
2. high reactor vessel pressure
3. low reactor water level
4. high main steam line radiation
5. APRM Inop. Accept neutron monitoring system (individual inputs may be bypassed, but there is always some type of NMS scram) (0.5) each

REFERENCE
RPS-14, 15, 16, 17
212000K412 3.9/4.1
212000K412 ...(KA'S)

QUESTION 6.07 (2.00)

Given the following data for APRM channel C:

LPRM level:	A	B	C	D
LPRMs assigned:	5	4	4	4
LPRMs bypassed:	1	3	1	0

a. If APRM Channel Selector Switch on the local instrument is placed to the COUNT position, what would be the expected meter reading? Describe HOW you arrived at your answer. (1.0)

b. Based on the above information, is APRM C operable? Answer YES or NO and EXPLAIN WHY. (1.0)

ANSWER 6.07 (2.00)

a. (12 operable channels)(5% per operable channel) = 60%

OR

(60/125)(10v) = 4.8V
Either percentage or voltage is acceptable (1.0)

b. Inoperable (0.5) due to < 2 LPRMs per level (0.5)

REFERENCE
Technical Specifications, pg 3i
APRM-17, Figure 3
215005K104 3.6/3.6
215005A208 3.2/3.4
2150056011 3.4/4.1
215005A208 215005K104 2150056011 ...(KA'S)

QUESTION 6.08 (1.00)

How far above the top of the active fuel (TAF) is RPV level INSTRUMENT ZERO (with the exception of the wide range yarways)? (1.0)

ANSWER 6.08 (1.00)

164 inches (accept 152 to 176 inches) (1.0)

REFERENCE
N8I Figure 10
216000K122 3.6/3.8
216000K122 ...(KA'S)

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

QUESTION 6.09 (2.00)

Indicate whether each of the following are TRUE or FALSE: (2.0)

a. The pneumatic supply for the inboard MSIVs is instrument air with a N2 backup source.

b. The MSIVs pneumatic cylinders are capable of closing the MSIV without assistance from the closing springs.

c. Only one of the two control solenoids must de-energize to cause the MSIVs to close.

d. The MSIVs closing springs are capable of closing the MSIV without the assistance of the pneumatic cylinders.

ANSWER 6.09 (2.00)

a. false
b. true
c. false
d true

REFERENCE
MS-7, 8, 9
239001K601 3.1/3.3
239001K602 3.2/3.2
239001K602 239001K601 ...(KA'S)

QUESTION 6.10 (3.00)

For each of the conditions listed below, indicate in which direction the GOVERNOR VALVES and BYPASS VALVES will respond (answer with OPEN, CLOSE, NO CHANGE, or words to that effect). Assume the reactor is operating at power and the DEHC is in MODE 4. (3.0)

a. Raising the pressure control signal above the load reference.

b. Reducing the valve position limiter setting to below the pressure control signal.

c. A loss of the speed loop (speed signals) occurs.

ANSWER 6.10 (3.00)

	GOVERNOR VALVES	BYPASS VALVES
a.	No Change	Open More
b.	Close More	Open
c.	No Change	No Change

(6 at 0.5 each)

REFERENCE
DEH-6, 10, 11, 12
241000K106 3.8/3.9
241000K108 3.6/3.7
241000K615 2.3/2.4
241000K108 241000K106 241000K615 ...(KA'S)

QUESTION 6.11 (1.50)

For each of the recirculation pump seal problems below (a - c), select the indication(s) (1 - 7) that would apply. (1.5)

a. #1 seal failure

b. #2 seal restricting orifice plugged

c. #2 seal failure

INDICATIONS

1. #1 seal cavity pressure increases
2. #1 seal cavity pressure decreases
3. #2 seal cavity pressure increases
4. #2 seal cavity pressure decreases
5. OT Seal Leak Flow Det. A(B) High
6. Recirc A(B) Pump Seal STG Flow High
7. Recirc A(B) Pump Seal STG Flow Low

ANSWER 6.11 (1.50)

a. 3, 6
b. 3, 7
c. 4, 5

(3 at 0.25 each)

REFERENCE
Recirc - 8, 9, Figure 4
2020G16015 4.0/4.2*

202[illegible]3015 ...(KA'S)

QUESTION 6.12 (2.50)

State the effect on ADS actuation AND logic when the logic reset pushbutton is depressed under each of the following conditions (assume the ADS Inhibit switch is in AUTO): (2.5)

a. Reactor level is -160"
CS pump discharge pressure is 278 psig
ADS timer is at 90 seconds

b. Reactor level is -160"
ADS is actuated

c. Reactor level is -120"
ADS is actuated

d. ADS is actuated
Low pressure ECCS (CSCS) pump pressure indication is lost

ANSWER 6.12 (2.50)

a. The 120 second timer resets (0.5)

b. The ADS valves close (0.5), the timer resets (0.25), and the valves will reopen when the timer times out (0.25).

c. The ADS valves will close (0.5).

d. The ADS valves will close (0.5).

REFERENCE
NPR-9, Figure 5
218000K403 3.8/4.0
218000K403 ...(KA'S)

QUESTION 6.13 (1.50)

State which instruments or parameters provide the automatic bypass inputs for: (1.5)

a. RWM

b. RSCS

c. RBM

ANSWER 6.13 (1.50)

a. Steam flow (0.25), feed flow (0.25)

b. turbine first stage pressure (0.5)

c. Reference APRM (0.25), RMCS select matrix (0.25)

REFERENCE
RWM-20, RSCS-8, RBM-16
215002K403 2.9/3.0
201004K404 3.3/3.3
201006K404 3.4/3.5

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

QUESTION 7.01 (2.00)

a. When operating limitorque motor operated valves, how long should one wait (minimum) after releasing the switch before operating the valve in the opposite direction? (0.5)

b. A limitorque motor operated valve is operated using the manually engaged lever and handwheel. What should be done to the valve prior to returning the system to service? (1.0)

c. RHR-MO-25A was being stroke-tested from the control room when it apparently failed to stroke (green shut light on continuously). One operator suggests checking the valve's breaker. Another states that the breaker could not be tripped because indication is still present. Which one is correct? (0.5)

ANSWER 7.01 (2.00)

a. 3 seconds (0.5)

b. Stroke the valve electrically (1.0) to verify proper operation.

c. The operator that suggests checking the breaker is correct (0.5). The indication is energized from a separate 125 VDC supply.

REFERENCE
SOP 2.2.9, Rev 28, pg 6
291001K108 3.4/3.5
291001K109 2.7/2.7
291001K109 291001K108 ...(KA'S)

QUESTION 7.02 (2.00)

Following a trip of the main turbine, WHY must the valve positioner of one feed pump turbine be run to the upper limit? Your answer should include what this step accomplishes and why it is necessary to be performed. (2.0)

ANSWER 7.02 (2.00)

Low pressure steam to the RFF turbines will be lost due to the turbine trip (1.0), and running the valve positioner to the upper limit allows the use of high pressure steam to the RFP turbine (1.0), ensuring feed flow.

REFERENCE
SOP 2.2.28, Rev 43, pg 7
259001K120 3.1/3.2
259001A209 2.6/2.7
259001K120 259001A209 ...(KA'S)

QUESTION 7.03 (1.50)

HOW and WHY does increased air inleakage into the Offgas System affect the indicated Offgas radiation level? (1.5)

ANSWER 7.03 (1.50)

Indicated radiation level increases (0.5) due to the higher offgas flow reducing the holdup time for activated product decay (1.0).

REFERENCE
AP 2.4.7.1, Rev 12, pg 4
271000A215 2.7/2.9
271000A215 ...(KA'S)

QUESTION 7.04 (3.50)

a. The control room is filling with a noxious vapor from an undetermined source. The Shift Supervisor decides to implement the "Toxic Gas in Control Room" procedure. What 3 IMMEDIATE ACTIONS are required of operating personnel by this procedure? (1.5)

b. The above actions are determined inadequate and the control room is to be evacuated. What actions or verifications should be performed, if possible, prior to leaving the control room by the Control Room Operators? (2.0)

ANSWER 7.04 (3.50)

a. - Start the Control Room Ventilation Booster Fan (0.5) BF-C-1A.
- Stop the Control Room Ventilation Supply Fans (0.5) SF-C-1A & 1B.
- Essential control room personnel obtain self contained breathing apparatus and use as necessary (0.5).

b. - Scram the reactor
- Leave Mode Switch in RUN
- Verify all control rods inserted

After rods verified in, TRIP:
- Main turbine
- ONE feed pump
- TWO condensate booster pumps
- TWO condensate pumps

- Ensure that both RFP turbine turning gear control switches are in AUTO
(each item marked with a "-" is 0.25)

REFERENCE
AP 2.4.8.5, Rev 5, pg 1
EP 5.2.1, Rev 16, pg 1
2950166010 3.8*/3.6*
2950166010 ...(KA'S)

QUESTION 7.05 (3.00)

a. To avoid operation in the instability region of the power/flow curve, reactor power should not exceed the ___(1)___ rod line when total core flow is ___(2)___. (1.0)

b. What panel indication will alert the operator that flow instabilities are occurring? (0.5)

c. If instabilities occur, what two methods are available to suppress the instabilities (excluding scram) and which is preferred? (1.5)

ANSWER 7.05 (3.00)

a. 1. 80% (0.5)
2. < 45% or < 33 Mlbm/hr (either at 0.5)

b. Accept LPRM or APRM oscillations or increased noise band on APRM recorder (0.5).

c. - inserting control rods (0.5)
- increasing core flow (0.5)
- preferred method is to reverse the actions that caused the flux oscillations (0.5).

REFERENCE
GOP 2.1.10, Rev 15, pg 4, 10
202001G010 3.5/3.7
295001G011 3.9/4.2
295001G011 202001G010 ...(KA'S)

QUESTION 7.06 (3.00)

For each of the following conditions (a - d), state which EOP(s), if any, should be applicable. (3.0)

a. Reactor water level 11"
Drywell pressure 1.87 psig
Drywell temperature 138 deg F

b. Suppression pool temperature 97 deg F
Reactor Building Sump A (NW Quad) indicates 40" (HI-HI at 34")
Turbines (main, RFP, HPCI, RCIC) tripped/ceased injecting on high reactor level

c. Reactor pressure 400 psig
Reactor water level -45"
Suppression pool level -1.0"
Suppression pool temperature 92 deg F
RCIC isolated due to high temperature in steam pipe area

d. Reactor water level 15"
Reactor pressure 1000 psig
Drywell pressure 1.9 psig

ANSWER 7.06 (3.00)

a. EOP-1 RPV Control

b. EOP-2 Primary Containment Control
EOP-3 Secondary Containment Control

c. EOP-1 RPV Control
EOP-3 Secondary Containment Control

d. none
(6 at 0.5 each)

REFERENCE
CNS EOPs
295026G011 4.4*/4.6*
295031G011 4.2/4.6*
295032G011 4.1/4.2*
295036G011 3.8*/4.1*
295036G01[illegible] 2950326011 2950316011 2950266011 ...(KA'S)

QUESTION 7.07 (2.00)

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 are TWO (2) negative consequences or concerns regarding excessive drywell temperatures during this event? (1.0)

ANSWER 7.07 (2.00)

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

b. - erroneous reactor water level indications
- failure of electrical components, i. e. wiring, solenoids, etc.
- unequal expansion of refueling bellows flange
(2 required at 0.5 each)

REFERENCE
CNS EOP 5.2.5.1, Loss of All Site AC Power Station Blackout, Rev 4, pg 3
295003A202 4.2*/4.3*
295028K102 2.9/3.1

295028K102 295003A202 ...(KA'S)

QUESTION 7.08 (2.00)

Indicate whether each of the following statements is TRUE or FALSE: (2.0)

a. A reactor startup is NOT permissible under natural circulation flow conditions.

b. A reactor startup is NOT permissible with only one recirculation pump in operation.

c. If the reactor is operating at power (both recirculation pumps in operation) and one recirculation pump trips, reactor operation may continue for no more than 24 hours.

d. A reactor recirculation pump may not be started if the reactor is in natural circulation flow and reactor power is greater than 1%.

ANSWER 7.08 (2.00)

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

REFERENCE
SOP 2.2.62, Rev 27, pg 13, 14
CNS Technical Specifications 3.3.F.
202001G005 3.4/4.2*
202001G011 3.4/4.2*
202001G011 202001G005 ...(KA'S)

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

QUESTION 7.09 (2.50)

A condition arises which requires entry into a high radiation area. The operator entering the area will receive a whole body dose of 40 mrem. The following personnel, with their related personal information, are available to do the work: (2.5)

NOTE: Each exposure below (qtr, yr, life) includes the exposure above it.

Candidate	1	2	3	4
Sex	male	male	female	male
Age	27	38	24	20
Today's exposure	50 mrem	10 mrem	10 mrem	20 mrem
Wkly/exposure	260 mrem	150 mrem	150 mrem	250 mrem
Qtr/exposure	870 mrem	600 mrem	485 mrem	920 mrem
Yr/exposure	2200 mrem	2995 mrem	500 mrem	2810 mrem
Life exposure	-	54730 mrem	5200 mrem	9770 mrem
Remarks	history unavailable	-	4 months pregnant	-

Each candidate is technically competent and physically capable of performing the task. Emergency limits do not apply and time constraints do not permit obtaining authorization for an exposure limit increase. Which candidates have acceptable exposure margins to perform the task? Indicate the reason(s) for rejecting a candidate for the job, if applicable.

ANSWER 7.09 (2.50)

Candidate #1: Acceptable (0.5)

Candidate #2: Rejected (0.25) since he will exceed the yearly limit of 3000 MREM (0.5).

Candidate #3: Rejected (0.25) since she will exceed 500 MREM/GESTATION PERIOD (0.5).

Candidate #4: Acceptable (0.5)

REFERENCE
CNS HPP 9.1.1.3, Rev 23, pg 13, 14
CNS HPP 9.1.2.1, Rev 18, pg 5, 6
294001K103 3.3/3.8
294001K103 ...(KA'S)

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

QUESTION 7.10 (2.50)

a. What is the purpose of the "Emergency Rod Movement Sheet"? (0.5)

b. List four (4) examples or conditions which may require the use of an "Emergency Rod Movement Sheet". (1.0)

c. If a power reduction from high power is required, what is the preferred method? (0.5)

d. When using control rods to reduce power, which rods should be selected, if possible? Answer with regard to the axial position of the rods selected. (0.5)

ANSWER 7.10 (2.50)

a. To document non-scheduled, out-of-sequence rod movements (0.5)

b. - alleviate thermal limit problems
- power reduction due to transient (accept examples of transient, i.e. recirc pump trip, reduced FW heating, clogged intake screen)
- recover from rod drift
- recover from single rod scram
(0.25 each)

c. reduce recirculation flow (0.5)

d. deep rods/more than 2/3 inserted into the core (0.5)

REFERENCE
NPP 10.13, Rev 15, pg 2
201003G001 3.6/3.7
201003G001 ...(KA'S)

QUESTION 7.11 (1.00)

How is it possible for the Control Room Operator to operate the RCIC turbine below 2200 rpm? (1.0)

ANSWER 7.11 (1.00)

By the use of the TEST potentiometer (1.0).

REFERENCE
SOP 2.2.67, Rev 32, pg 8
2170006007 3.8/3.7
2170006010 3.4/3.5
2170006010 2170006007 ...(KA'S)

QUESTION 8.01 (3.50)

a. List the four general conditions that would require the issuance of a Special Work Permit (SWP). Values NOT required. (1.0)

b. What is the NORMAL maximum length of time that a SWP will be in effect? (0.5)

c. What is the maximum extension that can be granted for a SWP? (0.5)

d. TRUE or FALSE. Health Physics personnel are exempt from the SWP issuance requirement during the performance of the radiation and contamination surveys for SWP evaluation. (0.5)

e. Once a SWP is initiated and authorized, copies are kept at WHAT FOUR (4) locations? (1.0)

ANSWER 8.01 (3.50)

a. - High area radiation
- High airborne contamination
- High surface contamination
- Industrial hazards
(0.25 each)

b. 1 month + 7 days (0.5)

c. 7 days (0.5)

d. True (0.5)

e. - job site
- SWP board
- HP office
- SS office (control room)
(0.25 each)

REFERENCE
HPP 9.1.1.4, Rev 16, pg 4, 6, 7
294001K103 3.3/3.8
294001K103 ...(KA'S)

QUESTION 8.02 (1.00)

Which of the four basic types of air breathing apparatus available at CNS may be used in a non-life supporting atmosphere? (1.0)

ANSWER 8.02 (1.00)

Self-contained (1.0)

REFERENCE
CNS Procedure 0.6, Rev 5, pg 8
294001K113 3.2/3.6
294001K113 ...(KA'S)

QUESTION 8.03 (2.50)

a. For fire door categories 1, 2, and 3, indicate the color dot on the door that correspnds to that category and, if obstructed and open, what type of minimum observation of that area is required. (1.5)

b. TRUE or FALSE. If a fire door is open and unobstructed and is equipped with a functional automatic door closure device, it may be left in this condition without requiring a fire watch or patrol. (0.5)

c. TRUE or FALSE. Persons working (or otherwise occupied) in the immediate area of a fire door requiring a continuous fire watch may NOT act as the watch for that area as long as he is otherwise occupied. (0.5)

ANSWER 8.03 (2.50)

a. Category 1: Green dot, no monitoring required

Category 2: Yellow dot, continuous monitoring

Category 3: Red dot, minimum fire watch patrol
(0.25 for each color, 0.25 for each observation)

b. true (0.5)

c. false (0.5)

REFERENCE
CNS Procedure 0.16, Rev 5, pg 1, 2
294001K116 3.5/3.8
294001K116 ...(KA'S)

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

QUESTION 8.04 (3.00)

a. If a component's operability is being questioned or evaluated, at what point would the component be declared inoperable for Technical Specification Action time requirements? (1.0)

b. If a component's operability is being questioned, what method is used for determining the operability status of the component? (1.0)

c. When conducting maintenance on a system, at what point does the system become inoperable? (0.5)

d. When the maintenance is completed, at what point does the system become operable? (0.5)

ANSWER 8.04 (3.00)

a. The LCO clock starts as soon as it is clear that the component has a deficiency which makes it unable to carry out its intended function (1.0).

b. An evaluation is performed using the Component Operability Checklist (accept description of process, exact name of form not required)(1.0).

c. When some action has been initiated that would prevent the system from performing its required function (0.5).

d. When the SS has completed his review of the completed MWR (0.5).

REFERENCE
CNS Procedure 0.27, Rev 1, pg 2, 3, 7
294001A103 2.7/3.7
294001A103 ...(KA'S)

QUESTION 8.05 (2.50)

a. List four (4) general examples of NONCOMFORMANCE conditions that would require completion of a Noncomformance Report (specific examples not required). (2.0)

b. TRUE or FALSE. Any individual (NPPD personnel, contractors, consultants, etc.) having knowledge of a non-conformance item is responsible for ensuring that a NCR is generated. (0.5)

ANSWER 8.05 (2.50)

a. - Essential component or system malfunctions

- Failure to follow procedures or surveillances controlling the maintenance or operation of essential components or systems.

- Deficiencies in procedures or surveillances controlling the maintenance or operation of essential components or systems which could result in or has resulted in safety concerns.

- Tech Spec violations

- Situations reportable to the NRC per various sections of the CFR.

- Utilization of materials, parts, or components which are lacking documentation for or do not conform to certification requirements. (4 required at 0.5 each)

b. True (0.5)

REFERENCE
CNS Procedure 0.5.1, Rev 0, pg 1, 4
294001A103 2.7/3.7
294001A103 ...(KA'S)

QUESTION 8.06 (3.00)

List the five (5) criteria that must be satisfied prior to restarting the reactor following a scram per Conduct of Operations Procedure 2.0.6, "Reactor Post Trip Review and Restart Authorization Procedure." (3.0)

ANSWER 8.06 (3.00)

- The plant is in a safe condition.
- The cause of the scram is understood or it is attributed to a spurious trip and is unlikely to reoccur.
- Corrective action has been identified and appropriately implemented.
- The proper automatic operation of plant safety-related systems has been observed.
- The Division Manager of Nuclear Operations approves the restart of the plant.

(5 required at 0.6 each)

REFERENCE
Conduct of Operations Procedure 2.0.6, Reactor Post Trip Review and Restart Authorization Procedure, Rev 3, pg 6-7
201001G001 3.7/3.7
201001G001 ...(KA'S)

QUESTION 8.07 (2.00)

Per the Technical Specifications Limiting Safety System Settings, what are four (4) automatic protective actions designed to prevent exceeding the Reactor Coolant System pressure safety limits?
SETPOINTS NOT REQUIRED. (2.0)

ANSWER 8.07 (2.00)

- Reactor vessel high pressure scram
- Relief valve actuations
- Safety valve actuations
- Shutdown cooling valve isolation on high pressure

(0.5 each)

REFERENCE
CNS Technical Specification 1.2
CNS Technical Specification 2.2
290002G005 3.3/4.1
290002G005 ...(KA'S)

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

QUESTION 8.08 (3.50)

a. List five (5) devices/actions that would be considered temporary modifications per Conduct of Operations Procedure 2.0.7, Plant Temporary Modification Control. (2.5)

b. What FOUR (4) persons, by title, may perform the Safety Evaluation/ Technical Review for temporary modifications? (1.0)

ANSWER 8.08 (3.50)

a. - jumpers
- lifted leads
- fuse removal
- blocked relay
- booted contacts
- installed breaker test blocks/actuator links
- mechanical jumper
- installed/removed blank flanges
(5 required at 0.5 each)

b. The System Engineer (0.25) or on duty STA (0.25) in collaboration with the System Engineer and the CRS (0.25) or another SRO (0.25) when the CRS is not on site.

REFERENCE
Control of Operations Procedure 2.0.7, Plant Temporary Modifications Control, Rev 4, pg 3, 6
294001A103 2.7/3.7
294001A103 ...(KA'S)

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

QUESTION 8.09 (2.00)

Indicate if the following statements are TRUE or FALSE per Procedure 10.26, "Working Over or In Reactor Vessel Requirements." (2.0)

a. Film badges and dosimeters are to be worn on the outside of the protective clothing and securely taped.

b. Contact lenses are permitted only if the individual is also wearing safety glasses (when working over the open RPV).

c. Hand held tools used over or in the spent fuel storage pool ARE NOT required to be logged in through a control point.

d. Hand held tools and equipment which are used in the reactor vessel ARE required to be logged in through a control point.

ANSWER 8.09 (2.00)

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

REFERENCE
Nuclear Performance Procedure 10.26, Working over or In Reactor Vessel Requirements, Rev 0, pg 3, 4
2340000010 2.9/3.5
2340000010 ...(KA'S)

QUESTION 8.10 (2.00)

During refueling operations individual responsibilities are assigned in Procedure 10.21, "Special Nuclear Materials (SNM) Control and Accountability."

a. Who MUST direct the SNM handling operations involving SNM movement BETWEEN Item Control Areas? (0.5)

b. Who MAY direct the SNM handling operations involving SNM movement WITHIN Item Control Areas? (0.5)

c. Who functions as the SNM Executor? (0.5)

d. Who functions as the SNM Checker? (0.5)

ANSWER 8.10 (2.00)

a. An individual holding an SRO license (0.5).

b. An individual holding an RO license (0.5).

c. Control Room Refueling Monitor or Control Room Operator (accept either 0.5)

d. Refueling Floor Supervisor or SRO on the Refuel Floor (accept either 0.5)

REFERENCE
Nuclear Performance Procedure 10.21, Special Nuclear Materials Control and Accountability Instructions, Rev 1, pg 3
2340000001 3.4/3.8
2340000001 ...(KA'S)

Nebraska Public Power District

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TELEPHONE (402) 564-8561

NTD880127
February 18, 1988

U.S. Nuclear Regulatory Commission
Ryan Plaza Drive
Suite 1000
Arlington, Texas 76011

Attention: Dave Graves

Subject: Comments - NRC Examination Administered February 16-19, 1988.

Dear Mr. Graves:

Attached please find our comments on the questions and answers associated with the subject examinations given on February 16, 1988. We believe that our concerns and comments should be considered in the grading of the written exams administered and, in some cases, serve as a basis for refining several of the examination questions and answers.

Please contact us if you would like to pursue our comments further or if additional clarification is desired.

Sincerely,

L. G. Kuncl
Manager - Nuclear

LGK/sjt/LETS27

Attachment

cc: G. A. Trevors w/attachment
G. R. Horn w/attachment
J. W. Dutton w/attachment
K. C. Walden w/attachment
R. Brungardt w/o attachment
G. H. Reece w/o attachment
K. K. Finn w/o attachment
TS File

2/18/88

QUESTION 1.05 (2.00)

Why does core thermal power decrease at a much slower rate than indicated neutron power (2 reasons required) following a scram from high power operation? (2.0)

ANSWER 1.05 (2.00)

Thermal power drops at a slower rate due to decay heat (1.0) and the time delay in getting the previously generated heat out of the fuel pellet into the coolant. (1.0)

REF

CNS Reactor Theory, Pg. 7-22
292008K125 2.8/2.9
292008K130 3.2/3.5
292008K125 292008K130 ...(KA's)

1.05 COMMENT

The residual heat of components in the vessel will also reduce the rate of thermal power decrease.

RECOMMENDATION

Also accept residual heat of components.

REF

NPR Student Text Pg. 14

QUESTION 2.01 (3.00)

In the Reactor Core Isolation Cooling (RCIC) system:

a. What function does the RCIC lube oil cooler water perform after leaving the cooler? (1.0)

b. How would failure of the barometric condenser affect operation of the RCIC system? (One effect required) (1.0)

c. How is the turbine exhaust line protected from overpressure during system operation? Two required. (1.0)

ANSWER 2.01 (3.0)

a. It is used as the condensing medium for the barometric condenser. (1.0)

b. System isolation (1.0) due to high area temperature

c. Rupture diaphragms which exhaust to RCIC room (0.5)
Turbine trip on high exhaust pressure (0.5)

REF

RCIC Pg. 6, 7, 21
217000K404 3.0/3.1
217000K405 3.2/3.5
217000K405 217000K404 ...(KA'S)

2.01.b COMMENT

An airborne problem would occur. The student text states the purpose of the barometric condenser is "to prevent any leakage of the radioactive steam into the environment." The purpose does not include preventing high temperatures in the area.

RECOMMENDATION

Accept airborne problem as an answer for part b.

REF

Reactor Core Isolation Cooling Student Text Pg. 7.

QUESTION 2.02 (1.00)

How is SLC system flow capability verified without opening an injection path to the reactor vessel? (1.0)

ANSWER 2.02 (1.00)

Starting the pumps locally does not fire the squib valves (0.5) and the flow is to the test tank (0.5).

REF

SLC-14
211000K408 4.2*/4.2*
211000K408 ...(KA's)

2.02 COMMENT

The surveillance starts the pumps locally and goes from test tank to test tank.

RECOMMENDATION:

Also accept perform the appropriate surveillance.

REF

Procedure 6.3.8.1

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 pressure in Column B that initiates or allows that item. (2.0)

Column A	Column B
1. Shutdown cooling isolates	50 psig
2. Allows manual operation of the LPCI injection valve	75 psig
3. Automatically opens the LPCI injection valve	100 psig
4. Input to ADS	135 psig
	277 psig
	400 psig
	432 psig
	450 psig

b. What is the most limiting failure of a single component in the RHR system with regard to core protection? (1.0)

ANSWER 2.03 (3.00)

a. 1. 75 psig
2. 450 psig
3. 450 psig
4. 100 psig

(0.5 each)

b. LPCI injection valve failed shut (1.0)

REF

RHR-24, 37
205000K402 3.7/3.8
203000K106 3.9/3.9
203000K402 3.3/3.3
203000A211 3.4/3.6
205000K402 203000K402 203000K106 203000A211 ...(KA's)

2.03.a COMMENT

The setpoint for the input to ADS is required to be set $\geq$ 100 psig and $\leq$ 165 psig. Therefore either 100 psig or 135 psig is an acceptable answer.

RECOMMENDATION

Accept either 100 psig or 135 psig or both for number 4 in column A.

QUESTION 2.03 (3.00) (CONTINUED)

REF

Technical Specification Table 3.2.B
NPR Student Text Pg. 14

2.03.b COMMENT

The injection valve is a normally shut valve therefore if it fails it will be in the shut position.

RECOMMENDATION

Do not require "shut" for full credit.

REF

Introduction to CSCS Student Text Pg. 11.

QUESTION 2.09 (4.00)

a. List ten (10) of the valve operations that automatically occur on a turbine trip signal. Assume the plant is operating at power when the turbine trip occurs. (2.0)

b. What are four (4) of the five (5) protective devices that operate independently on the main turbine to prevent damage to the unit if the turbine was not taken out of service immediately? (2.0)

ANSWER 2.09 (4.00)

a.
1. turbine main stop valves close
2. control valves close
3. reheat stop valves close
4. intercept valves close
5. bypass valves open
6. feed system startup flow control isolation valves open
7. feed pump discharge valves close
8. extraction steam non-return valves close
9. extraction steam dump valves open
10. feed pump low pressure steam supply valves close
11. main turbine governor valve drain valves open
12. MSL drain valves shift from A5/B5 heaters to the main condenser

(10 required at 0.2 each)

b.
1. overspeed trip mechanism
2. low vacuum trip
3. low bearing pressure trip
4. thrust bearing trip
5. solenoid trip

(0.5 each)

REF

MN TURB-16, 17
245000A201 3.7/3.9
245000G007 3.5/3.6
245000G007 245000A201 ...(KA'S)

2.09.a COMMENT

The extraction steam non-return valves trip and act as check valves on a turbine trip vice close.

RECOMMENDATION

Accept that the extraction steam non-return valves trip instead of extraction steam non-return valves close.

REF

Extraction Steam and Heater Drains Student Text Pg. 14.

QUESTION 2.11 (2.00)

Match the following plant areas (a - h) with the type(s) of fire protection system (1 - 4) that is (are) available in that area:

(2.0)

NOTE: MORE THAN ONE TYPE OF SYSTEM MAY APPLY TO EACH AREA

a. Reactor feed pump room
b. Service water pump room
c. Diesel generator day tank rooms
d. Fire pump house - diesel fire pump room
e. Control building, cable spreading room (918')
f. Turbine generator bearings 1, 2, 3
g. Main control room

1. Fire Water System
2. Carbon Dioxide System
3. Halon 1301 System
4. No Automatic System Available

ANSWER 2.11 (2.00)

a. 1
b. 3
c. 1
d. 1
e. 1, 2
f. 2
g. 4
(a - g at 0.25 each)

REF

FP system description
286000G004 3.8/3.9
286000G004 ...(KA'S)

2.11 COMMENT

The answer to part c should be 2 (Carbon Dioxide) vice 1 (Fire Water System).

RECOMMENDATION

Accept 2 instead of 1 for part c.

REF

Fire Protection Student Text Pg. 15.

QUESTION 3.01 (3.00)

a. STATE whether the solenoids associated with the following valves are NORMALLY Energized or Deenergized. NO SCRAM SIGNAL EXISTS. (1.0)

1. Back-up Scram Valves
2. Scram Discharge Volume Vent and Drain Valves

b. Repositioning the Mode Switch from STARTUP/HOT STANDBY to RUN causes certain reactor scram functions to be bypassed and others to be effective. LIST the three (3) scram functions (or setpoints) which are bypassed AND the three (3) scram functions (or setpoints) which become effective when the Mode Switch is taken to RUN (2.0)

ANSWER 3.01 (3.00)

a. 1. Deenergized (0.5)
2. Energized (0.5)

b. Activated in RUN:
- MSIV Closure (0.33)
- Companion IRM/APRM (0.33)
- APRM 118% HIGH Flux (0.33)

Bypassed in RUN:
- IRM Inop (0.33)
- IRM Upscale (0.33)
- APRM 15% HIGH Flux (0.33)

REF

CRDH-17, 19
RPS-14, 16-18
212000K108 3.0/3.1
212000K412 3.9/4.1
212000A216 4.0/4.1
212000A216 212000K108 212000K412 ...(KA'S)

3.01 b COMMENT

The APRM High Flux setpoint should be a flow bias formula instead of 118%.

RECOMMENDATION

Accept the formula for the APRM flux.

REF

RPS Student Text Table 2

QUESTION 3.08 (1.50)

Assume both recirculation pumps are running at 80% speed. State how the recirculation pumps' speed is affected by each of the conditions below. Consider each case separately. (1.5)

a. The operator closes the B recirculation pump discharge valve to the mid position.

b. Two reactor feed pumps are operating and a feedwater problem causes RPV level to temporarily decrease to 20".

c. One of the two operating reactor feed pumps trips and the reactor scrams on low level.

ANSWER 3.08 (1.50)

a. (The B MG set trips and) the B recirc pump coasts to a stop (0.5)

b. No effect (0.5)

c. Both pumps runback to 45% speed (0.5)

REF

Recirculation System, Figure 14
202001A211 3.7/3.9
202001A212 3.6/3/8
202001A223 3.2/3.2
202001A211 202001A223 202001A212 ...(KA'S)

3.08 COMMENT

On a scram and the subsequent generator trip, the recirculation pump on the normal transformer will trip. Also feedwater will be reduced to below 20% causing the running recirculation pump runback to 20%.

RECOMMENDATION

The answer as stated is correct initially for the conditions stated, however if the candidate carried through with scenario he wi ' give more information. We have just recently changed one of our exam bank questions to reflect this also.

REF

Procedure 2.1.5

QUESTION 4.09 (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. What are TWO (2) negative consequences or concerns regarding excessive drywell temperatures during this event? (1.0)

ANSWER 4.09 (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. - erroneous reactor water level indications (0.5)
- failure of electrical components, i.e., wiring, solenoids, etc. (0.5)

REF

CNS EOP 5.2.5.1, Loss of All Site AC Power Station Blackout, Rev 4, Pg. 3
295003A202 4.2*/4.3*
295028K102 2.9/3.1
295028K102 295003A202 ...(KA'S)

4.09 COMMENT

As stated in the abnormal "Ventilation System Failure - Loss of Coolers in the Drywell" a concern with high drywell temperatures is unequal expansion of the refueling bellows flange.

RECOMMENDATION

Also accept unequal expansion of the refueling bellows flange.

REF

Abnormal Procedure 2.4.8.4.2

QUESTION 5.02 (2.50)

a. HOW will the Shutdown Margin (Reactivity Margin) just prior to a refueling outage compare with the Shutdown Margin following the refueling? WHY? Two (2) reasons required. (1.5)

b. At what point in cycle life is compliance with the Shutdown Margin Technical Specification verified? (0.5)

c. What reactor conditions must be present for the verification to be reasonably accurate? (0.5)

ANSWER 5.02 (2.50)

a. SDM prior to the outage will be larger (0.5) due to fission product poisoning (0.5) and fuel depletion. (0.5)

b. initial fuel loading or refueling (0.5)

c. cold, xenon free (0.5)

REF

LOTHM-TH-4.11-0, Shutdown Margin, Pg. 5
CNS Reactor Theory, Pg. 1-35 and 36
CNS Tech Spec 3.3.A Bases
K/A 292002 K1.14 2.6/2.9
292002K114 ...(KA'S)

5.02 b COMMENT

Fuel loading occurs at the beginning of the cycle.

RECOMMENDATION

Accept BOL

QUESTION 5.03 (3.00)

a. Does the magnitude of the initial level of source range counts affect the critical rod position? WHY? (1.0)

b. The reactor is brought critical at 40 on IRM range 2 with the shortest permissible stable positive period allowed by GOP 2.1.1, "Cold Startup." Heating power is determined to be 40 on range 8 of IRM's.

****SHOW ALL WORK****

1. What is the doubling time if the period remains constant? (1.0)

2. How long will it take for power to reach the point of adding heat if the period remains constant? (1.0)

ANSWER 5.03 (3.00)

a. No (0.5). The critical control rod position is a function of Keff or reactivity of the reactor and is not a function of the source count rate. (0.5)

b. 1. From GOP 2.1.1, shortest permissible stable period equals 50 sec. (0.5)
Thus doubling time equals 50/1.44 = 34.7 seconds (0.5)

2. 40% range 2 is equal to 0.04% on range 8
P(0) = 0.04 P(t) = 40 Period = 50 seconds
P(t) = P(0) e^(t/period)
40 = 0.04 e^(t/50 sec)
Time = 345.4 seconds or 5 min. 45 sec. (1.0)
(NOTE: Grade method if period is different)

REF

LOTM-TH-4.15-1
CNS Reactor Theory, Chapter 3
292003K108 2.7/2.8
292008K104 3.3/3.4
292008K104 292003K108 ...(KA'S)

QUESTION 5.03 (3.00) (CONTINUED)

1.06 a
5.03 a COMMENT

The question asked for initial level of source range counts. This could be interpreted as either the initial counts when the startup begins or source strength. At the beginning of startup the initial level of source range counts will be based on source strength and k_{eff}. The k_{eff} will affect both the initial counts at the beginning of a startup and the point that the reactor is critical. Therefore if the candidates discussed the initial level of source range counts they would have answered yes with an appropriate explanation. The students could base their answer on whether the question was asking for source strength or initial counts on the startup.

RECOMMENDATION

Also accept yes if the candidate provides an appropriate explanation.

REF

Reactor Physics, page 3-7 and 3-8

QUESTION 5.06 (2.00)

For each of the pairs of conditions listed below, state WHICH condition would have the GREATER differential rod worth and briefly, EXPLAIN WHY.

a. Reactor moderator temperature of 150 F or 500 F (1.0)

b. For a rod position 10 or position 40 of a core operating at 100% power (assume BOL) (1.0)

ANSWER 5.06 (2.00)

a. At 500 F (0.5) As moderator temperature increases, neutron leakage out of the fuel bundles in increased, thus the control rod is exposed to higher neutron flux and rod worth increases. (0.5)

b. At 40 (0.5) the core will be bottom peaked and the rod will be traveling through an area of high flux. (0.5)

REF

CNS Reactor Theory, pgs 5-27, 28
292005K110 2.8/3.3
292005K110 ...(KA'S)

5.06.b COMMENT

Students could say position 10 if they consider the fact that all other rods will probably be deep (00-16) which would reduce the worth of any shallow rods (32-48) due to shadowing. One section of the Reactor Theory text describes shallow rods as being shaping rods and deep rods as power rods. If the students interpret the question to ask only about a single rod at BOL when flux is bottom peaked, they could answer with position 40.

RECOMMENDATION

Accept either position 10 or position 40 if they provide an appropriate explanation.

REF

Rx Theory Text Rev 1 CH 5 Page 22, 25

QUESTION 7.10 (2.50)

a. What is the purpose of the "Emergency Rod Movement Sheet"? (0.5)

b. List four (4) examples or conditions which may require the use of an "Emergency Rod Movement Sheet". (1.0)

c. If a power reduction from high power is required, what is the preferred method? (0.5)

d. When using control rods to reduce power, which rods should be selected, if possible? Answer with regard to the axial position of the rods selected. (0.5)

ANSWER 7.10 (2.50)

a. To document non-scheduled, out-of-sequence rod movements (0.5)

b. - alleviate thermal limit problems
- power reduction due to transient
- recover from rod drift
- recover from single rod scram
(0.25 each)

c. reduce recirculation flow (0.5)

d. deep rods/more than 2/3 inserted into the core (0.5)

REF

NPP 10.13, Rev 15, Pg. 2
201003G001 3.6/3.7
201003G001 ...(KA'S)

7.10 b COMMENT

Procedure 10.13 gives examples of when "power reduction due to transient" applies. The candidates may have given examples such as recirculation pump trip, reduced feedwater heating, or excessive river debris clogging intake screens.

RECOMMENDATION

Also accept any of these individual events as transient answers.

REF

Procedure 10.13, page 2

QUESTION 8.01 (3.50)

a. List the four general conditions that would require the issuance of a Special Work Permit (SWP). Values NOT required. (1.0)

b. What is the NORMAL maximum length of time that a SWP will be in effect? (0.5)

c. What is the maximum extension that can be granted for a SWP? (0.5)

d. TRUE or FALSE. Health Physics personnel are exempt from the SWP issuance requirement during the performance of the radiation and contamination surveys for SWP evaluation. (0.5)

e. Once a SWP is initiated and authorized, copies are kept at WHAT FOUR (4) locations? (1.0)

ANSWER 8.01 (3.50)

a. - High area radiation
- High airborne contamination
- High surface contamination
- Industrial hazards
(0.25 each)

b. 1 month + 7 days (0.5)

c. 7 days (0.5)

d. True (0.5)

e. - job site
- SWP board
- HP office
- SS office (control room)
(0.25 each)

REF

HPP 9.1.1.4, Rev 16, Pg. 4, 6, 7
294001K103 3.3/3.8
294001K103 ...(KA'S)

8.01 e COMMENT

The SWP board is mounted in the laundry supply area on elevation 903.

RECOMMENDATION

Accept either SWP board or laundry supply area.

QUESTION 8.08 (3.50)

a. List five (5) devices/actions that would be considered temporary modifications per Conduct of Operations Procedure 2.0.7, Plant Temporary Modification Control. (2.5)

b. What FOUR (4) persons, by title, may perform the Safety Evaluation/Technical Review for temporary modifications? (1.0)

ANSWER 8.08 (3.50)

a. - jumpers
- lifted leads
- fuse removal
- blocked relay
- booted contacts
- installed breaker test blocks/actuator links
- mechanical jumper
- installed/removed blank flanges
(5 required at 0.5 each)

b. The System Engineer (0.25) or on duty STA (0.25) in collaboration with the System Engineer and the CRS (0.25) or another SRO (0.25) when the CRS is not on site.

REF

Control of Operations Procedure 2.0.7, Plant Temporary Modifications Control, Rev 4, Pg. 3, 6
294001A103 2.7/3.7
294001A103 ...(KA'S)

8.08 COMMENT

Some candidates may provide specific devices that require PTMs instead of listing the categories listed in the procedure. The PTM procedure also lists a category of "other."

RECOMMENDATION

Also accept specific items such as spool pieces as devices that require PTMs.

REF

Procedure 2.0.7, page 6

QUESTION 8.10 (2.00)

During refueling operations individual responsibilities are assigned in Procedure 10.21, "Special Nuclear Materials (SNM) Control and Accountability."

a. Who MUST direct the SNM handling operations involving SNM movement BETWEEN Item Control Areas? (0.5)

b. Who MAY direct the SNM handling operations involving SNM movement WITHIN Item Control Areas? (0.5)

c. Who functions as the SNM Executor? (0.5)

d. Who functions as the SNM Checker? (0.5)

ANSWER 8.10 (2.00)

a. An individual holding an SRO license (0.5)

b. An individual holding an RO license (0.5)

c. Control Room Refueling Monitor or Control Room Operator (accept either 0.5)

d. Refueling Floor Supervisor or SRO on the Refuel Floor (accept either 0.5)

REF

Nuclear Performance Procedure 10.21, Special Nuclear Materials Control and Accountability Instructions, Rev 1, Pg. 3
234000G001 3.4/3.8
234000G001 ...(KA'S)

8.10 COMMENT

Procedure 10.21 also states that the SNM checker can also be any individual who did not function as SNM Executor.

RECOMMENDATION

Also accept any RO or SRO who did not function as the SNM Executor.

REF

Procedure 10.21, page 3