U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-331/OL-88-01(DRS)

Docket No. 50-331 License No. DPR-49

Licensee: Iowa Electric Light and Power Company
Cedar Rapids, Iowa

Facility Name: Duane Arnold Energy Center

Examination Administered At: Palo, Iowa

Examination Conducted: December 13-15, 1988

RIII Examiner: J. C. Bjorgen Date 1/6/89

Chief Examiner: J. M. Keeton Date 1/6/89

Approved By: M. J. Jordan Date 1/6/89

Examination Summary

Examination administered on December 13-15, 1988 (Report No. 50-331/OL-88-01)
Written and Operating examinations were administered to four Senior Reactor Operator and two Reactor Operator candidates.
Results: All candidates passed all portions of the examination.

REPORT DETAILS

1. Examiners

J. C. Bjorgen, Region III
J. M. Keeton, Chief Examiner, Region III

2. Exit Meeting

An exit meeting was held on December 16, 1988. The following personnel attended the exit meeting:

Iowa Electric Company

R. Hannen, Plant Superintendent
G. VanMiddlesworth, Assistant Plant Superintendent, Operations and Maintenance
D. Wilson, Training Superintendent
R. Potts, Procedure Supervisor
P. Roy, Operations Training Supervisor
M. Meyer, Senior Instructor
M. Mitchell, Senior Instructor
P. Meek, Senior Instructor

U. S. Nuclear Regulatory Commission

J. Keeton, Chief Examiner
J. Bjorgen, Examiner
M. Parker, Senior Resident Inspector

The following topics were discussed at the exit meeting:

The examiners identified no generic concerns during the exit meeting.

The examiners expressed a concern that the materials provided to the NRC to develop the examination were not controlled copies. As a result, a significant number of procedure changes were received by the examiners after the written examinations had been prepared. Fortunately, the changes received had minimal impact on the examinations.

The examiners noted several examples of alarm response procedures that still referred to cancelled abnormal operating procedures. This item was referred to the Resident Inspector for future followup.

A general discussion was held concerning the examination process and when the results would be sent to the facility.

FACILITY COMMENTS AND NRC RESOLUTION OF COMMENTS

Facility Comment
Question 3.03

Answer the following questions with regard to the Standby Diesel Generator System.

a. A start signal should not be initiated within one minute of resetting an engine trip, generator trip, or initiating a manual shutdown. WHAT could occur if it was initiated TOO SOON?

Comment

We agree with the answer key for part a., but we request the examinee be given full credit for giving the answer that is stated in OI*324 (diesel generator); prevent inadvertent lockout. The DAEC procedure reference is incorrect and we have submitted a procedure change.

Reference

System Description G-2; OI 324--Precaution #14.

NRC Resolution

Comment accepted. "Prevent inadvertent lockout" was also accepted for full credit. Answer key was changed.

Facility Comment
Question 4.01

STATE WHICH coefficient(s) DOMINATE the "Power Coefficient of Reactivity" during:

a. Startup (reactor power < 1%).

Comment

Some confusion arose from question part a., because the exact point in the startup was not specified (e.g., operating in SRM, IRM, or PRM range). Also, the definition of power coefficient states that it combines the void coefficient and Doppler coefficient. Therefore, it is reasonable to assume that examinees would answer part a. by also considering definition of power coefficient.

We request that "Doppler coefficient" also be accepted and full credit be given for this response.

Reference

Reactor Theory 22, page 6.

NRC Resolution

Comment accepted. Full credit was for Doppler in part a. Answer key was changed.

Facility Comment
Question 4.07

OI 151, Core Spray System, states that following maintenance you should insure the system is filed and vented prior to starting the pump. STATE the purpose of this precaution and TWO possible CONSEQUENCES if it is NOT done.

Comment

We request that "air (gas) binding" be also accepted as a correct answer for this question. Our training materials state that this is also a generic concern with all pumps.

Reference

Fluid Flow 4, page 4-4 and 4-5.

NRC Resolution

Comment accepted. "Air (gas) binding" was also accepted for 0.5 point, not to exceed a total value of 1.0 point. Answer key was changed.

Facility Comment
Question 5.10

The reactor is operating near full power. You have just received a "Primary Containment Hi/Lo Pressure" alarm on 1C05B, C-5. A quick check of other indications show that pressure is 1.5 psig and gradually increasing and drywell cooling appears to be inadequate. IDENTIFY THREE actions that must be performed according to the ARP.

Comment

We request that "vent the drywell" as well as any of the other ARP steps be considered an acceptable response.

Reference

ARP 1C05B, C-5.

NRC Resolution

Comment partially accepted. The condition established in the stem of the question focus the three actions stated in the ARP that deal with inadequate drywell cooling. The other responses in the ARP deal primarily with drywell pressure control. However, other responses such as "Vent the drywell" were accepted as additional responses worth 0.25 point each. Answer key was changed.

Facility Comment
Question 5.12

An alarm on 1C07B, B-1, "LP Turbine 1G-1B Hi Back Pressure," has just annunciated.

a. IDENTIFY THREE systems/components that should be checked for normal operation according to the ARP.

b. According to the ARP, STATE the automatic action that occurs and the Emergency procedure you must enter if main condenser pressure increases to 19 inches Hg absolute.

Comment

References used for this question do not prioritize systems that should be checked on a degrading vacuum. The situation and operator experience will be used to determine which systems should be checked and in what order.

We request that equal grading be used for any answer which could cause a loss of vacuum.

References used in answer key provide sufficient guidance for this determination.

NRC Resolution

Comment accepted. Any 3 of 7 responses were accepted @ 0.5 point each. Answer key changed.

Facility Comment
Question 6.08

CHOOSE the statement that most accurately describes the concern if a tube leak develops in a RWCU Non-Regenerative Heat Exchanger:

a. Resin damage due to loss of cooling to NRHX.

b. Colder water being injected into the feedwater system.

c. Contamination of the RBCCW system.

d. Overpressurization of the RBCCW system.

Comment

We request that answer "d" overpressurization also be accepted since RBCCW is low pressure system interfacing with a system at reactor pressure.

Reference

System Description F-5, page 6.

NRC Resolution

Comment not accepted. The RBCCW system is provided with relief protection that would prevent overpressurization of the system. However, when the reliefs lift, contaminated water will be dumped to the sumps in containment thus causing contamination problems. Answer key was not changed.

Facility Comment
Question 6.11

You are starting up the RHR in shutdown cooling in accordance with OI 149, Section 5.3.

a. STATE WHY RHR loop B is preferred.

Comment

We agree with answer key. We wish to point out that students may have answered question by stating that RHR drain to radwaste can be done without entering torus since radwaste valves are located on "B" side of MO cross-tie. incorrect and we have submitted a procedure change.

This answer is correct and is synonymous with answer key.

Reference

System Description C-1, Figure 5.

NRC Resolution

Comment accepted. Also accepted discussion of RHR drain to radwaste being operable without torus entry. Answer key was changed.

Facility Comment
Question 6.23

On back shift, a fire is reported in one of the maintenance shops:

a. STATE the persons (position title) designated as Fire Bridge Chief.

b. WHAT is the minimum number of persons who should show up for the fire brigade?

c. Are those persons responding to the fire still counted as part of the "shift crew"?

Comment

We believe the answer key should be changed to "yes." A fire does result in shift crew members ("B" OSS, AO) acting as fire brigade members, however, performing as fire brigade team members is part of the duties of those crew members that respond to a fire. Therefore, Tech Specs with regard to minimum shift crew personnel are met.

Reference

Tech Specs Table 6.2-1; Tech Specs 6.2.

NRC Resolution

Comment accepted. "Yes" was accepted as the correct response. Answer key was changed.

U. S. NUCLEAR REGULATORY COMMISSION
SENIOR REACTOR OPERATOR LICENSE EXAMINATION
REGION 3

FACILITY: Duane Arnold

NAME: _____ REACTOR TYPE: BWR-GE4

DATE ADMINSTERED: 88/12/13

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	24.15	_____	_____	4.	REACTOR PRINCIPLES (7%) THERMODYNAMICS (7%) AND COMPONENTS (10%) (FUNDAMENTALS EXAM)
33.25	32.13	_____	_____	5.	EMERGENCY AND ABNORMAL PLANT EVOLUTIONS (33%)
45.25	43.72	_____	_____	6.	PLANT SYSTEMS (30%) AND PLANT-WIDE GENERIC RESPONSIBILITIES (13%)
103.5		_____ FINAL GRADE	_____%		TOTALS

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

_____
Candidate's Signature

START: _____ STOP: _____

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination, the following rules apply:

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

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

3. Use [illegible] or dark pencil only to facilitate legible reproductions.

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

5. Fill in the time you start and stop on the cover sheet of the examination.

6. Use only the paper provided for answers.

7. Print your name in the upper right-hand corner of each page of the exam.

8. The exam has one question per page. Write the answer beneath the question (start just below *****CATEGORY ...). Write only on one side of the exam and any extra answer sheets.

9. Number each answer continued on additional paper as to category and number, for example, 1.4, 6.3.

10. Attach continued answers to back of question to which it applies.

11. Place finished answer sheets face down on your desk or table.

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

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

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

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

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

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

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions with answers on top.

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

(3) Scratch paper used during the examination.

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

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

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

QUESTION 4.01 (1.00)

STATE WHICH coefficient(s) DOMINATE the "Power Coefficient of Reactivity" during:

a. Startup (reactor power <1%)

b. Power operation (reactor power is 86%)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.02 (1.50)

a. Provide the word DEFINITION of reactor period. (1.0)

b. As compared to BOL conditions, the effect of delayed neutrons on reactor period at EOL for the same reactivity addition will result in a (SHORTER, THE SAME, LONGER) period. (Choose one) (0.5)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.03 (1.00)

During a reactor startup, criticality has been achieved and control rods have been withdrawn to establish a 100 sec period. At what point would you expect to see period approach infinity? EXPLAIN WHY?

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.04 (1.50)

Match EACH ONE of the following terms in COLUMN A with the corresponding definition in COLUMN B. Choose ONE definition for each term.

COLUMN A	COLUMN B
a. Keff	1. An amount of fuel loaded into the core above that required for initial criticality to compensate for control rod motion.
b. Shut Down Margin	2. A measure of the fractional change of the neutron multiplication factor.
c. K-excess	3. 1 - Keff / Keff - 1
	4. A measure of how sub-critical the reactor is in terms of Keff.
	5. The % of neutrons which are born delayed.
	6. Keff - 1
	7. A ratio = (# neutrons produced from thermal fission) / (# neutrons produced from thermal fission in the preceeding generation)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.05 (1.00)

DEFINE the following terms:

a. Prompt neutrons.

b. Delayed neutrons.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.06 (1.50)

DESCRIBE THREE characteristics of Xenon 135 that cause substantial reactivity effects in the core following a change in power.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.07 (1.00)

OI 151, Core Spray System, states that following maintenance you should insure the system is filled and vented prior to starting the pump. STATE the purpose of this precaution and TWO possible CONSEQUENCES if it is NOT done.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

4. REACTOR PRINCIPLES (7%) THERMODYNAMICS (7%) AND COMPONENTS (10%) (FUNDAMENTALS EXAM)

QUESTION 4.08 (2.00)

a. DEFINE NPSH (Net Positive Suction Head).

b. EXPLAIN what occurs in a recirculation pump with insufficient NPSH.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.09 (1.00)

In regards to conducting a reactor heat balance, IDENTIFY the correct statement when determining reactor power:

a. If the feedwater flow rate used in the heat balance calculation was lower than the actual feedwater flow rate, then the actual power is higher than the calculated power.

b. If the steam flow used in the heat balance calculation was lower than the actual steam flow, then the actual power is higher than the calculated power.

c. If the RWCU return temperature used in the heat balance calculation was lower than the the actual RWCU return temperature, then the actual power is higher than the calculated power.

d. If the recirc pump heat input used in the heat balance calculation was omitted from the calculation, then the actual power is higher than the calculated power.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.10 (1.00)

IDENTIFY the thermal limit that prevents the fuel from reaching 2200 degrees F following a LOCA.

a. LHGR

b. APLHGR

c. MFLCPR

d. MFLPD

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.11 (1.00)

SELECT the term that is defined by "The fuel bundle power that would cause the onset of transition boiling at some point in the fuel bundle."

a. GEXL correlation power

b. Critical power

c. Maximum core power density

d. Maximum critical quality power

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.12 (1.00)

Increasing condenser vacuum (reducing absolute pressure) will cause the following effect on the plant:

a. Increase condenser temperature

b. Decrease rate of non-condensible gas removal

c. Increase condensate subcooling

d. Decrease main turbine efficiency

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.13 (1.00)

You are asked to verify that a pressure gauge in a saturated system is reading correctly. The pressure gauge reads 350 psig; therefore, a temperature instrument in the same area should read:
(SHOW YOUR WORK.)

a. 420 degrees F

b. 425 degrees F

c. 430 degrees F

d. 435 degrees F

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.14 (2.00)

According to the System Description, the Safety/Relief Valves provide four protection functions, MATCH the PROTECTION FUNCTION to the VALVE OP-DESCRIPTION: [Note: Consider SRV 4401 as having all these functions.]

PROTECTION FUNCTION	VALVE OP DESCRIPTION
1. Overpressure RELIEF protection.	a. The valves self-actuate to augment the spring safety valves.
2. Depressurization operation.	b. Two valves control pressure in a desired band if armed by any SRV opening and a high pressure scram signal.
3. LLS operation.	
4. Overpressure SAFETY operation.	c. The required valves are opened automatically or manually by indirectly operated devices as part of protection system for small line breaks.
	d. The valves open to limit the pressure rise.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.15 (1.50)

The number of successive start attempts on a Recirc Pump is limited to _____(a)_____ time(s) at ambient temperature. With the windings above ambient temperature, the motor can be started and brought to speed _____(b)_____ time(s) with additional attempts to be separated by 45 min in order to prevent _____(c)_____.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.16 (2.00)

The Generator Primary Lockout Relay, 286/P, protects the generator against several faults. MATCH the LOCKOUT that would be indicated to the FAULT for which protection is provided:

LOCKOUT	FAULT
1. Generator differential current	a. Protects T/G from overspeed and excess heat
2. Generator neutral overvoltage	b. Protects the LP turbine from operating at resonance frequencies
3. Generator loss of excitation	c. Protects the Auxiliary Transformer from overvoltage
4. Generator underfrequency trip	d. Protects the Generator on phase-to-phase ground fault
	e. Protects the Generator on unequal phase in and out current
	f. Protects the Generator if any fault protective relay fails to reset

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.17 (2.00)

The Yarway level indicating transmitters are temperature compensated; however, there are events that can cause erroneous level indication. MATCH the expected ERROR you would observe to the EVENT that has occurred.

EVENT	ERROR
1. Drywell temperature has increase 100 degrees F	a. Indicated level greater than actual
2. Large leak in variable leg	b. Indicated level less than actual
3. Large leak in reference leg	c. No error
4. Rapid pressure decrease	

[The ERRORs may be used more than once or not at all.]

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.18 (2.00)

Each Reactor Recirc Pump control circuit has TWO speed limiters. IDENTIFY WHICH limiter [LIMITER #1 (20%) -or- LIMITER #2 (45%)] will be in control following each of these events. (Assume both pumps running and all other systems are normal.)

a. Reactor is at 75% power a reactor feedpump trips and a reactor low level alarm is received.

b. Reactor is at 75% power and recirc pump A discharge valve starts drifting closed.

c. Reactor startup is in progress, one RFP is running, and reactor water level is 200 inches.

d. Reactor is at 55% power recovering from a recirc runback, reactor water level is normal, both reactor feedwater pumps are running, runback has not been reset.

(***** END OF CATEGORY 4 *****)

5. EMERGENCY AND ABNORMAL PLANT EVOLUTIONS
(33%)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE. *****)

QUESTION 5.01 (2.00)

As Shift Supervisor during mid-shift, the reactor is in the RUN Mode and you are required to IMMEDIATELY EVACUATE the control room. Answer each of the following statements TRUE or FALSE.

a. The reactor cannot be scrammed prior to leaving the control room; the same results will be accomplished by opening circuit breakers 'Bus A Ckt 02' and 'Bus B Ckt 02' at panel 1Y30 (Power Range Neutron Monitoring System).

b. When transferring control at 1C388, the Yellow Transfer Switch must be placed in transfer prior to transferring the other keylock switches to emergency.

c. Upon control room evacuation, you have 20 min to perform Section B - RPV Pressure and Level Control and Section F - Essential Switchgear Room Ventilation Control.

d. Upon leaving the control room, the MSIVs are left open to allow the condenser to be a heat sink; however, the MSIVs are required to be closed if the cooldown rate exceeds 100 degrees F/hr.

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.02 (2.00)

You are increasing reactor power from 70 to 100%, a 'Reactor Vessel HI/LO Level Recorder Alarm' on 1C05A, C-1, annunciates and level is decreasing. STATE FOUR actions that you should take to preclude a scram.

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.03 (2.00)

The reactor is operating at full power when the feeder breaker from the Aux Transformer to the 4160V Bus 1A2 trips.
IDENTIFY FOUR loads that will be lost because of load shedding.

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.04 (2.00)

During a reactor startup with the Mode switch in STARTUP, +24 vdc is lost to 1D50. STATE FOUR automatic actions that will occur according to AOP 375, "Loss of +24 VDC Power."

(*****-CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.05 (1.50)

If Instrument and Service Air is lost during reactor operation, you can expect to receive several alarms.

a. EXPLAIN WHY you may receive a ROD DRIFT alarm on 1C05B, C-7. [1.0]

b. STATE the action you must take if this alarm is received. [0.5]

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.06 (2.50)

ADDRESS each of the following ITEMS according to AOP 411, "GSW Abnormal Operation." Assume the reactor is at full power and consider each item independently.

a. STATE the immediate action that must be taken if GSW is lost and CANNOT be restored.

b. STATE the setpoint at which the Standby GSW pump should start.

c. STATE the parameter that could cause the MSIVs to close on loss of GSW.

d. STATE the system and parameter that will initiate a Turbine runback on loss of GSW.

e. STATE the action that must be taken if BOTH recirc MG lube oil temperatures reach 210 degrees F.

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.07 (2.50)

The reactor is operating at 95% power when feedwater heater strings 3A, 4A, and 5A isolate. According to AOP 646 "Loss of Feedwater Heating":

a. IDENTIFY THREE reponses, alarms, or parameter changes that you can expect to see at 1C05. (1.5)

b. DESCRIBE the initial action that must be taken. (1.0)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

5. EMERGENCY AND ABNORMAL PLANT EVOLUTIONS
(33%)

QUESTION 5.08 (2.50)

The NSOE is pulling control rods to the 100% rod line. Another operator reports that there is an increasing trend on the Main Steam Line Rad Monitor, RR-4448, and the Offgas Posttreat Rad Monitor, RR-4101, on 1C02. Both radiation levels are still well below the trip level.
STATE FIVE actions that you should take according to AOP 672.2, "Offgas Radiation / Reactor Coolant High Activity."

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.09 (3.00)

STATE the TWELVE immediate actions required by IPOI-5 upon a Reactor Scram. [Be brief, explanations are not necessary.]

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.10 (1.50)

The reactor is operating near full power. You have just received a 'Primary Containment Hi/Lo Pressure,' alarm on 1C05B, C-5. A quick check of other indications shows that pressure is 1.5 psig and gradually increasing and drywell cooling appears to be inadequate.
IDENTIFY THREE actions that must be performed according to the ARP.

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.11 (2.00)

EOP-1, RC/Q-4, states that "If the reactor CANNOT be shutdown with control rods before Torus water temperature reaches 110 degrees F," then inject Boron.

a. STATE action the operator must perform regarding the ADS at this time. (0.5)

b. EXPLAIN WHY it is important to inject Boron if MSIVs have shut and scram has failed. INCLUDE in your answer WHICH limit (curve) may be exceeded if Boron is not injected soon enough. (1.5)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.12 (2.50)

An alarm on 1C07B, B-1, 'LP Turbine 1G-1B Hi Back Pressure,' has just annunciated.

a. IDENTIFY THREE systems/components that should be checked for normal operation according to the ARP. (1.5)

b. According to the ARP, STATE the automatic action that occurs and the Emergency procedure you must enter if main condenser pressure increases to 19 inches Hg absolute. (1.0)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.13 (2.00)

AOP 304.1, "Loss of 4160V Non-essential Electrical Power," contains a Caution that applies FOUR constraints on Single Loop Operation (SLO).

a. Constraint a. specifies that STP 46F002 be performed immediately and STP 46F001 must performed if _____.
(Complete the phrase.)

b. Constraint b. limits operation to <45% flow and 80% load line. STATE WHEN these limits are no longer applicable during SLO.

c. STATE the maximum operating recirc pump speed allowed by constraint c (assume all conditions have been met for maximum SLO power operation).

d. Constraint d. states that reactor operation is permitted if Tech Spec requirements are met. STATE which thermal limit(s) is (are) of particular concern during SLO.

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.14 (2.50)

You are the Refuel Floor SRO during a refuel outage. MATCH the following OCCURRENCES to the ACTIONS you must take according to FRCHP #5. [Actions may be used more than once or not at all.]

OCCURRENCES	ACTIONS
a. A tornado is sighted East of Shellsburg.	1. Stop core component movement and evacuate torus, torus area, drywell and refuel floor.
b. The Control Room OSS reports that SRM count rate is rapidly increasing.	2. Stop core component movement and evacuate drywell and refuel floor.
c. Water level in the spent fuel pool is decreasing.	3. Stop core component movement and evacuate refuel floor.
d. Spent fuel assembly drops into the Cattle Chute.	4. Stop core component movement.
e. A refuel floor ARM alarms and is verified to be reading correctly.	

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.15 (2.75)

The reactor is operating near full power when the following indications are received:

A Turbine Building Hi Radiation alarm on 1C04.

A security guard calls and says it is getting hot on the turbine floor and looks like it is getting foggy.

The NSO states that Generator output has dropped a few MWe.

Turbine Building radiation is verified to be increasing on two points on the recorder at IC02.

a. Assuming that the indications signify a small steam line break per IPOI-C.1, "Steam Line Break Outside the Drywell."
STATE TWO criteria you use to determine the magnitude of the leak. (0.5)

b. If you determine that an isolation should have occurred,
STATE which EOP you are required to enter. (0.25)

c. STATE the FOUR IMMEDIATE actions that must be taken by the NSOE if ANY of the criteria in a. are met. (2.0)

(***** END OF CATEGORY 5 *****)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.01 (2.00)

During a reactor startup, reactor water level is +190 inches, reactor pressure is at 100 psi increasing, and the Reactor Water Cleanup System (RWCU) is being used to control reactor vessel water level.

a. STATE which TWO systems can receive the rejected water.

b. IDENTIFY the TWO most likely reasons/sources for excess reactor water level.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.02 (1.50)

a. TRUE or FALSE

The Standby Liquid Control (SBLC) system will shut down the reactor from any operating condition at any time in core life and is intended as a backup for RPS. (0.5)

b. STATE HOW sodium pentaborate is maintained in solution in the Storage Tank and in the Piping System when being discharged to the RPV. (1.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.03 (2.00)

a. STATE HOW the Standby Gas Treatment System (SBGT) is designed to respond to loss of all control air.

b. STATE the purpose of the activated charcoal filter bed in the SBGT, and HOW and WHY it would be affected if the electrical heater is lost following a LOCA.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.04 (2.50)

A LPCI initiation has caused the RHR pumps to start. RHR pump A tripped.

a. STATE THREE things that could have caused the automatic trip. (1.5)

b. RHR pump A may be restarted by clearing the trip condition, placing the pump control switch in STOP, and placing the control switch in START.
DESCRIBE WHAT placing the control switch in STOP accomplishes in the control circuit? (1.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.05 (1.00)

During plant startup, the Nitrogen Purge System is used to inert the containment. The nitrogen is heated prior to reaching containment. IDENTIFY any adverse effects that loss of heating could have on the systems or plant during inerting if unheated nitrogen is introduced to containment.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.06 (1.50)

You have just relieved the offgoing shift during a plant startup. The reactor is at 12% thermal power and you notice the mechanical vacuum pump is running. Is this a problem? EXPLAIN WHY or WHY NOT.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

6. PLANT SYSTEMS (30%) AND PLANT-WIDE GENERIC RESPONSIBILITIES (13%)

QUESTION 6.07 (1.75)

You are Shift Supervisor. An instrument technician informs you that he needs to perform maintenance on cabinet 1C-42 that requires deenergizing the RPS 120-V ac power supply. WHAT effect will this action have on the following:

a. PCIS Group I (0.5)

b. PCIS Group II (0.25)

c. Secondary Containment (0.5)

d. RPS trip systems (0.5)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.08 (1.00)

CHOOSE the statement that most accurately describes the concern if a tube leak develops in a RWCU Non-Regenerative Heat Exchanger:

a. Resin damage due to loss of cooling to NRHX.

b. Colder water being injected into the feedwater system.

c. Contamination of the RBCCW system.

d. Overpressurization of the RBCCW system.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.09 (1.50)

The High Pressure Coolant Injection (HPCI) system is being manually shut down following surveillance. The operator has started reducing the turbine speed in accordance with OI-152, Sec. 7.3, but was called to assist with another system problem. You notice HPCI turbine speed is still decreasing. According to the procedure:

a. WHAT speed is of concern. (0.50)

b. LIST TWO reasons for concern. (1.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.10 (2.00)

Fill in the blanks.

The purpose of the Automatic Depressurization System (ADS) is to function as a backup to the _____(a)_____ system. It is designed to reduce reactor pressure and allow low pressure systems to provide core cooling water to prevent fuel cladding temperature from exceeding _____(b)_____ degrees F. The ADS has short term capability of _____(c)_____ cycles at drywell design pressures after five hours post-LOCA and long term capability of _____(d)_____ cycles at 100 days following a design basis LOCA.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.11 (1.50)

You are starting up the RHR in shutdown cooling in accordance with OI 149, Sec 5.3.

a. STATE WHY RHR loop B is preferred. (1.0)

b. STATE the MAXIMUM pressure at which shutdown cooling can be initiated. (0.5)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.12 (1.50)

The Traversing In-core Probe is provided with an emergency shear valve. STATE the EMERGENCY circumstances that require this device to be actuated.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.13 (2.50)

With regards to Recirculation System:

a. - STATE the condition(s) that actuate(s) the End of Cycle RPT trip. (1.5)

b. STATE WHY this trip is neccessary. (1.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.14 (1.00)

The plant is operating normally at power when 'Recirc Pump A Seal Staging Flow HI/LO' alarms, flow is verified to be 0.2 gpm, and you note an INCREASE in No.2 seal pressure with NO CHANGE in No. 1 seal pressure. IDENTIFY which ONE of the following failures caused these indications.

a. Failure of No. 1 seal

b. Failure of No. 2 seal

c. Plugging of the No. 1 Labyrinth Seal

d. Plugging of the No. 2 Labyrinth Seal

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.15 (1.50)

STATE the TWO possible causes of a CRD Accumulator Trouble alarm (Setpoints NOT required) and DESCRIBE the action that must be taken to determine the cause.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.16 (1.50)

TRUE OR FALSE

a. On loss of normal 125 vdc control power, both ADS logic circuits A and B automatically shift to the alternate 125 vdc power supply.

b. Before the ADS will actuate automatically, it must receive Low-Low-Low Level, Low Level, RHR pump running, Core Spray pump running, AND 120s Timer timed-out signals.

c. Pressing the ADS Timer Reset Pushbuttons on 1C03 will stop the ADS 120s timer until the ADS Logic is reset.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.17 (2.00)

The Recirc Pump Operating Instruction, OI 264, Precautions and Limitations restrict the allowable recirc pump speed mismatch.

a. STATE the purpose of this precaution.

b. STATE the maximum allowable percent mismatch and the associated power levels.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.18 (1.00)

While operating at 100% power, a Group I isolation and reactor scram have occured. Data collected from the plant Process Computer and the plant operators indicate the following events occurred:

(1) The Group I isolation was caused by technician error.

(2) The reactor scram was caused by high reactor pressure.

(3) Both Reactor Feed Pumps tripped.

(4) Reactor water level decreased causing both HPCI and RCIC to auto start and inject to the reactor vessel.

(5) An operator secured HPCI, took manual control of RCIC, and maintained reactor vessel level.

(6) A feed pump was restarted. After level control was transferred to the feed pump, RCIC was secured.

(7) Plant was placed in a normal HOT SHUTDOWN condition.

Based on the information given above, IDENTIFY the correct statement concerning subsequent reactor operation.

a. Power operation cannot resume because HPCI auto initiated and injected to the reactor vessel.

b. Power operation cannot resume because the feed pumps should not have tripped.

c. Power operation cannot resume because a safety limit may have been violated.

d. Power operation cannot resume until the MSIVs have been inspected due to the Group I isolation signal.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.19 (2.00)

According to IPOI Sec. A, functionally the PCIS and NSSSS are one system, but the objectives of the two are different. STATE the OBJECTIVE of each system.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.20 (2.00)

TRUE or FALSE

a. An audit of the tagout records shall be performed monthly by the OS or his designee; however, he has the authority to waive the audit during an outage.

b. If the OSS determines that a Clearance must be changed, he has the sole responsibility for authorizing that change.

c. Upon completion of maintenance in the substation, the released Hold cards and warning tags shall be removed and destroyed.

d. When electrically disarming a CRD flow control block valve, only one tag is necessary for the four amphenols on the block valve.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.21 (2.00)

According to the ie: Safety Rule Book and IPOI 2, DAEC personnel may conduct drywell inspections only when authorized by the Shift Supervisor and certain criteria have been met.
STATE the FOUR criteria.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.22 (1.50)

STATE THREE conditions that allow you as OSS to waive a valve lineup page according to IPOI 7, 'Special Operations.'

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.23 (1.50)

On back shift, a fire is reported in one of the maintenance shops:

a. STATE the person (position title) designated as Fire Brigade Chief.

b. WHAT is the minimum number of persons who should show up for the fire brigade?

c. Are those persons responding to the fire still counted as part of the "shift crew"?

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.24 (2.50)

a. STATE the exposure rate limits (for a major portion of the body) which characterize EACH ONE of the following:

1. RADIATION AREA

2. HIGH RADIATION AREA

3. LOCKED HIGH RADIATION AREA (1.5)

b. STATE the definition of extremities as it pertains to radiation exposure of personnel. (1.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.25 (2.00)

Regarding the ALARA Emphasis Program, you have responsibilities as BOTH an individual and an Operations Shift Supervisor. STATE BOTH of your responsibilities.

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.26 (2.50)

TRUE or FALSE

a. When preparing the Main Generator for maintenance, the hydrogen must be purged using first CO2 then air.

b. Spare hydrogen cylinders may be stored near a hydrogen manifold if they are properly marked and tagged.

c. The Generator may be operated as long as the hydrogen purity remains above 80%.

d. When it is necessary to work on chlorine lines or equipment, all sources of chlorine shall be isolated and the lines vented to the atmosphere.

e. When placing a replaced guage glass in service, it must be pressurized carefully with only authorized personnel present.

(***** END OF CATEGORY 6 *****)
(********** END OF EXAMINATION **********)

DATA SHEET

REACTOR THEORY FORMULAS:

$$P = P_0 e^{t/\tau}$$

$$P = \frac{\Sigma \bar{\xi}_{th} V}{3.12 \times 10^{10} \text{ fissions/sec}}$$

$$P_{th} = \frac{1}{1 + (B^2 L_{th}^2)} = e^{-(B^2 L_{th}^2)}$$

$$P_f = e^{-(B^2 L_f^2)}$$

$$p = e^{-[N][I_{eff}]/\xi\Sigma_s}$$

$$C_1 (1-K_{eff1}) = C_2 (1-K_{eff2})$$

$$m = \frac{1}{1-K} = \frac{C_{final}}{C_{initial}}$$

$$\alpha_T = \frac{1}{f}\frac{\Delta f}{\Delta t} + \frac{1}{p}\frac{\Delta p}{\Delta t} - B^2 \left(\frac{\Delta L_f^2}{\Delta t} + \frac{\Delta L_{th}^2}{\Delta t}\right)$$

$$K_{eff} = \epsilon P_f p P_{th} f \eta$$

$$P = P_0 10^{SUR(t)}$$

$$SUR = 26.06/\tau$$

$$\rho = \frac{l^*}{\tau} + \frac{\bar{\beta}_{eff}}{1 + \tau}$$

$$\rho = \frac{K - 1}{K}$$

$$\Delta\rho = \ln \frac{K_{final}}{K_{initial}}$$

$$\tau = \frac{\bar{\beta}_{eff} - \rho}{\lambda\rho}$$

$$\tau = \frac{l^*}{\rho}$$

$$P_1 = P_0 \frac{\bar{\beta}_{eff} - \rho_0}{\bar{\beta}_{eff} - \rho_1}$$

DATA SHEET

THERMODYNAMICS AND FLUID MECHANICS FORMULAS:

$$\dot{Q} = \dot{m}\,\Delta h$$

$$\dot{Q} = U\,A\,(\Delta T_m)$$

$$\dot{Q} = \dot{m}\,c_p\,(\Delta T)$$

$$\eta = \frac{\dot{Q}_{in} - \dot{Q}_{out}}{\dot{Q}_{in}}$$

$$\eta_p = \frac{W_{actual}}{W_{supplied}}$$

$$\dot{m} = \rho A V$$

$$\dot{m} = KA\sqrt{\Delta P_x \rho}$$

$$\Delta T_m = \frac{\Delta T\,(in) - \Delta T\,(out)}{\ln\left(\frac{\Delta T\,(in)}{\Delta T\,(out)}\right)}$$

$$T_{cl} - T_{ps} = \frac{Gr^2}{4k}$$

$$\dot{Q} = \frac{A\,\Delta T_{total}}{\frac{\Delta x_a}{K_a} + \frac{\Delta x_b}{K_b} + \ldots + \frac{\Delta x_n}{K_n}}$$

$$\dot{Q} = \frac{2\pi L \Delta T}{\frac{1}{K} + \frac{\ln R_2/R_1}{K_2} + \frac{\ln R_3/R_2}{K_3}}$$

$$\dot{Q} = \alpha\,\delta\,A\,R^4$$

$$\eta = \frac{(h_{in} - h_{out})_{real}}{(h_{in} - h_{out})_{ideal}}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\rho_1 A_1 V_1 = \rho_2 A_2 V_2$$

$$\dot{m}_{nc} = KA_Q\sqrt[3]{\dot{Q}} = KA\,\Delta T\,\sqrt{\Delta T} = KA\,\Delta p\,\sqrt{\Delta P}$$

$$G = \frac{\Sigma_f \dot{g}_{th}}{8.8\times10^9}$$

$$\dot{Q} = \frac{kA\Delta T}{\Delta x}$$

DATA SHEET

CENTRIFUGAL PUMP LAWS:

$$\frac{N_1}{N_2} = \frac{\dot{m}_1}{\dot{m}_2} \qquad \frac{(N_1)^2}{(N_2)^2} = \frac{H_1}{H_2} \qquad \frac{(N_1)^3}{(N_2)^3} = \frac{P_1}{P_2}$$

RADIATION AND CHEMISTRY FORMULAS:

$R/hr = 6CE/d^2$ $\qquad I_x = I_0 e^{-mx}$ $\qquad C_1V_1 = C_2V_2$

$G = \frac{\text{Dilution Rate}}{\text{Volume}}$ $\qquad I = I_0 \left(\frac{i}{10}\right)^n$ $\qquad C = C_0 e^{-Gt}$

$A = A_0 e^{-\lambda t}$ $\qquad A = \lambda N$

CONVERSIONS:

1 gm/cm^3 = 62.4 lbm/ft^3 $\qquad$ Density of water (20 C) = 62.4 lbm/ft^3

1 gal = 8.345 lbm

1 ft^3 = 7.48 gal $\qquad$ Avogadro's Number = 6.023×10^{23}

1 gal = 3.78 liters $\qquad$ Heat of Vapor (H_2O) = 970 Btu/lbm

1 lbm = 454 grams $\qquad$ Heat of Fusion (ICE) = 144 Btu/lbm

e = 2.72 $\qquad$ 1 AMU = $1,66 \times 10^{-24}$ grams

π = 3.14159 $\qquad$ Mass of Neutron = 1.008665 AMU

1 KW = 738 ft-lbf/sec $\qquad$ Mass of Proton = 1.007277 AMU

1 KW = 3413 Btu/hr $\qquad$ Mass of Electron = 0.000549 AMU

1 HP = 550 ft-lbf/sec $\qquad$ One atmosphere = 14.7 psia = 29.92 in. Hg

1 HP = .746 KW $\qquad$ °F = 9/5 °C + 32

1 HP = 2545 Btu/hr $\qquad$ °C = 5/9 (°F - 32)

1 Btu = 778 ft-lbf $\qquad$ °R = °F + 460

1 MEV = 1.54×10^{-16} Btu $\qquad$ °K = °C + 273

h = 4.13×10^{-21} M-sec

1 W = 3.12×10^{10} fissions/sec

g_c = 32.2 lbm-ft/lbf-sec^2 $\qquad$ c^2 = 931 MEV/AMU

1 inch = 2.54 cm $\qquad$ C = 3×10^8 m/sec

$\sigma = 0.1714 \times 10^{-8}$ Btu/hr ft^2 R^4

DATA SHEET

AVERAGE THERMAL CONDUCTIVITY (K)

Material	K
Cork	0.025
Fiber Insulating Board	0.028
Maple or Oak Wood	0.096
Building Brick	0.4
Window Glass	0.45
Concrete	0.79
1% Carbon Steel	25.00
1% Chrome Steel	35.00
Aluminum	118.00
Copper	223.00
Silver	235.00
Water (20 psia, 200 degrees F)	0.392
Steam (1000 psia, 550 degrees F)	0.046
Uranium Dioxide	1.15
Helium	0.135
Zircaloy	10.0

MISCELLANEOUS INFORMATION:

$$E = mc^2$$

$$KE = 1/2\ mv^2$$

$$PE = mgh$$

$$V_f = V_0 + at$$

Geometric Object	Area	Volume
Triangle	$A = 1/2\ bh$	////////////////
Square	$A = s^2$	////////////////
Rectangle	$A = L \times W$	////////////////
Circle	$A = \pi r^2$	////////////////
Rectangular Solid	$A = 2(LxW + LxH + WxH)$	$V = L \times W \times H$
Right Circular Cylinder	$A = (2\ \pi r^2)h + 2(\pi r^2)$	$V = \pi r^2 h$
Sphere	$A = 4\ \pi r^2$	$V = 4/3\ (\pi r^2)$
Cube	////////////////////////////	$V = s^3$

DATA SHEET

MISCELLANEOUS INFORMATION (continued):

Material	Half-Life	Gamma Energy MEV per Disintegration	10 CFR 20 Appendix B				
				Table I		Table II	
				Col I Air uc/ml	Col II Water uc/ml	Col I Air uc/ml	Col II Water uc/ml
Ar-41	1.84 h	1.3	Sub	2×10^{-6}	-----	4×10^{-8}	------
Co-60	5.27 y	2.5	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
I-131	8.04 d	0.36	S	9×10^{-9}	6×10^{-5}	1×10^{-10}	3×10^{-7}
Kr-85	10.72 y	0.04	Sub	1×10^{-5}	-----	3×10^{-7}	------
Ni-65	2.52 h	0.59	S	9×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
Pu-239	2.41×10^{4} y	0.008	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
Sr-90	29 y	-----	S	1×10^{-9}	1×10^{-5}	3×10^{-11}	3×10^{-7}
Xe-135	9.09 h	0.25	Sub	4×10^{-6}	-----	1×10^{-7}	------
Any single radionuclide with $T_{1/2}$ > 2 hr which does not decay by alpha or spontaneous fission				3×10^{-9}	9×10^{-5}	1×10^{-10}	3×10^{-6}

Neutron Energy (MEV)	Neutrons per cm^2 equivalent to 1 rem	Average flux to deliver 100 mrem in 40 hours
thermal	970×10^{6}	670
0.02	400×10^{6}	280 (neutrons)
0.5	43×10^{6}	30 ----------
10	24×10^{6}	17 cm^2 x sec

Linear Absorption Coefficients μ (cm^{-1})				
Energy (MEV)	Water	Concrete	Iron	Lead
0.5	0.090	0.21	0.63	1.7
1.0	0.067	0.15	0.44	0.77
1.5	0.057	0.13	0.40	0.57
2.0	0.048	0.11	0.33	0.51
2.5	0.042	0.097	0.31	0.49
3.0	0.038	0.088	0.30	0.47

DUANE ARNOLD
SRO/RO EXAMS
CROSS REFERENCE

12/9/88

RO.	SRO
1.01	4.05
1.05	4.06
1.07	4.13
1.08	4.07
1.11	4.08
1.14	4.18
1.15	4.15
1.16	4.14
1.19	4.17
2.01	5.02
2.02	5.03
2.03	5.04
2.04	5.05
2.05	5.06
2.06	5.07
2.07	5.09
2.08	5.10
2.10	5.12
2.11	5.13
3.20	6.08
3.21	6.24
3.22	6.26

DAEC SRO EXAM ANSWER KEY

ANSWER 4.01 (1.00)

a. During reactor startup, the moderator temperature coefficient is dominant. (0.5)
b. At power, the void coefficient is dominant. (0.5)
[Doppler is additional acceptable answer in both cases, but only give half credit if it is the only answer given in ~~either case~~ b.]

REFERENCE

DAEC Reactor Theory, RT-22
GR I RT
292004K114 ..(KA's)

ANSWER 4.02 (1.50)

a. The amount of time required for reactor power to increase by a factor of e. (1.0)
b. Shorter. (0.5)

REFERENCE

DAEC Reactor Theory, RT-14
GR II RT
292003K105 292003K106 ..(KA's)

ANSWER 4.03 (1.00)

Period would approach infinity at the point of adding heat (0.5). Moderator temperature coefficient would cause power to turn as the moderator temperature increases (0.5).

REFERENCE

DAEC Reactor Theory
GR I RT
292008K108 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.04 (1.50)

a. 7
b. 4
c. 6
(0.5 pts each)

REFERENCE

DAEC Reactor Theory
GR II RT
292002K108 292002K109 292002K110 ..(KA's)

ANSWER 4.05 (1.00) RO 1.01

a. Neutrons emitted less than 10E-14 s following fission.
b. Neutrons produced by Beta decay of fission fragments.

REFERENCE

DAEC Reactor theory
GR II RT
292001K102 ..(KA's)

ANSWER 4.06 (1.50) RO 1.05

1. Xe 135 has a large absorption cross section for thermal neutrons (2.7 x 10E6 barns)
2. It is one of the most abundant fission products (occurs at one of the peaks of the fission product yield curve)
3. Can only be removed by decay or burnup
(0.5 pts each)
[Will accept other descriptions of Xe production, decay, and burnout.]

REFERENCE

DAEC Reactor Theory
GR II RT
292006K102 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.07 (1.00) RO 1.08

To prevent waterhammer (0.5) that could damage system piping or piping hangers (0.25) and increase injection time (0.25).
Air (gas) binding (0.5) [Total point value of question cannot exceed 1.0.]

REFERENCE

DAEC OI 151, SD C-1, and Thermodynamics Sec. 4
GR III TH
293006K105 ..(KA's)

ANSWER 4.08 (2.00) RO 1.11

a. NPSH is defined as the difference between total pressure at the eye of a pump (or inlet of a valve) and saturation pressure.
or
NPSH= Pi - Psat [or Psuction - Psat]

b. Cavitation would result in vibration (and noise) of the pump and pitting and corrosion of the pump parts, (especially the impeller). [Exact wording not necessary for full credit.]

REFERENCE

DAEC Fluid Flow, p 4-4
GR III TH and GR I COMP
293006K110 291004K106 ..(KA's)

ANSWER 4.09 (1.00)

b. (1.0)

REFERENCE

DAEC Thermodynamics, Sec. 16
GR I TH
293007K113 ..(KA's)

ANSWER 4.10 (1.00)

b. (1.0)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC Heat Transfer, Sec. 11
GR I TH
293009K110 ..(KA's)

ANSWER 4.11 (1.00)

b. (1.0)

REFERENCE

DAEC Heat Transfer, Sec. 8
GR I TH
293009K117 ..(KA's)

ANSWER 4.12 (1.00)

c. (1.0)

REFERENCE

DAEC Thermodynamics, Sec. 11
GR II TH
293004K112 ..(KA's)

ANSWER 4.13 (1.00) RO 1.07

d. (0.5)
350 psig + 14.7 = 364.7 psia
Extrapolating from the steam tables
364.7 psia = 435 degrees F (0.5)

REFERENCE

DAEC Thermodynamics, Sec. 10
GR II TH
293003K123 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.14 (2.00) RO 1.16

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

REFERENCE

DAEC SD A-6, p 7-8
GR I COMP
291001K101 291001K102 ..(KA's)

ANSWER 4.15 (1.50) RO 1.15

a. Two
b. One
c. Damage to motor windings (due to overheating)
(0.5 pts each)

REFERENCE

DAEC OI 264, p 7
GR I COMP
291005K106 202001G005 ..(KA's)

ANSWER 4.16 (2.00)

1. e
2. d
3. a
4. b
(0.5 pts each)

REFERENCE

DAEC SD G-1, p 17-20
GR I COMP
291008K102 291008K108 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.17 (2.00) RO 1.19

1. a
2. b
3. a
4. a
(0.5 pts each)

REFERENCE

DAEC SD A-5, p 11-12
GR I COMP
291002K109 ..(KA's)

ANSWER 4.18 (2.00) RO 1.14

a. Limiter #2
b. Limiter #1
c. Limiter #1
d. Limiter #2
(0.5 pts each)

REFERENCE

DAEC SD A-2
GR I COMP
291003K102 ..(KA's)

(***** END OF CATEGORY 4 *****)

ANSWER 5.01 (2.00)

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

REFERENCE

DAEC EOP 6
GR I EAP
295016G010 ..(KA's)

ANSWER 5.02 (2.00) RO 2.01

1. Determine cause of reactor water level decrease
2. Stop power change
3. Check the feed reg valves for proper operation
4. Check feed flow (check for feed pump trip)
5. If feed pump tripped, verify or perform recirc runback
6. Attempt to restore water level
7. Check steam/feed flow mismatch
(Any 4 @ 0.5 pts each)
[Will accept other reasonable responses related to feed system components, check for LOCA, etc.]

REFERENCE

DAEC ARP 1C05A, C-1
GR I EAP
295031G010 ..(KA's)

ANSWER 5.03 (2.00) RO 2.02

1. Reactor feedwater pump (1P-1B)
2. Reactor recirc MG set (1G-201B)
3. Circ water pump (1P-4B)
4. Condensate pump (1P-8B)
5. GSW pump (1P-58C)
6. Well pump (1P-89D)
(Any 4 @ 0.5 pts each)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC AOP 304.1, p 4
GR I EAP
295003K102 ..(KA's)

ANSWER 5.04 (2.00) RO 2.03

1. Rod withdrawal block
2. RPS A half scram
3. SBGTS train A starts
4. Reactor building ventilation system shuts down (inboard isolation)
5. PCIS Div I Group III isolation
(Any 4 @ 0.5 pts each)

REFERENCE

DAEC AOP 375, p 4
GR II EAP
295004A202 ..(KA's)

ANSWER 5.05 (1.50) RO 2.04

a. On loss of air, the Scram air header pressure may decrease to the point where scram inlet and outlet valves open (0.5) causing individual rods to start drifting or scramming (0.5). [Exact wording not required for full credit.]
b. Manually scram (0.5)

REFERENCE

DAEC AOP 518
GR II EAP
295019K201 ..(KA's)

ANSWER 5.06 (2.50) RO 2.05

a. Scram the reactor (0.5)
b. 50 psig [+/-5] (0.5)
c. High steam tunnel temperature (0.5)
d. Stator cooling water (0.25) temperature (>86 C) (0.25)
e. Scram the reactor (0.25) and trip both MG sets (0.25)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC AOP 411, p 4-9
GR II EAP
295018K101 ..(KA's)

ANSWER 5.07 (2.50) RO 2.06

a. 1. APRM power increasing
2. Reactor power higher than expected for core flow and rod line
3. Rod withdrawal block (rod block alarm)
4. APRM upscale alarm (or trip)
5. LPRM upscale alarm
6. RBM indication decreasing
(Any 3 @ 0.5 pts each)

b. Recirc flow must be runback (0.5) until reactor power is 20% less than initial power (<75%) (0.5) (CRAM group rods if necessary).

REFERENCE

DAEC AOP 646, p 2-5
GR I EAP
295014K207 ..(KA's)

ANSWER 5.08 (2.50)

1. Stop control rod motion
2. Consult Reactor Engineer
3. Request Chemistry perform a sample
4. Refer to Tech Spec (3.6.B) for I-131 dose equivalent
5. Reduce power to minimize release
6. Notify HP
7. Verify RWCU demineralizers are in service
8. If increase does not stop, shut down
9. If rate increase makes auto isolation and scram unavoidable, manual scram
(Answer 1 must be stated or deduct 0.5, any other 4 @ 0.5 pts each)

REFERENCE

DAEC AOP 672.2
GR I EAP
295017G003 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.09 (3.00) RO 2.07

1. Verify all rods fully inserted
2. Verify neutron flux (power) decreasing
3. Announce scram on page
4. Initiate backup manual scram
5. Place Mode switch in shutdown
6. Verify recirc pumps runback to 20% (or manually runback)
7. Dial feedwater level controller to 175 inches
8. Insert all SRM and IRM detectors
9. Maintain pressure < 1110 psig
10. Monitor condenser pressure (vacuum)
11. Check turbine status
12. After turbine trip, verify generator lockout
(0.25 pts each)

REFERENCE

DAEC IPOI 5, p 6-9
GR I EAP
295006G010 ..(KA's)

ANSWER 5.10 (1.50) RO 2.08

1. Verify that drywell fans are in fast.
2. Verify fan dampers are open.
3. Check (CV-4464 on 1C-23) status of the main plant intake coils.
(0.5 pts each, will also accept the following @ 0.25 each up to total value of question.)
4. Reduce reactor power
5. If CV-4464 is open with well water going to main plant coils, close CV-4464.
6. Verify proper operation of well water system.
7. Verify proper operation of Nitrogen Makeup system.
8. Vent the Drywell

REFERENCE

DAEC ARP 1C05B, C-5
GR I EAP
295024K218 295023G010 295027G010 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.11 (2.00)

a. Prevent automatic depressurization by placing ADS [DRYWL/RPV LOGIC] reset handswitches in override (0.5). [If candidate states inhibit vs override, only allow half credit.]
b. Following failure to scram [if Boron is not injected] with isolation, energy produced in the reactor will be discharged to the torus via SRVs (0.5). Torus water temperature will increase (0.5) approaching the Heat Capacity Temperature Limit (HCTL) (0.5).
[Exact wording not necessary for full credit, but all elements must be included.]

REFERENCE

DAEC EOP-1, RC/Q, NEDC 30796, p 8-185
GR I EAP
295013G007 295015G007 ..(KA's)

ANSWER 5.12 (2.50) RO 2.10

a. 1. Offgas
2. SJAEs
3. Cooling tower fans
4. Feed pump stuffing box seal leakoff tank
~~(Any 3 @ 0.5 pts each) The following additional answers will be accepted @ 0.25 pts each up to the value of part a.)~~
5. Circ water
6. Steam seals
7. Steam packing exhaust

Slet

b. Group 1 isolation (0.5) Enter EOP-1 (0.5)

REFERENCE

DAEC ARP 1C07B, B-1, IPDI 2, OI 691
GR II EAP
295002G007 295002G010 295002G011 ..(KA's)

ANSWER 5.13 (2.00) RO 2.11

a. Baseline values have not been established during SLO since last refueling. [0.5]
b. When baseline values have been established. [0.5]
c. 100% [0.5]
d. MAPLHGR [0.25] and MCPR [0.25]

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC AOP 304.1, Technical Specification 3.6.F, 3.12.A, and Bases
GR II EAP
295001G003 ..(KA's)

ANSWER 5.14 (2.50)

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

REFERENCE

DAEC FRCHP #5, p 11-13
GR I EAP
295023K101 295023K301 295023G010 ..(KA's)

ANSWER 5.15 (2.75)

a. 1. Two or more turbine building ARMs alarm.
2. Loss of 25 MWe from the generator.
3. Substantial danger to personnel in the turbine building.
(Any 2 @ 0.25 pts each)
b. EOP-1 (RPV Control) (0.25)
c. 1. Runback recirc pumps to minimum.
2. Manually scram the reactor.
3. Close all MSIVs and drains.
4. Take immediate scram actions.
(0.5 pts each)

REFERENCE

DAEC IPOI Sec. C.1
GR II EAP
295032A203 295032G011 295033A203 295033G011 ..(KA's)

(***** END OF CATEGORY 5 *****)

ANSWER 6.01 (2.00)

a. Main condenser (0.5) Waste collection tank (RADWASTE) (0.5)
b. Swell due to heatup (0.5) Control rod drive cooling water (0.5)

REFERENCE

DAEC SD B-4, p 38
GR II SYS
204000K109 ..(KA's)

ANSWER 6.02 (1.50)

a. False. (0.5)
b. The storage tank contains (two) heaters. (0.5) (Heater A is normally in auto controlling temperature between 75 and 85 F). The pumps and piping are heat traced. (0.5)

REFERENCE

DAEC SD C-4, p 1
GR I SYS
211000G004 211000K403 ..(KA's)

ANSWER 6.03 (2.00)

a. The dampers fail to positions that provide open flow paths (0.5) through the filter trains (0.5).
b. The purpose of the charcoal is to adsorb radioactive iodine (0.5). The iodine adsorption efficiency of the charcoal filter bed will be reduced because of the adsorption of water in the charcoal if the heater is lost. (0.5).

REFERENCE

DAEC SD E-11, p 1-3
GR I SYS
261000K405 261000K606 261000G007 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.04 (2.50)

a. No suction path sensed (Both torus suctions MO-1989 and 2069 closed)
Overcurrent
Ground fault
(0.5 pts each)

b. Removes the auto start signal (0.5) and allows the breaker anti-pump relay to deenergize (0.5)

REFERENCE

DAEC SD C-1, p 27
GR I SYS
203000G007 ..(KA's)

ANSWER 6.05 (1.00)

1. Line could freeze and stop the flow of N2. (Can't inert containment to Tech Spec requirement)
2. Piping could get so cold it could brittle fracture.
3. Containment may get cold enough to cause cracking. (Loss of Primary Containment)
4. Liquid nitrogen could enter containment and damage equipment.
(Any 1 @ 1.0 pts each)

REFERENCE

DAEC SD E-12, OI 573, IE Bulletin 84-01
GR I SYS
223001K608 ..(KA's)

ANSWER 6.06 (1.50)

Yes. (0.5) Operation of mechanical vacuum pump above 10% is not allowed. Any radioactivity collected in the main condenser is being released directly to the environment (0.5) and sufficient hydrogen may be collected in the condenser to cause an explosion when heated by the vacuum pump. (0.5)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC IPOI 2, p 7
GR 1I SYS
271000K404 ..(KA's)

ANSWER 6.07 (1.75)

a. MSIV outboard valves receive half isolation (0.25) the remainder of the Group I outboard valves close (0.25).
b. Group II outboard valves close (except for TIP and reactor vent valves) (0.25).
c. One SBGT starts (0.25) Lose R/B ventilation (supply and exhaust fans trip and valves close) (0.25)
d. Half scram (no rod motion) (0.5)

REFERENCE

DAEC SD E-13, p 22-28, Fig. 1
GR I SYS
223002K608 ..(KA's)

ANSWER 6.08 (1.00) RO 3.20

c (1.0)

REFERENCE

DAEC SD B-4, p 7
GR II SYS
204000K601 ..(KA's)

ANSWER 6.09 (1.50)

a. The procedure cautions against operation below 2000 RPM (0.5).
b. To prevent turbine exhaust check valve chatter (0.5), and to ensure adequate oil pressure (0.5).

REFERENCE

DAEC OI 152, p 7
GR I SYS
206000K501 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.10 (2.00)

a. HPCI
b. 2200
c. 5
d. 5
(0.5 pts each)

REFERENCE

DAEC SD A-7, p 1
GR I SYS
218000G004 ..(KA's)

ANSWER 6.11 (1.50)

a. RHR crosstie (MO-2010) allows starting and stopping shutdown cooling without entering the Torus. (1.0) (Also accept discussion of RHR to Radwaste drain.)
b. 135 psig [or 80-90 psi steam dome pressure] (0.5)

REFERENCE

DAEC OI 149, p 31
GR II SYS
205000K101 ..(KA's)

ANSWER 6.12 (1.50)

TIP cannot be retracted (0.5) and/or ball valve cannot be closed (0.5) and guide tube is defective and leaking (0.5). [Also accept wording in OI 878.6, i.e., only in an emergency when containment integrity is required (0.5) and equipment malfunction prevents withdrawing detector (0.5) so that ball valves can seal off the guide tube (0.5).]

REFERENCE

DAEC SD I-6, p 5, OI 878.6
GR III SYS
215001K401 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.13 (2.50)

a. The EOC RPT trip is actuated if >30% power (0.5) on turbine trip (0.5) or load reject (0.5).
b. This is to reduce the severity of turbine trip or load reject and will ensure thermal hydraulic limits (MCPR) are not exceeded (1.0).

REFERENCE

DAEC SD A-2, p 35
GR II SYS
202001K413 ..(KA's)

ANSWER 6.14 (1.00)

d. (1.0)

REFERENCE

DAEC SD A-2, Fig. 3
GR II SYS
202001A109 ..(KA's)

ANSWER 6.15 (1.50)

Low Pressure (of 970 psig) (0.25)
High Water Level in the instrument block (of 37 cc) (0.25)

At the accumulator alarm panel, the back lit button must be pressed. If the light goes out, the cause is water; if the light stays lit, the cause is gas pressure. (1.0)

REFERENCE

DAEC SD A-1, p 31
GR II SYS
201001G007 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.16 (1.50)

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

REFERENCE

DAEC SD A-7, p 8-10
GR I SYS
218000K606 ..(KA's)

ANSWER 6.17 (2.00)

a. To enhance the capability of the LPCI loop selection logic (0.5) to detect recirc loop breaks (0.5).
b. >80% power (0.25) fast pump shall not exceed 122% speed of slower pump (0.25)
<80% power (0.25) fast pump shall not exceed 135% speed of slower pump (0.25)

REFERENCE

DAEC OI 264, p 9-10, Tech Spec 3.6.F.1
GR I SYS
202002G005 ..(KA's)

ANSWER 6.18 (1.00)

c. (1.0)

REFERENCE

DAEC Technical Specification 1.0, 1.1.c, SD A-6, p 24
GR III SYS
239001K127 239001G005 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.19 (2.00)

PCIS is oriented toward prevention or limitation of the release of abnormally high radiation to the environment outside the primary containment. (1.0)
NSSSS is oriented toward maintaining the inventory of water within the reactor system, if possible, and in any event within the primary containment. (1.0)
[Exact wording not required for full credit, but all elements must be included.]

REFERENCE

DAEC IP01 Sec. A
GR I SYS
223002K301 223002K303 ..(KA's)

ANSWER 6.20 (2.00)

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

REFERENCE

DAEC ACP 1410.5, Tagout 4.1, 5.1.7, Hold-off 5.9.1, 6.3.3
GR I GEN
294001K102 ..(KA's)

ANSWER 6.21 (2.00)

1. SS and Operators are notified of entry and exit time and appropriate log entries are made.
2. The reactor is subcritical (<5% power).
3. The reactor system (RPV) pressure is less than 400 psi.
4. No evolutions are performed by operators that would significantly increase system pressure.
(0.5 pts each)
[Exact wording not required for full credit, but all elements should be present.]

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

REFERENCE

ie: Safety Rule Book, Sec 4-1-3, IPOI-7
GR I GEN
294001K114 ..(KA's)

ANSWER 6.22 (1.50)

1. No work was performed on systems in the indicated area.
2. The valves are in a HI Rad or Locked HI Rad area and system lineup can be verified by flow, pressure, etc.
3. No personnel have entered the area.
(0.5 pts each)
[Exact wording not required for full credit.]

REFERENCE

DAEC IPOI 7, p 21
GR I GEN
294001K101 ..(KA's)

ANSWER 6.23 (1.50)

a. 'B' Operations Shift Supervisor
b. 5
c. ~~No.~~ Yes
(0.5 pts each)

REFERENCE

DAEC Technical Specification, Sec 6.2 and ACP 1410.1, p 2
GR 1 GEN
294001K116 ..(KA's)

ANSWER 6.24 (2.50) RO 3.21

a. 1. > 2.5 mrem in any one hour or 100 mrem in 5 consecutive days
2. > 100 mrem in any one hour (but < 1000 mrem)
3. > 1000 mrem/hr
(0.5 pts each)
b. Hands and forearms (0.5) feet and ankles (0.5)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC HP SH-4, p 10, 10CFR20
GR I GEN
294001K103 ..(KA's)

ANSWER 6.25 (2.00)

1. Every individual is responsible and has the authority to make recommendations and to improve the ALARA Emphasis Program at DAEC. (1.0)
2. The Operations Shift Supervisor coordinates with the HP Group in conducting routine operations and responding to abnormal conditions assuring that ALARA concepts are appropriately included. (1.0) [Exact wording not necessary for full credit, but all elements should be included.]

REFERENCE

DAEC ACP 1411.1, p 2-3
GR I GEN
294001K104 ..(KA's)

ANSWER 6.26 (2.50) RO 3.22

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

REFERENCE

DAEC OI 695.2, p 5, ie: Safety Rule Book Sec 4-1-4, 4-2-4, 4-1-1
GR I GEN
294001K115 294001K111 294001K109 ..(KA's)

(***** END OF CATEGORY 6 *****)
(********** END OF EXAMINATION **********)

QUESTION	VALUE	REFERENCE
4.01	1.00	9000195
4.02	1.50	9000196
4.03	1.00	9000197
4.04	1.50	9000199
4.05	1.00	9000206
4.06	1.50	9000207
4.07	1.00	9000198
4.08	2.00	9000200
4.09	1.00	9000208
4.10	1.00	9000209
4.11	1.00	9000210
4.12	1.00	9000211
4.13	1.00	9000212
4.14	2.00	9000201
4.15	1.50	9000202
4.16	2.00	9000203
4.17	2.00	9000204
4.18	2.00	9000205
	25.00	
5.01	2.00	9000213
5.02	2.00	9000214
5.03	2.00	9000215
5.04	2.00	9000216
5.05	1.50	9000217
5.06	2.50	9000218
5.07	2.50	9000219
5.08	2.50	9000220
5.09	3.00	9000221
5.10	1.50	9000222
5.11	2.00	9000223
5.12	2.50	9000224
5.13	2.00	9000225
5.14	2.50	9000226
5.15	2.75	9000227
	33.25	
6.01	2.00	9000228
6.02	1.50	9000229
6.03	2.00	9000230
6.04	2.50	9000231
6.05	1.00	9000232
6.06	1.50	9000233
6.07	1.75	9000234
6.08	1.00	9000235
6.09	1.50	9000236
6.10	2.00	9000237
6.11	1.50	9000239
6.12	1.50	9000240
6.13	2.50	9000244
6.14	1.00	9000245
6.15	1.50	9000246
6.16	1.50	9000247

QUESTION	VALUE	REFERENCE
6.17	2.00	9000248
6.18	1.00	9000252
6.19	2.00	9000253
6.20	2.00	9000235
6.21	2.00	9000241
6.22	1.50	9000242
6.23	1.50	9000243
6.24	2.50	9000249
6.25	2.00	9000250
6.26	2.50	9000251
	45.25	
	103.5	

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION
REGION 3

FACILITY: Duane Arnold

NAME: _____ REACTOR TYPE: BWR-GE4

DATE ADMINSTERED: 88/12/13

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
26.50	26.43	_____	_____	1.	REACTOR PRINCIPLES (7%) THERMODYNAMICS (7%) AND COMPONENTS (11%) (FUNDAMENTALS EXAM)
27.50	27.43	_____	_____	2.	EMERGENCY AND ABNORMAL PLANT EVOLUTIONS (27%)
46.25	46.13	_____	_____	3.	PLANT SYSTEMS (38%) AND PLANT-WIDE GENERIC RESPONSIBILITIES (10%)
100.2		_____ FINAL GRADE	_____%		TOTALS

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

_____
Candidate's Signature

START: _____ STOP: _____

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NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination, the following rules apply:

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

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

3. Use [illegible] ink or dark pencil only to facilitate legible reproductions.

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

5. Fill in the [illegible] examination.

6. Use only the paper provided for answers.

7. Print your name in the upper right-hand corner of each page of the exam.

8. The exam has one question per page. Write the answer beneath the question (start just below *****CATEGORY ...). Write only on one side of the exam and any extra answer sheets.

9. Number each answer continued on additional paper as to category and number, for example, 1.4, 6.3.

10. Attach continued answers to back of question to which it applies.

11. Place finished answer sheets face down on your desk or table.

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

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

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

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

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

MASTER COPY

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

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions with answers on top.

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

(3) Scratch paper used during the examination.

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

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

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

QUESTION 1.01 (1.00)

DEFINE the following terms:

a. Prompt neutrons.

b. Delayed neutrons.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.02 (1.50)

Of the moderator, doppler, or void coefficient, STATE which one is described for EACH of the following characteristics:

a. More negative when control rod density is greatest.

b. Can be positive at low moderator temperatures near EOC.

c. More negative at EOL.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.03 (1.50)

The differential worth of a single control rod will _____,
(For each statement below state INCREASE or DECREASE.)

_____ a. if the void content around the rod INCREASES.

_____ b. if the moderator temperature INCREASES.

_____ c. if an adjacent control rod is WITHDRAWN during startup.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.04 (1.50)

a. EXPLAIN HOW and WHY Core Delayed Neutron Fraction (Beta-Core) changes over core life. (1.0)

b. HOW does this affect the reactor response to positive reactivity changes? (Less Rapid or More Rapid) (0.5)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.05 (1.50)

DESCRIBE THREE characteristics of Xenon 135 that cause substantial reactivity effects in the core following a change in power.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.06 (1.00)

Of the following characteristics for moderation, which one is NOT preferred?

a. Small atomic mass

b. Low moderating ratio

c. High scattering cross-section

d. Low absorption cross-section

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.07 (1.00)

You are asked to verify that a pressure gauge in a saturated system is reading correctly. The pressure gauge reads 350 psig; therefore, a temperature instrument in the same area should read:
(SHOW YOUR WORK.)

a. 420 degrees F

b. 425 degrees F

c. 430 degrees F

d. 435 degrees F

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.08 (1.00)

OI 151, Core Spray System, states that following maintenance you should insure the system is filled and vented prior to starting the pump. STATE the purpose of this precaution and TWO possible CONSEQUENCES if it is NOT done.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.09 (1.00)

a. The mechanism by which heat is transfered across the cladding is (CONDUCTION, CONVECTION, or RADIATION.)

b. As the core ages, a layer of "Crud" will build up. HOW does this affect the temperature drop across the clad (INCREASE, DECREASE, or REMAIN THE SAME)?

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.10 (1.00)

WHICH ONE of the following thermal limits protects the fuel from reaching a value of 1% plastic strain of Zircaloy cladding? (1.0)

a. Maximum thermal power

b. Average planer linear heat generation rate (APLHGR)

c. Linear heat generation rate (LHGR)

d. Total Peaking Factor

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.11 (2.00)

a. DEFINE NPSH (Net Positive Suction Head).

b. EXPLAIN what occurs in a recirculation pump with insufficient NPSH.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.12 (1.00)

The Feedwater system stop-check valves MO-4442 and MO-4441 are installed for which one of the following reasons?

a. Prevent backflow into low pressure feedwater heaters.

b. Interlock with vent valves to allow air in piping to be vented.

c. To keep injection lines filled with water.

d. Prevent pressurization of condensate system.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.13 (2.00)

TRUE or FALSE, EXPLAIN your response.

a. As absolute pressure in the condenser decreases, more energy can be extracted from the steam.

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

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.14 (2.00)

Each Reactor Recirc Pump control circuit has TWO speed limiters. IDENTIFY WHICH limiter [LIMITER #1 (20%) -or- LIMITER #2 (45%)] will be in control following each of these events. (Assume both pumps running and all other systems are normal.)

a. Reactor is at 75% power a reactor feedpump trips and a reactor low level alarm is received.

b. Reactor is at 75% power and recirc pump A discharge valve starts drifting closed.

c. Reactor startup is in progress, one RFP is running, and reactor water level is 200 inches.

d. Reactor is at 55% power recovering from a recirc runback, reactor water level is normal, both reactor feedwater pumps are running, runback has not been reset.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.15 (1.50)

The number of successive start attempts on a Recirc Pump is limited to _____(a)_____ time(s) at ambient temperature. With the windings above ambient temperature, the motor can be started and brought to speed _____(b)_____ time(s) with additional attempts to be separated by 45 min in order to prevent _____(c)_____.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.16 (2.00)

According to the System Description, the Safety/Relief Valves provide four protection functions, MATCH the PROTECTION FUNCTION to the VALVE OP DESCRIPTION: [Note: Consider SRV 4401 as having all these functions.]

PROTECTION FUNCTION	VALVE OP DESCRIPTION
1. Overpressure RELIEF protection.	a. The valves self-actuate to augment the spring safety valves.
2. Depressurization operation.	b. Two valves control pressure in a desired band if armed by any SRV opening and a high pressure scram signal.
3. LLS operation.	c. The required valves are opened automatically or manually by indirectly operated devices as part of protection system for small line breaks.
4. Overpressure SAFETY operation.	d. The valves open to limit the pressure rise.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.17 (1.00)

A correct statement concerning a Venturi flow device is that it:

a. Develops an output signal by measuring the differential pressure of the fluid as it passes through the device.

b. Can measure the rate of flow of incompressible fluids, but not of compressible fluids.

c. Develops an output signal by measuring the velocity of the fluid as it passes through the device.

d. Has head losses greater than the head losses produced by an orifice.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.18 (1.00)

Positive displacement pumps normally have relief valves located inside of the discharge valves. STATE the reason for this design consideration.

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.19 (2.00)

The Yarway level indicating transmitters are temperature compensated; however, there are events that can cause erroneous level indication. MATCH the expected ERROR you would observe to the EVENT that has occurred.

EVENT	ERROR
1. Drywell temperature has increase 100 degrees F	a. Indicated level greater than actual
2. Large leak in variable leg	b. Indicated level less than actual
3. Large leak in reference leg	c. No error
4. Rapid pressure decrease	

[The ERRORs may be used more than once or not at all.]

(***** END OF CATEGORY 1 *****)

2. EMERGENCY AND ABNORMAL PLANT EVOLUTIONS
(27%)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.01 (2.00)

You are increasing reactor power from 70 to 100%, a 'Reactor Vessel HI/LO Level Recorder Alarm' on 1C05A, C-1, annunciates and level is decreasing. STATE FOUR actions that you should take to preclude a scram.

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.02 (2.00)

The reactor is operating at full power when the feeder breaker from the Aux Transformer to the 4160V Bus 1A2 trips.
IDENTIFY FOUR loads that will be lost because of load shedding.

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.03 (2.00)

During a reactor startup with the Mode switch in STARTUP, +24 vdc is lost to 1D50. STATE FOUR automatic actions that will occur according to AOP 375, "Loss of +/-24VDC Power."

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.04 (1.50)

If Instrument and Service Air is lost during reactor operation, you can expect to receive several alarms.

a. EXPLAIN WHY you may receive a ROD DRIFT alarm on 1C05B, C-7. [1.0]

b. STATE the action you must take if this alarm is received. [0.5]

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.05 (2.50)

ADDRESS each of the following ITEMS according to AOP 411, "GSW Abnormal Operation." Assume the reactor is at full power and consider each item independently.

a. STATE the immediate action that must be taken if GSW is lost and CANNOT be restored.

b. STATE the setpoint at which the Standby GSW pump should start.

c. STATE the parameter that could cause the MSIVs to close on loss of GSW.

d. STATE the system and parameter that willI initiate a Turbine runback on loss of GSW.

e. STATE the actions that must be taken if BOTH recirc MG lube oil temperatures reach 210 degrees F.

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.06 (2.50)

The reactor is operating at 95% power when feedwater heater strings 3A, 4A, and 5A isolate. According to AOP 646 "Loss of Feedwater Heating":

a. IDENTIFY THREE reponses, alarms, or parameter changes that you can expect to see at 1C05. (1.5)

b. DESCRIBE the initial action that must be taken. (1.0)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.07 (3.00)

STATE the TWELVE immediate actions required by IPOI-5 upon a Reactor Scram. [Be brief, explanations are not necessary.]

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.08 (1.50)

The reactor is operating near full power. You have just received a 'Primary Containment Hi/Lo Pressure,' alarm on 1C05B, C-5. A quick check of other indications shows that pressure is 1.5 psig and gradually increasing and drywell cooling appears to be inadequate.
IDENTIFY THREE actions that must be performed according to the ARP.

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.09 (1.50)

EOP-6 "Shutdown Outside Control Room," section C - verify reactor scram, describes two methods to scram the reactor outside the control room. STATE the two alternate methods. (Locations not necessary.)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.10 (2.50)

An alarm on 1C07B, B-1, 'LP Turbine 1G-1B Hi Back Pressure,' has just annunciated.

a. IDENTIFY THREE systems/components that should be checked for normal operation according to the ARP. (1.5)

b. According to the ARP, STATE the automatic action that occurs and the Emergency procedure you must enter if main condenser pressure increases to 19 inches Hg absolute. (1.0)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.11 (2.00)

ADP 304.1, "Loss of 4160V Non-essential Electrical Power," contains a Caution that applies FOUR constraints on Single Loop Operation (SLO).

a. Constraint a. specifies that STP 46F002 be performed immediately and STP 46F001 must performed if _____.
(Complete the phrase.)

b. Constraint b. limits operation to <45% flow and 80% load line. STATE WHEN these limits are no longer applicable during SLO.

c. STATE the maximum operating recirc pump speed allowed by constraint c (assume all conditions have been met for maximum SLO power operation).

d. Constraint d. states that reactor operation is permitted if Tech Spec requirements are met. STATE which thermal limit(s) is (are) of particular concern during SLO.

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.12 (2.00)

The reactor is operating at 83% power. You receive a 'Main Gen 1G1 H2 & Stator Sys Trouble' alarm on 1C08C, D-4. The Auxiliary Operator reports that stator cooling flow is ZERO. STATE the action you must take if the Aux. Operator also reports that:

a. Conductivity is >10 micromhos. (1.0)

b. Conductivity is 1 micromho. (0.5)

c. Conductivity is 0.3 micromho. (0.5)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.13 (2.50)

For each of the following CONDITIONS (a through d), STATE which of the corresponding PROCEDURES (1 through 4) would need to be entered.
(More than one procedure may apply for each condition.
If none of the procedures are required to be entered then state "NONE.")

CONDITIONS

a. Drywell pressure increasing to 2.5 psig

b. Offgas Stack Rad above Hi-Hi

c. Torus water level 65% and increasing

d. Reactor building vent shaft exhaust 9 mR/hr

PROCEDURES

1. EOP 1 - RPV Control

2. EOP 2 - Primary Containment Control

3. EOP 3 - Secondary Containment Control

4. EOP 4 - Radioactivity Control

(***** END OF CATEGORY 2 *****)

3. PLANT SYSTEMS (38%) AND PLANT-WIDE GENERIC RESPONSIBILITIES (10%)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.01 (2.00)

During the design base LOCA (i.e., double-ended guillotine break), a Torus-Drywell Vacuum Breaker fails OPEN. DESCRIBE the effect this will have on containment parameters AND WHY.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.02 (1.75)

Standby Gas Treatment System is operating when A(B) SBGT CARBON BED HI TEMP DELUGE PERMISSIVE annunciator is received.

a. At WHAT carbon adsorber temperature will this be received? (0.5)

b. Initiation of the deluge system stops the affected SBGT train. STATE FIVE system responses to this initiation. (1.25)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.03 (2.00)

Answer the following questions with regard to the Standby Diesel Generator System.

a. A start signal should not be initiated within one minute of resetting an engine trip, generator trip, or initiating a manual shutdown. WHAT would occur if it was initiated TOO SOON? (0.5)

b. If a diesel starts automatically on a LOCA, all automatic shutdowns become inoperative except WHICH TWO? (1.0)

c. A time delay relay prohibits restarting of an electrical lube oil pump for 10 minutes after the generator has been shut down. STATE the reason for this time delay. (0.5)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.04 (1.00)

Choose the signal which will NOT isolate Reactor Water Cleanup Valve MO-2700, RWCU Supply Inboard Isolation. (1.0)

a. RWCU High Differential Flow at 40 gpm with 15 second time delay.

b. Activation of the Standby Liquid Control System.

c. RWCU Area Ambient Temperature at 130 degrees F.

d. RWCU Area Differential High Temperature at 14 degrees F dT above 100% power operation ambient temperature.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.05 (2.00)

a. STATE the normal power supply for the ADS logic circuits.

b. DESCRIBE the response of ADS upon a loss of normal power supply if a valid ADS initiation signal is received.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.06 (1.50)

STATE THREE conditions that must exist to use the Residual Heat Removal System to supplement the Fuel Pool Cooling and Cleanup System.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.07 (2.00)

Equalizing valves were installed in the control rod drive system to replace the original orificed check valve in the exhaust header. STATE TWO reasons for installing these valves.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.08 (1.50)

Manual operation of MSIV-LCS is inhibited from operation until TWO interlocks are satisfied.
STATE those interlocks including SETPOINTS.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.09 (3.00)

An automatic RCIC initiation has occurred. Subsequently, RCIC injection was automatically terminated due to high reactor water level.

a. WHICH component in the RCIC system functioned as a result of the system logic to automatically terminate the injection? (0.5)

b. Assuming no operator action, HOW will RCIC respond to a subsequent continuously decreasing water level? (1.0)

c. If a RCIC "Turbine Test" had been in progress when the initial automatic initiation signal had been received, HOW would the system have responded? (1.0)

d. If, following the initiation, the RCIC turbine had tripped on overspeed (125% of rated), could RCIC injection be restarted from the Control Room? EXLAIN. (0.5)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.10 (1.00)

OI-149, "Residual Heat Removal System," cautions not to override an ECCS System initiation unless, by at least two independent indications, ONE of TWO items are verified. STATE these TWO items.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.11 (2.50)

Annunciator "A" ("B") RECIRC MG SCOOP TUBE LOCK alarms in the control room, indicating the scoop tube locking feature is initiated for the associated M-G set.

a. LIST TWO conditions that would cause the scoop tube to lock in position. (1.0)

b. In order to reset the alarm and return to automatic scoop tube position control, STATE THREE operator actions that must be performed if the recirc pump has not tripped. (1.5)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.12 (2.00)

ANSWER each of the following Source Range Monitors (SRMs) statements TRUE or FALSE:

a. An interlock prevents detector withdrawal unless the SRM count rate is above 100 cps.

b. All SRM Rod Blocks are automatically bypassed when all Intermediate Range Monitor (IRM) Switches are on Range 3 or above.

c. The reactor period indication is still valid with the SRMs in their Fully Withdrawn position.

d. A RETRACT PERMIT will exist whenever a SRM detector is not at the full-out position and the Reactor Mode Switch is in STARTUP.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.13 (1.75)

Place the following Condenser Off-Gas System components in correct sequential flowpath from the steam jet air ejector to the Off-gas building vent:

a. Charcoal Absorbers
b. Offgas condenser
c. Catalytic Recombiner
d. Water Separator
e. Glycol cooled Cooler Condenser
f. Preheater
g. Moisture Separators

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.14 (2.50)

Answer each of the following questions regarding the Reactor Feedwater System:

a. Between the feed pump discharge and the outlet check valve, two tapoffs are provided. One is the return line to the Main Condenser. EXPLAIN the PURPOSE of this tapoff and possible CONSEQUENCES if the line is not functional. (1.0)

b. STATE the power level at which the second feedwater pump should be started. (0.5)

c. The feed pump control circuitry is interlocked with the condensate pumps. STATE TWO things this interlock prevents. (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.15 (2.75)

Address the following statements concerning the Recirculation System.

a. The speed limiter will generate a 20% flow control signal if either of two conditions exist. STATE the TWO conditions. (0.5)

b. LIST the signals, signal generation source, and setpoints for the Recirculation Pump EOC-RPT. (1.25)

c. EXPLAIN the purpose of the EOC-RPT. (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.16 (1.00)

A rod has been selected to be withdrawn to full-out position. LIST TWO indications that an overtravel condition has occurred.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.17 (1.50)

The Uninterruptible AC Control Power System provides power to non-safety related instruments necessary for operation of the plant.
STATE the THREE independent power sources in the ORDER they will supply power with the Mode Switch in AUTO RUN.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.18 (1.00)

According to OI 380, "250 VDC Power Distribution System," WHY is it important to continually maintain battery room ventilation?

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.19 (2.50)

a. EXPLAIN HOW undesired rod motion could occur if a scram outlet valve developed a seat leak. (1.0)

b. STATE HOW would this control rod motion (part a) is detected. (0.5)

c. STATE HOW control rod drive high temperatures following a scram could be an indication of a scram discharge volume leak. (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.20 (1.00)

CHOOSE the statement that most accurately describes the concern if a tube leak develops in a RWCU Non-Regenerative Heat Exchanger:

a. Resin damage due to loss of cooling to NRHX.

b. Colder water being injected into the feedwater system.

c. Contamination of the RBCCW system.

d. Overpressurization of the RBCCW system.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.21 (2.50)

a. STATE the exposure rate limits (for a major portion of the body) which characterize EACH ONE of the following:

1. RADIATION AREA

2. HIGH RADIATION AREA

3. LOCKED HIGH RADIATION AREA (1.5)

b. STATE the definition of extremities as it pertains to radiation exposure of personnel. (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.22 (2.50)

TRUE or FALSE

a. When preparing the Main Generator for maintenance, the hydrogen must be purged using first CO2 then air.

b. Spare hydrogen cylinders may be stored near ~~the~~ a hydrogen manifold if they are properly marked and tagged.

c. The Generator may be operated as long as the hydrogen purity remains above 50%.

d. When it is necessary to work on chlorine lines or equipment, all sources of chlorine shall be isolated and the lines vented to the atmosphere.

e. When placing a replaced guage glass in service, it must be pressurized carefully with only authorized personnel present.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.23 (1.50)

Communications must be maintained with all personnel in enclosed or confined spaces. STATE THREE methods that can be used to maintain communications.

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.24 (2.00)

With regard to DAEC Administrative Control Procedure 1410.5, "Tagout Procedure":

a. STATE the required actions if a necessary Hold Card is missing. (1.5)

b. If the person whose name is on the Hold Card is not onsite and cannot be reached, WHO can authorize release of the Hold Card? (0.5)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.25 (1.50)

If an error is made in the Operations Log Book, HOW is it corrected? (STATE THREE items, be specific.)

(***** END OF CATEGORY 3 *****)
(********** END OF EXAMINATION **********)

DATA SHEET

REACTOR THEORY FORMULAS:

$$P = P_0 e^{t/\tau}$$

$$P = \frac{\Sigma \bar{\xi}_{th} V}{3.12 \times 10^{10} \text{ fissions/sec}}$$

$$P_{th} = \frac{1}{1 + (B^2 L_{th}^2)} = e^{-(B^2 L_{th}^2)}$$

$$P_f = e^{-(B^2 L_f^2)}$$

$$p = e^{-[N][I_{eff}]/\xi\Sigma_s}$$

$$C_1 (1-K_{eff1}) = C_2 (1-K_{eff2})$$

$$m = \frac{1}{1-K} = \frac{C_{final}}{C_{initial}}$$

$$\alpha_T = \frac{1}{f}\frac{\Delta f}{\Delta t} + \frac{1}{p}\frac{\Delta p}{\Delta t} - B^2 \left(\frac{\Delta L_f^2}{\Delta t} + \frac{\Delta L_{th}^2}{\Delta t}\right)$$

$$K_{eff} = \epsilon P_f p P_{th} f \eta$$

$$P = P_0 10^{SUR(t)}$$

$$SUR = 26.06/\tau$$

$$\rho = \frac{l^*}{\tau} + \frac{\bar{\beta}_{eff}}{1 + \tau}$$

$$\rho = \frac{K - 1}{K}$$

$$\Delta\rho = \ln \frac{K_{final}}{K_{initial}}$$

$$\tau = \frac{\bar{\beta}_{eff} - \rho}{\lambda\rho}$$

$$\tau = \frac{l^*}{\rho}$$

$$P_1 = P_0 \frac{\bar{\beta}_{eff} - \rho_0}{\bar{\beta}_{eff} - \rho_1}$$

DATA SHEET

THERMODYNAMICS AND FLUID MECHANICS FORMULAS:

$$\dot{Q} = \dot{m}\,\Delta h$$

$$\dot{Q} = U\,A\,(\Delta T_m)$$

$$\dot{Q} = \dot{m}\,c_p\,(\Delta T)$$

$$\eta = \frac{\dot{Q}_{in} - \dot{Q}_{out}}{\dot{Q}_{in}}$$

$$\eta_p = \frac{W_{actual}}{W_{supplied}}$$

$$\dot{m} = \rho A V$$

$$\dot{m} = KA\sqrt{\Delta P_x\,\rho}$$

$$\Delta T_m = \frac{\Delta T\,(in) - \Delta T\,(out)}{\ln\left(\frac{\Delta T\,(in)}{\Delta T\,(out)}\right)}$$

$$T_{cl} - T_{ps} = \frac{Gr^2}{4k}$$

$$\dot{Q} = \frac{A\,\Delta T_{total}}{\frac{\Delta x_a}{K_a} + \frac{\Delta x_b}{K_b} + \cdots + \frac{\Delta x_n}{K_n}}$$

$$\dot{Q} = \frac{2\pi L \Delta T}{\frac{1}{K} + \frac{\ln R_2/R_1}{K_2} + \frac{\ln R_3/R_2}{K_3}}$$

$$\dot{Q} = \alpha\,\delta\,A\,R^4$$

$$\eta = \frac{(h_{in} - h_{out})_{real}}{(h_{in} - h_{out})_{ideal}}$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\rho_1 A_1 V_1 = \rho_2 A_2 V_2$$

$$\dot{m}_{nc} = KA_Q\sqrt[3]{\dot{Q}} = KA\,\Delta T\,\sqrt{\Delta T} = KA\,\Delta p\,\sqrt{\Delta P}$$

$$G = \frac{\Sigma_f \bar{g}_{th}}{8.8\times10^9}$$

$$\dot{Q} = \frac{kA\Delta T}{\Delta x}$$

DATA SHEET

CENTRIFUGAL PUMP LAWS:

$$\frac{N_1}{N_2} = \frac{\dot{m}_1}{\dot{m}_2} \qquad \frac{(N_1)^2}{(N_2)^2} = \frac{H_1}{H_2} \qquad \frac{(N_1)^3}{(N_2)^3} = \frac{P_1}{P_2}$$

RADIATION AND CHEMISTRY FORMULAS:

$$R/hr = 6CE/d^2 \qquad I_x = I_0\, e^{-mx} \qquad C_1V_1 = C_2V_2$$

$$G = \frac{\text{Dilution Rate}}{\text{Volume}} \qquad I = I_0 \left(\frac{i}{10}\right)^n \qquad C = C_0\, e^{-Gt}$$

$$A = A_0\, e^{-\lambda t} \qquad A = \lambda N$$

CONVERSIONS:

1 gm/cm^3 = 62.4 lbm/ft^3	Density of water (20 C) = 62.4 lbm/ft^3
1 gal = 8.345 lbm	
1 ft^3 = 7.48 gal	Avogadro's Number = 6.023 x 10^{23}
1 gal = 3.78 liters	Heat of Vapor (H_2O) = 970 Btu/lbm
1 lbm = 454 grams	Heat of Fusion (ICE) = 144 Btu/lbm
e = 2.72	1 AMU = 1.66 x 10^{-24} grams
π = 3.14159	Mass of Neutron = 1.008665 AMU
1 KW = 738 ft-lbf/sec	Mass of Proton = 1.007277 AMU
1 KW = 3413 Btu/hr	Mass of Electron = 0.000549 AMU
1 HP = 550 ft-lbf/sec	One atmosphere = 14.7 psia = 29.92 in. Hg
1 HP = .746 KW	°F = 9/5 °C + 32
1 HP = 2545 Btu/hr	°C = 5/9 (°F - 32)
1 Btu = 778 ft-lbf	°R = °F + 460
1 MEV = 1.54 x 10^{-16} Btu	°K = °C + 273
h = 4.13 x 10^{-21} M-sec	
1 W = 3.12 x 10^{10} fissions/sec	
g_c = 32.2 lbm-ft/lbf-sec^2	c^2 = 931 MEV/AMU
1 inch = 2.54 cm	C = 3 x 10^8 m/sec
σ = 0.1714 x 10^{-8} Btu/hr ft^2 R^4	

DATA SHEET

AVERAGE THERMAL CONDUCTIVITY (K)

Material	K
Cork	0.025
Fiber Insulating Board	0.028
Maple or Oak Wood	0.096
Building Brick	0.4
Window Glass	0.45
Concrete	0.79
1% Carbon Steel	25.00
1% Chrome Steel	35.00
Aluminum	118.00
Copper	223.00
Silver	235.00
Water (20 psia, 200 degrees F)	0.392
Steam (1000 psia, 550 degrees F)	0.046
Uranium Dioxide	1.15
Helium	0.135
Zircaloy	10.0

MISCELLANEOUS INFORMATION:

$$E = mc^2$$

$$KE = 1/2\ mv^2$$

$$PE = mgh$$

$$V_f = V_0 + at$$

Geometric Object	Area	Volume
Triangle	$A = 1/2\ bh$	////////////////////
Square	$A = S^2$	////////////////////
Rectangle	$A = L \times W$	////////////////////
Circle	$A = \pi r^2$	////////////////////
Rectangular Solid	$A = 2(LxW + LxH + WxH)$	$V = L \times W \times H$
Right Circular Cylinder	$A = (2\ \pi r^2)h + 2(\pi r^2)$	$V = \pi r^2 h$
Sphere	$A = 4\ \pi r^2$	$V = 4/3\ (\pi r^2)^3$
Cube	////////////////////////////////	$V = S^3$

DATA SHEET

MISCELLANEOUS INFORMATION (continued):

Material	Half-Life	Gamma Energy MEV per Disintegration	10 CFR 20 Appendix B				
				Table I		Table II	
				Col I Air uc/ml	Col II Water uc/ml	Col I Air uc/ml	Col II Water uc/ml
Ar-41	1.84 h	1.3	Sub	2×10^{-6}	-----	4×10^{-8}	------
Co-60	5.27 y	2.5	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
I-131	8.04 d	0.36	S	9×10^{-9}	6×10^{-5}	1×10^{-10}	3×10^{-7}
Kr-85	10.72 y	0.04	Sub	1×10^{-5}	-----	3×10^{-7}	------
Ni-65	2.52 h	0.59	S	9×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
Pu-239	2.41×10^{4} y	0.008	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
Sr-90	29 y	-----	S	1×10^{-9}	1×10^{-5}	3×10^{-11}	3×10^{-7}
Xe-135	9.09 h	0.25	Sub	4×10^{-6}	-----	1×10^{-7}	------
Any single radionuclide with $T_{1/2}$ >.2 hr which does not decay by alpha or spontaneous fission				3×10^{-9}	9×10^{-5}	1×10^{-10}	3×10^{-6}

Neutron Energy (MEV)	Neutrons per cm^2 equivalent to 1 rem	Average flux to deliver 100 mrem in 40 hours
thermal	970×10^{6}	670
0.02	400×10^{6}	280 (neutrons)
0.5	43×10^{6}	30 ----------
10	24×10^{6}	17 cm^2 x sec

Linear Absorption Coefficients μ (cm^{-1})				
Energy (MEV)	Water	Concrete	Iron	Lead
0.5	0.090	0.21	0.63	1.7
1.0	0.067	0.15	0.44	0.77
1.5	0.057	0.13	0.40	0.57
2.0	0.048	0.11	0.33	0.51
2.5	0.042	0.097	0.31	0.49
3.0	0.038	0.088	0.30	0.47

DUANE ARNOLD
SRO/RO EXAMS
CROSS REFERENCE

12/9/88

RO	SRO
1.01	4.05
1.05	4.06
1.07	4.13
1.08	4.07
1.11	4.08
1.14	4.18
1.15	4.15
1.16	4.14
1.19	4.17
2.01	5.02
2.02	5.03
2.03	5.04
2.04	5.05
2.05	5.06
2.06	5.07
2.07	5.09
2.08	5.10
2.10	5.12
2.11	5.13
3.20	6.08
3.21	6.24
3.22	6.26

ANSWER 1.01 (1.00) SRO 4.05

a. Neutrons emitted less than 10E-14 s following fission.
b. Neutrons produced by Beta decay of fission fragments.

REFERENCE

DAEC Reactor theory
GR II RT
292001K102 ..(KA's)

ANSWER 1.02 (1.50)

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

REFERENCE

DAEC RXTH-SH-22, pgs. 12 and 13
GR I RT
292004K114 ..(KA's)

ANSWER 1.03 (1.50)

a. Decrease
b. Increase
c. Increase
(0.5 pts each)

REFERENCE

DAEC RXTH-SH-27, pgs. 4 and 5
GR I RT
292005K109 ..(KA's)

ANSWER 1.04 (1.50)

a. Delayed Neutron Fraction decreases [0.5] over core life due to Pu-239 inventory increase [0.5].
b. More rapid. (0.5)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

MASTER COPY

REFERENCE

DAEC RXTH-SH 19b, pg. 3
GR II RT
292003K104 ..(KA's)

ANSWER 1.05 (1.50) SRO 4.06

1. Xe 135 has a large absorption cross section for thermal neutrons (2.7 x 10E6 barns)
2. It is one of the most abundant fission products (occurs at one of the peaks of the fission product yield curve)
3. Can only be removed by decay or burnup

(0.5 pts each)
[Will accept other descriptions of Xe production, decay, and burnout.]

REFERENCE

DAEC RXTH-SH29
GR II RT
292006K114 ..(KA's)

ANSWER 1.06 (1.00)

b. (1.0)

REFERENCE

DAEC RXTH-SH9, pg. 3
GR II RT
292001K104 ..(KA's)

ANSWER 1.07 (1.00) SRO 4.13

d. (0.5)
350 psig + 14.7 = 364.7 psia
Extrapolating from the steam tables
364.7 psia = 435 degrees F (0.5)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC Thermodynamics, Sec. 10
GR II TH
293003K123 ..(KA's)

ANSWER 1.08 (1.00) SRO 4.07 (air/gas binding)

To prevent waterhammer (0.5) that could damage system piping or piping hangers (0.25) and increase injection time (0.25).

~~Air (gas) binding~~

REFERENCE

DAEC OI 151, SD C-1, and Thermodynamics Sec. 4
GR III TH
293006K105 ..(KA's)

ANSWER 1.09 (1.00)

a. Conduction. (0.5)
b. Increase. (0.5)

REFERENCE

DAEC HT-4, pg. 5
GR I TH
293007K101 293007K103 ..(KA's)

ANSWER 1.10 (1.00)

c. (1.0)

REFERENCE

GR I TH
DAEC HT-10, pg. 5
293009K106 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

ANSWER 1.11 (2.00) SRO 4.08

a. NPSH is defined as the difference between total pressure at the eye of a pump (or inlet of a valve) and saturation pressure.
or
NPSH= Pi - Psat [or Psuction - Psat] [1.0]

b. Cavitation would result in vibration (and noise) of the pump and pitting and corrosion of the pump parts, (especially the impeller). [Exact wording not necessary for full credit.] [1.0]

REFERENCE

DAEC Fluid Flow, p 4-4
GR III TH and GR I COMP
293006K110 291004K106 ..(KA's)

ANSWER 1.12 (1.00)

c. (1.0)

REFERENCE

DAEC SH-RO FF-5, pg. 5
GR III TH
293006K105 291006K114 ..(KA's)

ANSWER 1.13 (2.00)

a. True [0.5] Turbine efficiency will increase [0.5].
b. False [0.5] The SJAEs are required to remove noncondesable gasses which are carried into the condenser by the steam [0.5].

REFERENCE

DAEC HT 12-8, SD D-2, p 5
GR II TH
293004K113 ..(KA's)

b

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

ANSWER 1.14 (2.00) SRO 4.18

a. Limiter #2
b. Limiter #1
c. Limiter #1
d. Limiter #2
(0.5 pts each)

REFERENCE

DAEC SD A-2
GR I COMP
291003K102 ..(KA's)

ANSWER 1.15 (1.50) SRO 4.15

a. Two
b. One
c. Damage to motor windings (due to overheating)
(0.5 pts each)

REFERENCE

DAEC OI 264, p 7
GR I COMP
291005K106 202001G005 ..(KA's)

ANSWER 1.16 (2.00) SRO 4.14

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

REFERENCE

DAEC SD A-6, p 7-8
GR I COMP
291001K101 291001K102 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

ANSWER 1.17 (1.00)

a.

REFERENCE

DAEC-FF-3, pg. 5
GR 1 COMP
291002K101 ..(KA's)

ANSWER 1.18 (1.00)

The relief valves prevent system damage in case the discharge valve is closed. (1.0)

REFERENCE

Duane Arnold Fluid Flow Suction Pumps, Pg. 4-5
GR I COMP
291004K118 ..(KA's)

ANSWER 1.19 (2.00) SRO 4.17

1. a
2. b
3. a
4. a
(0.5 pts each)

REFERENCE

DAEC SD A-5, p 11-12
GR I COMP
291002K109 ..(KA's)

(***** END OF CATEGORY 1 *****)

ANSWER 2.01 (2.00) SRO 5,02

1. Determine cause of reactor water level decrease
2. Stop power change
3. Check the feed reg valves for proper operation
4. Check feed flow (check for feed pump trip)
5. If feed pump tripped, verify or perform recirc runback
6. Attempt to restore water level
7. Check steam/feed flow mismatch

(Any 4 @ 0.5 pts each)

[Will accept other reasonable responses related to feed system components, check for LOCA, etc.]

REFERENCE

DAEC APR 1C05A, C-1
GR I EAP
295031G010 ..(KA's)

ANSWER 2.02 (2.00) SRO 5,03

1. Reactor feedwater pump (1P-1B)
2. Reactor recirc MG set (1G-201B)
3. Circ water pump (1P-4B)
4. Condensate pump (1P-8B)
5. GSW pump (1P-58C)
6. Well pump (1P-89D)

(Any 4 @ 0.5 pts each)

REFERENCE

DAEC AOP 304.1, p 4
GR II EAP
295003K102 ..(KA's)

ANSWER 2.03 (2.00) SRO 5,04

1. Rod withdrawal block
2. RPS A half scram
3. SBGTS train A starts
4. Reactor building ventilation system shuts down (inboard isolation)
5. PCIS Div I Group III isolation

(Any 4 @ 0.5 pts each)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC AOP 375, p 4
GR II EAP
295004A202 ..(KA's)

ANSWER 2.04 (1.50) SRO 5.05

a. On loss of air, the Scram air header pressure may decrease to the point where scram inlet and outlet valves open (0.5) causing individual rods to start drifting or scramming (0.5). [Exact wording not required for full credit.]
b. Manually scram (0.5)

REFERENCE

DAEC AOP 518
GR II EAP
295019K201 ..(KA's)

ANSWER 2.05 (2.50) SRO 5.06

a. Scram the reactor (0.5)
b. 50 psig [+/-5] (0.5)
c. High steam tunnel temperature (0.5)
d. Stator cooling water (0.25) temperature (>86 C) (0.25)
e. Scram the reactor (0.25) and trip both MG sets (0.25)

REFERENCE

DAEC AOP 411, p 4-9
GR II EAP
295018K101 ..(KA's)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.06 (2.50) SRO 5,07

a. 1. APRM power increasing
2. Reactor power higher than expected for core flow and rod line
3. Rod withdrawal block (rod block alarm)
4. APRM upscale alarm (or trip)
5. LPRM upscale alarm
6. RBM indication decreasing
(Any 3 @ 0.5 pts each) 7. LPRM UPSCALE LIGHTS ON FULL CORE DISPLAY
b. Recirc flow must be runback (0.5) until reactor power is 20% less than initial power (<75%) (0.5) (CRAM group rods if necessary).

REFERENCE

DAEC AOP 646, p 2-5
GR I EAP
295014K207 ..(KA's)

ANSWER 2.07 (3.00) SRO 5,09

1. Verify all rods fully inserted
2. Verify neutron flux (power) decreasing
3. Announce scram on page
4. Initiate backup manual scram
5. Place Mode switch in shutdown
6. Verify recirc pumps runback to 20% (or manually runback)
7. Dial feedwater level controller to 175 inches
8. Insert all SRM and IRM detectors
9. Maintain pressure < 1110 psig
10. Monitor condenser pressure (vacuum)
11. Check turbine status
12. After turbine trip, verify generator lockout
(0.25 pts each)

REFERENCE

DAEC IPOI 5, p 6-9
GR I EAP
295006G010 ..(KA's)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.08 (1.50) SRO 5.10

1. Verify that drywell fans are in fast.
2. Verify fan dampers are open.
3. Check (CV-4464 on 1C-23) status of the main plant intake coils. (0.5 pts each, will also accept the following @ 0.25 each up to total value of question.)
4. Reduce reactor power
5. If CV-4464 is open with well water going to main plant coils, close CV-4464.
6. Verify proper operation of well water system.
7. Verify proper operation of Nitrogen Makeup system.
8. Vent the drywell

REFERENCE

DAEC ARP 1C05B, C-5
GR I EAP, GR II EAP
295024K218 295023G010 295027G010 ..(KA's)

ANSWER 2.09 (1.50)

1. Turn off circuit breakers to Bus A CKT 02 and Bus B CKT 02 (or Power Range Monitoring System). (0.5)
2. Close V-17-61 (air supply to scram valve pilot air header) (0.5) AND Vent scram air header. (0.5) [Will accept trip turbine above 30% power for half credit.]

REFERENCE

DAEC EOP-6 pg 17, ARP 1C05B, C-3
GR II EAP
295016G006 295016G012 ..(KA's)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.10 (2.50) SRO 5,12

a. 1. Offgas
2. SJAEs
3. Cooling tower fans
4. Feed pump stuffing box seal leakoff tank
(Any 3 @ 0.5 pts each) ~~the following additional answers will be accepted @ 0.25 pts each up to the value of part a.)~~
5. Circ water
6. Steam seals
7. Steam packing exhaust

b. Group 1 isolation (0.5) Enter EOP-1 (0.5)

REFERENCE

DAEC ARP 1C07B, B-1, IPOI 2, OI 691
GR II EAP
295002G007 295002G010 295002G011 ..(KA's)

ANSWER 2.11 (2.00) SRO 5,13

a. Baseline values have not been established during SLO since last refueling. [0.5]
b. When baseline values have been established. [0.5]
c. 100% [0.5]
d. MAPLHGR [0.25] and MCPR [0.25]

REFERENCE

DAEC AOP 304.1, Technical Specification 3.6.F, 3.12.A, and Bases
GR II EAP
295001G003 ..(KA's)

ANSWER 2.12 (2.00)

a. (Immediately) runback recirc flow to minimum (20%) [0.5] and trip the turbine [0.5].
b. (Reduce voltage to zero) and trip the turbine (within 3 min.). [0.5]
c. (Reduce voltage to zero) and trip the turbine (within 1 hr). [0.5]

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC ARPs 1C08C, D-4, 1C83A A-1, B-1, and B-2.
GR I EAP
295005G005 295005G007 ..(KA's)

ANSWER 2.13 (2.50)

a. 1, 2

b. 3

c. 2

d. NONE.
(0.5 pts each = 2.5)

REFERENCE

DAEC EOPs 1,2,3 entry conditions
GR I, II, III EAP
295036G011 295031G011 295024G011 295026G011 295032G011
..(KA's)

(***** END OF CATEGORY 2 *****)

ANSWER 3.01 (2.00)

Steam flows from the drywell to the torus through the vacuum breaker equalizing the pressure. The steam is not forced through the downcomers and up through the water, but instead is dumped on the surface of the water in the torus. As a result, the drywell pressure will probably exceed design pressure. (2.0)

REFERENCE

DAEC System Description E-6, pg. 21
GR I SYS
223001K307 ..(KA's)

ANSWER 3.02 (1.75)

a. 255 (+/- 10) degrees F (0.5)
b. 1. Stop SBGT exhaust fan
2. De-energize the SBGT train dT heater
3. Close the cooldown/outside air valve
4. Open intake valve
5. Close fan inlet valve.
(0.25 pts each)

REFERENCE

DAEC System Description E-11, pg. 11
GR I SYS
261000K401 261000A304 ..(KA's)

ANSWER 3.03 (2.00)

a. Diesel generator would fail to start. (0.5) (Prevent inadertent Lockout)
b. 1. Engine overspeed. (0.5)
2. Generator fault. (0.5)
c. The delay allows the lube oil to drain from the upper crankline to prevent overfilling. (0.5)

REFERENCE

DAEC OI 324, pg. 6-8
GR I SYS
264000G010 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.04 (1.00)

b. (1.0)

REFERENCE

DAEC System Description RWCU, pg. 17
GR 1I SYS
204000K404 ..(KA's)

ANSWER 3.05 (2.00)

a. ADS Logic "A" - 125 VDC battery 1D1 (0.5)
ADS Logic "B" - 125 VDC battery 1D2 (0.5)
b. (Loss of normal 125 VDC power supply) will deenergize a relay and automatically shift to the other 125 VDC (0.25) except for ADS logic "A" which does not have a backup 125 VDC supply. (0.25)
All four ADS valves still open. (0.5)

REFERENCE

DAEC System Description A-7, pg. 12
GR I SYS
218000K201 218000K606 218000A005 ..(KA's)

ANSWER 3.06 (1.50)

1. Reactor Vessel is open.
2. Reactor well is filled.
3. Fuel pool gates are removed.
(0.5 pts each)

REFERENCE

DAEC Fuel Pool Cooling and Cleanup System, pg. 13
GR III SYS
233000K403 233000K402 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.07 (2.00)

1. Allows pressure in the exhaust header to be re-established (0.5) to avoid excessive initial rod withdraw speed of the CRD (0.5) following a scram or other conditions when a high differential pressure across the solenoid/speed control valve could exist (0.5).
2. To avoid subjecting the HCU solenoid valves to a continuous reverse leakage flow. (0.5)
   [Exact wording not necessary for full credit, but all elements must be present.]

REFERENCE

DAEC System Description CRDH, pg. 16
GR I SYS
201001K412 201001K408 ..(KA's)

ANSWER 3.08 (1.50)

The inboard MSIV of the loop being initiated is closed (0.5) Reactor Vessel Pressure has decayed (0.5) to less than 35 psig (0.5),

REFERENCE

DAEC MSIV-LCS System Description, pg. 13
GR III SYS
239003A401 ..(KA's)

ANSWER 3.09 (3.00)

a. The Turbine Steam Supply Valve (MO-2404) closed. (0.5)
b. When level decreases to the initiation level (119.5"), the 2404 valve will reopen. (1.0)
c. The turbine test circuitry would be automatically bypassed and the RCIC system would revert to flow control mode. (1.0)
d. No [0.25]. The mechanical overspeed must be reset locally [0.25].

REFERENCE

DAEC System Description B-2, pgs. 17, 24, 25, 36, 38
GR I SYS
217000A101 217000A103 217000A301 217000A402 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.10 (1.00)

Misoperation in Automatic mode is confirmed, (0.5) or Adequate core cooling is assured. (0.5)

REFERENCE

OI-149, "Residual Heat Removal System," Rev. 3, pg. 47
GR I SYS
203000G010 ..(KA's)

ANSWER 3.11 (2.50)

a. 1. Speed control failure
2. Manual initiation of scoop tube locking (from panel 1C04)
3. Local scoop tube brake power switch.
4. Loss of 125 VDC 1D1B (1D23)
(Any 2 @ 0.5 pts each)

b. 1. Raise speed until speed demand is at or above desired demand.
2. Slowly reduce speed until demand integrates down.
3. As demand drops to the desired level, reset the scoop tube.
(0.5 pts each)

REFERENCE

DAEC A2, pg. 32-33, OI 264, p 37-38
GR I SYS
202002K105 202002A205 ..(KA's)

ANSWER 3.12 (2.00)

a. False
b. False
c. True
d. False (Need Mode Switch in RUN)

REFERENCE

DAEC I-1, pgs. 23 and 24
GR I SYS
215004K106 215004K401 215004K503 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.13 (1.75)

f, c, b, d, e, g, a
(0.25 pts each, subtract 0.25 for each component out of order up to 1.75)

REFERENCE

DAEC D-7, Figure 1
GR II SYS
271000G007 ..(KA's)

ANSWER 3.14 (2.50)

a. Ensures adequate feed pump cooling during low power operation (0.5). The feed pump could be damaged by cavitation (or overheating) (0.5).
b. Accept 40 to 50% (0.5)
c. 1. Prevents starting a feed pump unless a condensate pump is already running. (0.5)
   2. Prevents starting a second feed pump unless both condensate pumps are running. (0.5)

REFERENCE

DAEC D-15, pgs. 1, 7, and 11, OI 644, p 17
GR I SYS
259001K401 259001K403 ..(KA's)

ANSWER 3.15 (2.75)

a. 1. Total feed flow is less than 20% for greater than 15 seconds. (0.25)
   2. Recirc pump discharge valve is not fully open. (0.25)
b. Turbine stop valves (0.25) less than or equal to 90% open (0.25) or CV fast closure [800 psi] (0.25) and reactor power equal to or greater than 30% (0.25) as measured by HP turbine first stage pressure. (0.25)
c. To mitigate the core wide pressurization transient (0.5) caused by a main turbine load rejection or turbine trip. (0.5) [Also accept, prevents EOC MCPR from decreasing too far, for partial credit.]

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

REFERENCE

GR II SYS
DAEC Lesson Plan A-2, pages 29 and Figure 18
202001K128 202001K413 202001K506 202002K402 ..(KA's)

ANSWER 3.16 (1.00)

1. The position of the four rod display for the selected rod will be blank.
2. The ROD OVERTRAVEL OUT annunciator will be activated.
(0.5 pts each)

REFERENCE

DAEC OI 856.3, Rev. 1, pg. 8
GR II SYS
214000A203 214000A402 ..(KA's)

ANSWER 3.17 (1.50)

1. AC drive motor (essential 480 VAC from MCC 1B32)
2. DC drive motor (250 VDC battery 1D4)
3. AC Transformer (1Y2 from essential 480 VAC from MCC1B42)
(0.4 pts for each source and 0.3 pts for the correct order.
Answer in parenthesis not necessary for full credit but is acceptable in lieu of answer not in parenthesis.)

NOTE: DAEC is scheduled to install a Static Inverter per DCP 1411; but, question is still valid with answers in parentheses if DCP has been completed.

REFERENCE

DAEC System Description G-4
GR II SYS
262001G007 ..(KA's)

ANSWER 3.18 (1.00)

Battery room ventilation should be continually maintained to preclude the formation of hydrogen gas pockets. (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

REFERENCE

DAEC OI 388, Rev. 1, pg. 6
GR II SYS
263000G010 ..(KA's)

ANSWER 3.19 (2.50)

a. Rx Vessel pressure on the under piston area can cause the device to drift in as the overpressure area depressurizes. (1.0)
b. A Rod Drift Alarm will be initiated. (0.5)
c. With a scram discharge volume leak, reactor water at high temperature continuously leaks past CRD seals to the SDV. (1.0)

REFERENCE

DAEC Lesson Plan A.1, CRD & CRDH
GR II SYS
201003G007 201003A203 201003K407 ..(KA's)

ANSWER 3.20 (1.00) SRO 6.08

c (1.0)

REFERENCE

DAEC SD B-4, p 7
GR II SYS
204000K601 ..(KA's)

ANSWER 3.21 (2.50) SRO 6.24

a. 1. > 2.5 mrem in any one hour or 100 mrem in 5 consecutive days
2. > 100 mrem in any one hour (but < 1000 mrem)
3. > 1000 mrem/hr
(0.5 pts each)
b. Hands and forearms (0.5) feet and ankles (0.5)

REFERENCE

DAEC HP-SH-4, p 5 and 10, 10CFR20
GR I GEN
294001K103 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.22 (2.50) SRO 6.26

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

REFERENCE

DAEC OI 695.2, p 5, ie: Safety Rule Book Sec 4-1-4, 4-2-4, 4-1-1
GR I GEN
294001K115 294001K111 294001K109 ..(KA's)

ANSWER 3.23 (1.50)

1. Telephone - via hardwire.
2. Two-way radios.
3. Someone outside the confined space who can see or hear the workers.
(0.5 pts each)
[Also accept other reasonable means of communications.]

REFERENCE

DAEC procedure 1141.11 REV 1, pg.4
GR I GEN
294001K114 ..(KA's)

ANSWER 3.24 (2.00)

a. Stop the affected work if a personnel or safety hazard exists. (0.5)
Make a duplicate Hold Card (plainly mark it "Duplicate"). (0.5)
Note "Duplicate tag issued" next to the pertinent entry on the Equipment Tagging form (work may be resumed when proper isolation has been verified). (0.5)
b. OSS (0.5)

REFERENCE

DAEC Admin. Proc. 1410.5, Tagout
GR I GEN
294001K102 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.25 (1.50)

1. Draw a single line through the error. (0.5)
2. Person making entry shall initial the error. (0.5)
3. Corrected entry shall follow or be placed above the crossout. (0.5)

REFERENCE

DAEC Proc. 1410.3 REV 1, pg. 3
GR I GEN
294001A106 ..(KA's)

(***** END OF CATEGORY 3 *****)
(********** END OF EXAMINATION **********)

QUESTION	VALUE	REFERENCE
3.18	1.00	9000185
3.19	2.50	9000186
3.20	1.00	9000187
3.21	2.50	9000188
3.22	2.50	9000189
3.23	1.50	9000192
3.24	2.00	9000193
3.25	1.50	9000194
	46.25	
	100.2	