

U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-288/OL-96-03
FACILITY DOCKET NO.: 50-288
FACILITY LICENSE NO.: R-112
FACILITY: Reed College
EXAMINATION DATES: September 24, 1996
EXAMINER: Patrick Isaac, Chief Examiner
SUBMITTED BY: Patrick Isaac 10/7/96
Patrick Isaac, Chief Examiner Date

SUMMARY:

During the week of September 23, the NRC administered retake examinations to three Reactor Operator candidates. All three candidates passed their respective examinations.

REPORT DETAILS

1. Examiners:
Patrick Isaac, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	3/0	0/0	3/0
Operating Test	0/0	0/0	0/0
Overall	3/0	0/0	3/0

ENCLOSURE 1

U. S. NUCLEAR REGULATORY COMMISSION
NON-POWER REACTOR LICENSE EXAMINATION

FACILITY: Reed College

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 1996/09/23

REGION: IV

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% is required to pass the examination. Examinations will be picked up one (1) hour after the examination starts.

<u>CATEGORY VALUE</u>	<u>CANDIDATE'S SCORE</u>	<u>% OF TOTAL</u>	<u>CATEGORY</u>
<u>20.00</u>	_____	_____ %	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS

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

Candidate's Signature

ENCLOSURE 2

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

001 a b c d ____

002 a b c d ____

003 a b c d ____

004 a b c d ____

005 a b c d ____

006 a b c d ____

007 a b c d ____

008 a b c d ____

009 a b c d ____

010 a b c d ____

011 a b c d ____

012 a b c d ____

013 a b c d ____

014 a b c d ____

015 a b c d ____

016 a b c d ____

017 a b c d ____

018 a b c d ____

019 a b c d ____

020 a b c d ____

(*** END OF CATEGORY A ***)
(***** END OF EXAMINATION *****)

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3. 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.
4. Use black ink or dark pencil only to facilitate legible reproductions.
5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet and each answer sheet.
6. Mark your answers on the answer sheet provided. **USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.**
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11. To pass the examination you must achieve a grade of 70 percent or greater in each category.
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EQUATION SHEET

$$\dot{Q} = \dot{m} c_p \Delta T = \dot{m} \Delta H = UA \Delta T$$

$$t^* = 5 \times 10^{-6} \text{ seconds}$$

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

$$SUR = 26.06 \left[\frac{\lambda_{eff} \rho}{\beta - \rho} \right]$$

$$M = \frac{1}{1 - K_{eff}} = \frac{CR_1}{CR_2}$$

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

$$T = \frac{t^*}{\rho - \beta}$$

$$\Delta \rho = \frac{K_{eff2} - K_{eff1}}{K_{eff1} \times K_{eff2}}$$

$$T_{\frac{1}{2}} = \frac{0.693}{\lambda}$$

$$DR = DR_0 e^{-\lambda t}$$

$$DR = \frac{6CiE(n)}{R^2}$$

$$P_{max} = \frac{(\rho - \beta)^2}{2\alpha(k)t}$$

$$SCR = \frac{S}{-\rho} \approx \frac{S}{1 - K_{eff}}$$

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

$$CR_1(-\rho_1) = CR_2(-\rho_2)$$

$$M = \frac{1 - K_{eff0}}{1 - K_{eff1}}$$

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

$$P = P_0 e^{\frac{t}{T}}$$

$$\rho = \frac{\beta(1 - \rho)}{\beta - \rho} P_0$$

$$T = \frac{t^*}{\rho} + \left[\frac{\beta - \rho}{\lambda_{eff} \rho} \right]$$

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

$$DR_1 d_1^2 = DR_2 d_2^2$$

$$\frac{\rho_2 \beta_2}{\rho_1 \beta_1} = \frac{\rho_2 \beta_2}{\rho_1 \beta_1}$$

$$\beta_{eff} = 0.007$$

DR — Rcm,
E — Mev,

Ci — curies,
R — feet

1 Curie = 3.7×10^{10} dis/sec

1 Horsepower = 2.54×10^3 BTU/hr

1 BTU = 778 ft-lbf

1 gal (H₂O) = 8 lbm

$c_p = 1.0$ BTU/hr/lbm/°F

1 kg = 2.21 lbm

1 Mw = 3.41×10^6 BTU/hr

°F = 9/5 °C + 32

°C = 5/9 (°F - 32)

$c_p = 1$ cal/sec/gm/°C

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 001 (1.00)

As power level increases, the Prompt Negative Temp. Coefficient (PNTC) causes:

- a. ^{238}U to absorb neutrons over a wider range, thus decreasing the number of neutrons available for fission with ^{235}U .
- b. Doppler resonance effects to decrease.
- c. The hydrogen atoms in the ZrH_2 to slow down more neutrons.
- d. More thermal neutron absorption by the moderator.

QUESTION: 002 (1.00)

During a fuel loading, as the reactor approaches criticality, the value of $1/M$:

- a. decreases toward zero
- b. decreases toward one
- c. increases toward infinity
- d. increases toward one

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 003 (1.00)

Select one of the following statements which correctly describes the influence of delayed neutrons on the neutron life cycle. Delayed neutrons:

- a. decrease the period of a reactivity addition because they thermalize more quickly than prompt neutrons.
- b. take longer to thermalize because they are born at higher energies than prompt neutrons.
- c. cause the length of the average neutron generation time to increase and reactor period to increase.
- d. increase the value of β_{eff} because they are born at higher energies than prompt neutrons.

QUESTION: 004 (1.00)

What is the stable Rx period which produces a power rise from 1 watt to 5 KW in 186 secs?

- a. 10 secs.
- b. 22 secs.
- c. 30 secs.
- d. 116 secs.

A. RX THEORY, THERMO & FAC OF CHARS

QUESTION: 005 (1.00)

Which one of the following completes the statement?

The largest amount of recoverable energy from fission of U-235 is due to the kinetic energy of the:

- a. Thermal neutrons
- b. Fast neutrons
- c. Fission fragments
- d. Beta decay particles

QUESTION: 006 (1.00)

What three materials help moderate Reed's reactor?

- a. Water, Zirconium Hydride, Boron carbide
- b. Graphite, water, concrete
- c. Graphite, water, Zirconium Hydride
- d. Zenon, samarium, promethium

QUESTION: 007 (1.00)

Given a source strength of 50 neutrons per second (N/sec) and a multiplication factor of 0.8, the expected neutron count rate would be:

- a. 125 N/sec
- b. 250 N/sec
- c. 400 N/sec
- d. 500 N/sec

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

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 008 (1.00)

Which ONE of the following is the reason for the -80 second period following a Rx scram?

- a. U235 affinity for source neutrons.
- b. Fuel temp. coefficient adding positive reactivity.
- c. Longest lived delayed neutron precursors decay constant.
- d. Amount of negative reactivity added on a scram exceeds the shutdown margin.

QUESTION: 009 (1.00)

In a subcritical Rx, K_{eff} is increased from 0.861 to 0.946. Which one of the following is the amount of reactivity that was added to the core?

- a. 0.085 delta-K/K
- b. 0.220 delta-K/K
- c. 0.104 delta-K/K
- d. 0.125 delta-K/K

QUESTION: 010 (1.00)

The purpose of the beryllium in the Am-Be neutron startup source is the following:

- a. to convert the installed Am241 to Am245
 - b. to moderate the neutrons produced by Am241
 - c. to convert to neutrons the γ emitted spontaneously by Am241
 - d. to enhance the conversion of Am241 to Np237
- (***** CATEGORY A CONTINUED ON NEXT PAGE *****)

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 011 (1.00)

Which one of the following describes the difference between a moderator and reflector?

- a. A reflector increases the fast non-leakage factor and a moderator increases the thermal utilization factor.
- b. A reflector increases the neutron production factor and a moderator increases the fast fission factor.
- c. A reflector decreases the thermal utilization factor and a moderator increases the fast fission factor.
- d. A reflector decreases the neutron production factor and a moderator decreases the fast non-leakage factor.

QUESTION: 012 (1.00)

The shim rod is withdrawn from the core.

Which one of the following explains the reactivity addition from the rod?

- a. Reactivity added will be equal for each inch of withdrawal.
- b. Reactivity addition per inch will be greatest from 40% to 60% withdrawn.
- c. The first 30% of rod travel will have the greatest reactivity addition per inch.
- d. The last 30% of rod travel will have the greatest reactivity addition per inch.

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 013 (1.00)

Which one of the following factors plays the MOST important role in determining the worth of a control rod?

- a. The value of the delayed neutron fraction.
- b. Reactor power.
- c. The rod speed.
- d. The flux shape.

QUESTION: 014 (1.00)

Which one of the following describes "Excess Reactivity"?

Excess reactivity is:

- a. a measure of the additional fuel loaded to overcome fission product poisoning.
- b. a measure of remaining control rod worth with the reactor exactly critical.
- c. the combined control rod negative reactivity worth required to keep the reactor shutdown.
- d. the maximum reactivity by which the reactor can be shutdown with one control rod fully withdrawn.

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

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 015 (1.00)

Which one of the following is the MAXIMUM amount of reactivity that can be promptly inserted into the reactor WITHOUT causing the reactor to go "Prompt Critical"?

- a. 0.10 dollars
- b. 0.50 dollars
- c. 0.90 dollars
- d. 1.25 dollars

QUESTION: 016 (1.00)

Reactor power is 100 kw with equilibrium Xenon (Xe) concentration. The reactor scrams (reactor power is instantly reduced to 0 kw). What will the Xenon concentration graph look like?

- a. Xenon concentration will decrease initially, then increase to a new equilibrium concentration.
- b. Xenon concentration will increase to peak in 8-12 hours then decay to zero.
- c. Xenon concentration will increase initially, then decrease to a new equilibrium concentration.
- d. Xenon concentration will decrease to a new equilibrium concentration.

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 017 (1.00)

Which one of the following statements describes the effect of an increase in fuel temperature in a TRIGA fuel element.

- a. The probability that a thermal neutron will lose energy in a collision with an excited state hydrogen atom in UZrHx increases.
- b. The probability that a neutron will escape from the element before being captured in the fuel meat increases.
- c. A shift in the thermal neutron spectrum, towards lower energies, occurs in the fuel element.
- d. The mean free path for fast neutrons in the fuel element is decreased.

QUESTION: 018 (1.00)

Which statement best describes the heat transfer mechanism at the Reed College Reactor?

- a. From the fuel center line, heat is transferred to the surface of the fuel rod by convection and is carried into the coolant by conduction.
- b. Heat is transmitted to the fuel rod surface by thermal radiation and carried to the coolant by conduction.
- c. Heat conducted to the surface of a fuel rod is carried into the coolant and out of the system by convection.
- d. The temperature distribution from the fuel center line to the coolant is linear.

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 019 (1.00)

Assume your reactor is being taken critical by periodically withdrawing equal reactivity control-rod increments. Comparing two consecutive control rod withdrawals, which one of the following statements is correct ?

- a. Time for power to stabilize will be equal for both withdrawals and the power increase will be the same for both withdrawals.
- b. The power increase will be the same for both withdrawals but the time for power to stabilize will be less for the second withdrawal.
- c. The power increase will be the same for both withdrawals but time for power to stabilize will be longer for the second withdrawal.
- d. The power increase will be larger for the second withdrawal and the time for power to stabilize will be longer for the second withdrawal.

QUESTION: 020 (1.00)

An initial count rate of 100 is doubled five times during startup. Assuming an initial $K_{eff}=0.950$, what is the new K_{eff} ?

- a. 0.957
- b. 0.979
- c. 0.988
- d. 0.998

(*** END OF CATEGORY A ***)
(***** END OF EXAMINATION *****)

A. RX THEORY, THERMO & FAC OP CHARS

ANSWER: 001 (1.00)

a

REFERENCE:

Reed Training Manual Sect. 10.5.2

ANSWER: 002 (1.00)

a

REFERENCE:

Reed Training Manual Sect. 8.6

ANSWER: 003 (1.00)

c

REFERENCE:

Reed Training Manual Sect 9.6

ANSWER: 004 (1.00)

b

REFERENCE:

Reed Training Manual Sect. 10.1

$$P_r = P_o e^{vT}$$

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

A. RX THEORY, THERMO & FAC OP CHARS

ANSWER: 005 (1.00)

c

REFERENCE:

Reed Training Manual Sect. 10.1

Lamarsh, J.R., Introduction to Nuclear Engineering, Addison-Wesley Publishing, Reading, Massachusetts, 1983. Sect. 3.7, Table 3.6, p. 77

ANSWER: 006 (1.00)

c

REFERENCE:

Reed Training Manual Sect. 10.5.2

ANSWER: 007 (1.00)

b

REFERENCE:

$$C.R. = S/(1 - K_{eff}) \quad C.R. = 50/(1 - 0.8) = 50/0.2 = 250$$

ANSWER: 008 (1.00)

c

REFERENCE:

Reed Training Manual Sect. 9.7

Lamarsh, J.R., Introduction to Nuclear Engineering, Addison-Wesley Publishing, Reading, Massachusetts, 1983. Sect. 7.1, p. 289.

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

A. RX THEORY, THERMO & FAC OP CHARS

ANSWER: 009 (1.00)

c

REFERENCE:

Lamarsh, J.R., Introduction to Nuclear Engineering, Addison-Wesley Publishing, Reading, Massachusetts, 1983. Sect. 4,1, p. 102 & Sect. 7.1, p. 282.

ANSWER: 010 (1.00)

c

REFERENCE:

Reed Training Manual Sect. 7.5.2
Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, Kreiger Publishing, Malabar, Florida, 1991, Sect. 2.70 2.74, pp. 65 -- 66.

ANSWER: 011 (1.00)

a

REFERENCE:

Reed Training Manual Sect. 10 2
Lamarsh, J.R., Introduction to Nuclear Engineering, Addison-Wesley Publishing, Reading, Massachusetts, 1983. Sect. 5.10, p. 213 215.

ANSWER: 012 (1.00)

b

REFERENCE:

Rod Curve

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

A. RX THEORY, THERMO & FAC OP CHARS

ANSWER: 013 (1.00)

d

REFERENCE:

Lamarsh, J.R., Introduction to Nuclear Engineering, Addison-Wesley Publishing, Reading, Massachusetts, 1983. Sect. 7.2, p. 303.

ANSWER: 014 (1.00)

b.

REFERENCE:

Reed Training Manual Sect. 10.3
Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, Kreiger Publishing, Malabar, Florida, 1991, Sect. 5.198, p. 300.

ANSWER: 015 (1.00)

c

REFERENCE:

REED Reactor Training Manual Sect. 9.8

$$k = 1 / (1 - \beta) \quad k = 1 \text{ when } \rho = \beta$$

ANSWER: 016 (1.00)

b.

REFERENCE:

Reed Training Manual Sect. 10.4.2
Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, Kreiger Publishing, Malabar, Florida, 1991, 5.56 5.80, pp. 250 260.

A. RX THEORY, THERMO & FAC OP CHARS

ANSWER: 017 (1.00)

b

REFERENCE:

RRF Training Manual, page 10-16.

ANSWER: 018 (1.00)

c

REFERENCE:

Reed Requal Exam 1990

ANSWER: 019 (1.00)

d

REFERENCE:

Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, Kreiger Publishing, Malabar, Florida, 1991, 3.161 3.163, pp. 190 191.

ANSWER: 020 (1.00)

d

REFERENCE:

$CR1/CR2 = (1 - K_{eff2})/(1 - K_{eff1})$
 $1/32 (1 - 0.95) = 1 - K_{eff2}$
 $1 - 0.05/32 = K_{eff2}$
 $K_{eff2} = 0.9984$

(***) END OF CATEGORY A (***)
 (***** END OF EXAMINATION *****)

A. RX THEORY, THERMO & FAC OP CHARS

ANSWER KEY

MULTIPLE CHOICE

001 a

002 a

003 c

004 b

005 c

006 c

007 b

008 c

009 c

010 c

011 a

012 b

013 d

014 b

015 c

016 b

017 b

018 c

019 d

020 d

(*** END OF CATEGORY A ***)
(***** END OF EXAMINATION *****)

U. S. NUCLEAR REGULATORY COMMISSION
NON-POWER REACTOR LICENSE EXAMINATION

FACILITY: Reed College

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 1996/09/23

REGION: IV

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<u>VALUE</u>	<u>SCORE</u>	<u>TOTAL</u>	
<u>20.00</u>	_____	_____ %	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS

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

Candidate's Signature

ENCLOSURE 2

B. NORMAL/EMERG PROCEDURES & RAD CON

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

001 a b c d ____

002 a b c d ____

003 a b c d ____

004 a b c d ____

005 a b c d ____

006 a b c d ____

007 a b c d ____

008 a b c d ____

009 a b c d ____

010 a b c d ____

011 a b c d ____

012 a b c d ____

013 a b c d ____

014 a b c d ____

015 a b c d ____

016 a b c d ____

017 a b c d ____

018 a b c d ____

019 a b c d ____

020 a b c d ____

(*** END OF CATEGORY B ***)
(***** END OF EXAMINATION *****)

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B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: 001 (1.00)

An irradiated sample provides a dose rate of 200 mr/hr at 3 ft. Approximately how far from the sample must a Radiation Area sign be posted?

- a. 5 ft.
- b. 8 ft.
- c. 20 ft.
- d. 50 ft.

QUESTION: 002 (1.00)

Which one of the following radiation detector types does not have an output intensity (current or pulse height) proportional to the incident radiation energy; i.e., if the incident energy increases, the output intensity does not increase?

- a. Ion Chamber
- b. GM
- c. Proportional Counter
- d. Scintillation

QUESTION: 003 (1.00)

Which one of the following is the best absorber of beta radiation?

- a. wood
- b. water
- c. concrete
- d. lead

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: 004 (1.00)

Based on the Requalification Plan for operators at the REED Reactor facility, each licensed operator must complete a minimum of _____ reactivity manipulations during each requalification year.

- a. 4
- b. 6
- c. 8
- d. 10

QUESTION: 005 (1.00)

A reactor sample has a disintegration rate of 5×10^{12} disintegrations per second. Each disintegration emits a .6 Mev gamma. What is the dose rate expected 5 feet from the above sample (assume point source)?

- a. 7 R/hr
- b. 19 R/hr
- c. 135 R/hr
- d. 162 R/hr

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: 006 (1.00)

Which one of the following conditions COMPLETELY satisfies the technical specification definition of "Reactor Shutdown?"

- a. When the reactor contains insufficient fissile material to attain criticality under optimum available conditions of moderation and reflection.
- b. When all scramable rods have been fully inserted, and the reactor is shutdown by greater than 0.7% delta K/K, and the console key has been removed from the console.
- c. When no work is in progress involving core fuel, and the reactor is subcritical by 0.7% delta K/K, and the console key has been removed from the console.
- d. When sufficient control rods are inserted to assure that the reactor is subcritical by at least 1.00 dollar of reactivity, with the fuel and moderator at ambient temperature.

QUESTION: 007 (1.00)

The Emergency Support Center is located within the:

- a. Site Boundary.
- b. Operations Boundary.
- c. Operations Boundary when the control room door is opened.
- d. The Emergency Planning Zone.

QUESTION: 008 (1.00)

A source of radiation release to the environment through the ventilation system during reactor operation is:

- a. Nitrogen-16 from the activation of air
- b. Argon-41 from the activation of air
- c. Nitrogen-16 from pool water evaporation
- d. Argon-41 from activation of pool water

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

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: 009 (1.00)

A system or component is defined as "operable" by Technical Specifications if:

- a. a channel check has been performed.
- b. it is capable of performing its intended function.
- c. it has no outstanding testing requirements.
- d. It is correctly lined-up and has an adequate source of power.

QUESTION: 010 (1.00)

Which one of the following requires a Radiation Work Permit (RWP)?

- a. Whenever a sample is being removed from the Lazy Suzan.
- b. When entering a potentially contaminated area.
- c. Whenever the expected whole body dose is in excess of 5 mR.
- d. Whenever the person performing the operation deems it necessary.

QUESTION: 011 (1.00)

While performing SOP 01, The Start-up Checklist, the operator places the Count Rate Channel switch to one of the calibrate positions and attempts to raise a control rod. The Source light illuminates and rod motion is noted to occur. Which one of the following describes what was just observed?

The operator checked that the:

- a. Rod Raising Interlock is operable.
- b. Source Interlock is operable.
- c. Rod Raising Interlock is inoperable.
- d. Source Interlock is inoperable.

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: 012 (1.00)

Which one of the following is a prerequisite prior to inspecting any control rod?

- a. Perform a shutdown margin calculation to ensure the reactor remains shutdown during the rod inspection.
- b. Move any two elements of the B ring to the fuel storage racks.
- c. Perform a reactor startup to evaluate core excess.
- d. Perform the "Calibration and Scram Check" portion of the Start-up Checklist to ensure the scram circuit is operable.

QUESTION: 013 (1.00)

You are the RO during a reactor startup. You verify that the core excess is \$3.15. Which of the following statements correctly lists your subsequent actions?

- a. Lower the Safety and Shim rods until equilibrium is reached. Calculate the shutdown margin.
- b. Shutdown the reactor. Notify the Reactor Supervisor.
- c. Record the critical rod positions after establishing equilibrium conditions. Complete the remainder of the Purpose Stamp.
- d. Shutdown the reactor. Notify the NRC at (301)816-5100.

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: 014 (1.00)

You are designated as "Checker" for the Start-up checklist just completed. Under the console section of the checklist, the following data is observed:

	<u>Calibration Pt.</u>	<u>Scram Setpoint</u>
Linear Channel	104%	273 kW
Percent Power Channel	103%	276 kW
Period Channel	5 sec	2.8 sec

Which one of the following describes your expected response to this data?
(According to the Tech. Specs.)

- a. The Period Channel Scram setpoint exceeds the allowable limit.
Operations cannot proceed.
- b. The Percent Power Scram setpoint exceeds the allowable limit.
Operations cannot proceed
- c. The Linear Channel Scram setpoint exceeds the allowable limit.
Operations cannot proceed
- d. All data is acceptable, operations can proceed.

QUESTION: 015 (1.00)

The REED reactor has been shutdown due to a fuel element leak. Which one of the following radioactive gases poses the most significant hazard during the search for the leaking fuel element? Assume that the fuel element is leaking during the search.

- a. Nitrogen-16
- b. Tritium
- c. Xenon-135
- d. Argon-41

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: 016 (1.00)

A point source of gamma radiation measures 50 mr/hr at 5 ft. What is the exposure rate (mr/hr) from the source at a distance of 10 ft.

- a. 25 mr/hr
- b. 12.5 mr/hr
- c. 6.25 mr/hr
- d. 17.5 mr/hr

QUESTION: 017 (1.00)

Which ONE of the following is the correct posting if the radiation level in the area is 75 mr/hr?

- a. CAUTION RADIATION AREA
- b. CAUTION RADIOACTIVE MATERIAL(S)
- c. CAUTION AIRBORNE RADIOACTIVITY AREA
- d. CAUTION HIGH RADIATION AREA

QUESTION: 018 (1.00)

In accordance with SOP-03, Reactor Operations, which one of the following statements describes when a STATUS STAMP is to be completed during operations at constant power.

- a. Whenever 30 minutes pass without an intervening shift change.
- b. Whenever a Technical Specification limit is exceeded.
- c. Whenever the reactor operator is temporarily replaced.
- d. When rods are moved to maintain the flux profile.

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

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: 019 (1.00)

The preferred hospital for dealing with radiological injuries is:

- a. Providence Hospital
- b. Good Samarital Hospital
- c. Mount Sinai Hospital
- d. Kaiser Permanente

QUESTION: 020 (1.00)

Per Reed's Emergency Implementation Procedures, where do facility personnel assemble when the Reactor Facility must be evacuated due to a fire?

- a. Chemistry Laboratory
- b. Reactor parking area
- c. Director's Office, Chem 102
- d. Chemistry building hallway

(***** END OF CATEGORY B *****)

B. NORMAL/EMERG PROCEDURES & RAD CON

ANSWER: 001 (1.00)

c

REFERENCE:

$$\begin{aligned} DR_1 D_1^2 &= DR_2 D_2^2 \\ (200 \text{ mr/hr})(3 \text{ ft}^2) &= (5 \text{ mr/hr}) X^2 \\ X &= \sqrt{(200 \times 9)/5} = 18.97 \approx 20 \text{ ft} \end{aligned}$$

ANSWER: 002 (1.00)

b

REFERENCE:

REED Training Manual, Sect. 6.2

ANSWER: 003 (1.00)

a

REFERENCE:

REED Training Manual, Sect. 3.4.2

ANSWER: 004 (1.00)

d

REFERENCE:

REED Reactor Facility Requalification Plan, Sect. 4.2

B. NORMAL/EMERG PROCEDURES & RAD CON

ANSWER: 005 (1.00)

b

REFERENCE:

1 Curie = 3.7×10^{10} dps $\Rightarrow (5 \times 10^{12} \text{ dps}) / 3.7 \times 10^{10} \text{ dps} = 135 \text{ Ci}$
 $\rightarrow \text{DR} = (6 \times 135 \times .6) / 52 = 19 \text{ R/hr}$

ANSWER: 006 (1.00)

c

REFERENCE:

Technical Specification Definition A.1

ANSWER: 007 (1.00)

a

REFERENCE:

REED Emergency Plan pg 8, 26

ANSWER: 008 (1.00)

b

REFERENCE:

Lamarsh, Intro. to Nuclear Eng., 2nd Ed., pg. 520
REED SAR pg. 7-6

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

B. NORMAL/EMERG PROCEDURES & RAD CON

ANSWER: 009 (1.00)

b

REFERENCE:

T.S. Definitions A.3

ANSWER: 010 (1.00)

c

REFERENCE:

SOP-28, Radiation Work Permits, 28.2

ANSWER: 011 (1.00)

d

REFERENCE:

Reed, SOP 01, Step 1.7.6.7, page 8.

ANSWER: 012 (1.00)

b

REFERENCE:

SOP-41, Control Rod Inspection, 41.4.2
REED Admin Procedures, pg AP-11

ANSWER: 013 (1.00)

b

REFERENCE:

SOP-02 sect. 2.7.2.2
(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

B. NORMAL/EMERGENCY PROCEDURES & RAD CON

ANSWER: 014 (1.00)

b

REFERENCE:

T.S. Table 1

ANSWER: 015 (1.00)

c

REFERENCE:

Facility Comments on 5/96 Written Examination
RRF SOP-91, 91.7.1

ANSWER: 016 (1.00)

b

REFERENCE:

RRF Training Manual ch. 2

ANSWER: 017 (1.00)

a

REFERENCE:

10 CFR 20.202

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

B. NORMAL/EMERG PROCEDURES & RAD CON

ANSWER: 018 (1.00)

c

REFERENCE:

SOP-03, 3.7.3.4

ANSWER: 019 (1.00)

b

REFERENCE:

Emergency Plan pg. EP-12, 3.1.14

ANSWER: 020 (1.00)

c

REFERENCE:

Emergency Implementation Procedures, EIP-3

(*** END OF CATEGORY B ***)
(***** END OF EXAMINATION *****)

B. NORMAL/EMERG PROCEDURES & RAD CON

ANSWER KEY

MULTIPLE CHOICE

001 c

002 b

003 a

004 d

005 b

006 c

007 a

008 b

009 b

010 c

011 d

012 b

013 b

014 b

015 c

016 b

017 a

018 c

019 b

020 c

(***** END OF EXAMINATION *****)

U. S. NUCLEAR REGULATORY COMMISSION
NON-POWER REACTOR LICENSE EXAMINATION

FACILITY: Reed College

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 1996/09/23

REGION: IV

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% is required to pass the examination. Examinations will be picked up one (1) hour after the examination starts.

<u>CATEGORY</u> <u>VALUE</u>	<u>CANDIDATE'S</u> <u>SCORE</u>	<u>% OF</u> <u>TOTAL</u>	<u>CATEGORY</u>
<u>20.00</u>	_____	_____%	C. PLANT AND RADIATION MONITORING SYSTEMS

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

Candidate's Signature

ENCLOSURE 2

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

001 a b c d ____

002 a b c d ____

003 a b c d ____

004 a b c d ____

005 a b c d ____

006 a b c d ____

007 a b c d ____

008 a b c d ____

009 a b c d ____

010 a b c d ____

011 a b c d ____

012 a b c d ____

013 a b c d ____

014 a ____ b ____ c ____ d ____

015 a b c d ____

016 a b c d ____

017 a b c d ____

018 a b c d ____

019 a b c d ____

(*** END OF CATEGORY C ***)
(***** END OF EXAMINATION *****)

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: 001 (1.00)

Which one of the following scrams is NOT required by Technical Specifications?

- a. Linear channel
- b. % power channel
- c. Manual
- d. Log channel

QUESTION: 002 (1.00)

The pool water level must be maintained at a specified level for proper skimmer operation. Why is this pool level necessary?

- a. Above this pool level, the reactor water system pumps will lose suction and fail.
- b. Below this level, air entry could interfere with proper operation of the rabbit tube.
- c. Above this level, the water pressure could damage the purification system filters.
- d. Below this level, air entry could reduce the effectiveness of the purification system demineralizers.

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: 003 (1.00)

Which one of the following would indicate a fuel element failure?

- a. A higher than normal pH as indicated by a water sample
- b. Slight discoloration of the pool water
- c. Above average fuel element temperature as indicated by a temperature probe
- d. Above average conductivity as indicated by a water sample at the exit of the fuel element

QUESTION: 004 (1.00)

The neutron absorber in Reed's reactor control rods is:

- a. Aluminum oxide
- b. Zirconium hydride
- c. Graphite powder
- d. Boron carbide

QUESTION: 005 (1.00)

What is the purpose of the orifice in the Primary Cooling System?

- a. To restrict coolant flow to 20 gpm through the demineralizers.
- b. To prevent excessive coolant flow back into the core.
- c. To restrict coolant flow to 100 gpm bypassing the demineralizers.
- d. To prevent excessive backpressure on the heat exchanger.

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: 006 (1.00)

Limit switches mounted on each drive assembly provide switching for console lights.

Which one of the following statements is FALSE?

- a. The DOWN light indicates that the control rod and rod drive are at their lower limits.
- b. The UP light indicates that the control rod and rod drive are at their upper limits.
- c. When the CONT/ON pushbuttons are depressed, the ON lights are extinguished.
- d. The CONT side light of the CONT/ON switch goes off less than one second after a scram occurs.

QUESTION: 007 (1.00)

What will be the effect of a high differential pressure across the filter on the reactor water pump and the demineralizer flows?

- a. Increase reactor water pump flow and increase demineralizer flow.
- b. Increase reactor water pump flow and decrease demineralizer flow.
- c. decrease reactor water pump flow and increase demineralizer flow.
- d. decrease reactor water pump flow and decrease demineralizer flow.

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: 008 (1.00)

Which one of the following ranges of nuclear instrumentation utilizes an uncompensated ion chamber as the neutron detection device?

- a. Count Rate channel
- b. Log N channel
- c. Linear Power channel
- d. % Power channel

QUESTION: 009 (1.00)

Which one of the following statements correctly describes the purpose of the PULL ROD in the control rod drive assembly?

- a. Provides rod full out position indication.
- b. Provides a means for manually adjusting rod position by pulling rod out.
- c. Provides rod bottom indication.
- d. Automatically engages the control rod on a pull signal.

QUESTION: 010 (1.00)

Which one of the following statements correctly describes the purpose of the potentiometer in the control rod drive assembly.

- a. Provides rod position indication when the electromagnet engages the connecting rod armature.
- b. Provides a variable voltage to the rod drive motor for regulating control rod speed.
- c. Provides potential voltage as required for resetting the electromagnet current.
- d. Provides the potential voltage to relatch the connecting rod.

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

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: 011 (1.00)

Which one of the following statements describes the drive speeds of the Shim rod, Regulating rod and Safety rod?

- a. The Shim rod drives at 24 inches per minute, the Regulating and Safety rods drive at 19 inches per minute.
- b. The Shim and Regulating rods drive at 24 inches per minute, the Safety rod drives at 19 inches per minute.
- c. The Safety rod drives at 24 inches per minute, the Regulating and Shim rods drive at 19 inches per minute.
- d. The Regulating rod drives at 24 inches per minute, the Safety and Shim rods drive at 19 inches per minute.

QUESTION: 012 (1.00)

In what region of the Pulse Size vs. Applied Voltage characteristic curve does the fission chamber operate?

- a. Geiger Muller
- b. Limited Proportionality
- c. Proportional
- d. Ionization

QUESTION: 013 (1.00)

Which one of the following occurs when the CAM reaches the "failsafe" setpoint?

- a. Amber light on.
- b. Amber light off.
- c. Amber light on and bell sounds.
- d. Amber light off and bell sounds.

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

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: 014 (2.00)

Match the facility radiation detector in column A with the type of radiological problem it detects in column B.

<u>Column A</u>	<u>Column B</u>
a. RAM	1. Gases and Particulates
b. CAM	2. Particulates Only
c. APM	3. Radiation Level
d. GSM	4. Gases Only

QUESTION: 015 (1.00)

The Reed Facility License grants permission for possession of 2 specific sources. Which one of the following describes these sources?

- a. A 2 mg Ra-226 and a 1.64 curie plutonium-beryllium source.
- b. A 1 curie americium-beryllium and a 1.64 curie plutonium-beryllium source.
- c. A 1.64 curie americium-beryllium and a 1 curie plutonium-beryllium source.
- d. A 2 mg Ra-226 and a 1 curie americium-beryllium source.

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: 016 (1.00)

Air contamination greater than the setpoint has been detected in the Reactor Room.

Which one of the following is the correct response by the ventilation system?

- a. The supply system will automatically stop, dampers will direct air through filters purging the room at 150 cfm.
- b. The supply system will shift to high speed, dampers will direct the exhaust to the ventilation stack at 150 cfm.
- c. The exhaust system will shift to high speed, dampers will direct air through filters purging the room at 150 cfm.
- d. The exhaust system will automatically stop, dampers will direct air through filters purging the room at 150 cfm.

QUESTION: 017 (1.00)

Which one of the following correctly describes how the cleanup system functions to minimize corrosion of reactor components?

The cleanup system

- a. maintains pool water pH at a basic value.
- b. maintains pool water pH at an acidic value.
- c. maintains pool water conductivity low.
- d. filters suspended particles from the pool water.

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

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: 018 (1.00)

With the rod control system in automatic mode, the circuit will change power on a +30 second period based on a rate signal from the _____ channel and a level signal from the _____ channel.

- a. linear, log-n
- b. log-n, linear
- c. startup, linear
- d. log-n, percent power

QUESTION: 019 (1.00)

Which one of the following describes the action of the rod control system to drive the magnet draw tube down after a dropped rod?

- a. Deenergizing the rod magnet initiates the rod down motion of the draw tube.
- b. Actuation of the MAGNET DOWN limit switch initiates the rod down motion of the draw tube.
- c. Actuation of the ROD DOWN limit switch initiates the rod down motion if the rod drive is withdrawn.
- d. Resetting the scram signal initiates the rod down motion of the draw tube.

(*** END OF CATEGORY C ***)
(***** END OF EXAMINATION *****)

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER: 001 (1.00)

d

REFERENCE:

Tech Specs Table I

ANSWER: 002 (1.00)

d

REFERENCE:

GA Triga Mechanical Maintenance and Operating Manual, pg. 81

ANSWER: 003 (1.00)

d

REFERENCE:

Facility Comments from exam administered in 1/95

ANSWER: 004 (1.00)

d

REFERENCE:

GA Triga Mechanical Maintenance and Operating Manual, pg. 15

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER: 005 (1.00)

c

REFERENCE

GA Triga Mechanical Maintenance and Operating Manual, pg. 78

ANSWER: 006 (1.00)

b

REFERENCE:

SAR pg. 5-12

GA TRIGA Electrical Maintenance Manual, pg. 22

ANSWER: 007 (1.00)

d

REFERENCE:

GA TRIGA Mechanical Maintenance and Operating Manual. pg. 77

ANSWER: 008 (1.00)

d

REFERENCE:

SAR Fig. 5-7, Block diagram of reactor instrumentation

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER: 009 (1.00)

c

REFERENCE:

RRF SAR (pg 5-8 thru 5-12)

ANSWER: 010 (1.00)

a

REFERENCE:

RRF SAR pg 5-12

ANSWER: 011 (1.00)

d

REFERENCE:

SAR pg. 5-11

ANSWER: 012 (1.00)

c

REFERENCE:

RRF Training Manual, pg. 6-8

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER: 013 (1.00)

b

REFERENCE:

Reed SOP-70, Section 70.7.3.2

ANSWER: 014 (2.00)

a, 3; b, 1; c, 2; d, 4

REFERENCE

SOP-30, Cal. of RAM; SOP-31, Cal. of CAM; SOP-32, Cal of APM; SOP-33, Cal. of GSM

ANSWER: 015 (1.00)

c

REFERENCE:

Reed Facility License, Section 2.

ANSWER: 016 (1.00)

a

REFERENCE:

SAR pg. 4-5

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER: 017 (1.00)

c

REFERENCE:

RRF SAR, Sect. 5.2.6 p. 5-7.

ANSWER: 018 (1.00)

b

REFERENCE:

RRF SAR, Sect. 5.3.2, p. 5-14

ANSWER: 019 (1.00)

c

REFERENCE:

GA TRIGA Mech. Maint. & Operating Manual

(*** END OF CATEGORY C ***)
(***** END OF EXAMINATION *****)

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER KEY

MULTIPLE CHOICE

- 001 d
- 002 d
- 003 d
- 004 d
- 005 c
- 006 b
- 007 d
- 008 d
- 009 c
- 010 a
- 011 d
- 012 c
- 013 b
- 014 a. 3; b. 1; c. 2; d. 4
- 015 c
- 016 a
- 017 c
- 018 b
- 019 c

(*** END OF CATEGORY C ***)
(***** END OF EXAMINATION *****)