

July 3, 2007

Mr. Steven G. Frantz, Director  
Reed Reactor Facility  
3203 SE Woodstock Blvd.  
Portland, OR 97202

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-288/OL-07-01, REED COLLEGE

Dear Mr. Frantz:

During the weeks of April 30 and May 7, 2007, the NRC administered initial operator licensing examinations at your Reed College Reactor facility. The examinations were conducted according to NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with 10 CFR 2.390 of the Commission's regulations, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) <http://www.nrc.gov/reading-rm/adams.html>. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Phillip T. Young at (301) 415-4094 or via internet e-mail [pty@nrc.gov](mailto:pty@nrc.gov).

Sincerely,

/RA/

Johnny Eads, Chief  
Research and Test Reactors Branch B  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

Docket No. 50-288

Enclosures: 1. Initial Examination Report No. 50-288/OL-07-01  
2. Facility Comments on NRC Written Examination  
3. Initial examination and answer key

cc w/encls:  
Please see next page

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DHughes

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Facility File (EBarnhill) O-6 F-2

JEads

**ADAMS ACCESSION #: ML071790231**

**TEMPLATE #:NRR-074**

OFFICE	PRTB:CE	IOLB:LA	PRTB:C
NAME	PYoung:mlc	EBarnhill	JEads:tls
DATE	6/29/2007	6/29/2007	6/29/2007

OFFICIAL RECORD COPY

Reed College

Docket No. 50-288

cc:

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Portland, OR 97204

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3203 S.E. Woodstock Boulevard  
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ATTN: David Stewart-Smith, Director  
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Salem, OR 97310

Test, Research, and Training  
Reactor Newsletter  
University of Florida  
202 Nuclear Sciences Center  
Gainesville, FL 32611

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

REPORT NO.: 50-288/OL-07-01

FACILITY DOCKET NO.: 50-288

FACILITY LICENSE NO.: R-112

FACILITY: Reed College

EXAMINATION DATES: April 30 - May 8, 2007

SUBMITTED BY: \_\_\_\_\_ 6/ /2007  
Phillip T. Young, Chief Examiner Date

**SUMMARY:**

During the weeks of April 30 and May 7, 2007, the NRC administered Examinations to 21 Operator Licensing Candidates. All 21 candidates passed their respective examinations.

**REPORT DETAILS**

1. Examiners: Phillip T. Young (CE), and Patrick Isaac

2. Results:

	<b>RO PASS/FAIL</b>	<b>SRO PASS/FAIL</b>	<b>TOTAL PASS/FAIL</b>
Written	12/0	0/0	12/0
Operating Tests	12/0	9/0	21/0
Overall	12/0	9/0	21/0

3. Exit Meeting:  
Phillip T. Young, NRC, Examiner  
Johnny Eads, NRC, Chief, Research and Test Reactors Branch "B"  
Stephen Frantz, Reed College, Facility Director

The NRC examiners thanked the facility for their support in the administration of examinations. The examiners complimented the facility on the quality of the training given to the candidates taking the examination.

ENCLOSURE 1

FACILITY COMMENTS ON NRC WRITTEN EXAMINATION WITH  
NRC RESOLUTIONS ADDED.

"Stephen Frantz" <sgfrantz@gmail.com>  
Reed College Exam April 2007  
Here are my comments on the written. Thank you.

FACILITY COMMENT - QUESTION A.003

We don't teach the percentage of neutrons that are thermal. I'll add it to the training program.

NRC RESPONSE

Comment Noted.

FACILITY COMMENT - QUESTION B.006

The correct answer is closer to "C" per Reed Emergency Plan, page 23.

NRC RESPONSE

Comment accepted. Correct answer to question B.006 changed to 'c.'

FACILITY COMMENT - QUESTION B.010

This question is the same as C11. One of them should probably be deleted. Also, the questions on automatic rod control all refer to the old automatic rod system which was replaced in 2003. So Questions B10, C11, and C12 don't have clear-cut answers to match the new system that was installed in 2006.

NRC RESPONSE

Comment accepted. Questions B.010 and C.012 deleted from the examination.

FACILITY COMMENT - QUESTION C.005

The time the emergency lights will work was removed from the Reed Emergency Plan a few years back after they were replaced. There is no correct answer anymore. This question should probably be deleted.

NRC RESPONSE

Comment accepted. Question C.005 deleted from the examination.

FACILITY COMMENT - QUESTION C.014

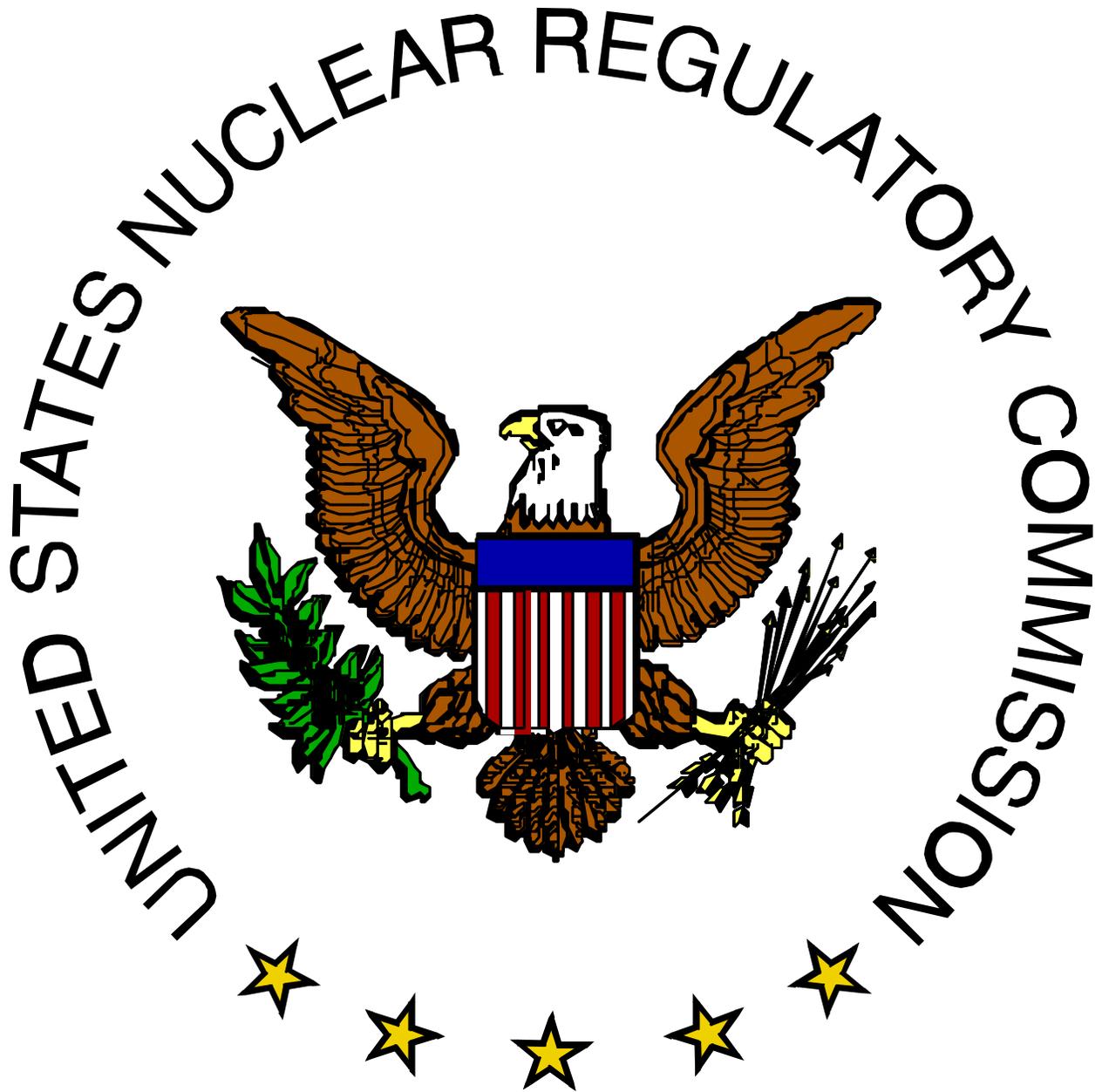
There is no correct answer since the period scram was removed.

NRC RESPONSE

Comment accepted. Question C.014 deleted from the examination.

ENCLOSURE 2

**REED COLLEGE**  
**WRITTEN EXAM W/ANSWERS**



**OPERATOR LICENSING EXAMINATION**  
**APRIL 30, 2007**

ENCLOSURE 3

**Question** A.001 [1.00 Points] (1.0)

Which of the following describes the "Photoelectric Effect?"

- a. A photon is incident on a slab of material and a different wavelength photon and electron are emitted from the material.
- b. A photon is absorbed by an atom, which excites an orbital electron. The excited electron emits a photon of the same wavelength.
- c. A high energy photon decays into an electron and a positron.
- d. A photon strikes a slab of metal material and an electron is liberated from the surface of the metal.

Answer: A.001 d.

Reference: RRF Training Manual

**Question** A.002 [1.00 Points] (2.0)

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.

Answer: A.002 c

Reference: Reed Requal Exam 1990

**Question** A.003 [1.00 Points] (3.0)

Which one of the following is the percentage of the total neutron flux made up by THERMAL neutrons while operating at 10 KW?

- a. 10%
- b. 33%
- c. 50%
- d. 75%

Answer: A.003 b.

Reference: Burn, R., Intro to Nuclear Reactor Operations, © 1982, § 3.2.4, pp. 3-12.

**Question** A.004 [1.00 Points] (4.0)

Which factor of the Six Factor formula is most easily varied by the reactor operator?

- a. Thermal Utilization Factor (f)
- b. Reproduction Factor ( $\eta$ )
- c. Fast Fission Factor ( $\epsilon$ )
- d. Fast Non-Leakage Factor ( $L_f$ )

Answer: A.004 a.

Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.2, pp. 3-13 — 3-18.

**Question** A.005 [1.00 Points] (5.0)

$K_{eff}$  for the reactor is 0.98. If you place an experiment worth **+\$1.00** into the core, what will the new  $K_{eff}$  be?

- a. 0.982
- b. 0.987
- c. 1.013
- d. 1.018

Answer: A.005 b.

Reference:  $SDM = (1 - k_{eff}) / k_{eff} = (1 - 0.98) / 0.98 = 0.02 / 0.98 = 0.02041$  or  $0.02041 / .0075 = \$2.72$ , or a reactivity worth ( $\rho$ ) of  $-\$2.72$ . Adding  $+\$1.00$  reactivity will result in a SDM of  $\$2.72 - \$1.00 = \$1.72$ , or  $.0129081 \Delta K/K$   
 $K_{eff} = 1 / (1 + SDM) = 1 / (1 + 0.0129081) = 0.987$

**Question** A.006 [1.00 Points] (6.0)

About two minutes following a reactor scram, period has stabilized, and is decreasing at a CONSTANT rate. If reactor power is  $10^{-5}$  % full power what will the power be in three minutes.

- $5 \times 10^{-6}$  % full power
- $2 \times 10^{-6}$  % full power
- $10^{-6}$  % full power
- $5 \times 10^{-7}$  % full power

Answer: A.006 c.

Reference:  $P = P_0 e^{-T/\tau} = 10^{-5} \times e^{(-180\text{sec}/80\text{sec})} = 10^{-5} \times e^{-2.25} = 0.1054 \times 10^{-5} = 1.054 \times 10^{-6}$

**Question** A.007 [1.00 Points] (7.0)

As primary coolant temperature increases, rod worth:

- increases due to higher reflector efficiency.
- decreases due to higher neutron absorption in the moderator.
- increases due to the increase in thermal diffusion length.
- remains the same due to constant poison cross-section of the control rods.

Answer: A.007 c.

Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.2, p. 3-18

**Question** A.008 [1.00 Points] (8.0)

Which ONE of the following statements correctly describes the influence of delayed neutrons on the neutron life cycle?

- Delayed neutrons decrease the average period of a reactivity addition because they thermalize more quickly than prompt neutrons.
- Delayed neutrons take longer to thermalize because they are born at higher energies than prompt neutrons.
- Delayed neutrons cause the length of the average neutron generation time to increase.
- Delayed neutrons are born later than prompt neutrons and make up a larger fraction of the fission neutrons.

Answer: A.008 c.

Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering*, Kreiger Publishing, Malabar, Florida, 1991, § 5.20, p. 236.

**Question** A.009 [1.00 Points] (9.0)

With the reactor on a constant period, which transient requires the longest time to occur?

A reactor power change of:

- a. 5% power -- going from 1% to 6% pwr
- b. 10% power -- going from 10% to 20% pwr
- c. 15% power -- going from 20% to 35% pwr
- d. 20% power -- going from 40% to 60% pwr

Answer: A.009 a.

Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering*, Kreiger Publishing, Malabar, Florida, 1991, § 5.18, p. 234.

**Question** A.010 [1.00 Points] (10.0)

What is the stable Reactor 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.

Answer: A.010 b.

Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering*, Kreiger Publishing, Malabar, Florida, 1991, § 5.18, p. 234.

**Question** A.011 [1.00 Points] (11.0)

Which ONE of the following statements describes Count Rate characteristics after a control rod withdrawal with the reactor subcritical? (Assume the reactor remains subcritical.)

- a. Count rate will rapidly increase (prompt jump) then gradually increase to a stable value.
- b. Count rate will rapidly increase (prompt jump) to a stable value.
- c. There will be no change in Count rate until criticality is achieved.
- d. Count rate will rapidly increase (prompt jump) then gradually decrease to the previous value.

Answer: A.011 a .

Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering*, Kreiger Publishing, Malabar, Florida, 1991, § 5.31, p. 240.

**Question** A.012 [1.00 Points] (12.0)

In a subcritical reactor,  $K_{eff}$  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

Answer: A.012 c.

Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering*, Kreiger Publishing, Malabar, Florida, 1991, § 3.44, p. 149 & § 5.9, p. 231.

**Question** A.013 [1.00 Points] (13.0)

Which one of the following describes "Excess Reactivity"?

- 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.

Answer: A.013 b.

Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering*, Kreiger Publishing, Malabar, Florida, 1991, § 5.198, p. 300.

**Question** A.014 [1.00 Points] (14.0)

Assume the following rod worths: Safety \$4.25, Shim \$4.05, Reg. \$1.75, and Core excess is \$2.5. Calculate the Shutdown Reactivity to satisfy the T.S. Minimum Shutdown Margin.

- a. \$3.3
- b. \$3.5
- c. \$6.1
- d. \$7.5

Answer: A.014 a.

Reference: T.S. Section F.3; also Reed Requal. Exam 88-89

**Question** A.015 [1.00 Points] (15.0)

The Reed College Triga Reactor is slightly undermoderated. Which one of the following statements correctly describes the reactor operating characteristic of "Undermoderated"?

- a. A decrease in core water temperature will cause a negative reactivity response.
- b. Reducing the amount of moderation will cause a positive reactivity response.
- c. An increase in core water temperature will cause a positive reactivity response.
- d. A decrease in core water density will cause a negative reactivity response.

Answer: A.015 d.

Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering*, Kreiger Publishing, Malabar, Florida, 1991, §§ 7.131 — 7.155, pp. 465 — 472.

**Question** A.016 [1.00 Points] (16.0)

Which statement best describes Xe-135 behavior following a Reactor Scram?

- a. Xenon concentration decreases due to production rate from fission stops.
- b. Xenon concentration decreases due to production rate from I-135 decay increasing.
- c. Xenon concentration increases due to production rate from Pm-149 increasing.
- d. Xenon concentration increases due to I-135 decay exceeding Xe-135 decay.

Answer: A.016 d.

Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering*, Kreiger Publishing, Malabar, Florida, 1991, §§ 5.56 — 5.80, pp. 250 — 260.

**Question** A.017 [1.00 Points] (17.0)

The reactor has been operating for 3 weeks at 230 KW, when a loss of cooling accident causes the reactor core to be completely uncovered. The core cannot be recovered with water and must remain cooled only by air.

According to the Safety Analysis Report (SAR), the main radiation hazard will be produced by the \_\_\_\_\_.

- a. melting of the fuel cladding when its temperature exceeds the melting point of aluminum
- b. rupture of the fuel cladding from the fission gas pressure buildup
- c. unshielded fuel elements in the reactor core
- d. activation of Argon-41 in the atmosphere of the reactor room

Answer: A.017 c.

Reference: SAR Section 2.1, and Section 7.3,

**Question A.018 [1.00 Points] (18.0)**

The reactor is critical at 10 KW. The regulating rod is pulled to insert a positive reactivity of \$0.18. Which one of the following will be the stable reactor period as a result of this reactivity insertion?

- a. 10 seconds
- b. 45 seconds
- c. 55 seconds
- d. 65 seconds

Answer: A.018 b.

Reference: Reactivity added = \$0.18 (.0075) = 0.00135 -  $\tau = (\beta - \rho) / \lambda_{\text{eff}} \rho = \frac{.0075 - .00135}{(.1) (.00135)} = 45.5 \text{ seconds}$

**Question A.019 [1.00 Points] (19.0)**

Reactor power has just been increased to 200 KW, and the reactor is operating in the automatic mode. The fuel temperature increases from 220 degrees to 225 degrees C. Given the following information:

Fuel temperature coefficient is -0.01% delta k/k/degree C.  
Regulating rod worth is 0.05% delta k/k/inch.

Which one of the following states HOW FAR and in WHAT DIRECTION the regulating rod moves? ASSUME none of the other control rods move.

- a. Regulating Rod moves out 0.2 inch.
- b. Regulating Rod moves in 0.2 inch.
- c. Regulating Rod moves out 1.0 inch.
- d. Regulating Rod moves in 1.0 inch.

Answer: A.019 c.

Reference: SAR Appendix E, SAR Section 5.2.7 Reed Reactor Facility Training Manual, Section 10.5.1, pg 10-15  
 $(-0.0001 \text{ delta k/k/degree C}) \times (5 \text{ degrees C}) = -0.0005 \text{ delta k/k}$  - therefore the rod must add +0.0005 dk/k to hold power stable:  $(0.0005 \text{ dk/k}) / (0.0005 \text{ dk/k/inch}) = 1.0 \text{ inch out}$

**Question** A.020 [1.00 Points] (20.0)

Which one of the following is the principal source of heat in the reactor after a shutdown from extended operation at 200 KW?

- a. Production of delayed neutrons
- b. Photoneutron-induced fissions
- c. Spontaneous fission of U-238
- d. Decay of fission fragments

Answer: A.020 d.

Reference: Nuclear Reactor Engineering, Glasstone & Sesonske, 1967, Section 2.187

(\*\*\*\*\* END OF SECTION A \*\*\*\*\*)

**Question:** B.001 [1.0 point] (1.0)

A small radioactive source is to be stored in the reactor building. The source is estimated to contain 2 curies and emit a 1.33 Mev gamma. Assuming no shielding was to be used, a Radiation Area barrier would have to be erected from the source at a distance of approximately:

- 6 inches
- 21 inches
- 21 feet
- 57 feet

Answer: B.001 d

Reference:  $DR = 6CEn/(f)(f) = 0.005 R = 6(2)(1.33)/x^2$ ,  $x^2 = 3192$ ,  $x = 56.50$  feet

**Question:** B.002 [1.0 point] (2.0)

Based on 10CFR55, which one of the following is the MINIMUM requirement that must be met to retain an "active" license?

- Must perform license duties at least 4 hours per calendar quarter.
- Must perform license duties a minimum of 8 hours per month.
- Must perform license duties a minimum of 5 eight-hour shifts per calendar quarter.
- Must perform license duties at least 40 hours per calendar year.

Answer: B.002 a

Reference: 10CFR55.53(e)

**Question:** B.003 [1.0 point] (3.0)

Operator "A" works a standard forty (40) hour work week. His duties require him to work in a radiation area for (4) hours a day. The dose rate in the area is 10 mR/hour. Which one of the following is the MAXIMUM number of days Operator "A" may perform his duties without exceeding 10CFR20 limits?

- 12 days
- 25 days
- 31 days
- 125 days

Answer: B.003 d.

Reference: 10CFR20.1201(a)(1)

$5000 \text{ mr} \times \frac{1 \text{ hr}}{10 \text{ mr}} \times \frac{\text{day}}{4 \text{ hr}} = 125 \text{ days}$

**Question:** B.004 [1.0 point] (4.0)

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. a functional test has been performed.

Answer: B.004 b.

Reference: REED T.S. Definitions

**Question:** B.005 [1.0 point] (5.0)

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

Answer: B.005 b.

Reference: SOP-03

**Question:** B.006 [1.0 point] (6.0)

Which one of the following is a definition for "Emergency Planning Zone" (EPZ)?

- a. The geographical area that is beyond the site boundary where the Reactor Director has direct authority over all activities.
- b. The Psychology building located on the REED College Campus.
- c. The area which includes the Psychology building and extends 250 feet in every direction from the center of the reactor.
- d. The area beyond the site boundary at which Protective Action Guide (PAG) could be exceeded.

Answer: B.006 ~~d~~: c. Changed per facility comment.

Reference: Emergency Plan

**Question:** B.007 [1.0 point] (7.0)

Which one of the following radioactive gases poses the most significant hazard within the reactor room during normal operations?

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

Answer: B.007 d.

Reference: NRC Requalification Exam - Chart of the Nuclides

**Question:** B.008 [1.0 point] (8.0)

While conducting a tour of a radiation area, your pocket dosimeter goes off-scale after being dropped. Which one of the following actions do you take?

- a. Stay where you are and call for help.
- b. Reset the dosimeter back to zero. Notify Health Physics after completion of tour.
- c. Leave the radiation area and notify Health Physics or Reactor Operations.
- d. Continue the tour making sure to stay out of High-radiation areas. Obtain a new dosimeter from Reactor Health Physics.

Answer: B.008 c.

Reference: NRC REED Examination Bank

**Question:** B.009 [1.0 point] (9.0)

Which one of the following has the ultimate responsibility to ensure the emergency grab bag has been taken when evacuating the facility?

- a. Emergency Coordinator.
- b. The Operator.
- c. The Director.
- d. The first staff member using the exit corridor.

Answer: B.009 b.

Reference: EIP.7-8

~~Question deleted per facility comment.~~

~~Question: B.010 [1.0 point] (10.0)~~

~~A power decrease is being performed with the control servo in the Automatic Mode. Which one of the following describes the method by which the control rods will be positioned to continue the power decrease when the regulating rod approaches 20% of its length?~~

- ~~a. Shift the servo to manual, insert the regulating rod, and then insert the shim and safety rods.~~
- ~~b. Shift the servo to manual, insert the shim and safety rods, and then return the servo to automatic.~~
- ~~c. Both the shim and the safety rods should automatically drive in to assist in the power reduction.~~
- ~~d. Manually insert the shim or the safety rod to assist in power control with the servo in automatic.~~

~~Answer: B.010 d.~~

~~Reference: SOP 03~~

**Question: B.011 [1.0 point] (11.0)**

Your Reactor Operator license expires after \_\_\_\_\_ years.

- a. 2
- b. 4
- c. 6
- d. 8

Answer: B.011 c.

Reference: 10CFR55.55(a)

**Question: B.012 [1.0 point] (12.0)**

Whose approval is necessary before radioactive material can be transferred to personnel of another department?

- a. The Senior Reactor Operator on duty.
- b. The Health Physicist.
- c. The Reactor Operations Committee.
- d. The Director.

Answer: B.012 d.

Reference: Admin Procedures Sect. 5.1

**Question:** B.013 [1.0 point] (13.0)

While performing a power calibration the difference between the calculated power and the linear power channel is 2.0%. Which one of the below statements is correct for this condition?

- a. A chamber adjustment of the linear power channel must be performed.
- b. A difference this great is suspect and may be an indication of "shadowing effect".
- c. No adjustment to the power instrumentations is necessary. The power calibration is complete.
- d. The adjustments will be verified by a follow-up calorimetric prior to taking the reactor to greater than 200 kW indicated power.

Answer: B.013 c.

Reference: SOP 44.7.1

**Question:** B.014 [1.0 point] (14.0)

Which one of the following is the minimum temperature above which the reactor shall be shutdown?

- a. 120 °F
- b. 148 °C
- c. 48.9 °F
- d. 50 °C

Answer: B.014 a.

Reference: Tech. Specs D.1

**Question:** B.015 [1.0 point] (15.0)

In the event of a pool level alarm and visual indication of abnormal loss of pool water, which ONE of the following actions is the reactor operator NOT allowed to perform if he is the Emergency Coordinator.

- a. Shutdown the reactor
- b. Isolate the Pool
- c. Notify a member of the ENCL
- d. Terminate the emergency

Answer: B.015 d.

Reference: E plan 3.3

**Question:** B.016 [1.0 point] (16.0)

Which one of the following is the definition for "Annual Limit on Intake" (ALI)?

- a. The concentration of a radionuclide in air which, if inhaled by an adult worker for a year, results in a total effective dose equivalent of 100 millirem.
- b. 10 CFR 20 derived limit, based on a Committed Effective Dose Equivalent of 5 rems whole body or 50 rems to any individual organ, for the amount of radioactive material inhaled or ingested in a year by an adult worker.
- c. The effluent concentration of a radionuclide in air which, if inhaled continuously over a year, would result in a total effective dose equivalent of 50 millirem for noble gases.
- d. Projected dose commitment values to individuals, that warrant protective action following a release of radioactive material.

Answer: B.016 b.

Reference: 10CFR20.1003

**Question:** B.017 [1.0 point] (17.0)

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

Answer: B.017 c.

Reference: Emergency Implementation Procedures, EIP Situation 7

**Question:** B.018 [1.0 point] (18.0)

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

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

Answer: B.018 d.

Reference: Tech Specs Table 1

**Question:** B.019 [1.0 point] (19.0) **Question Changed during examination.**

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

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

Answer: B.019 a.

Reference: Reed, SOP 01, Step 1.7.6.6.2

**Question:** B.020 [1.0 point] (20.0)

An entry was made in the log in red ink. Which one of the following is the significance of the red ink?

- a. It indicates only unexplained scrams.
- b. It indicates only inadvertent scrams.
- c. It indicates a fuel movement.
- d. It indicates all in-core changes.

Answer: B.020 c.

Reference: SOP 10, 10.7.1.2; 10.7.7.1; & 10.7.8.2

(\*\*\*\*\* END OF SECTION B \*\*\*\*\*)

**Question:** C.001 [1.0 point] (1.0)

Graphite inserts are placed in the top and bottom of the fuel element can. Which one of the following describes the function of these inserts?

- a. To absorb thermal neutrons
- b. To reduce neutron leakage
- c. To absorb fission product gases
- d. To increase fast neutron flux

Answer: C.001 b.

Reference: Training Manual 2006 11.2; Mech Manual 3.4

**Question:** C.002 [1.0 point] (2.0)

The rotary specimen rack contains 40 tubular aluminum containers. Of these 40, 1 tube has a hole in the bottom. Which one of the following describes the reason for this hole.

- a. To equalize pressure between the rack and tubes.
- b. To detect moisture in the bottom of the rack.
- c. To allow moisture buildup in the tubes to drain away.
- d. To allow dry air flow to flow through the rack bottom.

Answer: C.002 b.

Reference: Reed, Maintenance and Operating Manual, 4.1.1, page 30.

**Question:** C.003 [1.0 point] (3.0)

Which ONE of the following is NOT the location of a radiation area monitor?

- a. Sample Holding Pit
- b. Rabbit Terminus
- c. Control Room
- d. Counting Room

Answer: C.003 d.

Reference: Reed Reactor Facility SOP 30 – RAM Calibration §30.1

**Question:** C.004 [1.0 point] (4.0) **Question revised during the examination.**

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

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

Answer: C.004 ~~b:~~ **c.**

Reference: Reed SOP-70

**Question deleted per facility comment.**

~~**Question:** C.005 [1.0 point] (5.0)~~

~~All power is lost to the facility and the emergency battery lights are on as required. The reactor is safely shutdown with no imminent emergency apparent. Which of the following is the MAXIMUM length of time that the emergency lights are able to produce light?~~

- ~~a. 1 hour.~~
- ~~b. 3 hours.~~
- ~~c. 6 hours.~~
- ~~d. 12 hours.~~

~~Answer: C.005 **c.**~~

~~Reference: Reed, EIPs, Section 2.4~~

**Question:** C.006 [1.0 point] (6.0)

How does the control rod position indicator measure rod height?

- a. A potentiometer is attached to the control rod drive motor.
- b. A sonar detector measures the amount of control rod still in the core.
- c. An accelerometer determines the relative movement of the control rod.
- d. A radio-frequency detector measures the height of the control rod extension tube above the piston.

Answer: C.006 **a.**

Reference: Reed Reactor Facility Mech Manual 3.8

**Question:** C.007 [1.0 point] (7.0)

Which one of the following is the reason pool water conductivity must be maintained at or below 2 micro-mhos/cm?

- a. To maintain pool water pH 6.5 - 7.0.
- b. To maintain clarity of the water.
- c. To enhance the operation of the demineralizers.
- d. To decrease corrosion.

Answer: C.7 d

Reference: Reed, Mech Manual 5.11.8

**Question:** C.008 [1.0 point] (8.0)

Which one of the following describes the expected response of the Reed Reactor Facility 24-hour telephone communications if 110 VAC power to the Reed College switchboard is lost?

- a. The direct dial-in line and the special phone line will fail.
- b. The direct dial-in line will fail, but the special phone line will be unaffected.
- c. The direct dial-in line will shift to the special phone line.
- d. The direct dial-in line will be re-powered by a backup generator and the special line will be unaffected.

Answer: C.008 d.

Reference: EPlan, Section 3.1.8

**Question:** C.009 [1.0 point] (9.0)

The upper end fixture of each fuel element consists of a \_\_\_\_\_.

- a. knob for attaching the fuel handling tool and a rectangular spacer to prevent the fuel handling tool from damaging the fuel cladding
- b. knob for attaching the fuel handling tool and a triangular spacer to allow cooling water to flow through the upper grid plate
- c. a rectangular spacer to allow the top grid to provide lateral support and a triangular opening to allow sampling for fuel element failure
- d. a triangular spacer to allow the top grid to provide lateral support and a rectangular opening to allow sampling for fuel element failure

Answer: C.009 b.

Reference: SAR, Section 5.2.2 & Mech Manual 3.4

**Question:** C.010 [1.0 point] (10.0)

Which one of the following describes the design of the Reactor Water and Purification System that reduces the radiation level at the top of the reactor tank?

- a. The primary pump takes a suction three feet below the surface of the reactor pool to prevent Nitrogen-16 from reaching the pool surface.
- b. The reactor water purification system takes a suction three feet below the surface of the reactor pool to prevent Argon-41 from reaching the pool surface.
- c. The primary pump discharges through a diffuser nozzle directing water currents downward over the core to slow Nitrogen-16 from reaching the pool surface.
- d. The reactor water purification system discharges through a diffuser nozzle directing water currents downward over the core to slow Argon-41 from reaching the pool surface.

Answer: C.010 c.

Reference: SAR, Section 5.2.6

**Question:** C.011 [1.0 point] (11.0)

When reducing power in automatic, which one of the following describes the method by which the control rods will be positioned to continue the power reduction when the regulating rod approaches its lower limit?

- a. The operator must shift the servo to manual, insert the regulating rod, and then insert the shim and safety rods.
- b. The operator must shift the servo to manual, insert the shim and safety rods, withdraw the regulating rod a few positions and then return the servo to automatic.
- c. Both the shim and the safety rods should automatically drive in to assist in the power reduction.
- d. The operator should manually insert the shim or the safety rod to assist in power control with the servo in automatic.

Answer: C.011 d.

Reference: SOP 03, Section 3.7.8

**Question deleted per facility comment.**

~~Question: C.012 [1.0 point] (11.0)~~

~~A power increase is being performed with the control servo in the Automatic Mode. Which one of the choices below completes the following statement?~~

~~The control servo will increase reactor power at a constant period of \_\_\_\_\_ to match the reactor power detected by the \_\_\_\_\_.~~

- ~~a. +30 seconds; log-n channel~~
- ~~b. +30 seconds; linear channel~~
- ~~c. +10 seconds; log-n channel~~
- ~~d. +10 seconds; linear channel~~

~~Answer: C.012 d.~~

~~Reference: SAR Section 5.3.2; SOP 03, Section 3.7.5~~

**Question: C.013 [1.0 point] (13.0)**

Which one of the following describes the cooling mechanism of the Reed Reactor?

- a. Forced convection.
- b. Radiation.
- c. Natural conduction.
- d. Natural convection.

Answer: C.013 d.

Reference: T.S. D.1

**Question deleted - period scram removed - facility comment**

~~Question: C.014 [1.0 point] (14.0)~~

~~Which one of the following will result in a reactor scram signal?~~

- ~~a. Log-n channel produces a 3 second period signal.~~
- ~~b. Linear channel exceeds 100% on its lowest range.~~
- ~~c. Log-n channel exceeds 110% of full power.~~
- ~~d. Bulk reactor water temperature monitor exceeds 120 degrees F.~~

~~Answer: C.014 a.~~

~~Reference: Start-up Checklist~~

**Question:** C.015 [1.0 point] (15.0)

If the stack sampling pump fails, the \_\_\_\_\_ will be inoperable.

- a. Air Particulate Monitor (APM)
- b. Radiation Area Monitor (RAM)
- c. Continuous Air Monitor (CAM) and Air Particulate Monitor (APM)
- d. Continuous Air Monitor (CAM) and Radiation Area Monitor (RAM)

Answer: C.015 a.

Reference: SOP 34, Section 34.7, pg 1 -- SOP 32, Section 32.4.2; Emergency Implementing Plan, Section 1.2

**Question** C.016 [1.0 point] (16.0)

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

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

Answer: C. 016 d.

Reference: Mech Manual 3.7

**Question** C.017 [1.0 point] (17.0)

Which ONE of the following nuclear channels provides the operator with a continuous record of neutron flux from approximately one watt to full power?

- a. Period channel
- b. Log power channel
- c. Count rate channel
- d. Linear power channel

Answer: C.017 b.

Reference: Training Manual 2002 11.7

**Question** C.018 [1.0 point] (18.0)

Which ONE of the following radiation monitoring systems will NOT cause a ventilation confinement actuation?

- a. Particulate stack monitor
- b. RAM
- c. GSM
- d. CAM

Answer: C.018 b.

Reference: SOP 70.7.2.4

**Question** C.019 [1.0 point] (19.0)

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.

Answer: C.019 c.

Reference: Instrumentation Manual 12.2 page 12-3, Training Manual 2006 Figure 11.6

**Question** C.020 [1.0 point] (20.0)

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.

Answer: C.020 d.

Reference: Mech Manual 3.8

(\*\*\*\*\* END OF SECTION C \*\*\*\*\*)  
(\*\*\*\*\* END OF EXAMINATION \*\*\*\*\*)