July 12, 2006

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

SUBJECT: INITIAL AND RETAKE EXAMINATION REPORT NO. 50-288/OL-06-01, REED COLLEGE

Dear Mr. Frantz:

During the week of May 1, 2006, the NRC administered an initial operator licensing examination at your Reed College Reactor facility. On March 29, 2006, you administered an NRC prepared retake operator licensing examination 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. Paul Doyle Jr. at (301) 415-1058 or via internet e-mail pvd@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-06-01
2. Initial examination and answer key
3. Comment on Retake Written Examination
4. Retake examination and answer key

cc w/encls:
Please see next page

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ADAMS ACCESSION #: ML061780620 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE	IOLB:LA	PRTB:SC
NAME	Pdoyle:tls*	Ebarnhill*	JEads:tls*
DATE	6/28/2006	7/11/2006	7/12/2006

OFFICIAL RECORD COPY

Reed College Docket No. 50-288

cc:

Mayor of the City of Portland
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Portland, OR 97204

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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-04-01

FACILITY DOCKET NO.: 50-288

FACILITY LICENSE NO.: R-112

FACILITY: Reed College

EXAMINATION DATES: May 1–10, 2006

SUBMITTED BY: _____/RA/_____ 6/28/2006
Paul V. Doyle Jr., Chief Examiner Date

SUMMARY:

During the first two weeks of May the NRC administered Examinations to 26 Operator Licensing Candidates. All 26 candidates passed their respective examinations. During the last week of March, 2006 the NRC administered a Retake written examination to one Operator Licensing Candidate. This candidate also passed the administered examination. The NRC would like to recognize the quality of the candidates examined during the weeks of May 1 and May 8, 2006. The overall average for the RO candidates taking the written examination was over 90%, and all three examiners noted that all of the candidates performed well on their operating tests.

REPORT DETAILS

1. Examiners: Paul V. Doyle Jr. (CE), Patrick Isaac, Phillip Young

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	16/0	0/0	15/0
Operating Tests	15/0	11/0	26/0
Overall	16/0	11/0	27/0

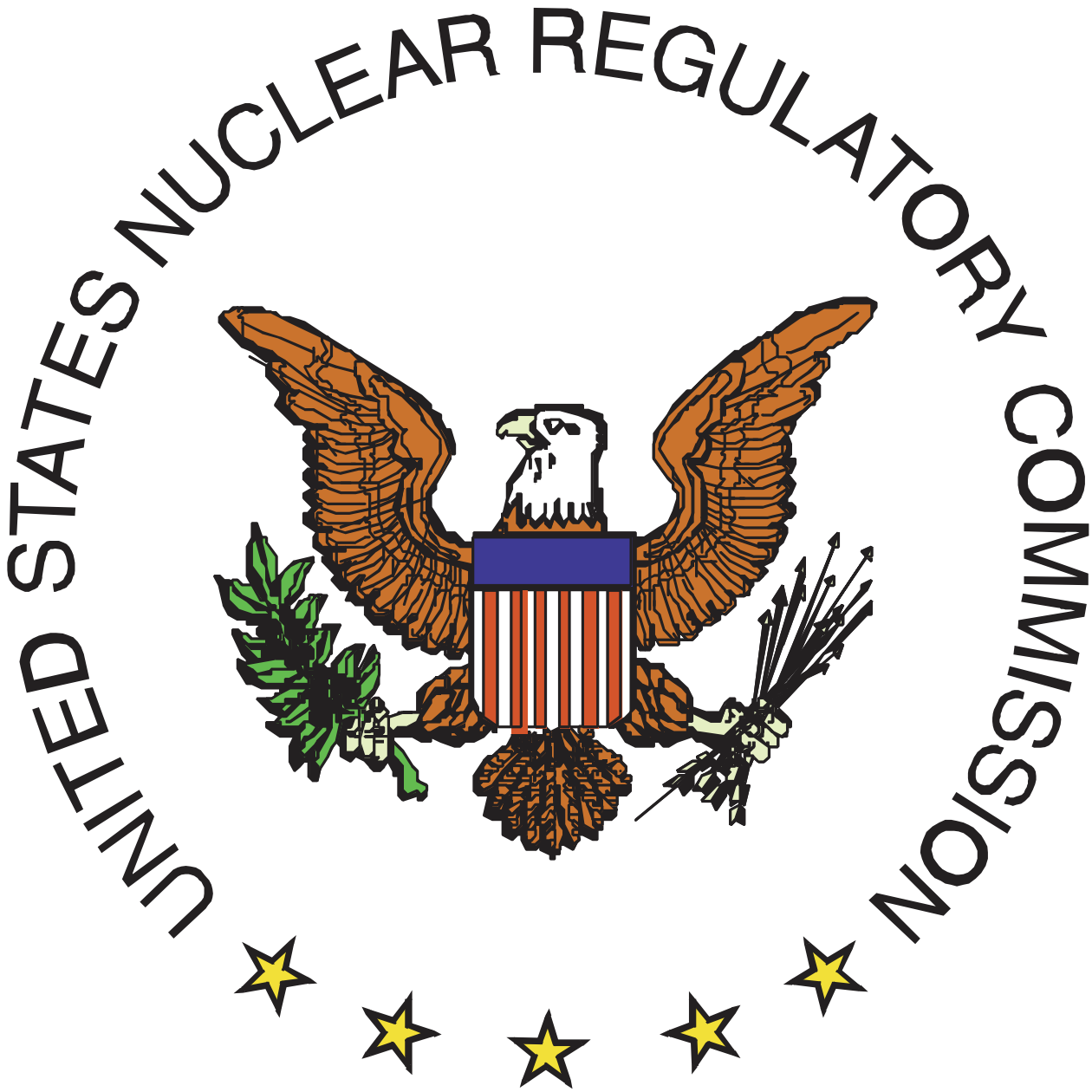
3. Exit Meeting:
Paul V. Doyle Jr., NRC, Examiner
Phillip T. Young, NRC, Examiner
Stephen Frantz, Reed College, Facility Director
Rachel Barnett, Reed College, Deputy Facility Director

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

OPERATOR LICENSING EXAMINATION

With Answer Key



REED COLLEGE

May 01, 2006

Enclosure 2

QUESTION A.1 [1.0 point]
Core excess reactivity (ρ_{ex}) changes with …

a. fuel element burnup

b. control rod height

c. neutron energy level

d. reactor power level

QUESTION A.2 [1.0 point]
Which ONE of the following is the definition of the term "*Cross-Section*?"

a. The probability that a neutron will be captured by a nucleus.

b. The most likely energy at which a charge particle will be captured.

c. The length a charged particle travels past the nucleus before being captured.

d. The area of the nucleus including the electron cloud.

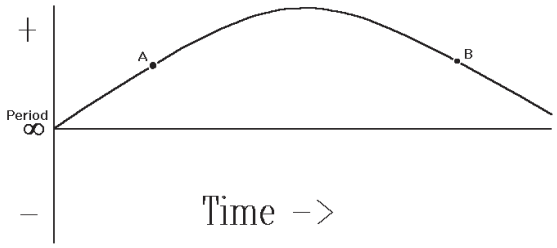
QUESTION A.3 [1.0 point]
Shown to the right is a trace of reactor **PERIOD** as a function of time. Between points A and B reactor **POWER** is …

a. continually increasing.

b. continually decreasing.

c. increasing, the decreasing.

d. constant.



QUESTION A.4 [1.0 point]
The difference between a moderator and a reflector is that a reflector …

a. increases the fast non-leakage factor and a moderator increases the thermal utilization factor.

b. increases the neutron production factor and a moderator increase the fast fission factor.

c. increases the neutron production factor, and a moderator decreases the thermal utilization factor.

d. decreases the fast non-leakage factor, and a moderator increases the thermal utilization factor.

QUESTION A.5 [1.0 point]

The term "*reactivity*" may be described as …

a. a measure of the core's fuel depletion.

b. negative when K_{eff} is greater than 1.0.

c. a measure of the core's deviation from criticality.

d. equal to $.50 when the reactor is prompt critical.

QUESTION A.6 [1.0 point]

The table provided lists data taken during a core loading. Estimate the number of fuel elements needed to go critical.

Count Rate	Number for Fuel Elements
842	2
936	4
1123	7
1684	12
2807	16

a. 9

b. 11

c. 13

d. 15

QUESTION A.7 [1.0 point]

During a startup you increase reactor power from 100 watts to 195 watts in a minute. Which ONE of the following is reactor period?

a. 30 seconds.

b. 60 seconds.

c. 90 seconds.

d. 120 seconds.

QUESTION A.8 [2.0 points, ½ each]

Identify each of the listed radioactive decays as either alpha (α), beta (β), gamma (γ) or neutron (n), or proton (p). Proton added as a choice during administration of the examination.

a. $_{35}Br^{87}$ o $_{33}As^{83}$

b. $_{35}Br^{87}$ o $_{35}Br^{86}$

c. $_{35}Br^{87}$ o $_{34}Se^{86}$

d. $_{35}Br^{87}$ o $_{36}Kr^{87}$

QUESTION A.9 [1.0 point]

The Fast Fission Factor (ε) is defined as "The ratio of the number of neutrons produced by …

a. fast fission to the number produced by thermal fission.

b. thermal fission to the number produced by fast fission.

c. fast and thermal fission to the number produced by thermal fission.

d. fast fission to the number produced by fast and thermal fission.

QUESTION A.10 [1.0 point]

Given the data in the table to the right, which ONE of the following is the closest to the half-life of the material?

a. 11 minutes

b. 22 minutes

c. 44 minutes

d. 51 minutes

TIME	ACTIVITY
0 minutes	2400 cps
10 minutes	1757 cps
20 minutes	1286 cps
30 minutes	941 cps
60 minutes	369 cps

QUESTION A.11 [1.0 point]

Which ONE of the following describes the characteristics of good moderators and reflectors?

a. High scattering cross-section and low absorption cross-section.

b. Low scattering cross-section and high absorption cross-section.

c. Low scattering cross-section and low absorption cross-section.

d. High scattering cross-section and high absorption cross-section.

QUESTION A.12 [1.0 point]

The number of neutrons passing through a square centimeter per second is the definition of which ONE of the following?

a. Neutron Population (np)

b. Neutron Impact Potential (nip)

c. Neutron Flux (nv)

d. Neutron Density (nd)

QUESTION A.13 [1.0 point]

Using the graphs provided in the handout. Choose the ONE which most closely depicts the reactivity versus time plot for xenon for the following evolution. Bring the reactor to 100% power (clean core) and operate for four days (96 hours). Shutdown the reactor for 15 hours. Bring the reactor to 50% power for a day (24 hours).

a. A

b. B

c. C

d. D

QUESTION A.14 [2.0 points, ½ each]

A fissile material is one which will fission upon the absorption of a **THERMAL** neutron. A fertile material is noe which upon absorption of a neutron becomes a fissile material. Identify each of the listed isotopes as either fissile or fertile.

a. Th^{232}

b. U^{233}

c. U^{235}

d. Pu^{239}

QUESTION A.15 [1.0 point]

A reactor is xenon free, with no experiments in the core. Given the following reactivity worths, calculate the actual (NOT Technical Specification Limit) Shutdown Margin.

	worth %ΔK/K		worth %ΔK/K
Shim-Safety Blade #1:	2.41	Shim-Safety Blade #2:	2.32
Shim-Safety Blade #3:	2.49	Shim-Safety Blade #4:	2.60
Regulating rod:	0.084	Excess Reactivity:	3.42

a. 9.90%

b. 6.48%

c 6.40%

d. 3.80%

QUESTION A.16 [1.0 point]

The reactor is operating at 100 KW. The reactor operator withdraws the Regulating Rod allowing power to increase. The operator then inserts the same rod to its original position, decreasing power. In comparison to the rod withdrawal, the period due to the rod insertion will be …

a. longer due to long lived delayed neutron precursors.

b. shorter due to long lived delayed neutron precursors.

c. same due to equal amounts of reactivity being added.

d. same due to equal reactivity rates from the rod.

QUESTION A.17 [1.0 point]

A thin foil target of 10% copper and 90% aluminum is in a thermal neutron beam. Given σ_a Cu = 3.79 barns, σ_a Al = 0.23 barns, σ_s Cu = 7.90 barns, and σ_s Al =1.49 barns, which ONE of the following reactions has the highest probability of occurring? A neutron …

a. scattering reaction with aluminum

b. scattering reaction with copper

c. absorption in aluminum

d. absorption in copper

QUESTION A.18 [1.0 point]

When performing rod calibrations, many facilities pull the rod out a given increment, then measure the time for reactor power to double (doubling time), then calculate the reactor period. If the doubling time is 42 seconds, what is the reactor period?

a. 29 sec

b. 42 sec

c. 61 sec

d. 84 sec

QUESTION B.1 [1.0 point]

The four Emergency Classifications used by the NRC are listed alphabetically below. Which ONE of the classifications is the ONLY one applicable to the Reed Reactor Facility?

a. Alert

b. General Emergency

c. Notification of Unusual Event

d. Site Area Emergency

QUESTION B.2 [1.0 point]

While working on an experiment, you receive the following radiation doses: 100 mrem (β), 25 mrem (γ), and 5 mrem (thermal neutrons). Which ONE of the following is your total dose?

a. 175 mrem

b. 155 mrem

c. 145 mrem

d. 130 mrem

QUESTION B.3 [2.0 points, ½ each]

Match type of radiation (1 thru 4) with the proper penetrating power (a thru d)

a. Gamma	1. Stopped by thin sheet of paper
b. Beta	2. Stopped by thin sheet of metal
c. Alpha	3. Best shielded by light material
d. Neutron	4. Best shielded by dense material

QUESTION B.4 [1.0 point]

10CFR50.54(x) states: *"A licensee may take reasonable action that departs from a license condition or a technical specification (contained in a license issued under this part) in an emergency when this action is immediately needed to protect the public health and safety and no action consistent with license conditions and technical specifications that can provide adequate or equivalent protection is immediately apparent."* 10CFR50.54(y) states that the minimum level of management which may authorize this action is …

a. any Reactor Operator licensed at the facility.

b. any Senior Reactor Operator licensed at the facility.

c. Facility Manager (or equivalent at facility).

d. NRC Project Manager

QUESTION B.5 [1.0 point]

According to the Emergency plan, the ***Site Boundary*** …

a. is the area enclosed within the reactor room.

b. is the area bounded by the reactor room, pump room, control room and the hallway adjacent to reactor room.

c. is the geographical area beyond the site boundary, where the Reactor Director has direct authority over all activities.

d. is bounded by a 250 foot radius from the reactor.

QUESTION B.6 [1.0 point]

Per Technical Specifications regarding the Area Radiation Monitor: "During short periods of repair to this monitor (up to _____), reactor operations may continue whil a detector capable of displaying gamma dose rate is utilized as a temporary substitute".

a. one day

b. two days

c. one week

d. two weeks

QUESTION B.7 [1.0 point]

Which ONE of the following is the 10 CFR 20 definition of **TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)**?

a. The sum of the deep does equivalent and the committed effective dose equivalent.

b. The dose that your whole body receives from sources outside the body.

c. The sum of the external deep dose and the organ dose.

d. The dose to a specific organ or tissue resulting from an intake of radioactive material.

QUESTION B.8 [1.0 point]

According to Technical Specification J.4.c experiments having reactivity worths greater than _____ shall be securely located or fastened to prevent inadvertent movement during reactor operations.

a. $.25

b. $.50

c. $.75

d. $1.0

QUESTION B.9 [1.0 point]

A small radioactive source is to be stored in the reactor building. The source reads 2 R/hr at 1 foot. Assuming no shielding is to be used, a Radiation Area barrier would have to be erected from the source at least a distance of approximately:

a. 400 feet

b. 40 feet

c. 20 feet

d. 10 feet

QUESTION B.10 [1.0 point]

When performing Wipe tests per SOP 23, no action is required unless any of the swipes reads greater than … (Note: this **IS** the limit for **CONTAMINATION**, **NOT** the good policy limit for cleanup.)

a. 10 dpm/100 cm^2

b. 50 dpm/100 cm^2

c. 100 dpm/100 cm^2

d. 1000 dpm/100 cm^2

QUESTION B.11 [2.0 points, $^2/_5$ each]

Match the tag on the Lazy Susan status board in column A with the correct sample description from column B.
Note: This question was modified during the administration of the examination, to conform with a newly modified facility operating procedure.

COLUMN A	COLUMN B
a. White with a "1".	1. Aluminum TRIGA tube
b. White with a "2".	2. Position not to be used without Director's permission.
c. Yellow	3. Position not to be used at all.
d. Orange	4. Shutdown Irradiation
e. Blue	5. Double loaded plastic TRIGA tube
	6. Single loaded plastic TRIGA tube

QUESTION B.12 [1.0 point]

Two Senior Reactor Operators (SROs) and one unlicensed trainee are the only people on-site during reactor operations. One SRO becomes ill and leaves the site. What action must be taken by the remaining SRO.

a. The reactor must be shutdown.

b. Operations may continue unrestricted.

c. Operations may continue ONLY if the remaining SRO remains in the control room.

d. Operations may continue ONLY if the remaining SRO remains within the Reactor Laboratory area.

QUESTION B.13 [1.0 point]

Which ONE of the following is the absolute **MAXIMUM STEADY-STATE** power level allowed by **TECHNICAL SPECIFICATIONS**?

a. 240 Kilowatts

b. 250 Kilowatts

c. 287.5 Kilowatts

d. 300 Kilowatts

QUESTION B.14 [1.0 point]

Which ONE of the following is **NOT** a part of the Technical Specifications definition of a *Shutdown* Reactor?

a. The console key is in the **OFF** position and the key is removed from the console and under the control of the licensed operator.

b. No work is in progress involving fuel handling or maintenance of the control rod mechanisms.

c. The minimum shutdown margin with the most reactive or the operable control elements withdrawn shall be $1.10

d. Sufficient control rods are inserted so as to assure the reactor is subcritical by a margin greater than 0.7 $\Delta K/K$, cold Xenon free.

QUESTION B.15 [1.0 point]

Which ONE of the following evolutions does **NOT** require the presence of a Senior Reactor Operator in the facility?

a. Performing a Same Day Startup Checklist.

b. Performing a Daily Shutdown Checklist.

c. Raising Power from 5 watts to 225 Kilowatts.

d. Performing a Fuel element Inspection.

QUESTION B.16 [1.0 point]
Which ONE of the following is a minimum requirement for visitors being escorted in the Reactor Bay?

a. 1 TLD per 10 members of the group.

b. 1 neutron-gamma sensitive pocket dosimeter for the tour guide.

c. 2 TLD badges for every 10 members of the group.

d. 1 pocket dosimeter for each member of the group.

QUESTION B.17 [1.0 point]
Technical specifications require the reactor to be shutdown if reactor pool limit exceeds 120EF. However, the pool temperature meter reads out in EC. Which of the temperatures in EC listed below corresponds to 120EF?

a. ~49EC

b. ~99EC

c. ~158EC

d. ~248EC

QUESTION B.18 [1.0 point]
The condition of “Notification of Unusual Event” encompasses all of the following except:

a. There is time available to take precautionary corrective steps.

b. Release is expected of radioactive material, which will require off-site response.

c. One or more elements of the emergency organization are likely to be notified.

d. Can be initiated by manmade events or natural phenomena.

QUESTION C.1 [1.0 point]

During operations at high (150 Kwatts) power, you lose compensating voltage for a compensated ion chamber. Which ONE of the following would be the resulting change in power level detected?

a. Small decrease in indicated power.

b. Small increase in indicated power.

c. Large decrease in indicated power.

d. Large increase in indicated power.

QUESTION C.2 [2.0 point, 0.5 each]

Match the control rod drive mechanism part from column "A" with the correct function in column "B".

	COLUMN A		COLUMN B
a.	Piston	1.	Provide rod bottom indication.
b.	Potentiometer	2.	Provide rod full withdrawn indication.
c.	Pull Rod	3.	Provide rod position indication when the electromagnet engages the armature.
d.	Push Rod	4.	Works with dash pot to slow rod near bottom of its travel.

QUESTION C.3 [1.0 point]

The gas used to move pneumatic tube “rabbit” samples into and out of the reactor is …

a. H

b. Air

c. CO_2

d. N_2

QUESTION C.4 [1.0 point]

A pipe flange downstream of the primary pump fails. What design feature prevents the pump from draining the pool?

a. Closure of an automatic valve sensitive to pool level.

b. Siphon breaks (holes) located in the pump suction piping.

c. Level in pool drops below minimum required to supply suction pressure to the pump.

d. Level in pool drops below the bottom of the suction piping.

QUESTION C.5 [1.0 point]

The reflector surrounding the reactor uses which ONE of the following materials to reflect neutrons?

a. Beryllium

b. Graphite

c. Polyethylene

d. Zirconium

QUESTION C.6 [2.0 points ⅔ each]

Identify which component of the purification system listed in column B is PRIMARILY designed to remove the impurities listed in column A.

a. dissolved solids	1. Filter
b. mosquito larvae	2. Ion Exchanger
c. suspended solids	3. Skimmer

QUESTION C.7 [1.0 point]

An experimenter drops and breaks open a sample vial in a laboratory room. He immediately runs out of the room and closes the door. You are called in to assist in the cleanup. Prior to opening the door you would take a reading using a(n)

a. Ion Chamber portable radiation detector to determine the radiation field strength.

b. Geiger-Müller portable radiation detector to determine the radiation field strength.

c. Ion Chamber portable radiation detector to determine whether contamination is present.

d. Geiger-Müller portable radiation detector to determine whether contamination is present.

QUESTION C.8 [1.0 point]

The ventilation system is designed so that: (Assume normal conditions, all equipment operating.)

a. the reactor room is at a higher pressure than the atmosphere.

b. the reactor room is at a lower pressure than the adjacent laboratory.

c. the reactor building is equal to atmospheric pressure.

d. the reactor room and the adjacent laboratory are always at the same pressure.

QUESTION C.9 [10 point]
Which ONE of the following is added weekly to the secondary cooling loop?

a. Algaecide to suppress biological growth in the cooling tower.

b. Chromate to minimize corrosion of the pipes.

c. Sodium-Chloride to increase the thermal conductivity of the water.

d. Ethyl-Glycol to prevents the water from freezing in cold temperatures.

QUESTION C.10 [1.0 point]
Which ONE of the following neutron flux monitoring channels provides a signal indicating the period of the reactor?

a. Linear Channel

b. Count Rate Channel

c. Log Channel

d. Percent Power Channel

QUESTION C.11 [1.0 point]
Where in the ventilation system is the gaseous stack monitor sampling loop located? Fan A is the reactor loop supply unit and Fan B is the reactor loop exhaust unit.

A. After the outlet of Fan B.

B. Before the inlet to Fan A.

C. After the outlet of Fan A.

D. Before the inlet to the Fan B.

QUESTION C.12 [1.0 point]
What is one of the purposes for the neutron count interlock?

A. To prevent the reactor from being manipulated to a critical position before the count rate channel is verified to be operable.

B. To provide a reference point where all instruments undergo a check before the reactor is brought to a critical position.

C. To allow for all experiments to be installed before the reactor is critical.

D. To ensure that a steady rate of startup to the critical position is achieved.

QUESTION C.13 [1.0 point]
Which ONE of the following describes the automatic actions for a high bulk water temperature alarm?

A. Display turns orange and buzzer turns on.

B. Old rotating red APM light turns on and buzzer turns on.

C. Display turns red and rotating red light on control room ceiling turns on.

D. Buzzer turns on and display starts blinking.

QUESTION C.14 [1.0 point]
What type of detectors are used in the APM, GSM, and CAM radiation monitoring systems?

A. Geiger-Mueller

B. Proportional counter

C. Ionization chamber

D. β^- Scintillation

QUESTION C.15 [1.0 point]
Which ONE of the following statements correctly describes the pneumatic transfer system path and operating pressure? The pneumatic transfer system exhausts to the …

a. reactor room and maintains the transfer system at a positive pressure.

b. building exhaust and maintains the transfer system at a positive pressure.

c. reactor room and maintains the transfer system at a negative pressure.

d. building exhaust and maintains the transfer system at a negative pressure

QUESTION C.16 [2.0 points, 0.5 each]
Which of the following instruments is used to detect High range Beta-Gamma radiation during an emergency condition?

a. Eberline Model E-140

b. Model RO-2

c. CD V - 700 model 6B

d. CD V - 715 model 1B

QUESTION C.17 [1.0 point]

Which one of the following does not provide any protective interlocks or actions?

a. Linear Power Channel.

b. Log Power (Log-N Channel).

c. Percent Power Channel.

d. Count Rate Channel.

QUESTION C.18 [1.0 point]

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.

A.01 a
REF: G

A.02 a
REF: x

A.03 a
REF:

A.04 a
REF:

A.05 c
REF:

A.06 b
REF: (See attached sketch, ~ 11 fuel elements)

A.07 c
REF: $P = P_0 e^{t/\tau}$ —> $\tau = t/\ln(P/P_0)$ $\tau = 60/\ln(195/100) = 60/\ln(1.95) = 89.84$. 90 sec.

A.08 a, α; b, n; c, p; d, β

A.09 c
REF:

A.10 b
REF:

A.11 a
REF: R

A.12 c
REF: x

A.13 c
REF: x

A.14 a, fertile; b, fissile; c, fissile; d, fissile
REF: x

A.15 d
REF: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, § 6.2.3 p. 6-4. SDM (cold/clean) = Total Rod worth - K_{excess} = (2.41 + 2.32 + 2.49 + 2.60 + 0.084) - 3.42 = 6.484%

A.16 a
REF:

A.17 a
REF:

A.18 c
REF: $\ln(2) = -\text{time}/\tau$ $\tau = \text{time}/(\ln(2)) = 60.59$. 61 seconds

B.01 c
REF:

B.02 d
REF:

B.03 a, 4; b, 2; c, 1; d, 3
REF:

B.04 b
REF: 10CFR50.54(y).

B.05 d
REF: Emergency Plan § 2.14

B.06 c
REF: Technical Specifications G.1

B.07 a
REF: 10 CFR 20.1003 *Definititions*

B.08 d
REF: Technical Specification J.4.c

B.09 c
REF: $\frac{DR_1}{X_2^{\,2}} = \frac{DR_2}{X_1^{\,2}} \qquad X_2^{\,2} = \frac{DR_1}{DR_2} X^2 \quad X^2 = \frac{2000}{5} \times 1^2 = 400\, ft^2 \quad X = 20\, ft$

B.10 d
REFERENCE SOP 23 *Health Physics Wipe Tests,* § 23.7.1.6.

B.11 a, 6; b, 5; c, 1; d, 3; e, 4
REFERENCE SOP 52 Lazy Susan Irradiations § 52.7.1.3, p. 3

B.12 c
REF: Administrative procedures § III.3.1(3)

B.13 c
REF: Technical Specifications § A.2 *Steady State Mode*

B.14 c
REF: Technical Specifications § A *Definitions*

B.15 c
REF: SOP-40, Fuel Element Inspection; SOP-05, Daily Shutdown Checklist; SOP-04 Same Day Startup and SOP-03, Reactor Operations.

B.16 d
REF: SOP-17

B.17 a
REF: Reed Reactor Facility SOP 63, SOP 70 and Technical Specifications.

B.18 b
REF: Reed Reactor Facility Emergency Plan §4.2

C.01 b
REF: Typical NRC examination question

C.02 a. 4; b. 3; c. 1; d. 2
REF: Reed Reactor Facility SAR p. 5-10, also NRC examination administered August 1992.

C.03 b
REF: Reed College Reactor Facility Description and Safety Analysis Report § 5.2.5, p. 5-7 3rd ¶

C.04 b
REF: TRIGA MK I Reactor Mechanical Maint. & Operating Manual, § 5.11.10, p. 85

C.05 b
REF: TRIGA MK I Reactor Mechanical Maint. & Operating Manual § 3.2 *Reflector*

C.06 a, 2; b, 3; c, 1
REF: TRIGA, MK I Reactor Mechanical Maint. & Operating Manual § 5.11.8

C.07 a
REF: Standard NRC question.

C.08 b
REF: Reed College Reactor Facility Description and Safety Analysis Report § 4.4, p. 4-5

C.09 a
REF:

C.10 c
REF: Reed Reactor Facility Training Manual Pg. 215

C.11 a
REF: Reed instructor manual - Lectures - Lecture 3; Cooling, etc. Slide 19 of 23

C.12 a
REF: Pg. 1 of 3; Safety Evaluation for Issuance of Amendment #7 to Amended Facility Operating License #R-112. Glasstone, S. and Sesonske, Nuclear Reactor Engineering, § 2.70 – 2.74, pp. 65 – 66.

C.13 c
REF: Reed Reactor Procedure Change Notice 03-02, modified per facility comment.

C.14 b
REF: Reed Reactor Procedure Change Notice 03-01

C.15 d
REF: RRF Description and SAR (pg 5-7)

C.16 b
REF: RRF introduction to Radiation and Rad. Inst. Manuals

C.17 b
REF: Reed, Instrumentation Maintenance Manual

C.18 a
REF: RRF SAR (pg 5-6 through 5-11)

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

FACILITY: Reed Reactor Facility

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 2006/05/01

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 brackets for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

Category Value	% of Total	Candidates Score	% of Category Value	Category
20.00	33.3	_____	____	A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
20.00	33.3	_____	____	B. Normal and Emergency Operating Procedures and Radiological Controls
20.00	33.3	_____	____	C. Facility and Radiation Monitoring Systems
60.00		_____	____% FINAL GRADE	TOTALS

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

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have neither received nor given assistance in completing the examination. This must be done after you complete the examination.

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.

7. The point value for each question is indicated in [brackets] after the question.

8. If the intent of a question is unclear, ask questions of the examiner only.

9. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition turn in all scrap paper.

10. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

11. To pass the examination you must achieve a grade of 70 percent or greater in each category.

12. There is a time limit of three (3) hours for completion of the examination.

13. When you have completed and turned in you examination, leave the examination area. If you are observed in this area while the examination is still in progress, your license may be denied or revoked.

A.1 a b c d ___

A.2 a b c d ___

A.3 a b c d ___

A.4 a b c d ___

A.5 a b c d ___

A.6 a b c d ___

A.7 a b c d ___

A.8a α β γ n p ___

A.8b α β γ n p ___

A.8c α β γ n p ___

A.8d α β γ n p ___

A.9 a b c d p ___

A.10 a b c d ___

A.11 a b c d ___

A.12 a b c d ___

A.13 a b c d ___

A.14a fertile fissile ___

A.14b fertile fissile ___

A.14c fertile fissile ___

A.14d fertile fissile ___

A.15 a b c d ___

A.16 a b c d ___

A.17 a b c d ___

A.18 a b c d ___

B.1 a b c d ___

B.2 a b c d ___

B.3a 1 2 3 4 ___

B.3b 1 2 3 4 ___

B.3c 1 2 3 4 ___

B.3d 1 2 3 4 ___

B.4 a b c d ___

B.5 a b c d ___

B.6 a b c d ___

B.7 a b c d ___

B.8 a b c d ___

B.9 a b c d ___

B.10 a b c d ___

B.11a 1 2 3 4 5 6 ___

B.11b 1 2 3 4 5 6 ___

B.11c 1 2 3 4 5 6 ___

B.11d 1 2 3 4 5 6 ___

B.11e 1 2 3 4 5 6 ___

B.12 a b c d ___

B.13 a b c d ___

B.14 a b c d ___

B.15 a b c d ___

B.16 a b c d ___

B.17 a b c d ___

B.18 a b c d ___

C.01 a b c d ___

C.02a 1 2 3 4 ___

C.02b 1 2 3 4 ___

C.02c 1 2 3 4 ___

C.02d 1 2 3 4 ___

C.03 a b c d ___

C.04 a b c d ___

C.05 a b c d ___

C.06a 1 2 3 ___

C.06b 1 2 3 ___

C.06c 1 2 3 ___

C.07 a b c d ___

C.08 a b c d ___

C.09 a b c d ___

C.10 a b c d ___

C.11 a b c d ___

C.12 a b c d ___

C.13 a b c d ___

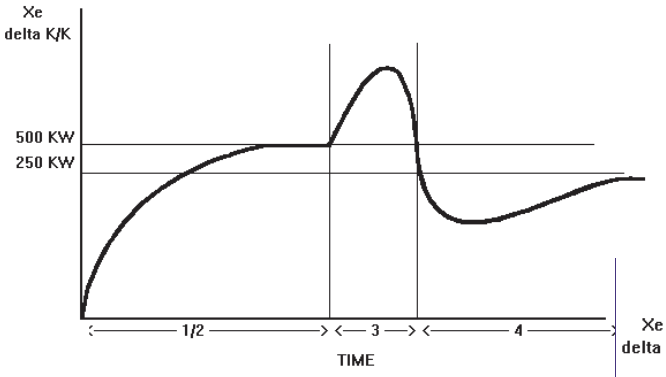
C.14 a b c d ___

C.15 a b c d ___

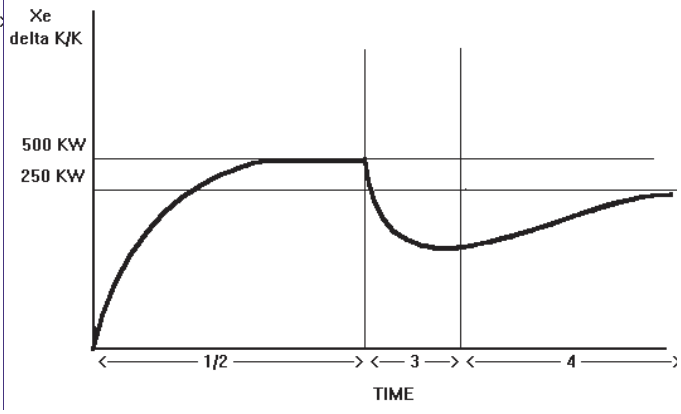
C.16 a b c d ___

C.17 a b c d ___

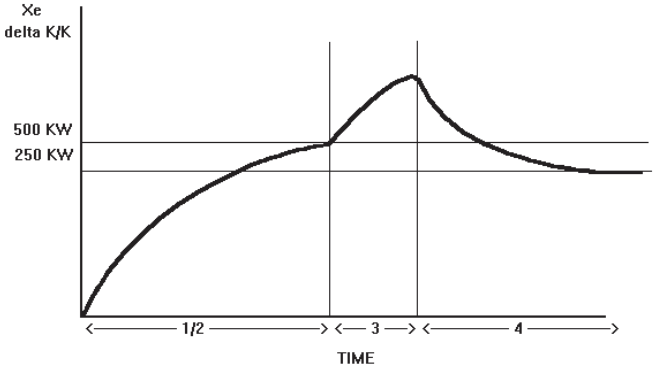
C.18 a b c d ___



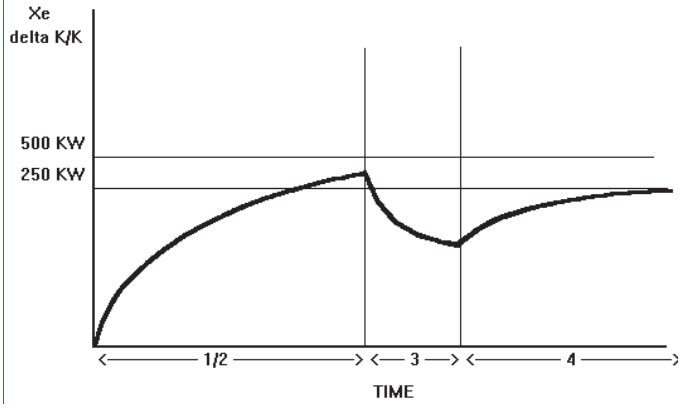
a



b



c

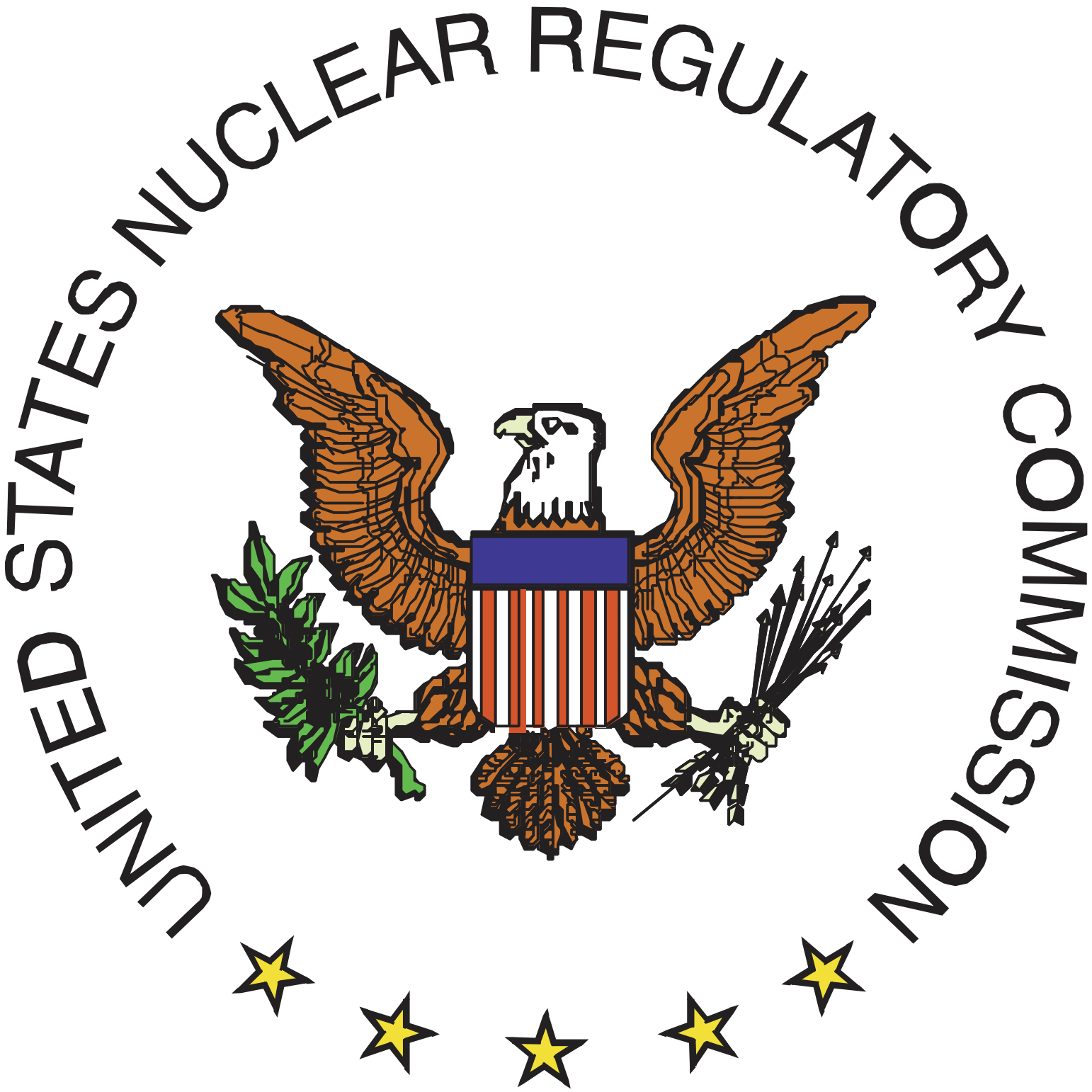


d

FIGURE A.13

OPERATOR LICENSING RETAKE EXAMINATION

With Answer Key



REED COLLEGE

March 29, 2006

ENCLOSURE 4

QUESTION C.1 [1.0 point]
The “PULL ROD” is associated with the …

a. Rod UP limit switch.

b. Rod DOWN limit switch.

c. Motor UP limit switch.

d. Motor DOWN limit switch.

QUESTION C.2 [1.0 point]
The purpose of the HEPA filter in the ventilation system is to reduce …

a. routine Ar^{41} emissions from the reactor bay.

b. fission gas (Xe & Kr) emissions from the reactor bay during a fuel element failure.

c. fission gas daughter release (Cs and Rb) during a fuel element failure.

d. routine N^{16} emissions from the reactor bay.

QUESTION C.3 [1.0 point]
The rabbit system uses air to send samples into and out of the reactor core. Which ONE of the following is the largest radiological problem associated with using air?

a. $_{6}C^{14}$

b. $_{7}N^{16}$

c. $_{8}O^{18}$

d. $_{18}Ar^{41}$

QUESTION C.4 [2 points, ½ each]
The Multi-Trend is out of commission. Identify whether each of the parameters must be read locally (LOCAL), or may still be read in the control room (CR).

a. Rod Position Indication

b. Primary Conductivity

c. Gaseous Stack Monitor

d. Percent Power

QUESTION C.5 [1.0 point]
Primary makeup water is added to the pool from city water through a hose …

a. directly into the pool.

b. into the suction of the primary pump.

c. into the discharge of the primary pump.

d. upstream of the demineralizers.

QUESTION C.6 [1.0 point]
Which ONE of the following is the main function performed by the DISCRIMINATOR circuit in the startup channel?

a. To generate a current signal equal and of opposite polarity as the signal due to gammas generated within the Log-N Channel Detector.

b. To filter out small pulses due to gamma interactions, passing only pulses due to neutron events within the Log-N Channel Detector.

c. To convert the linear output of the Log-N Channel Detector to a logarithmic signal for metering purposes.

d. To convert the logarithmic output of the metering circuit to a δt (differential time) output for period metering purposes

QUESTION C.7 [1.0 point]
On the rear wall (next to the window looking into the reactor bay) are two pushbuttons. Which ONE of the following correctly describes the action of these buttons.

a. Turn on and off the Primary and Secondary coolant Pumps.

b. Turn off (only) the primary and secondary coolant pumps.

c. Place the ventilation system into isolation mode and sound the evacuation alarm.

d. Reset the ventilation system and reset the evacuation alarm.

QUESTION C.8 [1.0 point]
A wire supplying current to a control rod electromagnet was inadvertently damaged but not noticed. When the operator attempts to raise the rod out of the core, the "**MOTOR IN**" light will:

a. go out, but the position indication will not function normally.

b. go out, and the position indication will function normally.

c. stay lit, but the position indication will not function normally.

d. stay lit, and the position indication will function normally.

QUESTION C.9 [1.0 point]
The neutron absorber in Reed's reactor control rods is:

a. Aluminum oxide

b. Zirconium hydride

c. Graphite powder

d. Boron carbide

QUESTION C.10 [1.0 point]
Which ONE of the following radiation monitors is routinely used to monitor Ar^{41} release to the environment?

a. APM

b. CAM

c. GSM

d. RAM

QUESTION C.11 [1.0 point]
Which ONE of the following parameters is NOT measured in the Primary Cooling/Purification System Loops?

a. Temperature

b. Flow Rate

c. Conductivity

d. pH

QUESTION C.12 [1.0 point]
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

QUESTION C.13 [1.0 point]
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 to reset the electromagnet current.

d. Provides the potential voltage to energize the electromagnet.

QUESTION C.14 [1.0 point]
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 C.15 [1.0 point]
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.

QUESTION C.16 [1.0 point]
Reactor Level has decreased by 8 inches over the last 8 hours. Which ONE of the following is the approximate leak rate?

a. 0.125 gallons per MINUTE

b. 1.25 gallons per MINUTE

c. 12.5 gallons per HOUR

d. 125 gallons per HOUR

QUESTION C.17 [1.0 point]
Which **ONE** of the following is ***NOT*** a design function of the purification system?

a. Reduce radiation level due to dissolved ions.

b. Reduce radiation due to gases in solution.

c. Reduce radiation due to suspended solids.

d. Reduce corrosion due to dissolved ions.

QUESTION C.18 [1.0 point]
One of the air sampling pumps in the loft fails. Which ONE of the following statements could be true.

a. The Air Particulate Monitor (APM) **ONLY** is out of commission.

b. the Continuous Air Monitor (CAM) **ONLY** is out of commission.

c. the Gaseous Stack Monitor (GSM) **ONLY** is out of commission.

d. the APM and the CAM are **BOTH** out of commission.

QUESTION C.19 [1.0 point]
Which ONE of the following is added weekly to the secondary cooling loop?

a. Algaecide to suppress biological growth in the cooling tower.

b. Chromate to minimize corrosion of the pipes.

c. Sodium-Chloride to increase the thermal conductivity of the water.

d. Ethyl-Glycol to prevent the water from freezing in cold temperatures

C.1 b
REF: Reed Reactor Facility Training Manual § 11.4.

C.2 c
REF: Standard NRC question. The HEPA is NOT in service during routine evolutions therefore A and D are incorrect. A HEPA filter is NOT designed to filter gases, therefore B is incorrect.
C.3 d
REF: Standard NRC question also,

C.4 a, CON; b, LOCAL; c, LOCAL; d, CON
REF: Check with Facility.

C.5 a
REF: Standard NRC Question.

C.6 a
REF: Old question, should still be good for new Fission Chamber circuitry.

C.7 b
REF: Facility supplied JPEG: Primary_Secondary Buttons#2CC5D.JPG

C.8 b
REF: Rewrite of NRC Examination question administered July 1992.

C.9 d
REF: GA TRIGA Maintenance and Operating Manual

C.10 c
REF: Examination Bank § C, question 66, also SOP 5, § 5.7.3, p. 2

C.11 d
REF: Reed College Reactor Facility Description and Safety Analysis Report § 5.2.6, last ¶, p. 5-7

C.12 b
REF: Emergency Plan

C.13 a
REF: RRF SAR (pg 5-6 through 5-11)

C.14 d
REF: GA TRIGA Mech. Maint. & Operating Manual

C.15 b
REF: Reed, Maintenance and Operating Manual, page 30.

C.16 b
REF: RRF Mech. Maint. & Op. Manual, p. 81 8 in/8 hr 6 1 in/hr x 75 gal/in 6 75 gal/hr
75 gal/hr × 1 hr/60 min = 1.25 gal/min

C.17 b
REF: Reed Reactor TRIGA Mark I Reactor Mechanical Maintenance & Operating Manual § 5.1 pg. 71.

C.18 b
REF: Reed Operator Training 2003 Lecture 06 Detectors & Radiation Monitors Slide # 36.

C.19 a
REF: Reed Reactor Training Manual, p. 239.

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

FACILITY: Reed Reactor Facility

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 2006/03/____

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Points for each question are indicated in brackets for each question. A 70% is required to pass the examination. The Examination will be picked up one (1) hour after the examination starts.

Category Value	% of Total	% of Candidates Score	Category Value	Category
20.00	33.3	_____	____	C. Facility and Radiation Monitoring Systems
20.00		_____	____%	TOTALS
			FINAL GRADE	

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

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

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C.01 a b c d ___

C.02 a b c d ___

C.03 a b c d ___

C.04a LOCAL CR ___

C.04b LOCAL CR ___

C.04c LOCAL CR ___

C.04d LOCAL CR ___

C.05 a b c d ___

C.06 a b c d ___

C.07 a b c d ___

C.08 a b c d ___

C.09 a b c d ___

C.10 a b c d ___

C.11 a b c d ___

C.12 a b c d ___

C.13 a b c d ___

C.14 a b c d ___

C.15 a b c d ___

C.16 a b c d ___

C.17 a b c d ___

C.18 a b c d ___

C.19 a b c d ___