July 13, 2005

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

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-288/OL-05-02, Reed College

Dear Mr. Frantz:

During two weeks starting May 2, 2005, the NRC administered operator licensing examinations at your Reed College Reactor. 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 V. Doyle Jr. at (301) 415-1058 or via internet e-mail pvd@nrc.gov.

Sincerely,

/RA/

Patrick M. Madden, Section Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-288

Enclosures: 1. Initial Examination Report No. 50-288/OL-05-02
2. Examination (Modified per facility comments)

cc w/encls: Please see next page

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EXAMINATION PACKAGE ACCESSION NO.: ML050490193
EXAMINATION REPORT ACCESSION #: ML051740529 **TEMPLATE #: NRR-074**

OFFICE	RNRP:CE		IROB:LA		RNRP:SC	
NAME	PDoyle		EBarnhill		PMadden	
DATE	6/29/2005		7/4/2005		7/11/2005	

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cc:

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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-05-02

FACILITY DOCKET NO.: 50-288

FACILITY LICENSE NO.: R-112

FACILITY: Reed College

EXAMINATION DATES: May 02-12, 2005

SUBMITTED BY: /RA/ 6/11/05
Paul V. Doyle Jr., Chief Examiner Date

SUMMARY:

The NRC administered Operator Licensing examinations to 21 Reactor Operator candidates and 11 Senior Reactor Operator candidates. One RO candidate failed Section C of the written examination. All other candidates passed their respective portions of the Examinations.

REPORT DETAILS

1. Examiners:
   Paul V. Doyle Jr., Chief Examiner
   Warren Eresian and Patrick Isaac, Examiners
2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	20/1	0/0	20/1
Operating Tests	21/0	11/0	32/0
Overall	20/1	11/0	31/1

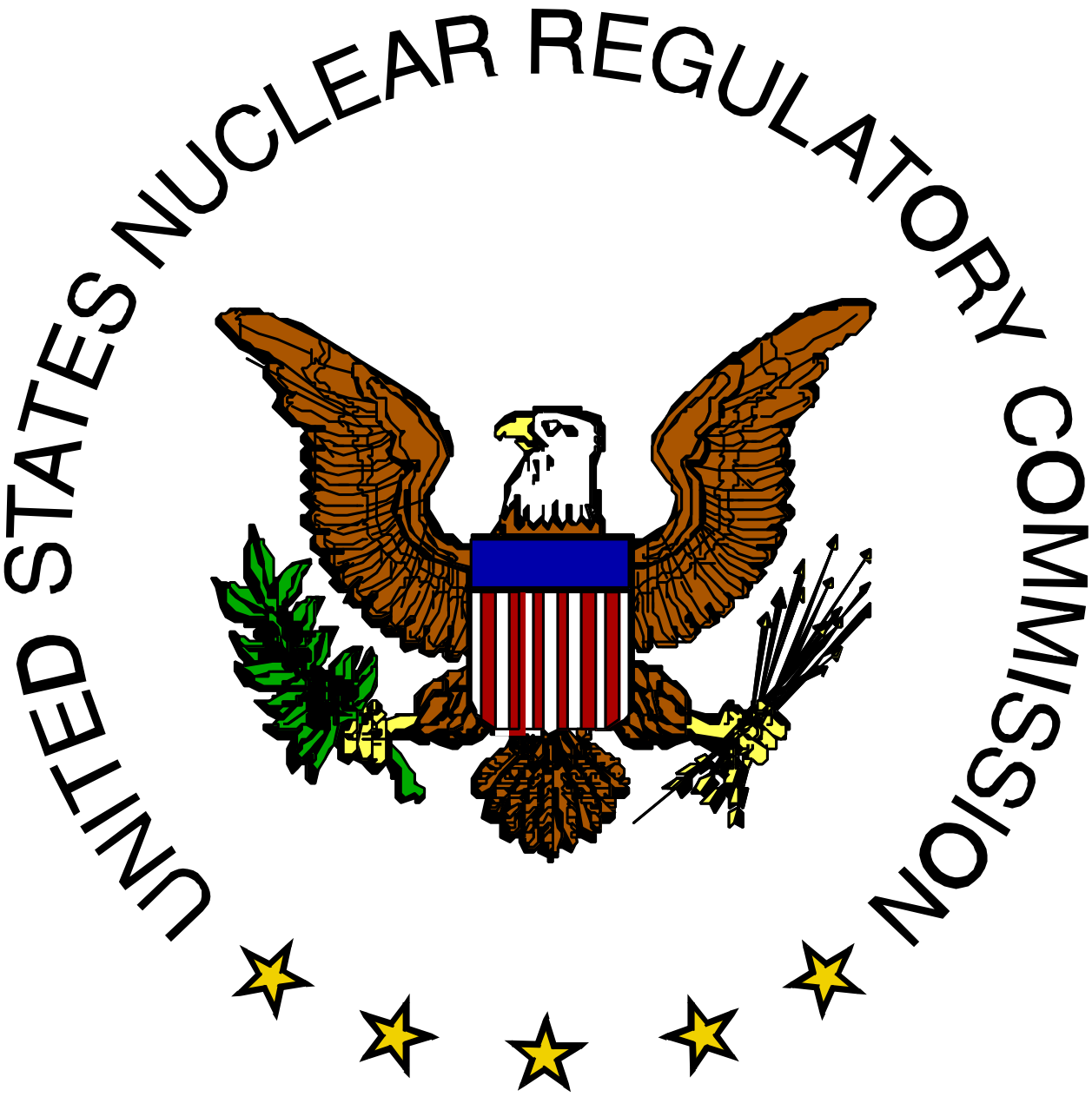
3. Exit Meeting:
   Paul V. Doyle Jr., NRC, Chief Examiner
   Patrick Isaac, NRC, Examiner
   Stephen Frantz, Reed College, Facility Director
   Rachel Barnett, Reed College Facility Associate Director

   During the exit meeting the examiners thanked the facility staff for their support in administering the examination. The facility staff presented the chief examiner with their comments on the written examination, which have been incorporated into the examination included as Enclosure 2 to this report. The examiners both noted that a few of the candidates stated that a purpose stamp was required every half hour during continuous operation, and a few candidates incorrectly stated that the fission chamber counts alpha pulses rather than pulses due to fission products.

ENCLOSURE 1

OPERATOR LICENSING EXAMINATION

With Answer Key



REED COLLEGE

May 02, 2005

ENCLOSURE 2

QUESTION A.1 [1.0 point]

You enter the control room and note that all nuclear instrumentation show a steady neutron level, and no rods are in motion. Which ONE of the following conditions CANNOT be true?

a. The reactor is critical.

b. The reactor is subcritical.

c. The reactor is supercritical.

d. The neutron source has been removed from the core.

QUESTION A.2 [1.0 point]

The two major fission products formed in a U^{235} fueled reactor, samarium and xenon, have both large absorption cross sections and a significant yield. Therefore they have a marked effect on the neutron multiplication factor by decreasing which factor in the six factor formula?

a. ϵ_{th} or P_{th} the thermal non-leakage probability

b. **0**, the fuel utilization factor

c. p, the resonance escape probability

d. f, the thermal utilization factor

QUESTION A.3 [1.0 point]

Which of the following power manipulations would take the longest to complete assuming the same period is maintained?

a. 1 Kilowatt: from 1 kW to 2 kW

b. 1.5 Kilowatts: from 2 kW to 3.5 kW

c. 2 Kilowatts: from 3.5 kW to 5.5 kW

d. 2.5 Kilowatts: from 5.5 kW to 8 kW

QUESTION A.4 [1.0 point]

After shutdown, the reactor will stabilize at a -80 second period. Which ONE of the following is the main contributor to this period?

a. The amount of negative reactivity introduced to the core.

b. The decay constant of the longest lived delayed neutron precursor.

c. The degree of neutron absorption by the fission products in the core.

d. The level of the prompt neutron population.

QUESTION A.5 [1.0 point]

The neutron microscopic cross-section for absorption $\mathbf{F}_a$ generally …

a. increases as neutron energy increases

b. decreases as neutron energy increases

c. increases as target nucleus mass increases

d. decreases as target nucleus mass increases

QUESTION A.6 [1.0 point]

Suppose the source strength in the core is 250 neutrons per second (N/sec) and the effective multiplication factor is 0.80. Select the closest stable neutron count rate from the list below:

a. 300 N/sec

b. 750 N/sec

c. 1250 N/sec

d. 1500 N/sec

QUESTION A.7 [1.0 point]

Which one of the following statements details the effect of fuel temperature on core operating characteristics? As fuel temperature …

a. increases, doppler peaks will become higher.

b. decreases, resonance escape probability will increase.

c. decreases, U^{238} will absorb more neutrons.

d. increases, the fast non-leakage probability will decrease.

QUESTION A.8 [1.0 point]

What is the approximate amount of time that it will take the amount of Xenon being produced to reach a peak after the reactor is shut down? On the attached Xenon reactivity curve it is noted as the difference between time T_{SD} and T_{Peak}.

a. 8 hours

b. 15 hours

c. 24 hours

d. 33 hours

QUESTION A. 9 [1.0 point]

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

a. Increases toward one

b. Decreases toward one

c. Increases toward infinity

d. Decreases toward zero

QUESTION A.10 [1.0 point]

Which ONE of the following describes the characteristics of a good moderator?

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.11 [1.0 point]

The reactor supervisor tells you that the K_{eff} for the reactor is 0.955. How much reactivity must you add to the reactor to reach criticality?

a. +0.0471

b. +0.0450

c. -0.0471

d. -0.0450

QUESTION A.12 [1.0 point]

You are increasing reactor power on a steady +26 second period. How long will it take to increase power by a factor of 1000?

a. 60 seconds (1 minute)

b. 180 seconds (3 minutes)

c. 300 seconds (5 minutes)

d. 480 seconds (8 minutes)

QUESTION A.13 [2.0 points, 0.5 each]

Match each term in column A with the correct definition in column B.

	Column A		Column B
a.	Prompt Neutron	1.	A neutron in equilibrium with its surroundings.
b.	Fast Neutron	2.	A neutron born directly from fission.
c.	Thermal Neutron	3.	A neutron born due to decay of a fission product.
d.	Delayed Neutron	4.	A neutron at an energy level greater than its surroundings.

QUESTION A.14 [1.0 point]

A characteristic peculiar to TRIGA fuel is that it has a relatively large (and quickly acting) …

a. pressure coefficient.

b. void coefficient.

c. bath temperature coefficient.

d. fuel temperature coefficient.

QUESTION A.15 [1.0 point]

Which ONE of the following is the correct reason that delayed neutrons enhance control of the reactor?

a. There are more delayed neutrons than prompt neutrons.

b. Delayed neutrons increase the average neutron generation time.

c. Delayed neutrons are born at higher energies than prompt neutrons and therefore have a greater effect.

d. Delayed neutrons take longer to reach thermal equilibrium.

QUESTION A.16 [1.0 point]

Which ONE of the following is the **DOMINANT** factor in determining the differential reactivity worth of a control rod?

a. Radial and axial flux.

b. Total reactor power.

c. Control rod speed.

d. Delayed neutron fraction.

QUESTION A.17 [1.0 point]
INELASTIC scattering is the process by which a neutron collides with a nucleus and …

a. recoils with the same kinetic energy it had prior to the collision

b. recoils with a lower kinetic energy than it had prior to the collision, with the nucleus emitting a gamma ray.

c. Is absorbed, with the nucleus emitting a gamma ray.

d. recoils with a higher kinetic energy than it had prior to the collision, with the nucleus emitting a gamma ray.

QUESTION A.18 [1.0 point]
Which one of the below describes why neutron sources are used in reactor cores?

a. Increase the count rate by an amount equal to the source contribution.

b. Increase the count rate by 1/M (M = Subcritical Multiplication Factor).

c. Provide the source neutrons to initiate the chain reaction when first starting-up the reactor.

d. Provide a neutron level high enough to be monitored by source range instrumentation.

QUESTION A.19 [1.0 point]
Which ONE of the following conditions will **INCREASE** the shutdown margin of a reactor.

a. Insertion of a positive reactivity worth experiment

b. Lowering moderator temperature (Assume negative temperature coefficient).

c. Burnout of a burnable poison.

d. Fuel depletion.

QUESTION B.1 [2.0 points, ½ each]

Identify whether each of the following experiments is Not Allowed (NA), must be doubly encapsulated (Double), or has no special requirements (NSR). Experiments which contain …

a. explosive materials.

b. Liquid fissionable materials

c. materials corrosive to reactor components.

d. compounds highly reactive with water.

QUESTION B.2 [2.0 points, 0.5 each]

Match the type of radiation in column A with its associated Quality Factor (10CFR20) from column B.

Column A	Column B
a. alpha	1
b. beta	2
c. gamma	5
d. neutron (unknown energy)	10
	20

QUESTION B.3 [2.0 points, 0.5 each]

Identify whether each of the following logbook entries would be made in black ink (BLACK), green ink, (GREEN), red ink (RED) or would be black with red underline (R/U)

a. Removed fuel element ___ for inspection.

b. Removed Neutron source from core.

c. Scram due to trainee error early during a startup.

d. At power, reactor scram due to loss of electrical power to facility.

QUESTION B.4 [1.0 point]

Many research reactors use different methods to reduce the dose due to N^{16} at the pool top. If the method used keeps the N^{16} ten (10) feet below the surface of the water, and a half-thickness for the N^{16} gamma(s) is one foot for water, then the dose due to N^{16} is reduced (approximately) by a factor of … (Note: Neglect any reduction in dose rate due to half-life.)

a. 20

b. 100

c. 200

d. 1000

QUESTION B.5 [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.6 [1.0 point]

Which ONE of the following is the definition of ***Emergency Action Level***?

a. a condition that calls for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

b. Specific instrument readings, or observations; radiation dose or dose rates; or specific contamination levels of airborne, waterborne, or surface-deposited radioactive materials that may be used as thresholds for establishing emergency classes and initiating appropriate emergency methods.

c. classes of accidents grouped by severity level for which predetermined emergency measures should be taken or considered.

d. a document that provides the basis for actions to cope with an emergency. It outlines the objectives to be met by the emergency procedures and defines the authority and responsibilities to achieve such objectives.

QUESTION B.7 [1.0 point]

The scram time for the scrammable control element were last measured on March 31, 2004. Which one of the following dates is the latest the maintenance may be performed again without exceeding a Technical Specifications requirement?

a. Six months later, September 30, 2005

b. 32 weeks later, November 10, 2005

c. 9 months later, December 31, 2005

d. 40 weeks later, January 5, 2006

QUESTION B.8 [1.0 point]

During a fire, you notice that the key for the main circuit breaker is not in the key hole. Where would you go to find the spare key?

a. the Emergency Grab Bag.

b. the Facility Director's desk in Room 102 of the chemistry building.

c. the Assistant Facility Director's desk in Room 102 of the chemistry building.

d. the desk in the control room.

QUESTION B.9 [2.0 points, 0.5 each]

Match the 10CFR55 requirements for maintaining an active operator license in column A with the corresponding time period from column B.

	Column A	Column B
a.	Renew License	1 year
b.	Medical Exam	2 years
c.	Pass Requalification Written Examination	4 years
d.	Pass Requalification Operating Test	6 years

QUESTION B.10 [1.0 point, ¼ each]

Choice A deleted during examination due to fact that Tritium is NOT a concern at Reed College. Also Point value changed to each

Identify the PRIMARY source (irradiation of air, irradiation of water, or fission product) of EACH of the radioisotopes listed.

a. ~~$_{4}H^{3}$~~ Deleted during examination!

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

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

d. $_{54}Xe^{135}$

QUESTION B.11 [2.0 points, ½ each] Question replaced during examination. See end of Section B.

~~Identify each of the following actions as either a channel **CHECK**, a channel **TEST**, or a channel **CAL**ibration.~~

~~a. Prior to startup you place a known radioactive source near a radiation detector, noting meter movement and alarm function operation.~~

~~b. During startup you compare all of your nuclear instrumentation channels ensuring they track together.~~

~~c. At power, you perform a heat balance (calorimetric) and determine you must adjust Nuclear Instrumentation readings.~~

~~d. During a reactor shutdown you note a -80 second period on Nuclear Instrumentation.~~

QUESTION B.12 [1.0 point]

Which ONE of the following conditions is a violation of Technical Specifications?

a. Core Excess Reactivity is 2.2 % **)** k/k with experiments in place.

b. Pool water conductivity is 2 **:** mhos/cm averaged over 1 month.

c. Bulk pool temperature during reactor operation is 120°F (48.9°C).

d. The RAM is inoperable (for a short period of time) during reactor operations.

QUESTION B.13 [1.0 point]

The CURIE content of a radioactive source is a measure of

a. the number of radioactive atoms in the source.

b. the amount of energy emitted per unit time by the source

c. the amount of damage to soft body tissue per unit time.

d. the number of nuclear disintegrations per unit time.

QUESTION B.14 [1.0 point]

A survey instrument with a window probe was used to measure an irradiated experiment. The results were 100 millirem/hr window open and 60 millirem/hr window closed. What was the gamma dose?

a. 100 millirem/hr

b. 60 millirem/hr

c. 40 millirem/hr

d. 140 millirem/hr

QUESTION B.15 [1.0 point]
Technical Specification 5.8 requires that "All fuel elements or fueled devices outside the reactor core shall be stored in a geometry such that the calculated K_{eff} is less than _____ under all conditions of moderation.

a. 0.80

b. 0.85

c. 0.90

d. 0.95

QUESTION B.11new [1.0 point] Question added during examination.
Which ONE of the following Emergency classifications is NOT credible at Reed College?

a. Alert.

b. General Emergency.

c. Non- Safety Related Event.

d. Notification of Unusual Event.

QUESTION B.16 [1.0 point] Question added during examination.
When removing a control element, per SOP-41 *Control Rod Inspection*, you must first remove [a] fuel element[s]. Which ONE of the following correctly describes the fuel elements required to be removed?

a. 1 from A ring

b. 1 from B ring

c. 2 from B ring

d. 2 from C ring

QUESTION C.1 [1.0 point]

WHICH ONE of the following is the purpose of the diffuser on the return of the primary coolant system?

a. Increase heat transfer rate due to increased mixing within the core.

b. Decrease the activation rate of O^{16} to N^{16} due to reduced time in core.

c. Increase transport time for N^{16} to reach surface of pool.

d. Break up of O^{16} bubbles in pool, thereby decreasing production of N^{16}.

QUESTION C.2 [1.0 point]

In order to minimize the effects of Ar^{41} from the pneumatic tube (rabbit) system, the …

a. exhaust of the system is connected to the Ar^{41} purge system.

b. piping is a recirculating loop with a CO_2 purge.

c. piping is a recirculating loop with an N_2 purge.

d. exhaust of the system is located in the facility exhaust stack.

QUESTION C.3 [1.0 point]

Which ONE of the following is the reason that primary temperature is maintained below 49°C? Above this temperature the …

a. diffusion of N^{16} from the pool increases dramatically.

b. bath temperature coefficient changes from negative to positive.

c. the purification system filter melts.

d. the demineralizer resin rate of depletion increases.

QUESTION C.4 [1.0 point]

Which ONE of the following is the method used to minimize mechanical shock to the standard control rods on a scram?

a. A small spring located at the bottom of the rod.

b. A piston, (part of the connecting rod) drives water out of a dashpot as the rod nears the bottom of its travel.

c. An electrical-mechanical brake energizes when the rod down limit switch is energized.

d. A piston (part of the connecting rod) drives air out of a dashpot as the rod nears the bottom of travel.

QUESTION C.5 [1.0 point]
Flow through the demineralizer loop is limited to 10 gallons per minute. This limit is to

a. prevent blowing resin out of the demineralizer thereby clogging the filter.

b. creating channels through the demineralizer reducing efficiency.

c. overpressurization of the demineralizer.

d. blowing the upstream filter into the demineralizer.

QUESTION C.6 [1.0 point]
Each fuel element contains a top and bottom reflector plugs which are made of …

a. zirconium

b. zirconium hydride

c. graphite

d. polyethylene

QUESTION C.7 [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.8 [1.0 point]
WHICH ONE of the following detectors is used primarily to measure N^{16} release to the environment?

a. NONE, N^{16} has too short a half-life to require environmental monitoring.

b. Stack Gas Monitor

c. Stack Particulate Monitor

d. Bridge Area Monitor

QUESTION C.9 [2.0 points, 0.4 each]

Using the figure provided, identify whether each of the dampers listed below is Open or Closed, Modulates on a ventilation system Isolation.

a. Damper 10

b. Damper 12

c. Damper 13

d. Damper 14

e. Damper 15

QUESTION C.10 [1.0 point]

Which ONE of the following facility detectors does **NOT** have an input signal into the Multitrend?

a. CAM

b. Log-N Channel

c. Bulk Water Temperature

d. Primary Conductivity

QUESTION C.11 [1.0 point, 0.333 each]

Match the detector type in column B with its respective Nuclear Instrument Channel in column A.

Instrumentation Channel	Detector Type
a. Linear	1. Fission Chamber
b. Log-N	2. Uncompensated Ion Chamber
c. Percent Power	3. Compensated Ion Chamber

QUESTION C.12 [1.0 point]

Following a scram, the lights for the regulating rod are as follows RED: OFF, White ON, BLUE: ON and Yellow: ON

a. Rod is still at top beginning to insert.

b. Rod is down but Motor is up

c. Rod and Motor are down, scram signal still present.

d. Rod and Motor are down, Scram is reset.

QUESTION C.13 [1.0 point]

Which ONE of the following is the reason for two conductivity probes in the purification system?

a. Primary and Backup indication.

b. Comparing the two readings you can measure the efficiency of the demineralizer.

c. Comparing the two readings you can calculate the pH.

d. Using two readings minimizes differences in temperature between the two probes.

QUESTION C.14 [1.0 point]

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.

QUESTION C.15 [1.0 point]

Which ONE of the following correctly describes how condensation is removed from the Lazy Susan?

a. Periodic draining of the pool, allowing the condensation to evaporate.

b. An electric heater is placed in an insulated specimen tube, which is inserted into the rack.

c. An inert gas is blown into the lazy susan to force the condensation out.

d. A water absorbent material is placed in a perforated specimen tube, which is inserted into the rack.

QUESTION C.16 [2.0 points, 0.5 each]

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

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

QUESTION C.17 [2.0 points, 0.5 each]

Match the Input Signal from the respective Control and Instrumentation circuits in COLUMN “A” to the correct outputs in COLUMN “B”. (Items in COLUMN B may be used more than once or not at all.)

	COLUMN A	COLUMN B
a.	Log-N Period channel	1. Indication Only
b.	Log Count Rate channel	2. Indication and Scram
c.	Linear Power channel	3. No Indication
d.	Percent Power channel	

A.1 c
REF: Reed Reactor Training Manual, § 8.1, p. 135

A.2 d
REF: Reed Reactor Training Manual, § 8.2 pp. 137-140

A.3 a
REF: $P = P_0 e^{t/T}$

A.4 b
REF: Reed Reactor Training Manual, § 9.7, Example 9.4, pp. 158-159

A.5 b
REF: Reed Reactor Training Manual, § 6.3, p. 114

A.6 c
REF: Reed Reactor Training Manual, § 8.4, p. 143

A.7 b
REF: Reed Reactor Training Manual, § 10.6, p. 206

A.8 a
REF: Reed Reactor Training Manual, § 10.4, p. 185

A.9 d
REF: Reed Reactor Training Manual, § 8.4, p. 145

A.10 a
REF: Reed Reactor Training Manual, § 10.5, p. 189

A.11 a
REF: $\rho D = (K_{eff1} - K_{eff2}) \div (K_{eff1} * K_{eff2})$ $\rho D = (0.9550 - 1.0000) \div (0.9550 * 1.0000)$
$\rho D = -0.0450 \div 0.9550 = -0.0471$

A.12 b
REF: $\ln (P/P_0) \times \text{period} = \text{time}$, $\ln(1000) \times 26 = 6.908 \times 26 = 179.6$. 180 seconds

A.13 a, 2; b, 4; c, 1; d, 3
REF: Reed Training Manual, §§ 7.3, 9.4 and 9.6, pp. 126, 151 and 154.

A.14 d
REF: Reed Reactor Training Manual, § 10.6, p. 194

A.15 b
REF: Reed Reactor Training Manual, § 9.7 p. 159

A.16 a
REF: Reed Reactor Training Manual, § 10.3, p. 173

A.17 b
REF: Reed Reactor Training Manual, § 3.3, p. 38

A.18 d or c 2nd answer added per facility comment.
REF: Standard NRC Question.

A.19 d
REF: Reed Reactor Training Manual, § 10.1

B.1 a, NA; b Double; c, Double; d, Double
REF: Technical Specification J.5, J.6

B.2 a, 20; b, 1; c, 1; d, 10
REF: 10CFR20.100x

B.3 a, RED; b, R/U; c, BLACK; d, GREEN;
REF:

B.4 d
REF: Basic Radiological Controls knowledge: “Half-Thickness and Tenth-Thickness". 2^{10} = 1024

B.5 d
REF: Technical Specification J.4(c)

B.6 b
REF: Emergency Plan, § 2.0 Definitions, p. 6.

B.7 c
REFERENCE T.S. §§ F.9.a (Semi-annual) and A.7 (not to exceed 32 weeks)

B.08 a
REF: Emergency Implementing Procedures, p. 4.

B.9 a, 6; b, 2; c, 2; d, 1
REF: 10CFR55.

B.10 ~~a, Water;~~ b, Air; c, Water; d, Fission
REF: Standard NRC question.

~~B.11 a, Check; b, Test; c, Cal; d, Check~~
~~REF: Technical Specification 1.2.1-3~~

B.11new b
REF: Emergency Plan

B.12 d
REF: Technical Specifications §§ D, E and G.

B.13 d
REF: Standard Health Physics Definition.

B.14 b
REF: Standard NRC Health Physics Question

B.15 a
REF: Technical Specifications § H.1

B.16 c
REF: SOP-x,

C.1 c
REF: Operation Support systems, § 1.2 2nd ¶.

C.2 d
REF: Operation Support systems, § 3.2 1st ¶.

C.3 d
REF: RRF TRIGA Mk I Mech. Maint. & Op. Manual, § 5.11.7

C.4 b
REF: RRF TRIGA Mk I Mech. Maint. & Op. Manual, § 5.11.3

C.5 b
REF: RRF TRIGA Mk I Mech. Maint. & Op. Manual, § 5.11.1

C.6 c
REF: Reed Reactor Training Manual, § 11.3, p. 204

C.7 d
REF: Reed Reactor Training Manual, § 11.6, pp. 214-215.

C.8 a
REF: Standard NRC Question

C.9 a, Closed; b, Open; c, Closed; d, Open e, Modulates
REF: Reed Reactor Training Manual § 11.8, 2nd ¶ on page 217.

C.10 d
REF: SOP-11, *Multitrend Operation*, § 11.7.1 1st ¶, page 2.

C.11 a, 3; b, 1; c, 2
REF: Reed Reactor Training Manual § 11.7 Instrumentation. Figure 11.3.

C.12 d
REF: Reed Reactor Training Manual § 11, Table 11.1.

C.13 b
REF: Reed Reactor Training Manual § 11.6, 4th ¶ on p. 214

C.14 a
REF: Reed Reactor Training Manual, § 11.x

C.15 d
REF: RRF TRIGA Mk I Mech. Maint. & Op. Manual, § 4.3.4, p. 41.

C.16 a, 3; b, 2; c, 2; d, 4
REF: SOP-30, *RAM Calibration*, § 30.1; SOP-31, *CAM Calibration*, § 31.1; SOP-32, *APM Calibration* § 32.1; SOP-33, *GSM Calibration* § 33.1

C.17 a. 1; b. 3; c, 2; d, 2
REF: SAR Figure 5-7 Block diagram of Reactor Instrumentation for Steady State Operation

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

FACILITY: Reed Reactor Facility

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 2005/05/02

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 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	% of Candidates Score	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.8 a b c d ___

A.9 a b c d ___

A.10 a b c d ___

A.11 a b c d ___

A.12 a b c d ___

A.13a 1 2 3 4 ___

A.13b 1 2 3 4 ___

A.13c 1 2 3 4 ___

A.13d 1 2 3 4 ___

A.14 a b c d ___

A.15 a b c d ___

A.16 a b c d ___

A.17 a b c d ___

A.18 a b c d ___

A.19 a b c d ___

B.1a N/A Double NSR ___

B.1b N/A Double NSR ___

B.1c N/A Double NSR ___

B.1d N/A Double NSR ___

B.2a 1 2 5 10 20 ___

B.2b 1 2 5 10 20 ___

B.2c 1 2 5 10 20 ___

B.2d 1 2 5 10 20 ___

B.3a Black Green Red R/U ___

B.3b Black Green Red R/U ___

B.3c Black Green Red R/U ___

B.3d Black Green Red R/U ___

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.9a 1 2 4 6 ___

B.9b 1 2 4 6 ___

B.9c 1 2 4 6 ___

B.9d 1 2 4 6 ___

B.10a Water Air Water Fission ___

B.10b Water Air Water Fission ___

B.10c Water Air Water Fission ___

B.10d Water Air Water Fission ___

B.11a Check Test CAL _____

B.11b Check Test CAL _____

B.11c Check Test CAL _____

B.11d Check Test CAL _____

B.12 a b c d ___

B.13 a b c d ___

B.14 a b c d ___

B.15 a b c d ___

C.1 a b c d ___

C.2 a b c d ___

C.3 a b c d ___

C.4 a b c d ___

C.5 a b c d ___

C.6 a b c d ___

C.7 a b c d ___

C.8 a b c d ___

C.9a Open Closed Moderates ___

C.9b Open Closed Moderates ___

C.9c Open Closed Moderates ___

C.9d Open Closed Moderates ___

C.9e Open Closed Moderates ___

C.10 a b c d ___

C.11a 1 2 3 ___

C.11b 1 2 3 ___

C.11c 1 2 3 ___

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.16a 1 2 3 4 ___

C.16b 1 2 3 4 ___

C.16c 1 2 3 4 ___

C.16d 1 2 3 4 ___

C.17a 1 2 3 ___

C.17b 1 2 3 ___

C.17c 1 2 3 ___

C.17d 1 2 3 ___