

February 13, 2008

Mr. Stephen I. Miller, Reactor Facility Director
Armed Forces Radiobiology Research Institute
Naval Medical Center
8901 Wisconsin Ave.
Bethesda, MD 20889-5603

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-170/OL-08-01, ARMED FORCES
RADIOBIOLOGY RESEARCH INSTITUTE

Dear Mr. Miller:

During the week of January 21, 2008, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your Armed Forces Radiobiology Research Institute Reactor reactor. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2, published in June 2007. Examination questions and preliminary findings were discussed at the conclusion of the examination with those members of your staff identified in the enclosed report.

In accordance with Title 10, Section 2.390 of the Code of Federal 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 <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room). The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. If you have any questions concerning this examination, please contact Patrick Isaac at 301-415-1019 or via email at pxi@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. 50-170

Enclosures: 1. Examination Report No. 50-170/OL-08-01
2. Written Examination

cc:
Please see next page

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Docket No. 50-170

- Enclosures: 1. Examination Report No. 50-170/OL-08-01
2. Examination and answer key

cc:

Please see next page

DISTRIBUTION w/ encls.:

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cc:

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EXAMINATION REPORT NO: 50-170/OL-08-01

FACILITY: ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE

FACILITY DOCKET NO.: 50-170

FACILITY LICENSE NO.: R-84

SUBMITTED BY: IRA 02/12/08
Patrick J. Isaac, Chief Examiner Date

SUMMARY:

During the week of January 21, 2008, the NRC administered a retake of Section B, Normal and Emergency Operating Procedures and Radiological Controls, of the written examinations to one Senior Reactor Operator Instant (SRO-I) candidate. The candidate passed the examinations.

REPORT DETAILS

1. Examiner: Patrick J. Isaac, Chief Examiner
2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	N/A	1/0	1/0
Operating Tests	N/A	Waived	Waived
Overall	N/A	1/0	1/0

3. Exit Meeting:

Stephen Miller, Facility Director AFRRRI
Patrick Isaac, NRC, Examiner

Mr. Miller stated that the written examination was well written and needed no corrections. The NRC Examiner thanked the facility for their support in the administration of the examinations.

U. S. NUCLEAR REGULATORY COMMISSION
RESEARCH AND TEST REACTOR OPERATOR LICENSING EXAMINATION

FACILITY: Armed Forces Radiobiology Research Institute

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 01/24/08

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the answer sheets provided. Points for each question are indicated in brackets for each question. You must score 70% to pass. Examinations will be picked up one (1) hour after the examination starts.

<u>Category Value</u>	<u>% of Total</u>	<u>Candidates Score</u>	<u>% of Category Value</u>	<u>Category</u>
<u>20.00</u>	<u>100</u>	_____	_____	B. Normal and Emergency Operating Procedures and Radiological Controls
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. The point value for each question is indicated in [brackets] after the question.
7. If the intent of a question is unclear, ask questions of the examiner only.
8. To pass the examination you must achieve a grade of 70 percent or greater .
9. There is a time limit of one (1) hour for completion of the examination.
10. When you have completed and turned in you examination, leave the examination area

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

001 a b c d _____

002 a b c d _____

003 a b c d _____

004 a b c d _____

005 a b c d _____

006 a b c d _____

007 a _____ b _____ c _____ d _____

008 a b c d _____

009 a b c d _____

010 a b c d _____

011 a b c d _____

012 a b c d _____

013 a b c d _____

014 a b c d _____

015 a b c d _____

016 a b c d _____

017 a _____ b _____ c _____ d _____ e _____

018 a b c d _____

Question B.1 [1.0 point]

A room contains a source which, when exposed, results in a general area dose rate of 175 millirem per hour. This source is scheduled to be exposed continuously for 35 days. Select an acceptable method for controlling radiation exposure from the source within this room.

- a. Post the area with the words "Danger-Radiation Area".
- b. Equip the room with a device to visually display the current dose rate within the room.
- c. Equip the room with a motion detector that will alarm in the chemistry building.
- d. Lock the room to prevent inadvertent entry into the room.

Question B.2 [1.0 point]

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:

- a. 6 inches
- b. 21 inches
- c. 21 feet
- d. 57 feet

Question B.3 [1.0 point]

Which one of the following is true about gammas when compared to alphas and betas ?

- a. Highest ionization potential
- b. Least penetrating
- c. For the same curie content, poses the greatest hazard when taken internally
- d. Poses the greatest whole body concern

Question B.4 [1.0 point]

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

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

Question B.5 [1.0 point]

A 4 inch thickness of steel reduces a gamma radiation dose rate from 60 mrem/hr to 6 mrem/hr. What is the dose rate if an additional 1 inch thickness of steel is added?

- a. 0.56 mrem/hr
- b. 1.50 mrem/hr
- c. 2.62 mrem/hr
- d. 3.37 mrem/hr

Question B.6 [1.0 point]

Which ONE of the following correctly defines a Safety Limit?

- a. Limits on important process variables which are found to be necessary to reasonably protect the integrity of certain physical barriers which guard against the uncontrolled release of radioactivity.
- b. The Lowest functional capability of performance levels of equipment required for safe operation of the facility.
- c. Settings for automatic protective devices related to those variables having significant safety functions.
- d. a measuring or protective channel in the reactor safety system.

Question B.7 [2.0 points, ½ each]

Match the values from column B for the Technical Specification limits listed in column A. (Values in Column B may be used more than once or not at all. Each limit in section A should have only one answer.)

<u>Column A</u>	<u>Column B</u>
a. Minimum Shutdown margin provided by the remaining control rods with the most reactive control rod fully withdrawn or removed.	1) \$0.50 (0.35% $\Delta k/k$)
	2) \$1.00 (0.7% $\Delta k/k$)
b. Total Maximum Reactivity worth of all experiments.	3) \$2.00 (1.4% $\Delta k/k$)
c. Total Maximum available Excess Reactivity above cold critical with or without all experiments in place	4) \$3.00 (2.1% $\Delta k/k$)
	5) \$4.00 (2.8% $\Delta k/k$)
d. Maximum allowable pulse (by Technical Specifications).	6) \$5.00 (3.5% $\Delta k/k$)

QUESTION B.8 [1.0 point]

A radiation survey instrument was used to measure an irradiated experiment. The results were 100 mrem/hr with the window open and 60 mrem/hr with the window closed. What was the beta dose rate?

- a. 40 mrem/hr
- b. 60 mrem/hr
- c. 100 mrem/hr
- d. 140 mrem/hr

QUESTION B.9 [1.0 point]

You use a **Geiger-Müller detector** at the same distance from two point sources having the **same curie strength**. Source A's gammas have an energy of 1.0 MeV, while Source B's gammas have an energy of 2.0 MeV. Which ONE of the following would you expect for the readings due to each source?

- a. The reading from source B is four times that of source A.
- b. The reading from source B is twice that of source A.
- c. Both readings are the same.
- d. The reading from source B is half that of source A.

QUESTION B.10 [1.0 point]

Which ONE of the following is the correct definition of a **CHANNEL CHECK**?

- a. The combination of sensor, line, amplifier, and output devices which are connected for the purposes of measuring the value of a parameter.
- b. An adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures.
- c. A qualitative verification of acceptable performance by observation of channel behavior. This verification, where possible, shall include comparison of the channel with other independent channels or systems measuring the same variable.
- d. The introduction of a signal into the channel for verification that it is operable.

QUESTION B.11 [1.0 point]

While working in an area marked "Caution, Radiation Area," you discover your dosimeter is off scale and you leave the area. Assuming you had been working in the area for 45 minutes, what is the maximum dose you would have received?

- a. 3.8 mr
- b. 35.6 mr
- c. 75 mr
- d. 100 mr

QUESTION B.12 [1.0 point]

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

- a. The concentration of a radio-nuclide in air which, if inhaled by an adult worker for a year, results in a total effective dose equivalent of 100 millirem.
- b. 10CFR20 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 radio-nuclide 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.

QUESTION B.13 [1.0 point]

Which ONE of the following actions is required in the event a Technical Specification safety limit is exceeded?

- a. Scram the reactor and notify the Director AFRRRI immediately.
- b. Evacuate the facility and report to the NRC within one hour of discovery.
- c. Reactor shutdown immediately and operation not resumed until authorized by the NRC.
- d. A safety limit violation report must be prepared and submitted to the NRC within 24 hours.

QUESTION B.14 [1.0 point]

Which ONE of the following conditions is a Reportable Occurrence per the Technical Specification definition?

- a. Operation of the reactor with a fuel temperature scram set at 550°C.
- b. Operation of the reactor at 10 kilowatts with purification system inlet temperature at 65°C.
- c. Irradiation of a sample containing 15 milligrams of explosive material.
- d. Operation with a pool level scram setpoint of 15 ft. above the top of the core.

QUESTION B.15 [1.0 point]

Which ONE of the following detectors is used primarily to measure N¹⁶ release to the environment?

- a. NONE; N¹⁶ has too short a half-life to require environmental monitoring.
- b. Stack Gas Monitor
- c. Stack Particulate Monitor
- d. Bridge Area Monitor

Question B.16 [1.0 point]

Per Technical Specifications, operation of the reactor with the ventilation system shutdown is ...

- a. not allowed.
- b. allowed up to 24 hours.
- c. allowed for periods of time during which the dampers shall be closed.
- d. not allowed if the dampers are closed.

Question B.17 [2.0 points, 0.4 each]

Match each of the electronics channels in column A with the reactor modes for which it must be operable in column B.

<u>Column A</u>	<u>Column B</u>
a. Fuel Temperature	1. Steady State ONLY
b. Linear Power Channel	2. Pulse ONLY
c. Log Power Channel	3. All Modes
d. High-Flux Safety Channel	
e. Pulse Energy Integrating Channel	

Question B.18 [1.0 point]

The reactor is considered "SHUTDOWN" according to Technical Specifications if:

- a. all operable control rods are inserted, the console key is removed and under control of a licensed operator.
- b. the reactor is subcritical by at least \$0.50 of reactivity.
- c. the console key is in the "OFF" position and no work is in progress involving refueling operations.
- d. power is less than 100 watts with fuel and bulk water temperatures less than 40 deg. C.

Answer Key

- B.1 d
REF: 10CFR20.1601(a)(3)
- B.2 d
REF: $DR = 6CE_n(f)(f) = 0.005 R = 6(2)(1.33)/x^2$, $x^2 = 3192$, $x = 56.50$ feet
- B.3 d
REF: Radiation Protection
- B.4 a
REF: 10CFR55.53(e)
- B.5 d
REF: 4 inches = 1/10 (6/60) shielding value layer.
1 inch = $10E^{-0.25} = .56$ shielding value layer OR: $I/I_0 = e^{-ux}$
Shielded dose = 6 mrem/hr X .56 = 3.37 mrem/hr
- B.6 a
REF: Technical Specifications §
- B.7 a, 1 (\$0.50); b, 4 (\$3.00); c, 6 (\$5.00) d, 5 (\$4.00)
REF: T.S. 3.1.3 *Reactivity Limitations* and 3.6 *Limitations on Experiments*
- B.8 a
REF: Instrument reads only γ dose with window closed. Instrument reads both β and γ dose with window open. Therefore, β dose is window open dose less window closed dose.
- B.9 c
REF: GM tubes are NOT sensitive to energy level.
- B.10 c
REF: Technical Specifications § 1, Definitions
- B.11 c
REF: (10 CFR 20.1003) - Maximum dose in a radiation area is 100 mr/hr. $100 \text{ mr/hr} \times 0.75 = 75 \text{ mr}$.
- B.12 b
REF: 10CFR20.1003
- B.13 c
REF: AFRRI TS 6.5.1, p 36.
- B.14 b
REF: Technical Specifications, 2.2, 3.3.a, 3.6.d and 3.2.2 (Table 2)

B.15 a

REF: SAR, § 3.4.1 1st ¶.

B.16 c

REF: Tech. Spec. 3.4.

B.17 a, 3; b, 3; c, 1; d, 3; e, 2

REF: Technical Specifications Table 1.

B.18 b

REF: AFRRRI T.S. 1.20.