

May 5, 2011

Dr. George E. Miller
Department of Chemistry
516 Physical Sciences 1
University of California, Irvine
Irvine, CA 92697-2025

SUBJECT: RETAKE EXAMINATION REPORT LETTER NO. 50-326/OL-11-01,
UNIVERSITY OF CALIFORNIA - IRVINE

Dear Dr. Miller:

During the week of April 18, 2011, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your University of California – Irvine Triga reactor. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. 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 Mr. John T. Nguyen at (301) 415-4007 or via internet e-mail John.Nguyen@nrc.gov.

Sincerely,

/RA/

Johnny Eads, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rule Making
Office of Nuclear Reactor Regulation.

Docket No. 50-326

Enclosures: 1. Examination Report No. 50-326/OL-11-01
2. Written Examination

cc : See next page

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ADAMS ACCESSION #: ML111170520

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Office	PROB/CE	IOLB/OLA	PROB/BC
Name	JNguyen	CRevelle	JEads
Date	4/26/11	5/4/11	05/5/11

OFFICIAL RECORD COPY

University of California at Irvine

Docket No. 50-326

cc:

Dr. Scott Rychnovsky, Chair
Department of Chemistry
University of California, Irvine
Irvine, CA 92697-2025

Mr. Steve Hsu
Radiological Health Branch
State Department of Health Services
P.O. Box 9442732
Sacramento, CA 94234-7320

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

EXAMINATION REPORT NO: 50-326/OL-11-01

FACILITY: UNIVERSITY OF CALIFORNIA - IRVINE

FACILITY DOCKET NO.: 50-326

FACILITY LICENSE NO.: R-116

SUBMITTED BY: IRA 04/23/2011
John T. Nguyen, Chief Examiner Date

SUMMARY:

During the week of April 18, 2011, the NRC administered the retake written examination to one Senior Reactor Operator Instant (SRO-I) candidate. The candidate passed all portions of the examinations.

REPORT DETAILS

1. Examiner: John T. Nguyen, Chief Examiner
2. Results:

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

3. Exit Meeting:

Alf Karl Mikael Nilsson, UCI, Senior Reactor Operator
John Nguyen, NRC, Examiner

The NRC Examiner thanked the facility for their support in the administration of the examination. The facility licensee had no comments on the written examination.

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

FACILITY: UNIVERSITY OF CALIFORNIA - IRVINE

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 04/19/2011

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% in each section to pass. Examinations will be picked up three (3) hours 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>16.00</u>	<u>33.33</u>	_____	_____	A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
<u>16.00</u>	<u>33.33</u>	_____	_____	B. Normal and Emergency Operating Procedures and Radiological Controls
<u>16.00</u>	<u>33.33</u>	_____	_____	C. Plant and Radiation Monitoring Systems
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 in each category.
9. There is a time limit of three (3) hours for completion of the examination.
10. When you have completed and turned in your examination, leave the examination area

EQUATION SHEET

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

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

$$\ell^* = 1 \times 10^{-4} \text{ seconds}$$

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

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

$$CR_1(1 - K_{\text{eff}_1}) = CR_2(1 - K_{\text{eff}_2})$$

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

$$M = \frac{1 - K_{\text{eff}_0}}{1 - K_{\text{eff}_1}}$$

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

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

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

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

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

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

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

$$\Delta \rho = \frac{K_{\text{eff}_2} - K_{\text{eff}_1}}{k_{\text{eff}_1} \times K_{\text{eff}_2}}$$

$$T_{\%} = \frac{0.693}{\lambda}$$

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

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

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

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

$$\frac{(\rho_2 - \beta)^2}{Peak_2} = \frac{(\rho_1 - \beta)^2}{Peak_1}$$

1 Curie = 3.7×10^{10} dis/sec

1 kg = 2.21 lbm

1 Horsepower = 2.54×10^3 BTU/hr

1 Mw = 3.41×10^6 BTU/hr

$$1 \text{ BTU} = 778 \text{ ft-lbf}$$

$$1 \text{ gal (H}_2\text{O)} \approx 8 \text{ lbm}$$

$$^{\circ}\text{F} = 9/5 \text{ }^{\circ}\text{C} + 32$$

$$^{\circ}\text{C} = 5/9 (\text{ }^{\circ}\text{F} - 32)$$

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.

A001 a b c d _____

A002 a b c d _____

A003 a b c d _____

A004 a b c d _____

A005 a b c d _____

A006 a b c d _____

A007 a b c d _____

A008 a b c d _____

A009 a b c d _____

A010 a b c d _____

A011 a b c d _____

A012 a b c d _____

A013 a b c d _____

A014 a b c d _____

A015 a b c d _____

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.

B001 a b c d _____

B002 a b c d _____

B003 a b c d _____

B004 a b c d _____

B005 a b c d _____

B006 a b c d _____

B007 a b c d _____

B008 a b c d _____

B009 a b c d _____

B010 a b c d _____

B011 a b c d _____

B012 a b c d _____

B013 a b c d _____

B014 a b c d _____

B015 a b c d _____

B016 a b c d _____

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.

C001 a b c d _____

C002 a b c d _____

C003 a b c d _____

C004 a b c d _____

C005 a b c d _____

C006 a b c d _____

C007 a b c d _____

C008 a b c d _____

C009 a b c d _____

C010 a b c d _____

C011 a b c d _____

C012 a b c d _____

C013 a b c d _____

C014 a b c d _____

C015 a b c d _____

***** END OF EXAMINATION *****

Question **B.1** [1.0 point]

The reactor is in a SHUTDOWN condition, as defined by UCI Technical Specifications, when....

- a. all rods are inserted and the reactor console is secured.
- b. the reactor is subcritical by at least \$1.00 of reactivity in the reference core condition with the reactivity worth of all installed experiments included.
- c. the reactor console is secured and no work is in progress involving core fuel, core structure, installed control rods, or control rod drives.
- d. no experiments are being moved or serviced that have, on movement, a reactivity worth exceeding the maximum value allowed for a single experiment of \$1.00.

Question **B.2** [1.0 point]

Two sheets of $\frac{1}{4}$ inch thick lead reduce a radiation beam from 400 mRem/hr to 200 mRem/hr at one foot. Which ONE of the following will be the radiation measurement at one foot if you add another two (for a total of 4) $\frac{1}{4}$ inch lead sheets?

- a. 50 mR/hr
- b. 75 mR/hr
- c. 100 mR/hr
- d. 150 mR/hr

Question **B.3** [1.0 point]

A room contains a source which, when exposed, results in a general area dose rate of 175 mRem/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. Lock the room to prevent inadvertent entry into the room.
- c. Equip the room with a motion detector that will alarm in the control room.
- d. Equip the room with a device to visually display the current dose rate within the room.

Question **B.4** [1.0 point]

The special unit for absorbed dose “Rem” is defined in 10 CFR Part 20 in terms of a dose equivalent. What does the term dose equivalent relate to?

- a. It is derived by accounting for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in one year.
- b. It is equal to the absorbed dose (Rad) multiplied by the quality factor (Q) of the radiation.
- c. It is equal to the absorbed dose (Rad) divided by the quality factor (Q) of the radiation.
- d. It is the equivalent dose one would receive during the 50-year period following intake.

Question **B.5** [1.0 point]

Which ONE of the following radioisotopes produces the highest ionizing energy gamma?

- a. H^3
- b. N^{16}
- c. Ar^{41}
- d. U^{235}

Question **B.6** [1.0 point]

Select the list that gives the order of types of radiation from the **LEAST** penetrating to the **MOST** penetrating (i.e. travels the further in air).

- a. neutron, gamma, beta, alpha.
- b. alpha, beta, neutron, gamma.
- c. beta, alpha, gamma, neutron.
- d. alpha, neutron, beta, gamma.

Question **B.7** [1.0 point]

Using a calibrated source of 5 curies of Co-60, what is the exposure rate at 6 feet from the source? Co-60 emits two gamma photons per decay with energies of 1.17 Mev and 1.33 Mev.

- a. 750 mR/hr
- b. 2.1 R/hr
- c. 8.3 R/hr
- d. 12.5 R/hr

Question **B.8** [1.0 point]

Which ONE of the following meets the objective of "Safety Limit"?

- a. Setting for an automatic protective device related to a variable having a significant safety function
- b. Limits on important process variables to protect the fuel element cladding
- c. Limits imposed on reactor core reactivity for a reference core condition
- d. Constraints included in the Technical Specifications that are required for safe operation of the facility

Question **B.9** [1.0 point]

Which ONE of the following materials shall NOT be irradiated at UCI?

- a. Iodine 135
- b. Strontium 90
- c. A short half-life material
- d. 30 mg of explosive material

Question **B.10** [1.0 point]

The standard fuel elements shall be measured for length and bend at intervals separated by not more than _____ of magnitude greater than \$1.00 of reactivity, but the intervals shall not exceed _____.

- a. 300 pulses, 60 months
- b. 500 pulses, 60 months
- c. 300 pulses, 36 months
- d. 500 pulses, 36 months

Question **B.11** [1.0 point]

An example of Byproduct Material would be....

- a. Pu-239
- b. U-233
- c. U-235
- d. Co-60

Question **B.12** [1.0 point]

“The reactor shall not be operated unless the excess reactivity is less than \$3.00.” This is an example of a:

- a. safety limit.
- b. limiting safety system setting.
- c. limiting condition for operation.
- d. surveillance requirement.

Question **B.13** [1.0 point]

Substantive changes to the installation/removal of fuel element procedure described in the SOP shall be made only with the approval of :

- a. the Senior Reactor Operator (SRO)
- b. the Reactor Supervisor (RS)
- c. the Radiation Safety Officer (RSO)
- d. the Reactor Operations Committee (ROC)

Question **B.14** [1.0 point]

Which ONE of the following is the correct statement regarding modes of the operation (ON-startup or OFF-shut off) of reactor systems identified below when the Reactor Operator activates the CAM alarm in the EMERGENCY MODE?

- a. pneumatic system blower: ON; purge exhaust fan: OFF; main air inlets: ON; central system alarm indication: OFF
- b. pneumatic system blower: ON; purge exhaust fan: ON; main air inlets: ON; central system alarm indication: ON
- c. pneumatic system blower: OFF; purge exhaust fan: OFF; main air inlets: ON; central system alarm indication: ON
- d. pneumatic system blower: OFF; purge exhaust fan: ON; main air inlets: OFF; central system alarm indication: ON

Question **B.15** [1.0 point]

Per UCI Technical Specifications, which ONE of the following will prevent application of air to the transient rods during the pulse mode?

- a. the REG rod is fully UP
- b. the SHIM rod is fully UP
- c. the steady state power is at 2 kW
- d. Cylinder of the adjustable transient stays at 50% of full length

Question **B.16** [1.0 point]

During an emergency, which ONE of the following is the line of succession regarding orderly authority of the Reactor Incident Commander?

- a. Reactor Supervisor, Senior Reactor Operator, most technically experienced on-site member of reactor staff, Radiation Protection Officer, Facilities Manager for School of Physical Sciences
- b. Most technically experienced on-site member of reactor staff, Reactor Supervisor, Senior Reactor Operator, Radiation Protection Officer, Facilities Manager for School of Physical Sciences
- c. Radiation Protection Officer, Reactor Supervisor, Senior Reactor Operator, most technically experienced on-site member of reactor staff, Facilities Manager for School of Physical Sciences
- d. Senior Reactor Operator, Reactor Supervisor, most technically experienced on-site member of reactor staff, Radiation Protection Officer, Facilities Manager for School of Physical Sciences

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

***** End of the Exam *****

Answer Key

B.1

Answer: b
Reference: TS 1.1

B.2

Answer: c
Reference: A ½ thickness is 2 sheets. Add another 2 sheets, a radiation level will reduce by another ½, or 100 mR/hr

B.3

Answer: b
Reference: 10CFR20.1601(a)(3)

B.4

Answer: b
Reference: 10CFR20.1003

B.5

Answer: b.
Reference: Chart of the Nuclides

B.6

Answer: b
Reference: NRC standard question

B.7

Answer: b
Reference: $R/hr = 6CE/r^2 = 6 \times 5 \times 1 \times (1.17+1.33) / 6^2 = 2.08 R/hr$

B.8

Answer: b
Reference: TS 2.1

B.9

Answer: d
Reference: TS 3.8

B.10

Answer: b
Reference: TS 4.1

B.11

Answer: d
Reference: Byproduct material is radioactive material made radioactive by the process of using special nuclear material; 10 CFR Part 20.1003

B.12

Answer: c
Reference: TS 3.3.1

B.13

Answer: d
Reference: TS 6.3

B.14

Answer: d
Reference: SOP 4.7.3

B.15

Answer: c
Reference: TS 3.4

B.16

Answer: a
Reference: EP 3.4