May 24, 2012

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

SUBJECT: EXAMINATION REPORT NO. 50-326/OL-12-01, UNIVERSITY OF CALIFORNIA - IRVINE

Dear Dr. Miller:

During the week of February 27, 2012, 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 with those members of your staff identified in the enclosed report at the conclusion of the examination.

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 H. Eads, Jr., 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-12-01
2. Written Exam with facility comments incorporated

cc w/o enclosures: See next page

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DISTRIBUTION:
PUBLIC RidsNrrDprPrta RidsNrrDprPrtb
Facility File (CRevelle) O-07 F-08

ADAMS ACCESSION #: ML12145A109 **TEMPLATE #: NRR-079**

Office	PROB/CE		IOLB/OLA		PROB/BC			
Name	JNguyen		CRevelle		JEads			
Date	3/27/12		5/24/12		5/24/102			

OFFICIAL RECORD COPY

cc:

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

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-12-01

FACILITY: UNIVERSITY OF CALIFORNIA - IRVINE

FACILITY DOCKET NO.: 50-326

FACILITY LICENSE NO.: R-116

SUBMITTED BY: **/RA/** 3/27/2012
John T. Nguyen, Chief Examiner Date

SUMMARY:

During the week of February 27, 2012, the NRC administered examinations to four Reactor Operators (RO) and one Senior Reactor Operator Instant (SRO-I) candidates. Two RO candidates failed both the written and operating examinations. All the other candidates 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	2/2	1/0	3/2
Operating Tests	2/2	1/0	3/2
Overall	2/2	1/0	3/2

3. Exit Meeting:

George Miller, UCI, Reactor Supervisor
Athan James Shaka, UCI, Senior Reactor Operator
Mikael Nilsson, UCI, Senior Reactor Operator
John Nguyen, NRC, Examiner

The NRC Examiner thanked the facility for their support during the administration of the examinations. The facility licensee had no comments on the written examination except the comments presented during the administrative of the examination, which have been incorporated into the examination included as Enclosure 2 to this report. The examiner also discussed generic weaknesses noted during the operating examination. The facility licensee promised taking actions to improve program performance in both written examination scores and operating test pass rates.

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

FACILITY: UNIVERSITY OF CALIFORNIA - IRVINE

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 02/27/2012

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.

Category Value	% of Total	Candidates Score	% of Category Value	Category
16.00	33.33	_____	____	A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
16.00	33.33	_____	____	B. Normal and Emergency Operating Procedures and Radiological Controls
16.00	33.33	_____	____	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 you examination, leave the examination area

EQUATION SHEET

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

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

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

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

$$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$$

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

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

$$M = \frac{1 - K_{eff_0}}{1 - K_{eff_1}}$$

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

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

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

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

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

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

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

$$\Delta\rho = \frac{K_{eff_2} - K_{eff_1}}{k_{eff_1} x\, K_{eff_2}}$$

$$T_{‰} = \frac{0.693}{\lambda}$$

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

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

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

$$DR_1 d_1^{\,2} = DR_2 d_2^{\,2}$$

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

1 Curie = 3.7×10^{10} dis/sec

1 Horsepower = 2.54×10^{3} BTU/hr

1 BTU = 778 ft-lbf

1 gal (H_2O) $\approx$ 8 lbm

1 kg = 2.21 lbm

1 Mw = 3.41×10^{6} BTU/hr

$°F = 9/5\ °C + 32$

$°C = 5/9\ (°F - 32)$

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 ____

A016 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 _____

C016 a b c d _____

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

Question A.1 [1.0 point]

Which ONE of the following factors in the "six factor" formula is MOST affected by the MODERATOR?

a. Fast fission factor

b. Reproduction factor

c. Thermal utilization factor

d. Resonance escape probability

Question A.2 [1.0 point]

Change was made during the administration of the examination

The injection of a sample results in a 50 millisecond period. If the scram setpoint is **250 KILOWATTS** and the scram delay time is 0.1 seconds, which ONE of the following is the peak power of the reactor at scram ~~shutdown~~?

a. 305 kW

b. 373 kW

c. 680 kW

d. 1847 kW

Question A.3 [1.0 point]

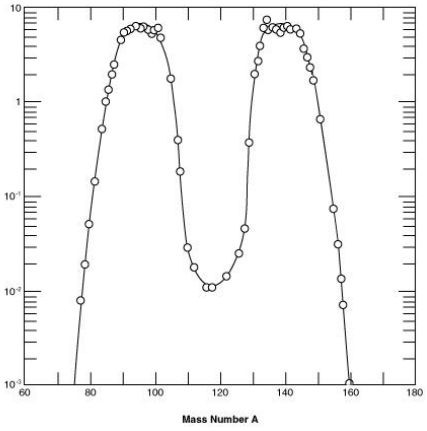
The following graph for U-235 depicts…:

a. axial flux distribution in the core

b. fission product yield distribution

c. radial flux distribution in the core

d. neutron energy distribution in the moderator



Question A.4 [1.0 point]

Two critical reactors at low power are identical, except that Reactor 1 has a beta fraction of 0.0078 and Reactor 2 has a beta fraction of 0.0065. Which ONE of the following best describes the response if an equal amount of positive reactivity is inserted into both reactors?

a. Period of the Reactor 1 will be longer than the period of the Reactor 2

b. Period of the Reactor 1 will be shorter than the period of the Reactor 2

c. Power of the Reactor 1 will be higher than the power of the Reactor 2

d. Power of the Reactor 1 will be lower than the power of the Reactor 2

Question A.5 [1.0 point]

Given the following Core Reactivity Data :

Control Rod	Total Worth ($)	Worth Removed at 1.5 watts ($)
SHIM Rod	3.70	1.70
REG Rod	2.80	2.60
Adjust Transient Rod	1.80	1.50
Fast Transient Rod	0.70	0.70

Which ONE of the following is the calculated shutdown margin that would satisfy the Technical Specification Minimum Shutdown Margin? Assume that all control rods are scramable.

a. 0.50

b. 2.50

c. 2.80

d. 6.50

Question A.6 [1.0 point]

Which ONE of the following is an example of alpha decay?

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

b. $_{35}Br^{87} \rightarrow {}_{35}Br^{86}$

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

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

Question A.7 [1.0 point]

Which ONE of the following is the correct amount of reactivity added if the multiplication factor, k, is increased from 0.800 to 0.950?

a. 0.150

b. 0.158

c. 0.188

d. 0.197

Question A.8 [1.0 point]

The time period in which the MAXIMUM amount of Xe-135 will be present in the core is approximately 8 hours after:

a. a startup to 100%power

b. a scram from 100% power

c. a power increase from 0% to 50%

d. a power decrease from 100% to 50%

Question A.9 [1.0 point]

In a just critical reactor, adding one dollar worth of reactivity will cause:

a. A sudden drop in delayed neutrons

b. The reactor period to be equal to $(\beta-\rho)/\lambda\rho$

c. A number of prompt neutrons equals to a number of delayed neutrons

d. The resultant period to be a function of the prompt neutron lifetime

Question A.10 [1.0 point]

Which ONE of the following conditions will **INCREASE** the core excess of a reactor?

a. Higher moderator temperature (assume negative temperature coefficient)

b. Insertion of a negative reactivity worth experiment

c. Burnout of a burnable poison

d. Fuel depletion

Question A.11 [1.0 point]

Which ONE of the following statements best describes on how moderator temperature affects the core operating characteristics?

a. Increase in moderator temperature will increase the neutron multiplication factor due to the resonance escape probability increase.

b. Increase in moderator temperature will increase the neutron multiplication factor due to the fast non leakage probability decrease.

c. Increase in moderator temperature will decrease the neutron multiplication factor due to the reproduction factor increase.

d. Increase in moderator temperature will decrease the neutron multiplication factor due to the resonance escape probability decrease.

Question A.12 [1.0 point]
An example of a **FISSILE ISOTOPE** which occurs **NATURALLY** is:

a. Pu-239

b. U-238

c. U-235

d. Th-232

Question A.13 [1.0 point] Changes were made during the administration of the examination
A reactor with K_{eff} = 0.8 contributes 1000 neutrons in the first generation. Changing from the first generation to the SECOND generation, how many total neutrons are there ~~in~~ after the second generation?

a. 1250

b. 1600

c. 1800

d. 2000

Question A.14 [1.0 point]
Which ONE of the following isotopes has the **HIGHEST** thermal neutron cross section?

a. Cd-112

b. Sm-149

c. Xe-135

d. U-238

Question A.15 [1.0 point]

Which ONE of the following describes the term **PROMPT DROP**?

a. A reactor is subcritical at negative 80-second period.

b. A reactor has attained criticality on prompt neutrons alone.

c. The instantaneous change in power level due to inserting a control rod.

d. The instantaneous change in power level due to withdrawing a control rod.

Question A.16 [1.0 point]

About two minutes following a reactor scram, the reactor period has stabilized and the power level is decreasing at a CONSTANT rate. Given that reactor power at time t_0 is 100 kW power, what will it be three minutes later?

a. 2 kW

b. 10 kW

c. 30 kW

d. 50 kW

Question B.1 [1.0 point]

Which ONE of the following is the 10CFR20 definition for "Annual Limit on Intake (ALI)"?

a. A derived limit for the amount of radioactive material taken into the body of a public member by inhalation or ingestion in a year. That value of intake would result in a Committed Effective Dose Equivalent of 1 rems whole body or 5 rems to any individual organ.

b. A derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. That value of intake would result in a Committed Effective Dose Equivalent of 1 rems whole body or 5 rems to any individual organ.

c. A derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. That value of intake would result in a Committed Effective Dose Equivalent of 5 rems whole body or 50 rems to any individual organ.

d. A derived limit for the amount of radioactive material taken into the body of a public member by inhalation or ingestion in a year. That value of intake would result in a Committed Effective Dose Equivalent of 0.1 rems whole body or 1 rems to any individual organ.

Question B.2 [1.0 point]

The radiation from an unshielded Co-60 source is 500 mrem/hr. What thickness of lead shielding will be needed to lower the radiation level to 5 mrem/hr? The HVL (half-value-layer) for lead is 6.5 mm.

a. 26 mm

b. 33 mm

c. 38 mm

d. 44 mm

Question B.3 [1.0 point, 0.25 each]

Identify each of the following surveillances as a channel check (**CHECK)**, a channel test (**TEST)**, or a channel calibration (**CAL)**.

a. During performance of the Daily Checklist, you press a SCRAM button to verify a scram on the safety system channel.

b. During performance of the Daily Checklist, you compare the readings of Radiation Area Monitor 1 and Radiation Area Monitor 2.

c. You expose a 2 mCi check source to the continuous air monitor (CAM) detector to verify that its output is operable.

d. Adjust the wide range linear channel in accordance with recent data collected on the reactor power calibration.

Question B.4 [1.0 point]

What is the **HALF LIFE** of the isotope contained in a sample which produces the following count rates?

Time (Minutes)	Counts per Minute (cpm)
Initial	900
30	740
60	615
90	512
180	294

a. 551 minutes

b. 312 minutes

c. 111 minutes

d. 88 minutes

Question B.5 [1.0 point]

Assume that there is no leak from outside of the demineralizer tank. You use a survey instrument with a window probe to measure the dose rate from the demineralizer tank. Compare to the reading with a window **CLOSED,** the reading with a window **OPEN** will :

a. increase, because it can receive an additional alpha radiation from (Al-27) (n,α), (Na-24) reaction.

b. remain the same, because the Quality Factors for gamma and beta radiation are the same.

c. increase, because the Quality Factor for beta and alpha is greater than for gamma.

d. remain the same, because the survey instrument would not be detecting beta and alpha radiation from the tank.

Question B.6 [1.0 point]

The annual dose limit to the lens of the eye for occupational adults is:

a. 0.1 rem

b. 5.0 rem

c. 15.0 rem

d. 50.0 rem

Question B.7 [1.0 point]

The maximum allowable dose for an emergency life saving which the UCI Emergency Director can authorize for a volunteer is:

a. 125 Rem

b. 100 Rem

c. 75 Rem

d. 50 Rem

Question B.8 [1.0 point]

In accordance with the Technical Specifications, which ONE of the following measuring channels is required to be operable in BOTH the Steady-State and Pulse modes?

a. Fuel temperature

b. Startup Count Rate

c. Standard Control Rod Position

d. Reactor Power Level (high range)

~~Question B.9 [1.0 point]~~ Question was deleted by the NRC staff after reviewing the examination. The reactor operator candidates are NOT responsible for memorizing the events in each class of the emergency.

~~Which ONE of the following would be an initiating condition for an ALERT status?~~

~~a. Fuel cladding damage~~

~~b. Minor explosion in the reactor room~~

~~c. Earthquake with damage to facility~~

~~d. Discovery of forced entry to the facility~~

Question B.10 [1.0 point]

Which ONE of the following types of experiments shall NOT be irradiated at the UCI REACTOR? The experiment contains:

a. corrosive materials

b. 15 mg of Explosive materials

c. Strontium-90 isotope with a total inventory of 2 microcuries

d. Iodine isotopes 131 through 135 with a total inventory of 0.1 curie

Question B.11 [1.0 point]

A system or component is defined as "OPERATING" by Technical Specifications if:

a. a channel check has been performed

b. a functional test has been performed

c. it has no outstanding testing requirements

d. it is capable of performing its intended function

Question B.12 [1.0 point]

The standard thermocouple fuel element located in the C-ring shall not exceed 755 °C. This is an example of:

a. Safety Limit (SL)

b. Limiting Safety System Setting (LSSS)

c. Limiting Conditions for Operation (LCO)

d. Pulse Operational Limit (POL)

Question B.13 [1.0 point]

Which ONE of the following documents requires the NRC approval for changes?

a. Major changes in the startup checklist

b Minor modification to the Technical Specifications

c Rearrange chapters in the Safety Analysis Report

d Revise the requalification operator licensing examination

Question B.14 [1.0 point]

What is the MINIMUM level of management who may authorize temporary changes to the procedures that do NOT changes their original intent?

a. Reactor Operator

b. Senior Reactor Operator

c. Reactor Supervisor

d. The Reactor Operations Committee

Question B.15 [1.0 point]

Argon-41 is produced by neutron absorption of argon-40. Argon-41 decays by:

a. a 1.3 Mev gamma with a half-life of 1.8 hours

b. a 6.1 Mev gamma with a half-life of 7 seconds

c. neutron emission with a half-life of 1.8 hours

d. a 1.3 Mev beta with a half-life of 7 seconds

Question B.16 [1.0 point]

You are the only reactor operator (RO) in the control room. The MINIMUM staff required for you to conduct an INITIAL STARTUP of the day is:

a. by yourself only

b. a Senior Reactor Operator on call

c. a Senior Reactor Operator in the control room

d. a Reactor Supervisor in the control room

Question C.1 [1.0 point]

Given the configuration of the LIGHTS associated with the SHIM rod/drive as follows: UP:OFF, DOWN: ON, CONT/ON: OFF, and no failure of switch lights. Identify the conditions of the SHIM rod.

a. Normal condition, rod insertion permissible

b. Abnormal condition, misadjusted rod down limit switch

c. Normal condition, either rod insertion or withdrawal permissible

d. Abnormal condition, rod has stuck above lower limit switch

Question C.2 [1.0 point]

The continuous air monitors (CAMs) are calibrated to detect the presence of:

a. Na^{24}

b. Ar^{41}

c. N^{16}

d. I^{131}

Question C.3 [1.0 point]

The Power Range Channel consists of :

a. An uncompensated ion chamber and a Power Range Monitor

b. A compensated ion chamber and a Power Range Monitor

c. An uncompensated ion chamber and a Wide Range Linear Monitor

d. A compensated ion chamber and a Wide Range Linear Monitor

Question C.4 [1.0 point]

Which ONE of the following best describes the thermocouples in each of the instrumented fuel elements (IFE)?

a. There are consisted of two chromel-alumel thermocouples embedded at the midpoint and one inch above vertical center in the IFE.

b. There are consisted of three chromel-alumel thermocouples embedded at the midpoint, one inch above, and below vertical center in the IFE.

c. There are consisted of two Resistance Temperature Detectors (RTDs) embedded at the midpoint and one inch below vertical center in the IFE.

d. There are consisted of three platinum-rhodium thermocouples embedded at the midpoint, one inch above, and below vertical center in the IFE.

Question C.5 [1.0 point]

For conducting the control rod reactivity worth calibration, the operators should stop measuring the 1.5-folding time before the indicated power exceeds:

a. 5 W

b. 15 W

c. 100 W

d. 1 kW

Question C.6 [1.0 point]

Which ONE of the following is the main function performed by the **DISCRIMINATOR** circuit in the Wide Range Monitor Channel?

a. To convert the signal from a fission counter to linear output over a range of 10^{-8} to 150 percent of full power.

b. To convert the signal logarithmic output of the metering circuit to a δt (delta time) output for period metering purposes.

c. To filter out small pulses due to gamma interactions, passing only pulses due to neutron events within the Wide Range Monitor Channel.

d. To generate a current signal equal and of opposite polarity as the signal due to gamma generated within the Wide Range Monitor Channel.

Question C.7 [1.0 point]
Which ONE of the following controls the AMOUNT OF REACTIVITY that is inserted by the transient rod during pulse operations?

a. The preset pulse timer setting that vents the pneumatic piston

b. The steady state power of the reactor prior to firing the pulse

c. The pressure of the air applied to the pneumatic piston

d. The position of the cylinder

Question C.8 [1.0 point]
Which ONE of the following can cause the Transient control rod interlock when a steady state mode is selected?

a. SHIM rod drive DOWN and SHIM control rod DOWN

b. Pneumatic cylinder DOWN and supply air energized

c. SHIM rod drive UP and SHIM control rod DOWN

d. Pneumatic cylinder UP and supply air energized

Question C.9 [1.0 point] Change was made during the administration of the examination
An illuminated YELLOW light alarm on an Eberline RAM (ARM) indicates:

a. calibration is required

b. battery power has switched OFF

c. the ARM may be failing or malfunctioning

d. alert for radiation level in its immediate area

Question C.10 [1.0 point]

The reactor operator places the CAM in the EMERGENCY ALARM MODE. Which ONE of the following is the correct mode of ventilation system?

a. Fume hood: ON; Main air inlets: ON; purge exhaust fan: ON

b. Fume hood: OFF; Main air inlets: OFF; purge exhaust fan: ON

c. Fume hood: ON; Main air inlets: ON; purge exhaust fan: OFF

d. Fume hood: OFF; Main air inlets: OFF; purge exhaust fan: OFF

Question C.11 [1.0 point, 0.25 each]

Changes were made during the administration of the examination

Match the inputs listed in column A with their responses listed in column B. (Items in column B may be used more than once or not at all). Assume that the reactor is in operation.

Column A	Column B
a. Fuel Temperature = ~~465~~ 415 °C	1. Indicate only
b. Detector HV supply failure	2. ~~Alarm and~~ Interlocks
c. Power Range Monitor = 110 %	3. Alarm and scram
d. Withdrawal of Shim and Transient rods simultaneously in Steady State mode	

Question C.12 [1.0 point]

The low-source-interlock signal comes from:

a. Fuel Temperature Monitor

b. Wide Range Monitor

c. Wide Range Linear Monitor

d. Power Range Monitor

QUESTION C.13 [1.0 point]

Significant quantities of Nitrogen-16 are produced by the irradiation of :

a. air in the beam ports

b. oxygen-16 in the reactor pool

c. air in irradiation cell

d. reactor building atmosphere

Question C.14 [1.0 point]

Which ONE of the following best describes the design of fuel element used at UCI reactor?

a. The fuel is a mixture of U-**Zn**-H alloy containing 8.5% weight of uranium enriched to 20% U^{235}.

b. The fuel is a mixture of U-**Zn**-H alloy containing 20% weight of uranium enriched to 8.5% U^{235}.

c. The fuel is a mixture of U-**Zr**-H alloy containing 20% weight of uranium enriched to 8.5% U^{235}.

d. The fuel is a mixture of U-**Zr**-H alloy containing 8.5% weight of uranium enriched to 20% U^{235}.

Question C.15 [1.0 point]

The reactor operator is conducting the Reactor Power Calibration. Which ONE of the following is an initial setup?

a. Primary water system: ON, Secondary water system: ON, Power level: 100 kW

b. Primary water system: ON, Secondary water system: OFF, Power level: 200 kW

c. Primary water system: OFF, Secondary water system: ON, Power level: 100 kW

d. Primary water system: OFF, Secondary water system: OFF, Power level: 200 kW

Question C.16 [1.0 point] Changes were made during the administration of the examination

Given the following sequence of events during the course of pulsing:

(1) The steady state power = 1.5 watts
(2) Power is applied to the pulse integrator
(3) The mode selector in the pulse mode
(4) A preset time sets 2 seconds

Reactor operator initiates a pulse by pressing the fire button. Which ONE of the following sequences of events takes place?

a. The transient rod air will be energized and de-energized in 1 second. The transient rod will drop back into the core. The transient cylinder automatically drives down.

b. The transient rod air will be energized and de-energized in 2 second. The transient rod will drop back into the core. The transient cylinder automatically drives down.

c. The transient rod air will be energized and immediately de-energized. The transient rod will drop back into the core. The transient cylinder stays at the same location.

d. The transient rod air will be ~~de-~~energized and then de-energized in 2 second. The transient rod and the cylinder stay at the same location.

********** End of Section C **********
********** End of the Exam **********

Answer Key

A.1
Answer: c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, Sec 3.3.1, page 3-16.

A.2
Answer: d
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982
$P = P_0 e^{t/\tau}$, $P = 250\ kW \times e^{0.1/0.05} = 250\ kW \times e^2 = 1847\ kW$

A.3
Answer: b
Reference: DOE Manual Vol. 1, pg. 57

A.4
Answer: a
Reference: Equation Sheet. $\tau = (\ell^*/\rho) + [(\beta-\rho)/\lambda_{eff}\rho]$

A.5
Answer: c
Reference:
Tech Spec SDM = ∑total rod worth removed at critical – most reactivity control rod worth
SDM = ∑(B) - Max (A) = $6.50 – $3.70 = $2.80

A.6
Answer: a
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume 1, Module 1

A.7
Answer: d
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 3.3.3, page 3-21.
In order to solve the question A.07, the applicant can use one of the following methods:
At k=0.8; ρ = ΔKeff/Keff or ρ = Keff-1/Keff = -0.2/0.8 =-0.25. At k=0.95, ρ =-0.05/0.95
ρ = -0.053. The difference between ρ is the answer ,i.e. -0.053-(-0.25)=0.197
Δ ρ = ρ1 – ρ2 where ρ1 = Keff1-1/Keff1 and ρ2 = Keff2-1/Keff2. Substitute ρ1 and ρ2 with Keff1 and Keff2 into the equation above, the result is Δρ = keff1-keff2/(keff1 x keff2)

A.8
Answer: b
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 8.4, page 8-9

A.9
Answer: d
Reference: UCI Instruction Manual for Operators, Sec 3.2.5, page 3-12

A.10
Answer: c
Reference: Standard NRC question

A.11
Answer: d
Reference: Burn, R., *Introduction of Nuclear Reactor Operations*, © 1982, Sec 3.3.1

A.12
Answer: c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* 1988 Section 3.2 page 3-2

A.13
Answer: c
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 5.3, p. 5.6
2-nd generation=n + K*n=1000+800=1800 neutrons

A.14
Answer: c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, Table2.5, page 2-59.

A.15
Answer: c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Page 4-21.

A.16
Answer: b
Reference: $P = P_0 e^{-T/\tau} = 100\ kW \times e^{(180sec/-80sec)} = 100\ kW \times e^{-2.25} = 0.1054 \times 100\ kW = 10\ kW$

Answer Key

B.1
Answer: c
Reference: 10CFR20.1003 Definitions and UCI Instruction Manual for Operators, Section 8.3.1

B.2
Answer: d
Reference: $DR = DR_{\circ} * e^{-\mu X}$
HVL (=6.5 mm) means the original intensity will reduce by half when a lead sheet of 6.5 mm is inserted. Find μ if the HVL is given as follows: $1 = 2 * e^{-\mu * 6.5}$;
μ = 0.10664. Find a thickness of Lead: 5 mrem/hr = 500 mrem/hr* $e^{-0.10664 * X}$; X= 43.2 mm

B.3
Answer: a = TEST; b = CHECK; c = TEST; d = CAL
Reference: UCI Technical specification § 1, Definitions

B.4
Answer: c
Reference: $A = A_o e^{-\lambda t}$
$294 = 900e^{-180\lambda}$, $180\lambda = -\ln 0.327$, $\lambda = 0.00623\ min^{-1}$
$t_{1/2} = 0.693 / \lambda$, $= 0.693 / 0.00623\ min^{-1}$, = 111 minutes

B.5
Answer: d
Reference: BASIC Radiological Concept (Betas and alpha don't make through the demineralizer tank)

B.6
Answer: c
Reference: 10 CFR 20 §§ 1201

B.7 Accept either “b” or “c” as the correct answers.
Answer: c or b
Reference: UCI Emergency Plan 7.4

B.8
Answer: a
Reference: UCI Technical Specifications 3.4

~~**B.9**~~ Question was deleted by the NRC staff after reviewing the examination. The reactor operator candidates are NOT responsible for memorizing the events in each class of the emergency.
~~Answer: a~~
~~Reference: Emergency Plan, Section 5.1 and 5.2~~

B.10
Answer: c
Reference: UCI Technical Specifications 3.8

B.11
Answer: d
Reference: UCI Technical Specifications, Section 1.18

B.12
Answer: b
Reference: UCI Technical Specifications, Section 2.1

B.13
Answer: b
Reference: 10 CFR 50.59

B.14
Answer: c
Reference: UCI Technical Specifications 6.3

B.15
Answer: a
Reference: Chart of the Nuclides

B.16
Answer: c
Reference: SOP, Section 4.1.1.e

Answer Key

C.1
Answer: b
Reference: UCI Instruction Manual for Operators, Table 6.1

C.2
Answer: d
Reference: UCI Instruction Manual for Operators, Section 8.7.1

C.3
Answer: a
Reference: SAR 7.2.6

C.4
Answer: b
Reference: NRC Standard Question

C.5
Answer: d
Reference: UCI SOP, Section 4.4.2

C.6
Answer: c
Reference: SAR 6.2.1

C.7
Answer: d
Reference: NRC Standard Question

C.8
Answer: d
Reference: UCI Instruction Manual for Operators, Section 6.3.2

C.9
Answer: d
Reference: UCI Instruction Manual for Operators, Section 8.7.2

C.10
Answer: b
Reference: UCI SOP, Section 4.7.3

C.11
Answer: a(1) b(3) c(3) d(2)
Reference: UCI Instruction Manual for Operators, Section 6.5

C.12
Answer: b
Reference: UCI Instruction Manual for Operators, Section 6.4.1

C.13
Answer: b
Reference: NRC Standard Question

C.14
Answer: d
Reference: UCI Instruction Manual for Operators, Section 5.2

C.15
Answer: b
Reference: UCI SOP, Section 4.3

C.16 Changes were made during the administration of the examination. The correct answer is "d".

Answer: ~~b~~ d
Reference: information during Walkthrough

**********END OF THE EXAM **********