October 8, 2010

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

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-326/OL-10-01,
UNIVERSITY OF CALIFORNIA - IRVINE

Dear Dr. Miller:

During the week of September 27, 2010, 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 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-10-01
2. Written Examination

cc w/out encls: Please see next page

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ADAMS ACCESSION No.: ML102800387 **TEMPLATE #: NRR-074**

Office	PROB/CE		IOLB/OLA		PROB/BC			
Name	JNguyen		CRevelle		JEads			
Date	10/6/10		10/08/10		10/08/10			

OFFICIAL RECORD COPY

cc:

Dr. Donald Blake, 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-10-01

FACILITY: UNIVERSITY OF CALIFORNIA - IRVINE

FACILITY DOCKET NO.: 50-326

FACILITY LICENSE NO.: R-116

SUBMITTED BY: /RA/ 10/6/2010
John T. Nguyen, Chief Examiner Date

SUMMARY:

During the week of September 27, 2010, the NRC administered examinations to one Reactor Operator and three Senior Reactor Operator Instant (SRO-I) candidates. One SRO-I candidate failed Section B, Normal and Emergency Operating Procedures and Radiological Controls, of the written 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	1/0	2/1	3/1
Operating Tests	1/0	3/0	4/0
Overall	1/0	2/1	3/1

3. Exit Meeting:

George Miller, Reactor Supervisor
John Nguyen, NRC, Examiner

The NRC Examiner thanked the facility for their support in the administration of the operating tests. 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.

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

FACILITY: UNIVERSITY OF CALIFORNIA - IRVINE

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 09/27/2010

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	34.04	_____	____	A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
16.00	34.04	_____	____	B. Normal and Emergency Operating Procedures and Radiological Controls
15.00	31.91	_____	____	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 kg = 2.21 lbm

1 Horsepower = 2.54×10^{3} BTU/hr

1 Mw = 3.41×10^{6} BTU/hr

1 BTU = 778 ft-lbf

1 gal (H_2O) ≈ 8 lbm

°F = 9/5 °C + 32

°C = 5/9 (°F - 32)

Section A Rx Theory, Thermo, and Facility Characteristics

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 _____

Section B Normal/Emerg. Procedures & Rad Con

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 _____

Section C Facility and Radiation Monitoring Systems

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 *****

Section A ℞ Theory, Thermo, and Facility Characteristics

Question A.1 [1.0 point] Change was made per facility comment during the administrative of the examination.
Which ONE of the following is the major source of energy (heat) generated after SHUTDOWN?

a. Delayed neutrons.

b. The gamma radiation.

c. The ~~kinetic~~ decay energy of the fission fragments.

d. The heat liberated from neutrons slowing down in media.

Question A.2 [1.0 point]
Which ONE of the following is the MOST affected factor in the six factor formula when a poison in the control rods is changed from BORON (B) to CADMIUM (Cd)?

a. Fast fission factor (ε).

b. Thermal utilization factor (f).

c. Neutron reproduction factor (η).

d. Resonance escape probability (p).

Question A.3 [1.0 point]
If the mean generation time for neutrons in a reactor is 0.1 sec and k = 1.001, the time for the power to double is:

a. 10 seconds

b. 69 seconds

c. 2 min

d. 1 hour

Question A.4 [1.0 point]

Which ONE of the following best describes the beta decay (β_{-1}) of a nuclide?

a. The atomic mass number unchanged, and the number of protons increases by 1.

b. The atomic mass number unchanged, and the number of protons decreases by 1.

c. The atomic mass number increases by 1, and the number of protons decrease by 1.

d. The atomic mass number increases by 2, and the number of protons increase by 1.

Question A.5 [1.0 point]

When compared to β, β_{eff} is …

a. smaller, because delayed neutrons are born at lower energies than prompt neutrons.

b. larger, because delayed neutrons are born at lower energies than prompt neutrons.

c. smaller, because delayed neutrons are born at higher energies than prompt neutrons.

d. larger, because delayed neutrons are born at higher energies than prompt neutrons.

Question A.6 [1.0 point]

Given a source strength of 100 neutrons per second (N/sec) and a multiplication factor of 0.8, the expected stable neutron count rate would be?

a. 125 N/sec

b. 250 N/sec

c. 400 N/sec

d. 500 N/sec

Question A.7 [1.0 point]

The reactor is on a **CONSTANT** positive period. Which ONE of the following power changes will take the **longest time** to complete?

a. 5%, from 95% to 100%

b. 10%, from 80% to 90%

c. 15%, from 15% to 30%

d. 20%, from 60% to 80%

Question A.8 [1.0 point]

The reactor is **SHUTDOWN** by 5.0% Δk/k with the count rate of 100 counts per second (cps). The Shim rods are withdrawn until the count rate is a steady 2000 cps. What is the value of K_{eff} at this point?

a. 0.952

b. 0.973

c. 0.998

d. 1.020

Question A.9 [1.0 point]

The term ***PROMPT JUMP*** refers to…

a. the instantaneous change in power due to raising a control rod.

b. a reactor which has attained criticality on prompt neutrons alone.

c. a reactor which is critical due to both prompt and delayed neutrons.

d. a negative reactivity insertion which is greater than $\beta_{eff.}$

Section A Rx Theory, Thermo, and Facility Characteristics

Question A.10 [1.0 point]

Which **ONE** of the following conditions will **INCREASE** the shutdown margin of a reactor?

a. Lowering moderator temperature (assume negative temperature coefficient).

b. Insertion of a positive reactivity worth experiment.

c. Burnout of a burnable poison.

d. Fuel depletion.

Question A.11 [2.0 points, 0.5 each]

Match each of the terms in column A with the correct definition from column B.

Column A	Column B
a. Fast neutrons	1. Neutrons released directly from fission.
b. Prompt neutrons	2. High energy neutrons.
c. Slow neutrons	3. Neutrons released from decay of fission products.
d. Delayed neutrons	4. Low energy neutrons.

Question A.12 [1.0 point]

Assume that the worths of the Shim rod, Reg rod, Adjustable Transient rod (ATR), and Fast Transients rod (FTR) are, respectively, $3.70, $2.80, $1.80 and $0.70. The reactor is critical at 5 W after WITHDRAWING the following control rod worths: Shim rod fully up, Reg rod at $2.00, ATR fully down, FTR at $0.50. What is the core excess?

a. -$0.90

b. $2.80

c. $6.20

d. $9.00

Question A.13 [1.0 point]

Which **ONE** of the following is the time period in which the maximum amount of Xe^{135} will be present in the core?

a. 8 to 10 hours after a startup to 100% power.

b. 4 to 6 hours after a power increase from 50% to 100%.

c. 4 to 6 hours after a power decrease from 100% to 50%.

d. 8 to 10 hours after a scram from 100%.

Question A.14 [1.0 point]

The reactor is critical at 5 W. Which **ONE** of the following is the **MINIMUM** reactivity that must be added to produce prompt criticality?

a. Reactivity equal $1.10.

b. Reactivity equal to the β_{eff}.

c. Reactivity when K_{eff} equals 1.008.

d. Reactivity when the stable reactor period equals 3 seconds.

Question A.15 [1.0 point]

Which of the following physical characteristics of the TRIGA fuel accounts for the majority of the negative temperature feedback?

a. Geometric buckling

b. Doppler broadening

c. Thermal expansion of the fuel matrix

d. Hardening of the neutron spectrum caused by heating the U-ZrH fuel

Question B.1 [1.0 point]

An accessible area within the facility has general radiation levels of 500 mrem/hr. What would be the EXPECTED posting for this area?

a. "Caution, Very High Radiation Area"

b. "Danger, Airborne Radioactivity Area"

c. "Danger, High Radiation Area"

d. "Caution, Radiation Area"

Question B.2 [1.0 point, 0.25 each]

Match the 10 CFR 55 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.3 [1.0 point]

Exposing a 2 mCi check source to the continuous air monitor (CAM) detector to verify that its output is operable is…

a. a Channel Test.

b. a Channel Check.

c. a Channel Calibration.

d. a Channel Verification.

Section B Normal, Emergency and Radiological Control Procedures

Question B.4 [1.0 point]

Class II, "Untried" experiment must be submitted to …

a. the Reactor Operator and such experiment shall be reviewed and approved by the Reactor supervisor.

b. the Reactor Supervisor and such experiment shall be reviewed and approved by the Reactor Administrator.

c. the Reactor Supervisor and such experiment shall be reviewed and approved by the ROC.

d. the Reactor Administrator and such experiment shall be reviewed and approved by the Radiation Safety Officer.

Question B.5 [1.0 point, 0.25 each]

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

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

Question B.6 [1.0 point]

Which **ONE** of the following is considered a damaged fuel?

a. In measuring the transverse bend, its lateral bending exceeds 1/16 inches over the length of the cladding.

b. In measuring the elongation, its length exceeds its original length by 1/16 inches.

c. A reactivity worth of fuel element is $0.02 less than the previous measure.

d. Fuel element that performed 500 pulses of magnitude greater than $1.50.

Section B Normal, Emergency and Radiological Control Procedures

Question B.7 [1.0 point]

In order to maintain an active reactor or senior reactor operator license, the license-holder must perform the functions of his/her position for at least:

a. four hours per calendar quarter.

b. six hours per calendar quarter.

c. one hour per month.

d. sixteen hours per year

Question B.8 [1.0 point]

The power level monitoring channels shall be calibrated at least _____ by calorimetric calibration.

a. monthly

b. quarterly

c. annually

d. biennially

Question B.9 [2.0 points, 0.5 each]

New paragraph was added per facility comment during the administrative of the examination.

Match each of the measuring channels in column A with the reactor modes for which it must be operable in column B. Items in column B is to be used only once.

Column A	Column B
a. Fuel Temperature	1. Steady State ONLY
b. Reactor Power Level	2. Pulse ONLY
c. Startup Count Rate	3. All Modes
d. Reactor Power Level (high range)	4. During Reactor Startup

Section B Normal, Emergency and Radiological Control Procedures

Question B.10 [1.0 point]

As permitted by 10 CFR 50.59, the UCI reactor facility may:

a. Modify systems and change the Technical Specifications (TS) if the NRC is notified afterwards.

b. Perform new and little understood experiments when they are for research.

c. Determine the affects of modifications and their impact on TS.

d. Redefine the boundaries of accidents previously analyzed in the Safety Analysis Report (SAR).

Question B.11 [1.0 point]

A radioactive source reads 35 Rem/hr on contact. Five hours later, the same source reads 1.5 Rem/hr. What will the sample read in another five hours?

a. 55 mrem

b. 65 mrem

c. 75 mrem

d. 750 mrem

Question B.12 [1.0 point]

After 5 pulses, a gamma survey in a working area shows a radiation level of 1 R/hr. What is the longest time you can remain in that area without exceeding 50 mRem TEDE?

a. 1 min

b. 3 min

c. 10 min

d. 15 min

Section B Normal, Emergency and Radiological Control Procedures

Question B.13 [1.0 point, 0.25 each]

Identify each of the following as a Safety Limit **(SL),** a Limiting Safety System Setting **(LSSS),** a Limiting Condition for Operation **(LCO),** or a normal operation **(NO)**

a. The temperature of a fuel element is 1000°C.

b. The temperature of a fuel element is 800°C at B-ring.

c. The maximum step insertion is $3.00 in the pulse mode.

d. The pool water level is 20 feet above the reactor top grid plate.

Question B.14 [1.0 point]

Which **ONE** of the following types of experiments shall **NOT** be irradiated at UCI Triga reactor?

a. The experiment can generate radioactive gases or aerosols.

b. The movable experiment has a reactivity worth of – $1.10.

c. The experiment has an I-131 inventory of 0.1 curies.

d. The experiment contains a corrosive material.

Question B.15 [1.0 point]

Which **ONE** of the following is the appropriate Emergency Classification due to a fuel handling accident in which major damage to fuel cladding occurs?

a. Non-Reactor, Safety-related Events

b. Notification of Unusual Events

c. Alert

d. Site Area Emergency

Section C Plant and Radiation Monitoring Systems

Question C.1 [1.0 point]

The UCI Adjustable Transient Rod is located at:

a. B-ring.

b. C-ring.

c. D-ring

d. F-ring.

Question C.2 [1.0 point]

Which **ONE** of the following is the actual design feature which prevents siphoning of primary water on a failure of the primary piping?

a. Signal from a float switch shuts off the primary pump.

b. Signal from a float switch shuts a valve in the pump suction line.

c. All components of the water piping on both systems are above pool water level.

d. Level in the pool drops below the Net Positive Suction Head pressure minimum required to operate the pump.

Question C.3 [1.0 point]

Graphite inserts are placed in the top and bottom of the fuel element. Which **ONE** of the following best describes the function of these inserts?

a. To absorb thermal neutrons.

b. To reduce neutron leakage.

c. To absorb fission product gases.

d. To increase fast neutron flux.

Section C Plant and Radiation Monitoring Systems

Question C.4 [1.0 point]

On a loss of normal electrical power, which **ONE** of the following systems is **NOT** provided by an emergency diesel generator?

a. RAM

b. CAM

c. Primary cooling pump

d. Emergency lightning in the control room

Question C.5 [1.0 point]

What is the maximum acceptable time between the initiation of a scram signal, and the time that the SHIM rod is fully inserted in the core?

a. 2500 msec.

b. 2000 msec.

c. 1000 msec.

d. 500 msec.

Question C.6 [1.0 point]

The output of the compensated ion chamber (CIC) provides the signal for:

a. Period Channel.

b. Wide Range Linear Power Channel.

c. Power Range Channel (0 to 125% power).

d. Log Power Channel (10^{-8} to 200 % of full power).

Section C Plant and Radiation Monitoring Systems

Question C.7 [2.0 points, 0.5 each]

Match the input signals listed in column A with their respective responses listed in column B. (Items in column B may be used more than once or not at all.)

Column A	Column B
a. Manual scram.	1. Indication only.
b. 30-sec period.	2. Indication and scram
c. 110% in linear channel	3. Indication and interlock
d. Apply air to the Adjustable Transient Rod while its cylinder is fully up at steady state mode.	

Question C.8 [1.0 point]

Which one of the following correctly describes the operation of a Thermocouple?

a. A bi-metallic strip which winds/unwinds due to different thermal expansion constants for the two metals, one end is fixed and the other moves a lever proportional to the temperature change.

b. a junction of two dissimilar metals, generating a potential (voltage) proportional to temperature changes.

c. a precision wound resistor, placed in a Wheatstone bridge, the resistance of the resistor varies proportionally to temperature changes.

d. a liquid filled container which expands and contracts proportional to temperature changes, one part of which is connected to a lever.

Section C Plant and Radiation Monitoring Systems

~~Question C.9 [1.0 point]~~

Question deleted during administrative of the examination. No correct answer in the distractors. This question will not factor into the candidates' grades.

~~If the Linear Power Channel output is 7% higher than the calculated thermal power calibration, the reactor operator needs to adjust the Linear Power Channel output by:~~

~~a. adjusting the CIC detector high voltage.~~

~~b. move the neutron source away from the CIC detector.~~

~~c. physically adjusting the height of the detectors in the support assembly.~~

~~d. move the graphite reflector to change the neutron flux near the detectors.~~

Question C.10 [1.0 point]

For calibration of the control rod, the operator calculates the reactor period by measuring the time required for the power to double or power to triple. This technique is called:

a. Rod Drop Method

b. Positive Period Method

c. Negative Period Method

d. Thermal Power Calibration Method

Question C.11 [1.0 point]

Which **ONE** of the following is the main function of the demineralizer in the primary purification system?

a. Remove soluble impurity to maintain low conductivity in the tank water.

b. Reduce N-16 formation, thus reduce the dose rate at the reactor pool.

c. Absorb thermal neutrons, thus increase life of the reactor pool.

d. Absorb tritium, thus maintain purity of the pool water.

Section C Plant and Radiation Monitoring Systems

Question C.12 [1.0 point]

Which **ONE** of the following best depicts the series of boundaries preventing fission product release to the environment?

a. Core shroud, pool water, positive sealing dampers

b. Pool water, reactor tank wall, high efficiency particulate air (HEPA) filters

c. Stainless steel fuel element cladding, pool water, positive sealing dampers, HEPA filters

d. Zirconium hydride lattice structure, pool water, HEPA filters

Question C.13 [1.0 point]

Which **ONE** of the following elements is used as the neutron absorber in the Shim control rod?

a. Hafnium

b. Cadmium and boron

c. Borated stainless steel

d. Graphite with boron carbide

Question C.14 [1.0 point]

Which **ONE** of the following is a correct mode of ventilation system when CAM is placed in the **EMERGENCY** alarm mode?

a. Main air inlets: OFF; purge exhaust fan: ON; pneumatic system blower: OFF

b. Main air inlets: ON; purge exhaust fan: OFF; pneumatic system blower: ON

c. Main air inlets: OFF; purge exhaust fan: ON; pneumatic system blower: ON

d. Main air inlets: ON; purge exhaust fan: OFF; pneumatic system blower: OFF

Section C Plant and Radiation Monitoring Systems

Question C.15 [1.0 point]

A neutron flux will activate isotopes in air. The primary isotope we worry about in the pneumatic transfer system is …

a. N^{16} (O^{16} (n,p) N^{16}).

b. Kr^{80} (Kr^{79} (n, γ) kr^{80}).

c. Ar^{41} (Ar^{40} (n, γ) Ar^{41}).

d. H^{2} (H^{1} (n, γ) H^{2}).

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

Answer Key

A.1 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 3.2.1

A.2 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 4.5.

A.3 b
REF: T = L/k-1
T = .1/(1.001-1) = 100
$N = N_o e^{t/T}$
$2 = e^{t/100} \rightarrow .693 = t/100 \rightarrow t = 69.3$ seconds

A.4 a
REF: Chart of the Nuclides

A.5 b
REF: Fundamentals of Nuclear Reactor Engineering (FONRE), § 29.d, p. 29

A.6 d
REF: $CR = S/(1-K) \rightarrow CR = 100/(1 - .8) = 500$

A.7 c
REF: Time is related to ratio of final power to initial power. 2:1 is the largest ratio.

A.8 c
REF: $K_{eff1}=1/1- \rho_1$
$K_{eff1} =1/(1-(-.05)) \text{—>} K_{eff1}= 0.952$,
$Count_1*(1-K_{eff1}) = Count_{2*}(1-K_{eff2})$ $Count_1*(1-0.952) = Count_{2*}(1-K_{eff2})$
$100*(1-0.952) = 2000(1- K_{eff2})$; $K_{eff2} = 0.998$

A.9 a
REF: FONRE, § 79.h(3), p. 68

A.10 d
REF Standard NRC question

A.11 a, 2; b, 1; c, 4; d, 3
REF: FONRE, §§ 24 & 25, pp. 27 & 28

A.12 b
REF: Total worth=$(3.7+2.8+1.8+0.7)=$9; Reactivity at 5 W= $3.7 + $2.0 + $0.5 = $6.2
Core excess = Total worth – Reactivity at 5 W
$9.0-$6.2 = $2.8

Section A ℞ Theory, Thermo, and Facility Characteristics

A.13 d
REF: NRC Standard Question

A.14 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 4.2.

A.15 d
REF: TRIGA Fuel Design

Section B Normal, Emergency and Radiological Control Procedures

Answer Key

B.1 c
REF: 10CFR20

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

B.3 a
REF: T.S. Section 1.3

B.4 c
REF: UCINRF SOP, Sec 2.1

B.5 a, 4 b, 2 c, 1 d, 3
REF: Reactor Training Manual - *Health Physics*

B.6 a
REF: Technical Specifications §§ 4.1.b

B.7 a
REF: Requalification Program.

B.8 c
REF: Technical Specifications §§ 4.3

B.9 a, 3; b, 1; c, 4; d, 2
REF: Technical Specifications 3.3

B.10 b or c second answer added per facility comment during the administrative of the examination
REF: 10 CFR 50.59

B.11 b
REF $DR = DR_{\circ} * e^{-\lambda t}$
$1.5\ rem/hr = 35\ rem/hr * e^{-\lambda(5hr)}$
$Ln(1.5/35) = -\lambda * 5 \rightarrow \lambda = 0.623$; solve for another 5 hour later
DR $DR = 1.5\ Rem * e^{-0.623*(5)}$
$DR = 6.6 * 10^{-2}$ Rem or ~65 mrem

B.12 b
REF: 1000mR per hour or 16.7 mR per min (1000mR/60min).
To exceed 50 mR, staff can stay ~(50 mR/16.7 mR)*min or 3 min.

B.13 a, SL; b, LSSS; c, LCO; d, NO
REF: Technical Specifications §§ 2.1 and 2.3.

Section B Normal, Emergency and Radiological Control Procedures

B.14 b
REF: UCINRF SOP, Sec 2.4.1

B.15 c
REF: EP, Sec 4.3

Answer Key

C.1 c
REF: SAR, §§ Figure 4-13

C.2 c
REF: SAR, § 13.4.1, page 13-15

C.3 b
REF: SAR, § 4.2 ¶.

C.4 c
REF: Instruction Manual for Operators, Sec 4.9

C.5 c
REF: Technical Specifications §§ 3.1

C.6 b
REF: Instruction Manual for Operators, Sec 6.2.2

C.7 a,2 b,1 c,2 d,3
REF: Instruction Manual for Operators, Sec 6.2 and TS 3.4

C.8 b
REF: NRC Standard Question

~~C.9 c~~
~~REF: UCINRF SOP, Sec 4.3.2~~
Question deleted during administrative of the examination. No correct answer in the distractors. This question will not factor into the candidates' grades.

C.10 b
REF: UCINRF SOP, Sec 4.4.2.b

C.11 a
REF: NRC Standard Question

C.12 c

REF: NRC Standard Question

C.13 d
REF: Instruction Manual for Operators, Sec 5.3

Section C Plant and Radiation Monitoring Systems

C.14 a
REF: UCINRF SOP, Sec 4.7.3

C.15 c
REF: NRC Standard Question

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