August 30, 2011

Dr. Tatjana Jevremovic, Director
University of Utah Nuclear Research Reactor
50 South Central Drive
University of Utah
Salt Lake City, UT 84112

SUBJECT: EXAMINATION REPORT NO. 50-407/OL-11-01, UNIVERSITY OF UTAH

Dear Dr. Jevremovic:

During the week of August 8, 2011, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your Utah Nuclear Triga Reactor. The examination was 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 Phillip T. Young at 301-415-4094 or via internet e-mail Phillip.young@nrc.gov.

Sincerely,

/RA/

Johnny H. Eads, Jr., Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-407

Enclosures:
1. Examination Report No. 50-407/OL-11-01
2. Facility comments with resolution
3. Written examination with facility comments incorporated

cc without enclosures: see next page

August 30, 2011

Dr. Tatjana Jevremovic, Director
University of Utah Nuclear Research Reactor
50 South Central Drive
University of Utah
Salt Lake City, UT 84112

SUBJECT: EXAMINATION REPORT NO. 50-407/OL-11-01, UNIVERSITY OF UTAH NUCLEAR TRIGA REACTOR

Dear Dr. Jevremovic:

During the week of August 8, 2011, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your Utah Nuclear Triga Reactor. The examination was 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.

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OFFICE	PROB:CE		IOLB:LA		PROB:BC	
NAME	PYoung		CRevelle		JEads	
DATE	*8/25/11*		8/25/11		8/30/11	

OFFICIAL RECORD COPY

cc:

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Test, Research, and Training
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Universities of Florida
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U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-407/OL-11-01

FACILITY DOCKET NO.: 50-407

FACILITY LICENSE NO.: R-126

FACILITY: UNIVERSITY OF UTAH NUCLEAR RESEARCH REACTOR

SUBMITTED BY: **/RA/** 8/18/2011
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of August 8, 2011, the NRC administered license examinations to four Senior Reactor Operator license candidates. The candidates passed all applicable portions of the examination.

REPORT DETAILS

1. Examiner: Phillip T. Young, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	0	4/0	4/0
Operating Tests	0	4/0	4/0
Overall	0	4/0	4/0

3. Exit Meeting:

Phillip T. Young, NRC, Examiner
Dr. Tatjana Jevremovic, Director
Dongok Choe, Ph.D. Research Assistant Professor University of Utah

The NRC Examiner thanked the facility for their support in the administration of the examinations and acknowledged the quality of the candidates for this examination. The examiner noted applicant weaknesses in knowledge of and application of 10CFR50.59 and the ability to relate knowledge of sub-critical multiplication to control console indications when bringing the reactor critical.

ENCLOSURE 1

FACILITY COMMENTS WITH NRC RESOLUTION

Question C.03

Comment The University of Utah officially requests to delete one problem in section C of the SRO exam that is given on Aug. 09, 2011 at the University of Utah:

Justification This problem describes the control rod mechanism but the figure on the problem shows the old control rod system not current control rod system.

NRC Resolution This comment is accepted and the question is deleted from this examination.

Question C.12

Comment The University of Utah requests to change the answer for "C.12".

Justification The NRC marked "a" is the answer for C.12 but according to SAR section 4.6.2, page 4-13, and current configuration of the ventilation system, the correct answer must be "c". Actually, in the event of release of particulate or gaseous isotopes, the dampers will closed and air in the reactor room bypass through a HEPA filtration system maintaining the reactor room at a negative pressure compare to outside.

NRC Resolution This comment is accepted and the answer to this question is changed to reflect "c." as the correct answer.

ENCLOSURE 2

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

FACILITY: UNIVERSITY OF UTAH NUCLEAR RESEARCH REACTOR

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 8/9/2011

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the Answer sheet provided. Attach all Answer sheets to the examination. Point values are indicated in parentheses for each question. A 70% in each category is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
16.00	33.3	_____	_____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
16.00	33.3	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
14.00	33.3	_____	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
46.00		_____ FINAL GRADE	_____ %	TOTALS

All work done on this examination is my own. I have neither given nor received aid.

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have neither received nor given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

4. Use black ink or dark pencil only to facilitate legible reproductions.

5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet and each answer sheet.

6. Mark your answers on the answer sheet provided. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. The point value for each question is indicated in [brackets] after the question.

8. If the intent of a question is unclear, ask questions of the examiner only.

9. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition turn in all scrap paper.

10. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

11. To pass the examination you must achieve a grade of 70 percent or greater in each category.

12. There is a time limit of three (3) hours for completion of the examination.

13. When you have completed and turned in you examination, leave the examination area. If you are observed in this area while the examination is still in progress, your license may be denied or revoked.

EQUATION SHEET's

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

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

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

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

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

$$CR_1(1-K_{eff_1}) = CR_2(1-K_{eff_2})$$
$$CR_1(-\rho_1) = CR_2(-\rho_2)$$

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

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

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

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

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

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

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

EQUATION SHEET's

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

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

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

$$T_{½} = \frac{0.693}{\lambda}$$

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

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

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

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

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

EQUATION SHEET's

DR – Rem, Ci – curies, E – Mev, R – feet

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

°F = 9/5°C + 32

1 gal (H_2O) ≈ 8 lbm

°C = 5/9 (°F - 32)

c_P = 1.0 BTU/hr/lbm/°F

c_p = 1 cal/sec/gm/°C

Section A Rx Theory, Thermo & Fac. Operating Characteristics

Question A.01 [1.0 point] (1.0)
The neutron microscopic cross-section for absorption σ_a generally …

a. increases as neutron energy increases
b. decreases as neutron energy increases
c. increases as target nucleus mass increases
d. decreases as target nucleus mass increases

Answer: A.01 b.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988

Question A.02 [1.0 point] (2.0)
A reactor is subcritical with a K_{eff} of 0.955. Which ONE of the following is the MINIMUM reactivity ($\Delta K/K$) that must be added to produce prompt criticality? Given βeff=0.007

a. 0.007
b. 0.047
c. 0.054
d. 0.064

Answer: A.02 c.
Reference: from k=0.995 to criticality (k=1), $\rho = (k-1)/k = -0.047\ \Delta k/k$ or $0.047\ \Delta k/k$ needs to be added to reach criticality. From criticality to JUST prompt, $\rho = \beta eff$ is required, so minimum reactivity = 0.047+0.007= 0.054

Question A.03 [1.0 point] (3.0)
A reactor is slightly supercritical with the following values for each of the factors in the six-factor formula:

Fast fission factor =	1.03	Fast non-leakage probability =	0.84
Resonance escape probability =	0.96	Thermal non-leakage probability =	0.88
Thermal utilization factor =	0.70	Reproduction factor =	1.96

A control rod is inserted to bring the reactor back to critical. Assuming all other factors remain unchanged, the new value for the thermal utilization factor is:

a. 0.698
b. 0.702
c. 0.704
d. 0.708

Answer: A.03 a.
Reference: Introduction to Nuclear Operation, Reed Burn, 1982, Sec 3.2

Question A.04 [1.0 point] (4.0)
Which one of the following factors is the most significant in determining the differential worth of a control rod?

a. The rod speed.
b. Reactor power.
c. The flux shape.
d. The amount of fuel in the core.

Answer: A.04 c
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 2, Module 3, Enabling Objective 5.4, p. 51.

Question A.05 [1.0 point] (5.0)
What is β_{eff}?

a. The time required for the reactor to change by a power of e
b. The fraction of all fission neutrons that are born as delayed neutrons
c. The fraction of all delayed neutrons which reach thermal energy
d. The fractional change in neutron population per generation

Answer: A.05 c.
Reference: DOE Handbook, Vol. 2, Section 2.0

Question A.06 [1.0 point] (6.0)
Reactor power is increasing by a factor of 10 every minute. The reactor period is:

a. 65 seconds.
b. 52 seconds.
c. 26 seconds.
d. 13 seconds.

Answer: A.06 c.
Reference: $P=P_o e^{t/\tau}$ $\tau = 60/\ln(10) = 26.06$ sec

Question A.07 [1.0 point] (7.0)
Which ONE of the following elements will slow down fast neutrons most quickly, i.e. produces the greatest energy loss per collision.

a. Oxygen-16
b. Uranium-238
c. Hydrogen-1
d. Boron-10

Answer: A.07 c.
Reference: DOE Handbook, Volume 1, Module 2, Enabling Objective 2.12.

Question A.08 [1.0 point] (8.0)
Which of the following statements is true about Xenon following a reactor scram?

a. The concentration of ^{135}Xe will decrease due to reduced nuclear flux
b. The concentration of ^{135}Xe will decrease by natural decay into ^{135}I
c. The concentration of ^{135}Xe will increase due to the decay of the ^{135}I inventory.
d. The concentration of ^{135}Xe will remain constant until it is removed via neutron burnout during the subsequent reactor startup.

Answer: A.08 c.
Reference: DOE Handbook, Vol. 2, Section 4. Following a reactor shutdown, xenon-135 concentration will increase due to the decay of the iodine inventory of the core.

Question A.09 [1.0 point] (9.0)
Which **ONE** of the following conditions will **DECREASE** the shutdown margin of a reactor?

a. Increase moderator temperature (Assume negative temperature coefficient).
b. Insertion of a negative reactivity worth experiment.
c. Burnout of a burnable poison.
d. Fuel depletion.

Answer: A.09 c.
Reference: Standard NRC question

Question A.10 [1.0 point] (10.0)
The ratio of the number of neutrons in one generation to the number of neutrons in the previous generation defines the:

a. effective multiplication factor.
b. fast fission factor.
c. neutron non-leakage factor.
d. neutron reproduction factor.

Answer: A.10 a.
Reference: Introduction to Nuclear Operation, Reed Burn, 1982, Sec 3.3

Question A.11 [1.0 point] (11.0)
During the time following a reactor scram, reactor power decreases on an 80 second period, which corresponds to the half-life of the longest-lived delayed neutron precursors, which is approximately

a. 80 seconds
b. 55 seconds
c. 40 seconds
d. 20 seconds

Answer: A.11 b.
Reference: Lamarsh, J. “Introduction to Nuclear Engineering” p. 88 Group 1 is the longest-lived delayed neutron precursor for thermal fission in U-235, with a half-life of 55.72 sec.

Section A Rx Theory, Thermo & Fac. Operating Characteristics

Question A.12 [1.0 point] (12.0)
Given the following Core Reactivity Data at critical (**not at UUTR**):

Control Rod	Total Worth (%dk/k)	Worth Removed (%dk/k)
Safety Rod 1	2.70	1.68
Safety Rod 2	3.20	2.60
Safety Rod 3	2.60	1.52
Regulating Rod	0.40	0.40

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. 2.70
b. 3.00
c. 5.70
d. 6.20

Answer: A.12 b
Reference: SDM = $\sum$(B) – Maximum rod worth in (A) = (1.68+2.60+1.52+0.4) %dk/k - 3.2%dk/k 6.20%dk/k – 3.20%dk/k = 3.00 %dk/k

Question A.13 [1.0 point] (13.0)
You enter the control room and note that all nuclear instrumentation show a steady neutron level, and no rods are in motion. Which ONE of the following conditions CANNOT be true?

a. The reactor is critical.
b. The reactor is subcritical.
c. The reactor is supercritical.
d. The neutron source has been removed from the core.

Answer: A.13 c
Reference: Burn, R., *Introduction of Nuclear Reactor Operations*, © 1988,

Question A.14 [1.0 point] (14.0)
Inelastic scattering can be described as a process whereby a neutron collides with a nucleus and:

a. recoils with a lower kinetic energy, with the nucleus emitting a gamma ray.
b. recoils with the same kinetic energy it had prior to the collision.
c. is absorbed by the nucleus, with the nucleus emitting a gamma ray.
d. recoils with a higher kinetic energy, with the nucleus absorbing a gamma ray.

Answer: A.14 a.
Reference: DOE Handbook Vol I, pg. 45

Question A.15 [1.0 point] (15.0)
Which one of the following statements correctly describes the property of a **GOOD MODERATOR**?

a. It slows down fast neutrons to thermal energy levels via a large number of collisions.
b. It reduces gamma radiation to thermal energy levels via a small number of collisions.
c. It slows down fast neutrons to thermal energy levels via a small number of collisions.
d. It reduces gamma radiation to thermal energy levels via a large number of collisions.

Answer: A.15 c.
Reference: DOE Handbook, Volume 1, Module 2, Enabling Objective 2.13.

Question A.16 [1.0 point - 0.2 each] (16.0)
Given a mother isotope of $({}_{35}Br^{87})^{*}$, identify each of the daughter isotopes as a result of α, β^{+}, β^{-}, γ, or n, decay.

a. ${}_{33}As^{83}$
b. ${}_{34}Se^{87}$
c. ${}_{35}Br^{86}$
d. ${}_{35}Br^{87}$
e. ${}_{36}Kr^{87}$

Answer: A.16 a. = α; b. = β^{+}; c. = n; d. = γ; e. = β^{-}
REF: STD NRC question.

(***** END OF CATEGORY A *****)

Section B Normal/Emergency Procedures and Radiological Controls

Question B.01 [1.0 point] (1.0)

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

a. all rods are inserted and the reactor console is secured.

b. the reactor is subcritical by at least $1.00 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 work is in progress involving incore fuel handling or refueling operations, maintenance of the reactor or its control mechanisms, or insertion or withdrawal of incore experiments.

Answer: B.01 b.
Reference: TS 1.2

Question B.02 [1.0 point] (2.0)

Two sheets of ¼ inch thick lead reduce a radiation beam from 200 mR/hr to 100 mR/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) ¼ inch lead sheets?

a. 20 mR/hr.

b. 35 mR/hr.

c. 50 mR/hr.

d. 70 mR/hr.

Answer: B.02 c.
Reference: A ½ thickness is 2 sheets. Add another 2 sheets, a radiation level will reduce by another ½, or 50 mR/hr

Question B.03 [1.0 point] (3.0)

A room contains a source which, when exposed, results in a general area dose rate of 200 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. Lock the room to prevent inadvertent entry into the room.

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 control room.

d. Post the area with the words "Danger-Radiation Area".

Answer: B.03 a.
Reference: 10CFR20.1601(a)(3)

Section B Normal/Emergency Procedures and Radiological Controls

Question B.04 [1.0 point] (4.0)
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

Answer: B.04 b.
Reference: 10CFR20.1003 and NRC Training Material

Question B.05 [1.0 point] (5.0)
Which ONE of the listed radioisotopes produces the highest ionizing energy gamma?

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

Answer: B.05 b.
Reference: Chart of the Nuclides

Question B.06 [1.0 point] (6.0)
Two point sources have the same curie strength. Source A's gammas have an energy of 1 Mev, whereas Source B's gammas have an energy of 2 Mev. You obtain readings from the same GM tube and Ion Chamber at 10 feet from each source. Concerning the four readings, which ONE of the following statements is correct?

a. The reading from Source B is twice that of Source A for both meters.

b. The reading from Source B is twice that of Source A for the Ion chamber but the same for the GM tube.

c. The reading from Source B is half that of Source A for the GM tube, but the same for the Ion Chamber.

d. The reading from both sources is the same for both meters.

Answer: B.06 b
Reference: NRC standard question

Section B Normal/Emergency Procedures and Radiological Controls

Question B.07 [1.0 point] (7.0)
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

Answer: B.07 b.
Reference: $R/hr = 6CE/r^2 = 6 \times 5 \times 1*(1.17+1.33)/ 6^2 = 2.08$ R/hr

Question B.08 [1.0 point] (8.0)
Which one of the following meets the definition of "Safety Limit"?

a. Setting for a 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

Answer: B.08 b.
Reference: TS 1.2

Question B.09 [1.0 point] (9.0)
Which ONE of the following materials shall NOT be irradiated at UUTR?

a. A corrosive material.
b. A short half-life material.
c. 30 mg of explosive material.
d. Unsecured experiment of 0.50% $\Delta k/k$.

Answer: B.09 c.
Reference: TS 3.6

Section B Normal/Emergency Procedures and Radiological Controls

Question B.10 [1.0 point] (10.0)
During an **EMERGENCY**, actions require personnel to protect facility or to control fires, a planned emergency exposure to the whole body could be allowed up to ____ to save a life.

a. 25 rem
b. 50 rem
c. 75 rem
d. 100 rem

Answer: B.10 c.
Reference: EP 7.2

Question B.11 [1.0 point] (11.0)
The OPERATIONS BOUNDARY is defined as:

a. 1205 MEB only.
b. Reactor Bay.
c. 1206 MEB only.
d. 1205 MEB and 1206 MEB.

Answer: B.11 d.
Reference: Emergency Plan, section 2.0

Question B.12 [1.0 point] (12.0)
"The reactor shall not be operated unless the pH of the pool water shall be between 5.0 and 8.0." This is an example of a:

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

Answer: B.12 c.
Reference: TS Chapter 3

Section B Normal/Emergency Procedures and Radiological Controls

Question B.13 [1.0 point] (13.0)
During Reactor operations, the Senior Reactor Operator (SRO) becomes ill and is taken to the hospital. Only the Reactor Operator (RO) and an experienced student remain in the facility. Reactor operations:

a. must be discontinued because both an RO and an SRO must be in the facility to satisfy Administrative Policy

b. must be discontinued because both an RO and an SRO must be in the facility to satisfy Technical Specifications

c. may continue until a replacement SRO can arrive at the facility within 60 minutes

d. may continue since the RO can monitor the console while the student can carry out prescribed written instructions and the RO shall call another SRO who is designated as the SRO-on call

Answer: B.13 d.
Reference: TS 6.2

Question B.14 [1.0 point] (14.0)
A system or component is defined as "operable" by Technical Specifications if:

a. a channel check has been performed.

b. it is capable of performing its intended function in a normal manner.

c. it has no outstanding testing requirements.

d. a functional test has been performed.

Answer: B.14 b.
Reference: TS 1.4

Question B.15 [1.0 point] (15.0)
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.

Answer: B.15 b.
Reference: TS 3.3.1

Section B Normal/Emergency Procedures and Radiological Controls

Question B.16 [1.0 point] (16.0)
Which one of the following does **NOT** require NRC approval for changes?

a. Technical Specifications

b. Requalification plan

c. SOP

d. Emergency Plan

Answer: B.16 c.
Reference: 10 CFR 50.54 (q); 10 CFR 50.59; 10 CFR 55.59

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

Section C Facility and Radiation Monitoring Systems

Question C.01 [1.0 point] (1.0)
A signal of notification to the UUTR University Police Services is initiated by:

a. reactor pool water level low
b. Percent Power alarm
c. primary water pump off
d. ventilation system off

Answer: C.01 a.
Reference: Facility walkthrough

Question C.02 [1.0 point] (2.0)
Helium gas is used in the pneumatic transfer system instead of compressed air because:

a. it is more compressible
b. it does not retain moisture
c. it minimizes Ar-41 production
d. it minimizes N-16 production

Answer: C.02 c.
Reference: SAR 10.2

Question deleted from examination per facility comment.
~~**Question** C.03 [2.0 point, 0.5 each] (4.0)~~
~~Using the attached diagram of a control rod drive mechanism, match the component part names in Column A with the diagram points in Column B. (Numbers in Column B will be used one time.)~~

~~Column A~~	~~Column B~~
~~a. Motor~~	~~1~~
~~b. Helipot~~	~~2~~
~~c. Limit switches~~	~~3~~
~~d. Brake~~	~~4~~
	~~5~~
	~~6~~

~~Answer: C.03 a. = 1; b. = 3; c. = 6; d. = 2~~
~~Reference: SAR Figure 5.3.7.2~~

Section C Facility and Radiation Monitoring Systems

Question C.04 [1.0 point] (5.0)
The signal for the period monitoring channel is provided from the:

a. Startup channel.

b. Log -N channel.

c. Linear channel.

d. Percent Power channel.

Answer: C.04 b.
Reference: SAR 7.2

Question C.05 [1.0 point, 0.25 each] (6.0)
Match the purification system conditions listed in column A with their respective causes listed in column B. Each choice is used only once.

Column A	Column B
a. High Radiation Level at demineralizer.	1. Channeling in demineralizer.
b. High Radiation Level downstream of demineralizer.	2. Fuel element failure.
c. High flow rate through demineralizer.	3. High temperature in demineralizer system
d. High pressure upstream of demineralizer.	4. Clogged demineralizer

Answer: C.05 a. = 2; b. = 3; c. = 1; d. = 4;
Reference: Standard NRC cleanup loop question

Question C.06 [1.0 point] (7.0)
Each fuel element shall contain a maximum of …

a. 9.0 weigh percent uranium which has a maximum enrichment of less than 20 %.

b. 9.0 weigh percent uranium which has a maximum enrichment of less than 30 %.

c. 20 weigh percent uranium which has a maximum enrichment of less than 9 %.

d. 20 weigh percent uranium which has a maximum enrichment of less than 30 %.

Answer: C.06 a.
Reference: TS 5.1

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Question C.07 [1.0 point] (8.0)
In the control rod drive system, the contact light will be extinguished if the **MAGNET DOWN** microswitch is …

a. actuated AND the **ROD DOWN** microswitch is actuated.
b. **NOT** actuated AND the **ROD DOWN** microswitch is actuated.
c. actuated **OR** the **ROD DOWN** microswitch is **NOT** actuated.
d. **NOT** actuated **OR** the **ROD DOWN** microswitch is actuated.

Answer: C.07 b.
Reference: Standard NRC Question

Question C.08 [1.0 point, 0.25 each] (9.0)
For each of the gasses listed in column A identify its primary source (i.e. neutron irradiation of **air**, neutron irradiation of **W**ater or **F**ission **P**roduct).

a. H^3
b. N^{16}
c. Ar^{41}
d. Xe^{138}

Answer: C.08 a = W; b = W; c = Air; d = FP
Reference: Standard NRC Question

Question C.09 [2.0 point, 0.5 each] (11.0)
Match the input signals listed in column A with their respective responses listed in column B. (Items in column B is to be used more than once or not at all.)

Column A	Column B
a. HV loss to Log Power Channel.	1. Indication only.
b. Percent Power Channel=110% power.	2. Indication and rod prohibit
c. Linear Channel=100% power	3. Indication and reactor scram
d. Start up Channel= 1 cps	4. Indication and rod run in

Answer: C.09 a. = (1); b. = (3); c. = (3); d. = (2)
Reference: SAR 7.2

Section C Facility and Radiation Monitoring Systems

Question C.10 [1.0 point] (12.0)
Which ONE of the following best describes the reason for the high sensitivity of Geiger-Mueller tube detector?

a. Coating with U-235.
b. A longer length tube, so target is larger for all incident events.
c. Lower voltage applied to the detector helps to amplify all incident events.
d. Any incident radiation event causing primary ionization results in ionization of entire detector.

Answer: C.10 d.
Reference: Standard NRC Question

Question C.11 [1.0 point] (13.0)
The equations which describe the operation of the neutron source are:

a. Pu-239 -> alpha + U-235 B-10 + alpha -> N-13 + neutron
b. Pu-239 -> beta + Am-239 B-10 + beta -> Be-9 + neutron
c. Pu-239 -> alpha + U-235 Be-9 + alpha -> C-12 + neutron
d. Pu-239 -> beta + Am-239 Be-9 + beta -> Li-8 + neutron

Answer: C.11 c.
Reference: NRC standard question

Question C.12 [1.0 point] (14.0)
Which ONE of the following describes the operation of the ventilation system in the event of a release of particulate or gaseous activity?

a. The inlet and outlet damper open and the reactor room filter damper opens forcing air through the filter and maintaining a negative pressure in the reactor room.

b. The inlet and outlet dampers close and the dampers for the reactor room and hood filter open to route the building air through the filtration system.

c. The inlet and outlet dampers close and the air is bypassed through a HEPA filtration system maintaining the reactor room at a negative pressure.

d. The outlet damper closes, inlet damper opens, forcing air through the HEPA filter and maintaining the reactor room at a slight positive pressure in relation to the laboratory.

Answer: C.12 ~~a.~~ c. per facility comment
Reference: SAR 9.1

Section C Facility and Radiation Monitoring Systems

Question C.13 [1.0 point] (15.0)
On the control panel the indicating lights for the SHIM rod are as follows: the **CONT** light is **ON**, the **UP** light is **OFF** and the **DOWN** light is **OFF**. What is the condition of the Shim Rod?

a. The rod mechanism is at the top of travel, but the rod is at the bottom.
b. The rod mechanism and the rod are both at the top of travel.
c. The rod mechanism and the rod are both at the bottom of travel.
d. The rod mechanism and the rod are both between the bottom and top of travel.

Answer: C.13 d.
Reference: NRC Walk through

Question C.14 [1.0 point] (16.0)
Following a loss of building electrical power, power for the radiation monitors and the facility intrusion detectors is supplied by:

a. an UUTR emergency generator.
b. an uninterruptible power supply (UPS) within the reactor room.
c. an uninterruptible power supply (UPS) from the main building.
d. power will be lost completely and will not return until building power returns.

Answer: C.014 b.
Reference: SAR8.2

(***** END OF CATEGORY C *****)
(***** END OF EXAMINATION *****)