October 6, 2014

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-14-02, UNIVERSITY OF UTAH

Dear Dr. Jevremovic:

During the week of September 8, 2014, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your University of Utah 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 e-mail Phillip.Young@nrc.gov.

Sincerely,

/RA/

Kevin Hsueh, 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-14-02
2. Facility comments on the written examination
3. Written examination with comments incorporated

cc without enclosures: see next page

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DISTRIBUTION w/ encls.:
PUBLIC PROB r/f KHsueh Facility File CRevelle (O07-F8)

ADAMS ACCESSION #: ML14260A468 NRR-079

OFFICE	PROB:CE		IOLB:LA		PROB:BC	
NAME	PYoung		CRevelle		KHsueh	
DATE	9/22/2014		9/25/2014		10/06/2014	

OFFICIAL RECORD COPY

cc:

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Test, Research, and Training
Reactor Newsletter
Universities of Florida
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Salt Lake City, UT 84114-4850

U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-407/OL-14-02

FACILITY DOCKET NO.: 50-407

FACILITY LICENSE NO.: R-126

FACILITY: University of Utah Nuclear Research Reactor

SUBMITTED BY: **/RA/** 9/22/2014
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of September 8, 2014, the NRC administered license examinations to one Reactor Operator and two Senior Reactor Operator license candidates. The applicant passed all 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	1/0	1/0	2/0
Operating Tests	1/0	2/0	3/0
Overall	1/0	2/0	3/0

3. Exit Meeting:
Phillip T. Young, Chief Examiner - US NRC
Ryan C. Schow, Reactor Supervisor - University of Utah Nuclear Research Reactor

The NRC thanked the facility for their support during the administration of the examinations and accepted their comments on the written examination for review.

ENCLOSURE 1

FACILITY COMMENTS WITH NRC RESOLUTION

Question: A.009

Comment: The key for A-9 listed the answer as b. but the calculation shown below the reference says the correct answer is d. 87 seconds. This was obviously just an editorial error but is being included in the comments for completeness.

Justification: See comment.

NRC Resolution: This comment is accepted and answer is changed d.

Question: A.013

Comment: The written exam accidentally included the key answer on the exam for the candidates.

Justification: None

NRC Resolution: The question was deleted from the examination during the administration of the examination.

Question: B.003

Comment: Question B.3 asks the candidates to identify which ONE from a list of instrument channels that would require the reactor to be in a shutdown condition. 3 of the answers are correct choices: b. Reactor Tank Water Level, c. Startup Count Rate, and d. Fuel Element Temperature. The Technical Specifications 3.2.3 Tables 1 and 2 have all 3 of the choices listed as required channels.

Due to three different choices being correct we request the question be removed from the exam.

Justification: Technical Specifications 3.2.3 Tables 1 and 2.

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

Question: B.005

Comment: Question B.5 asks the candidates to identify what the maximum dose equivalent limit for life saving and who may authorize it per the University of Utah Emergency Plan. The key answer says c. 75 rem and Radiation Safety Officer. The correct answer should be d. 75 rem and Reactor Supervisor per 7.2 of the University of Utah Emergency Plan. The Reactor Supervisor (RS) authorizes this exposure and not the Radiation Safety Officer.

We request that key be modified to reflect the answer as d. 75 rem, Reactor Supervisor.

Justification: 7.2 of the University of Utah Emergency Plan

NRC Resolution: This comment is accepted and answer is changed d.

Question: B.015

Comment: The written exam accidentally included the key answer on the exam for the candidates.

Justification: None

NRC Resolution: The question was deleted from the examination during the admiration of the examination.

Question: C.001

Comment: The written exam accidentally included the key answer on the exam for the candidates.

Justification: None

NRC Resolution: The question was deleted from the examination during the admiration of the examination.

Question: C.005

Comment: Question C.5 asks which two alarms provide sight and sound indication of high radiation conditions in the reactor room and at Campus Security Headquarters. The key answer says d. Pool top area radiation monitor and Reactor pool low water level.
The correct answer is b. Reactor Tank area radiation monitor and Reactor pool low water level. The location names of the area radiation monitors are given in SAR 7.7.1 as Reactor Ceiling, Reactor Tank, the stack, and the counting lab. Reactor tank is listed and pool top is not in SAR 7.7.1

We request that key be modified to reflect the answer as b. Reactor Tank area radiation monitor and Reactor pool low water level.

Justification: SAR 7.7.1

NRC Resolution: This comment is accepted and answer is changed b.

Question: C.014

Comment: The key {Proctor/Master} contains two question C.14's. The second C.14 on the key regarding the ventilation system is not on the exam provided to the candidates.

Justification:

NRC Resolution: The Proctor/Master examination was corrected to reflect this comment.

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

FACILITY: UNIVERSITY OF UTAH NUCLEAR RESEARCH REACTOR

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 9/09/2014

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
20.00	33.3	_____	_____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
20.00	33.3	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.00	33.3	_____	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
60.00		_____ FINAL GRADE	_____ %	TOTALS

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

_____
Candidate's Signature

ENCLOSURE 3

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.

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

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

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

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

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

$$CR_1(-\rho_1) = CR_2(-\rho_2)$$

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

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

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

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

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

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

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

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

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

$$T_{‰} = \frac{0.693}{\lambda}$$

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

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

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

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

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

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

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) ≈ 8 lbm

c_P = 1.0 BTU/hr/lbm/°F

1 kg = 2.21 lbm

1 Mw = 3.41×10^6 BTU/hr

°F = 9/5 °C + 32

°C = 5/9 (°F - 32)

c_p = 1 cal/sec/gm/°C

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.001 [1.0 point] {1.0}
Which alteration or change to the core will most strongly affect the thermal utilization factor.

a. Buildup of fission products in fuel.

b. Removal of moderator.

c. Addition of U^{238}

d. Removal of a control rod.

Answer: A.01 d.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 2, Module 3, Enabling Objective 1.2, p. 04.

Question A.002 [1.0 point] {2.0}
Which one of the following conditions would INCREASE the shutdown margin of a reactor?

a. Inserting an experiment adding positive reactivity.

b. Lowering moderator temperature if the moderator temperature coefficient is negative.

c. Depletion of a burnable poison.

d. Depletion of uranium fuel.

Answer: A.02 d.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 2, Module 4, Enabling Objective 3.6 p. 28.

Question A.003 [1.0 point] {3.0}
The term "Prompt Critical" refers to:

a. the instantaneous jump in power due to a rod withdrawal

b. a reactor which is supercritical using only prompt neutrons

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

d. a reactivity insertion which is less than $ß_{eff}$

Answer: A.03 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 2, Module 4, Enabling Objective 2.8, p. 15.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.004 [1.0 point] {4.0}
An experimenter makes an error loading a rabbit sample. Injection of the sample results in a 100 millisecond period. If the scram setpoint is 125 kW and the scram delay time is 0.1 seconds, WHICH ONE of the following is the peak power of the reactor at shutdown.

a. 125 kW

b. 250 kW

c. 340 kW

d. 125 kW

Answer: A.04 c.
Reference: $P = P_0 e^{t/\tau}$, $P = 125 \text{ kwatt} \times e^{0.1/0.1} = 125 \times e = 339.79$

Question A.005 [1.0 point] {5.0}
Which one of the following is the principal source of heat in the reactor after a shutdown from extended operation at 100 KW?

a. Production of delayed neutrons

b. Subcritical reaction of photoneutrons

c. Spontaneous fission of U^{238}

d. Decay of fission fragments

Answer: A.05 d.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 1, Module 1, Enabling Objective 4.9, p. 61.

Question A.006 [1.0 point] {6.0}
WHICH ONE of the following describes the MAJOR contributions to the production and depletion of xenon in the reactor?

a. Produced directly from fission and depletes by neutron absorption only.

b. Produced from radioactive decay of iodine and depletes by neutron absorption only.

c. Produced directly from fission and depletes by radioactive decay and neutron absorption.

d. Produced from radioactive decay of iodine and depletes by radioactive decay and neutron absorption.

Answer: A.06 d.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.007 [1.0 point] {7.0}
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.07 c.
REF: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 2, Module 3, Enabling Objective 5.4, p. 51.

Question A.008 [1.0 point] {8.0}
The term K_{eff} is defined as …

a. absorption/(production + leakage)
b. (production + leakage)/absorption
c. (absorption + leakage)/production
d. production/(absorption + leakage)

Answer: A.08 d.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.009 [1.0 point] {9.0}
Reactor power increases from 30 watts to 60 watts in one minute. Reactor period is …

a. 30 seconds
b. 42 seconds
c. 60 seconds
d. 87 seconds

Answer: A.09 ~~b.~~ d. answer changed per facility comment
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

$$\ln\left(\frac{P}{P_0}\right)=\frac{t}{t} \quad t=\frac{60\text{sec}}{\ln(2)}=86.56$$

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.010 [1.0 point] {10.0}
Which one of the following statements describes why installed neutron sources are used in reactor cores?

a. To increase the count rate by an amount equal to the source contribution.
b. To increase the count rate by 1/M (M = Subcritical Multiplication Factor).
c. To provide neutrons to initiate the chain reaction.
d. To provide a neutron level high enough to be monitored by instrumentation.

Answer: A.10 d
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 1, Module 2, Enabling Objective 1.1, p. 01.

Question A.011 [1.0 point] {11.0}
Which one of the following is true concerning the differences between prompt and delayed neutrons?

a. Prompt neutrons account for less than one percent of the neutron population while delayed neutrons account for approximately ninety-nine percent of the neutron population.
b. Prompt neutrons are released during fast fissions while delayed neutrons are released during thermal fissions.
c. Prompt neutrons are released during the fission process while delayed neutrons are released during the decay process.
d. Prompt neutrons are the dominating factor in determining the reactor period while delayed neutrons have little effect on the reactor period.

Answer: A.11 c
R Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 1, Module 2, Enabling Objective 3.1, pp. 30–32.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.012 [1.0 point] {12.0}
Regulating rod worth for a reactor is 0.001 ΔK/K/inch. The moderator temperature coefficient (α_{Tmod}) for the same reactor is 0.0005 ΔK/K/□F. If moderator temperature increases by 9□F. By how much, and in which direction must the regulating rod move to compensate?

a. 4½ inches, outward
b. 9 inches, outward
c. 4½ inches, inward
d. 9 inches, inward

Answer: A.12 a
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume x, Module x, Enabling Objective x.x, p. xx.
A 9□F HEATUP, will add 9□F × -0.0005 ΔK/K/□F = -0.0045 ΔK/K. To compensate, the regulating rod must add 0.0045 positive reactivity, which implies move out. +0.0045 ΔK/K ÷ 0.001 ΔK/K/inch = 4.5 inches

~~**Question** A.013 [1.0 point] {13.0}~~ Deleted during administration of the examination.
~~Core excess reactivity changes with…~~
~~a. Fuel burnup~~
~~b. Neutron Level~~
~~c. Control Rod Height~~
~~d. Reactor Power Level~~
~~Answer: A.13 a.~~
~~Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §~~

Question A.014 [1.0 point] {14.0}
The number of neutrons passing through a square centimeter per second is the definition of which ONE of the following?

a. Neutron Population (np)
b. Neutron Impact Potential (nip)
c. Neutron Flux (nv)
d. Neutron Density (nd)

Answer: A.14 c.
REF: Introduction to Nuclear Reactor Operations, ©1982, Reed Robert Burn §

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.015 [1.0 point] {15.0}
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.15 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988

Question A.016 [1.0 point] {16.0}
Several processes occur during the neutron cycle which increase or decrease the number of neutrons. Which ONE of the following describes a process which INCREASES the number of neutrons?

a. Fast Non-Leakage probability ($\mathcal{L}_f$)
b. Resonance Escape Probability (p)
c. Thermal Utilization Factor (f)
d. Reproduction Factor (η)

Answer: A.16 d
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume x, Module x, Enabling Objective x.x, p. xx.

Question A.017 [2.0 points, 0.4 each] {17.0}
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.17 a, α; b, β^+; c, n; d, γ; e, β^-
Reference: STD NRC question.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.018 [1.0 point] {18.0}
Which ONE of the following is the definition of the term “Cross-Section?”

a. The probability that a neutron will be captured by a nucleus.

b. The most likely energy at which a charge particle will be captured.

c. The length a charged particle travels past the nucleus before being captured.

d. The area of the nucleus including the electron cloud.

Answer: A.18 a.
Reference: Introduction to Nuclear Reactor Operations, ©1982, Reed Robert Burn §

Question A.019 [1.0 point] {19.0}
Given the data in the table to the right, which ONE of the following is the closest to the half-life of the material?

		TIME	Activity
		0 minutes	2400 cps
		10 minutes	1757 cps
		20 minutes	1286 cps
		30 minutes	941 cps
		60 minutes	369 cps

	a. 11 minutes		
	b. 22 minutes		
	c. 44 minutes		
	d. 51 minutes		

Answer: A.19 b.
Reference:

Question A.020 [1.0 point] {20.0}
Which of the following atoms will cause a neutron to lose the most energy during an elastic scattering reaction?

a. O^{16}

b. C^{12}

c. U^{235}

d. H^{1}

Answer: A.20 d.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Section B Normal/Emergency Procedures & Radiological Controls

Question B.001 [1.0 point, ⅓ each] {1.0}
Identify the source for the listed radioisotopes. irradiation of **air**, **water**, or **fission** product.

a. N^{16}

b. Ar^{41}

c. Xe^{188}

Answer: B.01 a. = water; b. = air; c. = fission product
Reference: Standard NRC question

Question B.002 [1.0 point] {2.0}
The Quality Factor (QF) is used to convert …

a. dose in rads to dose equivalent in rems.

b. dose in rems to dose equivalent in rads.

c. contamination in rads to contamination equivalent in rems.

d. contamination in rems to contamination equivalent in rads.

Answer: B.02 a.
Reference: 10CFR20.1003 Definitions, also the University of Utah, Radiation Protection Program, Biological Effects of Radiation, page 3.

~~**Question** B.003 [1.0 point] {3.0}~~ Question deleted due to facility comment.
~~Maintenance on which ONE of the listed instrument channels requires the reactor to be in the shutdown condition with all control rods fully inserted, and power to the control-rod magnets and actuating solenoid switched off and the key removed?~~

~~a. Continuous Air Radiation Monitor~~
~~b. Reactor Tank Water Level~~
~~c. Startup Count Rate~~
~~d. Fuel Element Temperature~~

~~Answer: B.03 d.~~
~~Reference: Technical Specifications § 3.2.3, Table 1~~

Section B Normal/Emergency Procedures & Radiological Controls

Question B.004 [1.0 point] {4.0}

A gamma source emits 8 R/hour @ 1 foot. How long could you work four (4) feet from the source without exceeding your yearly Whole body limit from 10CFR20? Assume you have already received 3 R this year.

a. 1 hour

b. 2 hours

c. 4 hours

d. 8 hours

$D_1R_1^2 = D_2R_2^2 \quad D_2 = D_1\frac{R_1^2}{R_2^2} \quad D_2 = 8\frac{R}{hr}\frac{1^2}{4^2} = \frac{8\frac{R}{hr}}{16} = \frac{1}{2}\frac{R}{hr}$

Answer: B.04 c.

Stay time = Total allowed dose (5R) less amount already received (3R) divided by ½ R/hr. 2 ÷ ½ = 4 hours.

Reference: See equation

Question B.005 [1.0 point] {5.0}

The University of Utah Emergency Plan states that the limits of 10 CFR 20 may be exceeded to rescue injured personnel. Which ONE of the following is the maximum dose equivalent limit for life saving, and who may authorize it?

a. 25 rem, Radiation Safety Officer

b. 25 rem, Reactor Supervisor

c. 75 rem, Radiation Safety Officer

d. 75 rem, Reactor Supervisor

Answer: B.05 ~~c.~~ d. answer changed per facility comment

REF: U. Utah Emergency Plan, § 7.2 Protective Action Values

Question B.006 [1.0 point] {6.0}

Following an evacuation of the facility during an emergency. Who by title, may authorize reentry (according to the Emergency Plan)?

a. Radiation Safety Officer

b. Reactor Supervisor, with advice of Radiation Safety Officer

c. Any Senior Operator, with advice of Radiation Safety Officer

d. Any NRC licensed Operator, with advice of any health physics technician.

Answer: B.06 b.

Reference: Emergency Plan, § 3.4

Section B Normal/Emergency Procedures & Radiological Controls

Question B.007 [1.0 point] {7.0}
Which ONE of the following conditions would require you, (the console operator) to shutdown the reactor immediately?

a. The reactor period channel fails to a reading of -∞
b. The ventilation exhaust fan failed two minutes ago.
c. The startup channel fails downscale (reading ≤ zero).
d. The freon compressor EPR valve fails open.

Answer: B.07 c.
Reference: U of U TS 3.3.3 Reactor Safety System (Loss of Startup Count Rate Interlock) Table 2

Question B.008 [1.0 point] {8.0}
Listed below are the four standard emergency classifications defined by the NRC. Which ONE of the listed classifications is used at the University of Utah Research Reactor?

a. Alert
b. General Emergency
c. Site-Area Emergency
d. Unusual Event

Answer: B.08 d.
Reference: U. Utah Emergency Plan § 4.0, Emergency Classification System

Question B.009 [1.0 point] {9.0}
You initially remove a sample from the pool reading 1 R/hr at 30 cm from the source. You then replace the sample in the pool. An hour later you remove the sample and the reading is now 390 mR/hr at 30 cm. You again replace the sample back in the pool. How much longer should you wait to be able to bring out the sample without generating a high radiation area?

a. ½ hour
b. 1 hour
c. 1½ hours
d. 2 hours

Answer: B.09 c.
Reference: Burn, Reed Robert, Introduction to Nuclear Reactor Operations, © 12, 1988, Appendix 3.
Solving for LAMBDA (λ): $I_t = I_0 e^{-\lambda t}$ 390 mR/hr ÷ 1000 mR/hr = $e^{-\lambda 1hr}$ ln(0.39) = -λ * 1 hr.
λ = 0.9416 hour-1 SOLVING for additional time: If = It $e^{-\lambda t}$
100mR/hr = 390 mR/hr e-0.9416 (time)
ln (0.25) = -0.9163 * time time = 1.4454

Section B Normal/Emergency Procedures & Radiological Controls

Question B.010 [1.0 point] {10.0}
Which ONE of the following correctly describes the relationship between a Safety Limit (SL) and a Limiting Safety System Setting (LSSS)?

a. The SL is a maximum operationally limiting value that prevents the LSSS from being reached during normal operations.

b. The SL is a parameter that ensures the integrity of the fuel cladding. The LSSS initiates protective action to preclude reaching the SL.

c. The LSSS is a parameter that ensures the integrity of the fuel cladding. The SL initiates protective action to preclude reaching the LSSS.

d. The SL is a maximum setpoint for instrumentation response. The LSSS is the minimum number of channels required to be operable.

Answer: B.10 b.
Reference: Technical Specifications

Question B.011 [1.0 point] {11.0}
Which ONE of the following accidents has been analyzed as having the gravest consequences at the U of U reactor facility?

a. Total loss of coolant from the reactor tank.

b. Rapid insertion of reactivity into the core.

c. Cladding rupture of one highly irradiated fuel element.

d. Accidental misplacement of a single experiment with the maximum allowable reactivity worth.

Answer: B.11 c.
Reference: SAR § 13.2.1 MHA

Section B Normal/Emergency Procedures & Radiological Controls

Question B.012 [1.0 point] {12.0}

You perform the Semi-Annual Thermal Power Calibration with Reactor Power indicating 95% power. According to the power calculation indicated power was 8% below actual power. What action is required?

a. None.

b. Notify the U.S. Nuclear Regulatory Commission, Region IV, within 24 hours.

c. Call the Reactor Supervisor and inform him that you have violated T.S. 3.1 Normal Operation.

d. Adjust the power channel in accordance with Form CENTER-012, Semi-Annual Thermal Power Calibration.

Answer: B.12 d.
Reference: UNEP-012, Semi-Annual Thermal Power Calibration (Recalibrate power channel if the indicated power deviates from the calculated power by $\geq$5%)
UNEP-13, Adjustment of Power Channels

Question B.013 [1.0 point] {13.0}

At what power level is the startup source removed from the reactor?

a. 0.1 watt

b. 1.0 watt

c. 10 watts

d. 1 Kilowatt

Answer: B.13 b.
Reference: Form UNEP-001R10, TRIGA PRESTART CHECKLIST Step 4.51.3

Question B.014 [1.0 point] {14.0}

Following a spill, you would obtain yellow and magenta tape or rope from …

a. The cabinet immediately outside the control room entrance.

b. The locked box at the classroom entrance.

c. The control room, behind the console.

d. The CENTER Director's office.

Answer: B.14 a.
Reference: Form UNEP-015

Section B Normal/Emergency Procedures & Radiological Controls

~~**Question** B.015 [1.0 point, 0.25 each] {15.0}~~ Deleted during administration of the examination.
~~Identify each of the following as either a Safety Limit (SL), a Limiting Safety System Setting (LSSS) or a Limiting Condition for Operations (LCO).~~

~~a. The temperature in a aluminum-clad low hydride fuel element shall not exceed 530□C.~~
~~b. The scram time from the instant that a safety system setting is exceeded to the instant that the slowest programmable rod reaches its fully inserted position shall not exceed 2 seconds.~~
~~c. For a core composed entirely of stainless steel clad, high hydride fuel elements or a core composed of steel clad, high hydride fuel elements with low hydride fuel elements in the F or G hexagonal ring only, … the maximum temperature of the instrumented fuel rod in the A ring is 800□C.~~
~~d. The Shutdown Margin referred to the cold-critical xenon-free condition, with the highest worth rod fully, withdrawn is greater than $0.50.~~

~~Answer: B.15 a. = SL; b. = LCO; c. = LSSS; d. = LCO;~~
~~Reference: Technical Specifications §§ 2.1, 2.2, 3.2(1) and 3.3.1~~

Question B.016 [1.0 point, 0.25 each] {16.0}
Match the radiation reading from column A with its corresponding radiation area classification (per 10CFR20) listed in column B. (Items listed in column B may be used more than once or not at all.)

Column A		Column B	
a.	10 mRem/hr	1.	Unrestricted Area
b.	150 mRem/hr	2.	Radiation Area
c.	10 Rem/hr	3.	High Radiation Area
d.	550 Rem/hr	4.	Very High Radiation Area

Answer: B.16 a. = 2; b. = 3; c. = 3; d. = 4.
Reference: 10CFR20.1003 Definitions

Section B Normal/Emergency Procedures & Radiological Controls

Question B.017 [1.0 point,] {17.0}
Which ONE of the following is the facility you would send a contaminated injured person per the Emergency Plan?

a. St. Mark's Hospital
b. LDS Hospital
c. University Hospital
d. InterMountain Health Care

Answer: B.17 c.
Reference: Emergency Plan § 8.3.

Question B.018 [1.0 point,] {18.0}
Which ONE of the following types of experiments is NOT required to be doubly encapsulated? Experiments which contain …

a. explosive materials.
b. Iodine isotopes 131 through 135.
c. materials corrosive to reactor components.
d. compounds highly reactive with water.

Answer B.18 b
Reference: Technical Specification 3.8.2

Question B.019 [1.0 point,] {19.0}
Technical Specification 4.3.3 requires the Area Radiation Monitoring system to be calibrated annually and to be verified operable …

a. quarterly
b. monthly
c. weekly
d. daily

Answer: B.19 d.
Reference: Technical Specification 4.7

Section B Normal/Emergency Procedures & Radiological Controls

Question B.020 [1.0 point,] {20.0}
Fuel shall be stored in a geometrical array where the K_{eff} is less than …

a. 0.75
b. 0.8
c. 0.85
d. 0.9

Answer: B.20 d.
Reference: Technical Specification 5.4.

Section C Facility and Radiation Monitoring Systems

~~**Question** C.001 [1.0 point] {1.0}~~ Deleted during administration of the examination.
~~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.~~

~~Answer: C.01 a.~~
~~Reference: Standard NRC question.~~

Question C.002 [1.0 point] {2.0}
Which ONE of the following parameters is NOT be measured in the Primary Coolant Circulation System Loop?

a. Temperature

b. Flow

c. Conductivity

d. pH

Answer: C.02 d.
Reference: SAR Figure 5.1-2 and SAR 5.4.3

Question C.003 [1.0 point] {3.0}
Which ONE of the following reflector materials is in the cans surrounding the core?

a. Heavy water (D_2O)

b. Cadmium (Cd)

c. Beryllium (Be)

d. Polyethylene

Answer: C.03 a.
Reference: SAR 4.2

Question C.004 [1.0 point] {4.0}
Which ONE of the following methods is used to compensate for gamma radiation in a Compensated Ion Chamber?

a. Pulses smaller than a height (voltage) are stopped by a pulse-height discriminator circuit from entering the instrument channel's amplifier.

b. The chamber contains concentric tubes one of which detects both neutrons and gammas the other only gammas, are wired electronically to subtract the gamma signal, leaving only the signal due to neutrons.

c. The signal travels through a Resistance-Capacitance (RC) circuit, converting the signal to a power change per time period effectively deleting the signal due to gammas.

d. A compensating voltage equal to a predetermined "source gamma level" is fed into the pre-amplifier electronically removing source gammas from the signal. Fission gammas are proportional to reactor power and therefore not compensated for.

Answer C.04 b.
Reference: Standard NRC question.

Question C.005 [1.0 point] {5.0}
Two alarms provide sight and sound indication of high radiation conditions in the reactor room and at Campus Security Headquarters. Which ONE of the following choices lists these two alarms?

a. Reactor Tank area radiation monitor and Neutron Generator Monitor
b. Reactor Tank area radiation monitor and Reactor pool low water level.
c. Pool Top area radiation monitor and Neutron Generator Monitor
d. Pool top area radiation monitor and Reactor pool low water level.

Answer: C.05 ~~d.~~ b. answer changed per facility comment
Reference: SAR 7.7.1 Description of Operation, § III.I.B.2

Question C.006 [1.0 point] {6.0}
On the control panel the indicating lights for the SHIM rod are as follows: the CONT light is OFF, the UP light is ON 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 at the bottom of travel.

Answer: C.06 a
Reference: SAR 7.3.1

Question C.007 [1.0 point] {7.0}
Immediately upon loss of normal AC power to the facility the security system will receive power from…

a. a temporary AC generator located at the EPA ground station
b. temporary batteries which will be installed by University Maintenance personnel.
c. a UPS installed within the facility.
d. emergency generators located at the Hospital Generating Plant.

Answer: C.07 c.
Reference: SAR 8.2

Question C.008 [1.0 point] {8.0}
Which ONE of the following facility scrams is NOT required by Technical Specifications?

a. Loss of console power
b. Magnet current key switch
c. Chamber High Voltage
d. Reactor Tank Water Level

Answer: C.08 c.
Reference: Technical Specifications, § 3.2.1, Table 1

Question C.009 [1.0 point] {9.0}
The purpose of the cleanup system is to minimize corrosion of the cladding on the fuel elements and to minimize the…

a. need for cooling the pool
b. growth of algae in the pool
c. generation of tritium ($_1H^3$) in the pool.
d. activation of dissolved materials in the pool.

Answer: C.09 d.
Reference: SAR 5.2.3

Question C.010 [1.0 point] {10.0}
An experimenter drops a radioactive source while transporting it. The container opens and the source is lying on the floor unshielded. Prior to entering the room, you would hold up a __1__ to the door, to measure __2__.

a. Geiger-Müller, radiation dose (field)
b. Geiger-Müller, contamination
c. Ion Chamber, radiation dose (field)
d. Ion Chamber, contamination

Answer: C.10 c.
Reference: Standard NRC question

Question C.011 [1.0 point] {11.0}
WHICH ONE of the following components is primarily responsible for maintain pool water conductivity?

a. Water Filter
b. Demineralizer
c. Skimmer
d. Water Softener

Answer: C.11 b.
Reference: SAR 5.2.3

Question C.012 [1.0 point] {12.0}
WHICH ONE of the following detectors is used primarily to measure N^{16} release to the environment?

a. NONE, N^{16} has too short a half-life to require environmental monitoring.
b. Continuous Air Monitor Particulate Channel
c. Continuous Air Monitor Gaseous Channel
d. Continuous Air Monitor Iodine Channel

Answer: C.12 a.
Reference: Chart of the Nuclides.

Question C.013 [1.0 point] {13.0}
Which ONE of the following will result in a reactor scram?

a. Reactor Period = 7 sec
b. Bulk Water Temperature = 105º F
c. % Power Channel = 108%
d. Linear Power Channel = 100%

Answer: C.11 d
Reference: Technical Specifications 3.2.3

Question C.014 [1.0 point] {14.0}
Which ONE of the following methods is actually used to minimize the shock to the control rods during a reactor scram?

a. A small spring on the pull rod.
b. A piston (part of the connecting rod), drives water out of a dashpot as the rod nears the bottom of its travel.
c. An electro-mechanical brake on the motor energizes as the rod down switch is energized.
d. A small spring on the bottom of the control rod.

Answer: C.14 b.
Reference: SAR 7.3.1

This question deleted from the Master examination per facility comment, it was not on the applicant written examination as administered.

~~**Question** C.014 [1.0 point] {14.0}~~

~~Which ONE of the following is the reason that the ventilation system maintains a negative pressure in the reactor room?~~

~~a. To reduce pressure on the reactor tank.~~
~~b. To ensure proper operation of the Continuous Air Monitor.~~
~~c. To facilitate opening of the door between the control room and the reactor room.~~
~~d. To ensure that any radioactive contaminants go through the stack, vice through any cracks in the room.~~

~~Answer: C.14 d.~~
~~Reference: SAR 9.1~~

Question C.015 [1.0 point] {15.0}

Identify the type of heat mechanism (listed in column B) primarily responsible for removing heat for each of the facility regions listed in column A.

Column A	Column B
a. Centerline to outside edge of fuel	1. Conduction
b. Core to pool water	2. Forced Convection
c. Pool water to heat exchanger	3. Natural Convection
d. Heat exchanger to Freon	4. Radiative

Answer: C.015 a. = 1; b. = 3; c. = 2; d. = 2
Reference: Standard NRC question

Question C.016 [1.0 point] {16.0}

The UUTR control rods are located at:

a. C1, C5, and C9
b. D1, D7, and D13
c. E1, E9, and E17
d. E1, E10, and E18

Answer: C.16 b.
Reference: SAR, Figure 4.1, University of Utah Reactor Core

Question C.017 [1.0 point] {17.0}
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. Level in the pool drops below siphon break holes in the primary suction pipe.
d. Level in the pool drops below the Net Positive Suction Head pressure minimum required to operate the pump.

Answer: C.17 c.
Reference: SAR 5.2.4

Question C.018 [1.0 point] {18.0}
On a loss of normal electrical power, which ONE of the following systems is NOT provided by the uninterrupted power supply (UPS)?

a. ARM
b. CAM
c. Reactor Console
d. Primary Cooling Pump

Answer: C.18 d.
Reference: SAR 8

Question C.019 [1.0 point] {19.0}
What is the maximum acceptable time between the initiation of a scram signal, and the time that the safety rod is fully inserted in the core?

a. 2.5 sec.
b. 2 sec.
c. 1.0 sec.
d. 0.75 sec.

Answer: C.19 b.
Reference: TS 3.2

Question C.020 [1.0 point] {20.0}

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.20 c.
Reference: SAR 10.2.1.2