February 16, 2016

Mr. Timothy DeBey
U.S. Geological Survey
6th and Kipling
Denver Federal Center
Building 15, MS 974
Denver, Colorado 80225

SUBJECT: EXAMINATION REPORT NO. 50-274/OL-16-01, U.S. GEOLOGICAL SURVEY

Dear Mr. DeBey:

During the week of January 18, 2016, the NRC administered an operator licensing examination at your U.S. Geological Survey 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 with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the Code of Federal Regulations Section 2.390, 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 NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Phillip T. Young at (301) 415-4094 or via internet e-mail phillip.young@nrc.gov.

Sincerely,

/RA/

Anthony J. Mendiola, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-274

Enclosures: 1. Examination Report No. 50-274/OL-16-01
2. Facility comment with NRC resolution
3. Examination and answer key

cc w/o enclosures: See next page

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ADAMS ACCESSION #: ML16042A086 **TEMPLATE #: NRR-079**

Office	PROB/CE	IOLB/OLA	PROB/BC
Name	PYoung by CRevelle	CRevelle	AMendiola
Date	2/11/2016	2/11/2016	2/16/2016

OFFICIAL RECORD COPY

cc:

Environmental Services Manager
480 S. Allison Pkwy.
Lakewood, CO 80226

State of Colorado
Radiation Program
HMWM-RM-B2
4300 Cherry Creek Drive South
Denver, CO 80246

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

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

REPORT NO.: 50-274/OL-16-01

FACILITY DOCKET NO.: 50-274

FACILITY LICENSE NO.: R-113

FACILITY: U.S. Geological Survey

EXAMINATION DATES: January 20, 2016

SUBMITTED BY: Patrick Isaac for 02/11/16
Phillip T. Young, Chief Examiner Date

SUMMARY:

On January 20, 2016, the NRC administered an Operator Licensing Examination to a Reactor Operator license candidate at the U.S. Geological Survey. The candidate 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	1/0	0/0	1/0
Operating Tests	1/0	0/0	1/0
Overall	1/0	0/0	1/0

3. Exit Meeting:
Phillip T. Young, NRC, Examiner
Mr. Tim DeBey, U.S. Geological Survey, Reactor Supervisor

During the exit meeting the examiner thanked Mr. DeBey for his support of the examinations and discussed the fact that written exam comments were due one week from the administration of the examination. Examination comments are included in Enclosure 2 to this report.

RO written examination comment from the USGS facility.

FACILITY COMMENT: C.003
The Continuous Air Monitor under goes an operational testing each reactor operating day using:
a. a Cs-137 source
b. a pulse signal generator
c. an internal check source
d. comparison readings obtained from portable instruments
Answer: C.03 b.
Reference: CAM Calibration Procedure

This question should have choice “a” as the correct answer, not “b”. The referenced CAM Calibration Procedure says, “A single point operational test is performed by placing a small ^{137}Cs check source, permanently mounted on a dummy filter holder”. The reference is the GSTR “HP Instrument Calibration Procedure” dated October 2013.

Recommendation: Change the correct answer to “a”.

NRC RESOLUTION
The examiner agrees with the facility comment. Question C.003 correct answer will be changed to “a.”

ENCLOSURE 2

ENCLOSURE 3

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

FACILITY: USGS

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 01/20/2016

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% in each section 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	CATEGORY VALUE	% OF 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 THE 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.

EQUATION SHEET

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

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

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

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

$$M = \frac{1 - K_{eff_t}}{1 - K_{eff}}$$

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

$$CR_1 (1 - K_{eff}) = CR_2 (1 - K_{eff})$$

$$M = \frac{CR_2}{CR_1}$$

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

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

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

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

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

$$T = \frac{\lambda^*}{\rho} + \left[\frac{\beta - \rho}{\rho (\lambda_{eff} \beta)} \right]$$

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

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

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

$$T_{1/2} = \frac{0.693}{6 Ci E (n)}$$

$$DR = \frac{}{R^2}$$

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

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 & Facility Operating Characteristics

Question A.001 [1.0 point] {1.0}
At the beginning of a reactor startup, Keff is 0.90 with a count rate of 30 CPS. Power is increased to a new, steady value of 60 CPS. The new Keff is:

a. 0.910

b. 0.925

c. 0.950

d. 0.975

Answer: A.01 c.
Reference: (CR2/CR1) = (1-Keff1)/(1-Keff2)
(60/30) = (0.90)(1-Keff2) Keff2 = 0.95

Question A.002 [1.0 point] {2.0}
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.02 c.
Reference: Lamarsh, Intro to Nuclear Eng, 2nd ed., pg. 73

Question A.003 [1.0 point] {3.0}
The effective neutron multiplication factor, K_{eff} , is defined as:

a. K_{eff} = production/(absorption + leakage).

b. K_{eff} = (production + leakage)/absorption.

c. K_{eff} = (absorption + leakage)/production.

d. K_{eff} = absorption/(production + leakage).

Answer: A.03 a.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 149.

Question A.004 [1.0 point] {4.0}
As the moderator temperature increases, the resonance escape probability:

a. increases, since the moderator becomes less dense.

b. decreases, since the time required for a neutron to reach thermal energy increases.

c. remains constant, since the effect of moderator temperature change is relatively small.

d. increases, since the moderator-to-fuel ratio increases.

Answer: A.04 b.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 264.

Question A.005 [1.0 point] {5.0}
Following a scram, the value of the stable reactor period is:

a. infinity, since neutron production has been terminated

b. about 50 seconds, because the rate of negative reactivity insertion rapidly approaches zero.

c. about -10 seconds, as determined by the rate of decay of the shortest lived delayed neutron precursors.

d. about -80 seconds, as determined by the rate of decay of the longest lived delayed neutron precursors.

Answer: A.05 d.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory

Question A.006 [1.0 point] {6.0}
What are the three materials that are designed as moderators/reflectors, for your reactor?

a. Zirconium Hydride [ZrH_2], Concrete, and Graphite

b. Water, Graphite, and ZrH_2

c. Graphite, Water, and Aluminum

d. Aluminum, Concrete, and Water

Answer: A.06 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory

Question A.007 [1.0 point] {7.0}
Which ONE of the following coefficients will be the first one to start turning reactor power after a power excursion from full power?

a. Zr-Fuel Temperature

b. Moderator Temperature

c. Power

d. Void

Answer: A.07 a.
Reference: GSTR Requal Exam 1/90

Question A.008 [1.0 point] {8.0}
Which ONE of the following is a correct statement concerning the factors affecting control rod worth?

a. The withdrawal of a rod causes the rod worth of the remaining inserted rods to increase.

b. Fuel burn up causes the rod worth to increase in the center of the core.

c. Fuel burn up causes the rod worth for periphery rods to decrease.

d. As Rx power increases rod worth increases.

Answer: A.08 a.
Reference: Lamarsh, Introduction to Nuclear Engineering, 2nd ed., pg. 303
Glasstone and Sesonske, Nuclear Reactor Eng., 3rd ed., Sect. 5.183

Question A.009 [1.0 point] {9.0}
A step insertion of positive reactivity in a critical reactor causes a momentary rapid increase in the neutron population, known as a prompt jump. Which ONE of the following describes the cause of this increase?

a. An immediate increase in the prompt neutron population.

b. A shortening of the delayed neutron generation when power increases.

c. The positive reactivity insertion due to the rapid fuel temperature coefficient feedback.

d. The step insertion produces a rate of reactivity addition which exceeds the delayed neutron fraction, β_{eff}.

Answer: A.09 a.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 240.

Question A.010 [1.0 point] {10.0}
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.10 c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

Question A.011 [1.0 point] {11.0}
Which ONE of the following conditions describes a critical reactor?

a. $K_{eff} = 1$; $\Delta k/k$ (ρ) = 1

b. $K_{eff} = 1$; $\Delta k/k$ (ρ) = 0

c. $K_{eff} = 0$; $\Delta k/k$ (ρ) = 1

d. $K_{eff} = 0$; $\Delta k/k$ (ρ) = 0

Answer: A.11 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1984, § 3.3.4, pp. 3-23.

Question A.012 [1.0 point] {12.0}
Which ONE of the following will be the resulting stable reactor period when a $0.25 reactivity insertion is made into an exactly critical reactor core? (Assume a beta of .0070 and a lambda of .1 sec^{-1})

a. 50 seconds

b. 38 seconds

c. 30 seconds

d. 18 seconds

Answer: A.12 c
Reference: Glasstone & Sesonske, pg 239, Sec 5.28 $T = (\beta_{eff} - \rho)/(\rho \lambda)$
$T = (.0070 - .00175)/.1 \times .00175$ T = 30 seconds

Question A.013 [1.0 point] {13.0}
The neutron microscopic cross-section for absorption (σ_a) of an isotope 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.13 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory

Question A.014 [1.0 point] {14.0}
Which one of the following describes the MAJOR contributor to the production and depletion of Xenon respectively in a STEADY-STATE OPERATING reactor?

	Production	Depletion
a.	Radioactive decay of Iodine	Radioactive Decay
b.	Radioactive decay of Iodine	Neutron Absorption
c.	Directly from fission	Radioactive Decay
d.	Directly from fission	Neutron Absorption

Answer: A.14 b.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1988, §§ 8.1 —8.4, pp. 8-3 — 8-14.

Question A.015 [1.0 point] {15.0}
Which one of the following factors has the LEAST effect on K_{eff}?

a. Fuel burnup.

b. Increase in fuel temperature.

c. Increase in moderator temperature.

d. Xenon and samarium fission products.

Answer: A.15 a.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.2, p. 3-18.

Question A.016 [1.0 point] {16.0}
Which ONE of the following is the reason for operating with thermal neutrons rather than fast neutrons?

a. As neutron energy increases, neutron absorption in non-fuel materials increases exponentially.

b. Probability of fission is increased since thermal neutrons are less likely to leak out of the core.

c. The absorption cross-section of U-235 is much higher for thermal neutrons.

d. The fuel temperature coefficient becomes positive as neutron energy increases.

Answer: A.16 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982

Question A.017 [1.0 point] {17.0}
The reactor supervisor tells you the reactor is shutdown with a shutdown margin of 12%. An experimenter inserts an experiment in the core and nuclear instrumentation increases from 100 counts per minute to 200 counts per minute. What is the new K_{eff} of the reactor?

a. 0.920

b. 0.946

c. 0.973

d. 1.000

Answer: A.17 b.
Reference: Standard NRC Question:

$$K_{eff_1} = \frac{1}{1+SDM} = \frac{1}{1+0.12} = 0.892857$$

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

$$1-K_{eff_2} = \frac{100}{200}(1-0.892857) = (0.0535715)$$

$$K_{eff_2} = 0.9464285$$

Question A.018 [1.0 point] {18.0}
With the reactor on a constant period, which of the following changes in reactor power would take the **LONGEST** time?

a. 5% — from 1% to 6%

b. 15% — from 20% to 35%

c. 20% — from 40% to 60%

d. 25% — from 75% to 100%

Answer: A.18 a.
Reference: $P = P_0 e^{t/\tau}$ $\ln(P/P_0) = t/\tau$ Since you are looking for which would take the longest time it is obvious to the most casual of observers that the ratio P/P_0 must be the largest.

Question A.019 [1.0 point] {19.0}
During a fuel loading, as the reactor approaches criticality, the value of 1/M is plotted. Which ONE of the following describes the slope of the 1/M curve?

a. decreases toward zero

b. decreases toward one

c. increases toward infinity

d. increases toward one

Answer: A.19 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory

Question A.020 [1.0 point] {20.0}
Which one of following is the correct reason that delayed neutrons enhance control of the reactor?

a. There are more delayed neutrons than prompt neutrons.

b. Delayed neutrons take longer to reach thermal equilibrium.

c. Delayed neutrons increase the average neutron generation time.

d. Delayed neutrons born at higher energies than prompt neutrons & therefore have a greater effect.

Answer: A.20 c.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.2.4, p. 3-12.

(*** End of Section A ***)

Section C - Plant and Rad Monitoring Systems

Question B.001 [1.0 point] {1.0}
Which ONE of the following is NOT a required condition for the reactor to be considered "Shutdown"?

a. No work is in progress involving fuel handling or maintenance of control mechanisms.

b. The console key is in the "OFF" position and the key is removed from the console and under the control of a licensed operator.

c. The minimum shutdown margin, with the most reactive of the operable control elements withdrawn shall be $1.10

d. Sufficient control rods are inserted so as to assure the reactor is subcritical by a margin greater than $0.70, cold without Xenon.

Answer: B.01 c.
Reference: Technical Specifications, App. A

Question B.002 [1.0 point] {2.0}
A system or component is defined as “operable” by Technical Specifications if:

a. a channel check has been performed.

b. a functional test has been performed.

c. it has no outstanding testing requirements.

d. it is capable of performing its intended function.

Answer: B.02 d.
Reference: Technical Specifications, Section A.5.

Question B.003 [1.0 point] {3.0}
Which one of the following is NOT a condition for double encapsulation of a sample? If the sample contains …

a. material corrosive to the reactor components.

b. material worth greater than $1.00 reactivity.

c. material which reacts violently with water.

d. liquid fissionable material.

Answer: B.03 b.
Reference: Technical Specifications, I.5.

Question B.004 [1.0 point] {4.0}
Which ONE of the following would be a Class I experiment?

a. A new experiment.

b. A previously run experiment.

c. A major modification of a previous experiment.

d. An experiment with a reactivity worth greater than necessary to produce a prompt critical condition in the reactor.

Answer: B.04 b.
Reference: Administrative Procedures, Section 4.5 - Experimental Review and Approval
.

Question B.005 [1.0 point] {5.0}
A survey instrument with a window probe was used to measure an irradiated experiment. The results were 100 mrem/hr window open 40 mrem/hr window closed. What was the gamma dose?

a. 140 mrem/hr

b. 100 mrem/hr

c. 60 mrem/hr

d. 40 mrem/hr

Answer: B.05 d.
Reference: Window closed shield beta. 40 mrem/hr must be gamma

Question B.006 [1.0 point] {6.0}
In accordance with the Technical Specifications, which ONE situation below is permissible when the reactor is operating?

a. A pool water level of 17 feet.

b. A bulk pool temperature of 70 degrees C.

c. A total, absolute reactivity worth of in-core experiments of $3.00.

d. A pulse reactivity insertion of 2.9% delta k/k.

Answer: B.06 c.
Reference: Technical Specifications, Section I.4.

Question B.007 [1.0 point] {7.0}
In accordance with the Emergency Plan, the “emergency planning zone” is:

a. the area within the operations boundary.

b. the area within the site boundary.

c. the Nuclear Science building.

d. the assembly area.

Answer: B.07 a.
Reference: USGS Emergency Plan, Definitions.

Question B.008 [1.0 point] {8.0}
An accessible area within the facility has a general radiation level of 325 mrem/hour. What would be the **EXPECTED** posting for this area?

a. "Caution, Airborne Radioactivity Area"

b. "Caution, Radiation Area"

c. "Danger, High Radiation Area"

d. "Grave Danger, Very High Radiation Area"

Answer: B.08 c.
Reference: Standard NRC question

Question B.009 [1.0 point] {9.0}
Preparations are being made to measure the elongation and bending of many fuel elements. Which ONE of the following staffing requirements applies at the start of the fuel movement?

a. A Senior Reactor Operator in charge

b. A Senior Reactor Operator in charge
A Reactor Operator at the console

c. A Senior Reactor Operator in charge
A Reactor Operator at the console
A reactor Health Physicist

d. A Senior Reactor Operator in charge
A Reactor Operator at the console
The Reactor Supervisor

Answer: B.09 c.
Reference: Procedure for Fuel Loading and Unloading

Question B.010 [1.0 point] {10.0}
If a complete loss of water was to occur with the reactor having been operating at 1000 Kw power, which ONE of the following would be the primary hazard of concern?

a. Keeping the reactor shutdown.

b. Core meltdown due to loss of cooling.

c. Clean up of the highly radioactive coolant water.

d. The vertical beam of radiation from the uncovered core.

Answer: B.10 d.
Reference: Safety Analysis pg. 9-7

Question B.011 [1.0 point] {11.0}
In accordance with the Emergency Plan, “emergency action levels” are:

a. documented instructions that detail the implementation actions and methods required to achieve the objectives of the emergency plan.

b. projected radiological doses or dose commitment values to individuals that warrant protective action following a release of radioactive material.

c. conditions which call for immediate actions, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

d. specific instrument readings, observations, radiological dose or dose rates, etc., which may be used as thresholds for establishing emergency classes and initiating appropriate emergency measures.

Answer: B.11 d.
Reference: USGS Emergency Plan, Definitions.

Question B.012 [1.0 point, 0.25 each] {12.0}
Research and Test reactors primarily worry about two isotopes N^{16} and Ar^{41}. Identify the approximate half-life and gamma energy for each. (Each item has only one answer.)

Isotope			Radiological Parameters	
a. Ar^{41} half-life	1) 1.8 sec	2) 1.8 min	3) 1.8 hour	4) 1.8 day
b. Ar^{41} gamma energy	1) 10 KeV	2) 100 KeV	3) 1 MeV	4) 10 MeV
c. N^{16} half-life	1) 7 sec	2) 7 min	3) 7 hour	4) 7 day
d. N^{16} gamma energy	1) 6 kev	2) 60 keV	3) 600 keV	4) 6 Mev

Answer B.12 a. = 3; b. = 3; c. = 1; d. = 4
Reference: Standard NRC Question

Question B.013 [1.0 point] {13.0}
In accordance with GSTR Procedure No. 2, “Reactor Power Calibration”, a percent power indicating channel which is incorrect by more than 1.5% power is adjusted to agree with the true power by:

a. mechanically adjusting the pointers on the meters to give the proper indication.
b. adjusting the compensating voltage to the ion chamber to give the proper indication.
c. adjusting the high voltage to the ion chamber to give the proper indication.
d. changing its position to give the proper indication.

Answer: B.13 d.
Reference: GSTR Procedure No. 2, pg. 2.

Question B.014 [1.0 point] {14.0}
The **CURIE** content of a radioactive source is a measure of

a. the number of radioactive atoms in the source.
b. the number of nuclear disintegrations per unit time.
c. the amount of damage to soft body tissue per unit time.
d. the amount of energy emitted per unit time by the source.

Answer: B.14 b.
Reference: Standard Health Physics Definition.

Question B.015 [1.0 point] {15.0}

10CFR50.54(x) states: *"A licensee may take reasonable action that departs from a license condition or a technical specification (contained in a license issued under this part) in an emergency when this action is immediately needed to protect the public health and safety and no action consistent with license conditions and technical specifications that can provide adequate or equivalent protection is immediately apparent."* Per 10CFR50.54(y), as a minimum, this action must be approved by …

a. a Reactor Operator licensed at the facility.

b. a Senior Reactor Operator licensed at the facility.

c. the Facility Manager (or equivalent at facility).

d. the U.S. Nuclear Regulatory Commission Project Manager

Answer: B.15 b.
Reference: 10CFR50.54(y)

Question B.016 [1.0 point] {16.0}

The reactor is operating at 950 Kw. The Reactor Operator receives a request for a central thimble experiment of $1.25 worth. Which ONE of the following best describes the actions required by the RO prior to loading the sample?

a. Check the sample classification and estimated reactivity. Shutdown the reactor prior to loading the sample.

b. Check the sample estimated reactivity and effects on SDM. Reduce Rx power to approximately 900 KW prior to inserting the sample.

c. Check the sample classification. Ensure the sample is firmly fixed in position and make appropriate entry in logbook prior to loading the sample.

d. Consider possible effects on SDM. Ensure the sample is a Class II experiment. Closely monitor reactor power while the sample is being loaded.

Answer: B.16 a.
Reference: GSTR procedure: Loading and Unloading the Central Thimble.

Question B.017 [1.0 point] {17.0}
Following an evacuation due to a radiological emergency, who by procedure may authorize re-entry?

a. Senior Reactor Operator on Duty with concurrence of the Health Physicist
b. University Police with the concurrence of the Health Physicist
c. the Reactor Health Physicist and the Reactor Supervisor
d. Emergency Director

Answer: B.17 c.
Reference: Emergency Plan, 4.6 ¶.

Question B.018 [1.0 point] {18.0}
In the event of an area evacuation, personnel should proceed to the emergency assembly area, located in:

a. Parking lot on south side of Building 15.
b. Reactor staff office.
c. The control room.
d. Room 153

Answer: B.18 a.
Reference: Emergency Plan, 2. Definitions

Question B.019 [1.0 point] {19.0}
The continuous air monitor is out of service waiting on back ordered parts for repair. As a result:

a. the reactor cannot be operated.
b. the reactor can continue to operate.
c. the reactor can continue to operate only if the alarm set points of the area radiation monitors are lowered.
d. the reactor can continue to operate only if the monitor is replaced by a portable monitor with a read-out and capable of alarming.

Answer: B.19 a.
Reference: Technical Specifications, Section F.2.

Question B.20 [1.0 point] {20.0}
Which of the following is not considered to cause a whole body exposure?

a. Ar-41

b. I-131

c. Xe-133

d. Kr-88

Answer: B.20 b.
Reference: Glasstone/Sesonske - Chapter 9

(*** End of Section B ***)

Section C - Plant and Rad Monitoring Systems

Question C.001 (1.00 point) {1.0}
Which ONE of the following describes the action of the rod control system to drive the magnet draw tube down after a dropped rod?

a. Resetting the scram signal initiates the rod down motion of the draw tube.

b. Deenergizing the rod magnet initiates the rod down motion of the draw tube.

c. Actuation of the MAGNET DOWN limit switch initiates the rod down motion of the draw tube.

d. Actuation of the ROD DOWN limit switch initiates the rod down motion if the rod drive is withdrawn.

Answer: C.01 d.
Reference: GA TRIGA Mech. Maint. & Operating Manual pg 2-18

Question C.002 (1.00 point) {2.0}
The Air Particulate Monitor "Alert" alarm is activated when count rate rises above:

a. 1000 cpm

b. 3000 cpm

c. 5000 cpm

d. 10K cpm

Answer: C.02 b.
Reference: ROM 1-4 Rev 04/14

Question C.003 (1.00 point) {3.0}
The Continuous Air Monitor under goes an operational testing each reactor operating day using:

a. a Cs-137 source

b. a pulse signal generator

c. an internal check source

d. comparison readings obtained from portable instruments

Answer: C.03 ~~b.~~ a. per facility comment
Reference: CAM Calibration Procedure

Question C.004 (1.00 point) {4.0}
Which ONE of the following temperatures is measured by the thermocouples in the instrumented fuel element?

a. Inside surface of the fuel element cladding.

b. Outer surface of the fuel.

c. Interior of the fuel.

d. Center of the zirconium rod.

Answer: C.04 c.
Reference: Hazards Summary Report, Section 5.2.

Question C.005 (1.00 point) {5.0}
Pool water conductivity in the purification system is measured:

a. at the inlet to the demineralizer.

b. at the outlet of the flow meter.

c. at the discharge of the pump.

d. at the inlet of the filter.

Answer: C.05 a.
Reference: Hazards Summary Report, Figure 5-12

Question C.006 (1.00 point) {6.0}
Which ONE of the following is the approximate worth of all control rods and transient rod?

a. 2.1% delta k/k.

b. 6.3% delta k/k.

c. 8.4% delta k/k.

d. 10.5% delta k/k.

Answer: C.06 b.
Reference: Hazards Summary Report, Section 5.3.2.

Question C.007 (1.00 point) {7.0}
Which ONE of the following is the purpose of the bottom grid plate?

a. Provides support for core components.

b. Acts as a safety plate to prevent the possibility of a fuel rod dropping out of the core.

c. Acts as a safety plate to prevent the possibility of a control rod dropping out of the core.

d. Provides a catch plate for small tools and hardware which may have dropped into the core.

Answer: C.07 a.
Reference: Hazards Summary Report, Section 5.1.

Question C.008 (1.00 point) {8.0}
Water which has been treated by the Purification system is returned:

a. to the outlet of the heat exchanger.

b. to the inlet of the heat exchanger.

c. to the outlet of the primary pump.

d. directly to the reactor tank.

Answer: C.08 d.
Reference: Hazards Summary Report, Figure 5-12

Question C.009 (1.00 point, 0.2 points each) {9.0}
Match the item listed in Column A with the correct position on the GSTR TRIGA Cross Section attached. Items listed in Column A may be used more than once or not at all.

Column A	Column B
a. Pneumatic Transfer System	1.
b. Ion Chamber	2.
c. Control Rod	3.
d. Reflector	4.
e. Rotary Specimen Rack	5.
	6.
	7.
	8.

Answer: C.09 a. = 2; b. = 3; c. = 1; d. = 7; e. = 4 .
Reference: Hazard Summary Report Figure 5 - 1

Section C - Plant and Rad Monitoring Systems

Question C.010 (1.00 point, 0.2 points each) {10.0}
Match the item listed in Column A with the correct position on the GSTR Pneumatic – electrical Transient – Rod Drive diagram attached. Items listed in Column A may be used more than once or not at all.

Column A	Column B
a. Drive Motor	1.
b. Potentiometer Drive Gear	2.
c. Shock Absorber	3.
d. Damper	4.
e. Piston	5.
	6.
	7.
	8.

Answer: C.10 a. = 7; b. = 6; c. = 1; d. = 8; e. = 5
Reference: Hazard Summary Report Figure 5 – 7.

Question C.011 (1.00 point) {11.0}
Which ONE of the following conditions is NOT a requirement to enter the Square Wave mode of operation?

a. Power less than 1 kW.
b. Period greater than 26 seconds.
c. Reactor in Steady State mode.
d. All control rods and transient rod above the down limit.

Answer: C.11 d.
Reference: GA Control Console Operators Manual.

Question C.012 (1.00 point) {12.0}
Which ONE of the following radiation monitors is interlocked with the ventilation system?

a. CAM.
b. Reactor console.
c. Top of the reactor.
d. Entrance to reactor laboratory.

Answer: C.12 a.
Reference: Hazards Summary Report, Section 9.3.1.

Question C.013 (1.00 point) {13.0}
Which ONE of the following will NOT automatically activate Building 15 evacuation alarm?

a. Fire alarm.

b. Air particulate monitor.

c. Gaseous stack monitor.

d. Continuous air monitor alarm.

Answer: C.13 c.
Reference: Emergency Procedures, Section 7.3.3.

Question C.014 (1.00 point) {14.0}
The neutron source used in the reactor is a:

a. plutonium-beryllium source.

b. polonium-americium source.

c. polonium-beryllium source.

d. antimony-beryllium source.

Answer: C.14 c.
Reference: Hazards Summary Report, Section 5.6.

Question C.015 (1.00 point) {15.0}
At the GSTR total primary loop flow equals _____ , and flow through the purification loop is normally _____ .

a. 250 gpm, 25 gpm

b. 300 gpm, 25 gpm

c. 350 gpm, 20 gpm

d. 400 gpm, 20 gpm

Answer: C.15 c.
Reference: Hazard Summary Report Figure 5 – 12

Question C.016 (1.00 point) {16.0}
Which ONE of the following describes the purpose of the Draw Tube in a control rod drive assembly?

a. Actuates the rod down microswitch.

b. Provides rod full out position indication.

c. Connects to the electromagnet to move the rod.

d. Automatically engages the control rod on a withdraw signal.

Answer: C.16 c.
Reference: Hazards Summary Report, Section 5.4.1.

Question C.017 (1.00 point) {17.0}
Which ONE is NOT an input to the Regulating Rod Servo?

a. % demand potentiometer

b. Linear power channel

c. Rod raising interlock

d. Period channel

Answer: C.17 c.
Reference: Previous USGS exam (2008) and TRIGA Instrumentation Manual

Question C.018 (1.00 point) {18.0}
Limit switches mounted on each drive assembly provide switching for console lights. What is the significance of a "MAGENTA" rod color and a "BLACK" magnet box?

a. Reactor scram, control rod drive down.

b. Drive between limits, rod down, no magnet current.

c. Drive completely up, rod is down, no magnet contact.

d. Rod and drive completely withdrawn, magnet making contact.

Answer: C.18 c.
Reference: Previous USGS exam (2008) and Control Console Operator's Manual pg. 1-5

Question C.019 (1.00 point, 0.25 points each) {19.0}
Match the purification system conditions listed in column A with their respective causes listed in column B. Each choice is used only once. Higher than normal …

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

Answer: C.19 a. = 2; b. = 3; c. = 1; d. = 4
Reference: Standard NRC cleanup loop question.

Question C.020 (1.00 point) {20.0}

One of the differences between the transient control rod and the other control rods is that the transient control rod:

a. contains an air void while the other rods do not.

b. is 43 inches long while the other rods are 37 inches long.

c. has a reactivity rod worth of about twice that of each of the other rods.

d. has 21 inches of borated graphite in the upper section while the other rods have 15 inches of borated graphite in the upper section.

Answer: C.20 a.
Reference: Hazards Summary Report, Section 5.3.1.

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