March 31, 2008

Mr. Timothy DeBey
Reactor Director
U.S. Geological Survey
Box 25046 - Mail Stop 424
Denver Federal Center
Denver, CO 80225

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-274/OL-08-01, U.S. GEOLOGICAL SURVEY

Dear Mr. DeBey:

During the week of March 10, 2008, the NRC administered an operator licensing examination at your GSTR Facility. 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 pty@nrc.gov.

Sincerely,

/RA/

Johnny Eads, Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-274

Enclosures: 1. Initial Examination Report No. 50-274/OL-08-01
2. Written examination with facility comments incorporated

cc without enclosures:
See next page

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See next page
DISTRIBUTION w/ encls.:

PUBLIC	PRTB r/f	RidsNRRDPRPRTA
RidsNRRDPRPRTB	Facility File (CHart) O-12 G-15	

ADAMS ACCESSION #: ML080810447 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PYoung pty		CHart cah		JEads jhe	
DATE	03/19/2008		3/28/2008		3/31/2008	

OFFICIAL RECORD COPY

cc:

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Denver, CO 80225

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-08-01

FACILITY DOCKET NO.: 50-274

FACILITY LICENSE NO.: R-113

FACILITY: UNITED STATES GEOLOGICAL SURVEY

EXAMINATION DATES: 3/10 – 12/2008

SUBMITTED BY: **/RA/** 3/14/2008
Phillip T. Young, Chief Examiner Date

SUMMARY:

Two Reactor Operator applicants took the examination given the week of March 10, 2008. Both applicants's passed all portions of the examination.

REPORT DETAILS

1. Examiners: Phillip T. Young, Chief Examiner, NRC

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	2/0	0/0	2/0
Operating Tests	2/0	0/0	2/0
Overall	2/0	0/0	2/0

3. Exit Meeting:
Phillip T. Young, NRC, Examiner
Timothy DeBey, Reactor Director

The examiner thanked Mr. DeBey for the facility support during the examinations. There were no generic issues identified during the examinations. The facility provided the following comments on the written examination:

ENCLOSURE 1

Hi Phillip,
Here are the comments that I have about four of the exam questions. Please let me know if you have any questions.
Thanks, Tim

Question A.006
I believe the answer should be (a) “An immediate increase in the prompt neutron population.” I do not have your Reference, but DOE-HDBK-1019/2-93, “Reactor Theory”, page 14 states, “The positive reactivity insertion is followed immediately by a small immediate power increase called the prompt jump. This power increase occurs because the rate of production of prompt neutrons changes abruptly as the reactivity is added. Recall from an earlier module that the generation time for prompt neutrons is on the order of 10-13 seconds. The effect can be seen in Figure 2. After the prompt jump, the rate of change of power cannot increase any more rapidly than the built-in time delay the precursor half-lives allow. Therefore, the power rise is controllable, and the reactor can be operated safely. ”

Question B.010
I believe the answer should be (a) “Both dose rates are the same”.
This is because G-M tubes are not sensitive to energy, as given in the Reference. Since the curie level of both sources are the same and a G-M tube is used as the detector, the dose rates will be the same.

Question C.001
I believe the answers should be: a=0, b=1, c=0, d=3, e= 4&5, f= 2&6; which is a change of answers to c, e, and f compared to the answer sheet.
The answers for c and f are related because the detectors for the two safety channels are “uncompensated ion chamber”, as indicated in the text file that accompanied the I & C system block diagram. The answers for e should be 4&5 because these are the two fuel temperature channels of the instrumentation system and they both have thermocouples for sensors.

Question C.011
I believe this answer should be (c) “Drive completely up, rod is down, no magnet contact.” The Reference, “GA Control Console Operator’s Manual”, p 1-5, states, “For each shim rod and the regulator rod, the small square box at the bottom of the drive mechanism indicates the status of the rod magnet power. If the box is yellow, then magnet power is ON. If the box is black, then magnet power is OFF.” If the magnet power is OFF, then the control rod will be dropped (down) and the magnet will not be making contact.

NRC Response:

All comments are accepted as stated.

US NRC LICENSE EXAMINATION

U.S. GEOLOGICAL SURVEY, NO. 50-274

WRITTEN EXAMINATION with ANSWER KEY - OL-08-01

MARCH 10, 2008

Question: A.001 [1.0 point] (1.0)
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.001 a.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 149.

Question: A.002 [1.0 point] (2.0)
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.002 b.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 264.

Question: A.003 [1.0 point] (3.0)
Which one of the following is the definition of the FAST FISSION FACTOR?

a. The ratio of the number of neutrons produced by fast fission to the number produced by thermal fission

b. The ratio of the number of neutrons produced by thermal fission to the number produced by fast fission

c. The ratio of the number of neutrons produced by fast and thermal fission to the number produced by thermal fission

d. The ratio of the number of neutrons produced by fast fission to the number produced by fast and thermal fission

Answer: A.003 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 3.3.1 p. 3-16.

Question: A.004 [1.0 point] (4.0)
Two different neutron sources were used during two reactor startups. The source used in the first startup emits ten times as many neutrons per second as the source used in the second startup. Assume all other factors are the same for the second startup. Which ONE of the following states the expected result at criticality?

a. Neutron flux will be higher for the first startup.

b. Neutron flux will be higher for the second startup.

c. The first startup will result in a higher rod position (rods further out of the core).

d. The second startup will result in a higher rod position (rods further out of the core).

Answer: A.004 a.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982

Question: A.005 [1.0 point] (5.0)
Which ONE of the following is the principal source of energy (heat generation) in the reactor 15 minutes following a reactor shutdown from extended operation at full power?

a. Production of delayed neutrons.

b. Subcritical multiplication of neutrons.

c. Spontaneous fission of U-238.

d. Decay of fission products.

Answer: A. 005 d.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982

Question: A.006 [1.0 point] (6.0)
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.006 a ~~b~~. Per facility comment.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 240.

Question: A.007 [1.0 point] (7.0)
A reactor is subcritical with a K_{eff} of 0.984. and a count rate of 1500 cps on the startup instrumentation. Rods are withdrawn until the count rate is 6000 cps. At this point, the value of K_{eff} is:

a. 0.992
b. 0.994
c. 0.996
d. 0.998

Answer: A.007 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982
CR1/CR2 = (1 - K2)/(1 - K1) ; 1500/6000 = (1 - K2)/(1 - 0.984) ; K2 = 0.996

Question: A.008 [1.0 point] (8.0)
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.008 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982

Question: A.009 [1.0 point] (9.0)
The equations which describe the operation of the installed neutron source in the reactor are:

a. Am-241 -> alpha + Np-237
Be-9 + alpha -> C-12 + neutron

b. Am-241 -> alpha + Np-237
B-10 + alpha -> N-13 + neutron

c. Am-241 -> beta + Cm-241
Be-9 + beta -> Li-8 + neutron

d. Am-241 -> beta + Cm-241
B-10 + beta -> Be-9 + neutron

Answer: A.009 a.
Reference: Chart of Nuclides’

Question: A.010 [1.0 point] (10.0)
Which ONE of the following conditions describes a critical reactor?

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

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

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

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

Answer: A.010 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1984, § 3.3.4, pp. 3-23.

Question: A.011 [1.0 point] (11.0)
In choosing a Fuel-Moderator material ZrH ratio of 1.7, the limiting effect or factor verses other ratios is the:

a. relative widely spaced cracks that occur, in higher ratios, due to the elevated temperatures produced by pulsing

b. large volume changes associated with the with the phase transformations that occur in higher ratios.

c. zirconium hydride chemical reactivity rate with water associated with lower ratios.

d. hydrogen gas over pressure at higher fuel temperatures.

Answer: A.011 d.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982

Question: A.012 [1.0 point] (12.0)
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.012 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.013 [1.0 point] (13.0)
Two reactors are identical except that Reactor 1 has a beta fraction of 0.0072 and Reactor 2 has a beta fraction of 0.0060. An equal amount of positive reactivity is inserted into both reactors. Which ONE of the following will be the response of Reactor 2 compared to Reactor 1?

a. The resulting power level is lower.

b. The resulting power level is higher.

c. The period of the power increase is shorter.

d. The period of the power increase is longer.

Answer: A.013 c.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 237.
$\tau = (\ell^*/\rho) + [(\beta-\rho)/\lambda_{eff}\rho]$. The reactor with the smaller beta fraction will have the shortest period.

Question: A.014 [1.0 point] (14.0)
<u>Inelastic scattering</u> can be described as a process whereby a neutron collides with a nucleus and:

a. recoils with the same kinetic energy it had prior to the collision.

b. is absorbed by the nucleus, with the nucleus emitting a gamma ray.

c. recoils with a lower kinetic energy, with the nucleus emitting a gamma ray.

d. recoils with a higher kinetic energy, with the nucleus absorbing a gamma ray.

Answer: A.014 c.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 70.

Question: A.015 [1.0 point] (15.0)
A reactor with an initial population of $1x10^8$ neutrons is operating with $K_{eff} = 1.001$. Considering only the <u>increase</u> in neutron population, how many neutrons (of the increase) will be prompt when the neutron population changes from the current generation to the next? Assume $\beta_{eff} = 0.007$.

a. 700.

b. 7,000.

c. 99,300.

d. 100,000.

Answer: A.015 c.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 230.
Increase = $1.001x10^8 - 1x10^8 = 1x10^5$. Prompt neutron population = $0.993x1x10^5$ = 99,300.

Question: A.016 [1.0 point] (16.0)
Starting with a critical reactor at low power, a control rod is withdrawn from position X and reactor power starts to increase. Neglecting any temperature effects, in order to terminate the increase with the reactor again critical but at a higher power, the control rod must be:

a. inserted back to position X.

b. inserted deeper than position X.

c. inserted, but not as far as position X.

d. inserted, but exact position depends on power level.

Answer: A.016 a.
Reference: In the absence of any temperature effects, core reactivity returns to zero when the Rods are returned to their original positions.

Question: A.017 [1.0 point] (17.0)
Which ONE of the following is the description of a thermal neutron?

a. A neutron which possesses thermal rather than kinetic energy.

b. The primary source of thermal energy increase in the reactor coolant during reactor operation.

c. A neutron that has been produced in a significant time (on the order of seconds) after its initiating fission took place.

d. A neutron that experiences no net change in kinetic energy after several collisions with atoms of the diffusing media.

Answer: A.017 d.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 13.

Question: A.018 [1.0 point] (17.0)
In a subcritical reactor with K_{eff} = 0.861, +0.104 delta k/k reactivity is added. As a result, the new K_{eff} is:

a. 0.899

b. 0.946

c. 0.989

d. 1.0574

Answer: A.018 b.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 231.
Initial reactivity = (K - 1)/K = (0.861 - 1)/0.861 = -0.1614 delta k/k. Final reactivity = -0.1614 + 0.104 = -0.0574 delta k/k; k = 1/(1 + 0.0574) = 0.946

Question: A.019 [1.0 point] (19.0)
Which ONE of the following is responsible for the constant rate of power change several minutes after a reactor scram from full power?

a. The decay of the longest-lived delayed neutron precursors.

b. The decay of the shortest-lived delayed neutron precursors.

c. The mean average decay of the delayed neutron precursors.

d. The decay of fission product gammas producing photoneutrons.

Answer: A.019 a.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 120.

Question: A.020 [1.0 point] (20.0)
As a reactor continues to operate over time, for a <u>constant</u> power level, the thermal neutron flux:

a. decreases, due to the increase in fission product poisons.

b. increases, in order to compensate for fuel depletion.

c. decreases, because fuel is being depleted.

d. remains the same.

Answer: A.020 b.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 105.

Question: B.001 [1.0 point] (1.00)
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.001 c.
Reference: Technical Specifications, Section I.4.

Question: B.002 [2.0 points, ½ each] (3.00)
Match type of radiation (a thru d) with the proper penetrating power (1 thru 4)

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

Answer: B.002 a. = 4; b. = 2; c. = 1 d. = 3
Reference: Standard Question:

Question: B.003 [1.0 point] (4.00)
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.003 d.
Reference: Technical Specifications, Section A.5.

Question: B.004 [1.0 point] (5.00)
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.004 a.
Reference: USGS Emergency Plan, Definitions.

Question: B.005 [1.0 point] (6.00)
An automatic scram signal required by the Technical Specifications when operating in the square-wave mode is:

a. short period.

b. high power level.

c. high fuel temperature.

d. loss of percent power channel high voltage.

Answer: B.005 b.
Reference: Technical Specifications, Table I.

Question: B.006 [1.0 point] (7.00)
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.006 d.
Reference: USGS Emergency Plan, Definitions.

Question: B.007 [1.0 point] (8.00)
Which ONE of the following activities requires the direct presence (supervision) of a senior licensed operator?

a. Reactor power calibration.

b. Removal of one (1) fuel element.

c. Control rod drop time measurement.

d. Removal of control rod for inspection.

Answer: B.007 b.
Reference: PROCEDURE FOR FUEL LOADING AND UNLOADING

Question: B.008 [2.0 points 0.5 each] (10.00)
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.008 a. = 3; b. = 3; c. = 1; d. = 4
Reference: Standard NRC Question

Question: B.009 [1.0 point] (11.00)
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 setpoints 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.009 a.
Reference: Technical Specifications, Section F.2.

Question: B.010 [1.0 point] (12.00)
Two different gamma point sources have the same curie strength. The gammas from Source A have an energy of 1 Mev, and the gammas from Source B have an energy of 2 Mev. The dose rate from each source is measured at a distance of 10 feet using a G-M tube. Which ONE of the following statements is correct?

a. Both dose rates are the same.

b. The dose rate of Source B is half that of Source A.

c. The dose rate of Source B is two times that of Source A.

d. The dose rate of Source B is four times that of Source A.

Answer: B.010 a ~~c~~. Per facility comment.
Reference: G-M tubes are not sensitive to energy.

Question: B.011 [1.0 point] (13.00)
Two centimeters of lead placed in a beam of gamma rays reduces the radiation level from 400 mR/hr to 200 mR/hr. Which ONE of the following is the total thickness of lead that would reduce the gamma radiation level from 400 mR/hr to 50 mR/hr?

a. 3 cm.

b. 4 cm.

c. 6 cm

d. 8 cm.

Answer: B.011 c.
Reference: Each 2 cm. of lead reduces the radiation level by a factor of 2. 6 cm reduces It by a factor of 8.

Question: B.012 [1.0 point] (14.00)
In accordance with the Technical Specifications, given the control rod worths and excess reactivity below, calculate the minimum shutdown margin.

Shim rod =	1.8% delta k/k	Regulating rod =	2.5% delta k/k
Safety rod =	2.0% delta k/k	Transient rod =	2.1% delta k/k
		Excess reactivity =	4% delta k/k

a. 1.8% delta k/k.

b. 1.9% delta k/k.

c. 4.4% delta k/k.

d. 8.4% delta k/k.

Answer: B.012 b.
Reference: Technical Specifications, Section E.5.
Shutdown margin + Excess reactivity = Rod worth (excluding the most reactive rod)

Question: B.013 [1.0 point] (15.00)
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.013 d.
Reference: GSTR Procedure No. 2, pg. 2.

Question: B.014 [1.0 point] (16.00)
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.014 b.
Reference: Glasstone/Sesonske - Chapter 9

Question: B.015 [1.0 point] (17.00)
Your Reactor Operator license expires after _____ years.

a. 2
b. 4
c. 6
d. 8

Answer B.015 c.
Reference: 10CFR55.55(a)

Question: B.016 [1.0 point] (18.00)
A Reactor Operator has not been actively performing functions and duties for over 6 months. To resume functions authorized by the license, issued under part 50.51, what is the minimum hours required to perform shift functions under the direction of an operator or senior operator as appropriate and in the position to which the individual will be assigned?

a. 12 hours

b. 4 hours

c. 8 hours

d. 6 hours

Answer: B.016 d.
Reference: 10 CFR 55.53(f)(2)

Question: B.017 [1.0 point] (19.00)
According to the "Pocket Dosimeter Drift Check Procedure," after a 24 hour drift check period, what is the maximum drift allowable if the dosimeter is to remain in service?

a. <1% from the initial reading

b. <5% from the initial reading

c. <1% of meter full scale

d. <2% of meter full scale

Answer: B.017 d.
Reference: USGS Pocket Dosimeter Drift Check Procedure

Question: B.018 [1.0 point] (20.00)
A pocket dosimeter is being calibrated in accordance with the "POCKET DOSIMETER CALIBRATION PROCEDURE." At the end of the predetermined exposure period (typically 25 minutes), what should the meter be reading?

a. 110 mr

b. 125 mr/hr

c. 180 mr

d. 250 mr

Answer: B.018 a.
Reference: USGS POCKET DOSIMETER CALIBRATION PROCEDURE

Question: C.001 [2.0 points, 0.333 points each] (2.00)
Match the measuring channel listed in Column A with the correct detector position on the GSTR Instrument Diagram attached. If an item in Column A is not used select 0. from Column B. Items listed in Column A may be used more than once or not at all.

Column A	Column B
a. Proportional counter	0.
b. Fission chamber	1.
c. Compensated Ion Chamber	2.
d. RTD	3.
e. Thermocouple	4.
f. Uncompensated Ion Chamber	5.
	6.

Answer: C.001 a. = 0; b = 1; c. = 0 ~~2 & 6~~; d. = 3; e = 4 & 5; f. = ~~0~~ 2 & 6
Changes to correct answers per facility comment.
Reference: Control System Block Diagram.

Question: C.002 [2.0 points, 0.4 points each] (4.00)
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. Isotope Removal Tube	2.
c. Control rod Drive	3.
d. Reflector	4.
e. Rotary Specimen Rack	5.
	6.
	7.
	8.
	9.
	10.

Answer: C.002 a. = 2; b. = 3; c. = 1; d. = 7; e. = 4 .
Reference: Hazard Summary Report Figure 5 - 1

Question: C.003 [2.0 points, 0.4 points each] (6.00)
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.
	9.

Answer: C.003 a. = 7; b. = 6; c. = 1; d. = 9; e. = 5 or 8 .
Reference: Hazard Summary Report Figure 5 – 7.

Question: C.004 [1.0 point] (7.00)
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.004 d.
Reference: GA Control Console Operators Manual.

Question: C.005 [1.0 point] (8.00)
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.005 a.
Reference: Hazards Summary Report, Section 9.3.1.

Question: C.006 [1.0 point] (9.00)
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.006 c.
Reference: Emergency Procedures, Section 7.3.3.

Question: C.007 [1.0 point] (10.00)
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.007 c.
Reference: Hazards Summary Report, Section 5.6.

Question: C.008 [1.0 point] (11.00)
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.008 c.
Reference: Hazard Summary Report Figure 5 – 12

Question: C.009 [1.0 point] (12.00)
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.009 c.
Reference: Hazards Summary Report, Section 5.4.1.

Question: C.010 [1.0 point] (13.00)
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.010 c.
Reference: GA TRIGA Instrumentation Maintenance Manual

Question: C.011 [1.0 point] (14.00)
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.011 c ~~d~~. Per facility comment.
Reference: GA Control Console Operator's Manual pg. 1-5

Question: C.012 [1.0 point] (15.00)
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.012 a.
Reference: Hazards Summary Report, Section 5.3.1.

Question: C.013 [1.0 point] (16.00)
Which ONE of the following statements is NOT a reason for maintaining a minimum reactor pool level during reactor operation?

a. Provide Net Positive Suction Head (NPSH) to the reactor water pump

b. Proper "Dash Pot" action for the control rods during a scram

c. Ensure proper operation of the pool skimmer

d. Provide shielding from the core

Answer: C.013 a.
Reference: GA TRIGA Mechanical Maintenance and Operating Manual pg. 4-13

Question: C.014 [1.0 point] (17.00)
An important design feature of the fuel-moderator elements is:

a. an enrichment of 90%, allowing for prolonged operations before refueling.

b. the reduced neutron absorption provided by the zirconium cladding.

c. the prompt negative temperature coefficient of reactivity.

d. the inclusion of the burnable poison erbium.

Answer: C.014 c.
Reference: Hazards Summary Report, Section 5.1.

Question: C.015 [1.0 point] (18.00)
Which ONE of the following statements describes the moderating properties of Zirconium Hydride?

a. Elevation of the hydride temperature increases the probability that a thermal neutron will escape the fuel-moderator element before being captured.

b. The probability that a neutron will return to the fuel element before being captured elsewhere is a function of the temperature of the hydride.

c. The ratio of hydrogen atoms to zirconium atoms affects the moderating effectiveness for slow neutrons.

d. The hydride mixture is very effective in slowing down neutrons with energies below 0.025 eV.

Answer: C.015 a.
Reference: GA TRIGA Mark I Reactor Hazards Analysis.

Question: C.016 [1.0 point] (19.00)
Maximum fuel temperatures are expected to occur in the:

a. B-ring fuel elements.

b. D-ring fuel elements.

c. F-ring fuel elements.

d. G-ring fuel elements.

Answer: C.016 a.
Reference: Hazards Summary Report, Section 7.3.3.

Question: C.017 [1.0 point] (20.00)
The reactor is in the AUTOMATIC mode at a power level of 500 kW. The neutron detector from which the control system receives its input signal fails low (signal suddenly goes to zero). As a result:

a. the control system inserts the regulating rod to reduce power, to try to match the power of the failed detector.

b. the control system drops out of the AUTOMATIC mode into the MANUAL mode.

c. the control system withdraws the regulating rod to try to increase power.

d. the reactor scrams.

Answer: C.017 c.
Reference: Hazards Summary Report, Section 5.5.2.