April 29, 2011

Paul Whaley, Associate Director
Nuclear Engineering Teaching Lab
University of Texas at Austin
NETL-PRC Bldg 159
10100 Burnet Rd
Austin, TX 78758

SUBJECT: EXAMINATION REPORT NO. 50-602/OL-11-01, UNIVERSITY OF TEXAS AT AUSTIN

Dear Mr. Whaley:

During the week of April 11, 2011, the Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your TRIGA Reactor. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed 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/

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

Docket No. 50-602

Enclosures: 1. Examination Report No. 50-602/OL-11-01
2. Facility comments on written examination with NRC Resolution
3. Written examination with facility comments incorporated

cc: Michael Krause, Reactor Supervisor
cc: w/o enclosures: See next page

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cc: Michael Krause, Reactor Supervisor
cc: w/o enclosures: See next page

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ADAMS ACCESSION No. ML111150563 **TEMPLATE #:NRR-074**

OFFICE	PROB:CE		IOLB:LA	E	PROB:SC	
NAME	PYoung		CRevelle		JEads	
DATE	4/26/2011		4/27/2011		4/29/11	

OFFICIAL RECORD COPY

cc:

Governor's Budget and
Planning Office
P.O. Box 13561
Austin, TX 78711

Bureau of Radiation Control
State of Texas
1100 West 49th Street
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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.: 50-602/OL-11-01

FACILITY DOCKET NO.: 50-602

FACILITY LICENSE NO.: R-129

FACILITY: University of Texas TRIGA Reactor

EXAMINATION DATES: April 11 to 13, 2011

SUBMITTED BY: **/RA/** 4/19/2011
Phillip T. Young, Chief Examiner Date

SUMMARY:

The NRC administered an operator licensing examination to two Reactor Operator candidates. Both candidates passed all portions of their respective examinations.

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
   Michael Krause, Reactor Supervisor, TRIGA Reactor, University of Texas

The chief examiner met with the facility staff to discuss the overall administration of the examination.

Facility Comments with NRC Resolution

From: m.krause@mail.utexas.edu [mailto:m.krause@mail.utexas.edu]
Sent: Thursday, April 21, 2011 10:34 AM
To: Young, Phillip
Subject: Comments on Exam Conducted Week of April 11,2011

PT,

Please find below a summary of the Facility comments and discussion we had on the written exam when you were here the week of April 11, 2011.

Question B.007 The indicated answer to this question is referenced as (a), the actual correct answer is (d), please review and revise the expected correct answer.

Question C.008 The indicated answer to this question is referenced as (c), the actual correct answer is (b), please review and revise the expected correct answer.

Question C.014 This question should be removed, it is out of date. The question references original GA console software function which has changed during control system upgrades implemented over the life of the facility.

Question C.017 This question can be confusing and have multiple correct answer combinations. The **Through** beam ports (1 & 5) are also actually **Tangential**, beam port 3 which is **Radial** also goes **Through** the reflector and is labeled as **Piercing** in SAR Figure 4-27 which is not an available answer. Consider revising or removing.

Thank you again for working around the schedule of our exam candidates.

Michael Gene Krause, P.E.
Reactor Supervisor
Manager Operations & Maintenance
Nuclear Engineering Teaching Laboratory

NRC Resolution:

Question B.007: Comment accepted on typographical error, answer key changed to reflect ‘d’ as the correct answer.

Question C.008: Comment accepted on typographical error, answer key changed to reflect ‘b’ as the correct answer.

Question C.014: Comment accepted, this question was deleted from the examination.

Question C.017: Comment **not** accepted, the control room right hand display (“Texas Status Window”) labels the beam ports as asked for on the examination. This display is always in visual sight of anyone operating the reactor.

ENCLOSURE 2

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

FACILITY: University of Texas - Austin

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 04/11/2011

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 brackets 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	% of Candidates Score	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
19.00 ~~20.00~~	33.3			C. Facility and Radiation Monitoring Systems
59.00 ~~60.00~~	100.0			TOTALS

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

_____
Candidate's Signature

ENCLOSURE 3

Section A - Reactor Theory, Thermo & Facility Operating Characteristics

Question A.001 [1.00 point] (1.0)

A reactor is slightly supercritical with the following values for each of the factors in the six-factor formula:

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

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

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

Answer: A.001 a.
Reference: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 2. Since K_{eff} is being reduced, the thermal utilization factor must be less than its original value.

Question A.002 [1.00 point] (2.0)

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.002 a.
Reference: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 14.

Section A - Reactor Theory, Thermo & Facility Operating Characteristics

Question A.003 [1.00 point] (3.0)
As primary coolant temperature increases, rod worth:

a. increases due to higher reflector efficiency.

b. increases due to the increase in thermal diffusion length.

c. decreases due to higher neutron absorption in the moderator.

d. remains the same due to constant poison cross-section of the control rods.

Answer: A.003 b.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.2, p. 3-18

Question A.004 [1.00 point] (4.0)
Which ONE of the following is true concerning the differences between prompt and delayed neutrons?

a. Prompt neutrons are released during fast fissions while delayed neutrons are released during thermal fissions.

b. Prompt neutrons are released during the fission process while delayed neutrons are released during the decay of fission products.

c. Prompt neutrons are the dominating factor in determining the reactor period while delayed neutrons have little effect on the reactor period.

d. 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.

Answer A.004 b.
Reference: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 2, pg. 29.

Question A.005 [1.00 point] (5.0)
Which ONE of the following conditions would INCREASE the shutdown margin of a reactor?

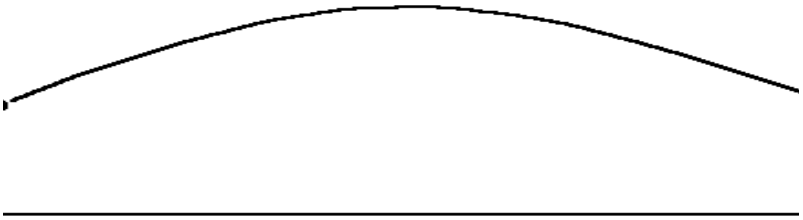
a. Depletion of uranium fuel.

b. Decreasing fuel temperature.

c. An experiment which adds positive reactivity.

d. Depletion of burnable poison added to the uranium fuel.

Answer: A.005 a.
Reference: UT-TRIGA Technical Specifications, 1.26. Any process which adds negative reactivity increases the shutdown margin.



Question A.006 [1.00 point] (6.0)
Shown above is a trace of reactor period as a function of time. Between points A and B, reactor power is:

a. continually increasing.
b. increasing, then decreasing.
c. continually decreasing.
d. constant.

Answer: A.006 a.
Reference: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 11. Since the period is always positive, power must be increasing.

Question A.007 [1.00 point, 0.25 each] (7.0)
Match each term in column A with the correct definition in column B.

Column A	Column B
a. Prompt Neutron	1. A neutron in equilibrium with its surroundings.
b. Fast Neutron	2. A neutron born directly from fission.
c. Thermal Neutron	3. A neutron born due to decay of a fission product.
d. Delayed Neutron	4. A neutron at an energy level greater than its surroundings.

Answer: A.007 a = 2; b = 4; c = 1; d = 3
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 2.5, p. 2-36.

Question A.008 [1.00 point] (8.0)
During fuel loading, which ONE of the following will have NO effect on the shape of the 1/M plot?

a. The location of the detector (or detectors) in the core.
b. The location of the source in the core.
c. The order of fuel placement.
d. The source strength.

Answer: A.008 d.
Reference: UT-TRIGA Trn Man, Vol. IV, Nuclear Physics & Rx Theory, Module 4, pg. 5.

Question A.009 [1.00 point] (9.0)
Which of the following does NOT affect the Effective Multiplication Factor (Keff)?

a. The moderator-to-fuel ratio.
b. The current time in core life.
c. The physical dimensions of the core.
d. The strength of installed neutron sources.

Answer: A.009 d.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.4, p. 3-21.

Question A.010 [1.00 point] (10.0)
K_{eff} for the reactor is 0.98. If you place an experiment worth +$1.00 into the core, what will the new K_{eff} be?

a. 0.982
b. 0.987
c. 1.013
d. 1.018

Answer: A.010 b
Reference: SDM = $(1-k_{eff})/k_{eff}$ = (1-0.98)/0.98 = 0.02/0.99 = 0.02041 or 0.02041/.0075 = $2.72, or a reactivity worth (ρ) of -$2.72. Adding +$1.00 reactivity will result in a SDM of $2.72 - $1.00 = $1.72, or .0129081 ΔK/K
K_{eff} = 1/(1+SDM) = 1/(1 + 0.0129081) = 0.987

Question A.011 [1.00 point] (11.0)
About two minutes following a reactor scram, period has stabilized, and is decreasing at a CONSTANT rate. If reactor power is 10^{-5} % full power what will the power be in three minutes.

a. 5×10^{-6} % full power
b. 2×10^{-6} % full power
c. 10^{-6} % full power
d. 5×10^{-7} % full power

Answer: A.011 c.
Reference: $P = P_0 e^{-T/\tau} = 10^{-5} \times e^{(-180sec/80sec)} = 10^{-5} \times e^{-2.25} = 0.1054 \times 10^{-5} = 1.054 \times 10^{-6}$

Question A.012 [1.00 point] (12.0)
Core excess reactivity changes with…

a. Fuel burnup
b. Neutron Level
c. Control Rod Height
d. Reactor Power Level

Answer: A.012 a.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 6.2 p. 6-1 — 6-4.

Question A.013 [1.00 point] (13.0)
INELASTIC SCATTERING is the process by which a neutron collides with a nucleus and …

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

Answer: A.013 c.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 2.4.5 p. 2-28.

Question A.014 [1.00 point] (14.0)
The term *PROMPT JUMP* refers to …

a. an instantaneous change in power due to withdrawal of a control rod.
b. a reactor which has attained criticality on prompt neutrons alone.
c. a reactor which is critical on both prompt and delayed neutrons.
d. a negative reactivity insertion which is less than β_{eff}.

Answer: A.014 a.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 4.7, p. 4-21

Question A.015 [1.00 point] (15.0)
Which ONE of the following elements will slow down fast neutrons **least** quickly, i.e. produces the smallest energy loss per collision?

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

Answer: A.015 b.
Reference: UT-TRIGA Trn Man, Vol. IV, Nuclear Physics & Rx Theory, Module 2, pp. 24-27.

Question A.016 [1.00 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, but exact position depends on power level
b. inserted, but not as far as position X
c. inserted deeper than position X
d. inserted back to position X

Answer: A.016 d.
Reference: UT-TRIGA Trn Man, Vol. IV, Nuclear Physics & Rx Theory, Module 4, pg. 24.

Question A.017 [1.00 point] (17.0)
For the same constant reactor period, which ONE of the following transients requires the SHORTEST time to occur? A power increase of:

a. 5% of rated power - going from 1% to 6% of rated power.
b. 15% of rated power - going from 10% to 25% of rated power.
c. 30% of rated power - going from 20% to 50% of rated power.
d. 50% of rated power - going from 50% to 100% of rated power.

Answer: A.017 d.
Reference: UT-TRIGA Trn Man, Vol. IV, Nuclear Physics & Rx Theory, Module 4, pg.11.

Question A.018 [1.00 point] (18.0)
The reactor is operating in the automatic mode at 50% power. A problem in the secondary cooling system causes the primary coolant temperature to increase by 5 degrees F. Given that the primary coolant temperature coefficient is -7.0×10^{-5} Δ k/k/deg. F and the differential rod worth of the regulating rod is 8.87×10^{-5} Δk/k/inch, the change in the position of the regulating rod will be:

a. eight (8) inches in.
b. eight (8) inches out.
c. four (4) inches in.
d. four (4) inches out.

Answer: A.018 d.
Reference: UT-TRIGA Trn Man, Vol. IV, Nuclear Physics & Rx Theory, Module 3, pg. 21.
Since coolant temperature increased, negative reactivity was added. Therefore, the rod must add positive reactivity, i.e. withdrawn out. $7 \times 5 \times 10^{-5} / 8.75 \times 10^{-5} = 4$ inches.

Question A.019 [1.00 point] (19.0)
Which ONE of the following statements describes the difference between Differential (DRW) and Integral (IRW) rod worth curves?

a. IRW is the slope of the DRW at a given rod position.

b. IRW relates the worth of the rod per unit of travel to rod position. DRW relates the total reactivity added by the rod to the rod position.

c. DRW relates the worth of the rod per unit of travel to rod position. IRW relates the total reactivity added by the rod to the rod position.

d. DRW relates the time rate of reactivity change to rod position. IRW relates the total reactivity in the core to the time rate of reactivity change.

Answer: A.019 c.
Reference: UT-TRIGA Trn Man, Vol. IV, Nuclear Physics & Rx Theory, Module 3, pg. 51.

Question A.020 [1.00 point] (20.0)
Delayed neutron precursors decay by beta decay. Which reaction below is an example of beta decay?

a. $_{35}Br^{87}$ -> $_{33}Kr^{83}$
b. $_{35}Br^{87}$ -> $_{35}Kr^{86}$
c. $_{35}Br^{87}$ -> $_{34}Kr^{86}$
d. $_{35}Br^{87}$ -> $_{36}Kr^{87}$

Answer: A.020 d.
Reference: UT-TRIGA Trn Man, Vol. IV, Nuclear Physics & Rx Theory, Module 1, pg. 24.

Section B - Normal / Emergency Procedures & Radiological Controls

Question B.001 [1.0 point] {1.0}

The reactor is operating at full power with experiments in progress. Given the parameters listed {a. through d.} and the fact no corrective actions are to be taken, which ONE condition below is **NOT** permissible when the reactor is operating?

a. Shim rod #1 has a scram time of 1 second.

b. Shutdown Margin is calculated at 2.8% Δk/k.

c. The pool water conductivity measures 5.5 μmho/cm.

d. the reactivity worth of the only secured experiment is 1.8% Δk/k.

Answer: B.001 d.
Reference: TS Section 3.3.1.c.

Question B.002 [1.0 point] {2.0}

A small radioactive source is to be stored in the reactor bay with no shielding. The source reads 2 R/hr at 1 foot. A “Radiation Area” barrier would have to be erected approximately ___ from the source.

a. 400 feet

b. 40 feet

c. 20 feet

d. 10 feet

Answer: B.002 c.
Reference:

$$\frac{DR_1}{X_2^2} = \frac{DR_2}{X_1^2}X_2^2 = \frac{DR_1}{DR_2}X_1^2$$

$$X_2^2 = \frac{2000}{5} \times 1^2 = 400ft^2 X_2 = 20ft$$

Section B - Normal / Emergency Procedures & Radiological Controls

Question B.003 [1.0 point] {3.0}
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. Emergency Director with concurrence of the Health Physicist.
d. Emergency Director.

Answer: B.003 d.
Reference: Emergency Plan, § 2.1.1, 4th ¶.

Question B.004 [1.0 point] {4.0}
Which ONE of the following would be an initiating condition for a Non-Reactor Specific Emergency?

a. Damage to building reactor systems or facility utilities.
b. > 20 mr/hr at operations boundary from unknown source.
c. Nearby, threatening, or impending natural disaster.
d. Discovery of forced entry or SNM theft.

Answer: B.004 c.
Reference: Procedure E-Plan, Emergency Classification.

Question B.005 [1.0 point] {5.0}
The Safety System channels required to be operable in <u>all</u> modes of operation are:

a. manual scram and reactor high power scram (1.1 MW).
b. fuel element temperature scram (550°C) and manual scram.
c. fuel element temperature scram (550°C), reactor high power scram (1.1 MW), and manual scram.
d. reactor high power scram (1.1 MW), loss of high voltage scram, and fuel element temperature scram (550°C).

Answer: B.005 b.
Reference: Technical Specifications, Section 3.2.3.

Section B - Normal / Emergency Procedures & Radiological Controls

Question B.006 [1.0 point, 0.25 each] {6.0}
Match 10 CFR 55 requirements listed in Column A for an actively licensed operator with correct time period from Column B. Column B answers may be used once, > once, or not at all.

Column A	Column B
a. License Expiration	1. 1 year
b. Medical Examination	2. 2 years
c. Requalification Written Examination	3. 3 years
d. Requalification Operating Test	4. 6 years

Answer: B.006 a. = 4; b. = 2; c. = 2; d. = 1
Reference: 10 CFR 55

Question B.007 [1.0 point] {7.0}
Which ONE statement below describes the basis for the Safety Limit applicable to fuel temperature?

a. High fuel temperature combined with lack of adequate cooling could result in fuel melt.

b. Pulsing the reactor at high fuel temperatures could result in loss of fuel element cladding integrity.

c. Excessive hydrogen produced as a result of the zirconium-water reaction is potentially explosive.

d. Excessive gas pressure between the fuel-moderator and cladding may result in loss of fuel element cladding integrity.

Answer: B.007 ~~a.~~ Answer changed to 'd.' to correct typographical error.
Reference: SAR, Section 4-1.

Question B.008 [1.0 point] {8.0}
"The reactivity of an experiment shall be measured before an experiment is considered functional." This is an example of a:

a. safety limit.

b. limiting safety system setting.

c. limiting condition for operation.

d. surveillance requirement.

Answer: B.008 d.
Reference: Technical Specifications, Section 4.1.1.

Section B - Normal / Emergency Procedures & Radiological Controls

Question B.009 [1.0 point, 0.25 each] {9.0}

Match each of the following actions in Column A with the correct term from the Technical Specifications in Column B. Only one term from Column B may be used for each action in Column A.

Column A	Column B
a. Immersing a thermometer in an ice bath, then in boiling water and noting the readings.	1. Channel Check
b. Placing a source next to a radiation detector and observing meter movement.	2. Channel Test
c. Performing a determination of reactor power with a heat balance, then adjusting a power meter to correspond to the heat balance.	3. Channel Calibration
d. Observing the overlap between two different neutron detectors as power increases.	

Answer: B.009 a. = 2; b. = 2; c. = 3; d. = 1.
Reference: Technical Specifications, Definitions.

Question B.010 [1.0 point] {10.0}

The area radiation monitor at the pool level has been out of service for one day. 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 monitor is replaced by a locally-alarming unit of similar range.

d. the reactor can continue to operate only if the alarm setpoints of the remaining area radiation monitors are lowered.

Answer: B.010 a.
Reference: Technical Specifications, Section 3.3.3c.

Section B - Normal / Emergency Procedures & Radiological Controls

Question B.011 [1.0 point] {11.0}
Two point sources have the same Curie strength. Source A's gammas have an energy of 1 Mev, while Source B's gammas have an energy of 2 Mev. You obtain a reading from the same GM tube 10 feet from each source. Concerning the two readings, which ONE of the following statements is true?

a. The reading from Source B is four times that of Source A.
b. The reading from Source B is twice that of Source A.
c. The reading from Source B is the same as Source A.
d. The reading from Source B. is half that of Source A.

Answer: B.011 c.
Reference: GM tubes cannot distinguish between energies.

Question B.012 [1.0 point] {12.0}
Following an abnormal shutdown, what is the lowest level of authority that can authorize a reactor restart is:

a. the Reactor Operator on duty at the time of the shutdown.
b. a Senior Reactor Operator.
c. the Reactor Supervisor.
d. the NETL Director.

Answer: B.012 b.
Reference: OPER-2, Reactor Startup and Shutdown.

Question B.013 [1.0 point] {13.0}
Prior to the movement of fuel out of the reactor, movement of any control rod drive is prevented by:

a. de-energizing the magnets.
b. removing the neutron source.
c. removing power from the drive motor.
d. mechanically blocking the rod from moving.

Answer: B.013 b.
Reference: FUEL-1, Movement of Fuel.

Question B.014 [1.0 point, 0.25 each] {14.0}
Match the radiation reading from column A with its corresponding radiation area classification (per 10 CFR 20) listed in column B. (Assume gamma radiation)

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.014 a. = 2; b. = 3; c. = 3; d. = 4
Reference: 10 CFR 20.1003, Definitions

Question B.015 [1.0 point] {15.0}
Two inches of shielding reduce the gamma exposure in a beam of radiation from 400 mR/hr to 200 mR/hr. If you add an **additional four** inches of shielding what will be the new radiation level? (Assume all reading are the same distance from the source.)

a. 25 mR/hr
b. 50 mR/hr
c. 75 mr/hr
d. 100 mr/hr

Answer: B.015 b.
Reference: Nuclear Power Plant Health Physics and Radiation Protection

Question B.016 [1.0 point] {16.0}
In accordance with the Technical Specifications, which one situation below is permissible when the reactor is operating?

a. The reactor power trip setpoint is set at 1.010 kW.
b. The Transient Rod withdrawal time is 18 seconds.
c. One fuel temperature measuring channel is inoperable.
d. One control rod inoperable but is in its fully withdrawn position.

Answer: B.016 a.
Reference: Technical Specifications, Section 3.2

Section B - Normal / Emergency Procedures & Radiological Controls

Question B.017 [1.0 point] {17.0}
The reactor has been shutdown following operations which achieved 1200 kW. WHO may authorize restart of the Reactor?

a. The Reactor Supervisor
b. The Facility Director
c. The Reactor Operations Committee
d. The Nuclear Regulatory Commission

Answer: B.017 d.
Reference: Tech. Specs, § 6.5.1.a Action to be taken in the Event a Safety Limit is Exceeded. p. 32.

Question B.018 [1.0 point] {18.0}
For a radiation worker at NETL to exceed the facility individual dose limits, written permission is required from the _____ .

a. Health Physicst
b. Radiation Safety Officer
c. Facility Director
d. Reactor Supervisor and Nuclear Reactor Committee

Answer: B.018 c.
Reference: HP00-3 NETL ALARA Program

Question B.019 [1.0 point] {19.0}
Half-way through a 6 hour reactor operation you discover that the normal ventilation exhaust damper has been blocked open by a student performing experiments. You cannot move the damper because it is damaged. Which one of the following actions should you take?

a. Immediately secure reactor operations and comply with the requirements for reportable events.
b. Immediately secure reactor. This event is not reportable if the damper is repaired within 48 hours.
c. Continue with reactor operations. Up to one week is allowed to repair the damper.
d. Continue with reactor operations. The CAM will offer adequate protection.

Answer: B.019 a.
Reference: Technical Specifications, Section 3.3.2.a

Question B.020 [1.0 point] {20.0}

The CURIE content of a radioactive source is a measure of

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

Answer: B.020 c.
Reference: Standard Health Physics Definition.

Section C: - Plant and Rad Monitoring Systems

Question C.001 [1.00 point] {1.0}
Complete the following statement. Fuel in the UT TRIGA is a homogeneous mixture of uranium-_____ hydride alloy containing _____% by weight of uranium enriched to <_____%.

a. graphite, 20, 8.5
b. zirconium, 20, 8.5
c. graphite, 8.5 , 20
d. zirconium, 8.5, 20

Answer: C.001 d.
Reference: SAR Section 4.4.5

Question C.002 [1.00 point] {2.0}
Which ONE of the following temperatures is measured by the thermocouples in the instrumented fuel element?

a. Interior of the fuel.
b. Outer surface of the fuel.
c. Center of the zirconium rod.
d. Surface of the fuel element cladding.

Answer: C.002 a.
Reference: SAR Figure 4-29

Question C.003 [1.00 point] {3.0}
Carbon Dioxide or Nitrogen is used in the pneumatic transfer system because:

a. it does not retain moisture.
b. it minimizes the production of Argon-41.
c. it is more compressible than compressed air, which minimizes the pressure required to move samples.
d. it is a better neutron absorber than compressed air, thus inserting negative reactivity in the event of a leak.

Answer: C.003 b.
Reference: SAR Section 7.4.2

Section C: - Plant and Rad Monitoring Systems

Question C.004 [1.00 point] {4.0}
With reference to the heat exchanger in the coolant system, differential pressure is measured between the cooling system inlet and secondary outlet. The purpose of this measurement is:

a. provide an alarm if the secondary system pump discharge pressure exceeds the cooling system pump suction pressure.

b. alarm when the cooling system inlet pressure exceeds the secondary outlet pressure.

c. alarm when the secondary outlet pressure exceeds the cooling system inlet pressure.

d. to measure the difference in flow rate of the primary and secondary loops.

Answer: C.004 b.
Reference: SAR Section 5.2.1

Question C.005 [1.00 point] {5.0}
How does the ventilation system respond to a high radiation alarm from the air particulate monitor?

a. If the ventilation system was not running prior to the high radiation alarm, it automatically starts. If running, continues to operate.

b. The supply fan continues to operate, while the return fan stops. Supply and return dampers remain open.

c. Both the supply and return fans stop, and supply and return dampers close.

d. The return fan continues to operate, while the supply fan stops.

Answer: C.005 c.
Reference: Technical Specifications 3.3.2

Question C.006 [1.00 point] {6.0}
Bulk pool water temperature is limited to 48 degrees C in order to ensure that:

a. demineralizer resins are not damaged.

b. activation of pool water impurities is limited.

c. nucleate boiling does not occur on fuel element surfaces.

d. the expansion of pool water at high temperatures does not reduce the moderating capability of the coolant.

Answer: C.006 a.
Reference: UT-TRIGA Reactor Technical Specifications, Appendix A.3

Section C: - Plant and Rad Monitoring Systems

Question C.007 [1.00 point] {7.0}
Which 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. De-energizing 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.007 d.
Reference: GA Maintenance Manual

Question C.008 [1.00 point] {8.0}
During reactor operation, the HVAC system may be operated in the REACTOR OFF mode, provided that:

a. reactor power is less than 100 kW.
b. the argon purge system is operating.
c. the air particulate monitor is operable.
d. reactor operation is less than eight (8) hours duration.

Answer: C.008 ~~c.~~ Answer changed to 'b.' to correct typographical error.
Reference: OPER-5.

Question C.009 [1.00 point] {9.0}
Which is NOT a condition that must exist for the system to enter the Pulse mode?

a. System in Manual Mode.
b. Reactor period must be infinite.
c. Transient rod all the way down.
d. Reactor power less than 1 kW.

Answer: C.009 b.
Reference: Control Console Operator's Manual, Pulse Mode pg. 6-1

Section C: - Plant and Rad Monitoring Systems

Question C.010 [1.00 point] {10.0}
The temperature of the water in the secondary side of the heat exchanger is controlled by:

a. a temperature controller which allows some of the cooling water to bypass the heat exchanger.

b. varying the speed of the secondary coolant (chill water) pump.

c. a flow control valve at the outlet of the secondary pump.

d. a flow control valve at the outlet of the heat exchanger.

Answer: C.010 a.
Reference: SAR 5.2.1.

Question C.011 [1.00 point] {11.0}
The Argon Purge System receives inputs from two air suction points. They are:

a. the pool surface and reactor bay.

b. the reactor bay and control room.

c. the reactor bay and beam port manifold.

d. the pool surface and beam port manifold.

Answer: C.011 d.
Reference: SAR Section 7.2.2

Question C.012 [1.00 point] {12.0}
Each fuel element contains a top and bottom reflector plugs which are made of …

a. graphite

b. zirconium

c. Stainless Steel

d. zirconium hydride

Answer: C.012 a.
Reference: SAR § 4.4.5 2nd ¶.

Section C: - Plant and Rad Monitoring Systems

Question C.013 [1.00 point] {13.0}
Which ONE of the following is the neutron absorbing medium in the control rods?

a. Boron carbide
b. Samarium
c. Halfnium
d. Xenon

Answer: C.013 a.
Reference: SAR § 4.4.8

Question deleted per facility comment.
~~**Question** C.014 [1.00 point] {14.0}~~
~~You are the reactor operator and the reactor is in the AUTOMATIC mode at a power level of 900 kW. You observe that shim rod number one rod color is MAGENTA and the magnet box is BLACK. Which one of the following results would you expect to see as a result of these indications?~~
~~a. the control system drops out of the AUTOMATIC mode into the MANUAL mode.~~
~~b. the control system withdraws the regulating rod.~~
~~c. the control system inserts the regulating rod.~~
~~d. the reactor scrams.~~
~~Answer: C.014 a.~~
~~Reference: UT-TRIGA Trn Man, Vol. II, Control Console Operator's Manual, page 5-3~~
~~UT-TRIGA Trn Man, Vol. II, Rx I & C Systems, page 26.~~

Question C.015 [1.00 point] {15.0}
Which ONE of the following neutron flux detectors provides a signal indicating the Log N period of the reactor?

a. Fission chamber
b. Gamma ion chamber
c. Compensated ion chamber
d. Uncompensated ion chamber

Answer: C.015 a.
Reference: SAR Section 6.1.1

Section C: - Plant and Rad Monitoring Systems

Question C.016 [1.00 point] {16.0}
WHICH ONE of the following is the purpose of the pool stirrer?

a. Increase transport time for N_{16} to reach surface of pool.
b. Break up of O_{16} bubbles in pool, thereby decreasing production of N_{16}.
c. Increase mixing within the core, for a more accurate reading of bulk pool temperature.
d. Increase mixing within the core, for a more accurate reading of pool water conductivity.

Answer: C.016 c.
Reference: SURV-2, Reactor Pool Power Calibration

Question C.017 [1.00 point, 0.20 each] {17.0}
Classify the five beam ports. Each Beam Port has only one answer.

a. Beam Port 1 **Tang**ential
b. Beam Port 2 **Thru**
c. Beam Port 3 **Rad**ial
d. Beam Port
e. Beam Port

Answer: C.017 a. = Thru; b. = Tang; c. = Rad; d, = Radial; e. = Thru
Reference: Operation Support Systems §§ 3.4.1 – 3.4.3.

Question C.018 [1.00 point] {18.0}
WHICH ONE of the following detectors is used primarily to measure N16 release to the environment?

a. NONE, N16 has too short a half-life to require environmental monitoring.
b. Stack Particulate Monitor
c. Bridge Area Monitor
d. Stack Gas Monitor

Answer: C.018 a.
Reference: Standard NRC Question

Section C: - Plant and Rad Monitoring Systems

Question C.019 [1.00 point] {19.0}
Which ONE of the following types of detector is used in the Area Radiation Monitor system?

a. Proportional Counter.
b. Scintillation Detector.
c. Ionization Chamber.
d. Geiger-Mueller Tube.

Answer: C.019 d.
Reference: UT-TRIGA Training Manual, Vol. II,
Rx Instrumentation & Control Systems, page 36.

Question C.020 [1.00 point, 0.333 each] {20.0}
Match the purification system functions in column A with the purification component listed in column B. (Note items from column B may be used more than once, or not at all.)

Column A	Column B
a. remove floating dust, bug larvae, etc.	1. Demineralizer (Ion Exchanger)
b. remove dissolved impurities	2. Skimmer
c. remove suspended solids	3. Filter
d. maintain pH	

Answer: C.020 a. = 2; b. = 1; c. = 3; d. = 1
Reference: SAR § 5.2.2., also UT TRIGA - Operational Support Systems, § 1.1 Reactor Water Systems page 4